Performance Enhancement
of
Boiler, Heat Exchanger
and
Evaporator Pilot-Plants

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Chapter 1

Introduction

1.1 Introduction

A pilot plant is a small industrial system which is operated to generate information about the behavior of the system for use in design of larger facilities. The pilot plant can be used for training personnel for a full-scale plant.The main objective is to enthuse students to conduct experiments by the arousing their curiosity. This would help them in learning basic and advanced concepts through remote experimentation. To share costly equipment and resources, which are otherwise available to limited number of users due to constraints on time and geographical distances we are communicating our plant around the world through virtual labs. Virtual Labs would cater to students at the undergraduate level, post graduate level as well as to research scholars.

Pilot plants is available to control from variety of controllers like Programmable Logic Controllers, Distributed Control Systems and simulation tools and test control strategies. Comparative studies can be done not only in class of control strategies but also in class of different controllers.

The main aim of this work is to make this pilot-plants run continuously and efficiently from local as well as remote domain

1.2 Problem Statement

Focus on enhancing the performance of Boiler Heat Exchanger and Evaporator Pilot Plants for running the Pilot Plants continuously and efficently

1.3 Objective

The objective of this project as follows :

1. Putting the Pilot-Plant back in service & Recommissioning.
2. Recommissioning of Boiler, Heat Exchanger & Evaporator Pilot Plant with
    - Local PLC (Micrologix 1400)
    - Remote PLC (RXLogix 5000)
    - DCS (Emerson DeltaV)
    - Virtual PLC
    - Virtual DCS

3. Development of SCADA for Boiler,Heat Exchanger & Evaporator Pilot Plant.
4. Networking of different Pilot Plants
5. Make both the pilot plants fully functional.

Part I

Boiler And Heat Exchanger

Chapter 2

Literature Survey

2.1 Functional definition

1. **Boiler**

   A boiler is an enclosed vessel that provides a means for combustion heat to be transferred into water until it becomes heated water or steam. The hot water or steam under pressure is then usable for transferring the heat to a process. Water is a useful and cheap medium for transferring heat to a process. When water is boiled into steam its volume increases about 1,600 times, producing a force that is almost as explosive as gunpowder. This causes the boiler to be extremely dangerous equipment that must be treated with utmost care.[1].

   The process of heating a liquid until it reaches its gaseous state is called evaporation. Heat is transferred from one body to another by means of (1) radiation, which is the transfer of heat from a hot body to a cold body without a conveying medium, (2) convection, the transfer of heat by a conveying medium, such as air or water and (3) conduction, transfer of heat by actual physical contact, molecule to molecule.

Boiler Make & Year	:	Non IBR Boiler & 2012
MCR(Maximum Continuous Rating)	:	30Kg/hr
Rated Working Pressure	:	3.5 Bar
Type of Boiler	:	Drum Boiler

Table 2.1: Boiler Specification

2. **Boiler Specification**

   The heating surface is any part of the boiler metal that has hot gases of combustion on one side and water on the other. Any part of the boiler metal that actually contributes to making steam is heating surface. The amount of heating surface of a boiler is expressed in square meters.

3. **Indian Boiler Regulation**

The Indian Boilers Act was enacted to consolidate and amend the law relating to steam boilers. Indian Boilers Regulation (IBR) was created in exercise of the powers conferred by section 28 & 29 of the Indian Boilers Act.

IBR Steam Boilers means any closed vessel exceeding 22.75 liters in capacity and which is used expressively for generating steam under pressure and includes any mounting or other fitting attached to such vessel, which is wholly, or partly under pressure when the steam is shut off.

IBR Steam Pipe means any pipe through which steam passes from a boiler to a prime mover or other user or both, if pressure at which steam passes through such pipes exceeds 3.5 kg/cm2 above atmospheric pressure or such pipe exceeds 254 mm in internal diameter and includes in either case any connected fitting of a steam pipe.

4. **Boiler Blowdown**

When water is boiled and steam is generated, any dissolved solids contained in the water remain in the boiler. If more solids are put in with the feed water, they will concentrate and may eventually reach a level where their solubility in the water is exceeded and they deposit from the solution. Above a certain level of concentration, these solids encourage foaming and cause carryover of water into the steam.The deposits also lead to scale formation inside the boiler, resulting in localized overheating and finally causing boiler tube failure.

It is, therefore, necessary to control the level of concentration of the solids and this is achieved by the process of blowing down',where a certain volume of water is blown off and is automatically replaced by feed water thus maintaining the optimum level of total dissolved solids (TDS) in the boiler water. Blow down is necessary to protect the surfaces of the heat exchanger in the boiler.However, blow down can be a significant source of heat loss, if improperly carried out.

5. **Shrink and swell effect in Boiler**
For the Boilers working at very high pressures and large evaporation rates,a phenomenon called swelling and shrinking of drum level makes such simple control strategies inadequate.
When steam demand increases pressure decreases, this results in formation of bubbles which indicates level high. This phenomenon is called as shrink.This absurd increase in the level will cause decrease in feed flow rate. Because of high drum pressure, bubbles formation increases. This phenomenon is called swell which causes further decrease in level.

6. **Heat Exchanger**

A heat exchanger is a piece of equipment built for efficient heat transfer from one medium to another. The media may be separated by a solid wall, so that they never mix, or they may be in direct contact. They are widely used in space heating, refrigeration, air conditioning, power plants, chemical plants, petrochemical plants, petroleum refineries, natural gas processing, and sewage treatment. There are two primary classifications of heat exchangers according to their flow arrangement. In parallel-flow heat exchangers, the two fluids enter the exchanger at the same end, and travel in parallel to one another to the other side. In counter-flow heat exchangers the fluids enter the exchanger from opposite ends.
A double-pipe heat exchanger is the simplest type of heat exchanger and can operate with co-current or counter-current flow.The design consists of a single small pipe (tubeside) inside of a larger one (shellside).A co-current heat exchanger is most commonly

used when you want the exiting streams to leave the exchanger at the same temperature. A counter-current heat exchanger is used more often than co-current because they allow for a more efficient transfer of energy.

7. **Fouling in Heat Exchanger**
   Fouling is the accumulation of unwanted material on solid surfaces which can contain living organisms (biofouling)or nonliving material.Fouling includes deposit formation, encrustation, crudding, deposition, scaling, scale formation,slagging, and sludge formation

2.2 Expected Outcome

1. Both the pilot plant will be fully functional.
2. User will able to control the plant by Local PLC, Remote PLC, Remote DCS, Virtual PLC & Virtual DCS.
3. User will able to monitor the plant by SCADA and will get alarm if something goes wrong.
4. Interconnection of various plants so as to run them simultaneously and in interaction
5. As an outcome we are expecting the pilot plants should run continuously and efficiently

Chapter 3

Insight of Boiler And Heat Exchanger Pilot-plants

3.1 Process Description

We have a pilot plant of Electrical Boiler and Pipe in pipe type Heat Exchanger as shown in below picture.

Figure 3.1: Boiler and Heat Exchanger Pilot plant Pilot Plant

The boiler drum made up SS304 contains water which is electrically heated with a PWM controller and generates steam at 4 bar and 144C. The water for heating is pumped from

a boiler feed water tank using a positive displacement pump. The steam generated flows towards the heat exchanger through an equal percentage globe valve which controls the steam flow.
The heat exchanger being of tubular counter flow type, water to be heated is pumped from a cold water tank from the other end using a centrifugal pump. The condensate formed in the heat exchanger during heat transfer is collected in a separate condensate tank. The hot water is collected in hot water tank which also be either mixed in the cold water tank or can be added partially/fully to the feed to the boiler to change the feed water temperature.

The boiler pilot plant is providing steam to other pilot plants such as evaporator, bio-reactor and batch process. The heat exchanger pilot plant is giving hot water for sterilization process of bio-reactor pilot plant and is able to provide hot water to batch process for CIP

3.2 Variables Measured

Following process variables are measured (Parenthesis content represents tag of variables):

1. Level of water in the boiler drum (LT-1)
2. Drum pressure (PT-1)
3. Steam temperature (TT-1)
4. Boiler feed water temperature (TT-5)
5. Boiler feed water flow ((FT-2)
6. Temperature from water from hot water tank for mixing with boiler feed water (TT-4)
7. Steam flow (FT-3)
8. Heat exchanger steam inlet temperature (TT-2)
9. Heat exchanger water inlet temperature (TT-4)
10. Heat exchanger water outlet temperature (TT-3)
11. Heat exchanger water flow (FT-1)

3.3 Function of important components

The instrumentation components in the boiler and heat exchanger plant can be divided in the following groups:

1. Sensors and transmitters
   The transducer measures a process variable while the transmitter transmits the data to the controller as a 4-20 mA current signal.(List with tag name are mentioned in index-A)

2. Final control elements
   The final control element adjusts the amount of energy/mass that goes into or out from process as commanded by the controller. Following are the final control elements used in the plant:
   a. Positive displacement pump for feeding boiler feed water : The speed of the motor and in turn feed flow is changed using variable frequency drive.
   b. Centrifugal pump for feeding cold water to heat exchanger: The speed of the motor

and in turn feed flow is changed using variable frequency drive.
c. Equal percentage globe control valve for manipulating steam flow : Current signal from controller is converted to pneumatic signal using an I/P converter which decides the valve opening.
d. Solenoid valve which has 2 positions (open or close): Opening of the valve allows mixing of hot water with the cold water feed for heat exchanger as well as changing the boiler feed water temperature.

3. Safety components
These components ensure process safety which generally refers to the prevention of unintentional releases of chemicals, energy, or other potentially dangerous materials (including steam) during the course of process that can have a serious effect to the plant and environment. Process safety involves, for example, the prevention of leaks, spills, equipment malfunction, over-pressures, over-temperatures, corrosion, metal fatigue and other similar conditions. Following instruments are included to keep process variables under safe limit as well as provide alarms interlocks to automatically take necessary action:
a. Pressure switch and temperature switch : Shuts off the boiler if drum pressure/temperature exceeds 4 bar/144 deg C .
b. Low level switches: For the boiler drum this switch, shuts off the heater if there is no water in the drum. For other tanks these switches are used to avoid dry running of pumps if there is nothing to pump in the tanks.
c. High level switches :Provided to the cold water and hot water tanks to avoid overflow of liquid.

3.4 Plant Control

Plant can be controlled in various ways mentioned as follows,

- Local controllers
- Matlab
- Remote Triggering (VPLC/VDCS)
- Contrologix PLC (Central PLC)
- Deltav DCS

To achieve these many ways of control, we communicate a local plant PLC (Micrologix 1400-1766 L32BWA) with a analog and 5 digital cards woth respective controller.We divide plant control methodologies in two ways as Local and Remote, where local way includes local controllers like 3 element controller from yokogawa (US3000) and Invensys temperature controller(3200 Series PID Temperature controllers) with on-off switches for pumps and heater as well as MATLAB.In remote way, includes Remote Triggering (VPLC/VDCS),Contrologix PLC (Central PLC), Deltav DCS.For a selection of controller, a hard switch on panel has given.

Figure 3.2: Local Panel for Boiler and Heat Exchanger

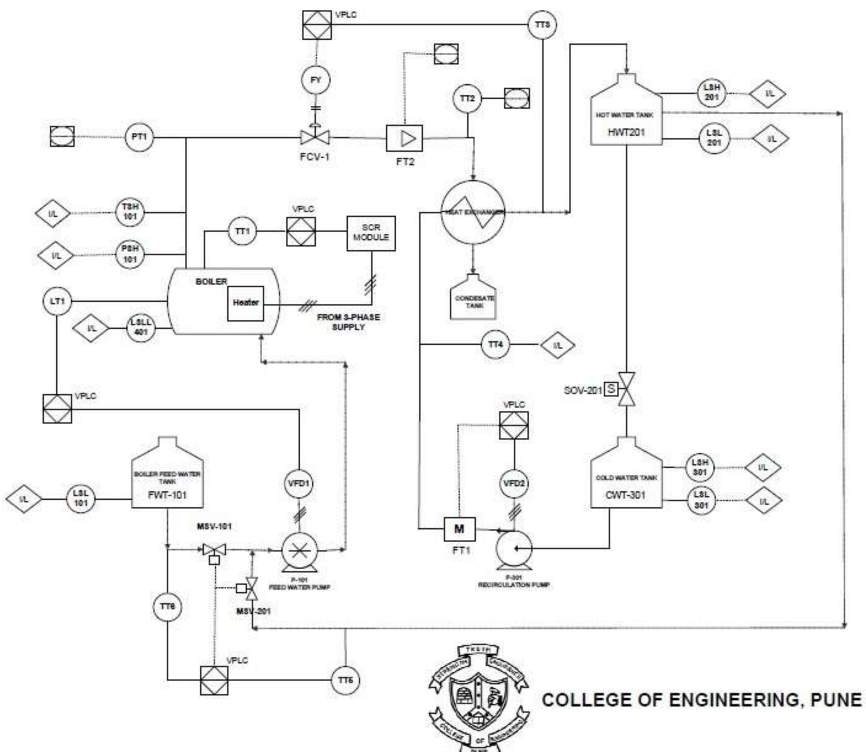


Figure 3.3: Piping and Instrument Drawing of Boiler and Heat Exchanger

3.5 Piping and Instrument Drawing of Boiler and Heat Exchanger

3.6 modeling equations of Boiler and Heat Exchanger

1. **Boiler**

Much of the behavior of the system can be captured by global mass and energy balances. Let the inputs to the system be the heat Q, the feed water mass flow rate q_f , and the steam mass flow rateq_s. Furthermore, let the outputs of the system be drum pressure p, and drum water level, l. This way of characterizing the system is convenient for modeling. To write the equations, let V denote volume,ρ denotes specific density, u specific internal energy, h specific enthalpy,t temperature and q flow rate. Furthermore,let subscripts s, w, f and m refer to steam, water, feed water,and metal, respectively. The total mass of drum is m_t and the specific heat of the metal is C_p. Mass balance and energy balance equation will be as following,

$$\begin{aligned} \frac{d}{dt}\left\{\rho_s V_{st} + \rho_w V_{wt}\right\} &= q_f - q_s & (3.1) \\ \frac{d}{dt}\left\{\rho_s u_s V_{st} + \rho_w u_w V_{wt} + m_t C_p t_m\right\} &= Q + q_f h_f + q_w h_w & (3.2) \end{aligned}$$

Modifying mass balance equation,

$$\begin{aligned} \frac{d}{dt}\left\{\rho_s V_{st} + \rho_w V_{wt}\right\} = q_f - q_s \\ V_{st}\frac{d\rho_s}{dt} + \rho_s\frac{dV_{st}}{dt} + \rho_w\frac{dV_{wt}}{dt} = q_s - q_s \qquad (3.3) \end{aligned}$$

As $\rho_w = constant$; its derivative becomes zero.
Substituting in equation(4);

$$\begin{aligned} V_{st} = V_d - V_{wt} && (3.4) \\ \left(V_d - V_{wt}\right)\frac{d\rho_s}{dt} + \rho_s\frac{\left(V_d - V_{wt}\right)}{dt} + \rho_w\frac{dV_{wt}}{dt} = q_s - q_s && (3.5) \\ \left(V_d - V_{wt}\right)\frac{d\rho_s}{dp}\frac{dp}{dt} + \rho_s\frac{d\left(V_{wt}\right)}{dt} + \rho_w\frac{d\left(V_{wt}\right)}{dt} = q_s - q_s && (3.6) \\ \left(V_d - Ah\right)\frac{d\rho_s}{dp}\frac{dp}{dt} + A\left(\rho_w - \rho_s\right)\frac{dh}{dt} = q_s - q_s && (3.7) \end{aligned}$$

Modifying energy balance equation,

$$\frac{d}{dt}\left\{\rho_s u_s V_{st} + \rho_w u_w V_{wt} + m_t C_p t_m\right\} = Q + q_f h_f + q_w h_w$$

Since internal energy is $(u = h - p/\rho)$,by substituting this relation in energy balance equation with equation(5);

$$\begin{aligned} \frac{d}{dt}\left\{\rho_s h_s V_{st} - pV_{st} + \rho_w h_w V_{wt} - pV_{wt} + m_t C_p t_m\right\} &= Q + q_f h_f + q_w h_w \\ \frac{d}{dt}\left\{\rho_s h_s\left(V_d - V_{wt}\right) - pV_d + \rho_w h_w V_{wt} + m_t C_p t_m\right\} &= Q + q_f h_f + q_w h_w \\ h_s\left(V_d - V_{wt}\right)\frac{d\rho_s}{dt} + \rho_s\left(V_d - V_{wt}\right)\frac{dh_s}{dt} + \rho_s h_s\frac{d\left(V_d - V_{wt}\right)}{dt} & \\ -\frac{dpV_d}{dt} + \rho_w V_{wt}\frac{dh_w}{dt} + \rho_w h_w\frac{dV_{wt}}{dt} + m_t C_p\frac{dt_m}{dt} &= Q + q_f h_f + q_w h_w \\ h_s\left(V_d - V_{wt}\right)\frac{d\rho_s}{dt} + \rho_s\left(V_d - V_{wt}\right)\frac{dh_s}{dt} + & \qquad (3.8) \end{aligned}$$

We can write equation(4) and (12) in of state space form;

$$\begin{aligned} m_{11}\frac{dV_{wt}}{dt} + m_{12}\frac{dp}{dt} &= q_s - q_s & (3.9) \\ m_{21}\frac{dV_{wt}}{dt} + m_{22}\frac{dp}{dt} &= Q + q_f h_f + q_w h_w & (3.10) \end{aligned}$$

where;

$$\begin{aligned}
m_{11} &= (\rho_w - \rho_s) \\
m_{12} &= (V_d - V_{wt})\frac{d\rho_s}{dp} + V_{wt}\frac{d\rho_s}{dp} \\
m_{21} &= (\rho_w h_w - \rho_s h_s) \\
m_{22} &= (V_d - V_{wt})\left(\rho_s\frac{dh_s}{dp} + h_s\frac{d\rho_s}{dp}\right) + \rho_w V_w\frac{dh_s}{dp}
\end{aligned} \tag{3.11}$$

When we solve equation (11) and (12) simultaneously for $\left(\frac{dV_{wt}}{dt}\right)$ and $\left(\frac{dp}{dt}\right)$ we will get result as following,

$$\frac{dV_{wt}}{dt} = \frac{Qm_{12} + \rho_w q_w (h_f m_{12} - m_{22}) - \rho_s q_s (h_s m_{12} - m_{22})}{(m_{12}m_{21} - m_{11}m_{22})} \tag{3.12}$$

$$\frac{dp}{dt} = \frac{\rho_w q_w - \rho_s q_s - m_{11}\frac{dV_{wt}}{dt}}{m_{12}} \tag{3.13}$$

2. **Heat Exchanger**

As we discussed in previous chapter,we have counter-current pipe in pipe type heat exchanger setup with all necessary sensors and actuators installed.
Since heat exchangers are so widely used in industry, it necessary for a chemical engineer to be able to optimize and control the system and know how independent variables will affect the outputs from system. To do this, a dynamic model is developed and utilized.
A dynamic model of a heat exchanger may be used, for example, to predict how a change in the fluid flow rates or the addition of an insulating jacket will affect the outlet temperature of the product stream. The model uses ordinary differential equations (ODEs) to describe the process and gives plots of the variables vs. time for the entire process. There are many independent variables in a heat exchanger, which can cause modeling to be very complex since multiple ODEs are required to define all of the process variables.

(a) Shell side (Outer Pipe)
   i. Fluid
   ii. Flow rate
   iii. Temperature
(b) Tube side (Inner Pipe)
   i. Fluid
   ii. Flow rate
   iii. Temperature
(c) Flow Configuration

As there is no mass accumulation so mass balance will not applied in Heat Exchanger

3. **Fouling in Heat Exchanger**
Fouling is the accumulation of unwanted material on solid surfaces which can contain living organisms (biofouling)or nonliving material.Fouling includes deposit formation, encrustation, crudding, deposition, scaling, scale formation, slagging, and sludge formation.Mathematical perspective of fouling is explained in this section with its effect

on heat exchanger and ways to remove it.
Fouling is a deposit of extraneous material that appears upon the heat transfer surface during lifetime of heat exchanger. This deposite adds heat resistance to heat transfer and oprationa capability of heat exchanger gets reduced. If deposit is in heavy content, then it causes significant change in flow rate and pressure is dropped which can be given mathematically as follows, For both smooth and rough tubes, estimate of pressre drop can be given as follows,

$$\frac{\triangle p}{\triangle L} = \xi \frac{\rho u^2}{2d_i} \tag{3.14}$$

where;
ξ= friction factor for smooth tubes, $\xi = 0.0056 + 0.5R_e^- 0.32$
For rough tubes, $\xi = 0.0014 + 1.056R_e^- 0.42$
$\triangle p$=pressure drop
$\triangle L$=change in length
u=flow velocity
ρ=density
d_i=inner diameter

Fouling parameters are as follows,

(a) fouling thickness (d_f)
(b) fouling resistance (R_f)
(c) heat transfer coefficient (U_f)

We can derive above parameters in two ways;theoretically and experimentally. Necessary mathematical relation is explained as below,

$$R_f = \frac{d_i}{2\lambda_d} \ln \frac{d_i}{d_f} \tag{3.15}$$

$$d_f = d_i \exp\left(\frac{2\lambda_d R_f}{d_i}\right) \tag{3.16}$$

where λ_d is thermal conductivity.
Total heat transfer rate can be given as (Subscript f denotes fouled condition),

$$\dot{Q} = UA\triangle T_m \tag{3.17}$$

$$\frac{1}{U_f} = \frac{1}{U_{clean}} + R_f \tag{3.18}$$

$$\dot{Q}_f = U_f A_f \triangle T_{mf} \tag{3.19}$$

where U denotes temperature coefficient, A is effective area of heat transfer and $\triangle T_m$ denotes logarithmic temperature difference.
For plate type Heat Exchanger, coefficient of heat transfer (U_f) can be estimated theoretically using following relation,

$$U_f = \frac{1}{\left(\frac{A_o}{A_i h_i}\right) + \left(\frac{A_o R_f}{A_i}\right) + \left(\frac{A_o \ln \frac{d_o}{d_i}}{2\lambda_d L}\right)} \tag{3.20}$$

We can evaluate U_{actual} experimentally from equation,where we know $\triangle T_m$, A and $\dot{Q}$, we calculate R_f from U_{clean} using following relations,

$$\dot{Q} = U_{actual} A \triangle T_m \quad (3.21)$$

$$R_f = \frac{1}{U_{claen}} - \frac{1}{U_{actual}} \quad (3.22)$$

For pipe in pipe type heat exchanger, thickness of fouling can be calculated as,

$$d_f = \frac{\left(R^2+1\right)^{0.5} \ln\left(\frac{1-S}{1-RS}\right)}{(R-1)\ln\left[\frac{2-S\left(R+1-(R^2+1)^{0.5}\right)}{2-S\left(R+1-(R^2+1)^{0.5}\right)}\right]} \quad (3.23)$$

$$R = \frac{T_1 - T_2}{t_2 - t_1} \qquad S = \frac{1}{R} \quad (3.24)$$

Thus we can evaluate fouling parameters for plate type as well as for tubular type heat exchanger. We can classify the methods to remove fouling in two ways as offline and online. In offline technique, heat exchangers are cleaned by mechanical and chemical means.In online mechanical cleaning, citric acud is used for where process fluid is water.In some systems,filters,.cyclones(inlet),brushes,vibrating springs and scrubbing devices,grit blasting are used. In some systems, hydro-steam cleaning technique is used by high pressure jet washing with or without chemical.Sometimes, abrasive bullets is forced through tubes by compressed air.These bullets have advantage of being able to negotiate tube bends,unlike other mechanical terms.
Thus fouling causes low heat transfer and pressure drop which eventually causes loss in energy and product quality and quantity for which heat exchangers should be cleaned regularly.

Chapter 4

Control Strategies

This chapter focuses on control schemes for our plant. Each sections of this chapter tell us the scope of control strategies and there implementation in various domains such as local and remote. It focuses on Boiler Drum level control and introduces MPC in Delta V DCS.

4.1 Local Domain

Boiler and heat exchanger plant has got some extra features when compared with the other pilot plants. It has got a dedicated three element controller from Yokogawa for boiler drum level control and a dedicated temperature controller from Eurotherm for heat exchanger temperature control. So the local PLC is not controlling the boiler level and temperature of heat exchanger. Local PLC role is to take care of the interlocks and transferring inputs and outputs to the remote domains such as DCS, Contrologix PLC and so on.

4.1.1 Yokogawa Three Element Controller US1000

The US1000-11 Dual Loop Digital Indicating Controller can easily be implemented as a three element boiler drum level/feed water controller. Steam drum level control is necessary to add makeup water as steam is delivered into the header pipe. The level measurement and feed water flow input are the process variables (PV) for a cascade control strategy. A steam flow signal is applied to the feed forward input of the US1000 allowing it to anticipate changes in the steam demand and adjust the feed water flow rate accordingly.

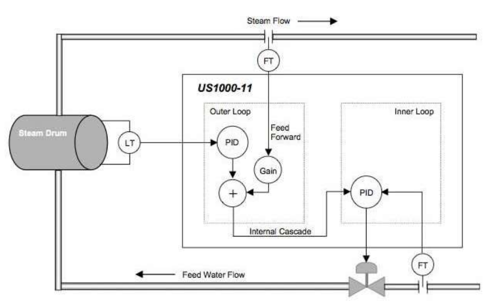


Figure 4.1: US1000 Three element control scheme

Multiple inputs allow the three element configuration for boilers with varying steam demands and feed water pressure. The digital communication option allows connectivity to a PC, providing an operator interface. US1000 is the right choice in digital control.

Inputs/Outputs

- The three analog inputs are pre- assigned for 1-5VDC. Square root extraction can be applied to the flow inputs if differential pressure transmitters are used. Input filters can be used for noisy flow signals.

- The control output is assigned as a 4-20mADC signal. The level input can be re-transmitted as an isolated 1-5VDC signal to a recorder or other receiving device. The US1000-11 has two isolated 24VDC supplies to power two field transmitters.

- Five discrete inputs are pre- assigned and functionality may be changed while configuring the US1000. DI1 allows the output to the feed water valve to be forced to a pre-set output value, e.g., fully open . If the contact input is made. DI2 allows the inner (feed water) control loop to be forced to AUTO, bypassing the CASCADE (remote) set point input from the outer level controller. DI3-5 permit switching from CASCADE/AUTO or AUTO/MANUAL.

- Four discrete outputs are available for alarming. The default functions are high and low alarms for both control loops. During configuration, the functions can be changed for specific requirements.

Figure 4.2: US1000 Three element controller from Yokogawa

4.1.2 Temperature controller form Eurotherm

1/4 DIN Model Number 3204 Eurotherm from Schneider Electric is the temperature controller which takes temperature Transmitter (TT-3) as Process variable and manipulate FCV opening to regulate the hot water temperature.

Figure 4.3: 3204 Eurotherm temperature controller

4.2 Controlling from ControlLogix system 1756-L61

The ControlLogix system of series 1756-L61 is chassis-based and provides the option to configure a control system that uses sequential, process, motion, and drive control in addition to communication and I/O capabilities.

RSLogix 5000 is a programming software of Contrologix which offers an easy- to- use IEC61131-3 compliant interface.It provides ladder logic, structured text, function block diagram and sequential function chart editors for program development as well as support for the S88 equipment phase state model for batch and machine control applications. We also used RSView32 works to develop SCADA and to log data. RSView32is an integrated, component-based HMI for monitoring and controlling automation machines and processes.It also integrates Microsoft's popular Visual Basic for Applications (VBA) as a built-in programming language and supports OPC standards as both a server and a client for fast, reliable communications with a wide variety of hardware devices.

Ladder programming for boiler and heat exchanger plant is done in Controllogix system and developed SCADA for the the same. The implemented controllers are explained in detail in this section. We consider variables as shown in Table (4.1).

4.3 Boiler Drum Level control

4.3.1 Overview

Proper operation of Drum Level Measurement and Control circuit is very crucial for uninterrupted operation of Boiler. Principle of measurement and three-element control of Boiler

Sr.No.	Controlled Variable	Manipulated Variable
1	Boiler Level	Feed Pump Speed Or Steam flow rate
2	Boiler Temperature	SCR
3	Heat Exchanger Outlet Temperature	Cold water pump speed Or Control Valve

Table 4.1: List of controlled and corresponding manipulated variable

Drum Level is explained here.Steam drum level control is necessary to add makeup water as steam is delivered into the header and to the associated process equipment. The system should control the drum level at a specific set point while compensating for varying steam demands and drum pressures. For a given volume of steam and blowdown leaving the steam drum, an equal amount of water should replace that inventory. Discussions here include the primary sensing devices and the various strategies used to control steam drum level and feed water rate

4.3.2 Level Measurement

The drum level is measured using a differential pressure transmitter.The output of the instrument increases as the differential pressure decreases.A condensing reservoir is installed to allow the high side of the D/P to measure the steam pressure plus the hydraulic pressure in the reference leg.The low pressure side senses the boiler drum pressure, the weight of the water above the low pressure tap and the weight of a column of saturated steam from the high pressure tap to the water level.Being a differential pressure device, the boiler drum pressure is canceled out of the measurement, leaving only the water column pressure difference.The level measurement is accurate only at a single drum pressure. If needed, a pressure measurement can compensate for varying drum pressures by applying a gain and bias to the drum level signal.

4.3.3 Swell and Shrink

Increase in steam flow rate is associated with the phenomenon of swelling. Steam and water mixture from water wall enters drum. Steam bubbles continuously leave bulk water from the interface between steam and water in drum. At steady state conditions, Drum Pressure is stable. Bubbles do not coalesce. Whenever the steam flow increases, there is a drop in drum pressure. This causes increased rate at which steam bubbles comes out of bulk water causing large number of bubbles rising from the bulk water and coalescing at the inter phase surface.This apparent increase in level will cause reduction in feed water flow and lesser quantity of water will enter drum.As soon as drum pressure stabilizes, the rate of steam bubbles coming out from bulk water reduces, and level starts shrinking at a very fast rate. Reduced feed flow further aggravates the situation and level starts dropping at very rapid rate.The feed control circuit many times is unable to cope with the situation leading to level dropping to tripping values.

Inversely, as the steam load decreases, the steam bubbles in the steam/water mixture decrease in size and volume. This causes a decrease in drum level, although the mass of water and steam has not changed. This phenomenon is called shrink.

4.3.4 Blowdown

When water is boiled and steam is generated, any dissolved solids contained in the water remain in the boiler. If more solids are put in with the feed water, they will concentrate and may eventually reach a level where their solubility in the water is exceeded and they deposit from the solution. Above a certain level of concentration, these solids encourage foaming and cause carryover of water into the steam. The deposits also lead to scale formation inside the boiler, resulting in localized overheating and finally causing boiler tube failure.

It is, therefore, necessary to control the level of concentration of the solids and this is achieved by the process of blowing down, where a certain volume of water is blown off and is automatically replaced by feed water thus maintaining the optimum level of total dissolved solids (TDS) in the boiler water.

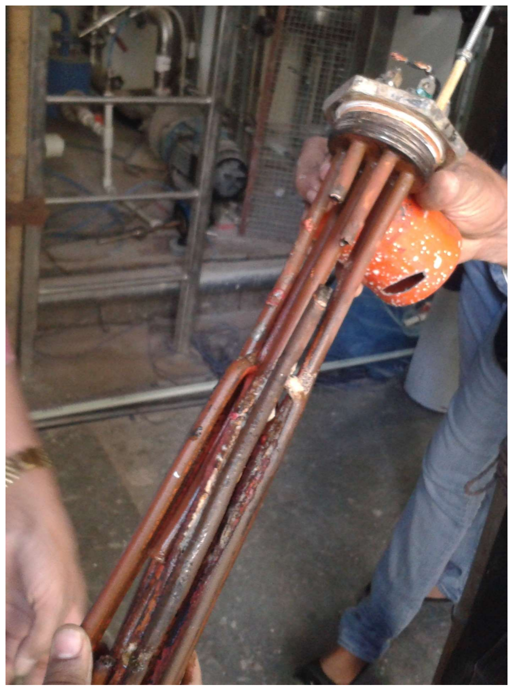


Figure 4.4: A damaged heater coil because of improper level maintenance and lack of blow down

4.3.5 Single element control

In this scheme called single element control, signals of measured level and set point are fed to the controller, output of which goes to the Variable Frequency drive(VFD).Depending upon the deviation of measured level from set point, controller output manipulates the VFD thus regulating the Feed Water flow rate to Drum.This scheme thus controls the mass of feed water going to drum.If Drum level drops below the set value, controller output causes increased VFD output and feed flow rate increases.In low operating pressure boilers with low evaporation rates, this type of single element control gives reasonable automatic level control.

Reasons for failure of single element drum level control are :

- When steam flow rate increases, due to swelling in level, feed flow rate decreases, which lead to depletion of mass of water in drum.
- When drum pressure reaches stability, coalesced bubbles collapse and drum level shrinks very fast.
- Due to already depleted quantity of water in drum and shrinking, level drop is rapid Inherent time lag in the process can not make up the water quantity in drum at the required rate.

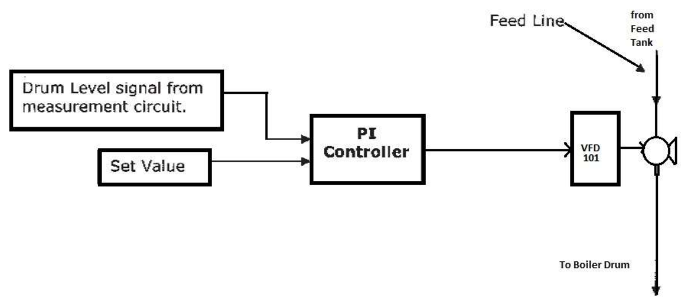


Figure 4.5: Single Element Drum level Control

Single element control is in one subroutine and it will be controlling boiler level at start up to when the boiler level is more than 86 % and temperature is more than 110 degree Celsius.

4.3.6 Two Element Drum Level Control

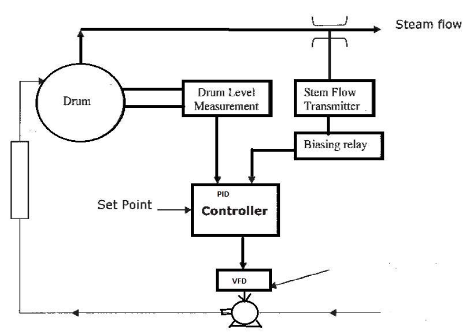


Figure 4.6: Two Element Drum level Control

The problem of reduced feed flow in case of increased steam flow encountered in single element control circuit is taken care of in two element control circuit by measuring the steam flow rate and using it as another input to the controller. In this type of control, tuning of Controller and Biasing relay is so arranged that feed flow rate shall always be equal to steam flow rate. VFD output is not dependent on level alone. This control philosophy prevents reduction in Feed Flow rate even if level swells.This avoids depletion of quantity of water present in drum. When level starts shrinking, feed flow increases and thus sudden at rapid fall in level is prevented.But feed flow may not match with steam flow in many operating conditions, leading to instability of the control.

4.3.7 Three Element Drum Level Control

In this control, Feed Flow transmitter measures feed flow and its output is connected to the computing relay to which is connected steam flow signal. Difference between steam flow and feed flow is then fed to drum Level control, to which drum level signal is also connected.Since actual measurement of feed flow is carried out, this control circuit gives very stable and high quality performance.

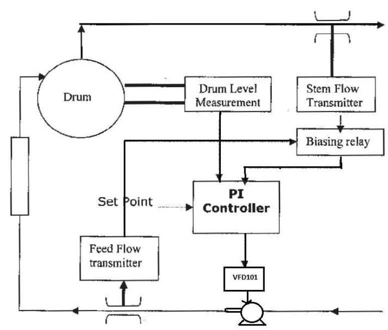


Figure 4.7: Three Element Drum level Control

Three Element control strategy is implemented in Contrologix 1756-L61. For start up single element control strategy is been used and once the level is reached above 86% and boiler temperature is above 110 degree Celsius three element control strategy is been activated.

4.4 Controlling from Delta V DCS

This section Deals with the programming and development of SCADA for boiler and heat exchanger pilot plant. It also elaborates the implementation of MPC in Delta V DCS.

4.4.1 About DeltaV

- Control Module
  Control strategies in the DeltaV system are configured in modules. A module, which is the smallest logical control entity in the system, contains algorithms, conditions, alarms, displays, historical information, and other characteristics that define the process equipment.Function blocks are building blocks for creating the continuous and discrete algorithms that perform the control or monitoring for the process. The DeltaV Library contains function block templates for analog control (bias/gain, lead/lag, PID, etc.), Logical, I/O (analog and discrete input/output), and other basic functions.Each function block contains parameters that can be modified to customize the algorithm. Algorithms range from simple input conversions to complex control strategies. Function blocks can be combined into composite function blocks to build complex algorithms.

- Collecting Displaying Data
  The DeltaV system supports the collection of user-specified parameter field values and alarms and events for long-term storage, retrieval, and presentation. There are three main aspects of continuous data collection and presentation:
  - Detection by defining history collection in the modules and nodes
  - Storage by the Continuous Historian subsystem
  - Presentation through the Process History View application

The DeltaV system also lets you export data to the Microsoft Excel spreadsheet software so that you can use that application's extensive analysis and reporting features.

- Operator Picture
  Delta V Operate in configure mode to create an operator picture for the process system.It is important to understand the operating environment for a Delta V process system before we start creating pictures to be used in that environment. The Delta V Operate application functions in two modes

  1. Configure mode used to create pictures
  2. Run mode used to run pictures in the Delta V Operate application

4.4.2 Auto tunning using Delta V insight

Once a control loop is designed and configured to govern a process it must be tuned. Making the necessary adjustments to provide for stable and responsive operation is referred as loop tunning. If a loop is tuned for responses that are too slow, the process is stable but not responsive. If the loop is tuned for responses that are too fast, it can be very responsive, but it might overshoot and cycle around the set point.The Objective is to achieve a reasonably responsive and stable control loop.

For auto tunning with Delta V insight one has to select the PID controller right and open with tune with insight as shown below. Before starting the tunning process in tune with

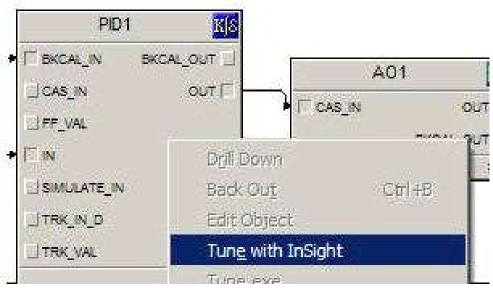


Figure 4.8: Opening Insight from Control Studio

insight, make sure that the loop is reasonably stabilized at the SP. If the PV is not close to the SP,begin the tuning from manual mode. When tunning a loop, the SP and output

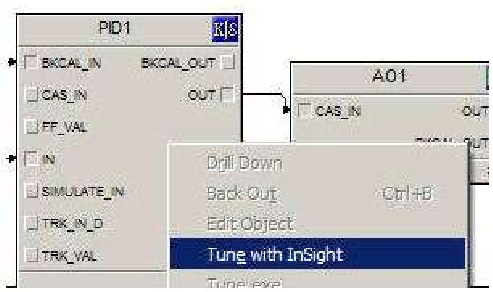


Figure 4.9: Opening Insight from Control Studio

should not be at either end of their respective ranges. The output must be no lower than 10 percent of the range and no higher than 90 percent of the range or the oscillations will be affected. The PV of the loop should be close to the SP when tuning is started. Insight check the value of SP and PV before tunning the loop. If the deviation is large this indicate that the loop is not stable. The tuner waits until the SP-PV values is with in the required limit.

If the tunning proceeds properly , the state changes to an active state and the control block actual mode changes to LO(local override). The time between each change in the block output depends on the process response time. for example , a change in the process input might not be immediately affected because of process delay in the controlled parameter. Watch the trend display area during tuning process. If loop trend traces are not typical or tunning does not start, restore initial loop conditions by clicking abort button. On rare occasions , Insight may not detect a response and test becomes stuck in LO mode with no PV movement,click abort button and repeat the procedure. while testing is active status is shown as testing process in test process panel. The progression of testing indicated by a bar graph showing percent completion.

A yellow circle icon appears next to the control block to indicate the test is active . The obtained results are shown here in this section. The recommended settings after the test can be updated to the controller by clicking update button.

