Fayoum University

Engineering Faculty

Electrical Engineering Department

B.Eng. Final Year Project

Automatic Control Process
For “SHAYBAH” Combined Cycle Power Generation
Using Foxboro® DCS

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J U L Y – ٢ ٠ ١ ٦

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DECLARATION

I hereby certify that this material, which I now submit for assessment on the programme of study leading to the award of Bachelor of Science in *Electrical Engineering* is entirely my own work, that I have exercised reasonable care to ensure that the work is original, and does not to the best of my knowledge breach any law of copyright, and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

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ABSTRACT

This document has been prepared by group of Undergraduate students in “faculty of Engineering Fayoum University” to implement Distributed Control System programing and simulation of “SHAYBAH - B٢٤” plant area combined cycle power generation located in **Rub' al Khal in Saudi Arabia**.

The DCS used is “Fox boro” I/A series software, resulting in closed feedback control loops implemented by “IACC” and GUI implemented by “Fox Draw”, for one of six identical blocks of “Once Through Steam Generator” which create the field of B٢٤.

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LIST OF ACRONYMS/ABBREVIATIONS

AC	Alternating current
ACC	Air Cooled Condenser
AI	Analog Input
ANSI	American National Standards Institute
API	American Petroleum Institute
AO	Analog Output
ALMS	Alarm Management System
ASCII	American Standard Code for Information Inter-change A widely used code and protocol used to represent individual characters and communicate files.
BOP	Balance of Plant
CCF	Combined Cycle Facility
CCR	Central Control Room
CGTCS	Combustible Gas Turbine Control System
CMS	Condition Monitoring System
CPF	Central Processing Facility
CPU	Central Processing Unit
CRT	Cathode Ray Tube
DC	Direct current
DCS	Distributed Control System
DI	Digital Input
DMR	Dual Modular Redundancy
DO	Digital Output

ESD	Emergency Shutdown
EPS	Equipment Protection System
ESP	Electric Submersible Pump
ETP	External Termination Panels
FAT	Factory Acceptance Test
FF	FOUNDATION Fieldbus
FO	Fiber Optic
GB	Giga-Byte
HIST	Host Interoperability Testing
HART	Highway Addressable Remote Transducer
HVAC	Heating, Ventilating and Air Conditioning
IAMS	Instrument Asset Management System
I/O	Input/output
IEEE	Institute of Electrical and Electronics Engineers
LAN	Local Area Network
LAS	Link Active Scheduler
LED	Light Emitting Diode
LSTK	Lump Sum Turnkey
Ma	Milli-Ampere
MB	Mega-Byte
MIS	Management Information System
MMI	Man Machine Interface
MMS	Machine Monitoring System
MTS	Maintenance Training System
NA	Not Applicable
NAOO	Northern Area Oil Operations

NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OPC	OLE for Process Control
OSPAS	Oil Supply Planning And Scheduling Department
OTS	Operator Training System
OTSG	Once Through Steam Generator
OWS	Operator Workstation
PAN	Plant Automation Network
P&ID	Piping and instrument diagram
PC	Personal Computer
PCN	Process Control Network
PCS	Process Control System
PFD	Process Flow Diagram
PI	Plant Information System
PIB	Process Interface Building
PID	Proportional Integral Derivative
PLC	Programmable logic controller
PSA	Power System Automation
RAM	Random Access Memory
RTD	Resistance Temperature Detector
RTU	Remote Terminal Unit
SAES	Saudi Aramco Engineering Standards
SAMA	Scientific Apparatus Manufacturers Association
SAMSS	Saudi Aramco Materials System Specifications
SAT	Site Acceptance Test

SCN	Safety Control Network
SER	Sequence of Events (SOE) Recording
STCS	Steam Turbine Control System
STG	Steam Turbine Generator
TCP/IP	Transmission Control Protocol/Internet Protocol
TIACS	Turbine Intake (Inlet) Air Cooling System
TMR	Triple modular redundant
UHF	Ultra High Frequency
UPS	Uninterruptible power supply
VHF	Very High Frequency
WAN	Wide Area Network

Chapter One

١ INTRODUCTION

١.١ PLANT OVERVIEW:

The Shaybah field is located in the eastern Rub' Al-Khali "Empty Quarter" in the southeastern part of Saudi Arabia, approximately ٥٠٠ miles (٨٠٠ km) from Dhahran. The current facilities, consisting of two satellite Gas Oil Separation Plants (GOSP-١and GOSP-٣) with Central Processing Facilities (GOSP-٢ and GOSP-٤) andinterconnecting crude and gas transfer lines, are designed to produce ٧٥٠ MBCD ofArabian Extra Light (AXL) crude oil.
The purpose of Shaybah AXL Crude Increment – ٢٥٠ MBCD Program (BI-١٠–٠٠٦١٤)is to maintain crude oil production and MSC targets by increasing the AXL crude oilproduction capacity of the remote Shaybah field from ٧٥٠ MBCD to ١,٠٠٠ MBCD.
The ٢٥٠ MBCD AXL Crude Increment facilities will increase the Shaybah field Producing Facilities design capacities to ١,٠٠٠ MBCD of stabilized AXL crude, with٣٠% water cut and at ٣,١٥٠ GOR. The facilities are to process ٢٥٠ MBCD of dry AXLcrude.
The facilities to be installed include
• Gas/Oil Separation Facilities
• Wet Crude Handling Facilities
• Gas Gathering and Compression Facilities
The BI-١٠-٠٠٦١٤ Project is separated into three packages, as shown below:
• ٢٥٠ MBCD AXL Crude Increment
• Combined Cycle Power Generation
• Supporting Facilities and Security Infrastructure
The Combined Cycle Power Generation facilities will produce ٢٢٠ to ٢٥٠ MW nominally or as required to meet various operating criteria in GOSP-٤. This will beachieved by converting the six simple cycle CGTGs in GOSP-٤ to combined cycleconfiguration and utilizing the HP and IP stream produced to drive Steam TurbineGenerators.
The Combined Cycle Power Generation package will provide Shaybah GOSP-٤ withspecific below outcomes and deliverables as follow:
• Combined Cycle Power Generation
- Six OTSGs (Once Through Steam Generator) coupled withCGTGs
- Two STGs (Steam Turbine Generator) receiving HP and IPsteam from the OTSGs.
- Two ACCs (Air Cooled Condenser) condensing steam through aircooled finned tubes
• Raw Water Supply; from two water wells in Sabkha #٤٠
• Pre-Treatment Facilities
• Ro/Demin. System
• Post-Treatment Facilities
• Condensate System including condensate pump and polishing unit
• Boiler Feed Water System
• Water Chemical Treatment System

• Electrical Works; new ١٣.٨kV Substation, ٢٣٠kV GIS extensionSUBSTATION S٥٣ RACK ROOM is provided in ١٣.٨KV Substation to house the control,protection, and monitoring systems associated with the OTSGs and BOP. STGs Control System shall be provided by STG supplier in local shelter in addition to CCR &Substation S٥٣,in order to conduct the combined cycle plant controls.Integrated Control and Safety System comprises of Process Automation for ProcessControl Emergency Shutdown System and Fire & Gas Detection System.

١.٢ DCS OVERVIEW

DCS (Distributed Control System) is a computerized control system used to control the production line in the industry.

While a product (Food, medicine, Oil..etc) passing through many stages in the factory before it reaches its final so the product can be sold out, during those stages it requires a kind of control in order to adjust the quality of it. However, to adjust the quality it is required to control many physical quantities such as pressure, Temperature..etc.

Furthermore, in some dangerous applications such as petrochemical factories and nuclear reactors the control will much critical, however, losing the control may lead to an explosion of the plant.

DCS System consists minimum of the following components.

١. Field Control station (FCS): It consists of input/output modules, CPU and communication bus.

٢. Operator station: It is basically human interface machine with monitor, the operator man can view the process in the plant and check if any alarm is presents and he can change any setting, print reports...etc.

٣. Engineering station: It is used to configure all input & output and drawing and any things required to be monitored on Operator station monitor.

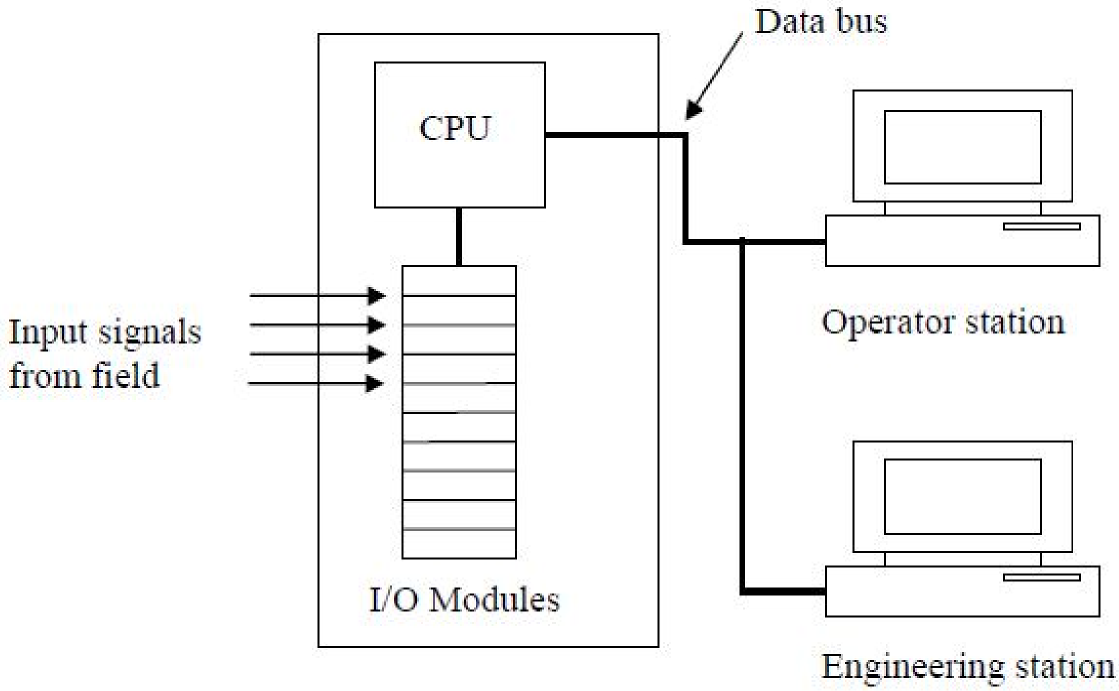


Figure ١:Basic configuration of a DCS System

A DCS typically uses custom designed processors as controllers and uses both proprietary interconnections and communications protocol for communication. Input and output modules form component parts of the DCS. The processor receives information from input modules and sends information to output modules. The input modules receive information from input instruments in the process (or field) and transmit instructions to the output instruments in the field. Computer buses or electrical buses connect the processor and modules through multiplexer or demultiplexers. Buses also connect the distributed controllers with the central controller and finally to the Human (HMI) or control consoles.

The elements of a DCS may connect directly to physical equipment such as switches, pumps and valves and to Human Machine Interface (HMI) via SCADA.
Distributed control systems (DCSs) are dedicated systems used to control manufacturing processes that are continuous or batch-oriented, such as oil refining, petrochemicals, central station power generation, fertilizers, pharmaceuticals, food and beverage manufacturing, cement production, steelmaking, and papermaking.

DCSs are connected to sensors and actuators and use set point control to control the flow of material through the plant. The most common example is a set point control loop consisting of a pressure sensor, controller, and control valve. Pressure or flow measurements are transmitted to the controller, usually through the aid of a signal conditioning input/output (I/O) device. When the measured variable reaches a certain point, the controller instructs a valve or actuation device to open or close until the fluidic flow process reaches the desired set point. Large oil refineries have many thousands of I/O points and employ very large DCSs. Processes are not limited to fluidic flow through pipes, however, and can also include things like paper machines

and their associated quality controls, variable speed drives and motor control centers, cement kilns, mining operations, ore processing facilities, and many others.
A typical DCS consists of functionally and/or geographically distributed digital controllers capable of executing from ١ to ٢٥٦ or more regulatory control loops in one control box. The input/output devices (I/O) can be integral with the controller or located remotely via a field network. Today's controllers have extensive computational capabilities and, in addition to proportional, integral, and derivative (PID) control, can generally perform logic and sequential control. Modern DCSs also support neural networks and fuzzy application.

DCS systems are usually designed with redundant processors to enhance the reliability of the control system. Most systems come with canned displays and configuration software which enables the end user to set up the control system without a lot of low level programming. This allows the user to better focus on the application rather than the equipment, although a lot of system knowledge and skill is still required to support the hardware and software as well as the applications. Many plants have dedicated groups that focus on this task. These groups are in many cases augmented by vendor support personnel and/or maintenance support contracts.

DCS may employ one or more workstations and can be configured at the workstation or by an off-line personal computer. Local communication is handled by a control network with transmission over twisted pair, coaxial, or fiber optic cable. A server and/or applications processor may be included in the system for extra computational, data collection, and reporting capability.

١.٣ DIFFERENCE BETWEEN DCS AND PLC

Turn the clock back ١٠-١٥ years: The programmable logic controller (PLC) is king of machine control while the distributed control system (DCS) dominates process control.
Today, the two technologies share kingdoms as the functional lines between them continue to blur. We now use each where the other used to rule. However, PLCs still dominate high-speed machine control, and DCSs prevail in complex continuous processes.
When PLCs were solely replacements for hard-wired relays, they had only digital I/O, with no operator interface or communications. Simple operator interfaces appeared, then evolved into increasingly complex interfaces as PLCs worked with increasingly complex automation problems. We went from a panel of buttons and I/O-driven lamps to PLC full-color customized graphic displays that run on SCADA software over a network.
Today, the decision between PLC and DCS often depends on business issues rather than technical features.

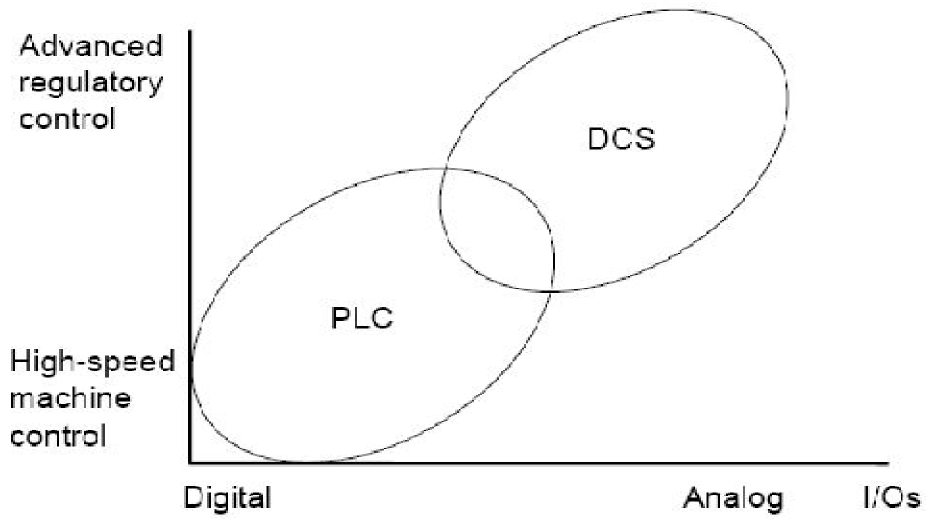


Figure ٦:DCS VS PLC

An important difference between DCSs and PLCs is how vendors market them. DCS vendors typically sell a complete, working, integrated, and tested system; offering full application implementation. They offer many services: training, installation, field service, and integration with your Information Technology (IT) systems. A DCS vendor provides a server with a relational database, a LAN with PCs for office automation, networking support and integration of third-party applications and systems. The DCS vendor tries to be your "one-stop shop." The PLC is more of a "do-it-yourself" device, which is sometimes simpler to execute.
PLCs are fast: They run an input-compute-output cycle in milliseconds. On the other hand, DCSs offer fractional second (١/٢ to ١/١٠) control cycles. However, some DCSs provide interrupt/event-triggered logic for high-speed applications.
Most DCSs offer redundant controllers, networks, and I/Os. Most give you "built-in" redundancy and diagnostic features, with no need for user-written logic.

١.٤ DIFFERENCE BETWEEN DCS AND SCADA

A primary differentiator between a SCADA system and other types of control systems such as DCS is the purpose to which the control system will be put.
In general DCS is focused on the automatic control of a process, usually within a confined area. The DCS is directly connected to the equipment that it controls and is usually designed on the assumption that instantaneous communication with the equipment is always possible.
A SCADA system is usually supplied to permit the monitoring and control of a geographically dispersed system or process. It relies on communication systems that may transfer data periodically and may also be intermittent. Many SCADA systems for high-integrity applications include capabilities for validating data transmissions, verifying and authenticating controls and identifying suspect data.
DCS is process state driven, while SCADA is even driven. DCS does all its tasks in a sequential manner, and events are not recorded until it is scanned by the station. In contrast, SCADA is event driven. It does not call scans on a regular basis, but waits for

an event or for a change in value in one component to trigger certain actions. SCADA is a bit more advantageous in this aspect, as it lightens the load of the host. Changes are also recorded much earlier, as an event is logged as soon as a value changes state.

١.٥ APPLICATIONS OF DCS AND SCADA

DCS is the system of choice for installations that are limited to a small locale, like a single factory or plant, while SCADA is preferred when the entire system is spread across a much larger geographic location, examples of which would be oil wells spread out in a large field.
Part of the reason for this is the fact that DCS needs to be always connected to the I/O of the system, while SCADA is expected to perform even when field communications fail for some time. SCADA does this by keeping a record of all current values, so that even if the base station is unable to extract new information from a remote location, it would still be able to present the last recorded values.
DCS and SCADA are monitoring and control mechanisms that are used in industrial installations to keep track and control of the processes and equipment; to ensure that everything goes smoothly, and none of the equipment work outside the specified limits.
The most significant difference between the two is their general design. DCS, or Data Control System, is process oriented, as it focuses more on the processes in each step of the operation. SCADA, or Supervisory Control and Data Acquisition, focuses more on the acquisition and collation of data for reference of the personnel who are charged with keeping track of the operation

Chapter Two

٢ FORMATTING DESCRIPTION

٢.١ DEFINITIONS

Decoder
Device that converts NTSC, PAL, SECAM or NTSC ٤.٤٣ video.
Aspect Ratio
The ratio of the width of any image to its height Integration
Specifications Document
A document prepared by VENDOR that provides the technical specifications for all thedifferent system and sub-system hardware interfaces, applications interfaces anddata communications requirements.
Job Specification
The scope of the work to be performed pursuant to a contract. It describes or references the applicable drawings, standards, specifications, as well as the administrative, procedural, and technical requirements that CONTRACTOR shallsatisfy or adhere to in accomplishing the work.
Non-Material Requirements
The complete set of documentation required from VENDOR and/or CONTRACTORduring the design and development of the project.
PCS
Refers to the Process Control System (PCS) comprising of Distributed ControlSystems, subsystems, marshalling cabinets and accessories supplied by VENDOR

System Design Document
A document prepared by VENDOR and/or the design CONTRACTOR that containsthe design narratives and the key design issues of the system.
System Development Plan
A document prepared by VENDOR and/or the design CONTRACTOR to outline thedevelopment steps, project schedules and major milestones.

٢.٢ CONTROL NARRATIVE

٢.٢.١ GENERAL

Modulating control system(MCS) is to conduct continuously closed-loop control to main systems and equipments of OTSG, turbine, and guarantee stability of main parameter of unit, and satisfy requirement of safety start-up, shut down and normal operation.

٢.٢.٢ Control strategy

- Conventional PID adjustment.
- Various loop structural forms such as cascade, three impulse, feed forward compensation, single loop &multi actuator etc.

٢.٢.٣ Measurement of redundancy transmitter

- Measurement signal of duplicate redundancy transmitter will select average value automatically, operator can choose to use average value of the two measurement signal by manual on graphic or only use one signal between them. If there is one signal between the two exceeds normal range when select the average value of the two signals, then the other one will be selected automatically as output value, and work of control system will not be affected. If the two signals all exceed normal range, then the control system which use the signal will be shifted to manual control with force.
- Measurement signal of triply redundancy transmitter will select intermediate value automatically, operator can choose to use intermediate value of the three measurement signal by manual on graphic or only use one signal among them. If there is one signal exceeds normal range when select the intermediate value of the threesignal, then average value of another two signal will be selected automatically as output value; if there are two signal exceed normal range, the rest signal will be selected as output value automatically, and work of control system will not be affected. If the three signals all exceed normal range, then the control system which use the signal will be shifted to manual control with force.

٢.٢.٤ Manual/auto shift

- Over limit or poor quality of measurement signal, shift to manual automatically.
- Auto operation condition is not satisfied, shift to manual automatically from logic interlock.
- Operator conduct manual/auto shift.

- Disturbance of equipment output will not be caused by manual/auto shift no matter operated by operating personnel or logic interlock.

٢.٢.٥ HP feed water system

٢.٢.٥.١ HP feed water shut-off bypass valve(MOV-1302)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٢

Permissive Open:

- Both FW CVs(*FCV*-٢٣٠,*FCV*-٢٣١) closed
- HP eco bypass CV(*TCV*-٠٥٥٢) closed
- OTSG in CC mode or (No GT flame On AND Allow HP FW SOV re-filling)

Auto Open:

- Feed water pump running (١oo٢ & FW pressure not low)
- HP Eco&Evap filling SOV closed(*MOV*-١٣٠٧)
- OTSG in CC mode or (No GT flame On and Eco&Evap level (*LIT*-٠٢٩١)< X٣ and Allow HP FW SOV re-filling)
- HP FW main CVs(*FCV*-٢٠٣) closedBoth HP ٣٠% FW CVs(*FCV*-٢٣١) AND HP economiser bypass CV(*TCV*-٠٥٢٢) closed
- Feedwater shut-off valve(*MOV*-١٢٧١) closed

Auto Close:

- Feedwater shut-off valve(*MOV*-١٢٧١) is open
- No feedwater pump running, after ١٥sec
- OTSG HP in Dry out mode
- No GT flame On and Eco&Evap level (*LIT*-٠٢٩١)> X٣

Protective Close:

- (HP in Dry out mode longer than ٦٠ sec orHP in Dry run mode) andHP

FW shut off bypass valve(*MOV*-١٣٠٢) not closed

٢.٢.٥.٢ HP feedwater shut-off valve(MOV-1271)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٢

Permissive Open:

- FW CV(*FCV*-٢٣٠,*FCV*-٢٣١) closed
- HP eco bypass CV(*TCV*-٠٥٢٢) closed
- ΔP (pump outlet pressure(*PIT*-٠٧٨٢) – economiser pressure(*PIT*-٠٧٨٣))<٧٢psig
- OTSG in CC mode or (No GT flame On AND Allow HP FW SOV re-filling)

Auto Open:

- Feedwater pump running (١oo٢ & FW pressure not low)
- HP Eco&Evap filling SOV closed(*MOV*-١٣٠٧)
- ΔP (pump outlet pressure(*PIT*-٠٧٨٢) – economiser pressure(*PIT*-٠٧٨٣))<٧٢psig
- OTSG in CC mode or (No GT flame On and Eco&Evap level (*LIT*-٠٢٩١)< X٣ and Allow HP FW SOV re-filling)
- HP FW main CVs(*FCV*-٢٠٣) closedBoth HP ٣٠% FW CVs(*FCV*-٢٣١) AND HP economiser bypass CV(*TCV*-٠٥٢٢) closed
- Feedwater shut-off bypass valve(*MOV*-١٣٠٢*)*has left closed position > ١٥ seconds ago

Auto Close:

- No feedwater pump running, after ١٥sec
- OTSG HP in Dry out mode
- No GT flame On and Eco&Evap level (*LIT*-٠٢٩١)> X٣

Protective Close:

- (HP in Dry out mode longer than ٦٠ sec orHP in Dry run mode) andHP FW shut off valve(*MOV*-١٢٧١) not closed

٢.٢.٥.٣ HP economiser vent shut-off valve(MOV-1298)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٢

Permissive Open:

- No GT flame on(*XS*-١٥٣٣)

Auto Open:

- No GT flame on(*XS*-١٥٣٣)
- Evaporator fill level(*LI*-٠٢٩١)>٨٣.٦٧% and <٨٥.٤٢%

Auto Close:

- GT flame on
- Evaporator fill level(*LI*-٠٢٩١)<٨٣.٦٧%longer than ٥ minutes
- No GT flame on(*XS*-١٥٣٣) and Feedwater supply in operation and FW SOV(*MOV*-١٢٧١) open AND Evaporator fill level (*LI*-٠٢٩١)>٨٥.٤٢%

Protective Close:

- GT flame on longer than ٣٠ sec and Eco ventvalve not closed (*MOV*-١٢٩٨) not closed

٢.٢.٥.٤ HP economizer and evaporator filling shut-off valve(MOV-1307)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٣

Permissive Open:

- No GT flame on(*XS*-١٥٣٣)
- Economiser vent shut-off valve(*MOV*-١٢٩٨) open
- Stack temperature <٢٠٣F

Auto Close:

- Evaporator filling level >٨٥.٤٢%(*LI*-٠٢٩١)
- Economiser vent valve(*MOV*-١٢٩٨) not open
- GT flame on(*XS*-١٥٣٣)

Protective Close:

- GT flame on longer than ٣٠ sec AND eco fillingshut-off valve (*MOV*-١٣٠٧) notClosed

٢.٢.٥.٥ HP separator blowdown shut-off valve(MOV-1272)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٣

Permissive Open:

- Both blow down control valves(*LCV*-٠٣٠٢*, LCV*-٠٣٠٣) closed

Auto Open:

- GT speed(*SY*-١٥٣٤)< ٢٠٠ rpm
- Separator level >٤.١٣%(*LIC*-٠٣٠٢)
- Separator pressure >٢٩psi

  OR all the following criteria are true
- GT speed(*SY*-١٥٣٤)> ٢٠٠ rpm
- No GT flame on(*XS*-١٥٣٣)
- Separator pressure > X١(*LIC*-٠٣٠٢)

  OR all the following criteria are true
- GT flame on(*XS*-١٥٣٣)
- Minimum Flow mode OR Level control mode OR separator level >٧.٣%(*LIC*-٠٣٠٢)
- Separator pressure >١٤.٥psi(*PI*-٠٣٩٢)

Auto Close:

- GT speed(*SY*-١٥٣٤)< ٢٠٠ rpm
- Separator level(*LIC*-٠٣٠٢)<٤.١٣% or Separator pressure <٢٩psi(*PI*-٠٣٩٢)

  OR all the following criteria are true

- Separator level <٧.٣% (*LIC*-٠٣٠٢)longer than ١ minute
- Benson mode or Dry run mode

  OR all the following criteria are true
- Separator level <٢.٢٢% (*LIC*-٠٣٠٢)
- Level mode

Protective Close:

- Separator level(*LIC*-٠٣٠٢)<٢.٢٢% longer than ٣٠ seconds (whennot closed) only during Level mode or Bensonmode or Dry run or DryOut mode

Protective Open:

- Separator level(*LIC*-٠٣٠٢)<٢.٢٢% (when not open and whenblow down tank(*LIC*-٠٢٦٢)<٩٠%)

٢.٢.٥.٦ HP superheater outlet drain valve(MOV-1303)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٣

Permissive Open:

- Drip leg temperature < H(*TI*-٠٥٨٥)
- Valve position < Maximum position

Auto Open:

The valve is opened during standstill every ٢ hours for ١ minute:

- GT speed < ٢٠٠ rpm (*SY*-١٥٣٤)
- HP steam pressure >٢٩psi (*PY*-٠٤٩٨)

The valve is opened during CC start-up

- GT speed > ٢٠٠ rpm for more than ١ minute (*SY*-١٥٣٤)
- HP steam pressure >١٤.٥psi (*PY*-٠٤٩٨)

During automatic draining (after start-up draining)

- GT flame on and OTSG at CC mode
- Separator pressure > X١(*PIT*-٣٩٢)
- Drip leg temperature <٥٤F above calculated saturation temperature

Auto Close:

The drain valve is closed during standstill

- GT speed < ٢٠٠ rpm(*SY*-١٥٣٤)
- ١ minute after opening of the valve

The valve is closed when all of the following criteria are true for ٥ minutes

- GT flame on(*XS*-١٥٣٣)
- Drip leg temperature >٥٤F above calculated saturation temperature(*TI*-٠٥٨٥,*PY*-٠٤٩٨*)*
- Steam flow > ٢٨٨٠٠lb/hr(*FIT*-٠٢٣٣,*FIT*-٠٣٠٥)
- Valve is not closed

The valve is also closed after start-up

- GT speed < ٢٠٠ rpm(*SY*-١٥٣٤)
- Drip leg temperature >٧٢٥F (*TI*-٠٥٨٥)

The drain valve is closed during automatic draining

- No GT flame on(*XS*-١٥٣٣)
- Separator pressure < X١(*PIT*-٣٩٢)
- Drip leg temperature >٥٤F above calculated saturation temperature(*TI*-٠٥٨٥,*PY*-٠٤٩٨*)*

Protective Close:

- Drip leg temperature >٧٢٥F longer than ٦٠ sec(*TI*-٠٥٨٥)

٢.٢.٥.٧ HP main steam drain valve(MOV-1273)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٣

٢.٢.٥.٨ HP main steam drain valve(MOV-1273)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٣

Permissive Open:

- Drip leg temperature < H(*TI*-٠٥٨٤)
- Valve position < Maximum position

Auto Open:

The valve is opened during standstill every ٢ hours for ١ minute:

- GT speed < ٢٠٠ rpm (*SY*-١٥٣٤)
- HP steam pressure >٢٩psi (*PY*-٠٤٩٨)

The valve is opened during CC start-up

- GT speed > ٢٠٠ rpm for more than ١ minute (*SY*-١٥٣٤)
- HP steam pressure >١٤.٥psi (*PY*-٠٤٩٨)

During automatic draining (after start-up draining)

- GT flame on and OTSG at CC mode
- Separator pressure > X١(*PIT*-٣٩٢)
- Drip leg temperature <٥٤F above calculated saturation temperature

Auto Close:

The drain valve is closed during standstill

- GT speed < ٢٠٠ rpm(*SY*-١٥٣٤)
- ١ minute after opening of the valve

The valve is closed when all of the following criteria are true for ٥ minutes

- GT flame on(*XS*-١٥٣٣)
- Drip leg temperature >٥٤F above calculated saturation temperature(*TI*-٠٥٨٤,*PY*-٠٤٩٨)
- Steam flow > ٢٨٨٠٠lb/hr(*FIT*-٠٢٣٣,*FIT*-٠٣٠٥)
- Valve is not closed

The valve is also closed after start-up

- GT speed < ٢٠٠ rpm(*SY*-١٥٣٤)
- Drip leg temperature >٧٢٥F (*TI*-٠٥٨٤)

The drain valve is closed during automatic draining

- No GT flame on(*XS*-١٥٣٣)
- Separator pressure < X١(*PIT*-٣٩٢)
- Drip leg temperature >٥٤F above calculated saturation temperature(*TI*-٠٥٨٤,*PY*-٠٤٩٨)

Protective Close:

- Drip leg temperature >٧٢٥F longer than ٦٠ sec(*TI*-٠٥٨٤)

٢.٢.٥.٩ HP attemperator spray water shut off valve(MOV-1276)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٤

Permissive Open:

- Spray water control valve closed(*PCV*-٠٤٢٤)

Auto Open:

- Steam temperature >٩٨٦F (*TIC*-٠٤٢٤)
- Steam flow > ٥٧٦٠٠lb/hr(*FIT*-٠٢٣٣,*FIT*-٠٣٠٥)
- Attemperator control valve(*TCV*-٠٤٢٤) closed
- Feedwater supply in operation
- GT flame on (*XS*-١٥٣٣)

Auto Close:

- Steam temperature <٩٧٧F (*TIC*-٠٤٢٤)
- Steam temperature(*TIC*-٠٤٢٤)<٩٨٦F and CV(*TCV*-٠٤٢٤) closed for more than ١ minute
- Steam flow <٥٧٦٠٠lb/hr for more than ٣ minutes (*FIT*-٠٢٣٣,*FIT*-٠٣٠٥)
- Feedwater supply not in operation
- No GT flame on(*XS*-١٥٣٣)

Protective Close:

- Attemperator outlet steam superheat (*TSH*-٠٤٢٤)<٩٠F (too close to saturation) longer than ٣٠ sec

٢.٢.٥.١٠ HPsteam shut-off bypass valve(MOV-1275)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٤

Permissive Open:

- No GT flame on(*XS*-١٥٣٣)
- Header steam SOV closed(*MOV*-١٢٨٥)

Auto Close:

- Steam shut-off valve(*MOV*-١٢٧٤) is open
- Pressure section at Dry Out mode and steam pressure <١٤٥psig (*PI*-٠٤٩٨)

Protective Close:

- Dry run mode and steam SOV not closed (*MOV*-١٢٧٤)

HP steam shut-off valve(MOV-١٢٧٤)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٤
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٤

Permissive Open:

- No GT flame on(*XS*-١٥٣٣)
- Header steam SOV closed(*MOV*-١٢٨٥)
- Differential pressure ΔP over valve < max(*PIC*-٠٤٩٨,*PIT*-٠٧٩٠)

Auto Close:

- Pressure section at Dry Out mode and steam pressure <١٤٥psi(*PIC*-٠٤٩٨)

٢.٢.٥.١١ HP FW main FCV shut-off valve(MOV-1051)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٢

Permissive Open:

- HP ١٠٠% FCV closed (*FCV*-٠٢٣٠)

Auto Open:

- Feedwater supply in operation
- Main feedwater shut-off valve open
- ١٠٠% FW CV closed(*FCV*-٠٢٣٠)
- Controller output > minimum position of ١٠٠% LCV(*FCV*-٠٢٣٠)
- Separator pressure >٧٢٥psi value for ١٠٠% LCV(*PIT*-٠٣٩٢)

Auto Close:

- No FW pumps running after a delay time
- (Control output to ١٠٠% FCV(*FCV*-٠٢٣٠)< minimum position or separator pressure < X٣ value for ١٠٠% FCV) (*PIT*-٠٣٩٢)and ١٠٠% LCV closed

Protective Close:

- HP Separator pressure <٧٢٥psi and FW supply inoperation longer than ٦٠ sec
- (HP in Dry out mode longer than ٦٠ sec orDry run mode) and HP FW shut off not closed

٢.٢.٥.١٢ HP ECO bypass shut-off valve(MOV-1052)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٢

Permissive Open:

- HP eco bypass CV closed (*TCV*-٠٥٥٢)

Auto Open:

- No GT flame on(*XS*-١٥٣٣)
- Feedwater supply in operation
- HP eco&evap filling SOV open

Auto Close:

- HP system in Dry out mode is not active
- HP eco&evap filling is not active(GT flame on OR Feedawater supply not in operation OR HP eco&evap filling SOV not open)

٢.٢.٦ IP feed water system

٢.٢.٦.١ IP feedwater shut-off valve(MOV-1278)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٥

Permissive Open:

- IP FW CV(*FCV*-٠٢٣٧) closed
- IP eco inlet drain(*MOV*-١٣١٣) closed
- OTSG in CC mode or(No GT flame On(*XS*-١٥٣٣) AND notafter Dry run)

Auto Open:

- Feedwater pump running
- IP system in CC mode or (No GT flame On(*XS*-١٥٣٣) and Eco&Evap level(*LI*-٠٢٨٧)< X٣ and Allow IP FW SOV re-filling)
- IP FW CV(*FCV*-٠٢٣٧) closed
- IP Eco inlet drain(*MOV*-١٣١٣) closed
- IP Eco &evap filling SOV closed(*MOV*-١٣٠٥)

Auto Close:

- No GT flame On and Eco&Evap level(*LI*-٠٢٨٧)> X٣
- No FW pumps running after ١٥sec

- IP system in Dry out mode

Protective Close:

- (OTSG in Dry out mode longer than ٦٠ sec orIP Dry run mode) and IP FW shut off(*MOV*-١٢٧٨) not closed

٢.٢.٦.٢ IP economiser vent shut-off valve(MOV-1322)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٥

Permissive Open:

- No GT flame on(*XS*-١٥٣٣)

Auto Open:

- No GT flame on(*XS*-١٥٣٣)
- Evaporator fill level(*LI*-٠٢٨٧)>٧٧. ٢٦% and <٧٧.٨١%.

Auto Close:

- GT flame on
- Evaporator fill level(*LI*-٠٢٨٧)<٧٧. ٢٦%longer than ٥ minutes
- No GT flame on(*XS*-١٥٣٣) and Feedwater supply in operation and FW SOV(*MOV*-١٢٧٨*)* open AND Evaporator fill level (*LI*-٠٢٨٧)>٧٧.٨١%

Protective Close:

- GT flame on longer than ٣٠ sec and Eco ventvalve not closed (*MOV*-١٣٢٢) not closed

٢.٢.٦.٣ IP economiser and evaporator filling shut-off valve(MOV-1305)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٥

- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٥

Permissive Open:

- No GT flame on(*XS*-١٥٣٣)
- Economiser vent shut-off(*MOV*-١٣٢٢) valve open
- Stack temperature <٢٠٣F

Auto Close:

- Evaporator filling level >٧٧.٢٦%(*LIT*-٠٢٨٧)
- Economiser vent valve(*MOV*-١٣٢٢) not open
- GT flame on(*XS*-١٥٣٣)

Protective Close:

- GT flame on(*XS*-١٥٣٣) longer than ٣٠ sec AND eco fillingshut-off valve(*MOV*-١٣٠٥) not closed

٢.٢.٦.٤ IP separator blowdown shut-off valve(MOV-1312)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٣

Permissive Open:

- Both blowdown control valves(*LCV*-٠٢٩٦,*LCV*-٠٢٩٨) closed

Auto Open:

- GT speed < ٢٠٠ rpm(*SY*-١٥٣٤)
- Separator level >٦.٠٦%(*LIC*-٠٢٩٦)
- Separator pressure >٢٩psig (*PI*-٠٤٩٧)

  OR all the following criteria are true
- GT speed > ٢٠٠ rpm(*SY*-١٥٣٤)
- No GT flame on(*XS*-١٥٣٣)
- Separator pressure >١٤.٥psig (*PI*-٠٤٩٧)

  OR all the following criteria are true

- GT flame on(*XS*-١٥٣٣)
- Minimum Flow mode OR Level control mode OR separator level >٩.٠٩%(*LIC*-٠٢٩٦)
- Separator pressure >١٤.٥psig (*PI*-٠٤٩٧)

Auto Close:

- GT speed < ٢٠٠ rpm(*SY*-١٥٣٤)
- Separator level <٦.٠٦%(*LIC*-٠٢٩٦) or Separator pressure <٢٩psig (*PI*-٠٤٩٧)
  OR all the following criteria are true
- Separator level <٩.٠٠٩% (*LIC*-٠٢٩٦) longer than ١ minute
- Benson mode or Dry run mode
  OR all the following criteria are true
- Separator level <٤.٢٤% (*LIC*-٠٢٩٦)
- Level mode

Protective Close:

- Separator level <٤.٢٤% (*LIC*-٠٢٩٦) (when not closed) only during Level mode or Benson mode or Dry run

Protective Open:

- Separator level(*LIC*-٠٣٠٢)<٢.٢٢% (when not open and whenblowdowntank(*LIC*-٠٢٦٢)<٩٠%)

٢.٢.٦.٥ IPsteam shut-off bypass valve(MOV-1281)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٥

Permissive Open:

- No GT flame on(*XS*-١٥٣٣)
- Header steam SOV closed(*MOV*-١٢٩٠)

Auto Close:

- Steam shut-off valve(*MOV*-١٢٨٢) is open
- Pressure section at Dry Out mode and steam pressure <X٥١psig (*PI*-٠٥٠٥)

Protective Close:

- Dry run mode and steam SOV not closed (*MOV*-١٢٨٢)

٢.٢.٦.٦ IP steam shut-off valve(MOV-1282)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٥
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٥

Permissive Open:

- No GT flame on(*XS*-١٥٣٣)
- Header steam SOV closed(*MOV*-١٢٩٠*)*
- Differential pressure ΔP over valve < max(*PIC*-٠٥٠٥*,PIT*-٠٧٨٩)

Auto Close:

- Pressure section at Dry Out mode and steam pressure <X٥١psi(*PIC*-٠٥٠٥)

٢.٢.٦.٧ IP economiser inlet drain shut-off valve(MOV-1313)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣١-٠٠٦
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٢-٠٠٦
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٥-٠٠٦
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٦-٠٠٦
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٨-٠٠٦
- P&ID B٢٤-A-PID-BA-٥٧٥١٥٩-٠٠٦

Permissive Open:

- (Dry out mode OR no GT flame on(*XS*-١٥٣٣))
- FW SOV closed (*MOV*-١٢٧٨)
- IP eco inlet temperature <٧٥٢F(*TIA*-٠٤٢٥)

Auto Open:

- After some minutes since start of Dry out
- IP FW SOV closed(*MOV*-١٢٧٨)
- IP steam pressure >١٤.٥psig (*PIT*-٠٤٩٧*)*
- IP eco inlet temperature <٧٥٢F(*TIA*-٠٤٢٥)

Auto Close:

- IP system not in Dry out mode for some minutes and GT flame on(*XS*-١٥٣٣)
- IP eco inlet temperature degree of superheat >٩F (*TSH*-٠٤٢٥)
- IP steam pressure <١٤.٥psig (*PIT*-٠٤٩٧)
- IP eco inlet temperature >٧٥٢F(*TIA*-٠٤٢٥)

Protective Close:

- GT flame on AND(no Dry out mode OR IP eco inlet temperature>H) Longer than ١ minute

٢.٢.٦.٨ IP outlet drain valve(MOV-1280)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٣

Permissive Open:

- Blowdown tank level <٩٥%(*LIC*-٠٢٦٢)

Auto Open:

The valve is opened during CC start-up,when all of the following criteria are true

- GT speed > ٢٠٠ rpm for more than ١ minute (*SY*-١٥٣٤)
- IP steam pressure >١٤psig (*PIC*-٠٥٠٥)