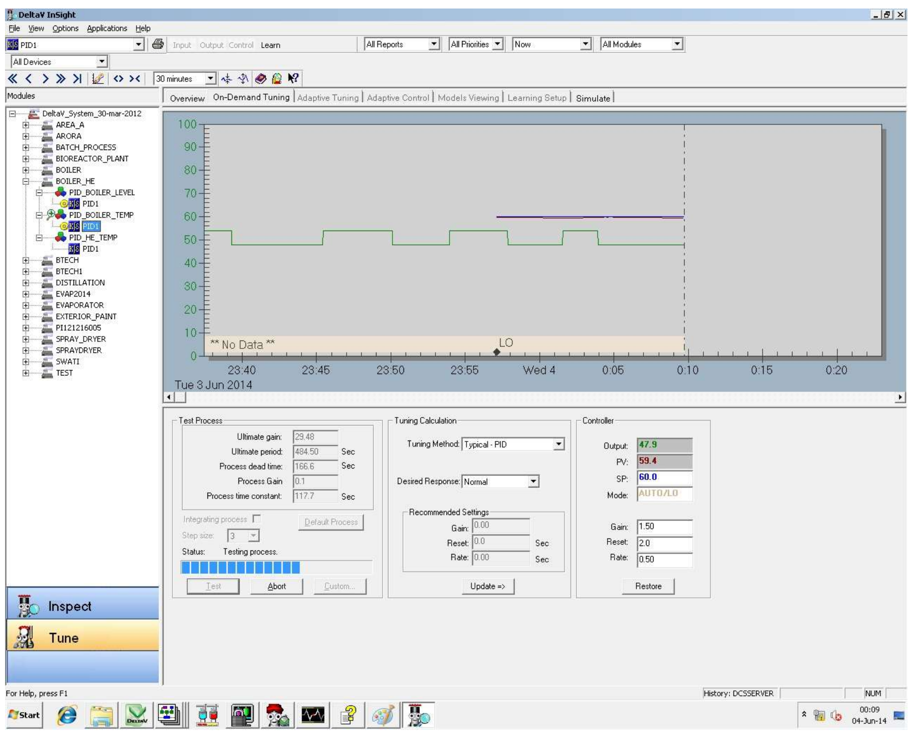


Figure 4.10: Tunning in progress, Delta V Insight

4.4.3 Model Predictive Control in Delta V DCS

Model Predictive Control (MPC) Function Block

The MPC function block is the basis of implementing multivariable control in a DeltaV system. This function block replaces standard PID control that utilizes feedforward, decoupling

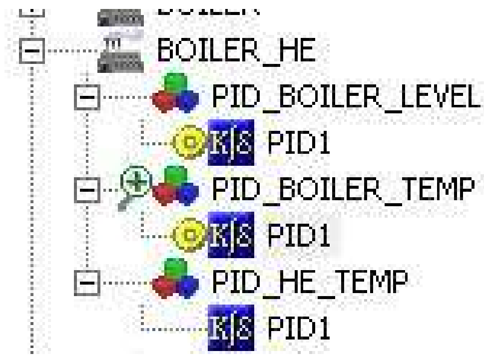


Figure 4.11: Tunning in progress, indicated by yellow circle

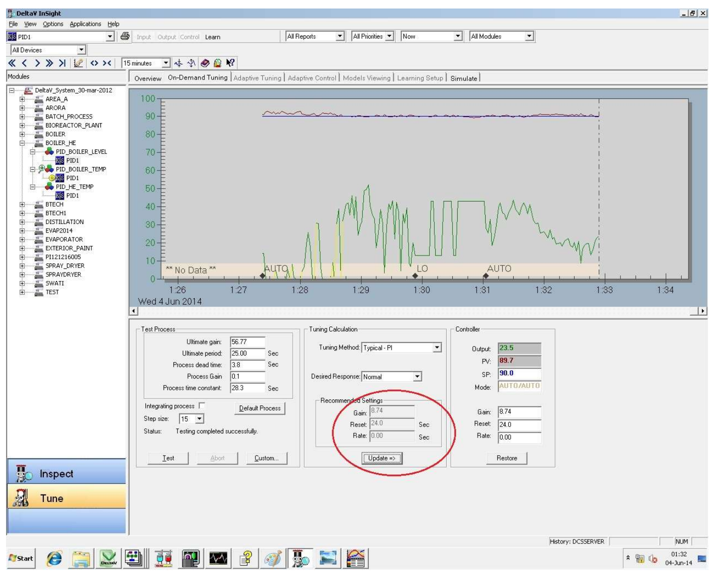


Figure 4.12: Tunning completed recommended values by insight is shown in circle

networks, and override for multivariable control. All parameters (manipulated, disturbance, constraint, and controlled) can be defined in the MPC function block for the desired process using Control Studio. The DeltaV Predict application can be launched from Control Studio.

The DeltaV Predict application is used to commission the MPC function block. When a module that contains the MPC block is downloaded, all inputs and outputs are assigned to the Continuous Historian.

Through the Predict application, we can change the manipulated inputs to the process so that we can collect historical data that reflects the process response to these changes. Using this historical data, the Predict application can identify the process step response to changes in the manipulated or disturbance inputs to the process. Also, the control definition used by the MPC function block can be generated from the model that is identified.

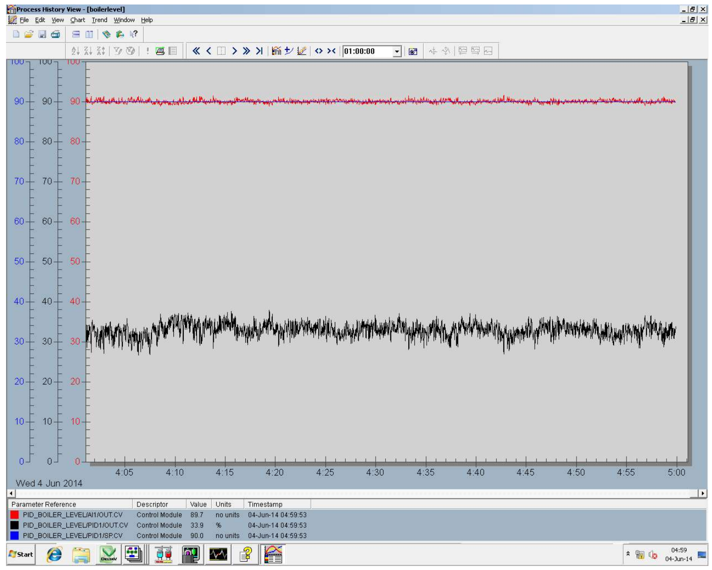


Figure 4.13: Boiler level maintained at 90% after autotunning with Delta V insight

MPC Configuration

Since the MPC block is an extensible function block, we can select the number of controlled, constraint, and disturbance parameters that are required to meet your process control needs. The number of manipulated and back calculation input parameters are set to equal the number of controlled parameters that you specify. The default is for the MPC block to have two controlled parameters. we can right-click the MPC function block and select Extensible Parameters. The maximum number of controlled, manipulated, disturbance , constrains is limited to four in our case. After specifying the number of inputs to meet application needs, select OK. The dialog closes, and the MPC block resizes to reflect the specified number of inputs (and outputs).

Once the number of inputs to the MPC block is defined, we can configure the parameters associated with this function block. To enter configuration information, right-click the MPC function block and then select Properties. We can specify the configurable parameters associated with the controlled, manipulated, disturbance, and constraint parameters. Click an input or output listed in this dialog and select the Modify button. Then, we can change the configurable values associated with this parameter.

For a controlled parameter, the following configuration dialog appears Provide the following configuration information.

- Description The parameter name that you want to appear in the Predict application and the MPC Operate view.

- Optimization The impact of the Control parameter on plant cost or profit. The selections are:

  - None - Not considered in the objective function. There is no cost or profit associated with this parameter
  - Maximize - the working setpoint of this Controlled Variable will increase until the setpoint is reached or decrease by as much as required to prevent constraint variables from violating their limits.

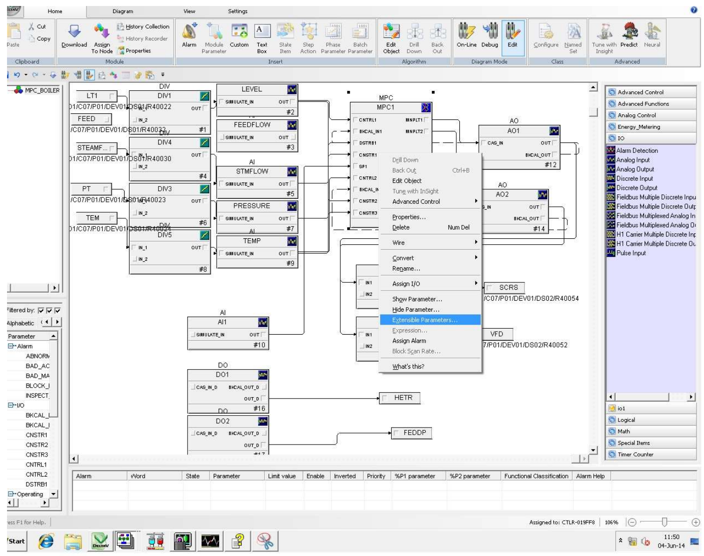


Figure 4.14: MPC in Control studio for Boiler Pilot plant

- Minimize - the working setpoint of this Controlled Variable will decrease until the setpoint is reached or increase by as much as required to prevent constraint variables from violating their limits.
- Observe Limit - the working setpoint of this Controlled Variable will drive towards the setpoint or move away from it by as much as required to prevent constraint variables from violating their limits.

The MPC function block provided by DeltaV Predict may be used to address multi variable control requirements. Predict application can be used to create process models and control definitions from process data. The automated test feature of the Predict application allows the step response of controlled or constraint outputs to be determined based on changes in the manipulated inputs. This capability can meet multi variable control requirements in all process industries. In many cases, the MPC function block can replace control techniques that have traditionally been used to address the control requirements of multi variable processes.Multi variable control is defined as control that uses multiple process measurements to produce one or more outputs.

4.4.4 DeltaV Predict

DeltaV Predict implements multi variable, model predictive control in DeltaV environments. It allows us to control interactive processes within measurable operating constraints while automatically accounting for process interaction and measurable disturbances. It also allows you to easily address the numerous small and medium-sized multi variable processes.

Predict allows those with moderate process control knowledge to apply MPC control strategies. It also makes applying such strategies easier and faster than it would be using a PID controller and traditional techniques to address process disturbances, operating constraints, and loop interaction through the application of feed forward, override control or decoupling networks. DeltaV Predict consists of the following set of tools:

- Model Predictive Control (MPC) function block - allows you to implement multivariable control strategies

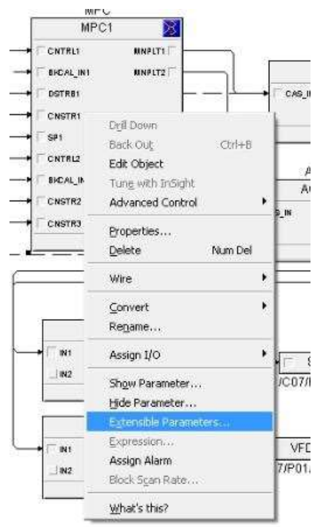


Figure 4.15: MPC block extensible parameter selection

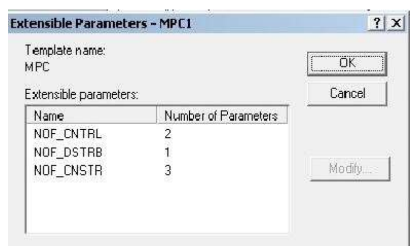


Figure 4.16: MPC block extensible parameter configuration window

- MPC Simulation function block - allows you to create multivariable training systems
- Predict application - allows you to commission the MPC function block and create process models to use with the MPC Process Simulator function block
- MPC Operate application and advanced control dynamos - enable operator to view and interact with control implemented with the MPC function block

4.4.5 Commissioning MPC

After downloading an MPC function block to a DeltaV controller, verify that the transmitters and valves that provide the inputs and utilize the outputs of the MPC function block are working correctly. Also, make sure the Continuous Historian is enabled and the area containing the module has been assigned to the Continuous Historian. Once you have verified all I/Os to the MPC function block, you can use the Predict application to commission the MPC control. You can select the Predict application by right-clicking the MPC function block when the module is online.Otherwise download the module and then right click and launch the predict application. In response, the Predict application is launched and the following interface appears.

The control (CNTRL) parameters are trended automatically. Up to six of the MPC inputs and outputs can be trended at one time. For good data values, trends appear in the

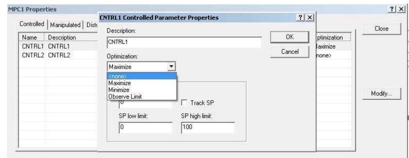


Figure 4.17: MPC block controlled parameter configuration window

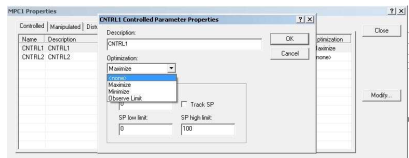


Figure 4.18: MPC block controlled parameter configuration window

colors indicated in the parameter data area. The color varies to indicate questionable status (yellow for uncertain or limited values, red for bad values). To add or delete a parameter from the trend, double-click the parameter in the Operate Trend pane. When right-click a selected parameter, options are provided that allow us to modify the trend view (that is, change the trend range). we can use the toolbar controls or the slider bar to adjust the time window that is shown on the trend.

Once the PV and SP are almost same we can launch test process. The predict application will automatically generate PRBS signal for manipulated variable and estimate the process model.

While testing is active, the actual mode of the MPC function block changes to LO. During testing, a manipulated parameter can be changed using the Operate Trend panel. The portion of testing that is complete is indicated by a progression bar. The estimated time remaining to complete the test is shown below the progression bar.

Upon completion of the test, a green area automatically covers portions of the trend associated with the time that testing was active. You can adjust the time covered by the green area either by dragging the start and end divider bars or positioning the bars by right-clicking the chart.

The area of test data that reflects normal process operating conditions is indicated by dragging the green area over the data on the trend window. You can exclude data within the green bar that does not represent normal operation by right-clicking within that area and stretching the resulting red bar over the bad data. After you select the test data, indicate if the control or constraint parameters are integrating and then choose Autogenerate to create a step response model for the process and the associated control.

Any disturbances included in the control should be closely examined. The associated step response might be inaccurate if an input did not change significantly in the data used for autogenerate. If this occurs, a warning message will be displayed when the model is generated. In addition, this will be indicated in some cases by the step response that is shown as a straight line (that is, no response). One means of determining if the step response is accurate is to compare the ARX model to the FIR response. This can be done by identifying yourself as an expert by selecting Options — Expert and choosing the FIR check box. Both responses will be displayed, as shown in the following figure. In some cases, the ARX and FIR responses might not agree. In such a case, we might need to use other data that includes times when the input changed. Then, you will need to regenerate the model and the controller. Alternatively, if one is familiar with the process dynamics, he can identify himself as an expert by selecting Options — Expert and then modify the step response to

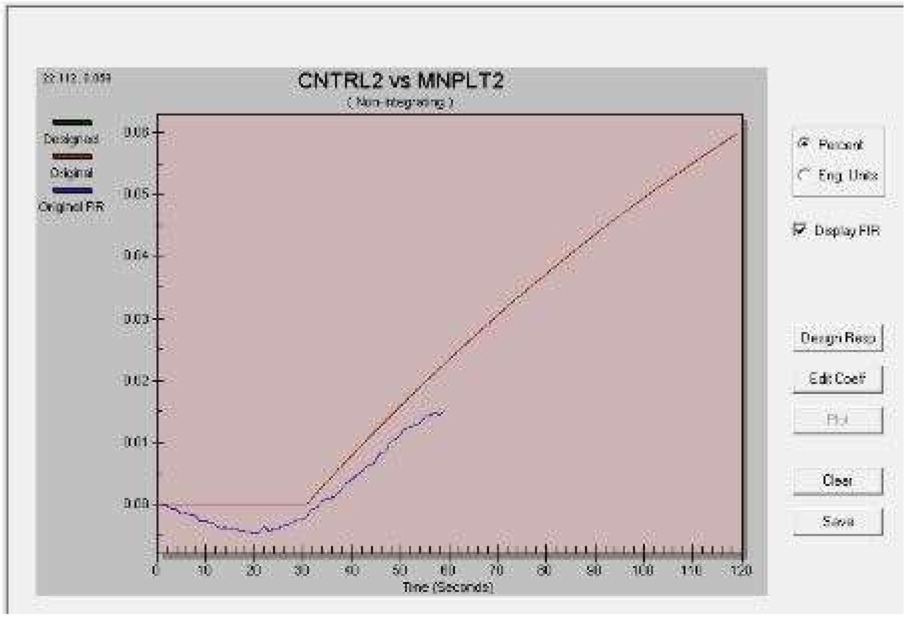


Figure 4.19: FIR and ARX response for controller with manipulated variable

reflect his knowledge of the process.Once done with the testing we can check the accuracy of model by selecting verify from model overview.

We can examine the accuracy of the model by selecting Verify from the model overview. In response, we can examine the calculated output based on the model (as opposed to the actual process output) either for the time frame defined by the green area of the trend plot or for the original data used in generating the model. If the model is accurate the result will be similar to the following figure.

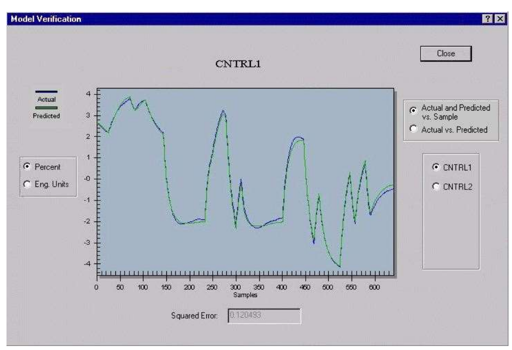


Figure 4.20: Model verification result reference

Once you are satisfied that the model accurately reflects the process dynamics, select Generate Control to update the MPC configuration for the new model. When the control is generated from a selected model, control parameters used to generate the control are displayed. In most cases, it is recommended by Delta V to leave the control generation parameters at their default values and select Start (in the Controller Generation window) to generate the control.

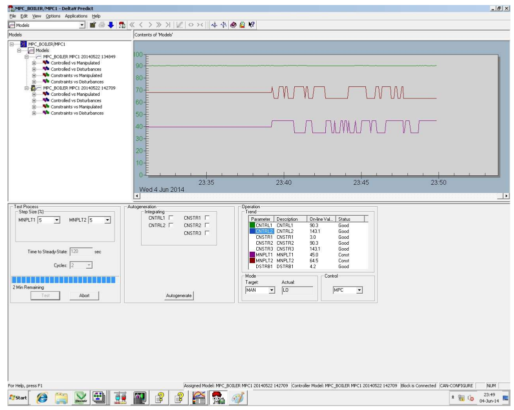


Figure 4.21: Delta V predict when testing is going on

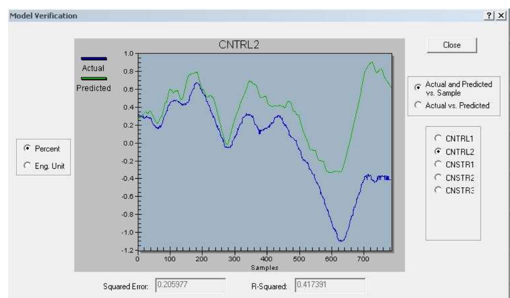


Figure 4.22: Model verification result obtained for CNTRL2

4.5 Controlling From Virtual Lab

4.5.1 Overview

Virtual Lab is a concept where College of Engineering Pune along with all IITS in the country provides a unique learning opportunity to all engineering aspirants around the world. In this concept they developed certain experiments where in which students can learn by them self the concepts of engineering ,utilizing the simulators online. One step ahead of this was a VTU concept which is Virtual Technical University where in which one has to enroll here as a faculty(Subject Master Expert) or student. This time instead of simulators there will be highly sophisticated and user friendly front end which on back end interacting with the real physical operating units.

Out of many such courses run by VTU, a few are PG Diploma in Industrial Automation,Process modeling and optimization and so on. For running this courses mere interaction with the simulators won't suffice. For example in case of tunning a PID controller the PV(Process Variable) is expected to change in accordance with the controller output to track the SP(Set Point). With the implementation of this concept the PID loop is interacting with real plant so that user or student who do not have such resources can learn all this from a remote distance just like a game, but a real game.

For virtual lab we developed programming and tested with the pilot plant. Testing PID tunning for non integrating process is mentioned in chapter 8.

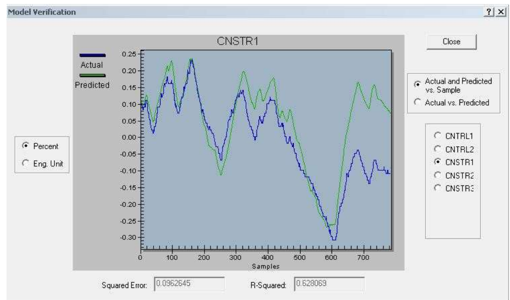


Figure 4.23: Model verification result obtained for CNSTR1

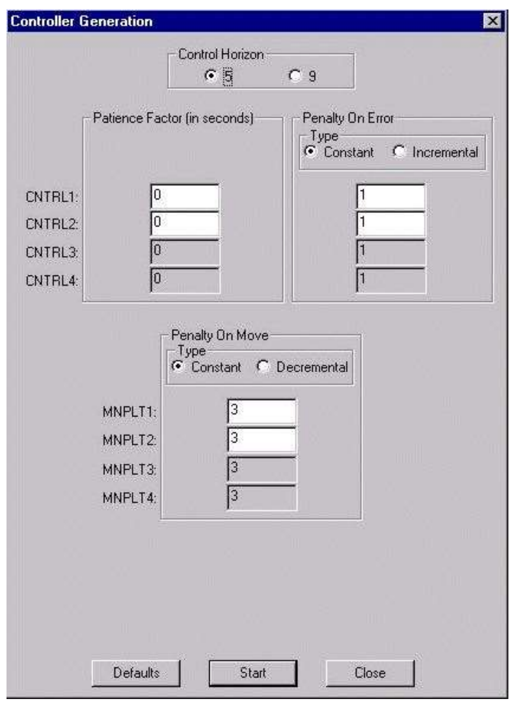


Figure 4.24: Controller generation window after test

Figure 4.25: Main page for student in VTU

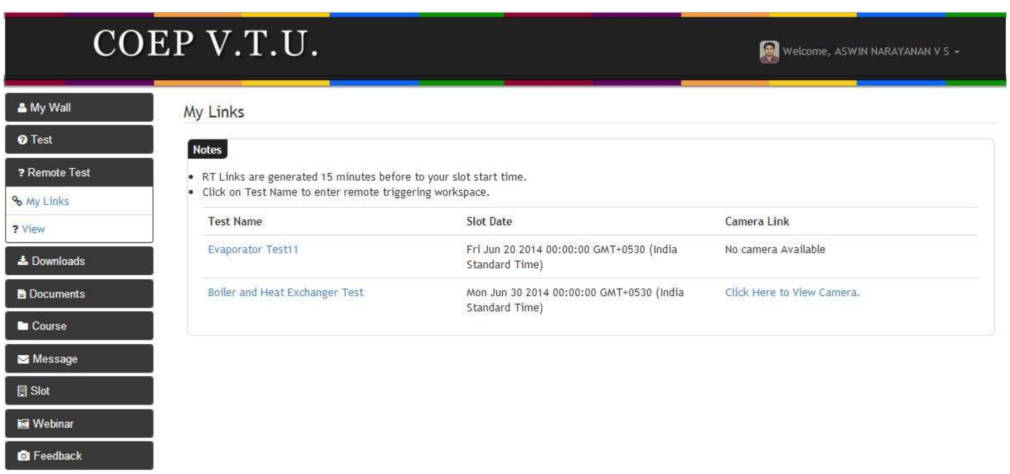


Figure 4.26: Remote test view showing Plant link as well as camera view

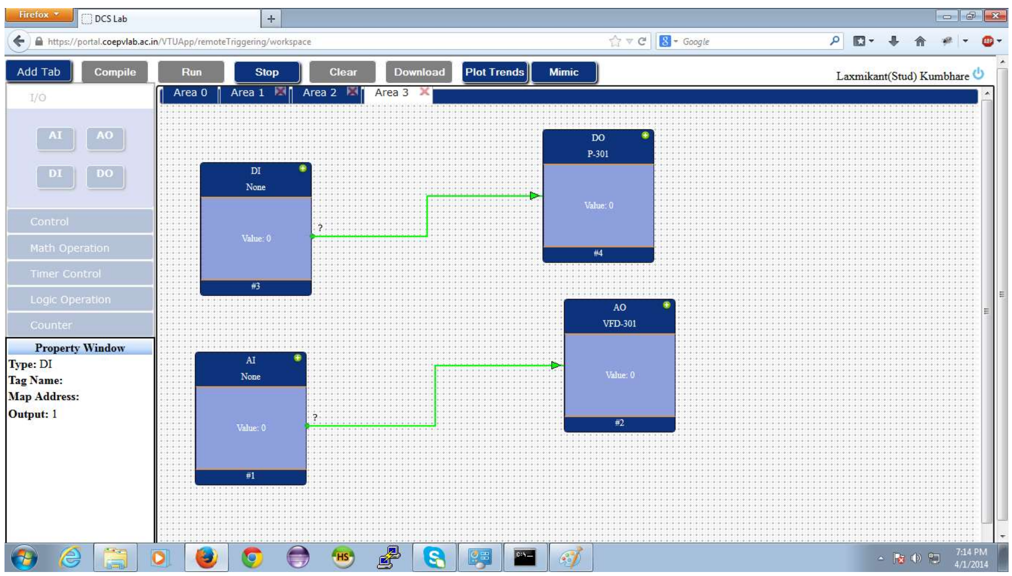


Figure 4.27: Remote test view showing Virtual DCS Blocks

Part II

Evaporator Pilot Plant

Chapter 5

Literature Survey

5.1 Forced Circulation Vaccum Evaporator

Forced circulation evaporators are used if boiling of the product on the heating surfaces is to be avoided due to the fouling characteristics of the product, or to avoid crystallization. The flow velocity in the tubes must be high, and high-capacity pumps are required.

The circulating product is heated when it flows through the heat exchanger and then partially evaporated when the pressure is reduced in the flash vessel (separator). The liquid product is typically heated only a few degrees for each pass through the heat exchanger. To maintain a good heat transfer within the heat exchanger it is necessary to have a high recirculation flow rate.

This type of evaporator is also used in crystallizing applications Evaporation occurs as the liquid is flash evaporated in the flash vessel/separator. Since milk, due to the protein content, is a heat-sensitive product, evaporation (i.e. boiling) at 100°C will result in denaturation of these proteins to such an extent that the final product is considered unfit for consumption.

The boiling section is therefore operated under vacuum, which means that the boiling/evaporation takes place at a lower temperature than that corresponding to the normal atmospheric pressure. The vacuum is created by a vacuum pump prior to start-up of the evaporator and is maintained by condensing the vapor by means of cooling water. A vacuum pump is used to evacuate incondensable gases from the milk.

The steam is introduced through the jacket. The space between the tubes is thus forming the heating section. The inner side of the tubes is called the boiling section. Together they form the so-called calandria. The concentrated milk and vapors leaving top of the calandria and get separated by using a separator. the vapours produced are condensed by a condenser.

5.1.1 Vaccum Evaporation

Vacuum evaporation is the process of causing the pressure in a liquid-filled container to be reduced below the vapor pressure of the liquid, causing the liquid to evaporate at a lower temperature than normal. Although the process can be applied to any type of liquid at any vapor pressure, it is generally used to describe the boiling of water by lowering the container's internal pressure below standard atmospheric pressure and causing the water to boil at room temperature.

5.1.2 Need for evaporator before Spray Drying

The first part before spray drying involves milk being pumped to an evaporator where it is concentrated in a series of steps to around 40-50% total solids. Omitting evaporation of the milk prior to drying is not economically feasible because the demand for energy would be severely increased.For example, the energy used in multiple effect evaporators with steam compression is about 10 times lower than in spray drying. Omission of evaporation would also result in an inferior quality milk powder because evaporation produces large powder particles that contain less occluded air, which results in an extended shelf-life.

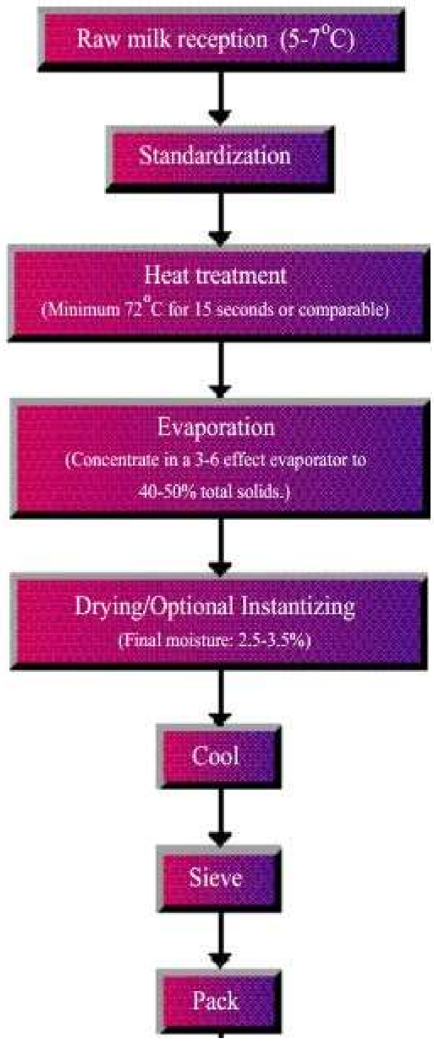


Figure 5.1: Milk Powder Production Steps

5.1.3 Difference between Boiling and Evaporation

Evaporation

- Occurs at any temperature.
- Occurs at the surface of liquid.
- No bubbles formed.

Boiling

- Occurs at defnite temperature-at Boiling Point.
- Occurs within Liquid.
- Bubbles appear.

5.1.4 Heat transfer coefficient in Evaporators

A practical presentation of the fundamental heat transfer principles underlying basic evaporation method and equipment has been given by Badger and Banchero (1955). The general equation describing heat transferred from the heating steam through the metal wall to the product being evaporated is

$$Q = V_0 \lambda_s = UA(T_s - T) = UA\Delta T \tag{5.1}$$

where Q = rate of heat transfer,

V_0= condensed steam rate,

λ_s= the latent heat of vaporization of steam at condensing temperature,

U = overall heat transfer coefficient,

A = heating surface area,

T_s= condensing steam temperature,

T = product evaporating temperature,

T = T_s T,temperature drop.
The overall heat transfer coefficient for condensing steam through a heating surface to liquid foods may be written as

$$\frac{1}{UA} = \frac{1}{h_s A_s} + \frac{X}{kA_m} + \frac{1}{h_f A_f} \tag{5.2}$$

where A_m= the mean area for the steam and product sides of the heat exchange surface,
A_s = steam-side heat transfer area,
h_s= steam-side heat transfer coefficient,
k = thermal conductivity of the wall material,
x = thickness of the wall,
h_f= liquid-side heat transfer coefficient,
and A_f = liquid-side heat transfer area

for tubular evaporators the equation becomes

$$\frac{1}{U_0} = \frac{1}{h_s} + \frac{d_0}{2k.ln(\frac{d_0}{d_i})} + \frac{d_0}{h_f.d_f} \tag{5.3}$$

where,
d_o= outside heat transfer tube diameter

d_i = inside heat transfer tube diameter.

Local heat transfer coefficients are generally expressed as dimensionless parameters, $h^* = h_d/k$, usually in function of the Reynolds (R_e) and Prandtl (P_r) numbers,

$$h^* = aRe^b Pr^c \tag{5.4}$$

Where,a,b,c are experimental constants

Forced circulation evaporators (Coulson and Richardson, 1978)

$$h^* = 0.023 R_e^{0.8} P_r^{0.4} \tag{5.5}$$

Chapter 6

Insight of Evaporator Pilot-Plants

This chapter introduces Industrial Evaporators and Provide a brief overview of their function and operation.Forced circulation Evaporator is discussed particularly The Final section of chapter introduces the Department of Instrumentation and Control's Evaporator Pilot Plant.The Evaporator is Forced Circulation Evaporator and it design,operation and instrumentation is described.

6.0.5 Function of important components

The instrumentation components in the evaporator plant can be divided in the following groups:

1. Sensors and transmitters

2. Final control elements

3. Safety components

Sensors and transmitters

The transducer measures a process variable in the plant while the transmitter produces an output signal, often in the form of a 420 mA electrical current signal.

Final control elements

Final control element is a physical device whose activation or movement causes a change in dynamic process as commanded by the controller. Following are the final control elements used in the plant:
a. Positive displacement pump for feed: The speed of the motor and in turn feed flow is changed using variable frequency drive depending on the level in the separator.
b. Centrifugal pump for recirculation: The speed of the motor and in turn feed flow is changed using variable frequency drive depending on the product concentration.
c. Equal percentage globe valve for manipulating steam flow: Takes proper action in terms of valve opening depending on the current signal from controller.

Figure 6.1: Evaporator Pilot Plant

Safety components

These components ensure process safety which generally refers to the prevention of unintentional releases of chemicals, energy, or other potentially dangerous materials (including steam) during the course of process that can have a serious effect to the plant and environment. Process safety involves, for example, the prevention of leaks, spills, equipment malfunction, over-pressures, over-temperatures, corrosion, metal fatigue and other similar conditions. Following instruments are included to keep process variables under safe limit as well as provide alarms interlocks to automatically take necessary action:

a. Pressure switch: Pressure switch on evaporator shuts off the steam if evaporator pressure/temperature exceeds operating limits.

b. Temperature switch: This switch shuts off the vapors from separator if in case the feed temperature exceeds the set point.

c. Low level switches: For the separator, shuts off the feed pump if level in the separator goes below the expected. For feed tank switch is provided so as to avoid dry running of pumps if there is nothing to pump in the tank.

d. High level switches: Provided for the separator and product tanks to avoid overflow of liquid.

6.1 Overview of Evaporator Pilot Plant

6.1.1 Functional definition

Evaporation is a special case of the unit operation called heat transfer. The aim of evaporation is to concentrate a solution consisting of a volatile solvent and a non-volatile solute. Steam is often used as a heating source. This unit operation is achieved by vaporizing part of the solvent to produce a concentrated solution. Most evaporation operations used by industry use water as the solvent. Evaporators are commonly found in the inorganic, organic, paper and sugar industries. Typical applications include the concentration of sodium hydroxide, brine, organic colloids and fruit juices

6.1.2 Process description

The evaporator used is of forced circulation type. Here, feed coming from feed tank is mixed with a high volumetric flow rate of recirculating liquor and is pumped in to a vertical heat exchanger, in which heat is exchanged with 3.5 bar steam coming from boiler which condenses on the outside of the tube walls. The liquor which passes up the inside of the tubes, boils and then passes to a separation vessel. In this vessel, liquid and vapor are separated. The liquid (now more concentrated than when it entered the evaporator) is recirculated and drawn as product when desired concentration is reached. The concentrated solution withdrawn from the evaporator is known as the thick liquor or process liquid which is collected in a product tank. This process liquid is further given as a feed to dryer plant.

Variable	Description
F1	Feed flow rate(kg/min)
F2	Product flow rate(kg/min)
F3	Circulating flow rate(kg/min)
F4	Vapor flow rate (kg/min)
F5	Condensate flow rate(kg/min)
X1	Feed composition(Percent)
X2	Product composition(Percent)
T1	Feed temperature(deg C)
T2	Product temperature(deg C)
T3	Vapor temperature(deg C)
L2	Separator level(meters)
P2	Operating pressure(kPa)
F100	Steam flow rate(kg/min)
T100	Steam temperature(deg C)
P100	Steam pressure(kPa)
F200	Cooling water flow rate(kg/min)
T200	Cooling water inlet temperature(deg C)
T201	Cooling water outlet temperature(deg C)
Q200	Condenser duty(kW)

Table 6.1: Evaporator Variables

6.2 List of Instruments

Sensors	Type	Range	Quantities
Temperature	Pt-100	0-200 ^0C	7
Flow	Vortex Flow Meter	0-40 kg/hr	1
	magnetic flowmeter	0-10000 lph	1
Pressure		0-2.5 bar	1
		0-5 bar	1
Level	Differential Pressure Type	0-500mm H_2O	1
Density	Inline	0-1.5 gm/ cm^3	1

Table 6.2: List of Sensors Evaporator Pilot Plant

The main aim of most evaporator control systems is to regulate ,conditions within the evaporator so that the product stream meets a particular specification. This requires that the control system minimizes fluctuations in the product composition arising from disturbances in the input stream or in the plant itself. The nature of the fluid, the operating conditions, the equipment design, and the manner of association with other plant, all influence the detailed nature of the control scheme That is why the plant and its associated control equipment should be considered together at the design stage. In particular where the process is associated with other processes in a plant with little or no storage capacity to act as a buffer between processes, care must be taken to guard against interaction between control loops. Even in the course of this work involving only a single process, certain control schemes showed pronounced interaction between control loops.

6.3 Operation

The liquid is circulated through the calandria by means of a circulation pump, where it is superheated at an elevated pressure, higher than its normal boiling pressure. Upon entering the separator, the pressure in the liquid is rapidly reduced resulting in some of the liquid being flashed, or rapidly boiled off. Since liquid circulation is maintained, the flow velocity in the tubes and the liquid temperature can be controlled to suit the product requirements independently of the pre-selected temperature difference

The often used evaporator, known as a forced circulation evaporator. In this evaporator, feed is mixed with a high volumetric flow rate of recirculation liquor and is pumped in to a vertical heat exchanger, in which heat is exchanged with steam which condenses on the outside of the tube walls. The liquor which passes up the inside of the tubes, boils and then passes to a separation vessel. In this vessel, liquid and vapor are separated. The liquid (now more concentrated than when it entered the evaporator) is re-circulated and drawn as product when desired concentration is reached. The concentrated solution withdrawn from the evaporator is known as the thick liquor or process liquid.

6.3.1 Standard Operating Procedure:

Referring to the P&ID of the process given in the indices, follow the procedures for start-up, Normal operation and shut down.

Start up Procedure

1. Fill the separator with feed from feed tank using feed pump
2. Check All Valves Status ,Keep it to Required Condition
3. Start the Vacuum Pump to Get Required Vacuum in the Separator
4. Start the Sealing Water supply for Circulation Pump, Vacuum Pump and Surface Condenser
5. Shut the feed supply and start circulating the feed in vertical heat exchanger
6. Adjust the steam supply to heat exchanger and circulation flow rate to get the required product concentration
7. The thin solution vapors generated due to heat exchange and flashing in Separator is passed through condenser and collected in condensate tank
8. Flashing of solution occurs at Separator as the operating pressure is reduced by using vacuum pump
9. In line density measurement is carried out using density meter
10. When the required product density is achieved the product outlet valve is opened partially
11. And the circulation of product is continued to avoid scaling of product on inside walls of heat exchanger at same time care must taken to maintain minimum level in separator by introducing fresh feed from feed tank
12. While shutting down, turn off the feed pump and cut off the steam supply by closing steam valve
13. Allow the circulation pump to run for some time and collect all product in product tank

6.3.2 Normal operation sequence

1. Make sure that feed tank has sufficient filled with solution
2. Observe the product concentration on controller
3. Check the performance of the parameters and carry the manipulations accordingly.
4. Once the unit is operating smoothly do not disturb any settings till the disturbance is to be generated.
5. Check the level of feed tank otherwise follow the shutdown sequence if the level drops down to its low limit

6.3.3 PLANT SHUT DOWN SEQUENCE

1. STOP STEAM
2. STOP FEED
3. COOL ALL EFFECT TO 38 TO 40 DEG C
4. STOP PROCESS CONDENSATE PUMP
5. STOP VACUUM PUMP
6. STOP COOLING WATER PUMP
7. STOP COOLING WATER FAN
8. STOP CP/TP PUMP
9. STOP SEALING WATER PUMP

6.4 Origin of disturbance

- Feed flow rate, density and enthalpy
- Calandria heat input rate, which may vary through changes in the heating medium supply pressure or temperature
- Condenser heat removal rate, which may vary because of changes in flow rate or temperature of the cooling medium (surface condenser) or flow rate (contact condenser)
- Pan pressure, through changes occurring in the condenser ejector system.
- Ambient conditions, which affect the rate of heat transfer from the equipment, or the operating pressure of any plant vented to the atmosphere.
- Variations in product withdrawal rate, originating in changing demands by Some succeeding process.