During automatic draining (after start-up draining),when all of the following criteria are true

- CC mode active
- IP steam pressure >١٤psig (*PIC*-٠٥٠٥)
- Dripleg level (*LIC*-٠٢٦٢)>٨٥% or dripleg level >٩٠%

The valve is opened during standstill,when all of the following criteria are true

- No GT flame on(*XS*-١٥٣٣)
- IP steam pressure >١٤psig (*PIC*-٠٥٠٥)
- Dripleg level (LIC-٠٢٦٢)> ٨٥% or dripleg level > ٩٠%
- OTSG not in Dry run

Auto Close:

The valve is closed when all of the following criteria are true for ٥ minutes

- GT flame on(*XS*-١٥٣٣)
- Steam temperature >٥٤F above calculated saturation temperature (*TSH*-٠٤٢٦)
- Steam flow > ٤٨٧٥ lb/hr(*FIA*-٠٢٣٩)
- Valve is not closed(*MOV*-١٢٨٠)
- Dripleg level (LIC-٠٢٦٢)<٨٥% and dripleg level <٩٠%, both longer than ٣٠ sec

The valve is also closed after start-up when one of the following criteria is true

- CC mode not active (due to Dry out)

The drain valve is closed during automatic draining when any of the following criteria is true

- IP steam pressure <١٤pisg (*PIC*-٠٥٠٥)
- Dripleg level (LIC-٠٢٦٢)< ٨٥% and dripleg level < ٩٠%, both longer than ٣٠ sec

The drain valve is closed during stand still when all of the following criteria are true

- No GT flame on(*XS*-١٥٣٣)
- IP steam pressure(*PIC*-٠٥٠٥)<١٠psig OR (Dripleg level (LIC-٠٢٦٢) <٨٥% and dripleg level <٩٠% both longer than ٣٠ sec)

Protective Close:

- Blow down tank level(LIC-٠٢٦٢) >٩٥% longer than ٦٠ sec
- Dry run or Dry out mode

٢.٢.٦.٩ IP outlet drain valve(MOV-1503)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٣

Permissive Open:

- Blowdown tank level <٩٥%(*LIC*-٠٢٦٢)

Auto Open:

The valve is opened during CC start-up,when all of the following criteria are true

- GT speed > ٢٠٠ rpm for more than ١ minute (*SY*-١٥٣٤)
- IP steam pressure >١٤psig (*PIC*-٠٥٠٥)

During automatic draining (after start-up draining),when all of the following criteria are true

- CC mode active
- IP steam pressure >١٤psig (*PIC*-٠٥٠٥)
- Dripleg level (*LIC*-٠٢٦٢)>٨٥% or dripleg level >٩٠%

The valve is opened during standstill,when all of the following criteria are true

- No GT flame on(*XS*-١٥٣٣)
- IP steam pressure >١٤psig (*PIC*-٠٥٠٥)
- Dripleg level (LIC-٠٢٦٢)> ٨٥% or dripleg level > ٩٠%
- OTSG not in Dry run

Auto Close:

The valve is closed when all of the following criteria are true for ٥ minutes

- GT flame on(*XS*-١٥٣٣)
- Steam temperature >٥٤F above calculated saturation temperature (*TSH*-٠٤٢٦)
- Steam flow > ٤٨٧٥ lb/hr(*FIA*-٠٢٣٩)
- Valve is not closed(*MOV*-١٥٠٣)
- Dripleg level (LIC-٠٢٦٢)<٨٥% and dripleg level <٩٠%, both longer than ٣٠ sec

The valve is also closed after start-up when one of the following criteria is true

- CC mode not active (due to Dry out)

The drain valve is closed during automatic draining when any of the following criteria is true

- IP steam pressure <١٤pisg (*PIC*-٠٥٠٥)
- Dripleg level (LIC-٠٢٦٢)< ٨٥% and dripleg level < ٩٠%, both longer than ٣٠ sec

The drain valve is closed during stand still when all of the following criteria are true

- No GT flame on(*XS*-١٥٣٣)
- IP steam pressure(*PIC*-٠٥٠٥)<١٠psig OR (Dripleg level (LIC-٠٢٦٢) <٨٥% and

dripleg level <٩٠% both longer than ٣٠ sec)

Protective Close:

- Blow down tank level(LIC-٠٢٦٢) >٩٥% longer than ٦٠ sec
- Dry run or Dry out mode

٢.٢.٧ HP bypass system

٢.٢.٧.١ HP steam bypass inlet shut-off valve(MOV-1283)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣٥-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٥-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٥-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٦-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٦-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٦-٠٠٣

Manual control

٢.٢.٧.٢ HP steam bypass outlet shut-off valve(MOV-1294)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣٥-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٥-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٥-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٦-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٦-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٦-٠٠٣

Manual control

٢.٢.٧.٣ HP steam bypass spray shut-off valve(XV-0800)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣٥-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٥-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٥-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٦-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٦-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٦-٠٠٣

Auto Open:

- HP steam bypass(*PV*-٠٥٠٩) output > ١٠%

Auto Close:

- HP steam bypass(*PV*-٠٥٠٩) output < ٢%

Protective Close:

- HP steam bypass(*PV*-٠٥٠٩) fast close

٢.٢.٧.٤ HP steam bypass drain valve(MOV-1284)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣٥-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٥-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٥-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٦-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٦-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٦-٠٠٣

Auto Open:

- HP steam bypass drain water temp< ٦٠٠F (*TIT*-٠٤٣٥,*TIT*-٠٤٣٦)

Auto Close:

- HP steam bypass drain water temp> ٦٣٠F (*TIT*-٠٤٣٥,*TIT*-٠٤٣٦)

٢.٢.٨ IP bypass system

٢.٢.٨.١ IP steam bypass inlet shut-off valve(MOV-1288)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣٧-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٧-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٧-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٨-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٨-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٨-٠٠٣

Manual control

٢.٢.٨.٢ IP steam bypass outlet shut-off valve(MOV-1295)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣٧-٠٠١

- P&ID B٢٤-A-PID-BA-٥٧٥١٣٧-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٧-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٨-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٨-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٨-٠٠٣

Manual control

٢.٢.٨.٣ IP steam bypass spray shut-off valve(XV-0810)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣٧-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٧-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٧-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٨-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٨-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٨-٠٠٣

Auto Open:

- IP steam bypass(*PV*-٠٥١٧) output > ١٠%

Auto Close:

- IP steam bypass(*PV*-٠٥١٧) output < ٢%

Protective Close:

- IP steam bypass(*PV*-٠٥١٧) fast close

٢.٢.٨.٤ IP steam bypass drain valve(MOV-1289)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٣٧-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٧-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٧-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٨-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٨-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٣٨-٠٠٣

Auto Open:

- IP steam bypass drain water level> XX% (*LIT*-٠٠٥٨,*LIT*-٠٢٥٧)

Auto Close:

- IP steam bypass drain water level< XX%(*LIT*-٠٠٥٨,*LIT*-٠٢٥٧)

٢.٢.٨.٥ Condensate drain tank pump A(GM-0878A/GM-0879A/GM-0880A/GM-0883A/GM-0884A/GM-0885A)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٣

Permissive Start:

- Motor control power available
- Pump stop status
- Motor remote mode
- Motor NOT protection trip

Auto Start:

- Condensate drain tank level >٧٧.٥% (*LIA*-٠٢٦٢) and pump A is lead selection
- Condensate drain tank level >٩٠.٥%(*LIA*-٠٢٦٢)
- Pump A in standby mode，and pump B run status loss

Auto Stop:

- Condensate drain tank level <٤٠%(*LIA*-٠٢٦٢)

Protective Stop:

- Condensate drain tank level <٣٠% (*LIA*-٠٢٦٢)

٢.٢.٨.٦ Condensate drain tank pump outlet valve(MOV-1292)

Reference Drawings

- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤١-٠٠٣
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠١
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٢
- P&ID B٢٤-A-PID-BA-٥٧٥١٤٢-٠٠٣

Auto Start:

- Any of pump running

Auto Stop:

- All of pump stopped

٢.٢.٩CHEMICAL DOSING SYSTEM FOR FEED WATER

The water from demine water tank filled in oxygen scavenger dosing tank ,mixed with oxygen scavenger , Injecting pump send chemical water to FW system The water from ١st RO product filled to ammonia dosing tank , mixed with ammonia send it to FW system.

٢.٢.٩.١ Ammonia dosing tank with agitator (GM-٠٩69)

Reference Drawings

- P&ID B٢٤-A-BA-٥٧٥٢٦٤-٠٠١
- P&ID B٢٤-A-BA-٥٧٥٢٦٤-٠٠٢

Permissive Start:

- Motor control power available
- Motor remote mode
- Pump stop status
- Motor NOT protection trip

Auto start:（one or more of the following criteria are true）

- Ammonia dosing tank with agitatorlevel(*LIT*-٠٢٨٣)H>٩٠%
- CFP discharge after chemical injection ph (*AIA*-٠٨٦٤*A*) H>٩

Auto stop:（one or more of the following criteria are true）

- Ammonia dosing tank with agitator level(*LIT*-٠٢٨٣)L<١٠%
- CFP discharge after chemical injection ph (*AIA*-٠٨٦٤*A*) L<٧

٢.٢.٩.٢ Ammonia injection pump A (GM-٠٩٧١A)

Reference Drawings

- P&ID B٢٤-A-BA-٥٧٥٢٦٤-٠٠١
- P&ID B٢٤-A-BA-٥٧٥٢٦٤-٠٠٢

Permissive Start:

- Motor control power available
- Motor remote mode
- Pump stop status
- Motor NOT protection trip
- Any CFP running

Auto start:（one or more of the following criteria are true）

- Pump A in standby mode, pump B run status loss.
- Pump A as lead pump and CFP discharge after chemical injection ph L<٦ (*AIT*-٠٨٦٤*A*)
- CFP discharge after chemical injection ph LL<٥ (*AIT*-٠٨٦٤*A*)

Auto stop:（one or more of the following criteria are true）

- Pump A as lag pump and CFP discharge after chemical injection ph H>٨ (*AIT*-٠٨٦٤*A*)
- CFP discharge after chemical injection ph HH >٩(*AIT*-٠٨٦٤*A*)

٢.٢.٩.٣ Boiler feed water pump A(GM-0813A)

Reference Drawings

- P&ID B٢٤-A-BA-٥٧٥١٣٣-٠٠١
- P&ID B٢٤-A-BA-٥٧٥١٣٣-٠٠٢
- P&ID B٢٤-A-BA-٥٧٥١٣٣-٠٠٣
- P&ID B٢٤-A-BA-٥٧٥١٣٤-٠٠١
- P&ID B٢٤-A-BA-٥٧٥١٣٤-٠٠٢
- P&ID B٢٤-A-BA-٥٧٥١٣٤-٠٠٣

Permissive start:（all of the following criteria are true）

- Motor control power available
- Motor remote mode
- Pump stop status
- Motor NOT protection trip
- Boiler feed water pump A outlet valve close

Auto start:（one or more of the following criteria are true）

- Pump A in standby mode, pump B run status loss.
- SEQ start boiler feed water pumpA

Auto stop:（one or more of the following criteria are true）

- SEQ stop boiler feed water pump A

Protective stop:（one or more of the following criteria are true）

- When boiler feed water pumpA start, outlet valve not open in ٣ sec.
- When outlet valve open after ٣ sec , boiler feed water pump A not start

٢.٢.٩.٤ Boiler feed water pump A outlet VLV(MOV-1265A)

Reference Drawings

- P&ID B٢٤-A-BA-٥٧٥١٣٣-٠٠١
- P&ID B٢٤-A-BA-٥٧٥١٣٣-٠٠٢
- P&ID B٢٤-A-BA-٥٧٥١٣٣-٠٠٣
- P&ID B٢٤-A-BA-٥٧٥١٣٤-٠٠١
- P&ID B٢٤-A-BA-٥٧٥١٣٤-٠٠٢
- P&ID B٢٤-A-BA-٥٧٥١٣٤-٠٠٣

Permissive open:（all of the following criteria are true）

- Valve in remote mode

Auto open:（one or more of the following criteria are true）

- Open with BFW A start Sequence

Auto close:（one or more of the following criteria are true）

- Close with BFW A start Sequence
- Close with BFW A stop Sequence

٢.٢.٩.٥ Boiler feed water pump A SEQ START

- SEQ close BFW A outlet VLV
- SEQ start BFW A
- SEQ open BFW A outlet VLV

٢.٢.٩.٦ Boiler feed water pump A SEQ STOP

- SEQ close BFW A outlet VLV
- SEQ stop BFW A

٢.٢.٩.٧Minimum flow control of boiler feed water pumpA (FV-٠212A)

Reference Drawings

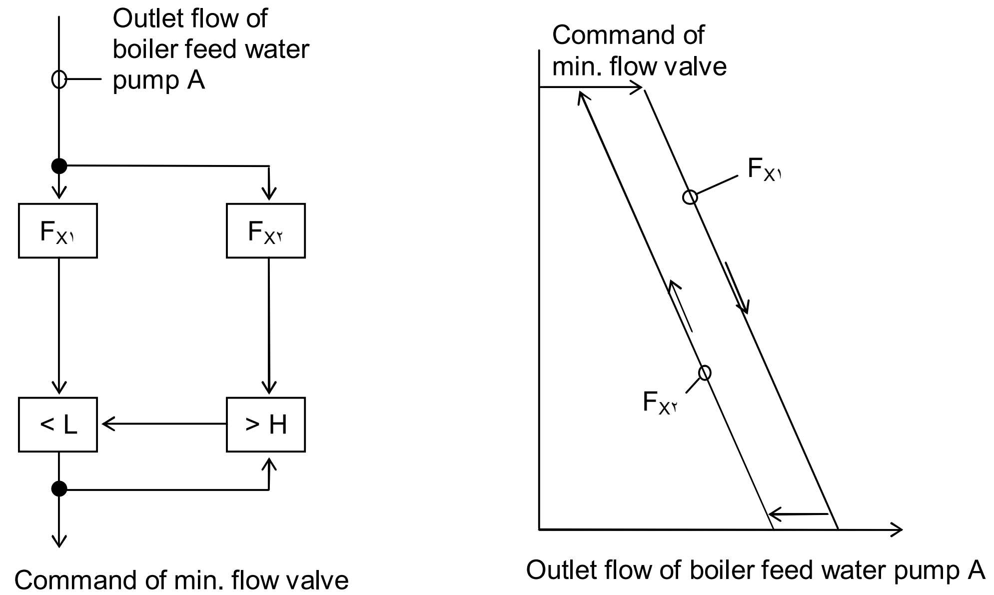
- P&ID B٢٤-A-BA-٥٧٥١٣٣-٠٠١
- P&ID B٢٤-A-BA-٥٧٥١٣٣-٠٠٢
- P&ID B٢٤-A-BA-٥٧٥١٣٣-٠٠٣
- P&ID B٢٤-A-BA-٥٧٥١٣٤-٠٠١
- P&ID B٢٤-A-BA-٥٧٥١٣٤-٠٠٢
- P&ID B٢٤-A-BA-٥٧٥١٣٤-٠٠٣

Control purpose

- Control min. feed water flow of each pump according to outlet flow of each boiler feed water pump, so as to confirm safety operation of pump.

Function description

- Outlet flow of boiler feed water pump a will be sent to function generator, and output of function generator will be acted as command of min. flow valve of pump. When signal of inlet flow increase, output of function generator will decrease; when signal of outlet flow reduce, output of function generator will increase. Output signal of function generator after correction is used for adjusting min. flow regulating valve of pump. There are two function generator in min. flow control loop, and the min. flow valve opening degree command will be formed after MIN selection and MAX selection, shown as below figure.



Controller	B25-FIT-0212A
Action	N/A
Final Control Element B٢5-FV-0212A	
Fail Action	FO

٢.٣ FOXBORO DISTRIBUTED CONTROL SYSTEM (DCS)

٢.٣.١ Introduction

The I/A Series distributed control system from Foxboro, measurably improves plant-wide operations, performance and asset utilization in today's modern manufacturing enterprise.
A key component of the Infusion Enterprise Control system, the I/A Series system offers the greatest breadth of capabilities for providing optimal performance for operators, engineers and maintenance personnel.
The Intelligent Automation (I/A) Series system is an Open Industrial System (OIS) that integrates and automates manufacturing operations. It is an expandable distributed system that allows a plant to incrementally tailor the system to its processing requirements.
The modules that make up the I/A Series system communicate with each other even though they can be located in a variety of locations. These locations depend upon the conditions and layout of the particular process Plant.
DCSs allow centralized configuration from the operator or engineering console in the control room. You can change programming offline, and download without restarting the system for the change to be effective.
DCSs allow inter-controller communications. You can do data exchange in most DCS systems ad hoc (no need for predefined data point lists). You access data by tag name, regardless of hardware or location.

٢.٣.٢. I/A Series System

The I/A Series system includes a set of application packages that are used to perform automatic and manual system management functions.

Figure ٢:I/A series system

٢.٣.٣ MAINSOFTWARE PACKAGES

- Fox view
- Fox select
- IACC I/A Series Configuration Component
- Fox Draw
- System Definition

٢.٣.٤ Fox view Human Interface

The term Human Interface refers to the way a workstation is set up to interact with the user.
There are two Human Interface versions, Fox View and the Display Manager. Here, you will be introduced to the Fox View Human Interface.
Many I/A Series systems use Fox View as its interface. Fox View allows a user to utilize numerous applications to:

- Respond to alarms
- Collect and interpret data
- Modify process variables
- Perform on-line trending
- Generate reports

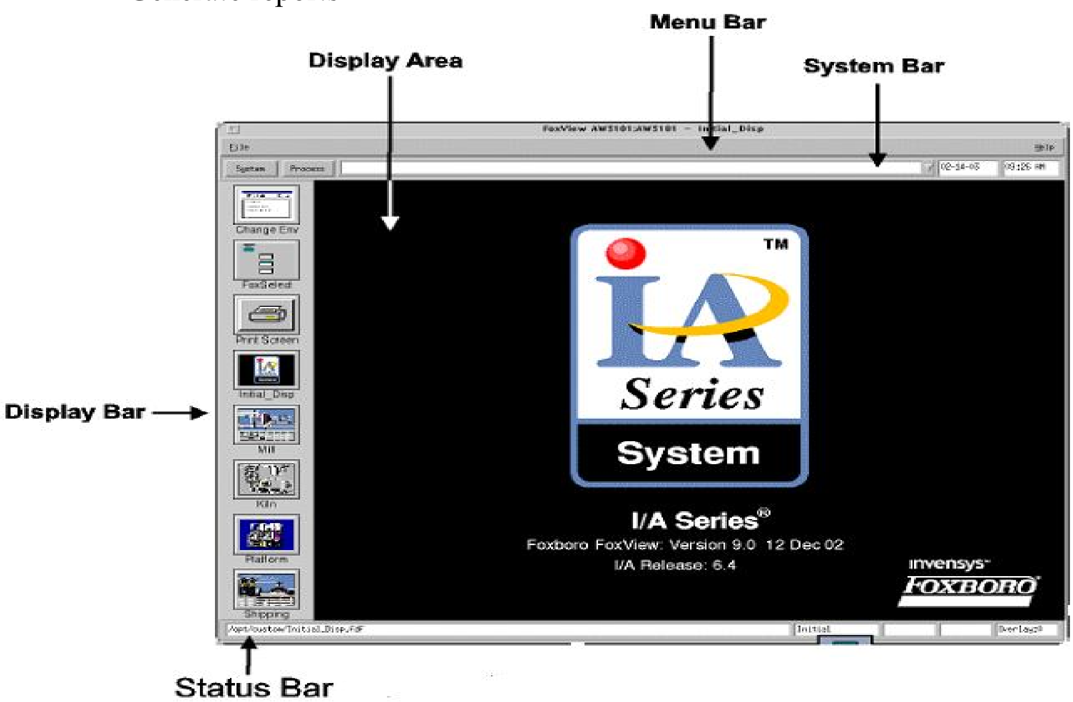


Figure ٤:FOXVIEW window

٢.٣.٥ Fox select

- It is an overview of the compounds and blocks in the control database.
- Turn ON and OFF compounds and their associated blocks.
- Expand a list of the network's stations and compounds.
- View a list of blocks within all connected stations, and sort the list by different criteria.
- Bring detail displays (Block Detail Displays, Compound Detail Displays, or Station Block Detail Displays) into Fox View.

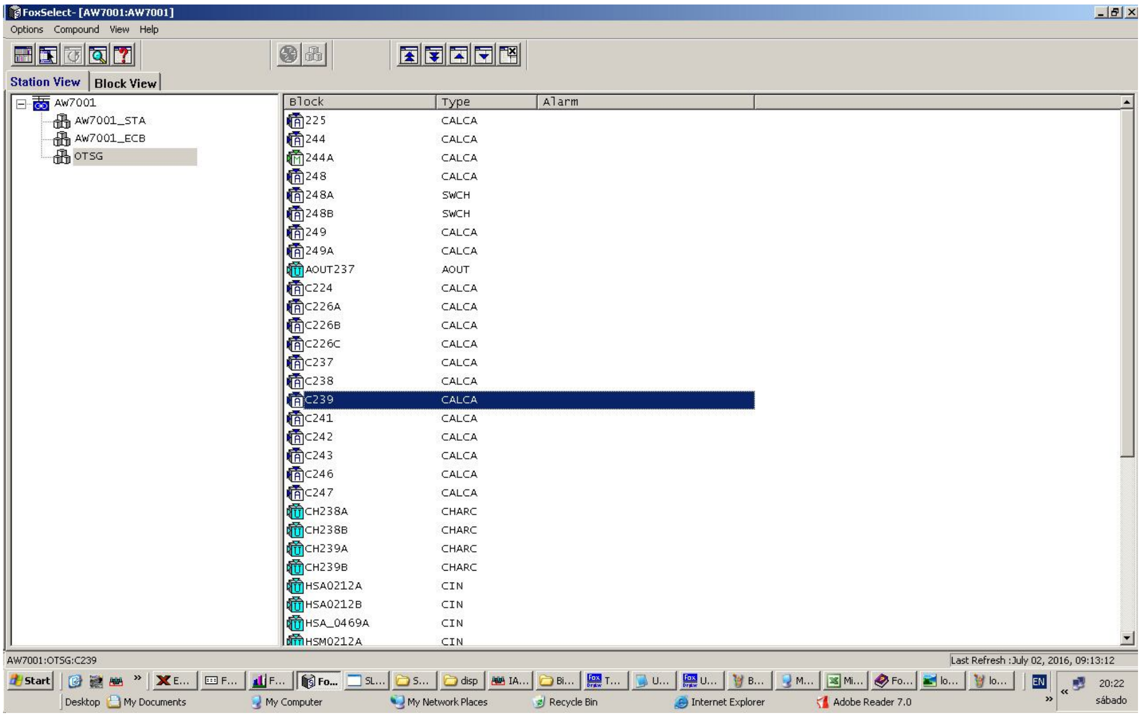


Figure ٥:FOXSELECT window

٢.٣.٦ I/A Series Configuration Component (IACC)

The I/A Series Configuration Component (IACC) pays for itself many times over from the productivity and quality gains made possible by using its rich set of intuitive and extensible engineering tools for project engineering and life-cycle maintenance.
IACC provides a powerful and integrated engineering environment for designing and maintaining control strategies, composite display objects and configuring the I/A Series system.

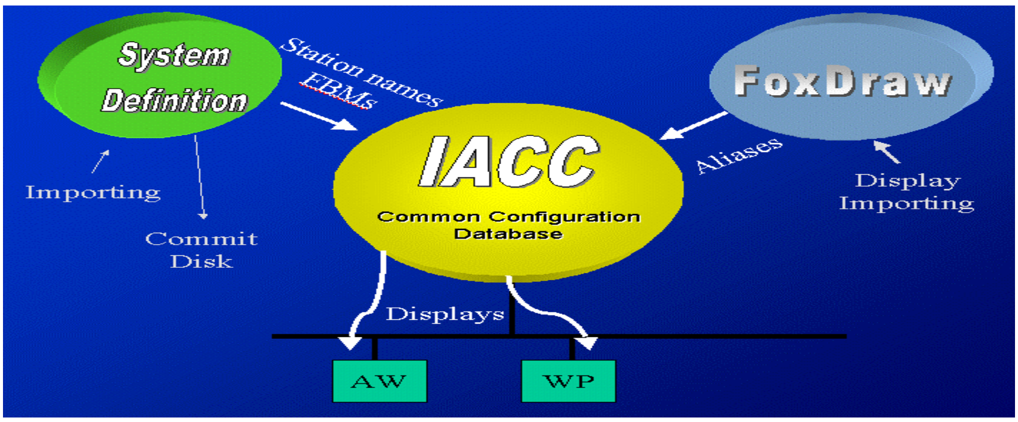


Figure ٦:IACC configuration

IACC includes the Intelligent Design Studio library with over ٣٠ of the most frequently encountered control strategies.
Having a Common Configuration Database eliminates the need to reenter data in several different configuration tools. This obviously saves time and reduces the chance

of mistakes. Using a Microsoft windows framework improves ease of use for both novice and advanced users.
Hardware independent engineering means that the engineer can configure a system without any I/A Series hardware.

IACC steps

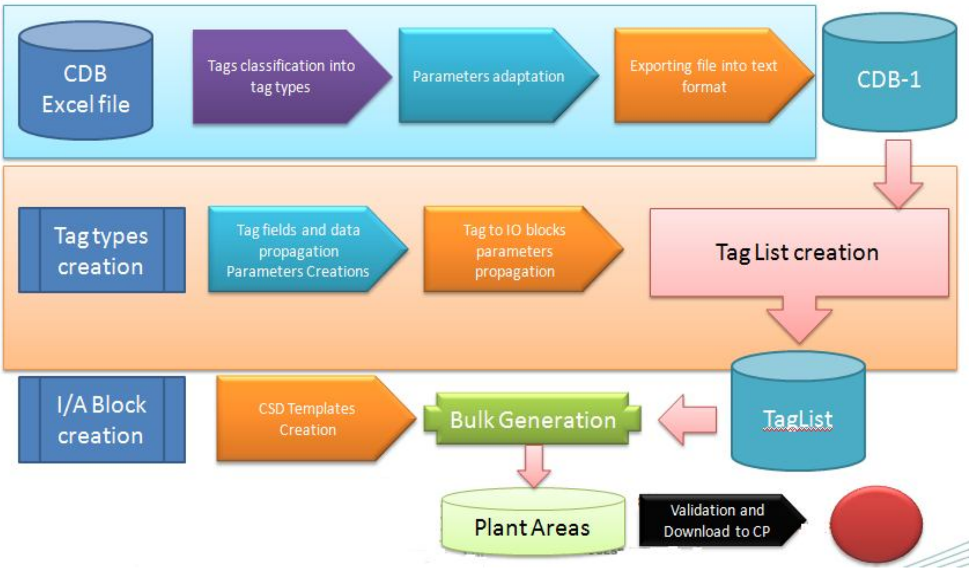


Figure ٧:Data Processing

١. Starting IACC

To start an IACC session:
١. Do one of the following:
♦ Click Start and select the IACC icon if it is included in the list of most recently used files.
♦ Choose Start > All Programs > IACC > IACC Studio

An IACC client can be configured for access to multiple databases on one or more servers. When multiple databases have been enabled, the IACC Databases dialog box lists the available databases.

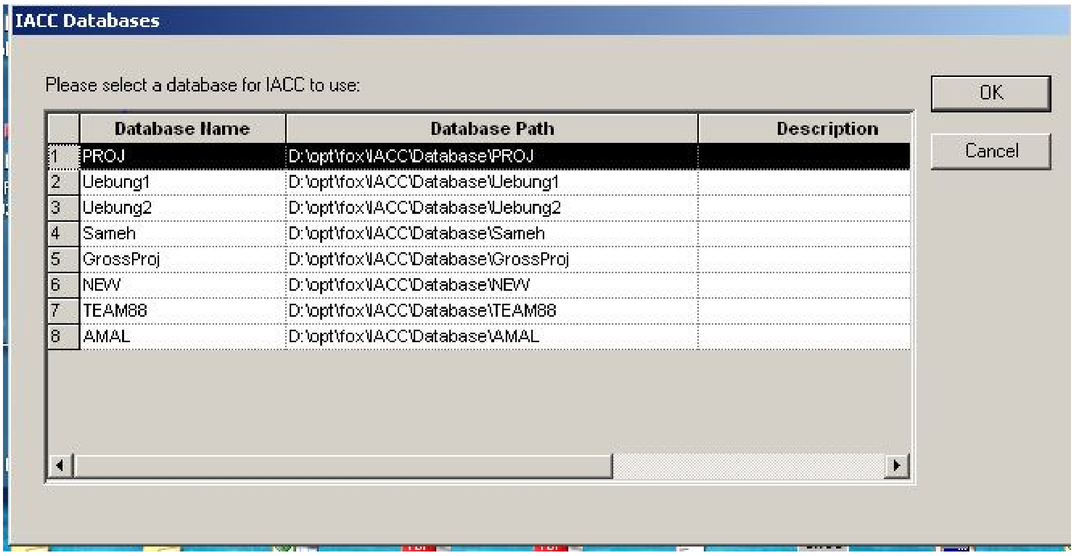


Figure ٨:IACC Databases Dialog Box

٢. Select a database and click OK.
IACC displays the Logon dialog box that provides security access to the IACC editors and functions.

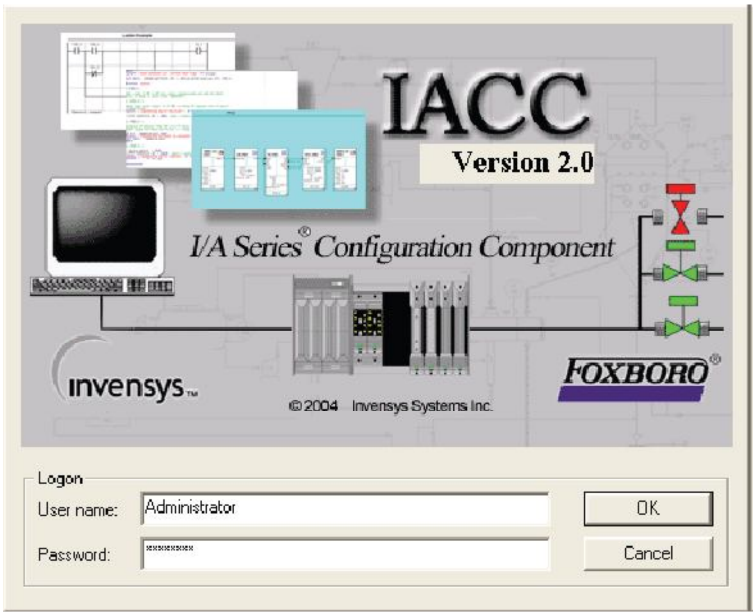


Figure ٩:Logon Dialog Box

٣. Enter the user name and password and click OK. The password is case-sensitive; the user name is not. The main IACC window is displayed.

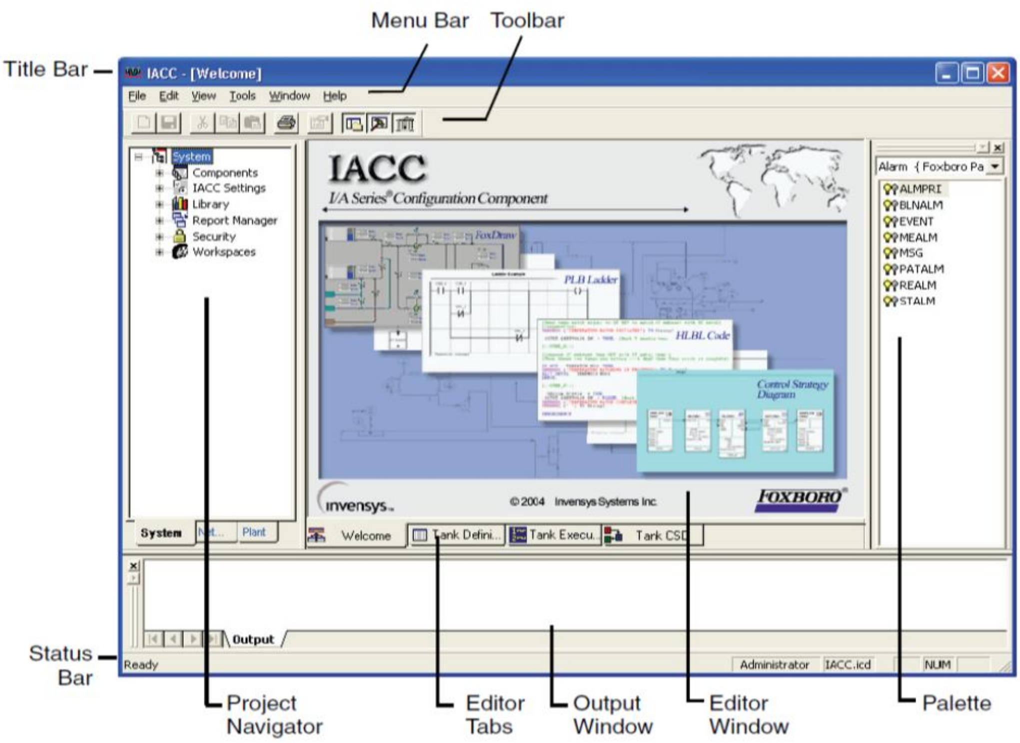


Figure ١١:IACC Windows and Menu Bars

Project Navigator

The Project Navigator (Figure ٢-٤), on the left side of the IACC window, is your view into the project database, using a tree structure similar to the folders display in Windows Explorer. The Project Navigator has three tab selections, each providing a different viewpoint:

System: Provides access to objects and definitions used in configuring your process control network. These resources include CSD Templates, TagLists, and libraries of standard I/A Series block definitions. The tab also provides access to report templates and security functions.

Network: Defines the network hardware and software used in the system. With this tab, you can view the hardware hierarchy, and you can create and modify both hardware and software objects. Pop-up menus enable you to specify options (parameter, hardware, and software) for hardware and software. The Network tab also provides access to compounds and their blocks once the compounds are assigned to a control station.

Plant: Groups configuration components by physical location, projects, plant equipment, processes, or whatever organizational method you choose. In the Plant tab, you define a hierarchy of Plant Area objects. Each Plant Area object allows you to create CSDs, compounds, and display files. You can also perform a variety of other control configuration tasks. The Project Navigator lists objects within each node alphabetically. You can set the Project Navigator to display the objects in the order they were created. It can also be configured to show the object type and a description in parentheses after the object name.

٢. Creating Defaults

Here, we will create three defaults for: AIN, PIDA and AOUT blocks.

AIN and AOUT Defaults:

١. Open the System tab in the Project Navigator window.

٢. Open Library then select I/A Block Types then Input/Output Blocks in the resulting pop-up menus.

٣. Right-click on AIN and select New Definition in the resulting pop-up menu. a new default (child) AIN١ will be created from the parent block AIN, so every change in the parent block will affect directly in the child one, but changes made in the child block will not change anything in the parent block, and this is the main advantage of using defaults.

٤. Now repeat step ٣ for AOUT block.

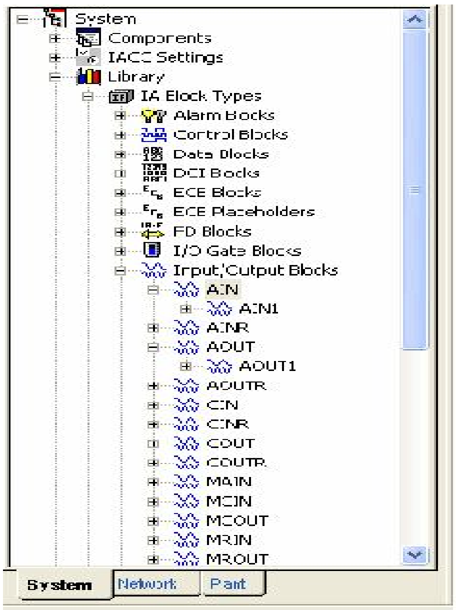


Figure ١٢:AIN and AOUT Defaults

SWCH Default

١. Open the System tab in the Project Navigator window.

٢. Open Library then select I/A Block Types then Control Blocks in the resulting pop-up menus.

٣. Right-click on SWCH and select New Definition in the resulting pop-up menu. a new default (child) SWCH١ will be created from the parent block SWCH, so every change in the parent block will affect directly in the child one, but changes made in the child block will not change anything in the parent block, and this is the main advantage of using defaults.

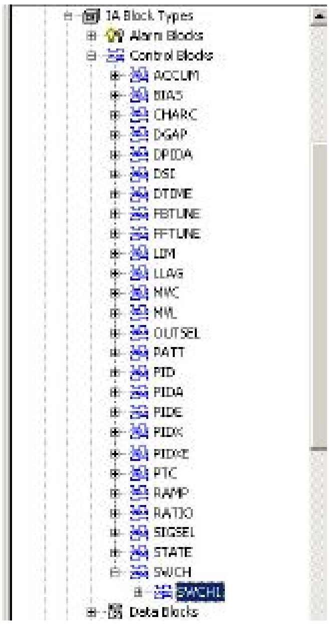


Figure ١٣:SWCH Default

CALCA Default

١. Open the System tab in the Project Navigator window.

٢. Open Library then select I/A Block Types then Logic Blocks in the resulting pop-up menus.

٣. Right-click on CALCA and select New Definition in the resulting pop-up menu. a new default (child) CALCA١ will be created from the parent block CALCA, so every change in the parent block will affect directly in the child one, but changes made in the child block will not change anything in the parent block, and this is the main advantage of using defaults.

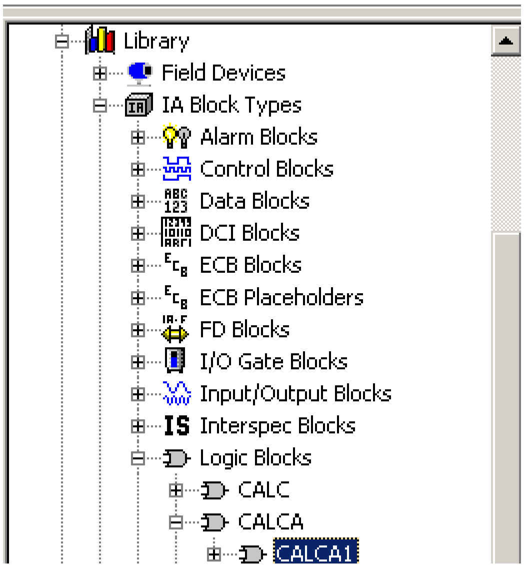


Figure ١٤:CALCA Default

٣. BUILDING A SIMPLE CSD

Here, you will build a typical loop, consisting of AIN, CALCA,SWCH and AOUT blocks. The Control Strategy Diagram (CSD) Editor is used to add blocks and establish links between them.

Adding Plant Areas

The Project Navigator's Plant tab can be organized to be similar to your own plant. This is done by simply adding plant areas to the Plant tab.

١. Open the Plant tab in the Project Navigator window.

٢. Right-click Plant and select New Plant Area in the pop-up menu. Plant Area ١ appears.

٣. Change the new plant area's name to B٢٤ .

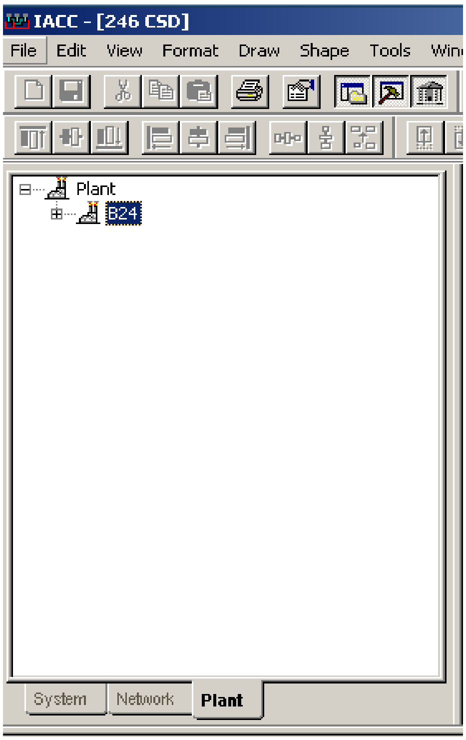


Figure ١٥:Adding Plant Area

Adding Blocks to a CSD

The Palette Window is used to add blocks to a CSD.
١. Close the IACC Welcome screen by selecting Close All in the Window menu.
٢. Ensure that the Plant tab is open in the Project Navigator window.
٣. Ensure that Plant and B٢٤ have been expanded. This is done by clicking the adjacent + boxes.
٤. Add a new CSD by right-clicking B٢٤ and then highlighting New and CSD and selecting Simple CSD in the resulting pop-up menus.
The name Simple CSD١ appears below B٢٤.
٥. Change the name Simple CSD١ to ٢٤٧.
٦. Open the CSD Editor for ٢٤٧ by right-clicking ٢٤٧ and then highlighting Editors and selecting CSD Editor in the resulting pop-up menus.
Note that the CSD name, ٢٤٧, appears in the IACC Title Bar, at the top of the CSD Editor window, and in a tab at the bottom of the CSD Editor window.
٧. Close the CSD Editor by opening the Window menu and selecting Close All.
٨. Reopen the CSD Editor for ٢٤٧ by simply double-clicking ٢٤٧.
٩. Use the System Tab to drag AIN, CALCA,SWCH and AOUT blocks (١ each) from the library into the CSD Editor window:
a) Open the Input/output Blocks portion of I/A Block Types.
b) Click-and-drag the default AIN١ into the left side of the CSD Editor window.
c) Click-and-drag the default AOUT١ into the right side of the CSD Editor window.
d) Open the Control Blocks portion of I/A Block Types.
e) Click-and-drag the default SWCH١and CALCA١ into the CSD Editor window,
١٠. Align the blocks along their top edge:
a) Select each block while the Shift key is depressed.
b) Click the Align Top button in the Tool Bar.

١١. Connect the points listed in the table below (in the CSD Editor window, use the click-and-drag method to draw a line between the parameters).