Of these, the main source of disturbances is the feed stream, particularly as most evaporators have their own subsidiary control loops regulating the heating medium conditions, and the condenser-ejector conditions

In a similar fashion it would be possible to control separately the feed flow rate and temperature, but at the risk of controller redundancy

6.5 Piping And Instrument Diagram for Evaporator

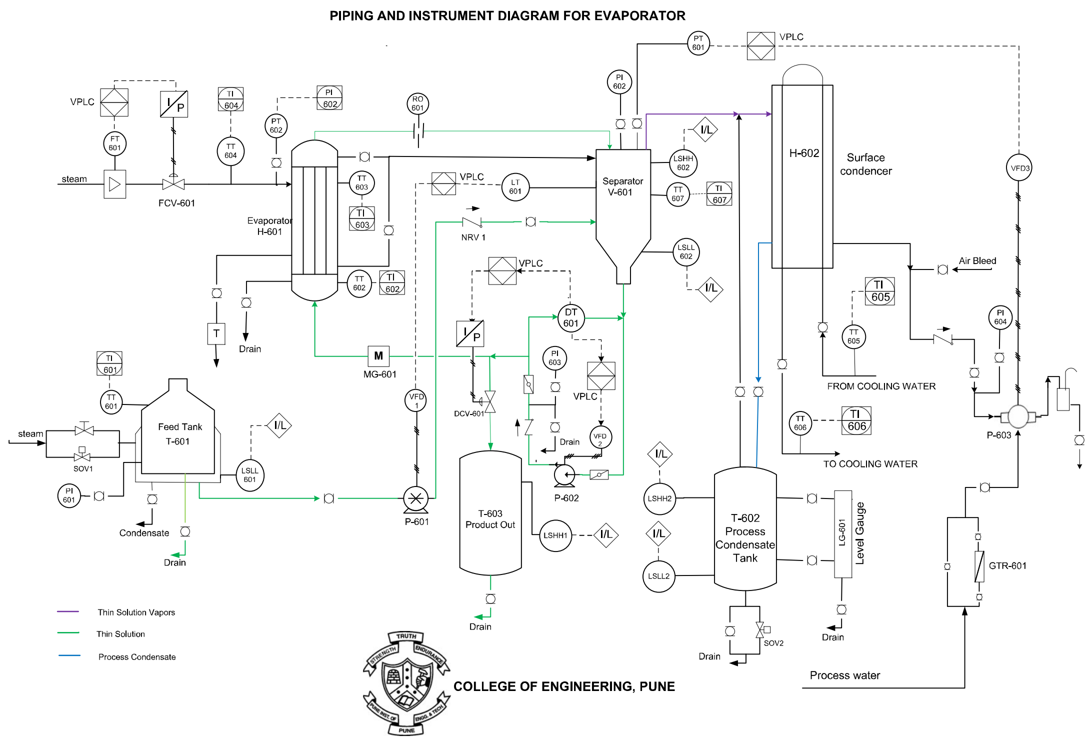


Figure 6.2: Piping And Instrument Diagram for Evaporator

Chapter 7

Modeling of Evaporator Pilot Plant

In this Modeling, it is assumed that:

- The overall heat transfer coefficient between milk and steam is constant
- It is considered that the liquid and vapor phase are at equilibrium condition
- Vapor accumulation in effects is negligible
- Heat transfer only occurs between milk and steam inside the shell and heat losses to environment are negligible
- by neglecting vapor space and Heat transfer Dynamics

7.0.1 The Non Linear Model:

Process Liquid mass balances

A mass balance on Total Process Liquid i.e. solvent and solute in the system yields

$$\rho A \frac{\mathrm{d}L_2}{\mathrm{d}t} = F_1 - F_4 - F_2 \tag{7.1}$$

where,
rho is liquid density,
A is cross sectional area of Evaporator,
the product ρ A is Assumed to be Constant

Process liquid solute mass balance

A mass balance on the solute in the process liquid phase

$$M \frac{\mathrm{d}X_2}{\mathrm{d}t} = F_1 X_1 - F_2 X_2 \tag{7.2}$$

where,

M is amount of liquid in the Evaporator

Process vapor mass balances:

A mass balance on the process vapour in the evaporator will express the total mass of water Vapour in the system

$$C\frac{\mathrm{d}P_2}{\mathrm{d}t} = F_4 - F_5 \tag{7.3}$$

where,

C is mass of vapor in to an equivalent pressure, This Constant can be derived from ideal gas Law

Process Liquid Energy Balances
The process liquid is assumed to always exist in its boiling point and to be perfectly mixed

The product liquid temperature is :

$$T_2 = 0.5616P_2 + 0.3126X_2 + 48.43 \tag{7.4}$$

which is linearisation of saturated liquid line for water about saturated steady state value and include a term to approximate boiling point elevation due to presence of solute

The vapor temperature is :

$$T_3 = 0.507P_2 + 55.0 \tag{7.5}$$

which is linearisation of the saturated line for water about the standard steady state value

The Dynamics of the energy balance are assumed to be very fast

$$F_4 = (Q_{100} - F_1 C_p(T_2 - T_1))/\lambda \tag{7.6}$$

7.1 Additional Relations

$$T_2 = 0.5616P_2 + 0.1326C_2 + 48.43 \tag{7.7}$$

$$T_3 = 0.507P_2 + 55.0 \tag{7.8}$$

$$F_2 = F_1 - F_4 \tag{7.9}$$

$$F_4 = \frac{\lfloor Q_{100} - F_1 C_p\left(T_2 - T_1\right)\rfloor}{\lambda} \tag{7.10}$$

$$T_{100} = 0.1538P_{100} + 90.0 \tag{7.11}$$

$$Q_{100} = F_{100}\lambda_s = UA_1(T_{100} - T_2) \tag{7.12}$$

$$Q_{200} = F_{200}C_p(T_{201} - T_{200}) \tag{7.13}$$

$$= UA_2(T_3 - 0.5(T_{200} - T_{201})) \tag{7.14}$$

$$F_5 = Q_{100}\lambda \tag{7.15}$$

$$UA_1 = 0.16(F_1 - F_3) \tag{7.16}$$

$$\tag{7.17}$$

Where,
M is Solute Holdup
λ is Latent heat of Vaporisation of Water
UA_2 is Heat transfer coefficient times the Heat transfer Area
C_p is Specific Heat

Heat required for Evaporation:

$$H = \frac{\left(\div \frac{w}{w} Product\right) - \left(\div \frac{w}{w} Feed\right)}{\lambda_s} + \lambda_s(condensate) \tag{7.18}$$

7.2 Heat Exchanger model equations

$$\frac{dT_{co}}{dt} = \frac{F_c}{(V_c \rho_c)}(T_{ci} - T_{co}) + \frac{U_{Ap}}{(C_{pc} C_c V_c)}(T_{ho} - T_{co}) \tag{7.19}$$

$$\frac{dT_{ho}}{dt} = \frac{F_h}{(V_h \rho_h)}(T_{hi} - T_{ho}) + \frac{U_{Ap}}{(C_{ph} \rho_h V_h)}(T_{co} - T_{ho}) \tag{7.20}$$

7.3 Plant Input And output Variables

Separator Variables

Input Variables	Output Variables	State Variables
F_1	L_2	L_2
F_2	X_2	X_2
F_4	P_2	P_2

Input Variables	Output Variables	State Variables
F_3	T_{co}	T_{co}
F_{100}	T_{ho}	T_{ho}
T_{100}		

7.3.1 Open loop non-linear model validation results

The whole evaporator plant was divided into three sections. one separator and two heat exchangers as shown above. The non linear model is validated in MATLAB and the validation results are as below.

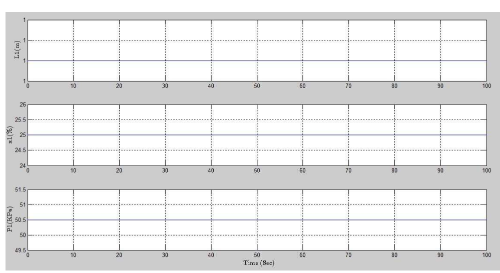


Figure 7.1: Steady state of separator

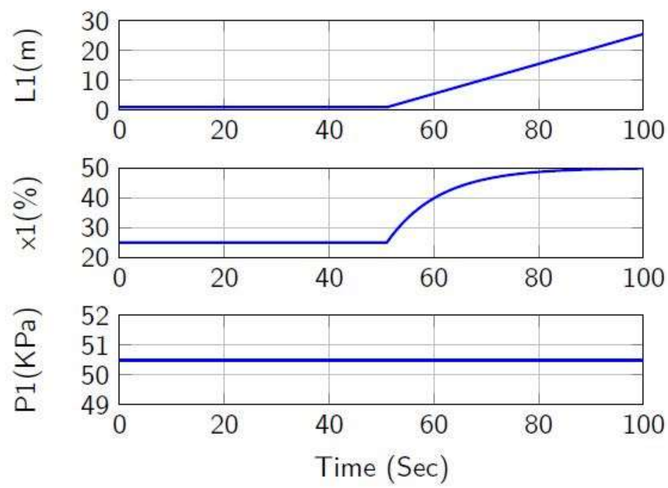


Figure 7.2: Plot when feed flow increases by 10 %

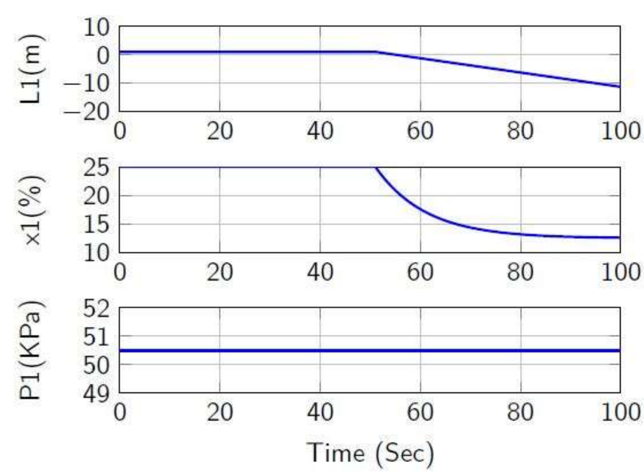


Figure 7.3: Plot when feed flow decreases by 10 %

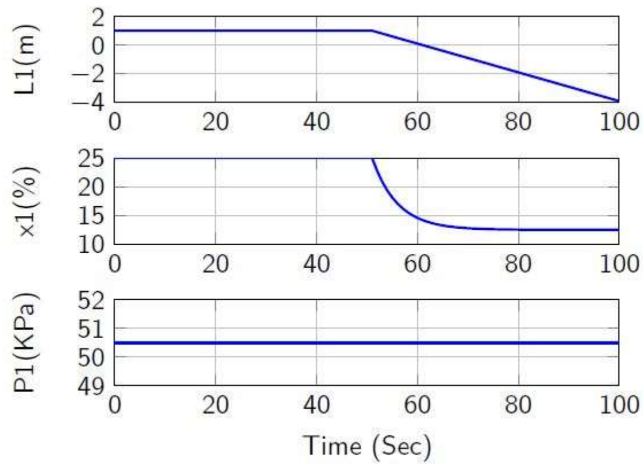


Figure 7.4: Plot when product flow increases by 10 %

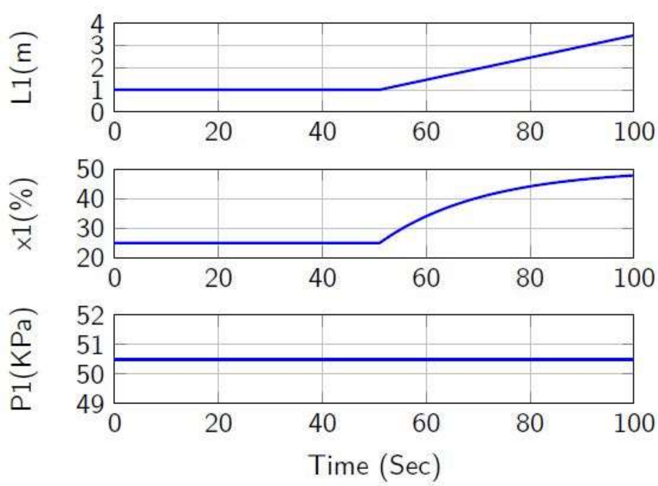


Figure 7.5: Plot when product flow decreases by 10 %

Chapter 8

Controlling From Various Domains

8.1 Overview

This chapter focuses on automation and control schemes for the evaporator pilot plant. Each section of this chapter tells us the scope of control strategies and there implementation in various domains such as local and remote.PID control is implemented in various domains. Generated square ,sine, ramp and PRBS test signals are generated in Micrologix 1400 PLC for checking the robustness of PID controller.

8.2 Local Domain

Local domain is having Micrologix 1400 PLC. Programming is done in RS logix 500 version 9 for automation and control of the evaporator pilot plant.Through use of the Proportional-Integral-Derivative (PID) controller, automated control systems enable complex production process to be operated in a safe and profitable manner.We achieve this by continually measuring process operating parameters such as Temperature, Pressure, Level, Flow, and Concentration, and then by making decisions to open or close a valve, slow down or speed up a pump, or increase or decrease heat so that selected process measurements are maintained at the desired values.

Sr.No.	Controlled Variable	Manipulated Variable
1	Seperator Level	Peristatic pump speed
2	Circulation Flow	Circulation pump speed
3	Separator Temperature	Circulation pump speed Or Control Valve
4	Separator Pressure	Vaccum pump speed
5	Product Flow	Product flow valve

Table 8.1: List of controlled and corresponding manipulated variable for Evaporator plant

The overriding motivation for modern control systems is safety. Safety encompasses the safety of people, the safety of the environment, as well as the safety of production equipment. The safety of plant personnel and people in the surrounding community should always be the highest priority in any plant operation. Good control is an individual control loops ability to achieve and maintain the desired control objective.

8.2.1 PID controller in micrologix 1400

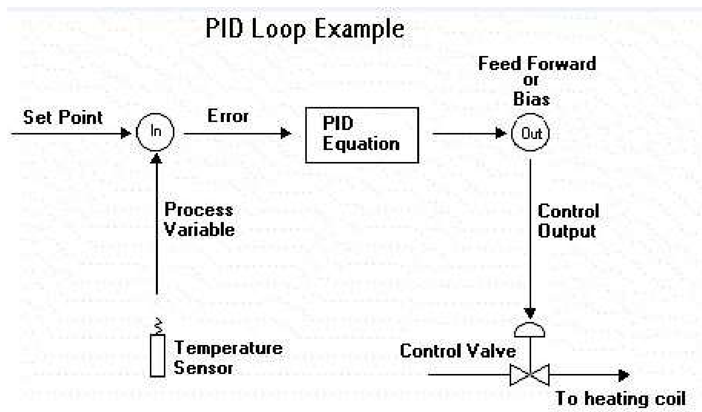


Figure 8.1: Typical PID program loop

This output instruction is used to control physical properties such as temperature, pressure, liquid level, or flow rate of process loops.The PID instruction normally controls a closed loop using inputs from an analog input module and providing an output to an analog output module as a response to effectively hold a process variable at a desired set point.The PID equation controls the process by sending an output signal to the actuator. The greater the error between the setpoint and the process variable input, the greater the output signal, and vice versa. An additional value (feed forward or bias) can be added to the control output as an offset. The result of the PID calculation (control variable) will drive the process variable you are controlling toward the set point Entering Parameters: PID File - (MicroLogix 1200, 1400 and 1500 only) Specify a PID file. If you have not already defined a PD filetype among your data files, it will be created for you. The file length is fixed at 23 words. The PD file replaces the old integer file control block. Control Block Length - (Not valid with MicroLogix 1200, 1400 or 1500) Specify an integer file, for example N7:0. The file length is fixed at 23 words.

Process Variable PV - The element address that stores the process input value. This address can be the location of the analog input word where the value of the input A/D is stored. You can also enter an integer address if you choose to pre-scale your input value to the range 0-16383.

Control Variable CV - The element address that stores the PID output. The output value ranges from 0-16383, with 16383 being the 100% "ON" value. This is normally an integer address, so that you can scale the PID output range to the particular analog range your application requires.

The PID controllers were implemented for the above mentioned loop and to test the robustness of a non integrating loop, created various test signals such as Square wave, Sine wave, Ramp wave and PRBS wave form. The response of the PID is checked by applying this waveform as set point and plotted the same in Factory talk view SCADA of micrologix.The

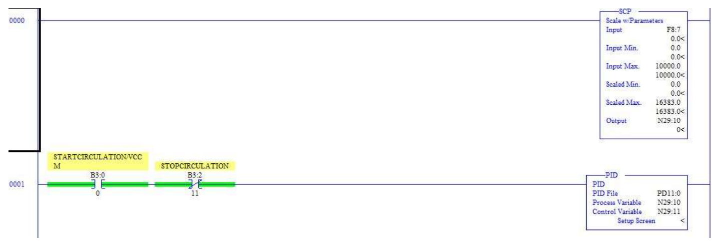


Figure 8.2: Typical PID program loop

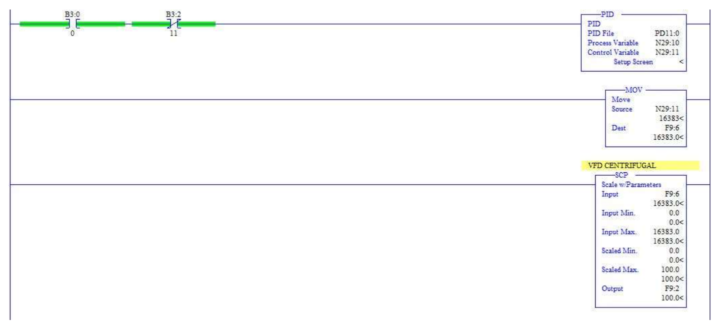


Figure 8.3: Typical PID program loop

programming is also shown in the appendix. The results are shown below where in which the Red line represents the SP green represents PV and blue for controller output.

8.3 Controlling from ControlLogix system 1756-L61

The ControlLogix system of series 1756-L61 is chassis-based and provides the option to configure a control system that uses sequential, process, motion, and drive control in addition to communication and I/O capabilities.

RSLogix 5000 is a programming software of Contrologix which offers an easy to use IEC61131-3 compliant interface.It provides ladder logic, structured text, function block diagram and sequential function chart editors for program development as well as support for the S88 equipment phase state model for batch and machine control applications. We also used RSView32 works to develop SCADA and to log data. RSView32is an integrated, component-based HMI for monitoring and controlling automation machines and processes.It also integrates Microsoft's popular Visual Basic for Applications (VBA) as a built-in programming language and supports OPC standards as both a server and a client for fast, reliable communications with a wide variety of hardware devices.

Ladder Programming for Evaporator pilot plant is done and developed the SCADA for the same in this domain.

8.4 Controlling from DeltaV DCS

8.4.1 About DeltaV

- Control Module
  Control strategies in the DeltaV system are configured in modules. A module, which is the smallest logical control entity in the system, contains algorithms, conditions,

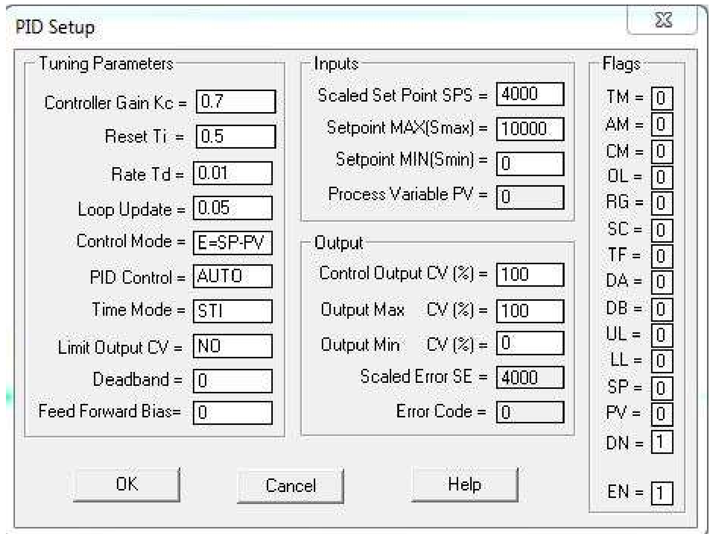


Figure 8.4: Typical PID set up screen

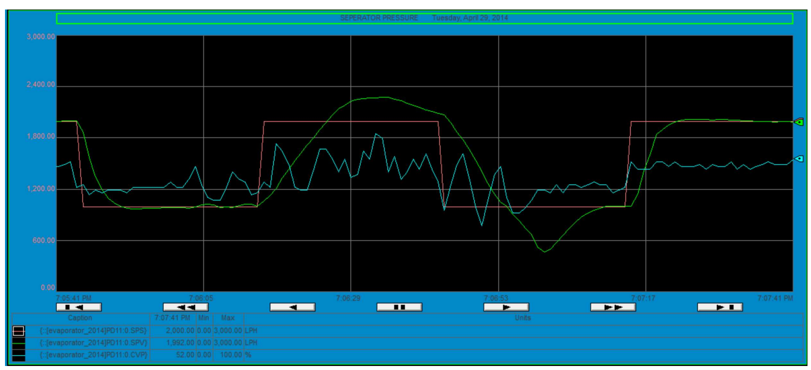


Figure 8.5: Tunning process with square wave.

alarms, displays, historical information, and other characteristics that define the process equipment.Function blocks are building blocks for creating the continuous and discrete algorithms that perform the control or monitoring for the process. The DeltaV Library contains function block templates for analog control (bias/gain, lead/lag, PID, etc.), Logical, I/O (analog and discrete input/output), and other basic functions. Each function block contains parameters that can be modified to customize the algorithm. Algorithms range from simple input conversions to complex control strategies. Function blocks can be combined into composite function blocks to build complex algorithms.

- Collecting Displaying Data
  The DeltaV system supports the collection of user-specified parameter field values and alarms and events for long-term storage, retrieval, and presentation. There are three main aspects of continuous data collection and presentation:
  - Detection by defining history collection in the modules and nodes
  - Storage by the Continuous Historian subsystem
  - Presentation through the Process History View application

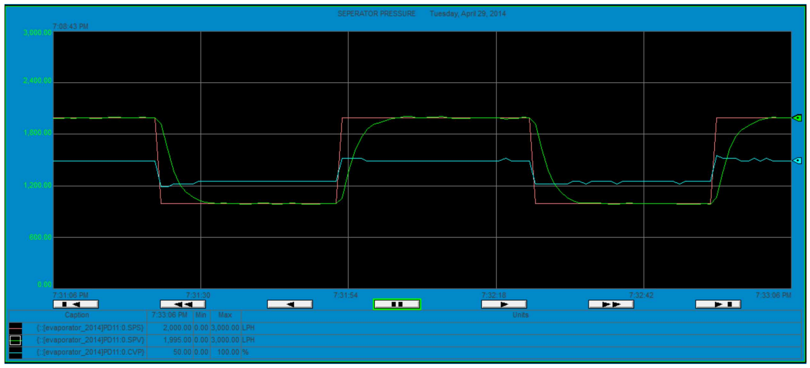


Figure 8.6: A tunned PID response for Square waveform when set point is varied between 1000 and 2000lph

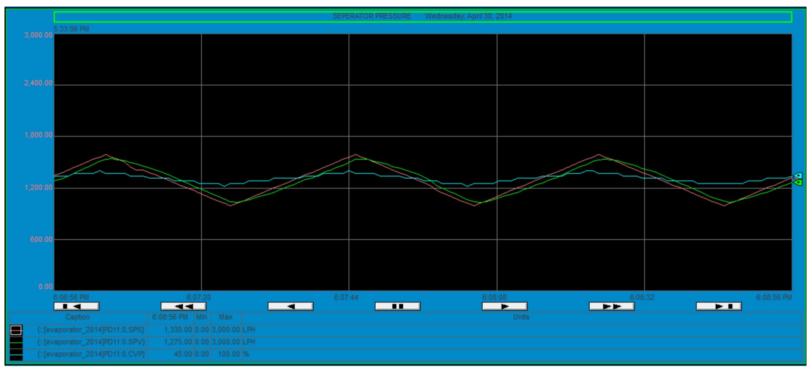


Figure 8.7: A tunned PID response for ramp waveform when set point is varied between 1000 and 1500 lph

The DeltaV system also lets you export data to the Microsoft Excel spreadsheet software so that you can use that application's extensive analysis and reporting features.

- Operator Picture
  Delta V Operate in configure mode to create an operator picture for the process system.It is important to understand the operating environment for a Delta V process system before we start creating pictures to be used in that environment. The Delta V Operate application functions in two modes

  1. Configure mode used to create pictures
  2. Run mode used to run pictures in the Delta V Operate application

8.4.2 Areas and Control Modules in Delta-V DCS for Evaporator Plant

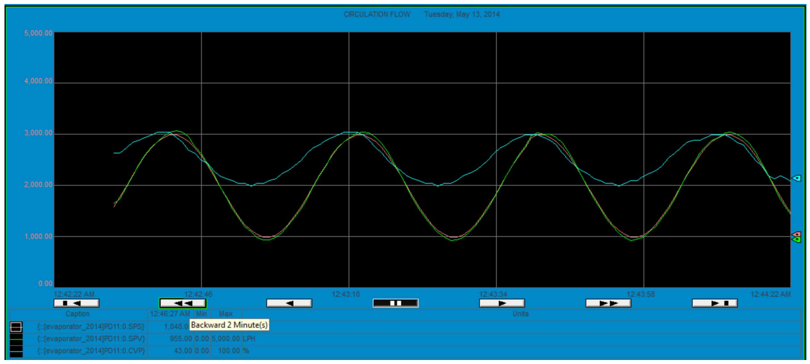


Figure 8.8: A tunned PID response for sine waveform whenset point is varied between 1000 and 3000lph

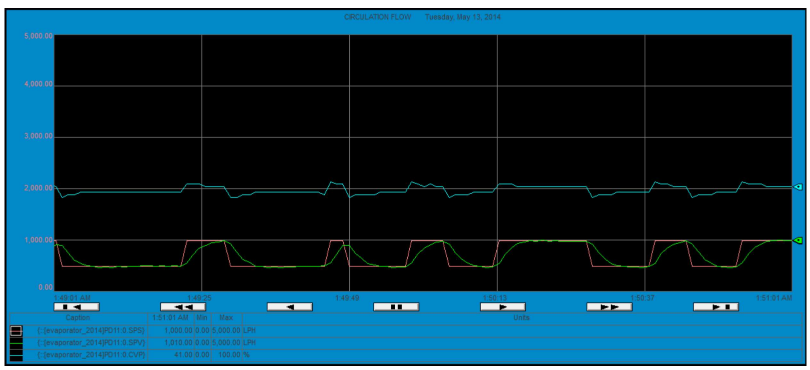


Figure 8.9: A tunned PID response for PRBS waveform when set point is varied between 500 and 1000lph

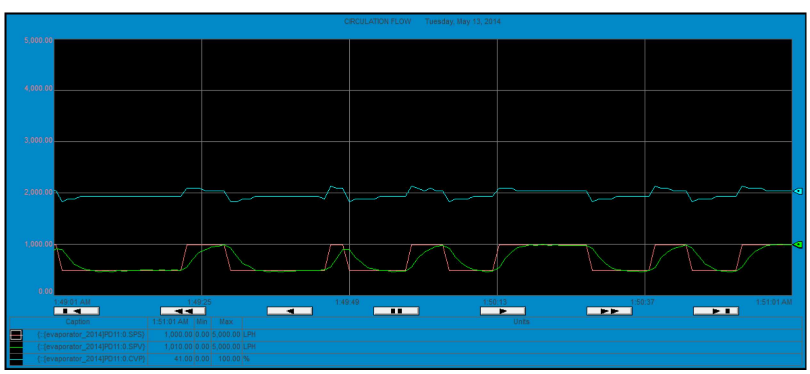


Figure 8.10: A tunned PID response for PRBS waveform, when setpoint is varied between 500 and 1000lph

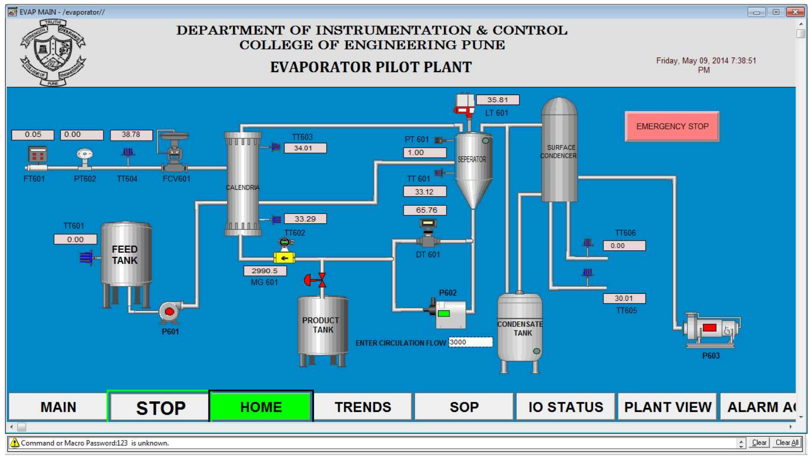


Figure 8.11: Evaporator main screen SCADA in local domain

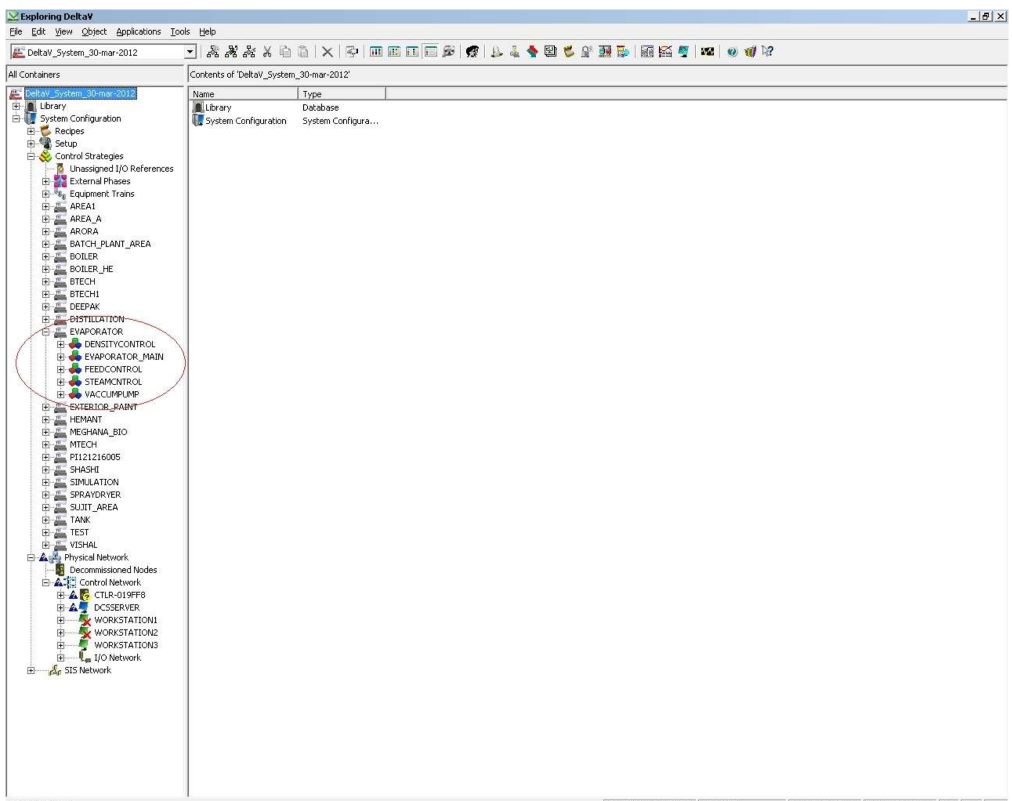


Figure 8.12: Area for Evaporator Plant in Delta-V Explorer

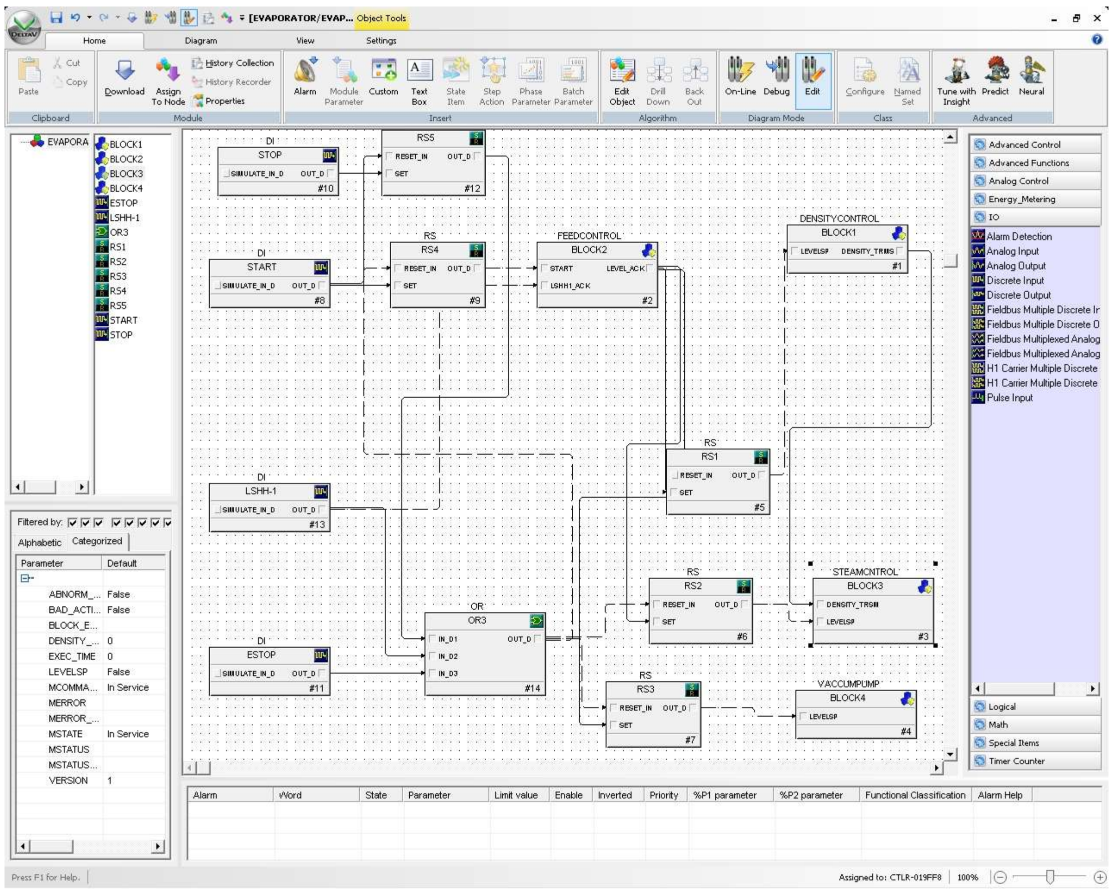


Figure 8.13: Evaporator Main module in Control Studio, Delta-V DCS

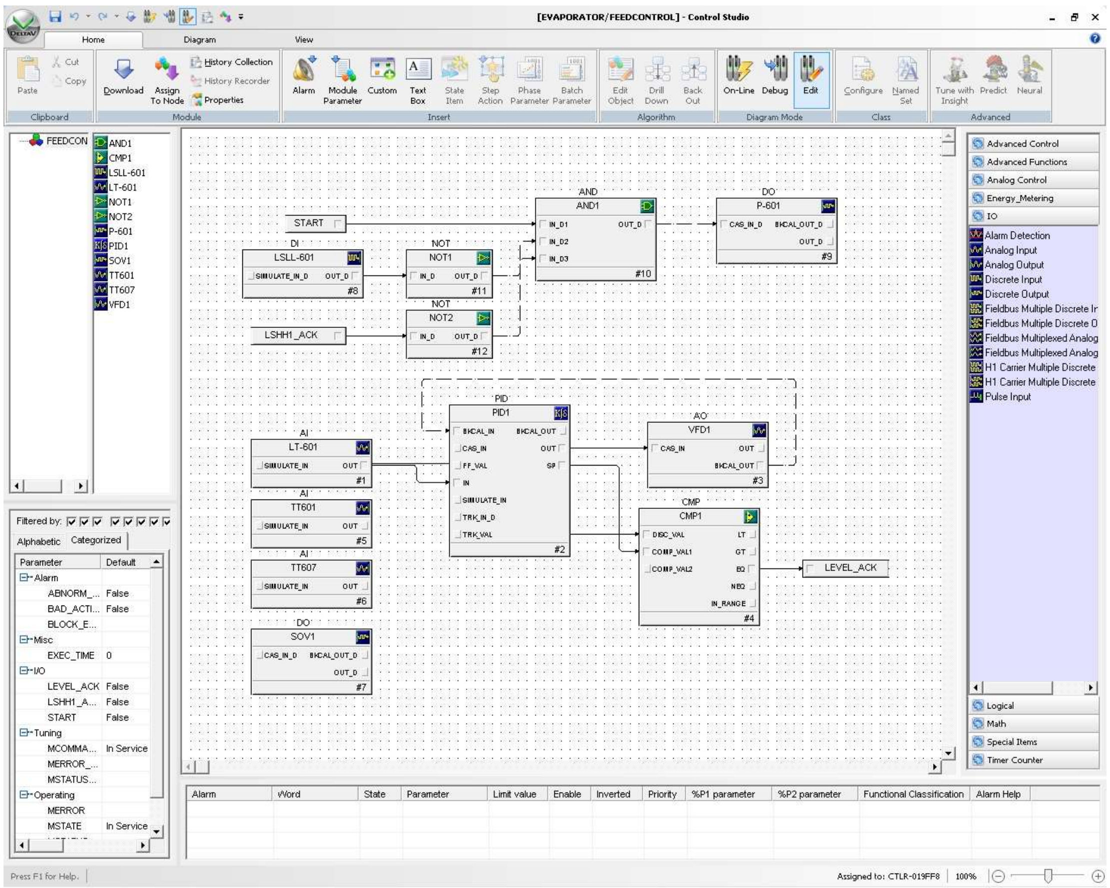


Figure 8.14: Seperator feed Control module of Evaporator Pilot Plant In Control Studio Delta-V DCS

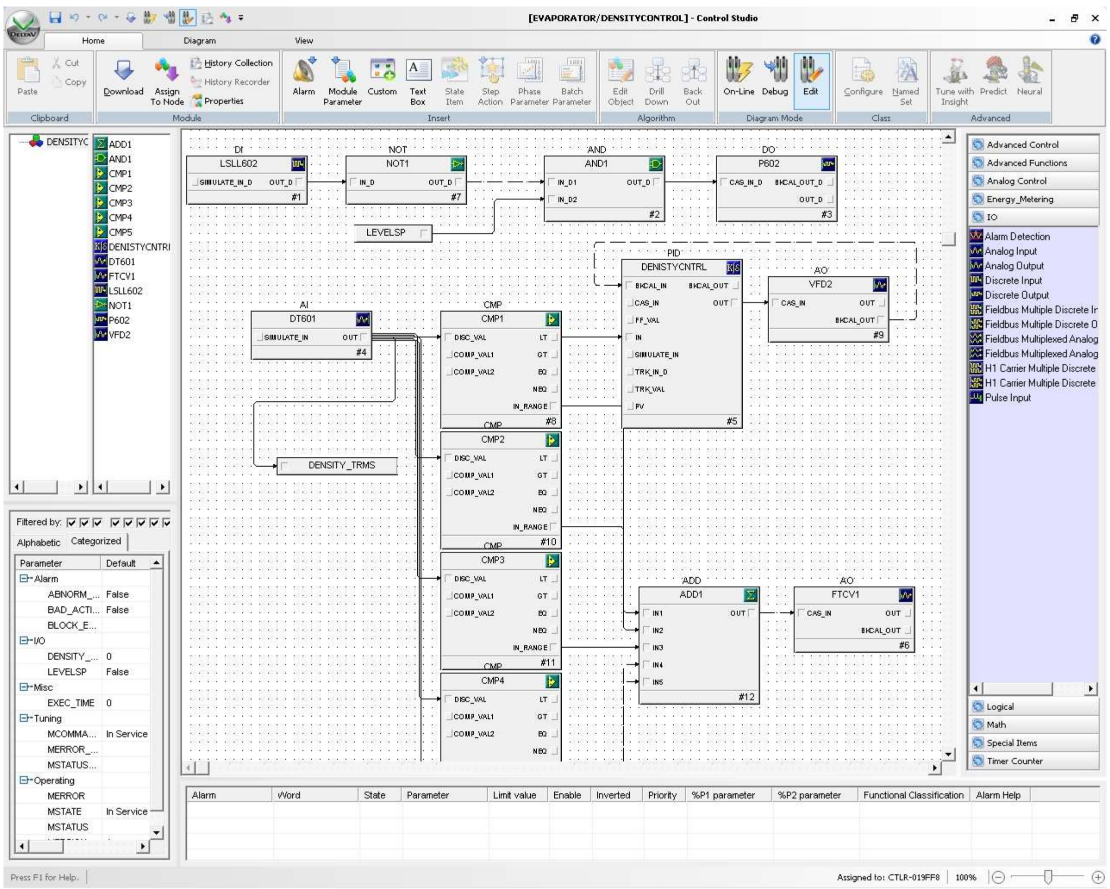


Figure 8.15: Density control module of Evaporator Pilot Plant In Control Studio Delta-V DCS