Connect this	To this
AIN١١.PNT	CALCA١.RI٠١
CALCA١.RO٠٢	SWCH١.INP٢
SWCH١.OUT	AOUT١.MEAS

Table ١:Blocks Connection

١٢. Rename the input/output blocks using the names listed in the project excel sheet:
a) Expand the ٢٤٧ CSD in the Project Navigator.
b) Right-click AIN١١ and select Rename in the resulting pop-up menu.
c) Change the name AIN١١ to PIT٠٥١٠A. The new name also appears in the CSD Editor window.
d) Repeat these steps for AOUT block.

Rename this	To this
AIN١١	PIT٠٥١٠A
AOUT١١	SP٠٥٠٩A

Table ٢:Blocks Name

The editor window should appear similar to the figure below.

Modifying Block Parameters

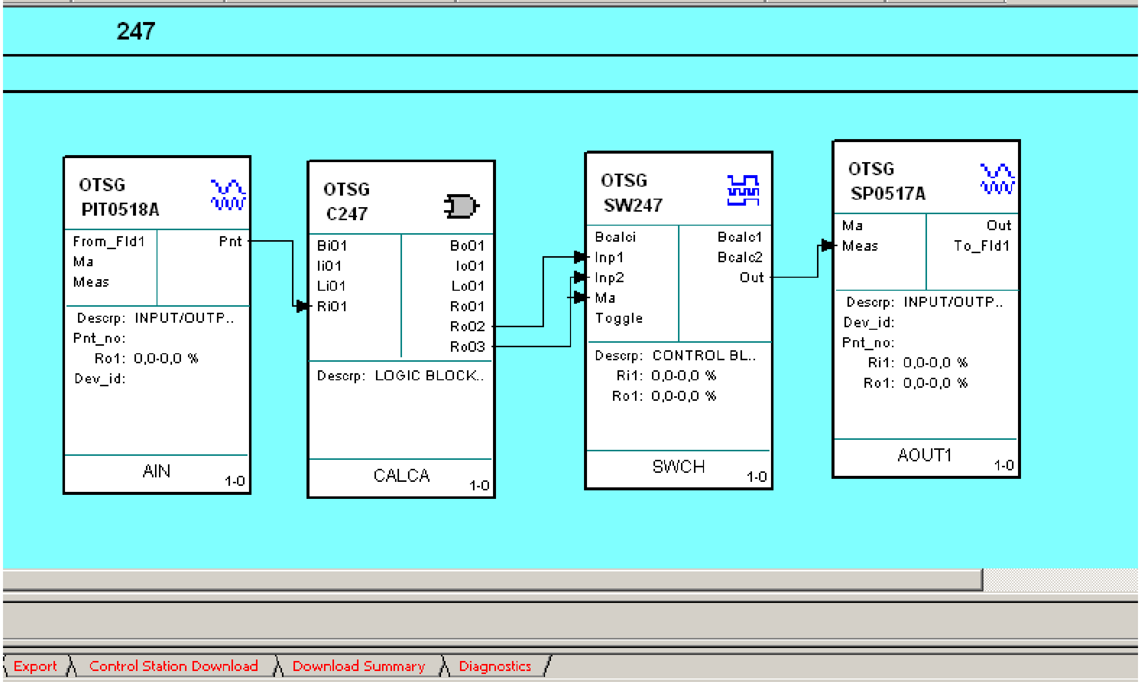


Figure ١٦:٢٤٧ CSD

Typically, blocks must be configured as given in the excel sheet. In this part, you will edit required parameters in each block as mentioned in the excel sheet.

Using the Properties Dialog Box:

١. Right-click the AIN block (PIT٠٥١٠A) in either the CSD Editor window or Project Navigator and select Properties in the resulting pop-up menu. The AIN: PIT٠٥١٠A Properties dialog box appears.

٢. Begin to edit necessary parameters as given in the excel sheet. Note that any changes appear in a different color in the Properties dialog٣. Repeat step ٢ for the AOUT,SWCH and CALCA blocks.

٤. Click OK in the Properties dialog box.

٤. Assigning a Control Loop to a Compound

Control loops, like the one you just created using the CSD Editor, should be assigned to a new or previously existing compound. In this exercise, it is assumed that a new compound is needed.

CSD Assignment to a Compound:

١. Ensure that the Plant tab in the Project Navigator and the B٢٤ plant area is still selected.

٢. Create a new compound by right-clicking AREA NATIH in the Project Navigator and then highlighting New and selecting Compound in the resulting pop-up menus. A default compound name, COMPND١, appears below Product A.

٣. Change the name COMPND١ to OTSG.

٤. Assign ٢٤٧ CSD to the OTSG compound:

a) Right-click ٢٤٧ CSD and select Assign Default Compound in the resulting menu. The Assign Default Compound dialog box appears. All the previously created compounds are listed.
b) Select OTSG I/A Compound. A checkmark appears in the adjacent box.
c) Click OK. The compound name OTSG now appears above the block name in each box in the CSD Editor window. Also, note that in the Project Navigator, the blocks have been assigned to this compound.

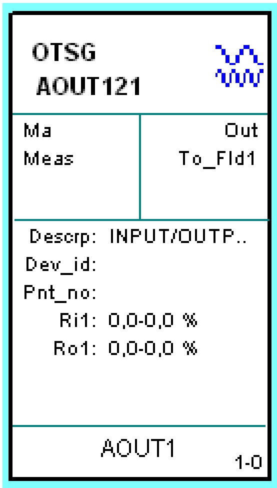


Figure ١٧:Assigning Default Compounds

٥. ExportingSave/Save-all Data

IACC is a database application. In order for a compound to run in real-time, it must be downloaded to a control station. Downloading can be accomplished with different ways. In this section we will lear how to make a saveall data for a compound and download it to ICC.
١. Ensure that the Plant tab in the Project Navigator is open and the B٢٤ plant area is selected.
٢. While selecting the plant area B٢٤, press FILE from the top menu then choose Export.
٣. You will have two formats to choose from:

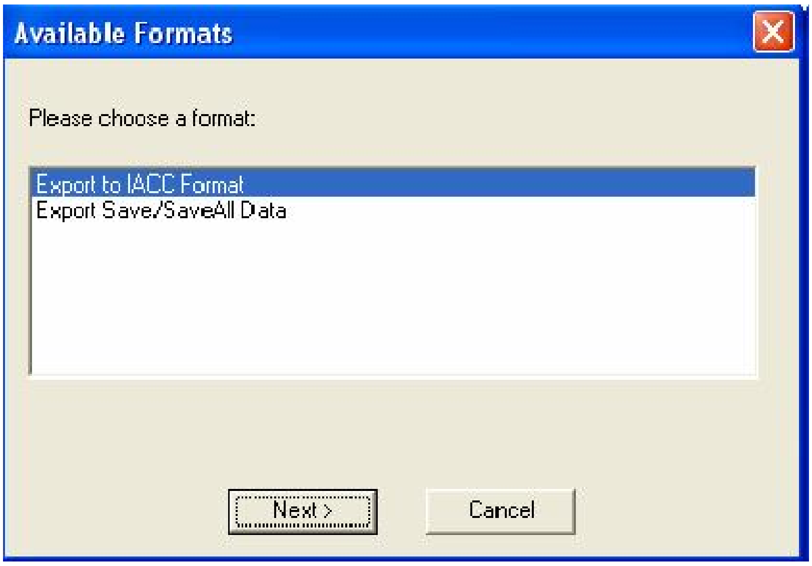


Figure ١٨:Export Window

٤. Choose Export to IACC Format, then Click the Next button.
٥. Choose the Destination to Save in .
٦. Click the Next button.
٧. Follow instructions until you finish export.

٦. CSD Templates

A CSD Template (CST) is a CSD that displays a process or a part of a process that will be used repeatedly to configure your control strategy. A CST contains a general block and connection strategy, which can be copied to produce multiple CSD Instances. Information from a taglist can be applied to a CSD Template during bulk generation to produce a unique CSD Instance. This new CSD instance can have its Compound and Control Station assigned as part of the Bulk Generation. Alternately, a CSD Template can be copied to form a CSD Instance, which is then modified in the CSD Editor to produce a unique CSD Instance.

CREATING A CSD TEMPLATE
a. open IACC.
b. expand system by clicking +, then components.
c. right click on CSD Template and rename it.
d. creat blocks and put the block in the template created by drag and drop the block in the template created.
f. rename the block by clicking + of the created template.

Figure ١٩:Creating CSD Template

٧. Taglists

After forming required the excel sheet with parameters required the next step is:
Importing Taglist
Through an excel sheet including the blocks and all parameters as the following excel sheet

	M	O	P	Q	R	S	V
1	Name	Loop_Name	Plant Area	CP	Compound	CST_Component	Description
2	FCV0230A	B24-F-0230A	B24	AW7001	OTSG	AOUT	FLOW CONTROL VALVE-FF
3	FCV0231A	B24-F-0230A	B24	AW7001	OTSG	AOUT	FLOW CONTROL VALVE-FF
4	TCV0552A	B24-T-0552A	B24	AW7001	OTSG	AOUT	TEMPERATURE CONTROL VALVE-FF
5	TCV0424A	B24-T-0424A	B24	AW7001	OTSG	AOUT	TEMPERATURE CONTROL VALVE-FF
6	TIC0424A	B24-T-0424A	B24	AW7001	OTSG	AOUT	DCS TEMPERATURE IND CONTROLLE
7	TICSA0424A	B24-T-0424A	B24	AW7001	OTSG	AOUT	DCS FUNCTION
8	FIC0237A	B24-F-0237A	B24	AW7001	OTSG	AOUT	DCS FLOW IND CONTROLLER
9	FIC0212A	B24-F-0212A	B24	AW7001	OTSG	AOUT	DCS FLOW IND CONTROLLER
10	FV0212A	B24-F-0212A	B24	AW7001	OTSG	AOUT	FLOW CONTROL VALVE-FF
11	FIC0212B	B24-F-0212B	B24	AW7001	OTSG	AOUT	DCS FLOW IND CONTROLLER
12	FV0212B	B24-F-0212B	B24	AW7001	OTSG	AOUT	FLOW CONTROL VALVE-FF
13	FIA0233A	B24-F-0233A	B24	AW7001	OTSG	AOUT	DCS FLOW IND ALARM

Table ٣:TagList Database

Custom Tag Types

You can create user-defined tag types using a pop-up menu from a tag type object in the Project Navigator. You can then open the newly created type using the Definition Editor to modify the type as follows:

• Add and delete parameters
• Change parameter attributes
• Select parameters to be displayed as column headings in the TagList Editor
• Specify which parameters appear when configuring tag data propagation.

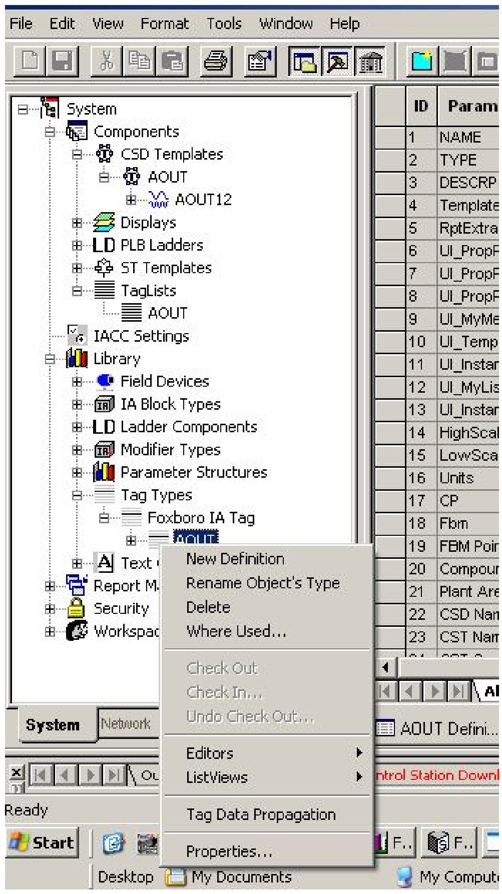


Figure ٢٠:Creating new Tag Type

٨. BULK GENERATION

Taglists and CSD templates are used to create CSDs. This Bulk Generation feature is invoked from the Taglist Editor and generates ECBs in the CSD using taglist data. In addition to identifying I/O points in a CSD, the taglist can be used to set parameters in other blocks in CSDs created or updated during bulk generation. You can specify tag propagation steps for any user-defined tag type, but not for the Foxboro I/A Tag. For example, you can map a description field in the taglist to the DESCRP parameter of the I/O blocks in the CSD. The following are some Bulk Generation rules:

• You can generate multiple CSD instances from the same CSD Template.

• The name of the new CSD instance is derived from the CSD Name field in the Tag List. If the name of an existing CSD instance is used, bulk generation overwrites the existing CSD instance with the new one. Thus, bulk generation can be used to update signal information in CSD instances you have already built.

• The CSD Template is identified in the CST name field in the Tag List.

• Every I/O block in the CSD Template must be mapped to a tag by having its name in the tag's CST Component field, the name of the CSD template in the CST Name field, and the name of the resulting CSD instance in the CSD name field.

Finally, after clicking the Finish button, compounds and CSDs are created and assigned to a plant area, based on entries in the taglist.

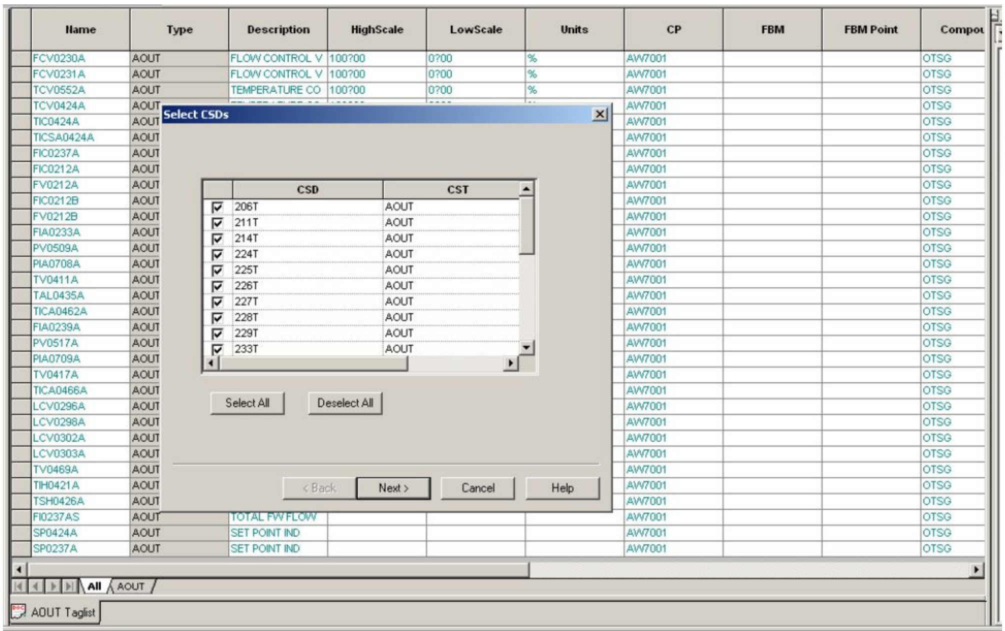


Figure ٢١:Selecting CSDs

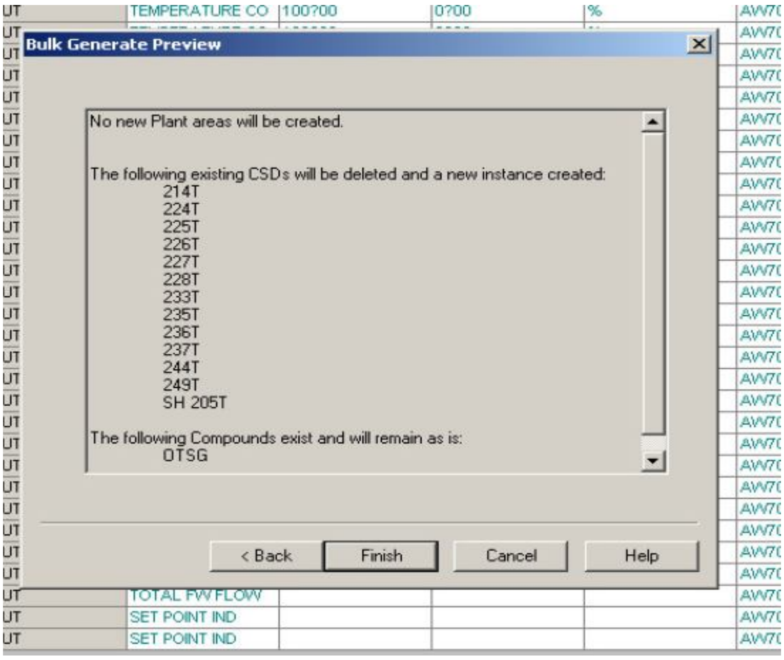
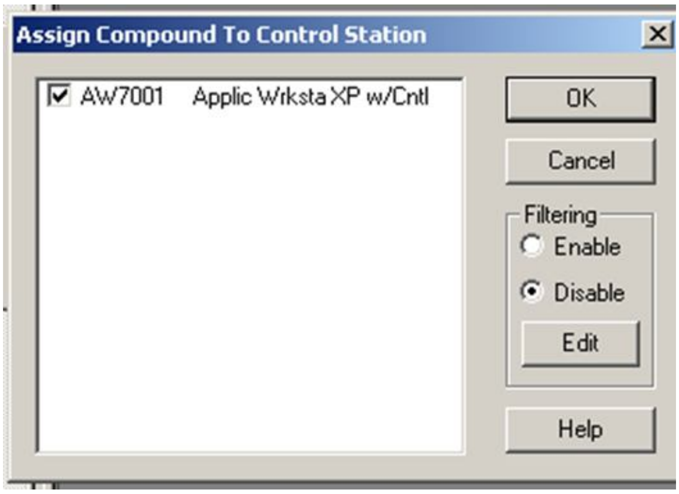


Figure ٢٢:Bulk Generation Preview

٩. Download

a- A plant area is created after bulk generation is done.
b- The compound to be downloaded must be assigned to a control station (AW٧٠٠١).



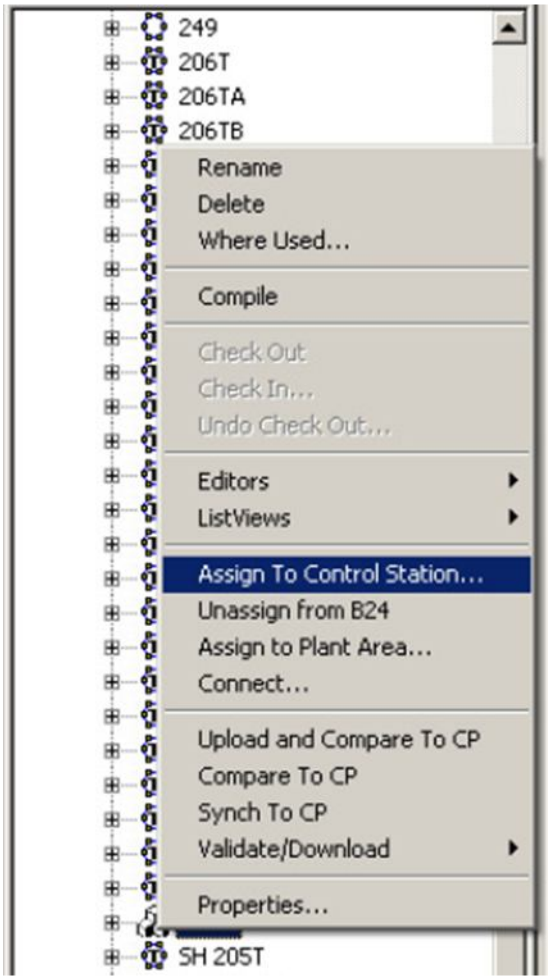


Figure ٢٣:Download Preview

c- Select Network tab, right click on CP (AW٧٠٠١) and choose validate then download. A specific compound can be downloaded without downloading the whole CP.

٢.٣.٧ Fox Draw

Fox Draw is a graphical display editor for creating and maintaining process displays. What is a display?

- a file (.fdf) that is constructed and configured to be viewed via Fox View
- represent a plant, a process area, or a detailed portion of a process
- is a “live” display
- configured to allow operator interaction with the process

٢.٣.٨ System Definition

System Definition identifies the I/A Series system components, the system softwarerequired by each component, the system component letter bugs, and other

systemcharacteristics for correctly loading system software and identifying the systemsoftware objects
System Definition produces a Commit diskette which is required for software installation and, therefore, must be completed before software installation

٢.٤ FUNCTIONAL DESIGN SPECIFICATION

٢.٤.١ Blocks used in IACC for Control Process

٢.٤.١.١AIN – Analog Input Block

Basic operation
The Analog Input Block (AIN) receives an input value from a single point of an analog, pulse count, or Intelligent Field Device type of Fieldbus Module (FBM) or Fieldbus Card (FBC), or from another block, and converts it into suitable form for use in an I/A Series control strategy. The input to the block is the digitized data from the FBM's Equipment Control Block (ECB), and the output is a value expressed in the appropriate engineering units.

Most Important Parameters in AIN Block
NAME,TYPE,DESCRP,PERIOD,LOOPID, MA

MEAS: Measurement is a value used as the source of the input to block operations when IOMOPT indicates that no FBM or FBC is connected (IOMOPT = ٠ or ٢). If an FBM or FBC is connected, (IOMOPT = ١) then MEAS is treated as an output, and the value and status of PNT are copied to the value and status of MEAS.

٢.٤.١.٢ AOUT – Analog Output Block

Basic operation
The Analog Output Block (AOUT) provides the control strategy with output capability for a single
analog value directed to any Fieldbus Module (FBM) or Fieldbus Card (FBC) capable of driving
analog outputs. The block supports Auto/Manual control, signal conditioning, biasing, and output balancing. Cascade initialization and supervisory control features are also available.

Most Important Parameters in AOUT Block
NAME,TYPE,DESCRP,PERIOD,LOOPID, MA

٢.٤.١.٣ PIDA Block

Basic operation
The PIDA controller implements continuous PID feedback and additive and multiplicative feedforward control of an analog loop . Its principal inputs, setpoint and measurement, are used to compute its output, the manipulated variable, based on user-set or adaptively tuned values of the tuning parameters – proportional band, integral time, derivative time, delay time, and setpoint relative gain. The feedforward capability can be used to decouple interacting loops, such as a slow level control cascading to a fast flow control, in addition to compensating for measured load upsets.

Most Important Parameters in PIDA Block
NAME,TYPE,DESCRP,PERIOD,LOOPID, MA

BCALCI: Back Calculation In is a real input that provides the initial value of the output before the block enters the controlling state, so that the return to controlling is bumpless. The source for this input is the back calculationoutput (BCALCO) of the downstream block. With V٤.٢ and later software,BCALCI contains the status bits which were formerly contained inthe INITI parameter. Therefore, INITI and INITO are not required forcascade initialization.

INCOPT: Increase/Increase Option is a Boolean input. When set true, INCOPT reverses the normal sense of the control action so that the controller outputincreases with increasing measurement.

LR: Local/Remote is a Boolean input that selects the setpoint source (٠ = Local; ١ = Remote). If LR is set to Remote, the source of the setpoint valueis the real input parameter RSP. When LR is set to Local, the source is theuser set input SPT.

MA: Manual /Auto is a Boolean input that controls the block's operating state:

٠ = Manual

١ = Auto.

MALOPT: Measurement Alarm Option is a configured short integer input thatenables absolute High and Low measurement alarming, or disables absolutealarming altogether.

٠ = No alarming

١ = High and Low measurement alarming

٢ = High measurement alarming only

٣ = Low measurement alarming only.

You can change MALOPT only by reconfiguring the block.

MODOPT: Mode Option is a configurable short integer. When the block is in Auto,MODOPT dictates the controller mode. The integer value ranges from ١to ٨:

١ = P – proportional only

٢ = I – integral only

٣ = PD – proportional plus derivative

٤ = PI – proportional plus integral .

SPT: Setpoint always represents the active controller setpoint. Setpoint is thereference variable that is compared with the MEAS input to produce theERROR signal. LR and SE determine the source of SPT.When LR is set to Remote, RSP is the source of SPT, which is secured.When LR is Local and SE is Disable, the user set value is the source ofSPT. When using the controller in only the Local mode, set LOCSP to ١(True). SPT can source the setpoint value to other blocks.When SE is enabled, Supervisory setpoint overrides all other setpointsources.

UNACK: Unacknowledge is a Boolean output that the block sets to True when itdetects an alarm. It is typically reset by operator action.

٢.٤.١.٤ CIN Block

Basic operation

The CIN block interfaces to an Equipment Control Block (ECB) which stores digital input or output values from an FBM or FBC. Each execution cycle, the block presents the value of the specified digital point at its output, called Contact Input (CIN). When no FBM or FBC is configured, the block input is taken from another block connected to the Input (IN) parameter. The CIN block provides optional point inversion, Bad I/O and State alarming, State Change message processing, and Auto/Manual capability.

Most Important Parameters in CIN Block
NAME, TYPE, DESCRP, PERIOD, LOOPID, MA

CIN: Contact Input is the block output. It represents the state of the inputpoint specified by IOM_ID and PNT_NO when IOMOPT indicatesthat an FBM or FBC is configured, or the value of the input IN otherwise. In any case, CIN is subject to optional inversion based on the state ofoption IVO.

IN: Input is an alternate source for the CIN block input, used when there isno connected FBM or FBC. When the block has a connected FBM orFBC, IN reflects the actual physical input, even when the output CIN isunder Manual control or when CIN is holding the last good value due tothe quality of the physical input.

IOMOPT: FBM Option is a boolean specifying whether an FBM or FBC connectionto the block exists. Values:

٠ = The CIN block obtains input values from the IN parameter.

١ = The block obtains input values from the FBM or FBC inputpoint specified by IOM_ID and PNT_NO.

NM٠: Name ٠ is a user-defined string of up to ١٢ characters sent with a Statealarm message to indicate that the message is a “return to normal” type.This means that CIN has transitioned from ١ to ٠ if INVALM is false, or٠ to ١ if INVALM is true.

NM١: Name ١ is a user-defined string of up to ١٢ characters sent with a Statealarm message to indicate that the message is an “into alarm” type. Thismeans that CIN has transitioned from ٠ to ١ if INVALM is false, or ١ to ٠if INVALM is true.

SCTXT٠: State Change Text ٠ is a text string sent with the State Change message toindicate that the state has changed from ١ to ٠, after any optional inversion.

SCTXT١: State Change Text ١ is a text string sent with the State Change message toindicate that the state has changed from ٠ to ١, after any optional inversion.

٢.٤.١.٥ COUT block

Basic operation

The COUT block interfaces to an Equipment Control Block (ECB) which contains digital outputvalues to an FBM or FBC. Each execution cycle, the block writes the value of the inputparameter Input (IN) to its output, called Contact Output (COUT). When an FBM or FBC isconfigured, the value of COUT also drives the connected output point.

Most Important Parameters in COUT Block
NAME, TYPE, DESCRP, PERIOD, LOOPID, MA

COUT: Contact Output is the output of the block. When there is a connected

FBM or FBC, its value is also transmitted to the connected output point.

IN: Input is the input to the block. Its value, after optional inversion and pulse

generation, is presented as the output COUT, and transmitted to any connected

FBM or FBC point.

٢.٤.١.٦ LLAG – Lead Lag Block

Basic operation

The Lead Lag (LLAG) Block dynamically compensates for changes in the measurement signal by initially overreacting (Lead) to the input, or gradually changing the output (Lag), or both. Theoutput has steady state levels that vary with the input when the block is in the Lead/Lag mode. Inthe Impulse mode, the block has a single steady state level that is dependent only on the BIASinput.

Most Important Parameters in LLAG Block
NAME, TYPE, DESCRP, PERIOD, LOOPID, MA

٢.٤.١.٧ CALCA – Advanced CalculatorBlock

Basic operation

The Advanced Calculator (CALCA) block provides both logical functions and arithmetic computational
capability within one integrated environment.
This block provides dual-operand efficiency in several mathematical and logical instructions,
resulting in as much as a three-to-one reduction in the length of your program relative to the same
calculations performed in a CALC block program.
The CALCA block does not support the clamping of real outputs, whereas the CALC block does.
With this exception, programs written for the CALC, MATH, or LOGIC blocks will execute in
the CALCA block without change.
The configuration process allows you to program the block by entering a series of up to ٥٠ programming
steps. Each program step is represented by a parameter string of up to ١٦ characters.

Most Important Parameters in CALCA Block

NAME, TYPE, DESCRP, PERIOD, LOOPID, MA

BI٠١ to BI١٦ :Boolean Inputs ١ through ١٦ are inputs to the block calculations which can be configured, linked to upstream blocks, or set when unlinked.

STEP٠١ to STEP٥٠:
Steps ١ through ٥٠ are string inputs of up to ١٦ characters. They are the ٥٠ executable commands that make up the CALCA block program.

٢.٤.١.٨ CHARC – Characterizer Block

Basic operation

The Characterizer block (CHARC) simulates signal characterization by building a "piecewise" linear
characteristic curve of up to ٢٠ segments. The MEAS is the block input. You determine the output characteristic and construct the curve using up to ٢١ separate break points. In operation, the block produces an output based on the MEAS and the user-specified characteristic curve.

Most Important Parameters in CHARC Block

NAME, TYPE, DESCRP, PERIOD, LOOPID, MEAS

BCALCI Back Calculation In is a real input that provides the initial value of the output before the block enters the controlling state, so that the return to controlling is bumpless.It is also the source of the output value when its integration bit, which puts the block into output tracking, is non-zero.
The source for this input is the back calculation output (BCALCO) of the downstream block.

BCALCO Back Calculation Output is a real output that is passed upstream for bumpless initialization purposes. It is the inverse interpolation of the output and is the value for the upstream block to write to avoid bumping the process.

٢.٤.١.٩ LIM – Limiter Block

Basic operation

The Limiter block, LIM, provides high and low absolute limiting and, if the option is configured, a rate of change limiting for a single real input. The block also provides boolean indicators to show which limiting functions are in effect, and a FOLLOW input which allows the block to override rate of change limiting.

Most Important Parameters in LIM Block

NAME, TYPE, DESCRP, PERIOD, LOOPID, MA

٢.٥ DCS CONTROL LOOP STRATEGIES

This function design specification document provides details about control loop template and complex loops that will be used for building the control strategy LAND_OIL PROJECT.

This FDS will handle two main types of control strategies:

١) Control loops templates: This type is used for describing the loops that are repeated many times with the same structure as analogue input indication, simple PID control loop, SDV indication …… etc

٢) Special loops: This type is used for describing the loops that are used only one or two times and not repeated with the same structure at another part of the project.

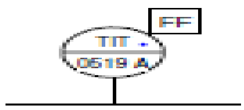
Each type will be described in a specific section.
Each section is organized as follows:

- P&ID Graphic Symbol
- Database Information
- Logic Diagram
- Operator Graphical Interface
- Blocks Interconnection Diagram

٢.٦ DCS CONTROL LOOPS TEMPLATES

٢.٦.١ AIN-TEMPLATE

٢.٦.١.١ P&ID graphic symbol



٢.٦.١.٢ Database Information

Tag Number	Instrument Type	Location	I/O Type	From	System
B٢٤-TI-٠٥١٩A	TEMP IND TRANSMITTER-FF	OTSG	AIN	Field	DCS

Table ٤:Indication in database

٢.٦.١.٣ Function Description

The philosophy -in this project- is to use single module FBM for the analogue inputs that will be used for monitoring only. However, redundant modules will be used for the analogue inputs that will be included in a control loop such as simple PID control loop. This template is used for receiving the analogue data that will be used for monitoring only and so it consists of only Real Input (RIN) block.
With I/A Series system software V٨.٤, theAIN block operating on the FCP٢٧٠ or ZCP٢٧٠ provides a variety of alarm detection and reporting features, including alarming for Bad I/O, out-of range values, and two sets of high and low limits.

٢.٦.١.٤ Operator Graphical Interface

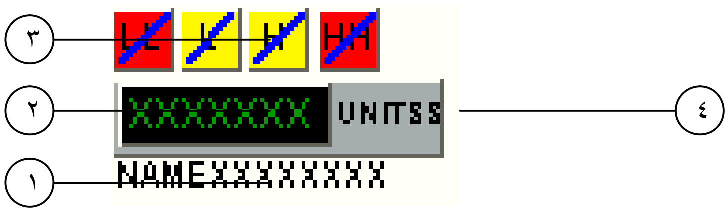


Figure ٢٤:AIN Indicator

It indicates for the operator:

١. Transmitter name

٢. Scaled reading

٣. Alarm type (Visibility according to configured alarms and generated alarm)

٤. Engineering unit

The visibility of the alarm is dependent on which alarm limit is configured and the alarm generated whenever the alarm limit is reached.

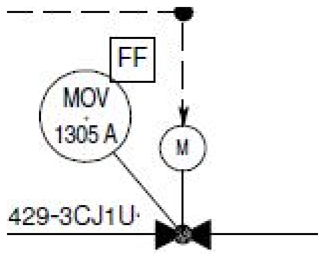
LL: for low low limit alarm. L: for low limit alarm

H: for high limit alarm. HH: for high high limit alarm

- For the L and H alarms blinking yellow indicates presence of the alarm. For the LL and HH alarms blinking red indicates presence of the alarm.
- The dash line over the different alarm texts appears whenever the operator inhibits the alarm from the symbol overlay.
- When the operator acknowledges the alarm from the symbol overlay all visible blinking alarms will convert to be steady.
- When the operator clicks on the symbol, the overlay will be opened in a predefined position.

٢.٦.٢ CIN –TEMPLET

٢.٦.٢.١ P&ID graphic symbol



٢.٦.٢.٢ Database Information

Tag Number	Instrument Type	Location	I/O Type	From /To	System
B٢٤-MOV-١٣٠٥AO	FW START-IP SHUT-OFF VLV OPENED	OTSG	DI	FIELD	DCS

Table ٥:Indication in database

٢.٦.٢.٣ Function Description

This template is used to provide representation of the hardwired digital status indications received from packages.

The digital data received from field will be indicated using a separate CIN block.

Operator Graphical Interface

Block Interconnection Diagram

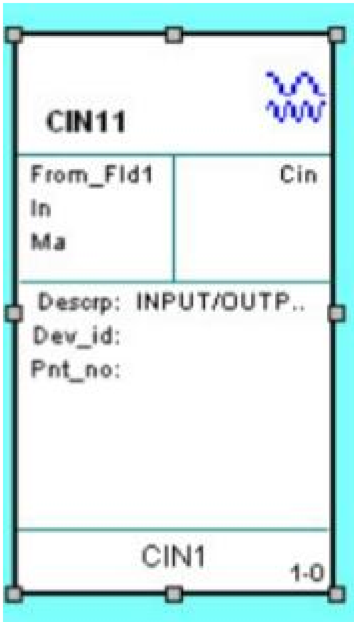
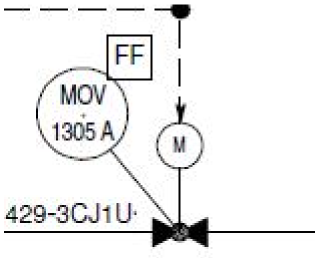


Figure ٢٥::CIN_ TEMPALTE in IACC

٢.٦.٣ COUT –TEMPLET

٢.٦.٣.١ P&ID graphic symbol



٢.٦.٣.٢ Database Information

Tag Number	Instrument Type	Location	I/O Type	From /To	System
B٢٤-MOV-١٣٠٥AOP	OPEN CMD	OTSG	DI-SERIAL	FIELD	DCS

Table ٦:Indication in database

٢.٦.٣.٣ Function Description

This template is used to provide the serial digital output to ESD system. The digital data of the COUT block will be packed through a PAKOUT block and send to ESD in packed format.

Operator Graphical Interface

- DO_E٠١ will have no symbol or overlay.

٢.٦.٣.٤ Blocks Interconnection Diagram

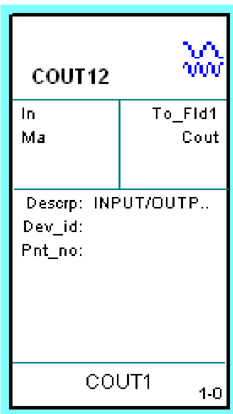


Figure ٢٦:COUT_ TEMPALTE in IACC

٢.٦.٤ VLV TEMPLATE

Function Description

This template is used to enable the control for the valve from the Dcs system

Database Information

Name	Loop_Name	CP	Compound	CSD Name	CST Name	CST_Component	BI03	BI04
MOV1271ACL	B24-M-1271A	24CP03	OTSG	107	VLV	COUT_3		
MOV1271ALR	B24-M-1271A	24CP03	OTSG	107	VLV	CIN-1		
MOV1271AOP	B24-M-1271A	24CP03	OTSG	107	VLV	COUT_1		
MOV1271ASP	B24-M-1271A	24CP03	OTSG	107	VLV	COUT_2		
HSO1271A	B24-M-1271A	24CP03	OTSG	107	VLV	CIN_2		
HSS1271A	B24-M-1271A	24CP03	OTSG	107	VLV	CIN_3		
HSC1271A	B24-M-1271A	24CP03	OTSG	107	VLV	CIN_4		
	B24-M-1271A	24CP03	OTSG	107	VLV	CALCA	OTSG:105.BO01	OTSG:106.BO02
MOV1302ACL	B24-M-1302A	24CP03	OTSG	103	VLV	COUT_3		
MOV1302ALR	B24-M-1302A	24CP03	OTSG	103	VLV	CIN_1		
MOV1302AOP	B24-M-1302A	24CP03	OTSG	103	VLV	COUT_1		
MOV1302ASP	B24-M-1302A	24CP03	OTSG	103	VLV	COUT_2		
HSO1302A	B24-M-1302A	24CP03	OTSG	103	VLV	CIN_2		
HSS1302A	B24-M-1302A	24CP03	OTSG	103	VLV	CIN_3		
HSC1302A	B24-M-1302A	24CP03	OTSG	103	VLV	CIN_4		
	B24-M-1302A	24CP03	OTSG	103	VLV	CALCA	OTSG:101.BO01	OTSG:102.BO02

Table ٧:VLV Taglist

Blocks Interconnection Diagram

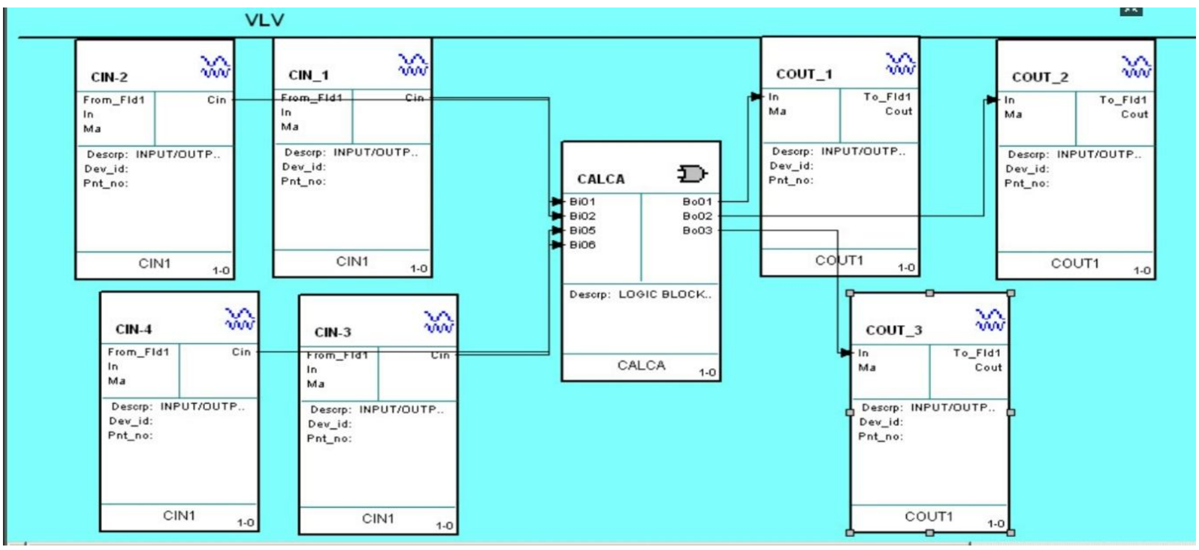


Figure ٢٧:VLV Template

CALCA Code

STEP٠١	IN BI٠٣
STEP٠٢	OSP ٣
STEP٠٣	OR BI٠٢
STEP٠٤	AND BI٠٤
STEP٠٥	AND BI٠١
STEP٠٦	OSP ٣
STEP٠٧	OUT BO٠١
STEP٠٨	AND BI٠١ BI٠٥
STEP٠٩	OSP ٣
STEP١٠	OUT BO٠٢
STEP١١	IN BI٠٧
STEP١٢	OSP ٣
STEP١٣	OR BI٠٦
STEP١٤	OR BI٠٨
STEP١٥	AND BI٠١
STEP١٦	OSP ٣
STEP ١٧	OUT BO٠٣
STEP ١٨	END

Table ٨:CALCA Code

٢.٧ HUMAN MACHINE INTERFACE (HMI)

٢.٧.١ What is a Display?

A display is a file that is constructed and configured to be viewed from a FoxView™ window or a Display Manager window.
A display can represent a plant, a process area, or a detailed portion of a process. A display canbe configured to allow operator interaction with the process by moving objects or typing inputs.
A display is composed of objects, each of which can be configured with attributes. Objectattributes determine the object's static and dynamic appearance and the actions an operator canperform on an object.
The term "object" includes primitive objects (such as lines, rectangles, circles, and text), libraryobjects, and bitmaps. Library objects include Invensys Foxboro supplied and user-built symbols,overlays, faceplates and trends. The term "symbols" refers to the vast collection of objects that you can copy to a display from Invensys Foxboro supplied and user-build palettes.

٢.٧.٢ OBJECT TYPES

٢.٧.٢.١ Bitmaps

Bitmaps are typically used as background images such as maps or plant overviews, and forcompany logos. A bitmap is not embedded in a display but is linked to a display. You canconfigure the bitmap's dynamic attributes to make it grow or shrink, change location, or bevisible or invisible based on the value of a process variable.