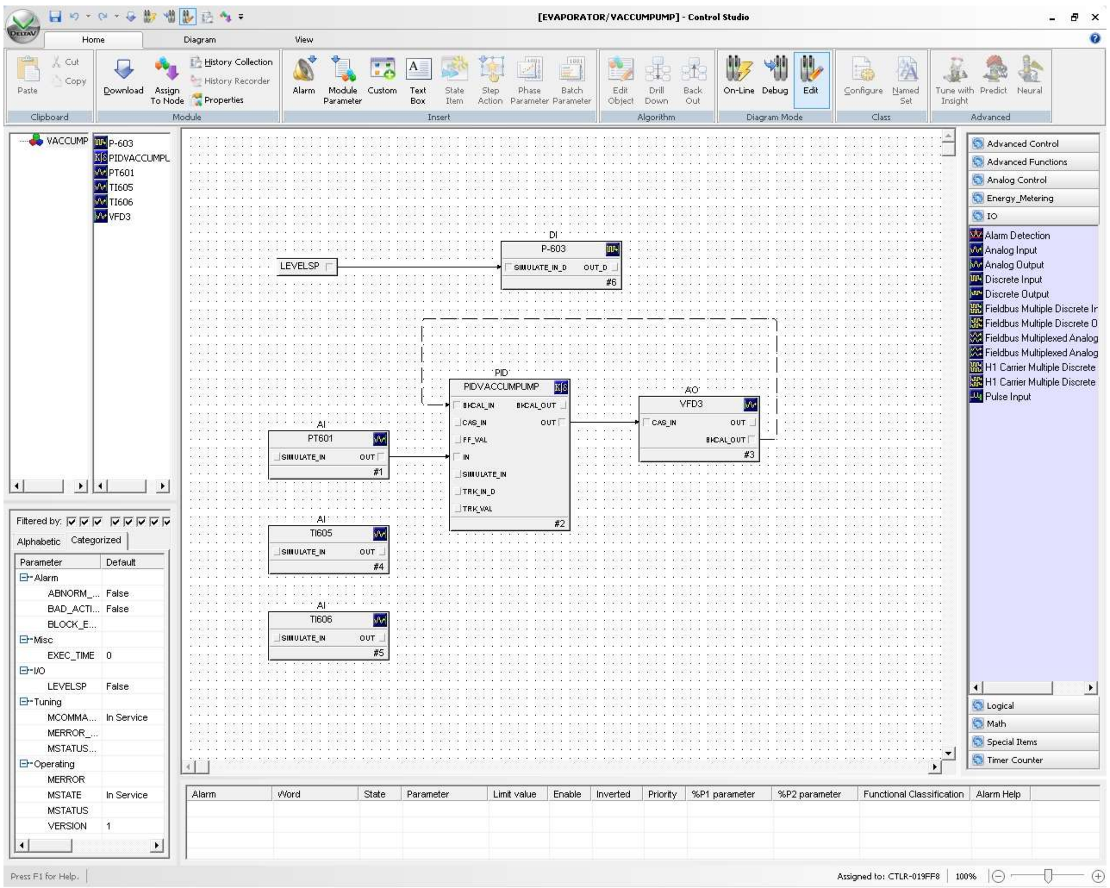


Figure 8.16: Vacuum pump speed control module of Evaporator Pilot Plant In Control Studio Delta-V DCS

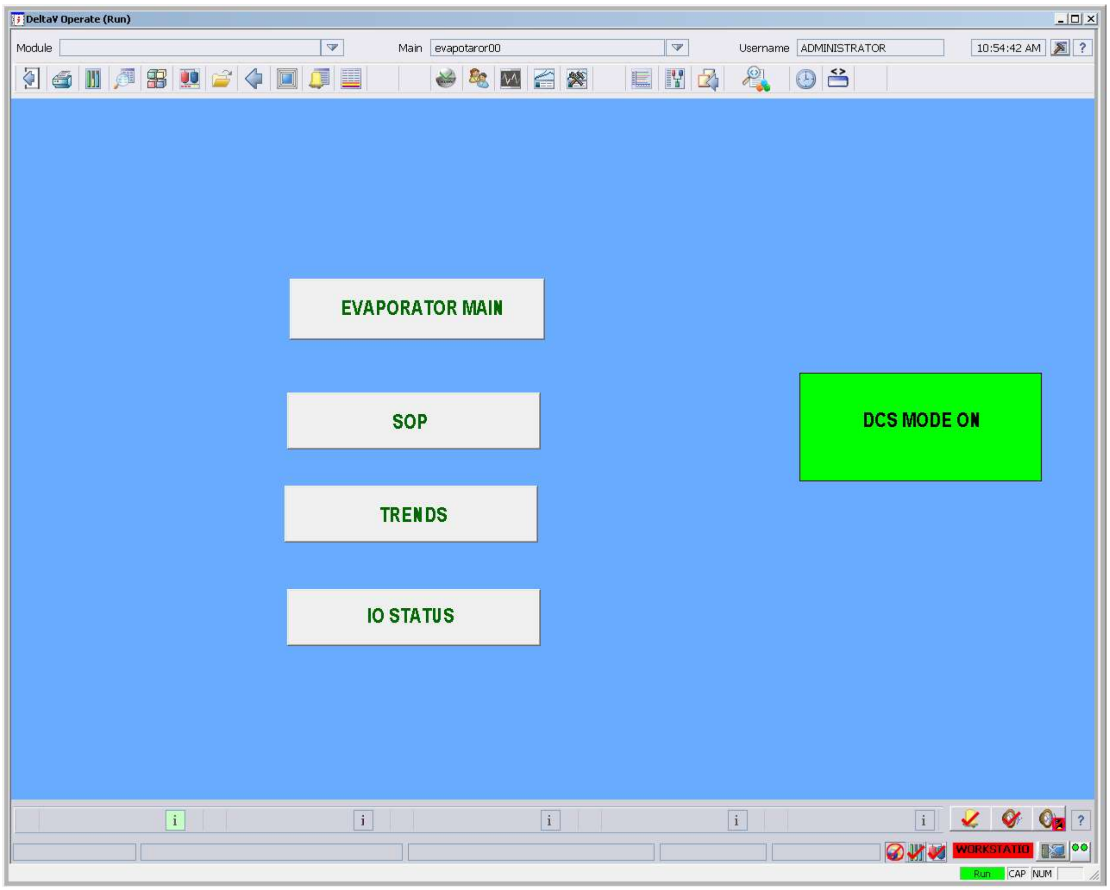


Figure 8.17: Home SCADA for Evaporator Pilot Plant in Delta-V DCS

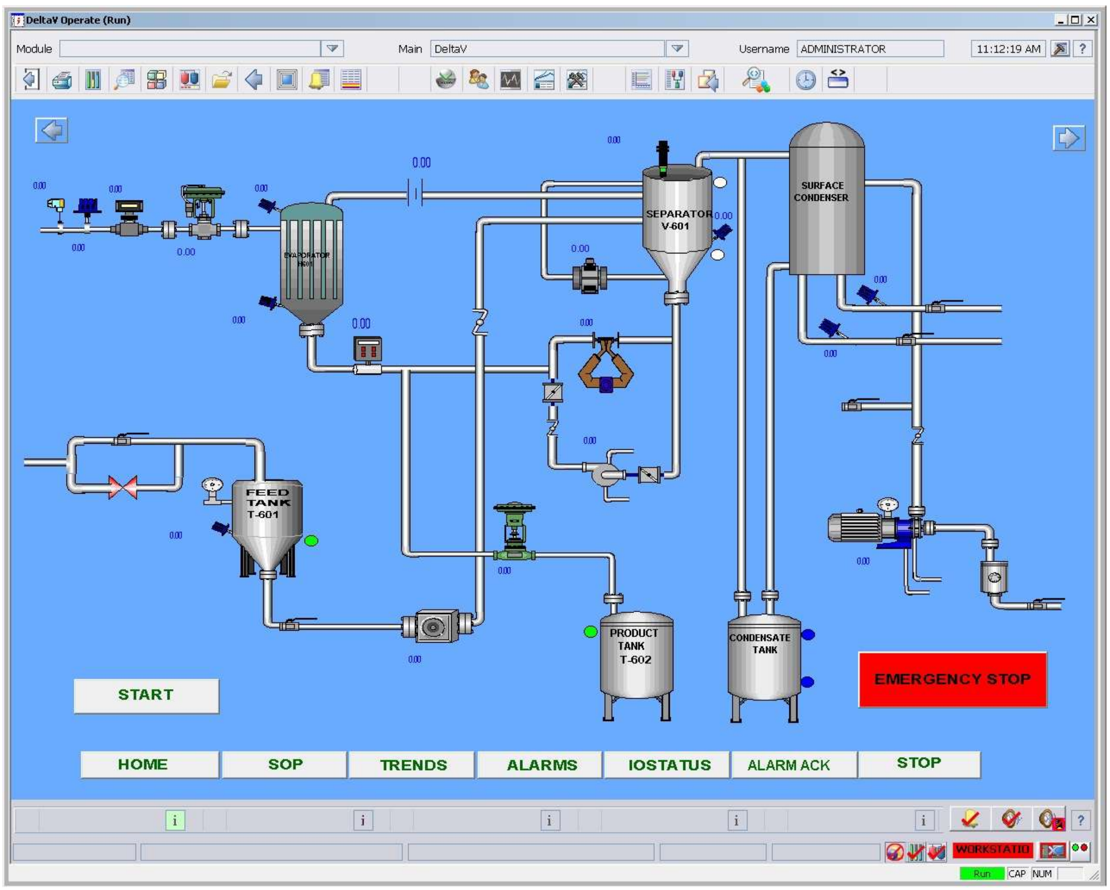


Figure 8.18: Main SCADA for Evaporator Pilot Plant in Delta-V DCS

Part III

communication

Chapter 9

Communication With Remote Domains

In this chapter we will discuss, how networking is done so that user can have multiple options to control. Local PLC provided two serial ports (one with RS232 compatible and other RS232/485) and Ethernet port utilizing Modbus and Ethernet IP protocols. We communicate Local Workstation PC (where MAT LAB and server for VPLC and VDCS resides) and local PLC with Modbus RTU RS232 serial protocol. Our objective is to run all the plants simultaneously from the DCS, for that we implemented daisy chaining using Modbus RTU 485 (Station ID for boiler & heat exchanger plant is 1). Contrologix PLC is connected with Ethernet IP protocol with the local machine as they are of same make . Communication for each end is explained briefly in different sections.

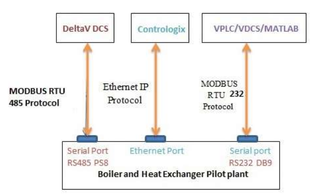


Figure 9.1: Communication Topology

9.1 Modbus RTU Protocol

Modbus Protocol is a messaging structure developed by Modicon in 1979. It is used to establish master-slave/client-server communication between intelligent devices. It is an open, serial (RS-232 or RS-485) protocol derived from the Master/Slave architecture. It is a widely accepted protocol due to its ease of use and reliability. Modbus RTU is widely used within

Building Management Systems (BMS) and Industrial Automation Systems (IAS). This wide acceptance is due in large part to MODBUS RTUs ease of use.

Modbus is considered an application layer messaging protocol, providing Master/Slave communication between devices connected together through buses or networks. On the OSI model, Modbus is positioned at level 7. Modbus is intended to be a request/reply protocol and delivers services specified by function codes. The function codes of Modbus are elements of Modbus request/reply PDUs (Protocol Data Unit).

The function code

eld of a MODBUS data unit is coded in one byte. Valid codes are in the range of 1 ... 255 decimal (128 255 reserved for exception responses). When a message is sent from a Client to a Server device the function code field tells the server what kind of action to perform. Function code "0" is not valid. For Establishing the communication we have to

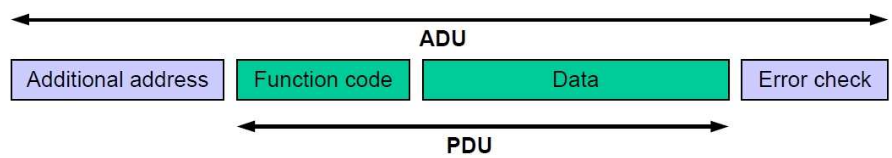


Figure 9.2: Data Packet Format

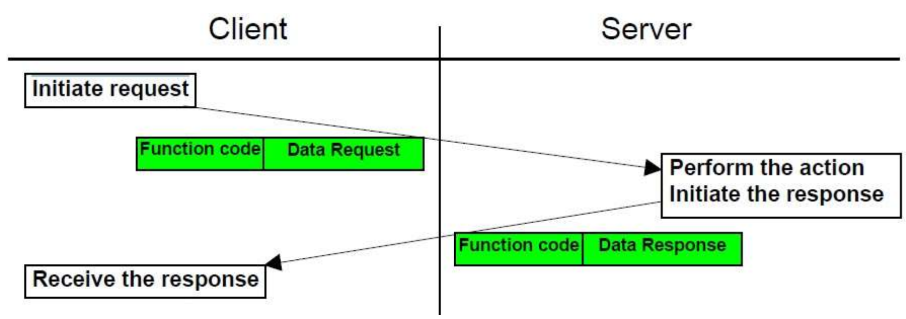


Figure 9.3: Server Client Communication

configure the channel setting in local PLC as shown in fig 9.5 for DCS & fig 9.7 for Virtual Lab/MATLAB. We created independent subroutine for each remote location so that when we select a specific remote location such as DCS by using hard switch the corresponding subroutine is enabled and executed .These subroutine in local logic for remote location will consists of only move instruction so that the remote terminals are able to access the input data, execute their logic and write the output data in the same subroutine.

In short when in remote domain the local PLC is not executing any logic but bypasses the input and output. At the same time the critical interlocks are taken care by hardware interlock as well so that we are not compromising any safety related issues.

We communicated MATLAB to Local PLC Micrologix 1400, with Modbus RTU protocol with RS232. For that, we used instructions like fread('name of com port') , fwrite('name of com port') to read and write from a slave PLC. For this, user has to configure port for settings shown in table, For example, code in MATLAB will be like following,

```
s=serial('COM1');
set(s,'BaudRate',19200)
set(s,'Timeout',0.1)
get(s)
```

fopen(s); this opens the port
fcloses; this opens the port
To access any process value, user have to generate PDU, (for that dedicated functions are written in MATLAB as shown in appendix D). To read gen-Pdu-read("MODBUS address") is used where to write gen-pdu-write("MODBUS address","value to be written") Thus we can have write or read operation on PLC with MATLAB.

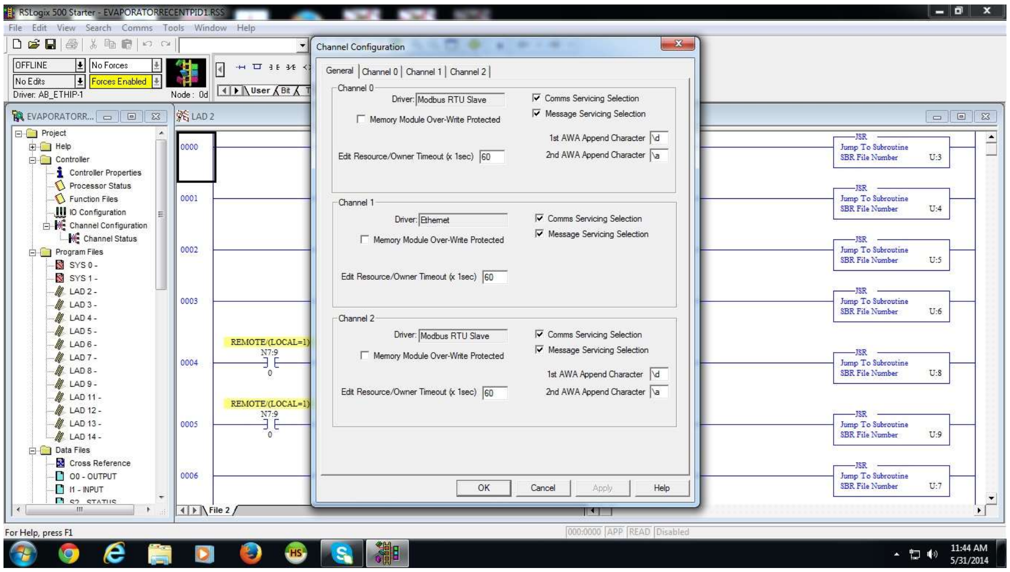


Figure 9.4: Channel configuration Genera1 in Micrologix 1400

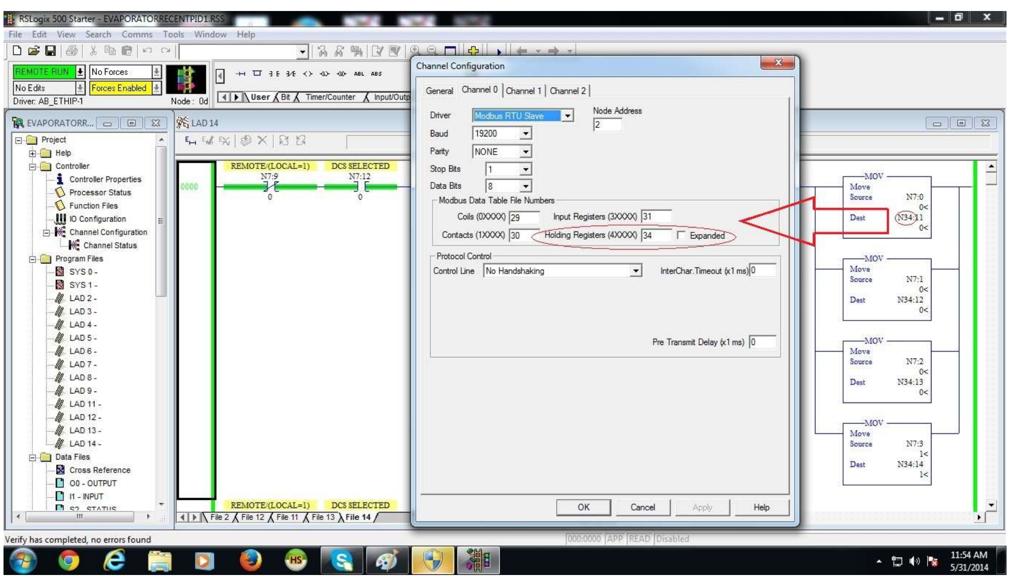


Figure 9.5: Channel configuration, channel 0 for DCS in Micrologix 1400

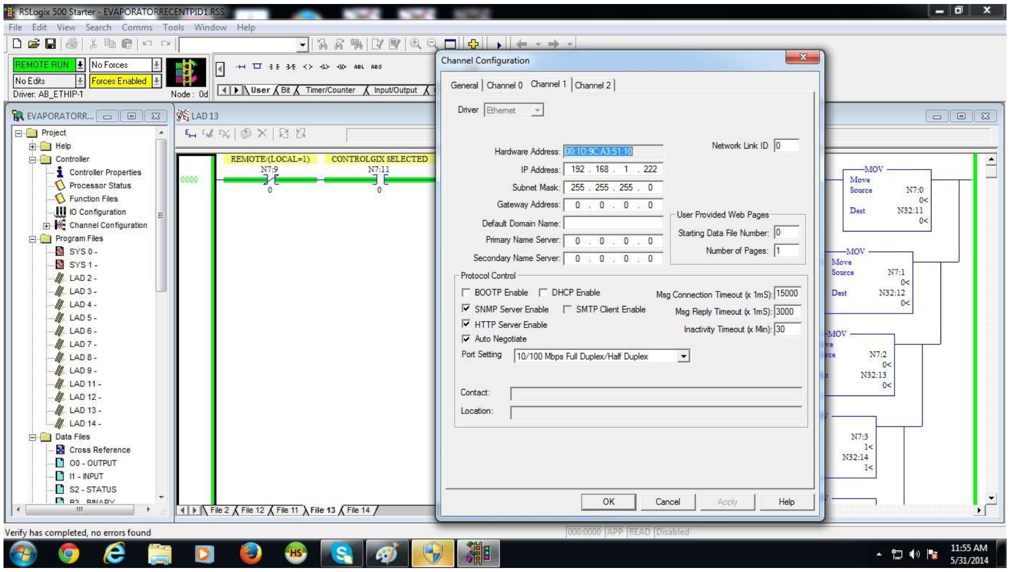


Figure 9.6: Channel configuration, channel 1 for Ethernet in Micrologix 1400

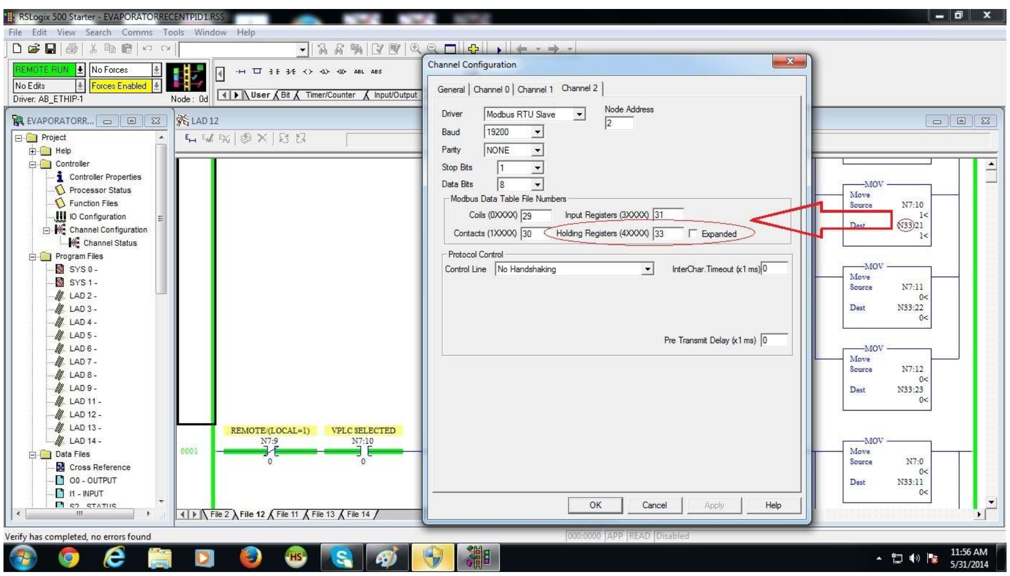


Figure 9.7: Channel configuration, channel 2 for Virtual Lab/MATLAB in Micrologix 1400

9.2 Contrologix PLC series 1756-L61 Communication Procedure

We are utilizing Contrologix Ethernet/IP module for communication with Micrologix 1400, with network defined by IP address of 192.168.1.xxx with subnet mask of 255.255.0.0. We have assigned an IP to Micrologix 1400 as 192.168.1.22x as static IP so that contrologix and micrologix will come in same network. Using RSLinx (v2.57.00) we add the node or slave

Micrologix 1400.We exchange data using messaging instruction in RSLogix5000. In ladder we add MSG instruction where we define from which register data is fetched from micrologix 1400 and new data file is defined with name SLC-AI[i] , SLC-AO[j] , SLC-DI[k] & SLC-DO[l] as array, where i,j,k,l represents the number of analog inputs,analog outputs,digital inputs & digital outputs respectively. Steps for messaging are shown as in figure(9.8 to 9.10). After downloading the main routine we can see the real time value in programming tags.

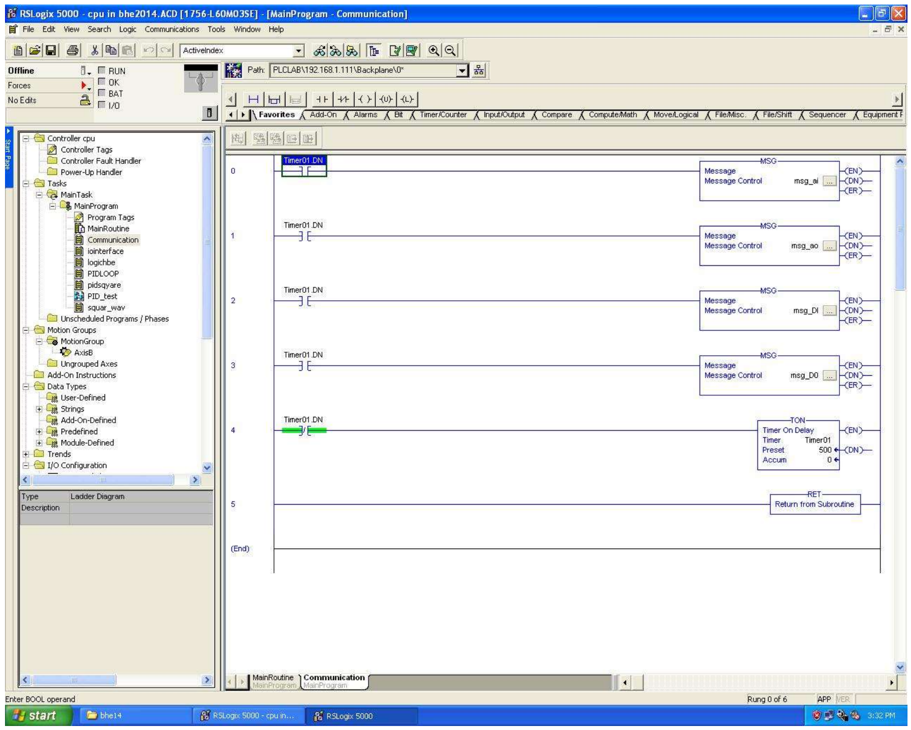


Figure 9.8: Communication subroutine in Contrologix 1756-L61

9.3 Delta V DCS Communication Procedure

We are utilizing the serial card Delta V DCS for our goal of daisy chaining. The standard Delta V Serial card supports serial devices that uses Mdbus RTU or ASCII protocol. The programmable serial card supports custom protocols. Both cards communicate through RS232, RS 422/485 full duplex signals. The serial card support both master and slave modes of communications. Master mode is normally used to communicate wit a PLC or other third party device supporting Modbus protocol. We are configuring the ports as master. The card is capable of emulating up to 16 slave devices on each port. we have to configure the device on the port and set them to different slave addresses.

9.4 Configuring Serial card

The serial card is one of the card type in the Delta V Explorer. Each serial card has two ports. Each port can support 16 serial devices. Once the serial card is configured we can set the serial port properties and add serial devices to the ports.

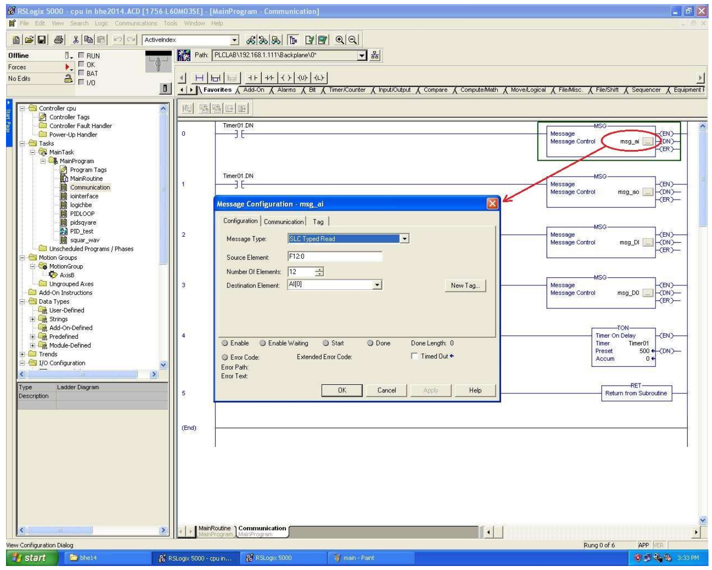


Figure 9.9: Message Instruction configuration for read operation in Contrologix 1756-L61

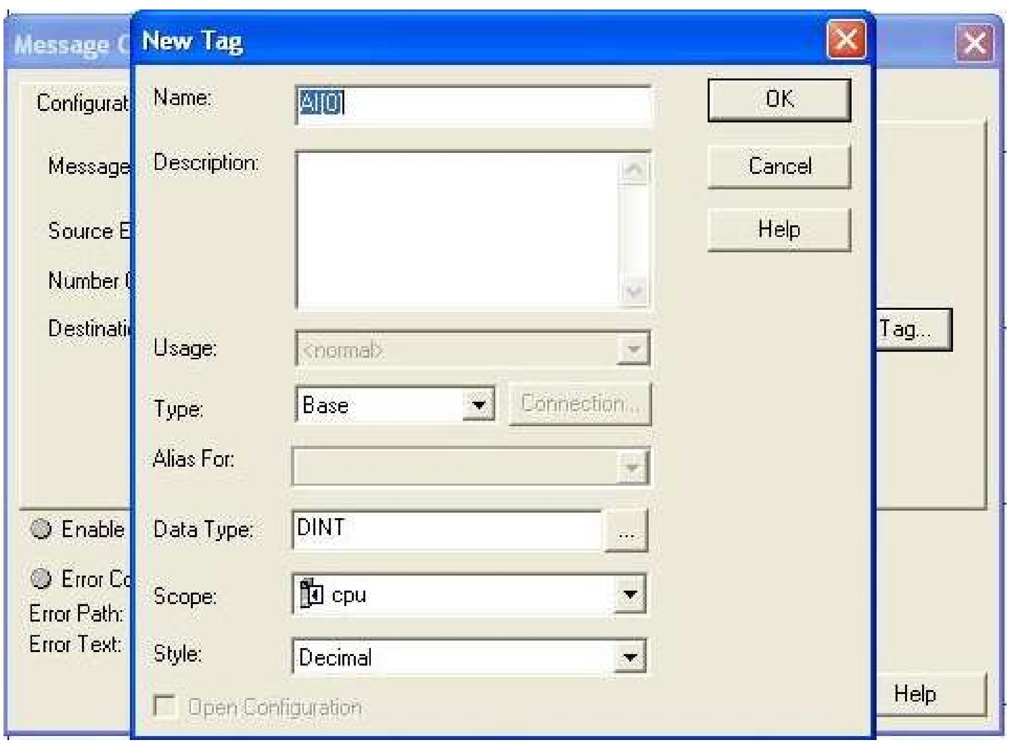


Figure 9.10: Message Instruction configuration (creating arrays in Contrologix 1756-L61

9.4.1 Configuring a Serial Device

To set a port to a specific modbus address, configure a device on the port and set the device address to the desired slave address. The DeltaV Explorer help provides step-by-

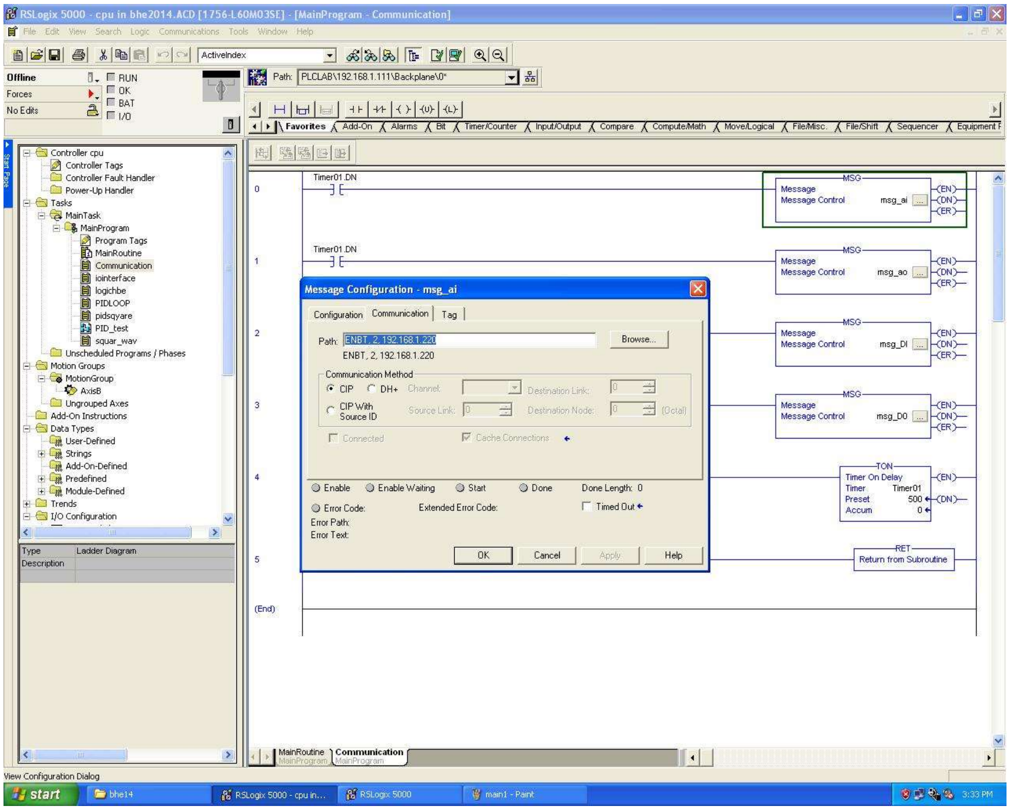


Figure 9.11: Message Instruction configuration (creating arrays in Contrologix 1756-L61

step instructions for adding serial devices. For example, the following steps describe how to configure two serial devices (a multi-port configuration) connected to port 1 of a serial card. Select port 1 (PO1) of the serial card. Right-click and select New Serial device. Set the device address to match the address of the physical device connected to the serial card. Repeat steps 1 through 3 for the second device. Set the address of the second device to match the address of the physical device connected to the serial card Download card 7 to complete your procedure.

9.4.2 Configuring a Dataset

In master mode, the Serial Card exchanges data with the serial device through a dataset. A dataset is a collection of parameters associated with a serial device. The parameters in the dataset hold data values that correspond to registers or data in a serial device. The dataset defines the type and amount of data being sent to or received from the serial device. All the data values for a dataset have the same properties. Properties include the data type, data direction, and so on. The data values in a dataset map to a contiguous series of serial device registers or data. **For example, the user needs a dataset with the following parameter values:**

- Output mode: Output
- DeltaV datatype: 16 bit uint with status
- PLC datatype: holding registers

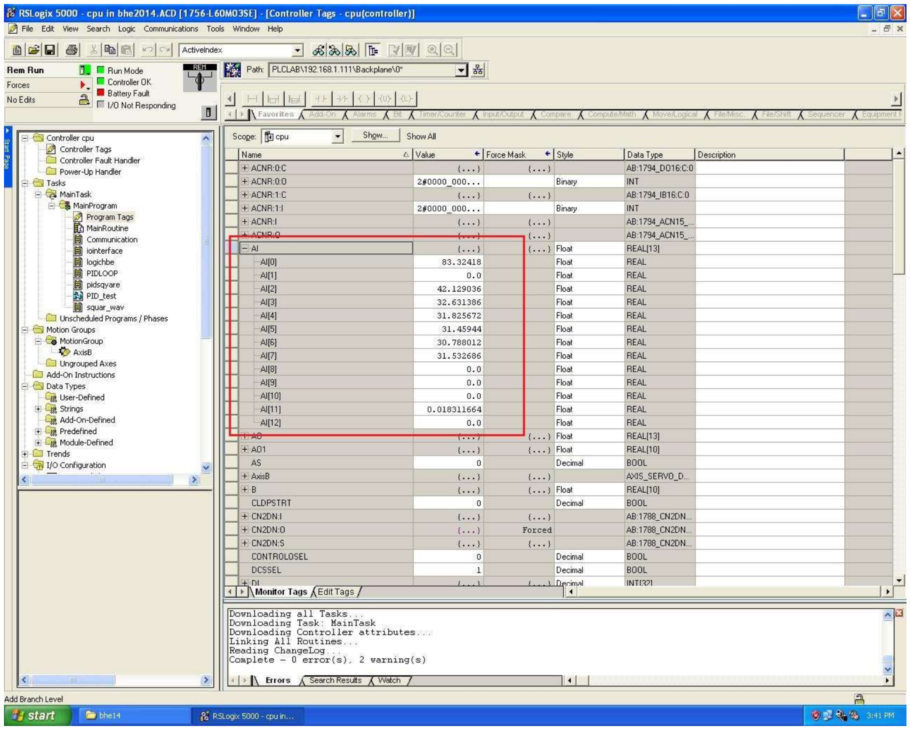


Figure 9.12: Online values from the field after succesfull communication in Contrologix 1756-L61

- PLC offset: 19
- Number of values: 13

The following steps describe how to configure the values:

- Select the device (for example, Dev01 under port PO1).
- Right click and select New Dataset.
- On the General tab select output in the Data direction field.
- On DeltaV tab select Floating point with status in the DeltaV data type field.
- On PLC tab select holding registers and set Number of values.