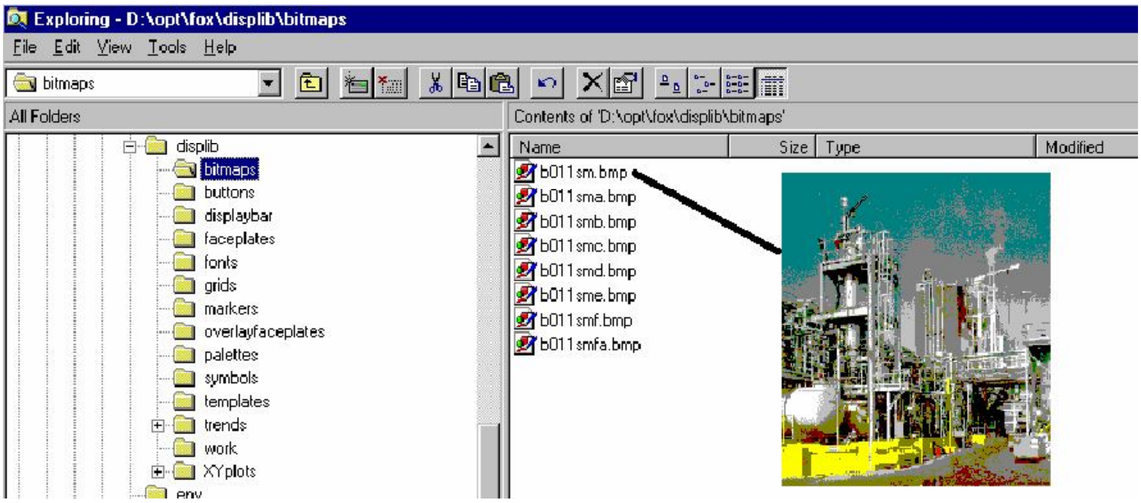


Figure ٢٨:BITMAPS

٢.٧.٢.٢ Trends

A trend can monitor the behavior of one or more process variables over time. You can configure up to eight trend graphs on a single base display (or base display plus library object).

A trend can display up to four numeric or Boolean process variables over time.

FoxDraw provides many trend types from which to choose.

Depending on trend configuration and operator permission (access levels) in FoxView, operators can reconfigure and save trends.

Trend time appears on the X-axis. The number of time stamps depends on the size of the graph.

Data values appear on the Y-axis. You can configure the trend and specify the parameters such as low and high values for each process variable's range. Individual ranges can be automatically scaled. The following figure displays a trend.

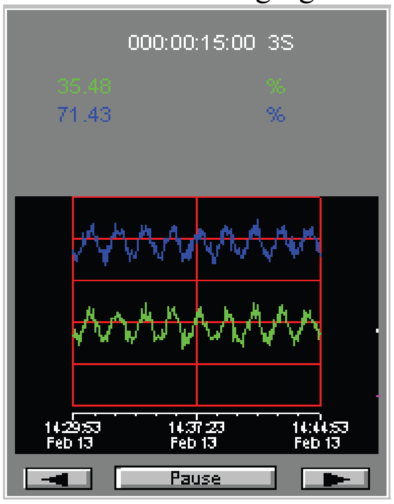


Figure ٢٩:Trend

٢.٧.٢.٣ Faceplates

A faceplate is a display object that shows critical parameters for a particular block.

Faceplates include supplied faceplates and user-built faceplates. Faceplates are library objects and have an .m١ extension. You can build a base display that contains up to eight faceplates. The following figure displays a faceplate.

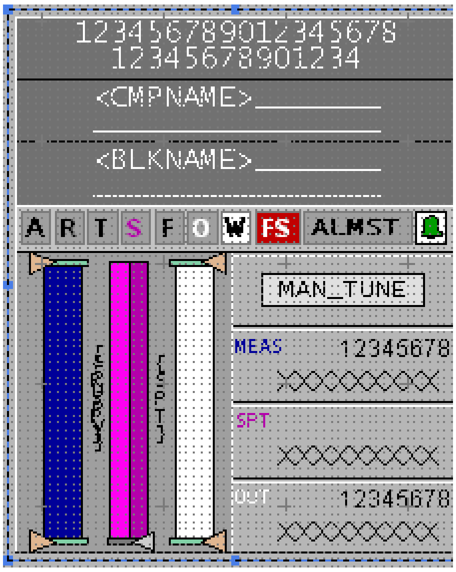


Figure ٢٠:Faceplate

٢.٧.٢.٤ Primitive objects

Primitive objects include lines, rectangles, polylines, polygons, curves, closed curves, circles, pies, sectors, ٣-point sectors, text, background text, comment objects, and scroll region objects.
Create primitive objects by using **Draw** toolbar tools or **Draw** menu commands.

٢.٧.٢.٥ Library objects

Library objects (.m١ files) refer to the objects that FoxDraw and FoxView recognize.
FoxDraw recognizes library objects stored in either of two display library directories:

♦ D:\opt\fox\displib
♦ D:\opt\customer\displib

The library objects are subdivided into groupings with appropriately named directories.
The subdirectories (bitmaps, buttons, faceplates, grids, palettes, symbols, templates, trends, and X/Y plots) serve as receptacles for the library objects.
FoxDraw includes over one thousand library objects. You can also build your own library objects.

٢.٧.٣ The Different Types of Displays

٢.٧.٣.١ Base display

Occupies the entire FoxView window (١٠٠ units wide by ٧٥ units high)in world coordinate units.
In FoxView, when another base display opens, the previous base display closes. You can open one or more overlays on top of a base display.
When you open an overlay, the base display does not close. A base display, however, can be hidden by a full-screen overlay. A base display file has an .fdf extension

٢.٧.٣.٢ Overlay display

Overlays are configured for performing certain operation like starting / stopping of pump, opening / closing of valve etc. This is used to avoid single click operation of important equipments from the main display. Overlays are ١/٤, ١/٢, ١/٨ sizes of screen. Overlays contain controller faceplates, Start / Stop, Auto / manual, Open / Close command and mode selection facilities.

Overlays are classified as follows:

- Custom Overlay for Pumps, Fin-Fan coolers, valves etc.
- Standard Overlay with standard controller faceplate

Custom overlays are developed to serve purpose like pump operation, valve operation etc. Standard overlays use standard faceplates and link them with particular tag.
Similar to a base display, an overlay display has an .fdf extension.

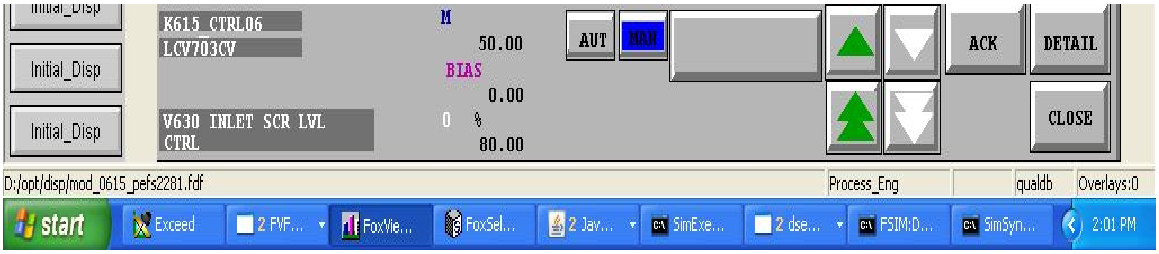


Figure٣١:overlay

٢.٧.٣.٣ Pallet

A window containing graphic objects that you can copy into your display.

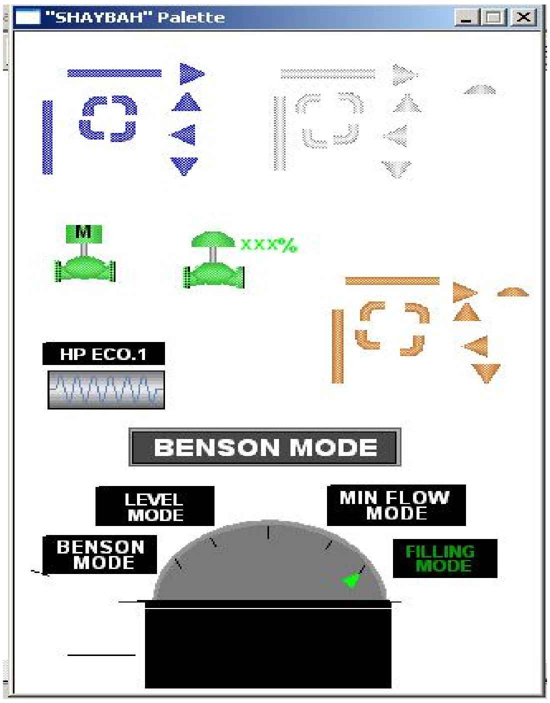


Figure ٣١:pallet

٢.٧.٣.٤ Detailed display

Detail Displays contain various options to provide flexibility to the operator for plant control, they also provide flexibility to the engineer for tuning and troubleshooting; the Detail Displays can be called from the DETAIL button on overlays or from "FoxSelect".

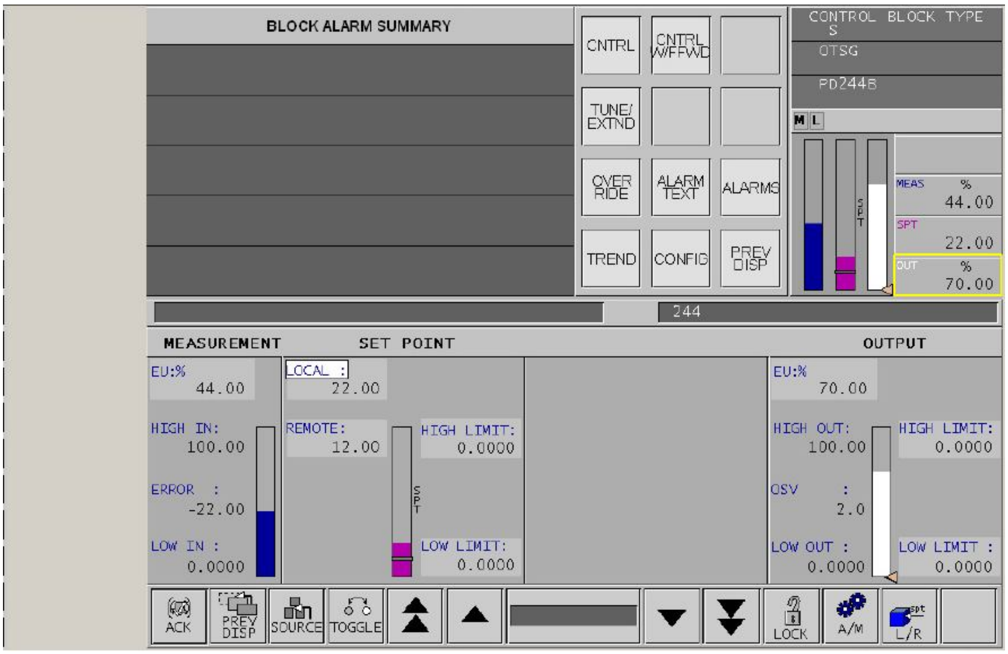


Figure ٣٢:Detailed Display

٢.٧.٣.٥ Group display

Group displays contain information on various process variables grouped together in a single display

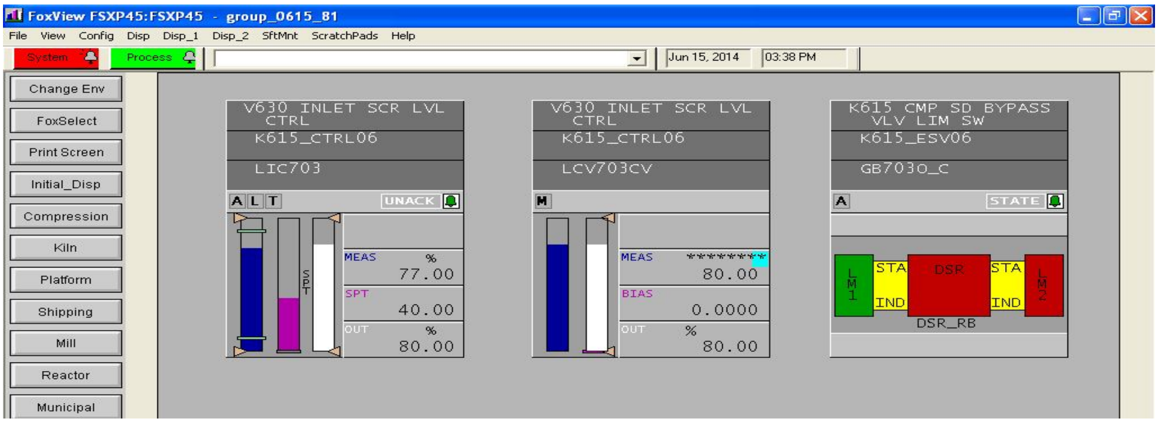


Figure ٣٣:Group Display

٢.٧.٣.٦ Process Flow Graphic

Process Graphic displays provide a P&ID representation of a portion of a unit. These displays are the primary point of operator action. All controllers, indicators, discrete equipment and contact alarms associated with the given area are shown. Normally, uncompensated flows are shown, and no advanced control points are shown. Page picks allow access to the associated overview, other Process Graphic displays, and Group displays. Any controller or piece of equipment that allows an operator action is pickable. Picking such an element opens a controller window (overlay) with complete details for that controller or equipment as well as buttons to allow all available operator actions

٢.٧.٤ Building Process Displays with FoxDraw

FoxDraw is a graphical display editor that allows the user to create and maintain displays for viewing process control variables. The displays can represent a plant, a process area, or a detailed portion of a process. The objects in a display can be dynamically connected to select variables or operator picks.

Basic objects can be drawn using the mouse in combination with FoxDraw's toolbars, menu items, and shortcut keys. Graphic attributes may be assigned to the objects and then configured to reflect process variable changes or operator actions. This configuration procedure will be discussed in alarm module.

FoxDraw also includes numerous palettes of objects, called symbols, such as pumps, tanks, pipes, motors, valves, and ISA symbols. User templates and palettes may also be created for storing complex objects and company standard symbols.

٢.٧.٥ Accessing Foxdraw

FoxDraw is accessed by the following procedure:

• Access an environment which has the CONFIG button assigned to the menu bar

• Select the CONFIG menu bar button

• Select FOXDRAW from the resulting pull-down menu

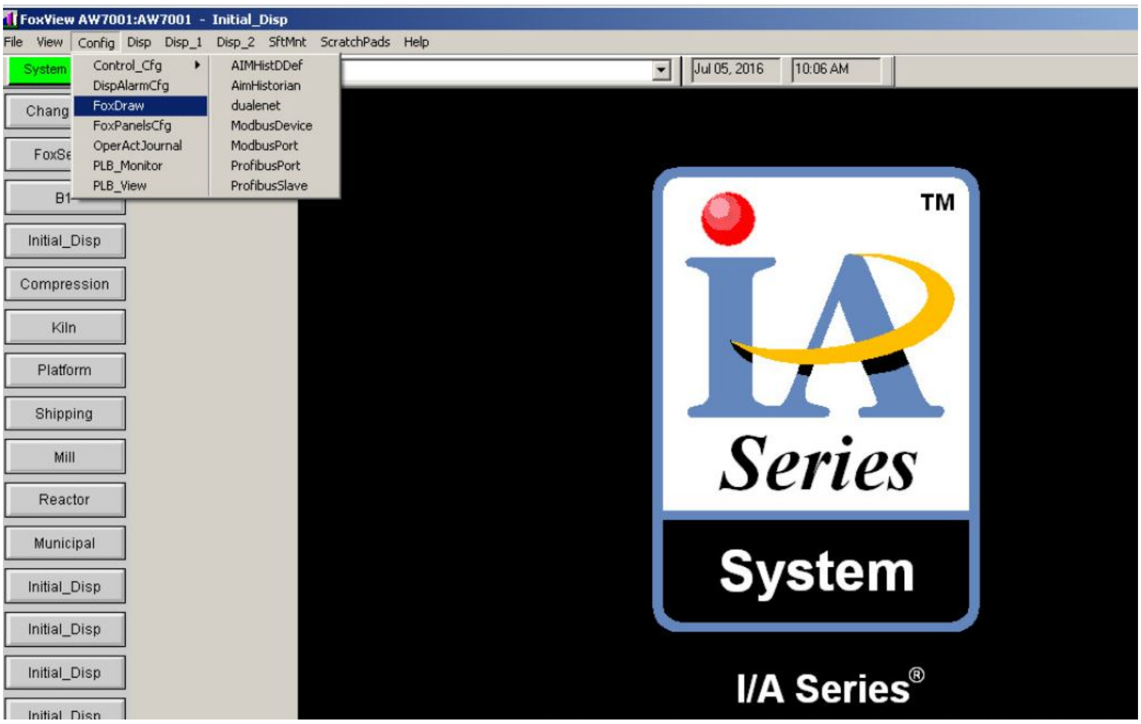


Figure ٣٤:Accessing Foxdraw

Foxdraw Screen

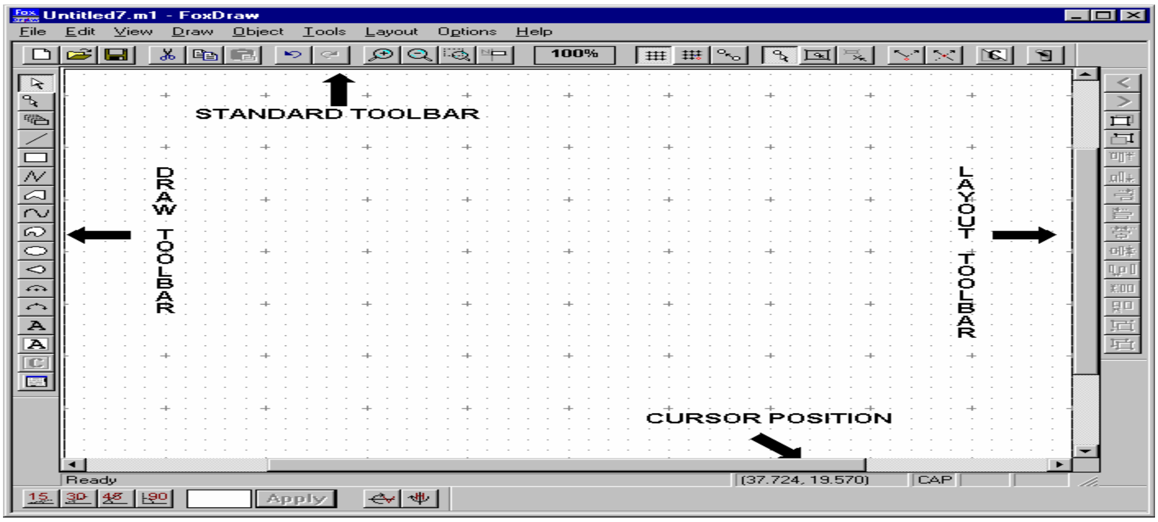


Figure ٣٥:Foxdraw Screen

٢.٧.٦ Configuring Process Displays with FoxDraw

Configuring an object means to connect the object to a process variable. This can be done to allow the operator to both observe and control the process through a graphic display.
There are two ways of configuring a display object. This is done using Dynamic Update and Operator Action.
Dynamic Update means that a process variable or a file is connected to one of the object's attributes, such as visibility or fill level. With this type of configuration, changes in an attribute are triggered dynamically by changes in the process variable. This type of configuration is used to monitor the system. No operator intervention is necessary.
Operator Action connects the entire object to an action, such as opening a display or changing a setpoint. An operator triggers the action by selecting the object. An individual object can have both Dynamic Update and Operator Action connections, although it can have only one operator action.
Each object type (rectangle, circle, text, etc.) has its own set of dynamic attributes, visibility, fill level, text
color, etc.).

٢.٧.٧ Display of P&ID Tags on Graphics

The tags in the display represent the tag in the control database and will not include the area number and will the replicate of that in the I/O database and that in theP&ID’s.

٢.٧.٨ Display Colors and Functionality

The top centre of every graphic will contain the graphic title in white Capital Letters. All process and overview graphics displays will have a GREY (FoxDraw color ٢٤) background. In Foxboro I/A standard the Cyan color indicates a communication failure.

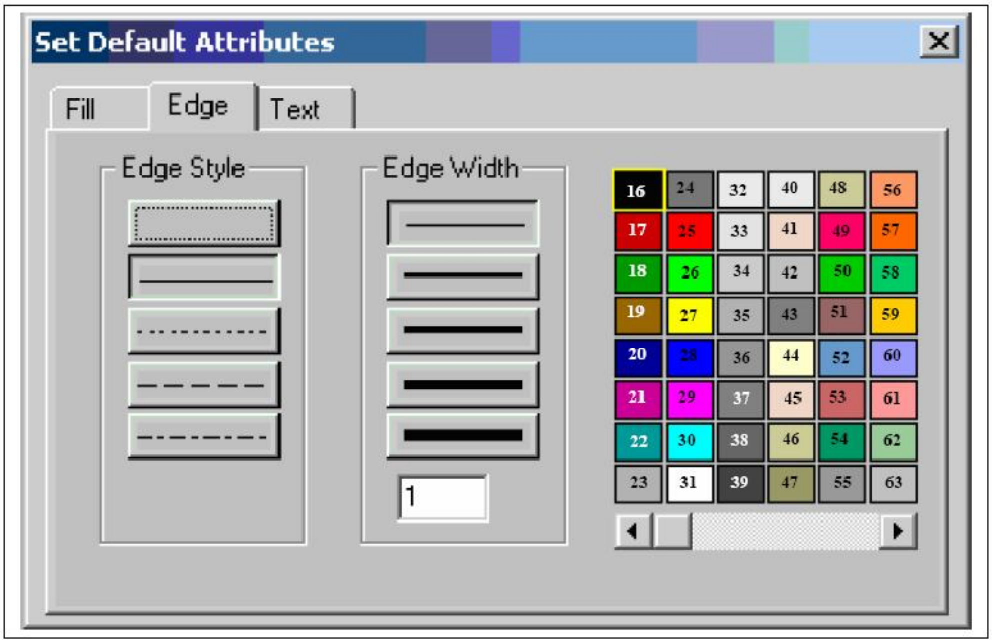


Figure ٣٦::Color Codes

٢.٧.٩ STATIC TEXT

Static text will be used to identify equipments such as tanks, vessels, etc… and process line contents. Static text will be added inside vessels for identification. The vessel type (ex: REACTOR) and vessel name (R١٠٠) should be inside the vessel where possible. The color for the static text will be black.

٢.٧.١٠ PROCESS LINES COLORS

Material	**FOXDRAW Color Code**
Air Nitrogen	White٣١
Water	Blue ٢٨
Gas	Orange ٥٧

Table ٨: Process Lines Colors

٢.٧.١١ The Project Displays

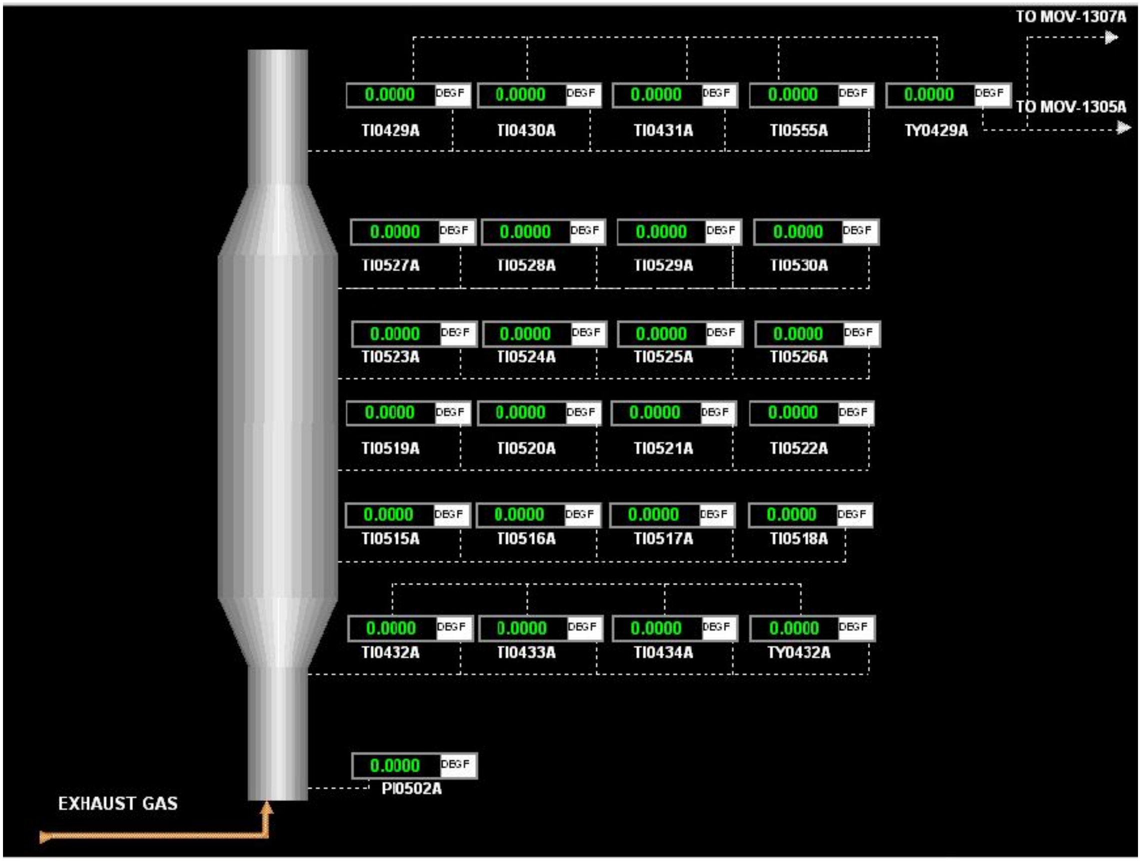


Figure ٣٧:OTSG A Exhaust System

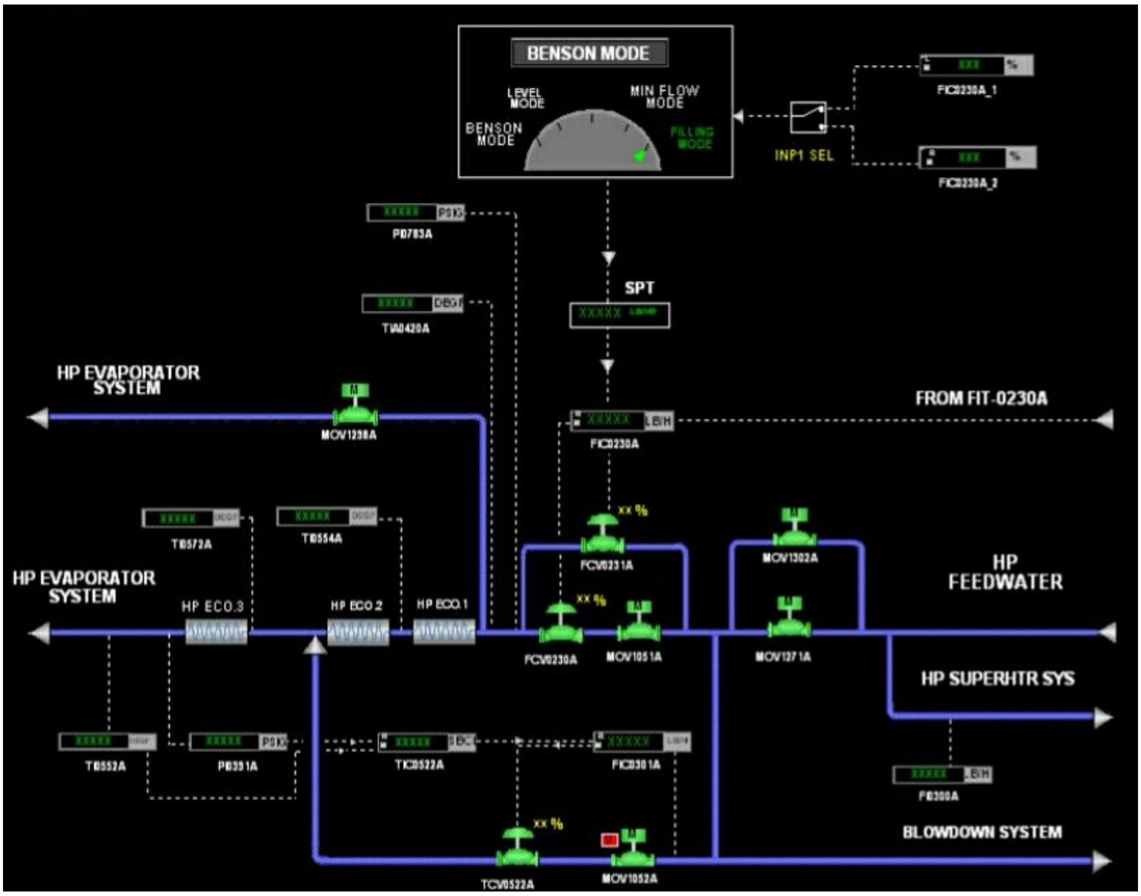


Figure ۳۸:OTSG A Economiser System

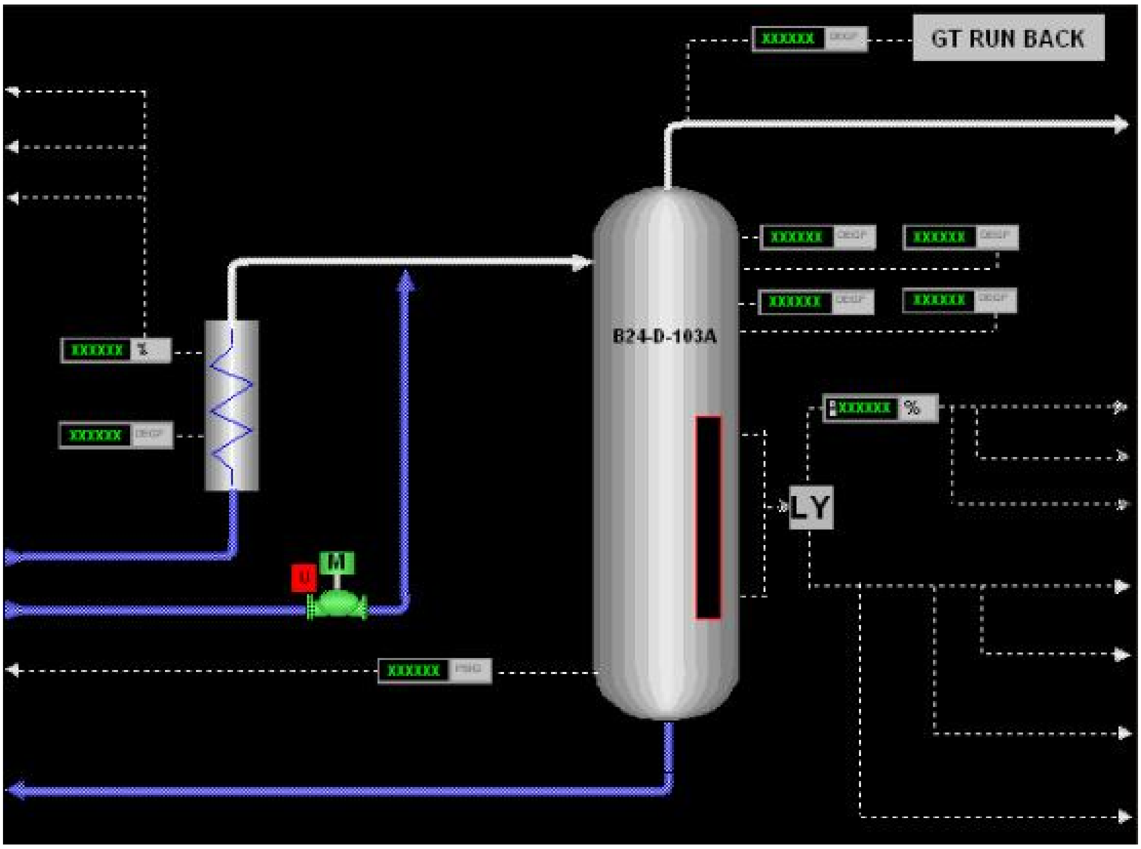


Figure ٣٩:OTSG A HP Evaporator System

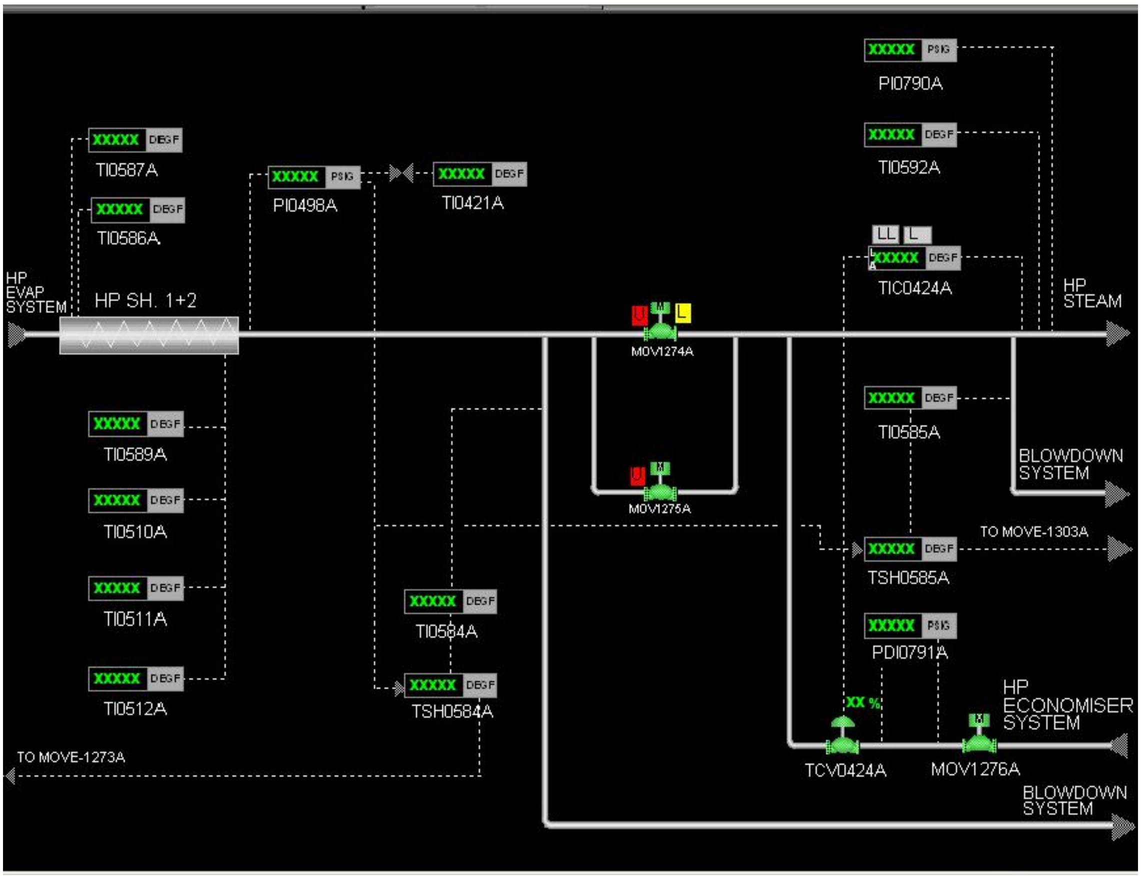


Figure ٤٠:OTSG A HP Super Heater System

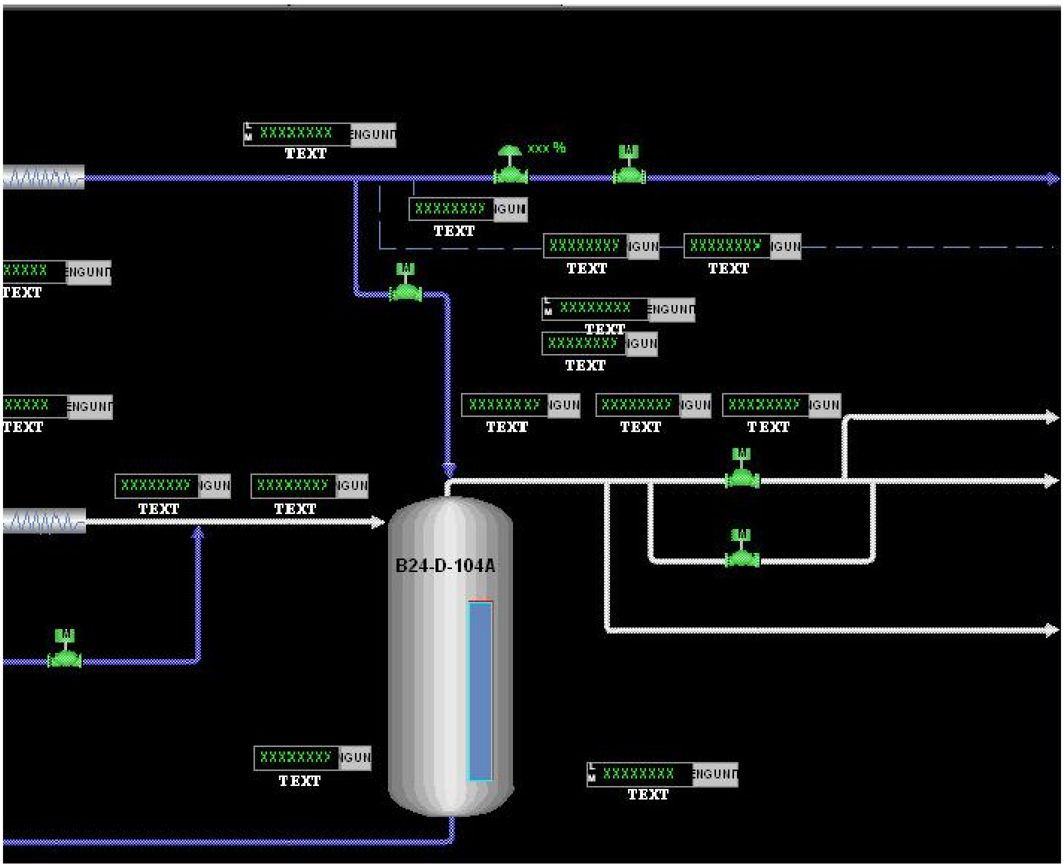


Figure ٤١:OTSG A IP System

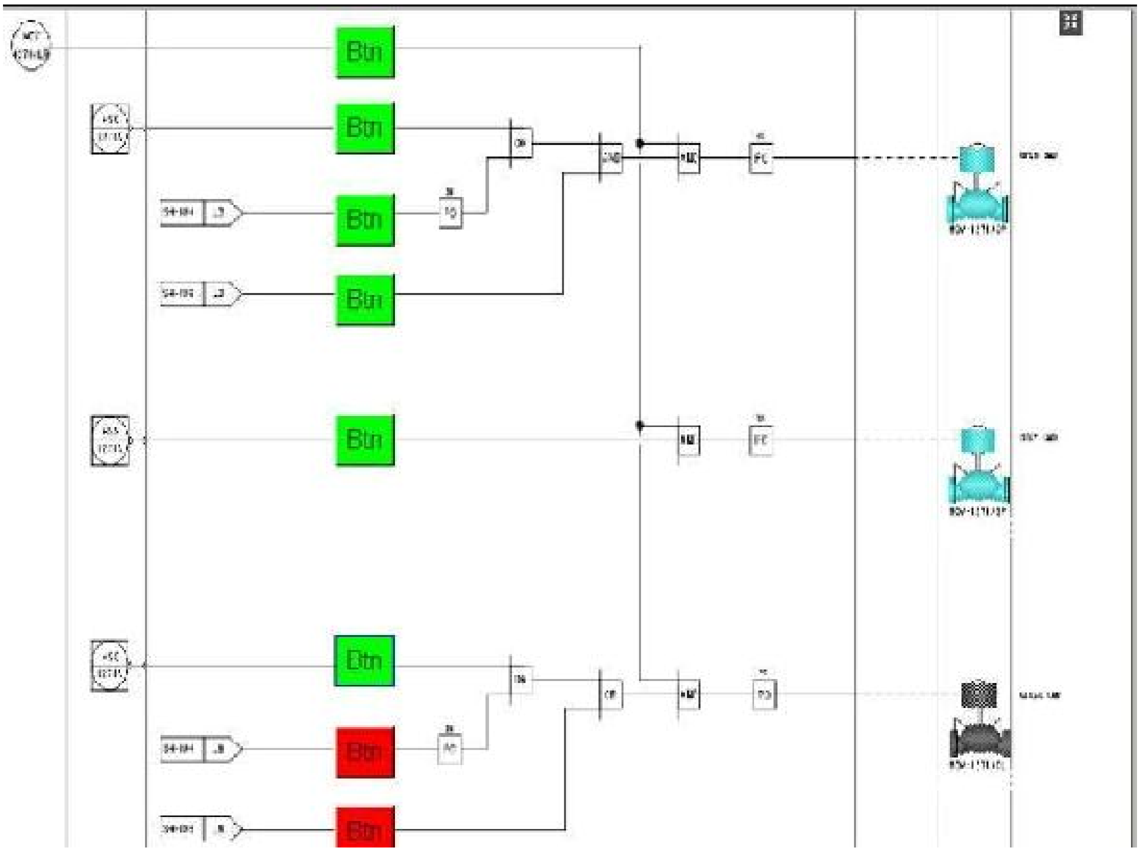


Figure ٤٢:VLV Display

Chapter Three

٣ CITATION AND REFERENCING

٣.١ REFERENCES FORMAT

Books:

[١] FoxDoc ٨.٤.١

[٢] Control Narrative Document"B٢٩-J-DOC-BE-٥٧٥٠٢٥_٢٠١٥٠٧٣١".

[٣] AMAPETCO-Control Loop FDS_rev٢٨٠٧٠٩.

[٤] Instrument list"B٢٤-J-DOC-BE-١٤٨٩٥٠_B".