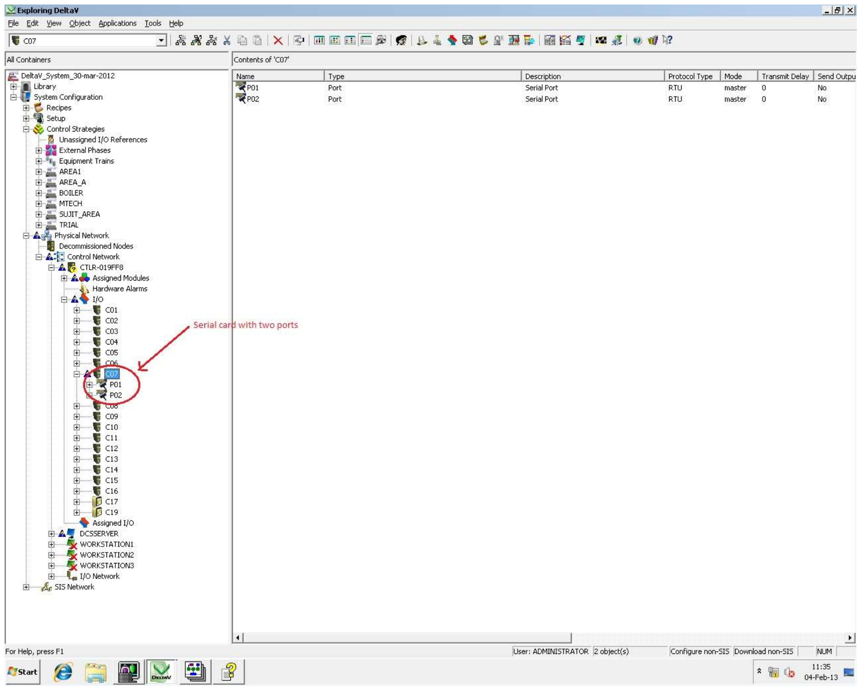


Figure 9.13: Delta V Explorer showing serial card 7 with two ports

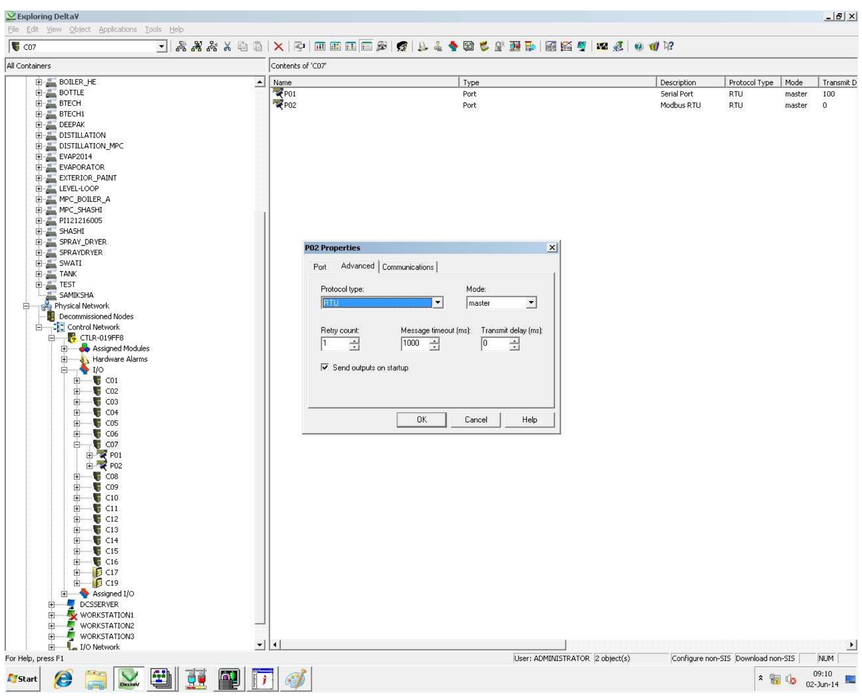


Figure 9.14: Delta V Explorer configuring ports

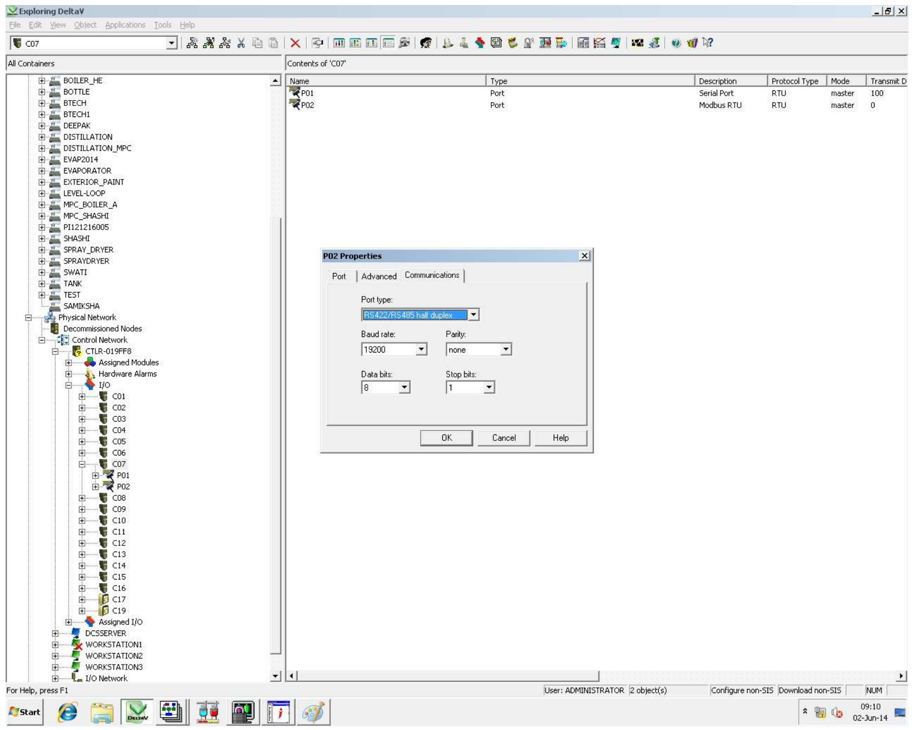


Figure 9.15: Delta V Explorer configuring ports

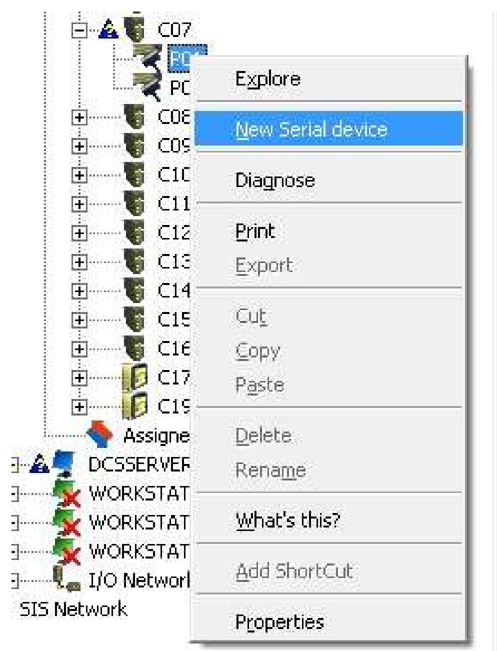


Figure 9.16: Delta V Explorer adding serial device

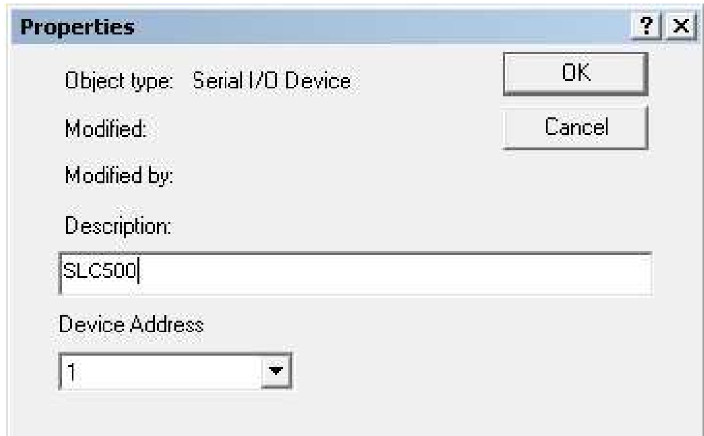


Figure 9.17: Delta V Explorer adding serial device

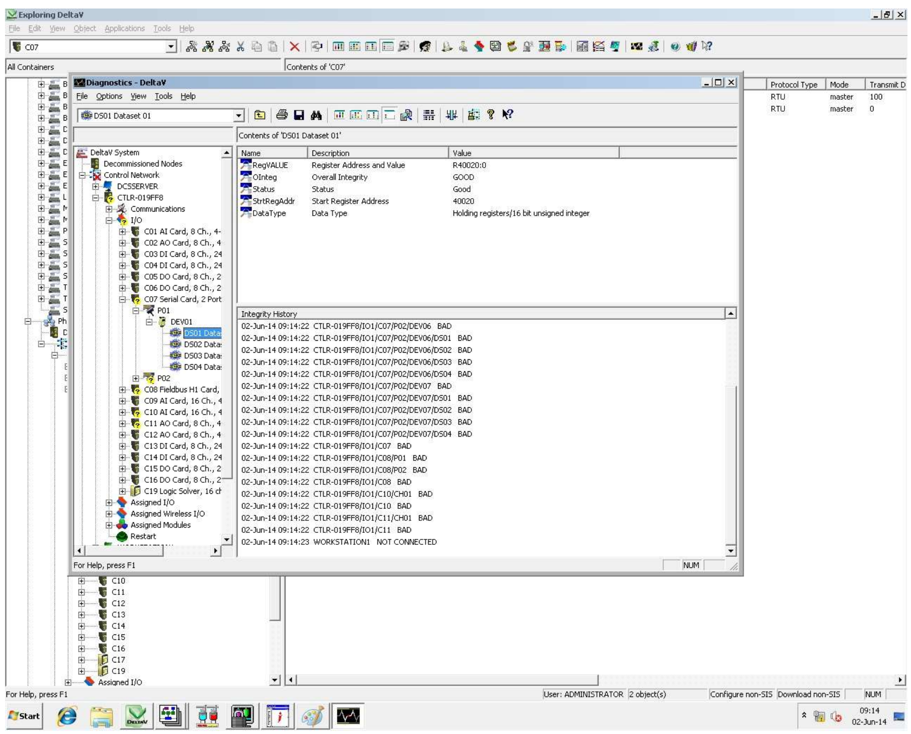


Figure 9.18: Delta V data diagnosing tool

9.4.3 Conclusion

Once the communication is established select the particular device, right click and select diagnose to open Delta V Diagnose tool. If the communication is proper it will show all the register value status as good. If it it showing connection BAD or Device failure the we have to trouble shoot our communication procedure. If you click on register values in diagnosis screen you can see the online values after successful communication. All the related

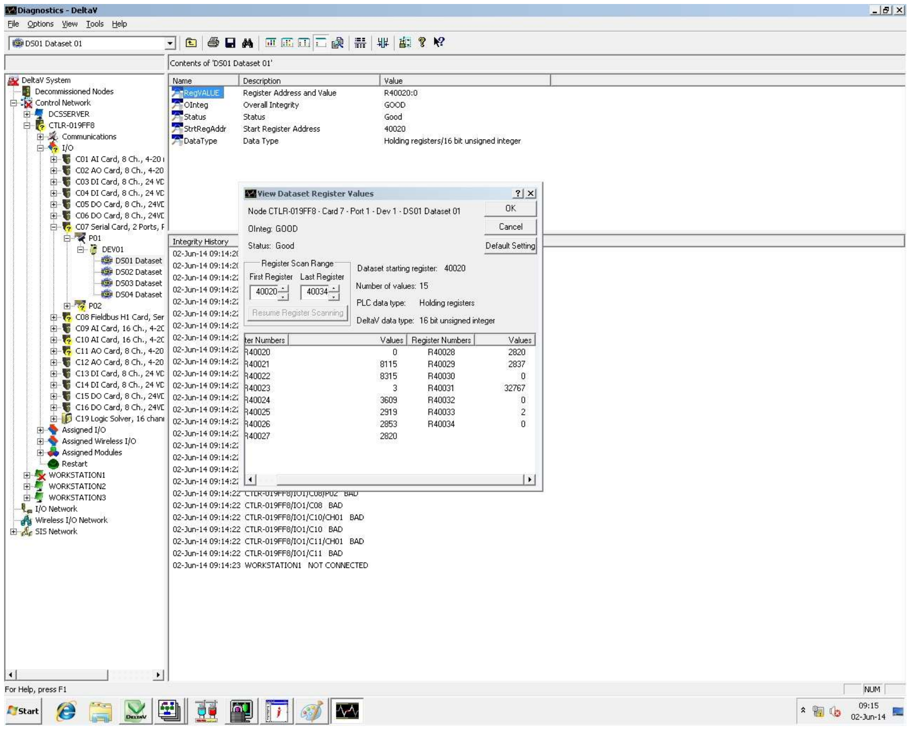


Figure 9.19: Delta V diagnosing tool shows online data after successful communication

Figure 9.20: RS 232 to 485 converter

procedures are shown in the figures.

We communicate Micrologix 1400 PLC in modbus RTU 485 using 8 PIN MINI DIN.Thogh this port is 485 compatible it is recommended to use a converter. So we used a 232 to 485 converter.The converter device used is shown in figure 9.20

Since the Boiler, Heat exchanger & Evaporator Plant have local PLC as Micrologix 1400. The communication procedure is same for all the devices. hence this chapter is common for both the plants

Chapter 10

Resultant Discussion

10.1 overview

The Pilot plants were erected commissioned and tested. All pilot plants were fully automated from various domains, developed SCADA for the same in all domains. Focused on control strategies simple PID , Cascade Control, 3 element control for boiler which helps to enhance the performance of pilot plants

10.2 Advantages of MPC

The implementation and commissioning of the MPC function block are far simpler and faster than traditional techniques such as cascade,feed forward etc in DCS domain.The difference is even more dramatic for applications involving a larger number of controlled, constraint, or disturbance parameters or the optimization of throughput.Applications that may benefit from MPC control can be identified based on application. It is best suited for the following applications.

- Single or multiple loop control that is characterized by either long delay or inverse process response. Since the control action taken by an MPC function block is based on a process response model, we can achieve better control than would be possible with PID feedback control or dead time compensation techniques, such as the Smith Predictor. The response model used by MPC is determined by the Predict application during commissioning
- The interaction of two or more control loops impact process operation (that is, a change in the output of one control loop impacts the control parameter of the other control loops in a significant manner). Such interaction is accounted for when control action is taken by the MPC function block. Therefore, control may be improved since any correction that is taken to adjust one control parameter only impacts that parameter.
- One or more disturbances to any controlled parameters are measured. By including these measurements in the control, the MPC function block compensates for the impact of disturbances. As such, changes in the disturbance input have little or no impact on the controlled parameters.
- One or more measurable constraints must be observed in control of the process. The MPC function block constantly calculates the impact of a disturbance or control action on constraint parameters. If the future value of a constraint output violates its limit,

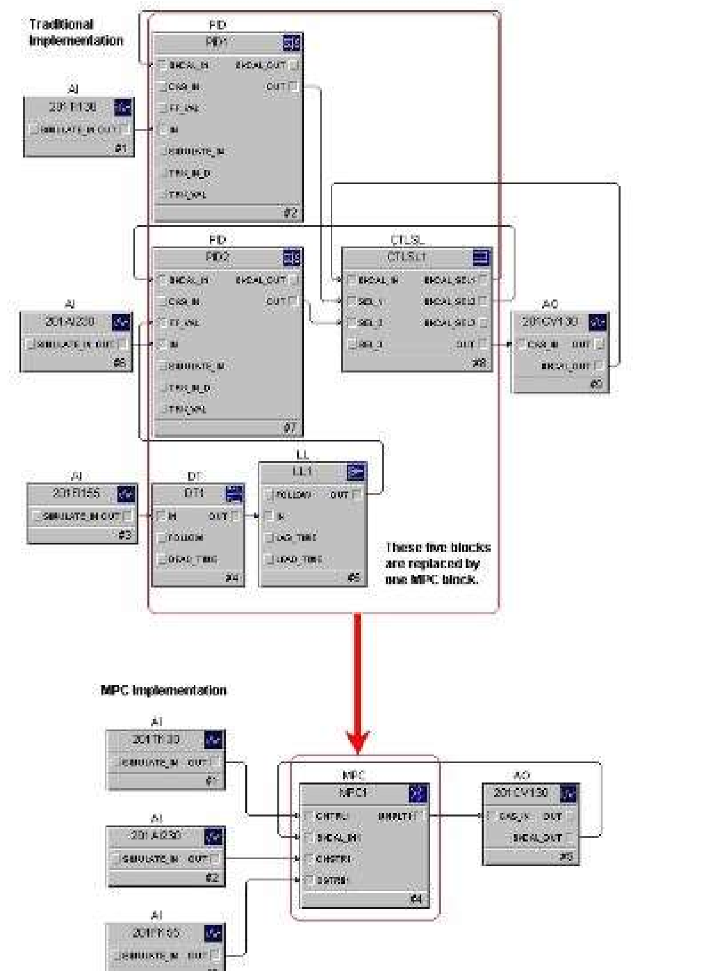


Figure 10.1: Comaprison of MPC with traditional Control

MPC takes the appropriate action to prevent the constraint limit from being violated.

- Production is limited by one or more inputs to a process. Control of the throughput may be included in the MPC along with the control associated with the inputs that limit production. Throughput is adjusted to maintain the process at its input limit and achieve maximum production

The execution rate of the MPC function block is limited to one second or slower. Therefore, MPC should be applied to processes where control requirements may be satisfied at these execution speeds.

10.3 Conclusion

Concluding the project by making the pilot plant fully functional and automatic. This project will help the future engineering aspirants a better practical way to understand and analyze various engineering problems and explore their potential to solve them. The MATLAB interfacing with PLC will surely help the students not only to come out with just simulation results but help them to compare with practical results as well. The communication of pilot plant through Virtual Lab helps the enthusiastic students around the world with minimum practical resources to understand the process by making avail our user friendly virtual PLC and DCS and can visualize and feel the real industrial environment through online cameras. The testing process of PID by using various waveforms mentioned in chapter 8 is implemented in our Virtual LAB so as to provide a platform to learn PID tunning for non integrating processes.

Part IV

Appendix

Appendix A

IO Details Of Boiler And Heat Exchanger

				Address				Switch selection		
Type	Sr.No	Parameter Discription	Tag	Modbus	Micrologix1400	RSLogix500	RSLogix500_RT	RSLogix5000	VPLC/VDCS	DCS
AI	1	BOILER LEVEL TX.	LT-1	40011	I:1:0	F8:24	F12:0	SLC_AI 0	N24:10	F11:0
	2	BOILER PRESSURE TX.	PT-1	40012	I:1:1	F8:29	F12:1	SLC_AI 1	N24:11	F11:1
	3	BOILER TEMPERATURE TX.1	TT-1	40013	I:1:2	F8:34	F12:2	SLC_AI 2	N24:12	F11:2
	4	STEAM TEMPERATURE TX.2	TT-2	40014	I:1:3	F8:39	F12:3	SLC_AI 3	N24:13	F11:3
	5	O/L TEMPERATURE TX.3	TT-3	40015	I:2:0	F8:44	F12:4	SLC_AI 4	N24:14	F11:4
	6	COLD WATER TEMPERATURE TX.4	TT-4	40016	I:2:1	F8:49	F12:5	SLC_AI 5	N24:15	F11:5
	7	HOT WATER TEMPERATURE TX.5	TT-5	40017	I:2:2	F8:54	F12:6	SLC_AI 6	N24:16	F11:6
	8	FEED WATER TEMPERATURE TX.6	TT-6	40018	I:2:3	F8:59	F12:7	SLC_AI 7	N24:17	F11:7
	9	VORTEX FLOW METER (STEAM FLOW)	FT3	40019	I:3:0	F8:64	F12:8	SLC_AI 8	N24:18	F11:8
	10	ELECTROMAGNETIC FLOW METER (CONDENSATE FLOW)	FT2	40020	I:3:1	F8:69	F12:9	SLC_AI 9	N24:19	F11:9
	11	POSITIVE DISP. PUMP WITH IN BUILT RPM METER (FEED FLOW)	FT1	40021	I:3:2	F8:74	F12:10	SLC_AI 10	N24:20	F11:10
	12	3 PHASE ENERGY METER	3PEM	40022	I:3:3	F8:79	F12:11	SLC_AI 11	N24:21	F11:11
	13	SPARE	SPARE	40023	-	-	-	-	-	-
	14	SPARE	SPARE	40024	-	-	-	-	-	-
	15	SPARE	SPARE	40025	-	-	-	-	-	-
	16	SPARE	SPARE	40026	-	-	-	-	-	-
	Sr.No	Parameter Discription	Tag	Modbus	Micrologix1400	RSLogix500	RSLogix500_RT	RSLogix5000	VPLC/VDCS	DCS
AO	1	VFD FOR BOILER FEED WATER PUMP	VFD 101	40031	O:0:4	F9:0	F12:30	SLC_A0 0	N24:31	F11:31
	2	VFD FOR COLD WATER PUMP	VFD 301	40032	O:0:5	F9:1	F12:31	SLC_A0 1	N24:32	F11:32
	3	SCR BASED FIRING RATE FOR HEATER MODULATION	SCR	40033	O:4:0	F9:2	F12:32	SLC_A0 2	N24:33	F11:33
	4	MODULATING SOLENOID VALVE-1	MSV 1	40034	O:4:1	F9:3	F12:33	SLC_A0 3	N24:34	F11:34
	5	MODULATING SOLENOID VALVE-2	MSV 2	40035	O:4:2	F9:4	F12:34	SLC_A0 4	N24:35	F11:35
	6	CONTROL VALVE FOR STEAM FLOW	FCV-1	40036	O:4:3	F9:5	F12:35	SLC_A0 5	N24:36	F11:36
	Sr.No	Parameter Discription	Tag	Modbus	Micrologix1400	RSLogix500	RSLogix500_RT	RSLogix5000	VPLC/VDCS	DCS
DI	1	BOILER DRUM LOW LEVEL SW	LSL-401	40041	I:0:0	N7:0	N30:41	SLC_DI 0	N24:41	N13:0
	2	BOILER DRUM HIGH TEMP. SW	TSH-401	40042	I:0:1	N7:1	N30:42	SLC_DI 1	N24:42	F11:42
	3	BOILER DRUM HIGH PRESSURE SW	PSH-401	40043	I:0:2	N7:2	N30:43	SLC_DI 2	N24:43	F11:43
	4	BOILER FD WTR TNK LOW LEVEL SW	LSL-101	40044	I:0:3	N7:3	N30:44	SLC_DI 3	N24:44	F11:44
	5	HOT WATER TANK HIGH LEVEL SW	LSH-201	40045	I:0:4	N7:4	N30:45	SLC_DI 4	N24:45	F11:45
	6	HOT WATER TANK LOW LEVEL SW	LSL-201	40046	I:0:5	N7:5	N30:46	SLC_DI 5	N24:46	F11:46
	7	COLD WATER TANK HIGH LEVEL SW	LSH-301	40047	I:0:6	N7:6	N30:47	SLC_DI 6	N24:47	F11:47
	8	COLD WATER TANK LOW LEVEL SW	LSL-301	40048	I:0:7	N7:7	N30:48	SLC_DI 7	N24:48	F11:48
	9	BOILER FEED WATER PUMP RUN FB	P101-R	40049	I:0:8	N7:8	N30:49	SLC_DI 8	N24:49	F11:49
	10	BOILER FEED WATER PUMP TRIP FB	P101-T	40050	I:0:9	N7:9	N30:50	SLC_DI 9	N24:50	F11:50
	11	COLD WATER PUMP RUN FB	P301-R	40051	I:0:10	N7:10	N30:51	SLC_DI 10	N24:51	F11:51
	12	COLD WATER PUMP TRIP FB	P301-T	40052	I:0:11	N7:11	N30:52	SLC_DI 11	N24:52	F11:52
	13	REMOTE/LOCAL SELECTOR SW	R/L	40053	I:0:12	N7:12	N30:53	SLC_DI 12	N24:53	F11:53
	14	VIRTUAL PLC SELECTED	VPLC SEL	40054	I:0:13	N7:13	N30:54	SLC_DI 13	N24:54	F11:54
	15	DCS SELECTED	DCS SEL	40055	I:0:14	N7:15	N30:56	SLC_DI 14	N24:55	F11:55
	16	CONTROLLOGIX SELECTED	CNTRL LGX SEL	40056	I:0:15	N7:14	N30:55	SLC_DI 15	N24:56	F11:56
	17	ACK PB	ACK	40057	I:0:16	N7:16	N30:57	SLC_DI 16	N24:57	F11:57
	18	SPARE	SPARE	40058	I:0:17	N7:17	N30:58	SLC_DI 17	N24:58	F11:58
	19	SPARE	SPARE	40059	I:0:18	N7:18	N30:59	SLC_DI 18	N24:59	F11:59
	20	SPARE	SPARE	40060	I:0:19	N7:19	N30:60	SLC_DI 19	N24:60	F11:60
	Sr.No	Parameter Discription	Tag	Modbus	Micrologix1400	RSLogix500	RSLogix500_RT	RSLogix5000	VPLC/VDCS	DCS
DO	1	FEED WATER PUMP START/STOP CMD	P-101	40072	O:0:0	N10:0	N30:71	SCL_DO 0	N24:71	F11:71
	2	COLD WATER PUMP START/STOP CMD	P-301	40073	O:0:1	N10:1	N30:72	SCL_DO 1	N24:72	F11:72
	3	HEATER ON/OFF CMD	HEATER	40074	O:0:2	N10:2	N30:73	SCL_DO 2	N24:73	F11:73
	4	HOT WATER TANK SOLENOID VALVE ON/OFF CMD	SOV-201	40075	O:0:3	N10:3	N30:74	SCL_DO 3	N24:74	F11:74
	5	HOOTER	HOOTER	40076	O:0:4	N10:4	N30:75	SCL_DO 4	N24:75	F11:75
	6	SPARE	SPARE	40077	O:0:5	N10:5	N30:76	SCL_DO 5	N24:76	F11:76
	7	SPARE	SPARE	40078	O:0:6	N10:6	N30:77	SCL_DO 6	N24:77	F11:77
	8	SPARE	SPARE	40079	O:0:7	N10:7	N30:78	SCL_DO 7	N24:78	F11:78
	9	SPARE	SPARE	40080	O:0:8	N10:8	N30:79	SCL_DO 8	N24:79	F11:79
	10	SPARE	SPARE	40081	O:0:9	N10:9	N30:80	SCL_DO 9	N24:80	F11:80
	11	SPARE	SPARE	40082	O:0:10	N10:10	N30:81	SCL_DO 10	N24:81	F11:81
	12	SPARE	SPARE	40083	O:0:11	N10:11	N30:82	SCL_DO 11	N24:82	F11:82

Figure A.1: IO details For Boiler And Heat Exchanger

Appendix B

IO Details Of Evaporator Pilot Plant

VPLC MODBUS LIST								
DIGITAL INPUT								
Sr. No.	DESCRIPTION	TAG NAME	MODBUS ADDRESS	Micrologix 1400	RsLogix 500	RsLogix 5000	DeltaV DCS	VPLC
1	Vibration Type Low Level Switch for Seperator(V-601)	LSLL	40011	I:0.0	N7:0.0	N32:11	N34:11	N33:11
2	Vibration Type High Level Switch for Seperator(V-601)	LSHH	40012	I:0.1	N7:1.0	N32:12	N34:12	N33:12
3	Vibration Type Low Level Switch for Feed Tank(T-601)	LSLL1	40013	I:0.2	N7:2.0	N32:13	N34:13	N33:13
4	Vibration Type High Level Switch for Product Tank	LSHH1	40014	I:0.3	N7:3.0	N32:14	N34:14	N33:14
5	Low Level Switch for Condensate Tank(T-602)	LSLL2	40015	I:0.4	N7:4.0	N32:15	N34:15	N33:15
6	High Level Switch for Condensate Tank(T-602)	LSHH2	40016	I:0.5	N7:5.0	N32:16	N34:16	N33:16
7	Peristaltic Pump Run Feedback	P-601-R	40017	I:0.6	N7:6.0	N32:17	N34:17	N33:17
8	Centrifugal Pump Run Feedback	P-602-R	40018	I:0.7	N7:7.0	N32:18	N34:18	N33:18
9	Vacuum Pump Run Feedback	P-603-R	40019	I:0.8	N7:8.0	N32:19	N34:19	N33:19
10	REMOTE/LOCAL SELECTOR SWITCH	R/L	40020	I:0.9	N7:9.0	N32:20	N34:20	N33:20
11	Virtual PLC Selector	VPLC SEL	40021	I:0.10	N7:10.0	N32:21	N34:21	N33:21
12	DCS Selected	DCS SEL	40022	I:0.12	N7:12.0	N32:23	N34:23	N33:23
13	Control Logix Selected	CNTRL LGX	40023	I:0.11	N7:11.0	N32:22	N34:22	N33:22
14	ACK PB	ACK	40024	I:0.13	N7:13.0	N32:24	N34:24	N33:24
15	Peristaltic Pump Selector Switch Feedback	P-601-SW	40025	I:0.15	N7:15.0	N32:26	N34:26	N33:26
16	Centrifugal Pump Selector Switch Feedback	P-602-SW	40026	I:0.14	N7:14.0	N32:25	N34:25	N33:25
17	Vacuum Pump Selector Switch Feedback	P-603-SW	40027	I:0.16	N7:16.0	N32:27	N34:27	N33:27
18	(SPARE) Product Tank Low Level Switch	SPARE	40028	I:0.17	N7:17.0	N32:28	N34:28	N33:28
19	SPARE	SPARE	40029	I:0.18	N7:18.0	N32:29	N34:29	N33:29
20	Emergency Stop	EM	40030	I:0.19	N7:19.0	N32:30	N34:30	N33:30
DIGITAL OUTPUT								
Sr. No.	DESCRIPTION	TAG NAME	MODBUS ADDRESS	Micrologix 1400	RsLogix 500	RsLogix 5000	DeltaV DCS	VPLC
1	Peristaltic Pump on/off	P-601	40031	O:0.0	N7:20.0	N32:31	N34:31	N33:31
2	Centrifugal Pump on/off	P-602	40032	O:0.1	N7:21.0	N32:32	N34:32	N33:32
3	Vacuum Pump on/off	P-603	40033	O:0.2	N7:22.0	N32:33	N34:33	N33:33
4	Hooter	H	40034	O:0.3	N7:23.0	N32:34	N34:34	N33:34
5	SPARE	SPARE	40035	O:0.4	N7:24.0	N32:35	N34:35	N33:35
6	SPARE	SPARE	40036	O:0.5	N7:25.0	N32:36	N34:36	N33:36
7	SPARE	SPARE	40037	O:0.6	N7:26.0	N32:37	N34:37	N33:37

8	SPARE	SPARE	40038	O:0.7	N7:27.0	N32:38	N34:38	N33:38
9	SPARE	SPARE	40039	O:0.8	N7:28.0	N32:39	N34:39	N33:39
10	SPARE	SPARE	40040	O:0.9	N7:29.0	N32:40	N34:40	N33:40
11	SPARE	SPARE	40041	O:0.10	N7:30.0	N32:41	N34:41	N33:41
12	SPARE	SPARE	40042	O:0.11	N7:31.0	N32:42	N34:42	N33:42
13	SPARE	SPARE	40043	O:1.0	N7:32.0	N32:43	N34:43	N33:43
14	SPARE	SPARE	40044	O:1.1	N7:33.0	N32:44	N34:44	N33:44
15	SPARE	SPARE	40045	O:1.2	N7:34.0	N32:45	N34:45	N33:45
16	SPARE	SPARE	40046	O:1.3	N7:35.0	N32:46	N34:46	N33:46
17	SPARE	SPARE	40047	O:1.4	N7:36.0	N32:47	N34:47	N33:47
18	SPARE	SPARE	40048	O:1.5	N7:37.0	N32:48	N34:48	N33:48
19	SPARE	SPARE	40049	O:1.6	N7:38.0	N32:49	N34:49	N33:49
20	SPARE	SPARE	40050	O:1.7	N7:39.0	N32:50	N34:50	N33:50

ANALOG INPUT

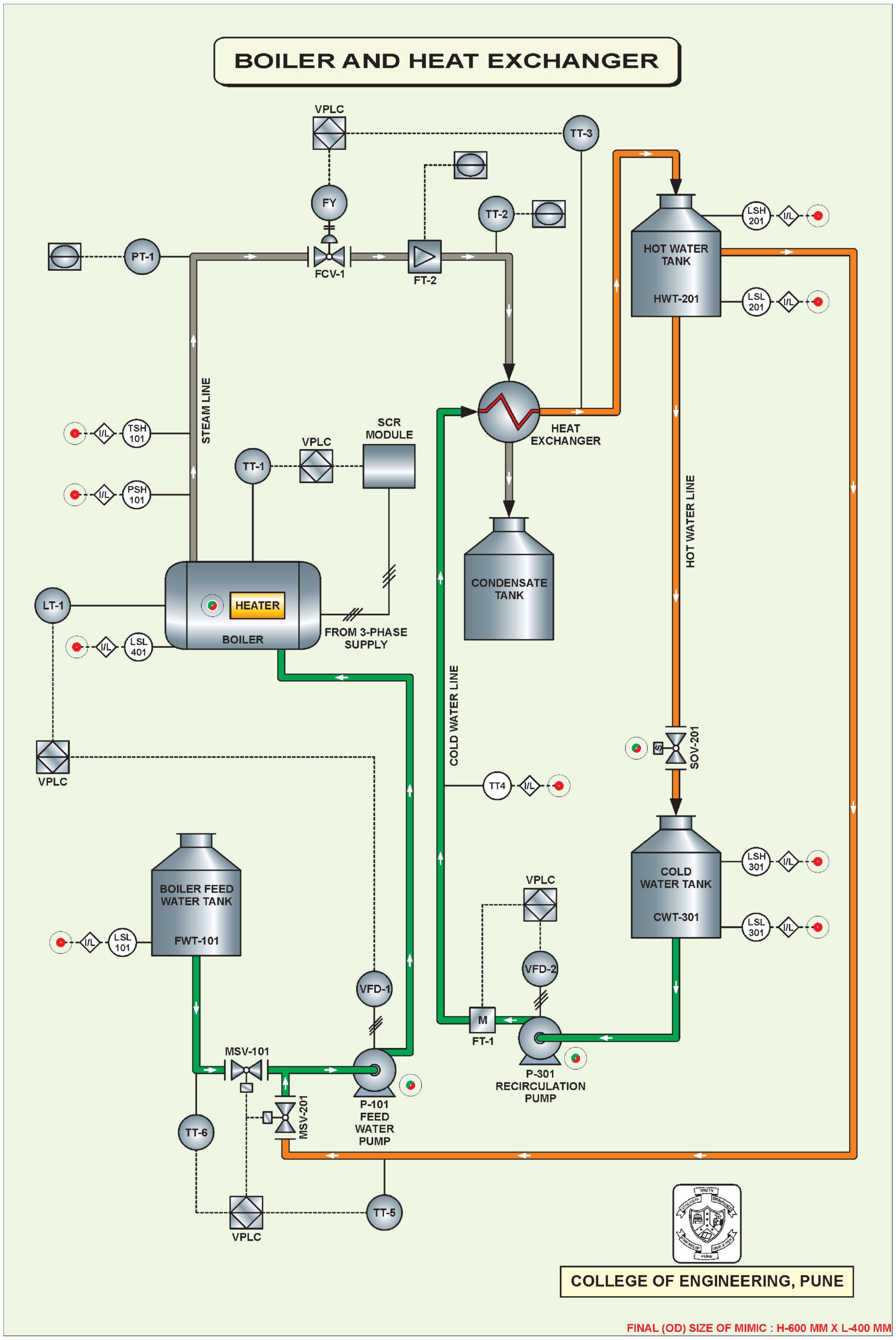
Sr. No.	DESCRIPTION	TAG NAME	MODBUS ADDRESS	Micrologix 1400	RsLogix 500	RsLogix 5000	DeltaV DCS	VPLC
1	Vortex Flow meter Transmitter for Steam Flow	FT-601	40051	I:0.4	F8:2	N32:51	N34:51	N33:51
2	Electro magnetic Flow Meter for Pump P-602	MG-602	40052	I:0.5	F8:7	N32:52	N34:52	N33:52
3	Integral Type Orifice Meter for Seperator V-601	RO 601	40053	I:0.6	F8:12	N32:53	N34:53	N33:53
4	Pressure Transmitter for Steam Line	PT 602	40054	I:0.7	F8:17	N32:54	N34:54	N33:54
5	Temp Transmitter for Feed tank T-601	TT 601	40055	I:2.0	F8:22	N32:55	N34:55	N33:55
6	Temp Transmitter for Calendria Bottom H-601	TT 602	40056	I:2.1	F8:27	N32:56	N34:56	N33:56
7	Temp Transmitter for Calendria Top H-601	TT 603	40057	I:2.2	F8:32	N32:57	N34:57	N33:57
8	Temp Transmitter for Steam Line	TT 604	40058	I:2.3	F8:37	N32:58	N34:58	N33:58
9	Temp Transmitter from Cooling Water Tower	TT 605	40059	I:3.0	F8:42	N32:59	N34:59	N33:59
10	Temp Transmitter To Cooling Water Tower	TT 606	40060	I:3.1	F8:47	N32:60	N34:60	N33:60
11	Temp Transmitter for Seperator V-601	TT 607	40061	I:3.2	F8:52	N32:61	N34:61	N33:61
12	Pressure Transmitter for Seperator V-601	PT 601	40062	I:3.3	F8:57	N32:62	N34:62	N33:62
13	Level Transmitter for Seperator V-601	LT 601	40063	I:4.0	F8:62	N32:63	N34:63	N33:63
14	Density Transmitter for Product Line	DT 601	40064	I:4.1	F8:67	N32:64	N34:64	N33:64
15	RPM Meter for Peristaltic Pump	RPM	40065	I:4.2	F8:72	N32:65	N34:65	N33:65
16	SPARE	SPARE	40066	I:4.3	F8:77	N32:66	N34:66	N33:66

ANALOG OUTPUT								
Sr. No.	**DESCRIPTION**	**TAG NAME**	**MODBUS ADDRESS**	**Micrologix 1400**	**RsLogix 500**	**RsLogix 5000**	**DeltaV DCS**	**VPLC**
1	Veriable Frequency Drive for Peristaltic Pump(P 601)	VFD 1	40071	O:0.4	F9:1	N32:71	N34:71	N33:71
2	Veriable Frequency Drive for Centrifugal Pump(P 602)	VFD 2	40072	O:0.5	F9:2	N32:72	N34:72	N33:72
3	Veriable Frequency Drive for Vacuum Pump(P 603)	VFD 3	40073	O:5.0	F9:3	N32:73	N34:73	N33:73
4	Steam Flow Control Valve	FCV 101	40074	O:5.1	F9:4	N32:74	N34:74	N33:74
5	Product Flow Control Valve	LCV-602	40075	O:5.2	F9:5	N32:75	N34:75	N33:75
6	SPARE	SPARE	40076	O:5.3	F9:6	N32:76	N34:76	N33:76

Appendix C

MIMIC Of Boiler,Heat Exchanger and Evaporator Pilot Plant

C.1 Boiler And Heat Exchanger



SS

Figure C.1: Mimic Of Boiler and Heat Exchanger

C.2 MIMIC of Evaporator Pilot Plant

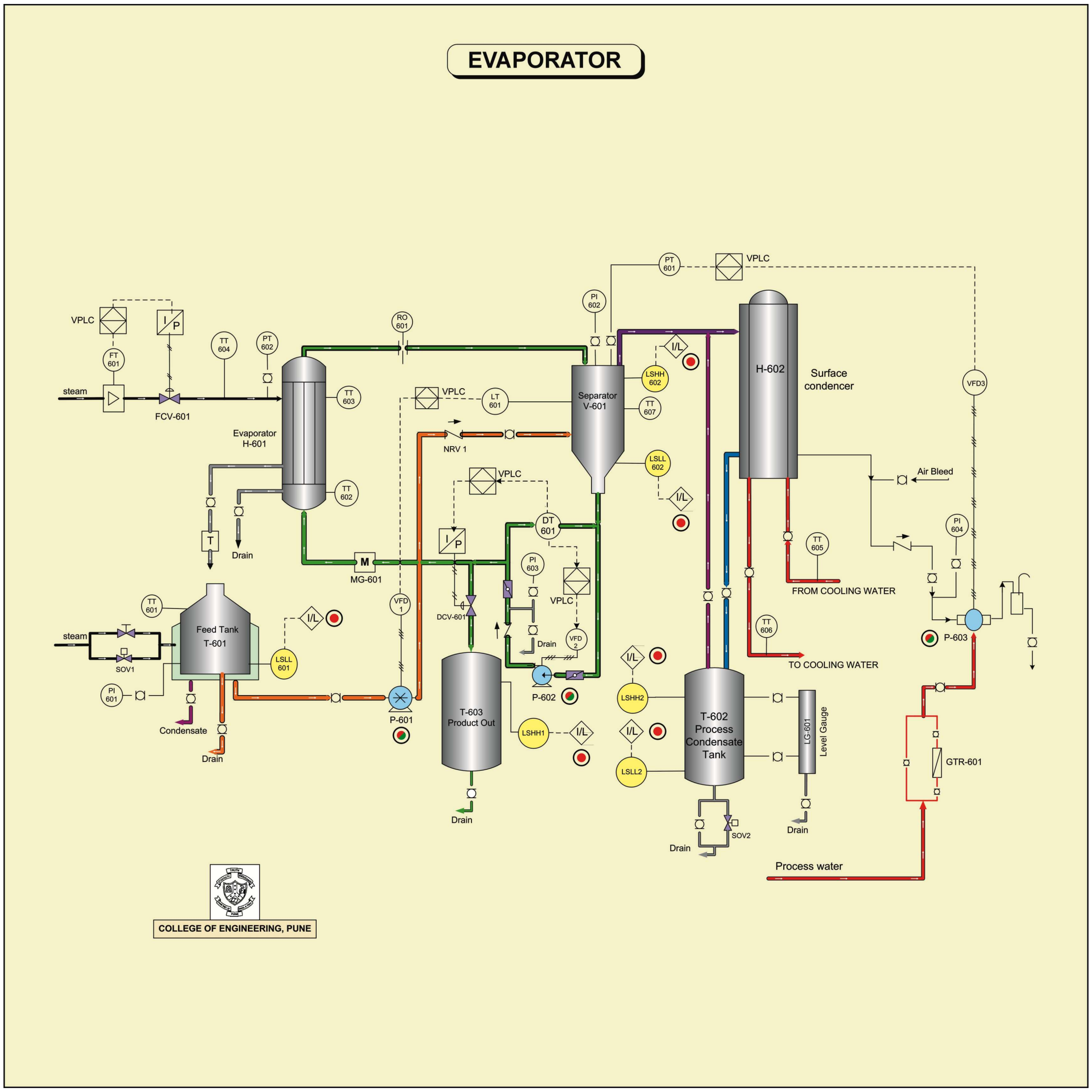


Figure C.2: Mimic of Evaporator Pilot Plant

Appendix D

Panel Drawings

D.1 Boiler & Heat Exchanger Panel Drawing

TITLE	*- BILL OF MATERIAL FOR VFD PANEL*
CUSTOMER	*- COLLEGE OF ENGINEERING PUNE*
PROJECT	*- BOILER & HEAT EXCHANGER*
PROJ. NO.	*- LTPL/2012-13/20*
CONSULTANT	*- --*

VFD PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY :	TITLE : BILL OF MATERIAL	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/06/2012		DATE:01/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :1/3		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/20/BOM2

BILL OF MATERIAL (ROCKWELL AUTOMATION)

Sr.No.	Cat. No.	Description	Qty
1	22A–A2P1N103	VFD,PF4,1PH,0.5HP	1
2	22A–A3P6N103	VFD,PF4,1PH,1HP	1

VFD PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY :	TITLE : BILL OF MATERIAL	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : ––	ALL DIMENSIONS ARE IN MM
				SHEET NO :2/3		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012–13/20/BOM2

BILL OF MATERIAL (BOUGHT - OUTS)

SR.NO.	TAG. NO.	DESCRIPTION	SPECIFICATIONS	MAKE			QTY
1	ENCLOSURE	1100+100 (H) x 600 (W) x 500 (D)	–	LOGICON	–	–	1
2	FAN1	LOUVER WITH FAN & FILTER 4"	230V,AC I/P	REXNORD	–	–	1
3	–	LOUVER WITH FILTER 4"	–	REXNORD	–	–	1
4	TL1	CFL LAMP WITH FITTING ACCESSORIES	230V,AC I/P	PHILIPS	–	–	1
5	DS1	DOOR LIMIT SWITCH	10A, AC	SIEMENS	–	–	1
6	MCB1	MCB, 4 POLE (AC SUPPLY)	4P/32A,10KA	SIEMENS	–	–	1
7	MCB2	MCB, 1 POLE (AC SUPPLY)	1P/2A,10KA	SIEMENS	–	–	1
8	MCB3	MCB, 2 POLE (AC SUPPLY)	2P/2A,10KA	SIEMENS	–	–	1
9	MCB4	MCB, 2 POLE (AC SUPPLY)	2P/6A,10KA	SIEMENS	–	–	1
10	MCB5	MCB, 2 POLE (AC SUPPLY)	2P/10A,10KA	SIEMENS	–	–	1
11	MCB6	MCB, 3 POLE (AC SUPPLY)	3P/16A,10KA	SIEMENS	–	–	1
12	E1	ELECTRICAL EARTH BUSBAR	150x25x3mm	REPUTED	–	–	2
13	CT1, 2 & 3	CT	50/5 VA	JD	STARLITE	AE	3
14	–	CT LINKS	–	–	–	–	3
15	TERMINALS (SCREW TYPE)	SINGLE DECKER FUSE TERMINALS	4 Sq. mm	ELMEX	–	–	*
16	TERMINALS (SCREW TYPE)	SINGLE DECKER TERMINALS	2.5 Sq. mm	ELMEX	–	–	*
17	TBP	POWER TERMINAL	10 Sq. mm	ELMEX	–	–	*
17	L1 TO L3	INDICATING LAMPS (RED,YELLOW,BLUE)	230V,AC	TEKNIC	–	–	3
18	THYR	THREE PHASE BURST FIRING THYRISTOR (TE 300)	20A	SAVIK	–	–	1
19	F7....F9	FUSES FOR THYRISTORISED MODULE	20A	SAVIK	–	–	3
20	3PEM	3PH. ENERGY METER WITH 4–20 MA OP	3 PH	SOCOMEK	–	–	1
21	NL	NEUTRAL LINK	20A	STANDARD	–	–	1

*** - AS PER POWER DISTRIBUTION / WIRING***

VFD PANEL

				SCALE : NTS	CHK.BY :	TITLE : BILL OF MATERIAL	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : ––	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :3/3		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012–13/20/BOM2

TITLE - *GENERAL ARRANGEMENT DRAWING FOR VFD PANEL*

CUSTOMER - *COLLEGE OF ENGINEERING PUNE*

PROJECT - *BOILER & HEAT EXCHANGER*

PROJ. NO. - *LTPL/2012-13/20*

CONSULTANT - *--*

VFD PANEL

				SCALE : NTS	CHK.BY :	TITLE : GENERAL ARRANGEMENT DRAWING	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :1/3		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/20/GA2

	9	8	7	6	5	4	3	2	1

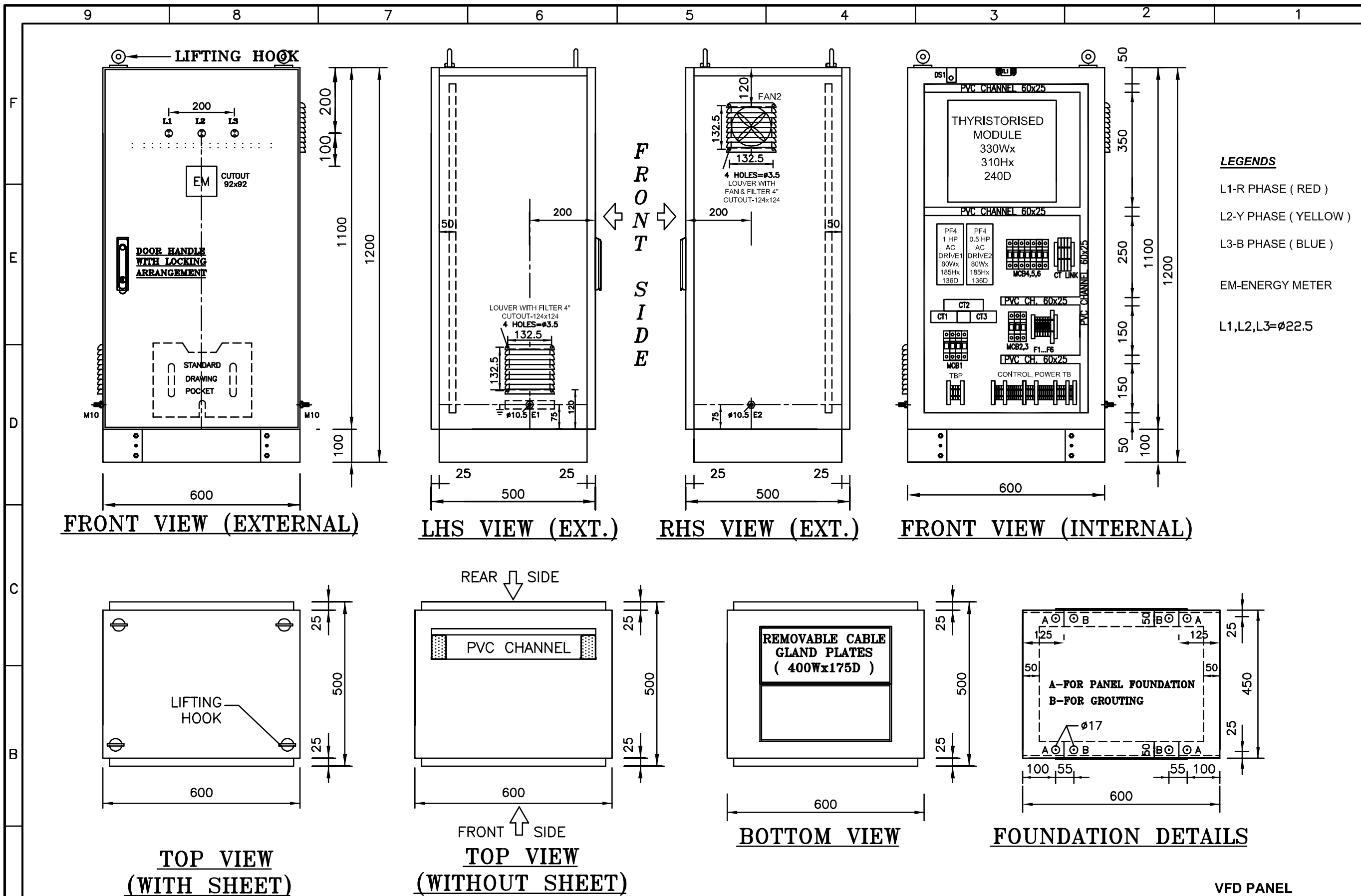
GENERAL SPECIFICATIONS : -

- PANEL FRONT DOOR SHALL BE 2mm. THICK CRCA SHEET STEEL.
- PANEL FRAME TOP / REAR / SIDE COVER SHALL BE 1.6 mm. THICK CRCA SHEET STEEL.
- BASE PLATE SHALL BE 2 mm. THICK CRCA SHEET STEEL.
- PANEL SHADE INSIDE / OUTSIDE - SIEMENS GREY (RAL-7032), BASE PLATE - ORANGE. (POWDER COATED)
- DEGREE OF PROTECTION IP - 42
- FRONT DOOR SHALL BE PROJECTED, REMOVABLE & LOCKABLE TYPE WITH KEY, PANEL IS FRONT ACCESIBLE ONLY
- FRONT DOOR SWING SHALL BE 120 DEG.
- CABLE ENTRY SHALL BE FROM BOTTOM.
- PANEL SHALL HAVE 4 NOS. REMOVABLE LIFTING HOOKS AT TOP.
- STANDARD DRAWING POCKET SHALL BE PROVIDED ON FRONT DOOR.
- CABLE TERMINATION SHALL BE DONE WITH PIN TYPE LUGS & USING TUBE FERRULES.
- 3 mm. THICK REMOVABLE, UNDRILLED GLAND PLATES SHALL BE PROVIDED.
- PVC / RUBBER GASKETING WILL BE PROVIDED FOR DOORS.
- 50x100x50x3 mm. THK. M.S. PLINTH SHALL BE USED & PAINTED BLACK. (FRONT & BACK COVER OF PLINTH SHALL BE REMOVABLE TYPE)
- EARTH BOLTS SHALL BE PROVIDED AT BOTH ENDS, WITH CU. BUSBAR OF 150x25X3 mm. SIZE FROM PANEL INSIDE FOR ELECTRICAL EARTHING.
- TOLERANCE +/- 5 mm OF PANEL DIMENSIONS.
- FOUNDATION DETAILS AS SHOWN IN DRAWING.
- PANEL MAKE : LOGICON
- EARTHING WIRE WILL BE PROVIDED BETWEEN PANEL DOOR & ELECTRICAL EARTH BUSBAR.

VFD PANEL

				SCALE : NTS	CHK.BY :	TITLE : GENERAL ARRANGEMENT DRAWING	LOGICON
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	TECHNOSOLUTIONS PVT.LTD.
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :2/3		PROJECT : BOILER & HEAT EXCHANGER	REV: 0	DRG.NO.2012-13/20/GA2

	9	8	7	6	5	4	3	2	1



REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY :	TITLE : GENERAL ARRANGEMENT DRAWING	LOGICON
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	TECHNOSOLUTIONS PVT.LTD.
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :3/3		PROJECT : BOILER & HEAT EXCHANGER — REV: 0	DRG.NO.2012-13/20/GA2

TITLE	- *SCHEMATIC WIRING DIAGRAM FOR VFD PANEL*
CUSTOMER	- *COLLEGE OF ENGINEERING PUNE*
PROJECT	- *BOILER & HEAT EXCHANGER*
PROJ. NO.	- *LTPL/2012-13/20*
CONSULTANT	- *--*

NOTES

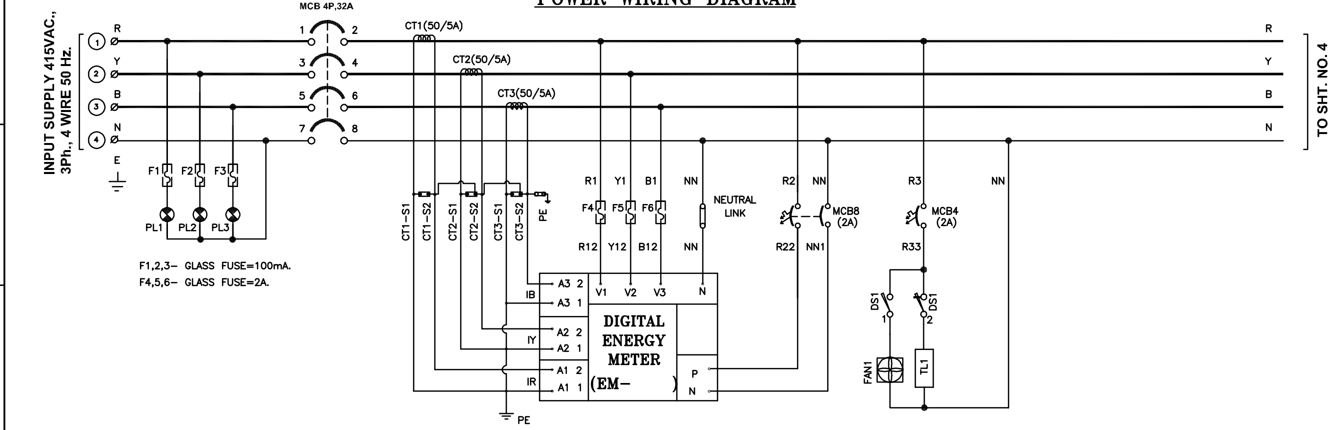
1 ⏚ THIS SYMBOL REPRESENTS ELECTRICAL EARTH.

2 ⏚ THIS SYMBOL REPRESENTS SCREEN / INSTRUMENTS EARTH.

VFD PANEL

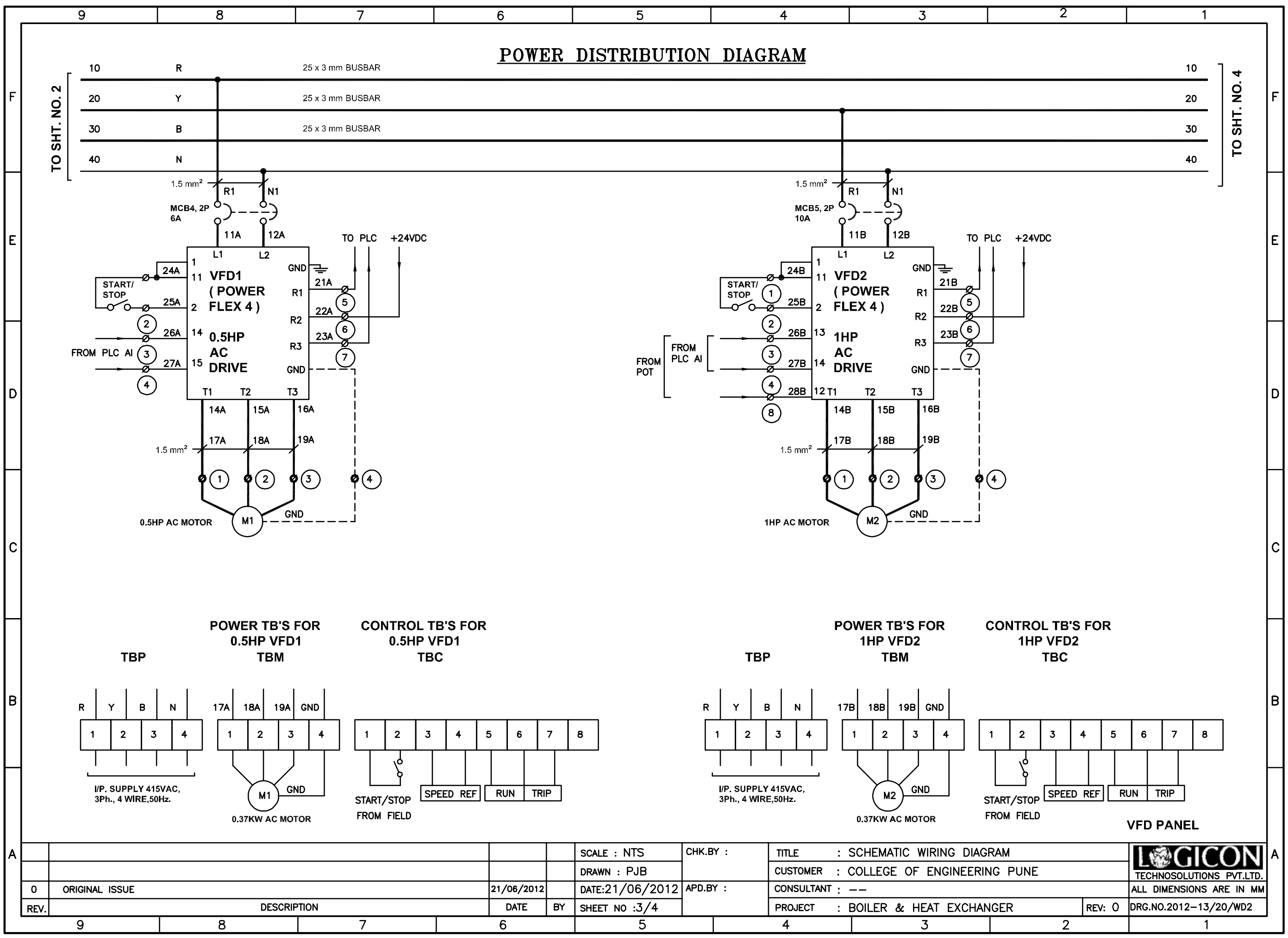
				SCALE : NTS	CHK.BY :	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :1/4		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/20/WD2

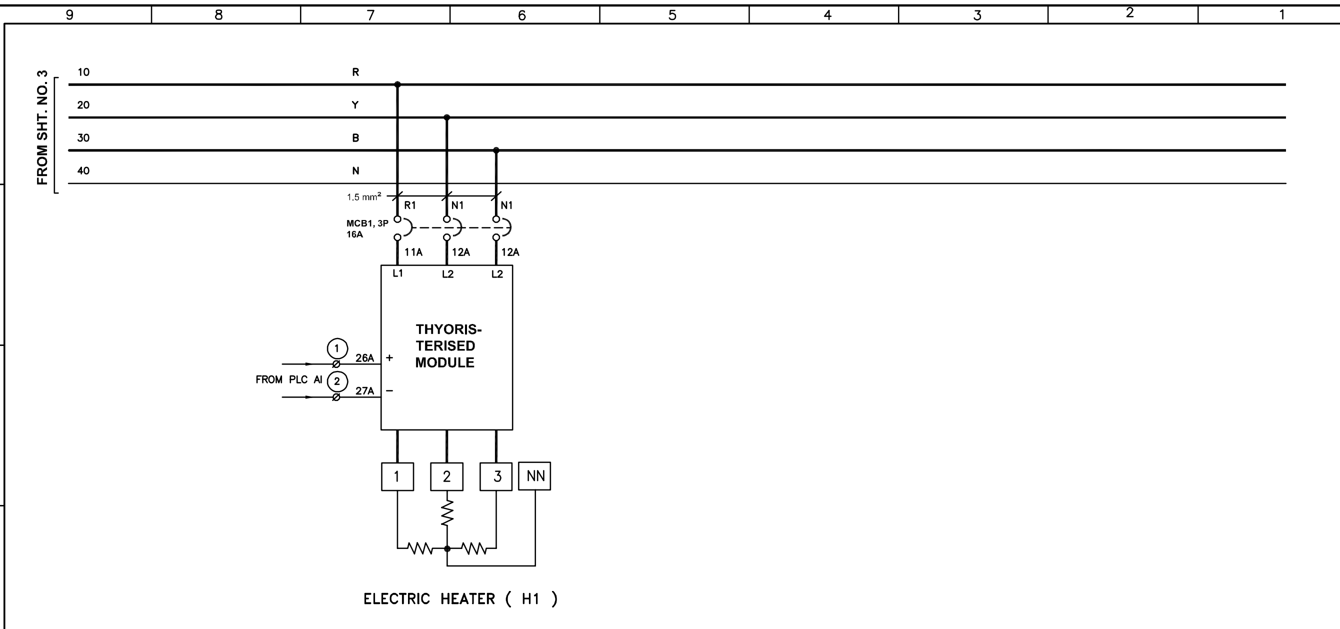
POWER WIRING DIAGRAM



VFD PANEL

			SCALE : NTS	CHK.BY :	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
			DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012	DATE:21/06/2012	APD.BY :	CONSULTANT : ––	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :2/4	PROJECT : BOILER & HEAT EXCHANGER	REV: 0	DRG.NO.2012–13/20/WD2


POWER DISTRIBUTION DIAGRAM
10 R 25 x 3 mm BUSBAR
20 Y 25 x 3 mm BUSBAR
30 B 25 x 3 mm BUSBAR
40 N
TO SHT. NO. 2
TO SHT. NO. 4
MCB4, 2P 6A
MCB5, 2P 10A
VFD1 (POWER FLEX 4) 0.5HP AC DRIVE
VFD2 (POWER FLEX 4) 1HP AC DRIVE
START/ STOP
FROM PLC AI
FROM PLC AI
FROM POT
TO PLC +24VDC
0.5HP AC MOTOR
1HP AC MOTOR
GND
POWER TB'S FOR 0.5HP VFD1 TBM
CONTROL TB'S FOR 0.5HP VFD1 TBC
POWER TB'S FOR 1HP VFD2 TBM
CONTROL TB'S FOR 1HP VFD2 TBC
TBP
I/P. SUPPLY 415VAC, 3Ph., 4 WIRE,50Hz.
0.37KW AC MOTOR
START/STOP FROM FIELD
SPEED REF
RUN
TRIP
VFD PANEL
SCALE : NTS
DRAWN : PJB
DATE:21/06/2012
SHEET NO :3/4
CHK.BY :
APD.BY :
TITLE : SCHEMATIC WIRING DIAGRAM
CUSTOMER : COLLEGE OF ENGINEERING PUNE
CONSULTANT : --
PROJECT : BOILER & HEAT EXCHANGER
REV: 0
LOGICON TECHNOSOLUTIONS PVT.LTD.
ALL DIMENSIONS ARE IN MM
DRG.NO.2012-13/20/WD2
0 ORIGINAL ISSUE 21/06/2012
REV. DESCRIPTION DATE BY



VFD PANEL

				SCALE : NTS	CHK.BY :	TITLE : SCHEMATIC WIRING DIAGRAM		LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE		
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --		ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :4/4		PROJECT : BOILER & HEAT EXCHANGER	REV: 0	DRG.NO.2012-13/20/WD2

TITLE - *WIRING SPECIFICATION FOR VFD PANEL*

CUSTOMER - *COLLEGE OF ENGINEERING PUNE*

PROJECT - *BOILER & HEAT EXCHANGER*

PROJ. NO. - *LTPL/2012-13/20*

CONSULTANT - *--*

VFD PANEL

				SCALE : NTS	CHK.BY :	TITLE : WIRING SPECIFICATION	LOGICON
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	TECHNOSOLUTIONS PVT.LTD.
0	ORIGINAL ISSUE	01/06/2012		DATE:01/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :1/2		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/20/WS2

WIRING SPECIFICATION

230V AC SUPPLY	PHASE (UPTO DISTRIBUTION TB)	RED	4 mm^2
	NEUTRAL (UPTO DISTRIBUTION TB)	BLACK	4 mm^2
	PHASE (AFTER DISTRIBUTION TB)	RED	1.5 mm^2
	NEUTRAL (AFTER DISTRIBUTION TB)	BLACK	1.5 mm^2
110V AC SUPPLY	PHASE (UPTO DISTRIBUTION TB)	RED	4 mm^2
	NEUTRAL (UPTO DISTRIBUTION TB)	BLACK	4 mm^2
	PHASE (AFTER DISTRIBUTION TB)	RED	1.5 mm^2
	NEUTRAL (AFTER DISTRIBUTION TB)	BLACK	1.5 mm^2
24V DC +VE	UPTO BUSBAR	BLUE	1.5 mm^2
	AFTER BUSBAR	BLUE	1.0 mm^2
24V DC –VE	UPTO BUSBAR	WHITE	1.5 mm^2
	AFTER BUSBAR	WHITE	1.0 mm^2
D/I WIRING		GREY	0.5 mm^2
D/O WIRING	MODULE TO RELAY COIL	GREY	0.5 mm^2
	RELAY CONTACT TO TERMINALS (PF)	BROWN	1.0 mm^2
	RELAY CONTACT TO TERMINALS (24VDC)	BLUE (+), WHITE (–)	1.0 mm^2
	RELAY CONTACT TO TERMINALS (230/110V AC)	RED (P), BLACK (N)	1.0 mm^2
A/I WIRING		ORANGE (+), WHITE (–)	0.5 mm^2
A/O WIRING		YELLOW (+), WHITE (–)	0.5 mm^2
EARTH	POWER	GREEN/YELLOW	2.5 mm^2
	INSTRUMENT	GREEN	1.5 mm^2

VFD PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY :	TITLE : WIRING SPECIFICATION	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/06/2012		DATE:01/06/2012	APD.BY :	CONSULTANT : ––	ALL DIMENSIONS ARE IN MM
				SHEET NO :2/2		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012–13/26/WS2

TITLE - ***SYSTEM ARCHITECTURE FOR PLC PANEL***

CUSTOMER - ***COLLEGE OF ENGINEERING PUNE***

PROJECT - ***BOILER & HEAT EXCHANGER***

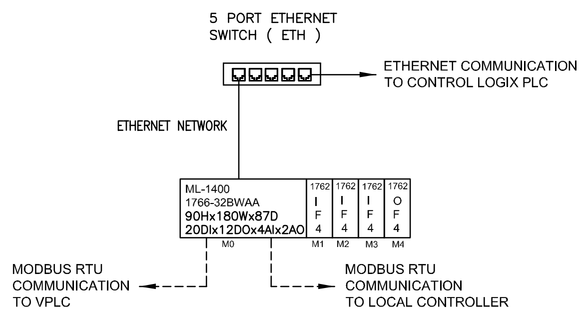
PROJ. NO. - ***LTPL/2012-13/20***

CONSULTANT - ***--***

PLC PANEL

				SCALE : NTS	CHK.BY :	TITLE : SYSTEM ARCHITECTURE	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :1/2		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/20/SA1

SYSTEM ARCHITECTURE



DETAILS

1766–L32BWAA – MICROLOGIX 1400 PROCESSOR
1762–IF4 – 4 CHANNEL ANALOG INPUT MODULE
1762–OF4 – 4 CHANNEL ANALOG OUTPUT MODULE
------ – MODBUS NETWORK
——— – ETHERNET NETWORK

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY :	TITLE : SYSTEM ARCHITECTURE	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : ––	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :2/2		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012–13/20/SA1

TITLE	***- BILL OF MATERIAL FOR PLC PANEL***
CUSTOMER	***- COLLEGE OF ENGINEERING PUNE***
PROJECT	***- BOILER & HEAT EXCHANGER***
PROJ. NO.	***- LTPL/2012-13/20***
CONSULTANT	***- --***

PLC PANEL

				SCALE : NTS	CHK.BY :	TITLE : BILL OF MATERIAL	LOGICON
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	TECHNOSOLUTIONS PVT.LTD.
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :1/3		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/20/BOM1

BILL OF MATERIAL (ROCKWELL AUTOMATION)

1	1766–L32BWAA	MICROLOGIX 1400 BASE UNIT WITH 20 DI & 12 DO, 4 AI & 2 AO	1
2	1762–IF4	4 CH. ANALOG INPUT MODULE	3
3	1762–OF4	4 CH. ANALOG OUTPUT MODULE	1

PLC PANEL

				SCALE : NTS	CHK.BY :	TITLE : BILL OF MATERIAL	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :2/3		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/20/BOM1

BILL OF MATERIAL (BOUGHT - OUTS)

Sr.No.	Description	Tag No	Catalog No.	Make	Qty
1	PANEL ENCLOSURE SIZE : 1475+100(H) X 1600(W) X 600(D)	-	_	LOGICON	1
2	COOLING FAN 4", 230VAC	FAN1, 2	_	REXNORD	2
3	LOUVER WITH FILTER, 4"	-	_	REPUTED	6
4	CFL LAMP WITH ITS ACCESSORIES,230VAC SUPPLY	TL1, TL2	_	PHILIPS	2
5	DOOR INTERLOCK SWITCH ASSEMBLY WITH 1NO +1NC CONTACT,230VAC	DS1, DS2	_	SIEMENS	2
6	UTILITY SOCKET , 230VAC,5A	SOC	_	ANCHOR	1
7	POWER SUPPLY,I/P 230VAC,O/P 24VDC,5A	PS	_	NHP	1
8	16 CHANNEL, 24VDC RELAY CARD WITH 2C/O OMRON RELAY	RC1	UL-24-DI6-2COB	UL	1
9	4 CHANNEL, 24VDC RELAY CARD WITH 2C/O OMRON RELAY	RC2,5,6	UL-24-D04-2COB	UL	3
10	8 CHANNEL, 24VDC RELAY CARD WITH 1C/O OMRON RELAY	RC3	UL-24-D08-1COB	UL	1
11	4 CHANNEL, 24VDC RELAY CARD WITH 1C/O OMRON RELAY	RC4	UL-24-D04-1COB	UL	1
12	4 C/O RELAY, 24VDC	RL-LR	MY4N DC24V	OMRON	1
13	BASE FOR 4 C/O RELAY	-	PYF14A-N	OMRON	1
14	CLIP FOR 4 C/O RELAY	-	PYC-A1	OMRON	1
15	MINIATURE CIRCUIT BREAKER, 2P / 16A,10KA	MCB1	5SX42167RC	SIEMENS	1
16	MINIATURE CIRCUIT BREAKER, 1P / 2A,10KA	MCB3,4,5	5SX41027RC	SIEMENS	3
17	MINIATURE CIRCUIT BREAKER, 2P / 6A,10KA	MCB6	5SX42067RC	SIEMENS	1
17	MINIATURE CIRCUIT BREAKER, 1P / 4A,10KA	MCB2	5SX41047RC	SIEMENS	1
18	LED TYPE INDICATION LAMP, CLEAR COLOUR, CONTROL SUPPLY ON , 230 VAC	L1	_	SIEMENS / TEKNIC	1
19	1 POLE 2 WAY COTROL SUPPLY ON/OFF SWITCH,16A	S1	_	SALZER	1
20	1 POLE 2 WAY ON/OFF SWITCH	S2,4,5,6	_	SALZER	4
21	1 POLE 3 WAY ROTARY SWITCH, 10A	S3	61049	SALZER	1
22	PUSH BUTTON FOR ACK (BLACK)	ACK	2AF	TEKNIC	1
23	5 PORT ETHERNET SWITCH,24VDC SUPPLY	ETH.SW.	SFNB5TX	PHOENIX	1
24	FUSE TERMINALS,4 SQMM	-	_	ELMEX	AS REQD
25	NON FUSE TERMINALS,2.5 SQMM	-		ELMEX	AS REQD
26	HOOTER,230VAC SUPPLY	H	_	CAPTAIN / CANDS	1
27	EARTHENING BUSBAR 25 X 3 MM THROUGHOUT PANELWITH M12 BOLTS	-	_	STD	1
28	INSTRUMENT EARTH BUSBAR 25 X 3 MM	-	_	STD	AS REQD
29	1:2 ISOLATOR FOR ANALOG INPUT & NOUTPUT	IS1,2.....11	-	SAPRE	11
30	INDICATORS FOR ANALOG I/P & O/P	PI1,2.....10	-	NISHKO	10
31	FLOW INDICATOR & TOTALISER (FREE ISSUE)	PI11,12	µcs 3000	-	2
32	50 Mtr ETHERNET CABLE	-	CAT5	DLINK	1
33	MIMIC 600(H) x 400(W)	-	-	STANDARD	1
34	THREE ELEMENT LEVEL CONTROLLER (FREE ISSUE)	-	UCS 1000	YOKOGAVA	1
35	TEMPERATURE CONTROLLER (FREE ISSUE)	-	3204	EUROTHERM	1
36	SPIKE GUARD	-	-	-	1
37	SPEED SET POT	P1,P2	-	STANDARD	2

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY :	TITLE : BILL OF MATERIAL	LOGICON
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	TECHNOSOLUTIONS PVT.LTD.
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :3/3		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/20/BOM1

TITLE - *GENERAL ARRANGEMENT DRAWING FOR PLC PANEL*

CUSTOMER - *COLLEGE OF ENGINEERING PUNE*

PROJECT - *BOILER & HEAT EXCHANGER*

PROJ. NO. - *LTPL/2012-13/20*

CONSULTANT - *--*

PLC PANEL

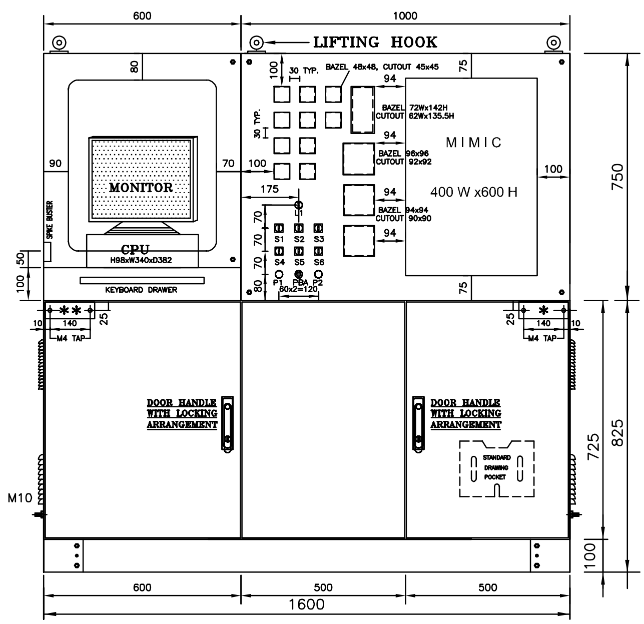
				SCALE : NTS	CHK.BY :	TITLE : GENERAL ARRANGEMENT DRAWING	LOGICON
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	TECHNOSOLUTIONS PVT.LTD.
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :1/6		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/20/GA1

GENERAL SPECIFICATIONS : -

- PANEL FRONT DOOR SHALL BE 2mm. THICK CRCA SHEET STEEL.
- PANEL FRAME TOP / REAR / SIDE COVER SHALL BE 1.6 mm. THICK CRCA SHEET STEEL.
- BASE PLATE SHALL BE 2 mm. THICK CRCA SHEET STEEL.
- PANEL SHADE INSIDE / OUTSIDE - SIEMENS GREY (RAL-7032), BASE PLATE - ORANGE. (POWDER COATED)
- DEGREE OF PROTECTION IP - 42
- FRONT DOOR SHALL BE PROJECTED, REMOVABLE & LOCKABLE TYPE WITH KEY, PANEL IS FRONT ACCESIBLE ONLY
- FRONT DOOR SWING SHALL BE 120 DEG.
- CABLE ENTRY SHALL BE FROM BOTTOM.
- PANEL SHALL HAVE 6 NOS. REMOVABLE LIFTING HOOKS AT TOP.
- STANDARD DRAWING POCKET SHALL BE PROVIDED ON FRONT DOOR.
- CABLE TERMINATION SHALL BE DONE WITH PIN TYPE LUGS & USING TUBE FERRULES.
- 3 mm. THICK REMOVABLE, UNDRILLED GLAND PLATES SHALL BE PROVIDED.
- PVC / RUBBER GASKETING WILL BE PROVIDED FOR DOORS.
- 50x100x50x3 mm. THK. M.S. PLINTH SHALL BE USED & PAINTED BLACK. (FRONT & BACK COVER OF PLINTH SHALL BE REMOVABLE TYPE)
- EARTH BOLTS SHALL BE PROVIDED AT BOTH ENDS, WITH CU. BUSBAR OF 150x25X3 mm. SIZE FROM PANEL INSIDE FOR ELECTRICAL EARTHING.
- INSTRUMENT EARTH BUSBAR OF SUITABLE SIZE OF 25x3 mm.PROVIDED.
- TOLERANCE +/- 5 mm OF PANEL DIMENSIONS.
- FOUNDATION DETAILS AS SHOWN IN DRAWING.
- PANEL MAKE : LOGICON
- EARTHING WIRE WILL BE PROVIDED BETWEEN PANEL DOOR & ELECTRICAL EARTH BUSBAR.

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY :	TITLE : GENERAL ARRANGEMENT DRAWING	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :2/6		PROJECT : BOILER & HEAT EXCHANGER — REV: 0	DRG.NO.2012-13/20/GA1



FRONT VIEW (EXTERNAL)

LEGENDS

L1 - CONTROL SUPPLY ON LAMP, CLEAR COLOR

PBA - ALARM ACKNOWLEDGE PB, BLACK COLOR

S1 - CONTROL SUPPLY ON / OFF SWITCH

S2 - LOCAL / REMOT SELECTOR SWITCH

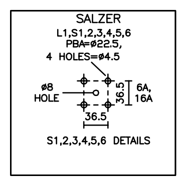
S3 - ROTARY SWICH

S4 - FEED PUMP ON / OFF SWITCH

S5 - COLD WATER PUMP ON / OFF SWITCH

S6 - HEATER ON / OFF SWITCH

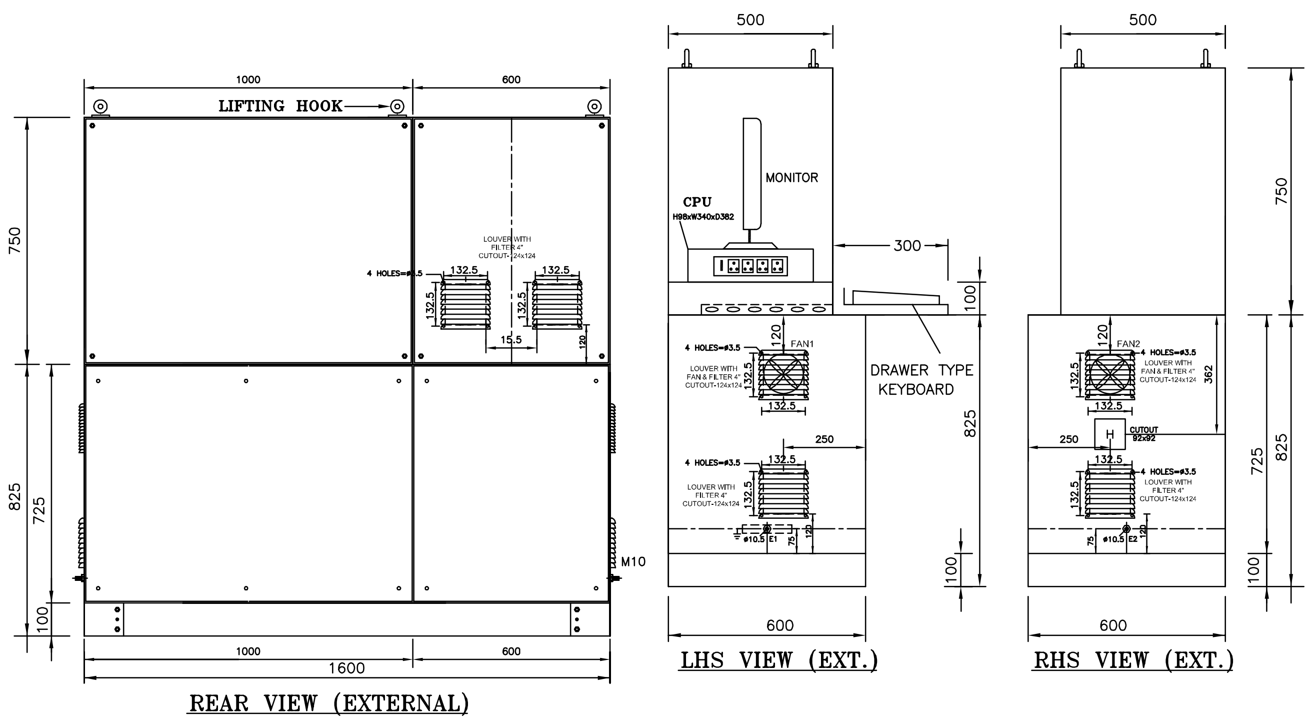
P1,P2 - SPEED SET POT



NAME PLATE DETAILS :- * – LOGICON (150Wx50H) ** – PANEL NAME (150Wx50H)

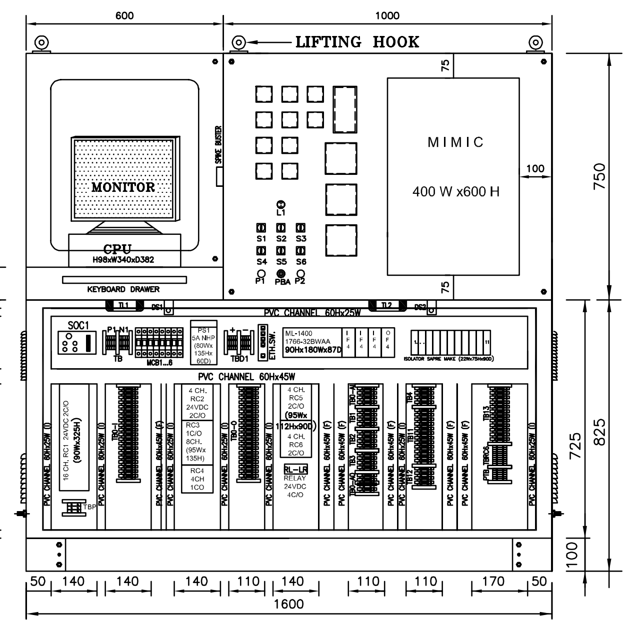
PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY :	TITLE : GENERAL ARRANGEMENT DRAWING	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :3/6		PROJECT : BOILER & HEAT EXCHANGER — REV: 0	DRG.NO.2012-13/20/GA1



PLC PANEL

				SCALE : NTS	CHK.BY :	TITLE : GENERAL ARRANGEMENT DRAWING	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :4/6		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/20/GA1



FRONT VIEW (INTERNAL)

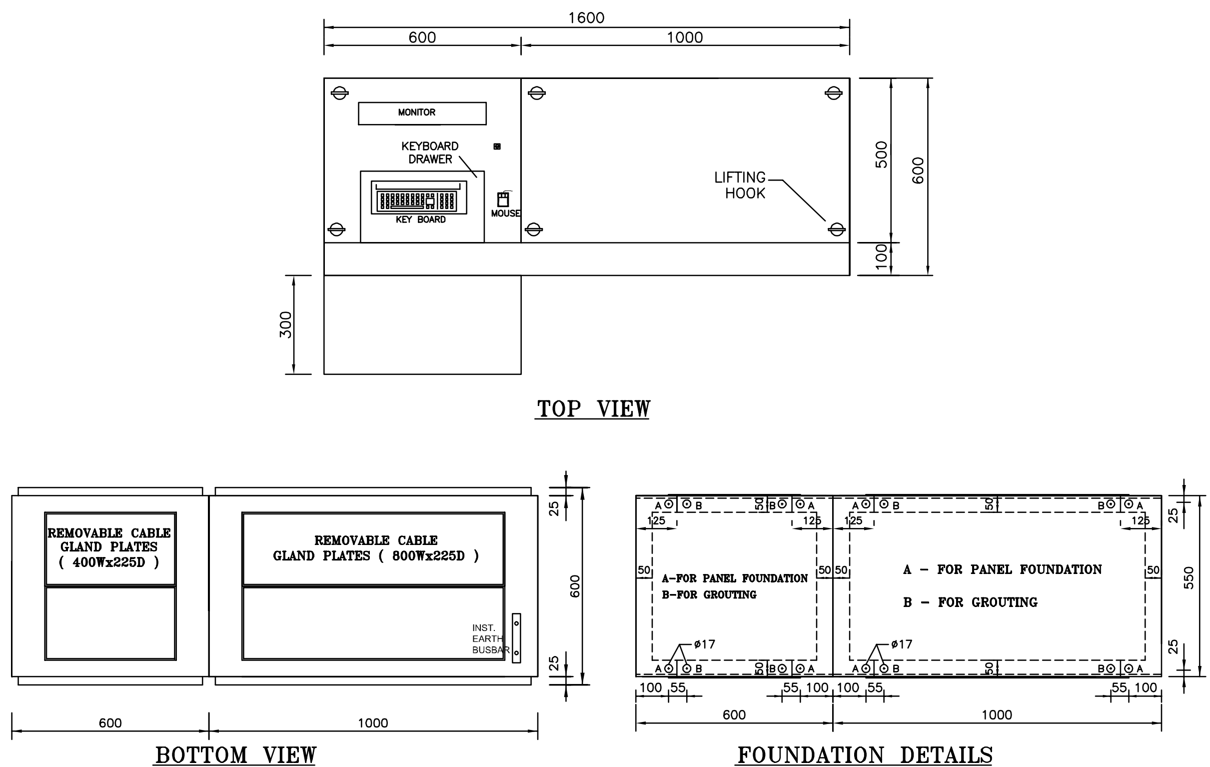
PLC PANEL

				SCALE : NTS	CHK.BY :	TITLE : GENERAL ARRANGEMENT DRAWING
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --
REV.	DESCRIPTION	DATE	BY	SHEET NO :5/6		PROJECT : BOILER & HEAT EXCHANGER — REV: 0

LOGICON TECHNOSOLUTIONS PVT.LTD.

ALL DIMENSIONS ARE IN MM

DRG.NO.2012-13/20/GA1



PLC PANEL

				SCALE : NTS	CHK.BY :	TITLE : GENERAL ARRANGEMENT DRAWING
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --
REV.	DESCRIPTION	DATE	BY	SHEET NO :6/6		PROJECT : BOILER & HEAT EXCHANGER REV: 0

LOGICON TECHNOSOLUTIONS PVT.LTD.

ALL DIMENSIONS ARE IN MM

DRG.NO.2012-13/20/GA1

TITLE - *SCHEMATIC WIRING DIAGRAM FOR PLC PANEL*

CUSTOMER - *COLLEGE OF ENGINEERING PUNE*

PROJECT - *BOILER & HEAT EXCHANGER*

PROJ. NO. - *LTPL/2012-13/20*

CONSULTANT - --

NOTES

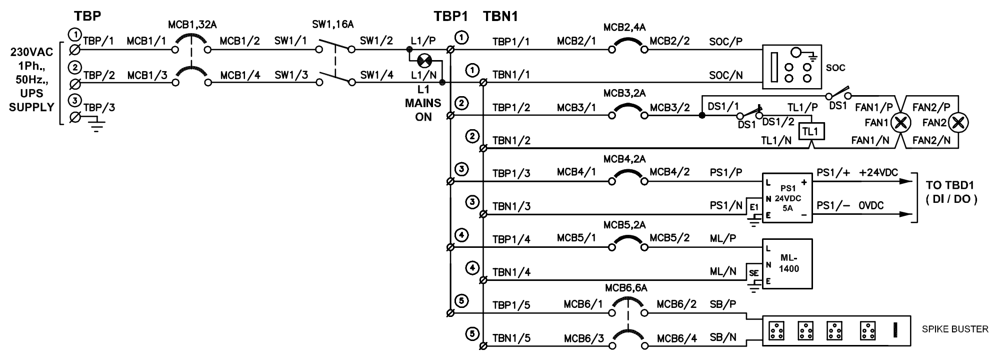
1 ⏚ THIS SYMBOL REPRESENTS ELECTRICAL EARTH.

2 THIS SYMBOL REPRESENTS SCREEN / INSTRUMENTS EARTH.

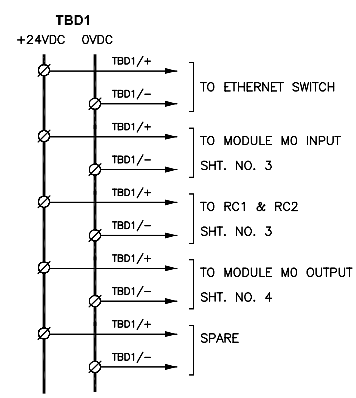
PLC PANEL

				SCALE : NTS	CHK.BY :	TITLE : SCHEMATIC WIRING DIAGRAM		LOGICON
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE		TECHNOSOLUTIONS PVT.LTD.
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --		ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :1/12		PROJECT : BOILER & HEAT EXCHANGER	REV: 0	DRG.NO.2012-13/20/WD1

AC POWER DISTRIBUTION



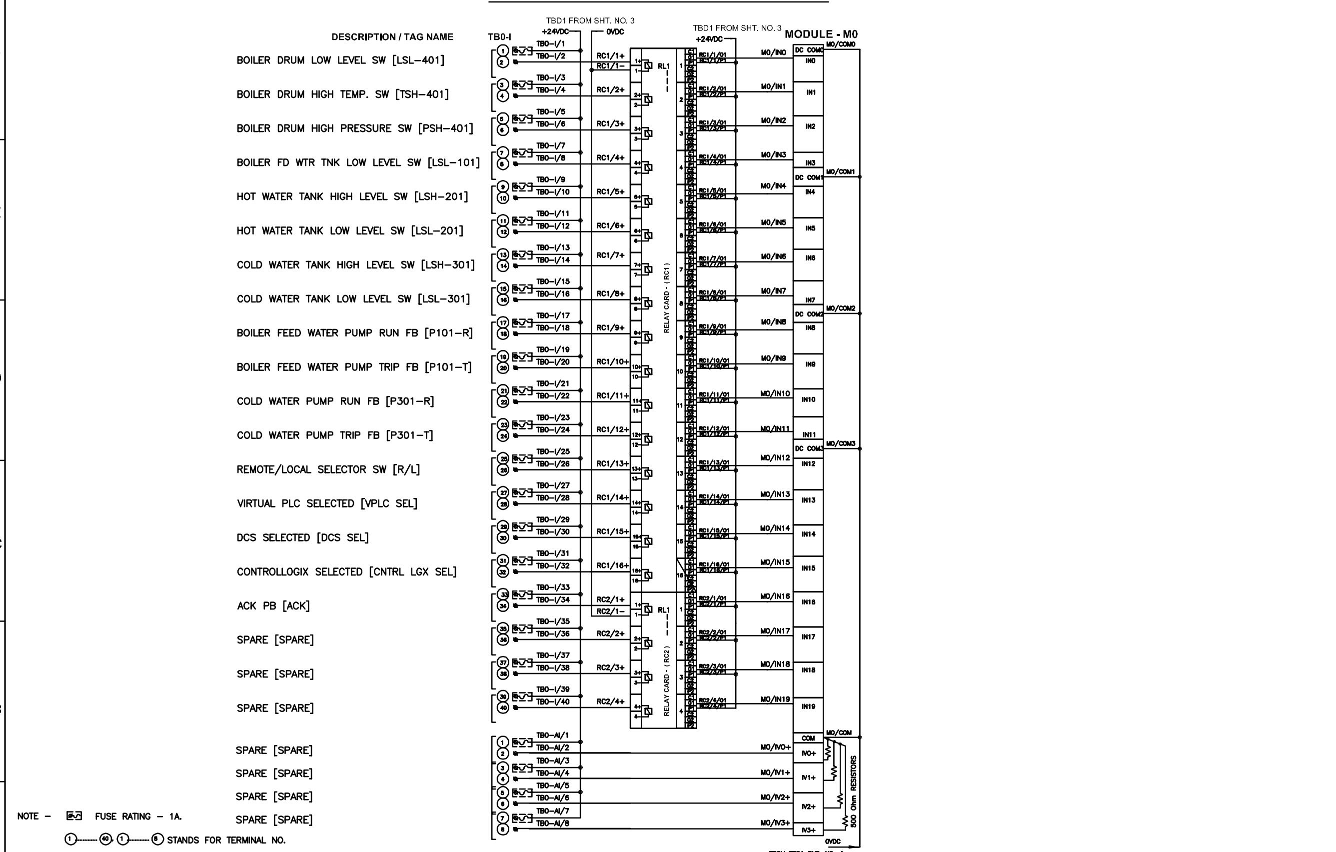
24VDC POWER DISTRIBUTION DIAGRAM



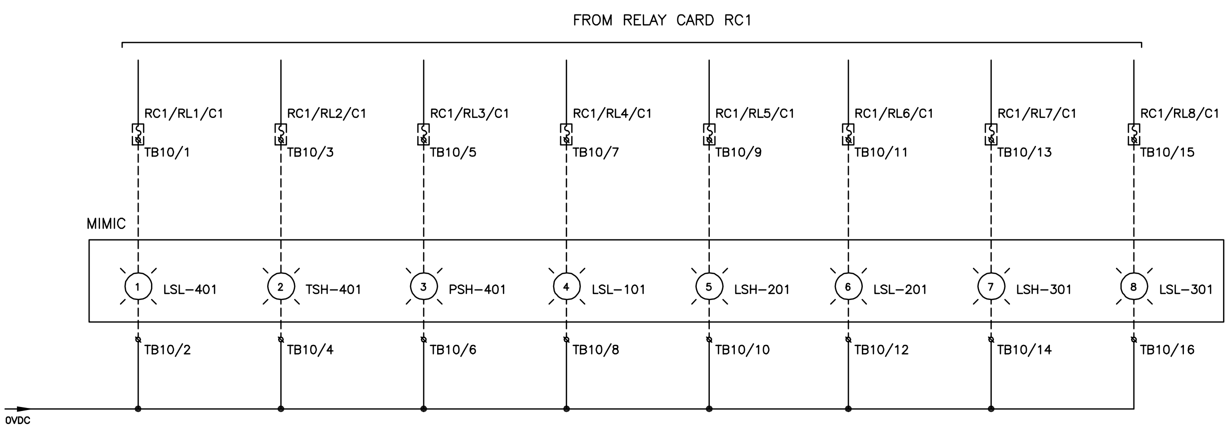
PLC PANEL

				SCALE : NTS	CHK.BY :	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :2/12		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/20/WD1

1766-L32BWAA ML-1400 DIGITAL I/P. WIRING DIAGRAM



				SCALE : NTS	CHK.BY :	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :3/12		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/20/WD1

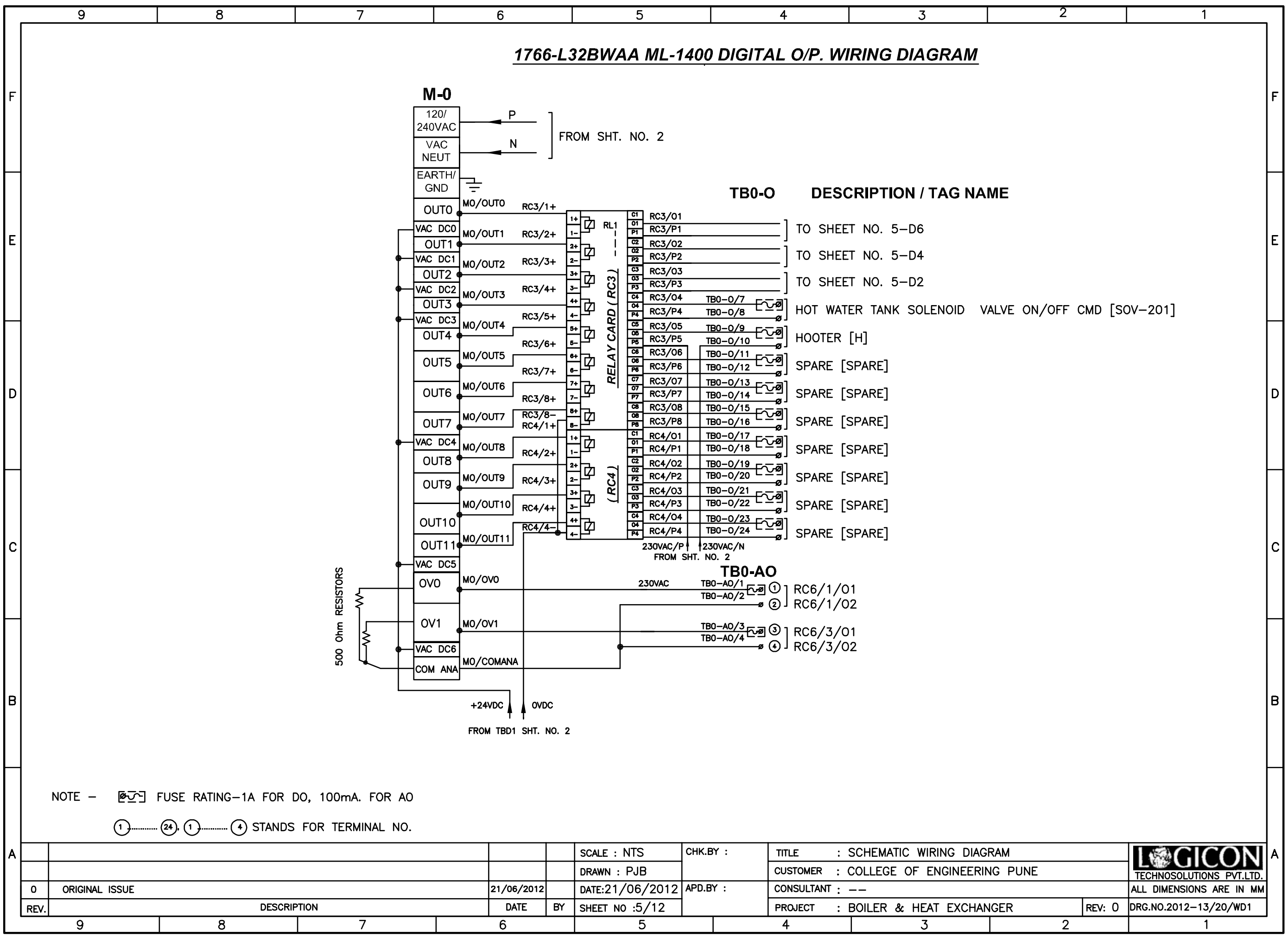


NOTE – FUSE RATING – 1A.

1 ...... 40, 1 ...... 8 STANDS FOR TERMINAL NO.

PLC PANEL

REV.	DESCRIPTION	DATE	BY					
				SCALE : NTS	CHK.BY :	TITLE : SCHEMATIC WIRING DIAGRAM		LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE		
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --		ALL DIMENSIONS ARE IN MM
				SHEET NO :4/12		PROJECT : BOILER & HEAT EXCHANGER	REV: 0	DRG.NO.2012-13/ /WD1


1766-L32BWAA ML-1400 DIGITAL O/P. WIRING DIAGRAM
M-0
120/ 240VAC
VAC NEUT
EARTH/ GND
P
N
FROM SHT. NO. 2
TB0-O
DESCRIPTION / TAG NAME
OUT0
VAC DC0
OUT1
VAC DC1
OUT2
VAC DC2
OUT3
VAC DC3
OUT4
OUT5
OUT6
OUT7
VAC DC4
OUT8
OUT9
OUT10
OUT11
VAC DC5
OV0
OV1
VAC DC6
COM ANA
M0/OUT0
M0/OUT1
M0/OUT2
M0/OUT3
M0/OUT4
M0/OUT5
M0/OUT6
M0/OUT7
M0/OUT8
M0/OUT9
M0/OUT10
M0/OUT11
M0/OV0
M0/OV1
M0/COMANA
RC3/1+
RC3/2+
RC3/3+
RC3/4+
RC3/5+
RC3/6+
RC3/7+
RC3/8+
RC3/8-
RC4/1+
RC4/2+
RC4/3+
RC4/4+
RC4/4-
RL1
RELAY CARD (RC3)
(RC4)
RC3/O1
RC3/P1
RC3/O2
RC3/P2
RC3/O3
RC3/P3
RC3/O4
RC3/P4
RC3/O5
RC3/P5
RC3/O6
RC3/P6
RC3/O7
RC3/P7
RC3/O8
RC3/P8
RC4/O1
RC4/P1
RC4/O2
RC4/P2
RC4/O3
RC4/P3
RC4/O4
RC4/P4
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TB0-O/8
TB0-O/9
TB0-O/10
TB0-O/11
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TB0-O/14
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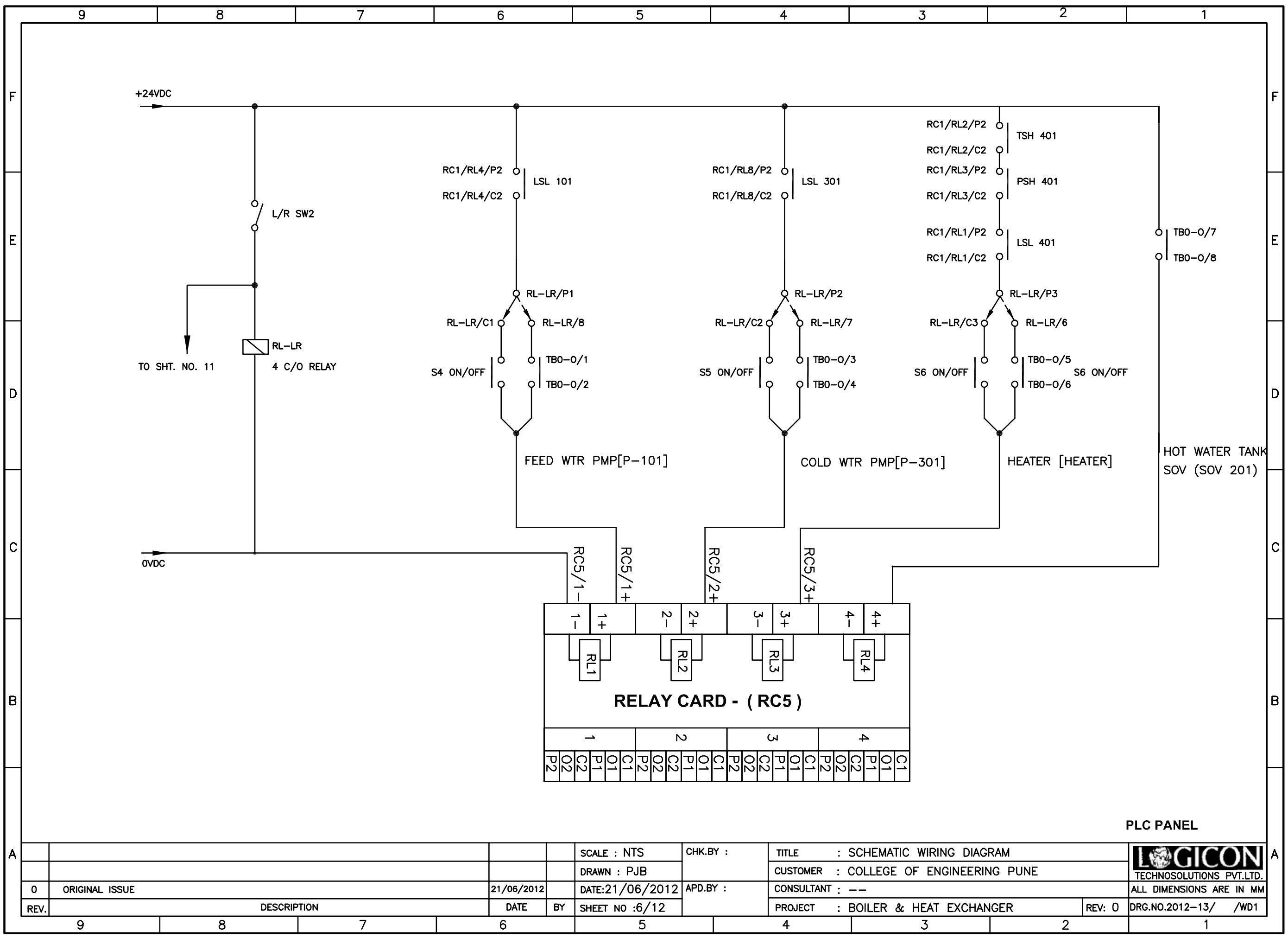
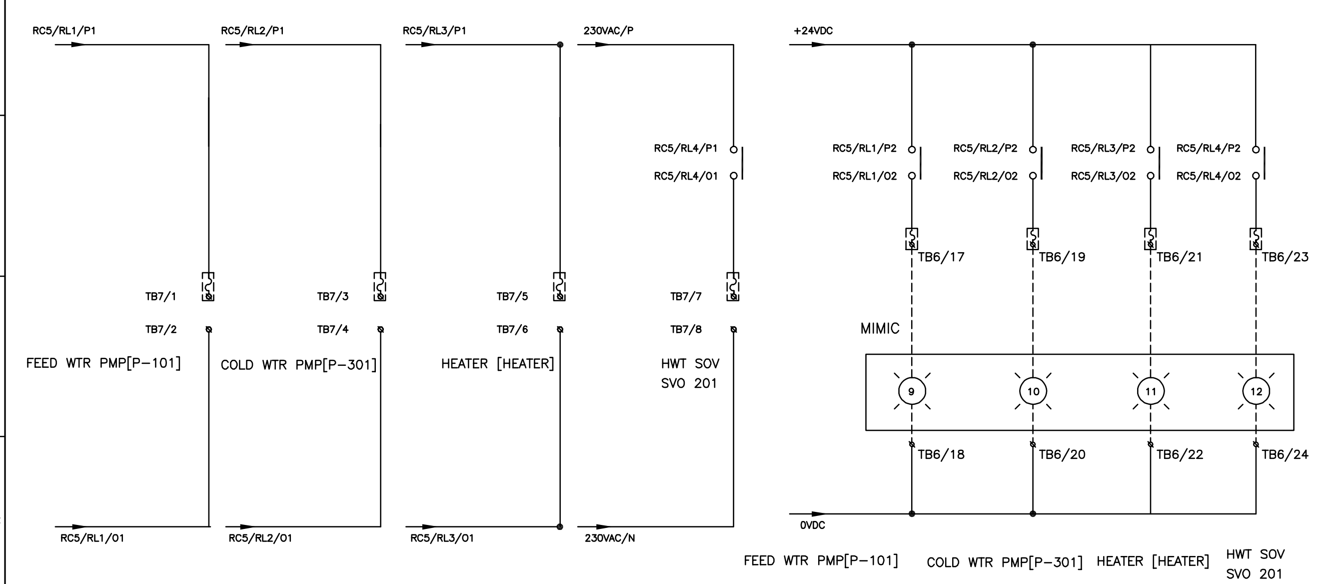
TB0-O/16
TB0-O/17
TB0-O/18
TB0-O/19
TB0-O/20
TB0-O/21
TB0-O/22
TB0-O/23
TB0-O/24
TO SHEET NO. 5-D6
TO SHEET NO. 5-D4
TO SHEET NO. 5-D2
HOT WATER TANK SOLENOID VALVE ON/OFF CMD [SOV-201]
HOOTER [H]
SPARE [SPARE]
SPARE [SPARE]
SPARE [SPARE]
SPARE [SPARE]
SPARE [SPARE]
SPARE [SPARE]
SPARE [SPARE]
230VAC/P
230VAC/N
FROM SHT. NO. 2
TB0-AO
230VAC
TB0-AO/1
TB0-AO/2
TB0-AO/3
TB0-AO/4
RC6/1/O1
RC6/1/O2
RC6/3/O1
RC6/3/O2
500 Ohm RESISTORS
+24VDC
OVDC
FROM TBD1 SHT. NO. 2
NOTE – FUSE RATING–1A FOR DO, 100mA. FOR AO
1 ... 24, 1 ... 4 STANDS FOR TERMINAL NO.
0
ORIGINAL ISSUE
21/06/2012
REV.
DESCRIPTION
DATE
BY
SCALE : NTS
DRAWN : PJB
DATE:21/06/2012
SHEET NO :5/12
CHK.BY :
APD.BY :
TITLE : SCHEMATIC WIRING DIAGRAM
CUSTOMER : COLLEGE OF ENGINEERING PUNE
CONSULTANT : ––
PROJECT : BOILER & HEAT EXCHANGER
REV: 0
LOGICON
TECHNOSOLUTIONS PVT.LTD.
ALL DIMENSIONS ARE IN MM
DRG.NO.2012–13/20/WD1



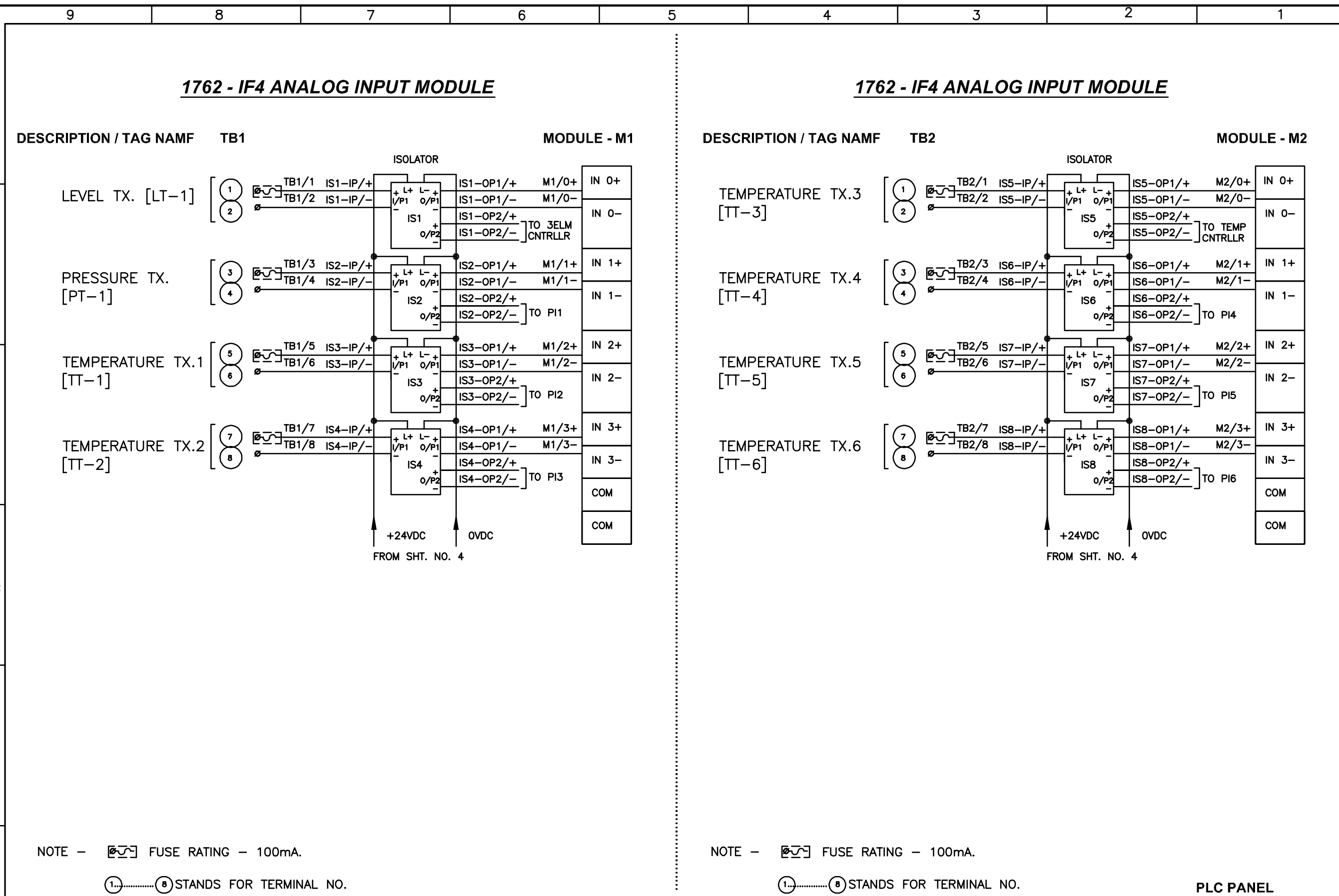
+24VDC
0VDC
L/R SW2
RL-LR
4 C/O RELAY
TO SHT. NO. 11
RC1/RL4/P2
RC1/RL4/C2
LSL 101
RL-LR/P1
RL-LR/C1
RL-LR/8
S4 ON/OFF
TB0-0/1
TB0-0/2
FEED WTR PMP[P-101]
RC1/RL8/P2
RC1/RL8/C2
LSL 301
RL-LR/P2
RL-LR/C2
RL-LR/7
S5 ON/OFF
TB0-0/3
TB0-0/4
COLD WTR PMP[P-301]
RC1/RL2/P2
RC1/RL2/C2
TSH 401
RC1/RL3/P2
RC1/RL3/C2
PSH 401
RC1/RL1/P2
RC1/RL1/C2
LSL 401
RL-LR/P3
RL-LR/C3
RL-LR/6
S6 ON/OFF
TB0-0/5
TB0-0/6
S6 ON/OFF
HEATER [HEATER]
TB0-0/7
TB0-0/8
HOT WATER TANK
SOV (SOV 201)
RC5/1-
RC5/1+
RC5/2+
RC5/3+
1- 1+ 2- 2+ 3- 3+ 4- 4+
RL1 RL2 RL3 RL4
RELAY CARD - (RC5)
1 2 3 4
P2 O2 C2 P1 O1 C1 P2 O2 C2 P1 O1 C1 P2 O2 C2 P1 O1 C1 P2 O2 C2 P1 O1 C1
PLC PANEL
0 ORIGINAL ISSUE 21/06/2012
REV. DESCRIPTION DATE BY
SCALE : NTS
DRAWN : PJB
DATE:21/06/2012
SHEET NO :6/12
CHK.BY :
APD.BY :
TITLE : SCHEMATIC WIRING DIAGRAM
CUSTOMER : COLLEGE OF ENGINEERING PUNE
CONSULTANT : --
PROJECT : BOILER & HEAT EXCHANGER
REV: 0
LOGICON
TECHNOSOLUTIONS PVT.LTD.
ALL DIMENSIONS ARE IN MM
DRG.NO.2012-13/ /WD1



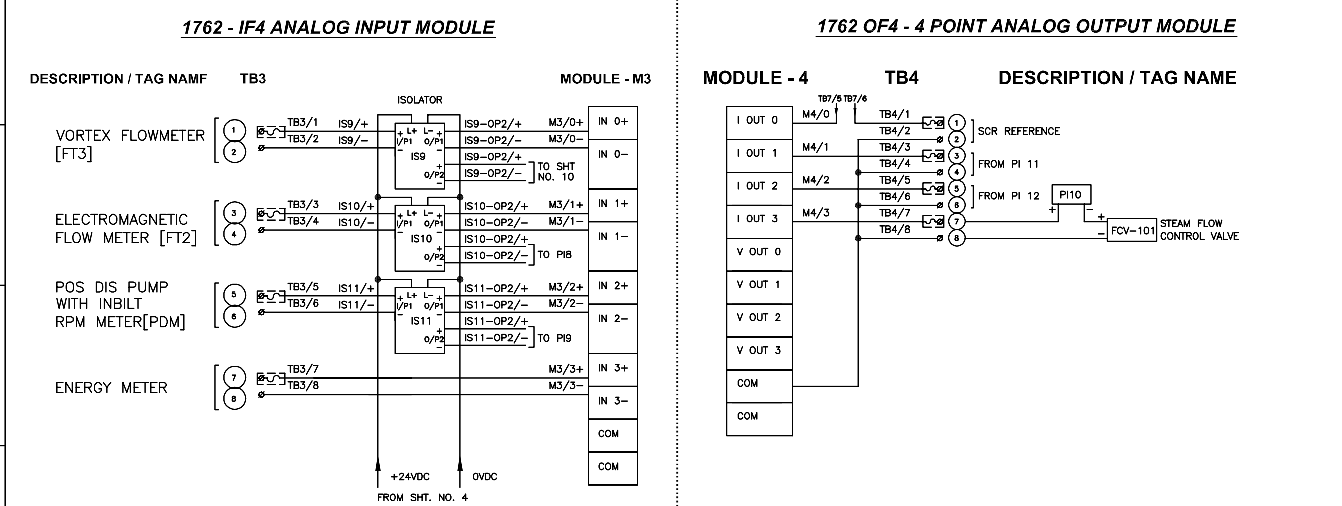
PLC PANEL

				SCALE : NTS	CHK.BY :	TITLE : SCHEMATIC WIRING DIAGRAM
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --
REV.	DESCRIPTION	DATE	BY	SHEET NO :7/12		PROJECT : BOILER & HEAT EXCHANGER REV: 0

LOGICON
TECHNOSOLUTIONS PVT.LTD.
ALL DIMENSIONS ARE IN MM
DRG.NO.2012-13/ /WD1



REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY :	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :8/12		PROJECT : BOILER & HEAT EXCHANGER — REV: 0	DRG.NO.2012-13/20/WD1



NOTE – FUSE RATING – 100mA.

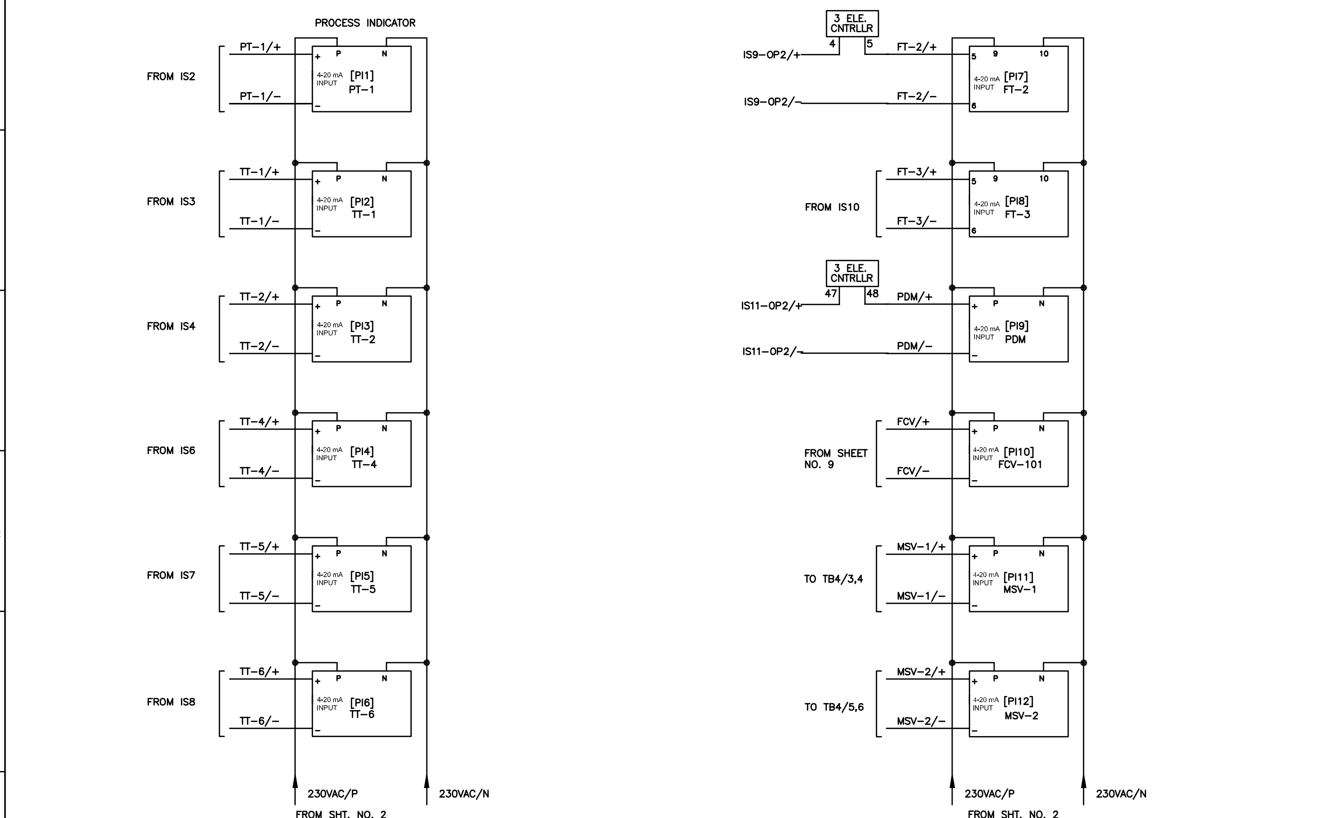
1 ... 8 STANDS FOR TERMINAL NO.

NOTE – FUSE RATING–100mA

1 ... 8 STANDS FOR TERMINAL NO.

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY :	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :9/12		PROJECT : BOILER & HEAT EXCHANGER — REV: 0	DRG.NO.2012-13/20/WD1



PLC PANEL

REV.	DESCRIPTION	DATE	BY				
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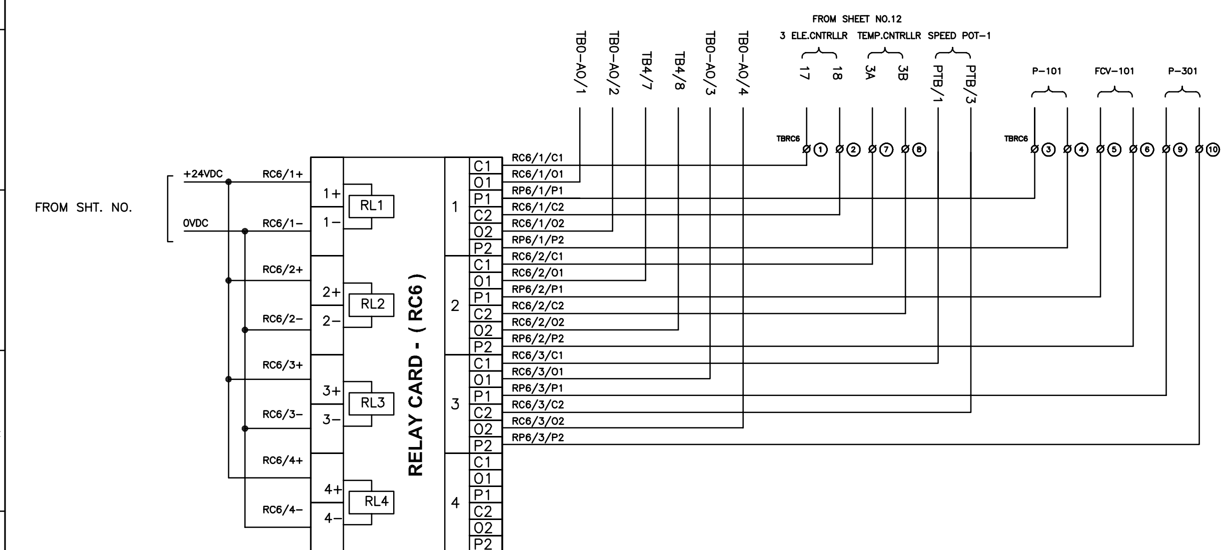
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	ALL DIMENSIONS ARE IN MM
				DATE:21/06/2012	APD.BY :	CONSULTANT : --	
				SHEET NO :10/12		PROJECT : BOILER & HEAT EXCHANGER — REV: 0	DRG.NO.2012-13/20/WD1



PLC PANEL

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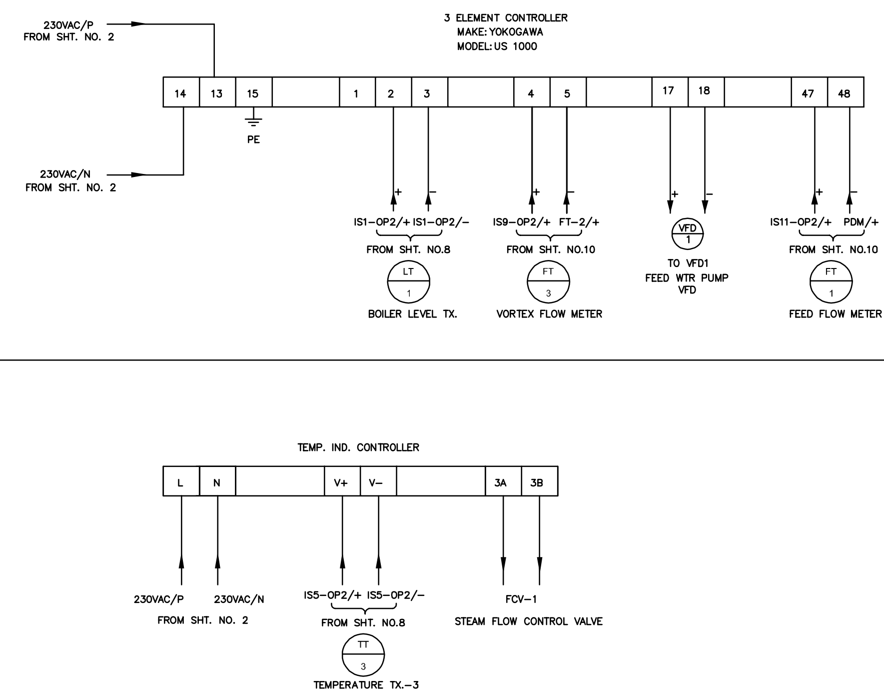
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	TECHNOSOLUTIONS PVT.LTD.
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :11/12		PROJECT : BOILER & HEAT EXCHANGER REV: 0	DRG.NO.2012-13/ /WD1



PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY :	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :12/12		PROJECT : BOILER & HEAT EXCHANGER — REV: 0	DRG.NO.2012-13/ /WD1

TITLE - ***WIRING SPECIFICATION FOR PLC PANEL***

CUSTOMER - ***COLLEGE OF ENGINEERING PUNE***

PROJECT - ***BOILER & HEAT EXCHANGER***

PROJ. NO. - ***LTPL/2012-13/20***

CONSULTANT - ***--***

PLC PANEL

				SCALE : NTS	CHK.BY :	TITLE : WIRING SPECIFICATION		LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE		
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --		ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :1/2		PROJECT : BOILER & HEAT EXCHANGER	REV: 0	DRG.NO.2012-13/20/WS1

WIRING SPECIFICATION

230V AC SUPPLY	PHASE (UPTO DISTRIBUTION TB)	RED	4 mm^2
	NEUTRAL (UPTO DISTRIBUTION TB)	BLACK	4 mm^2
	PHASE (AFTER DISTRIBUTION TB)	RED	1.5 mm^2
	NEUTRAL (AFTER DISTRIBUTION TB)	BLACK	1.5 mm^2
110V AC SUPPLY	PHASE (UPTO DISTRIBUTION TB)	RED	4 mm^2
	NEUTRAL (UPTO DISTRIBUTION TB)	BLACK	4 mm^2
	PHASE (AFTER DISTRIBUTION TB)	RED	1.5 mm^2
	NEUTRAL (AFTER DISTRIBUTION TB)	BLACK	1.5 mm^2
24V DC +VE	UPTO BUSBAR	BLUE	1.5 mm^2
	AFTER BUSBAR	BLUE	1.0 mm^2
24V DC −VE	UPTO BUSBAR	WHITE	1.5 mm^2
	AFTER BUSBAR	WHITE	1.0 mm^2
D/I WIRING		GREY	0.5 mm^2
D/O WIRING	MODULE TO RELAY COIL	GREY	0.5 mm^2
	RELAY CONTACT TO TERMINALS (PF)	BROWN	1.0 mm^2
	RELAY CONTACT TO TERMINALS (24VDC)	BLUE (+), WHITE (−)	1.0 mm^2
	RELAY CONTACT TO TERMINALS (230/110V AC)	RED (P), BLACK (N)	1.0 mm^2
A/I WIRING		ORANGE (+), WHITE (−)	0.5 mm^2
A/O WIRING		YELLOW (+), WHITE (−)	0.5 mm^2
EARTH	POWER	GREEN/YELLOW	2.5 mm^2
	INSTRUMENT	GREEN	1.5 mm^2

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY :	TITLE : WIRING SPECIFICATION	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	21/06/2012		DATE:21/06/2012	APD.BY :	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :2/2		PROJECT : BOILER & HEAT EXCHANGER	REV: 0 DRG.NO.2012-13/20/WS1

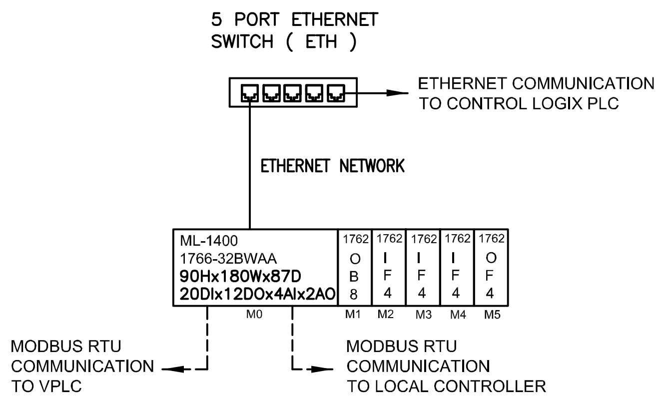
D.2 Evaporator Panel Drawing

TITLE	***- SYSTEM ARCHITECTURE FOR PLC PANEL***
CUSTOMER	***- COLLEGE OF ENGINEERING PUNE***
PROJECT	***- EVAPORATOR PROJECT***
PROJ. NO.	***- LTPL/2012-13/037***
CONSULTANT	***- --***

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY : KKZ	TITLE : SYSTEM ARCHITECTURE	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :1/2		PROJECT : EVAPORATOR PROJECT REV: 0	DRG.NO.2012-13/037/SA1

SYSTEM ARCHITECTURE



DETAILS

1766–L32BWAA – MICROLOGIX 1400 PROCESSOR
1762–OB8 – 8 CHANNEL DIGITAL INPUT MODULE
1762–IF4 – 4 CHANNEL ANALOG INPUT MODULE
1762–OF4 – 4 CHANNEL ANALOG OUTPUT MODULE
------ – MODBUS NETWORK
——— – ETHERNET NETWORK

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY : KKZ	TITLE : SYSTEM ARCHITECTURE	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : ––	ALL DIMENSIONS ARE IN MM
				SHEET NO :2/2		PROJECT : EVAPORATOR PROJECT REV: 0	DRG.NO.2012–13/037/SA1

TITLE	- ***BILL OF MATERIAL FOR PLC PANEL***
CUSTOMER	- ***COLLEGE OF ENGINEERING PUNE***
PROJECT	- ***EVAPORATOR PROJECT***
PROJ. NO.	- ***LTPL/2012-13/037***
CONSULTANT	- *--*

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY : KKZ	TITLE : BILL OF MATERIAL	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :1/3		PROJECT : EVAPORATOR PROJECT REV: 0	DRG.NO.2012-13/037/BOM1

BILL OF MATERIAL (ROCKWELL AUTOMATION)

1	1766–L32BWAA	MICROLOGIX 1400 BASE UNIT WITH 20 DI & 12 DO, 4 AI & 2 AO	1
2	1762–OB8	8 CH. DIGITAL OUTPUT MODULE	1
3	1762–IF4	4 CH. ANALOG INPUT MODULE	3
4	1762–OF4	4 CH. ANALOG OUTPUT MODULE	1

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY : KKZ	TITLE : BILL OF MATERIAL	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : ––	ALL DIMENSIONS ARE IN MM
				SHEET NO :2/3		PROJECT : EVAPORATOR PROJECT REV: 0	DRG.NO.2012–13/037/BOM1

BILL OF MATERIAL (BOUGHT - OUTS)

Sr.No.	Description	Tag No	Catalog No.	Make	Qty
1	PANEL ENCLOSURE SIZE : 1475+100(H) X 1900(W) X 600(D)	-	_	LOGICON	1
2	COOLING FAN 4", 230VAC	FAN1,2,3	_	REXNORD	3
3	LOUVER WITH FILTER, 4"	-	_	REPUTED	6
4	CFL LAMP WITH ITS ACCESSORIES,230VAC SUPPLY	TL1, TL2	_	PHILIPS	2
5	DOOR INTERLOCK SWITCH ASSEMBLY WITH 1NO +1NC CONTACT,230VAC	DS1, DS2	_	SIEMENS	2
6	UTILITY SOCKET , 230VAC,5A	SOC	_	ANCHOR	1
7	POWER SUPPLY,I/P 230VAC,O/P 24VDC,5A	PS	_	NHP	1
8	16 CHANNEL, 24VDC RELAY CARD WITH 2C/O OMRON RELAY	RC1	UL-24-DI6-2COB	UL	1
9	8 CHANNEL, 24VDC RELAY CARD WITH 2C/O OMRON RELAY	RC3,4	UL-24-D08-2COB	UL	2
10	4 CHANNEL, 24VDC RELAY CARD WITH 2C/O OMRON RELAY	RC2,5	UL-24-D04-2COB	UL	2
11	MINIATURE CIRCUIT BREAKER, 2P / 32A,10KA	MCB1	5SX42327RC	SIEMENS	1
12	MINIATURE CIRCUIT BREAKER, 1P / 2A,10KA	MCB3,4,6	5SX41027RC	SIEMENS	3
13	MINIATURE CIRCUIT BREAKER, 2P / 4A,10KA	MCB5	5SX42047RC	SIEMENS	1
14	MINIATURE CIRCUIT BREAKER, 2P / 6A,10KA	MCB7	5SX42067RC	SIEMENS	1
15	MINIATURE CIRCUIT BREAKER, 1P / 4A,10KA	MCB2	5SX41047RC	SIEMENS	1
16	LED TYPE INDICATION LAMP, CLEAR COLOUR, CONTROL SUPPLY ON , 230 VAC	L1	_	SIEMENS / TEKNIC	1
17	1 POLE 2 WAY COTROL SUPPLY ON/OFF SWITCH,16A	S1	_	SALZER	1
18	1 POLE 2 WAY ON/OFF SWITCH	S2,4,5,6	_	SALZER	4
19	1 POLE 3 WAY ROTARY SWITCH, 10A	S3	61049	SALZER	1
20	PUSH BUTTON FOR ACK (BLACK)	ACK	2AF	TEKNIC	1
21	5 PORT ETHERNET SWITCH,24VDC SUPPLY	ETH.SW.	SFNB5TX	PHOENIX	1
22	FUSE TERMINALS,4 SQMM	-	_	ELMEX	AS REQD
23	NON FUSE TERMINALS,2.5 SQMM	-		ELMEX	AS REQD
24	HOOTER,230VAC SUPPLY	H	_	CAPTAIN / CANDS	1
25	EARTHENING BUSBAR 25 X 3 MM THROUGHOUT PANELWITH M12 BOLTS	-	_	STD	1
26	INSTRUMENT EARTH BUSBAR 25 X 3 MM	-	_	STD	AS REQD
27	1:2 ISOLATOR FOR ANALOG INPUT & OUTPUT	IS1,2.....20	-	SAPRE	20
28	INDICATORS FOR ANALOG I/P & O/P	PI1,2.....20	-	NISHKO	20
29	1 Mtr ETHERNET CABLE	-	CAT5	DLINK	1
30	10 Mtr ETHERNET CABLE	-	CAT5	DLINK	1
31	MIMIC 600(H) x 600(W)	-	-	STANDARD	1
32	SPIKE GUARD	-	-	-	1
33	MUSHROOM TYPE EMERGENCY PUSH BUTTON	EM PB	-	-	1

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
0	ORIGINAL ISSUE	01/10/2012		SCALE : NTS	CHK.BY : KKZ	TITLE : BILL OF MATERIAL	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB	APD.BY : SBA	CUSTOMER : COLLEGE OF ENGINEERING PUNE	ALL DIMENSIONS ARE IN MM
				DATE:01/10/2012		CONSULTANT : --	REV: 0
				SHEET NO :3/3		PROJECT : EVAPORATOR PROJECT	DRG.NO.2012-13/037/BOM1

TITLE	- ***GENERAL ARRANGEMENT DRAWING FOR PLC PANEL***
CUSTOMER	- ***COLLEGE OF ENGINEERING PUNE***
PROJECT	- ***EVAPORATOR PROJECT***
PROJ. NO.	- ***LTPL/2012-13/037***
CONSULTANT	- ***--***

PLC PANEL

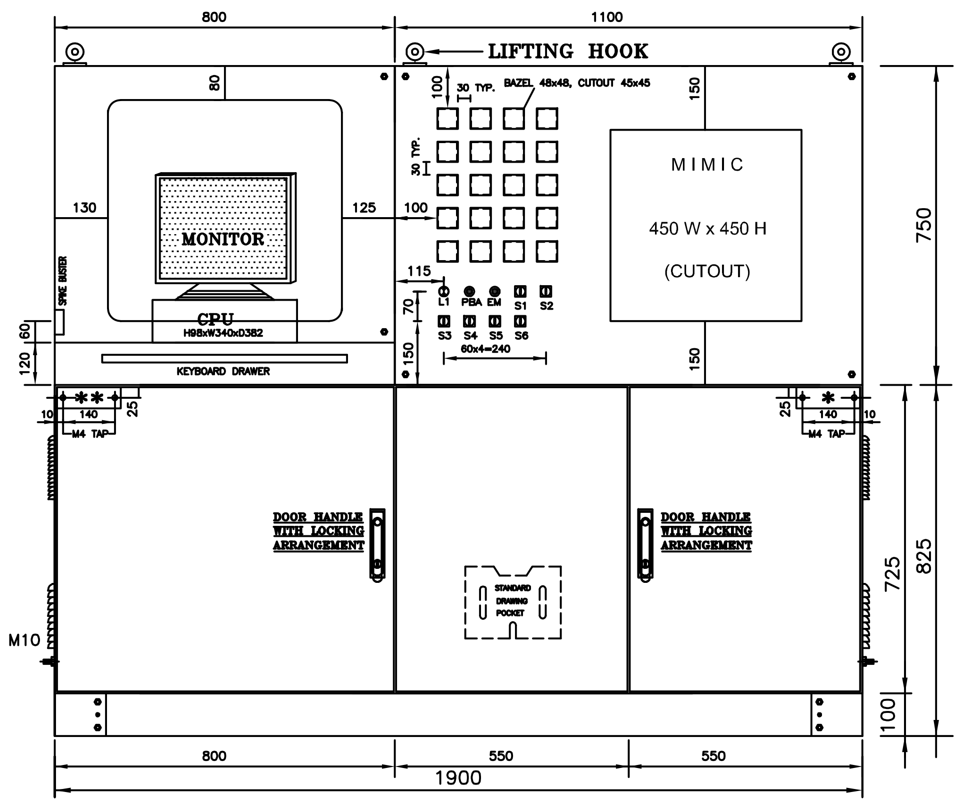
				SCALE : NTS	CHK.BY : KKZ	TITLE : GENERAL ARRANGEMENT DRAWING		LOGICON
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE		TECHNOSOLUTIONS PVT.LTD.
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --		ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :1/6		PROJECT : EVAPORATOR PROJECT	REV: 0	DRG.NO.2012-13/037/GA1

GENERAL SPECIFICATIONS : -

- PANEL FRONT DOOR SHALL BE 2mm. THICK CRCA SHEET STEEL.
- PANEL FRAME TOP / REAR / SIDE COVER SHALL BE 1.6 mm. THICK CRCA SHEET STEEL.
- BASE PLATE SHALL BE 2 mm. THICK CRCA SHEET STEEL.
- PANEL SHADE INSIDE / OUTSIDE - SIEMENS GREY (RAL-7032), BASE PLATE - ORANGE. (POWDER COATED)
- DEGREE OF PROTECTION IP - 42
- FRONT DOOR SHALL BE PROJECTED, REMOVABLE & LOCKABLE TYPE WITH KEY, PANEL IS FRONT ACCESIBLE ONLY
- FRONT DOOR SWING SHALL BE 120 DEG.
- CABLE ENTRY SHALL BE FROM BOTTOM.
- PANEL SHALL HAVE 6 NOS. REMOVABLE LIFTING HOOKS AT TOP.
- STANDARD DRAWING POCKET SHALL BE PROVIDED ON FRONT DOOR.
- CABLE TERMINATION SHALL BE DONE WITH PIN TYPE LUGS & USING TUBE FERRULES.
- 3 mm. THICK REMOVABLE, UNDRILLED GLAND PLATES SHALL BE PROVIDED.
- PVC / RUBBER GASKETING WILL BE PROVIDED FOR DOORS.
- 50x100x50x3 mm. THK. M.S. PLINTH SHALL BE USED & PAINTED BLACK. (FRONT & BACK COVER OF PLINTH SHALL BE REMOVABLE TYPE)
- EARTH BOLTS SHALL BE PROVIDED AT BOTH ENDS, WITH CU. BUSBAR OF 150x25X3 mm. SIZE FROM PANEL INSIDE FOR ELECTRICAL EARTHING.
- INSTRUMENT EARTH BUSBAR OF SUITABLE SIZE OF 25x3 mm.PROVIDED.
- TOLERANCE +/- 5 mm OF PANEL DIMENSIONS.
- FOUNDATION DETAILS AS SHOWN IN DRAWING.
- PANEL MAKE : LOGICON
- EARTHING WIRE WILL BE PROVIDED BETWEEN PANEL DOOR & ELECTRICAL EARTH BUSBAR.

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY : KKZ	TITLE : GENERAL ARRANGEMENT DRAWING	LOGICON
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	TECHNOSOLUTIONS PVT.LTD.
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :2/6		PROJECT : EVAPORATOR PROJECT REV: 0	DRG.NO.2012-13/037/GA1



FRONT VIEW (EXTERNAL)

LEGENDS

L1 - CONTROL SUPPLY ON LAMP, CLEAR COLOR

PBA - ALARM ACKNOWLEDGE PB, BLACK COLOR

S1 - CONTROL SUPPLY ON / OFF SWITCH

S2 - LOCAL / REMOT SELECTOR SWITCH

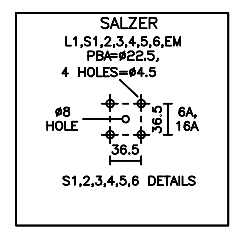
S3 - VPLC/CONTROL LOGIX/DCS SWITCH

S4 - PERISTALTIC PUMP ON / OFF SWITCH

S5 - CENTRIFUGAL PUMP ON / OFF SWITCH

S6 - VACUUM PUMP ON / OFF SWITCH

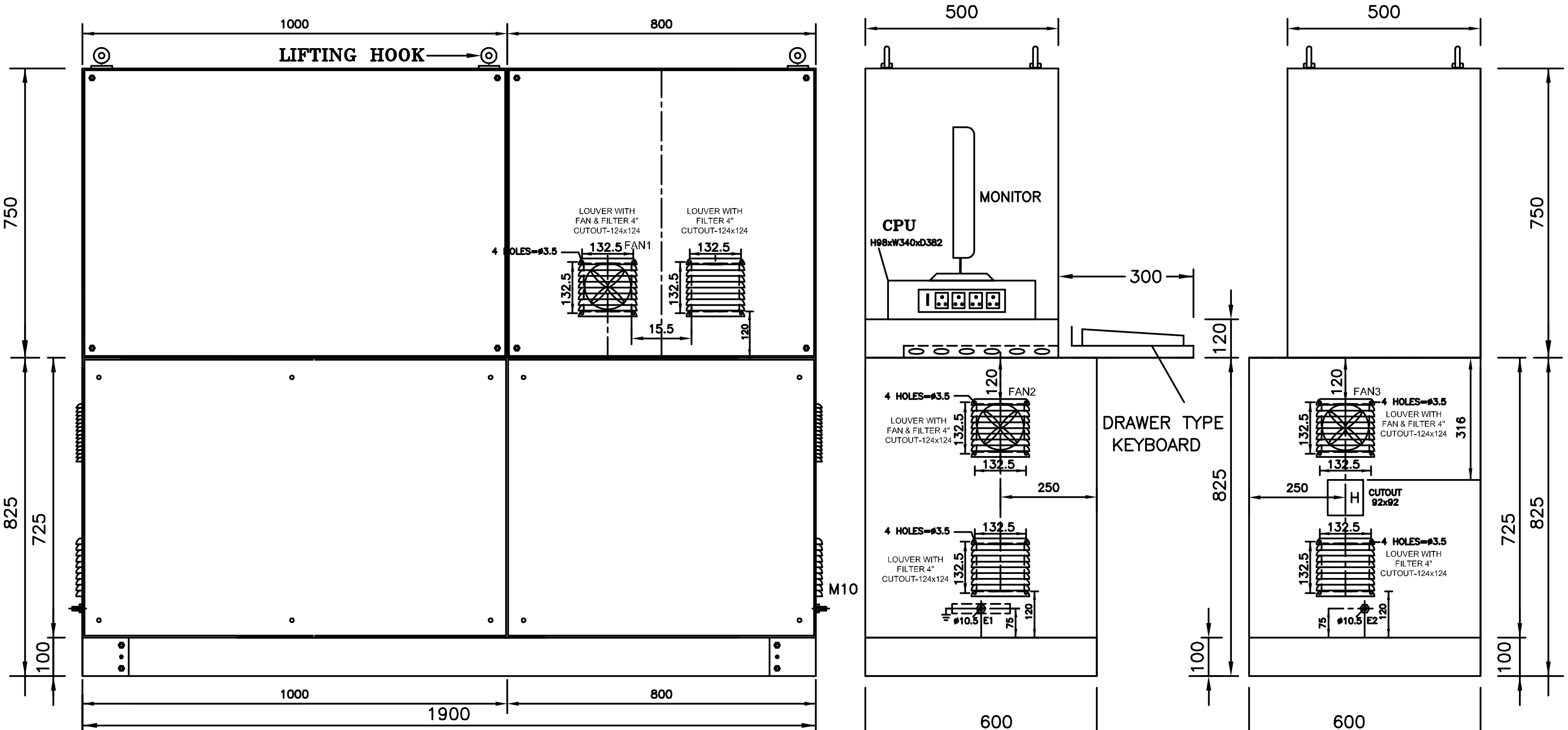
EM - EMERGENCY STOP



NAME PLATE DETAILS :- * — LOGICON (150Wx50H) ** — PANEL NAME (150Wx50H)

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY : KKZ	TITLE : GENERAL ARRANGEMENT DRAWING	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :3/6		PROJECT : EVAPORATOR PROJECT — REV: 0	DRG.NO.2012-13/037/GA1



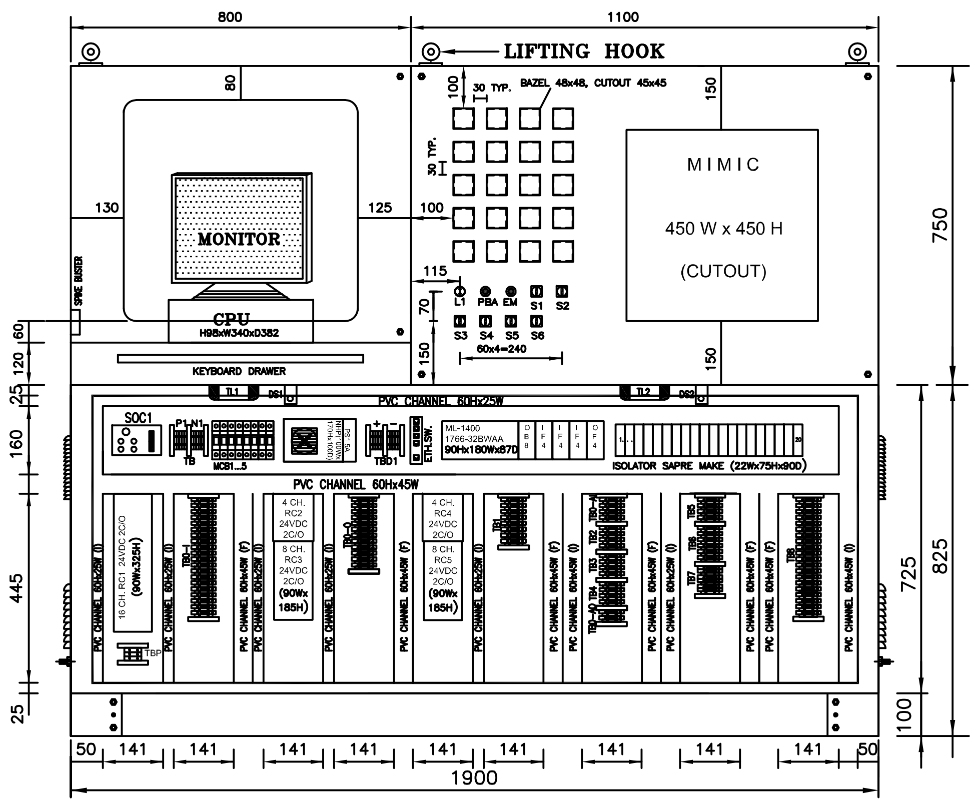
REAR VIEW (EXTERNAL)

LHS VIEW (EXT.)

RHS VIEW (EXT.)

PLC PANEL

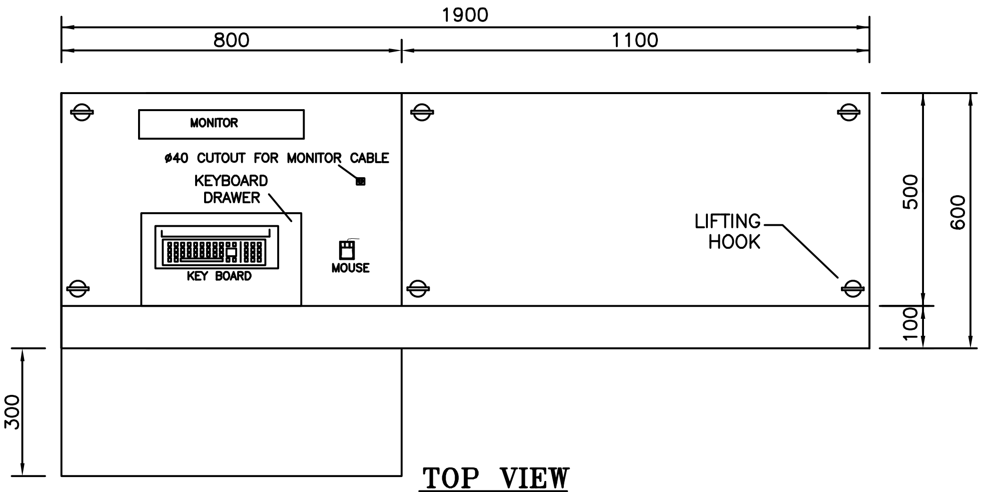
REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY : KKZ	TITLE : GENERAL ARRANGEMENT DRAWING	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :4/6		PROJECT : EVAPORATOR PROJECT — REV: 0	DRG.NO.2012-13/037/GA1



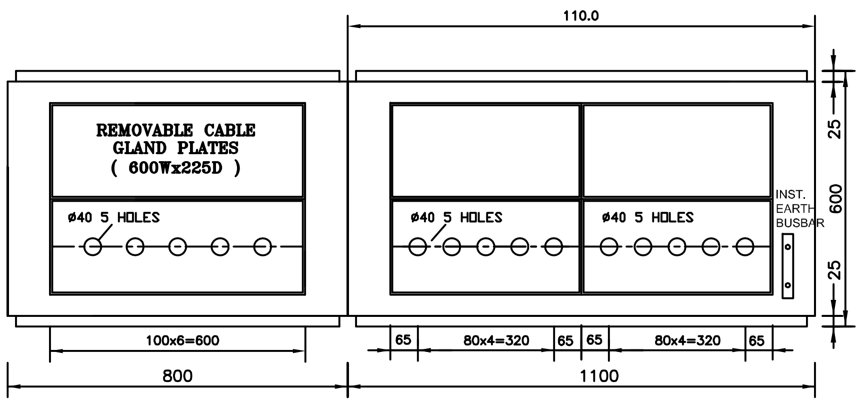
FRONT VIEW (EXTERNAL)

PLC PANEL

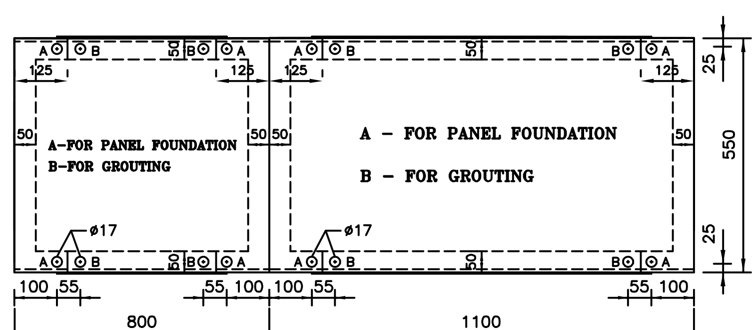
				SCALE : NTS	CHK.BY : KKZ	TITLE : GENERAL ARRANGEMENT DRAWING	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :5/6		PROJECT : EVAPORATOR PROJECT REV: 0	DRG.NO.2012-13/037/GA1



TOP VIEW



BOTTOM VIEW



FOUNDATION DETAILS

PLC PANEL

				SCALE : NTS	CHK.BY : KKZ	TITLE : GENERAL ARRANGEMENT DRAWING
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --
REV.	DESCRIPTION	DATE	BY	SHEET NO :6/6		PROJECT : EVAPORATOR PROJECT

REV: 0

LOGICON TECHNOSOLUTIONS PVT.LTD.

ALL DIMENSIONS ARE IN MM

DRG.NO.2012-13/037/GA1

TITLE	- *SCHEMATIC WIRING DIAGRAM FOR PLC PANEL*
CUSTOMER	- *COLLEGE OF ENGINEERING PUNE*
PROJECT	- *EVAPORATOR PROJECT*
PROJ. NO.	- *LTPL/2012-13/037*
CONSULTANT	- *--*

NOTES

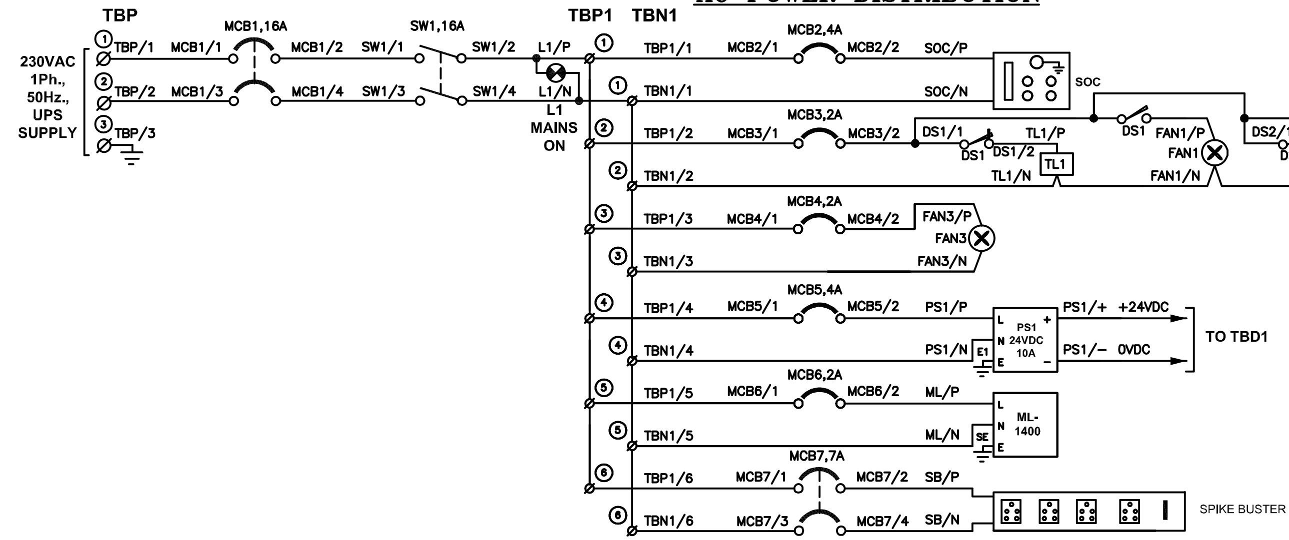
1 ⏚ THIS SYMBOL REPRESENTS ELECTRICAL EARTH.

2 THIS SYMBOL REPRESENTS SCREEN / INSTRUMENTS EARTH.

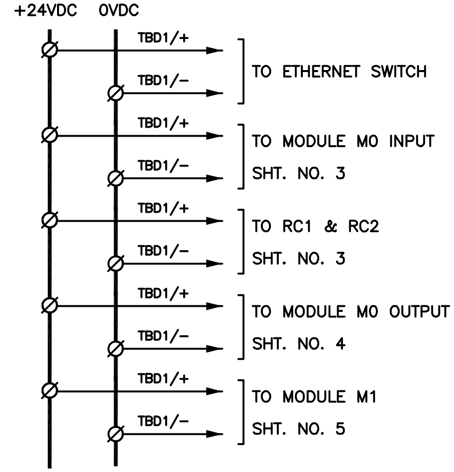
PLC PANEL

				SCALE : NTS	CHK.BY : KKZ	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :1/11		PROJECT : EVAPORATOR PROJECT REV: 0	DRG.NO.2012-13/037/WD1

AC POWER DISTRIBUTION



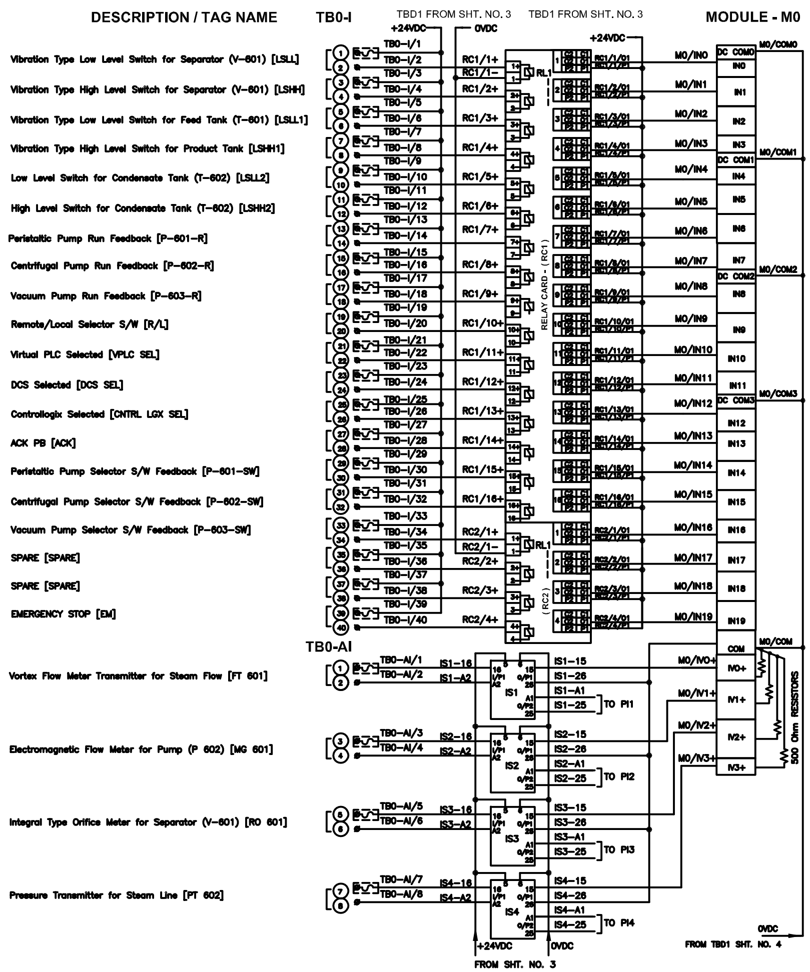
24VDC POWER DISTRIBUTION DIAGRAM



PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY : KKZ	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : ––	ALL DIMENSIONS ARE IN MM
				SHEET NO :2/11		PROJECT : EVAPORATOR PROJECT — REV: 0	DRG.NO.2012–13/037/WD1

1766-L32BWAA ML-1400 DIGITAL I/P. WIRING DIAGRAM



NOTE – FUSE RATING – 1A.

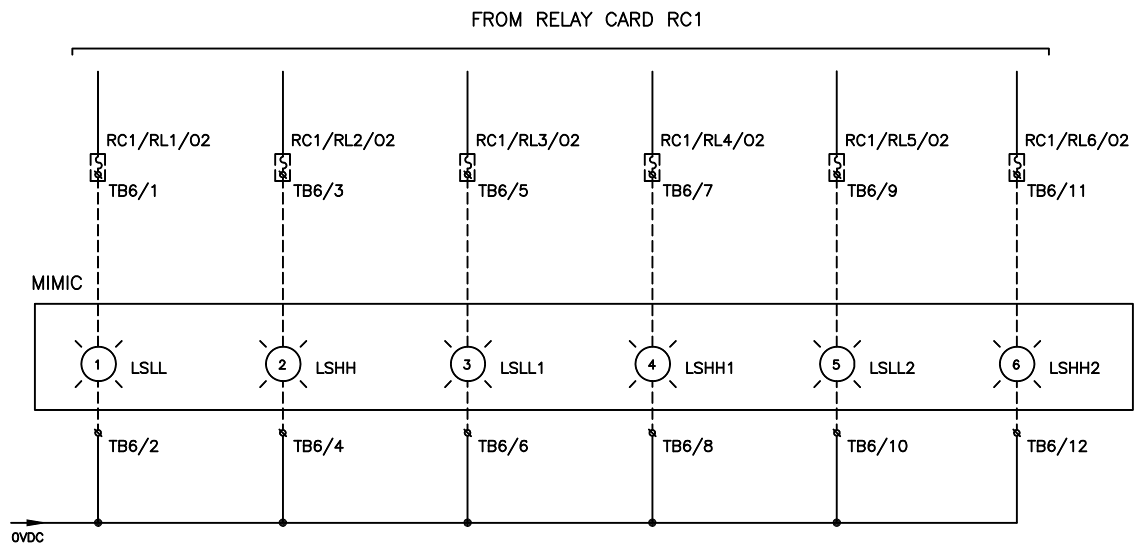
①—㊵ ①—⑧ STANDS FOR TERMINAL NO.

				SCALE : NTS	CHK.BY : KKZ	TITLE : SCHEMATIC WIRING DIAGRAM
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --
REV.	DESCRIPTION	DATE	BY	SHEET NO :3/11		PROJECT : EVAPORATOR PROJECT

LOGICON TECHNOSOLUTIONS PVT.LTD.

ALL DIMENSIONS ARE IN MM

REV: 0 DRG.NO.2012-13/037/WD1



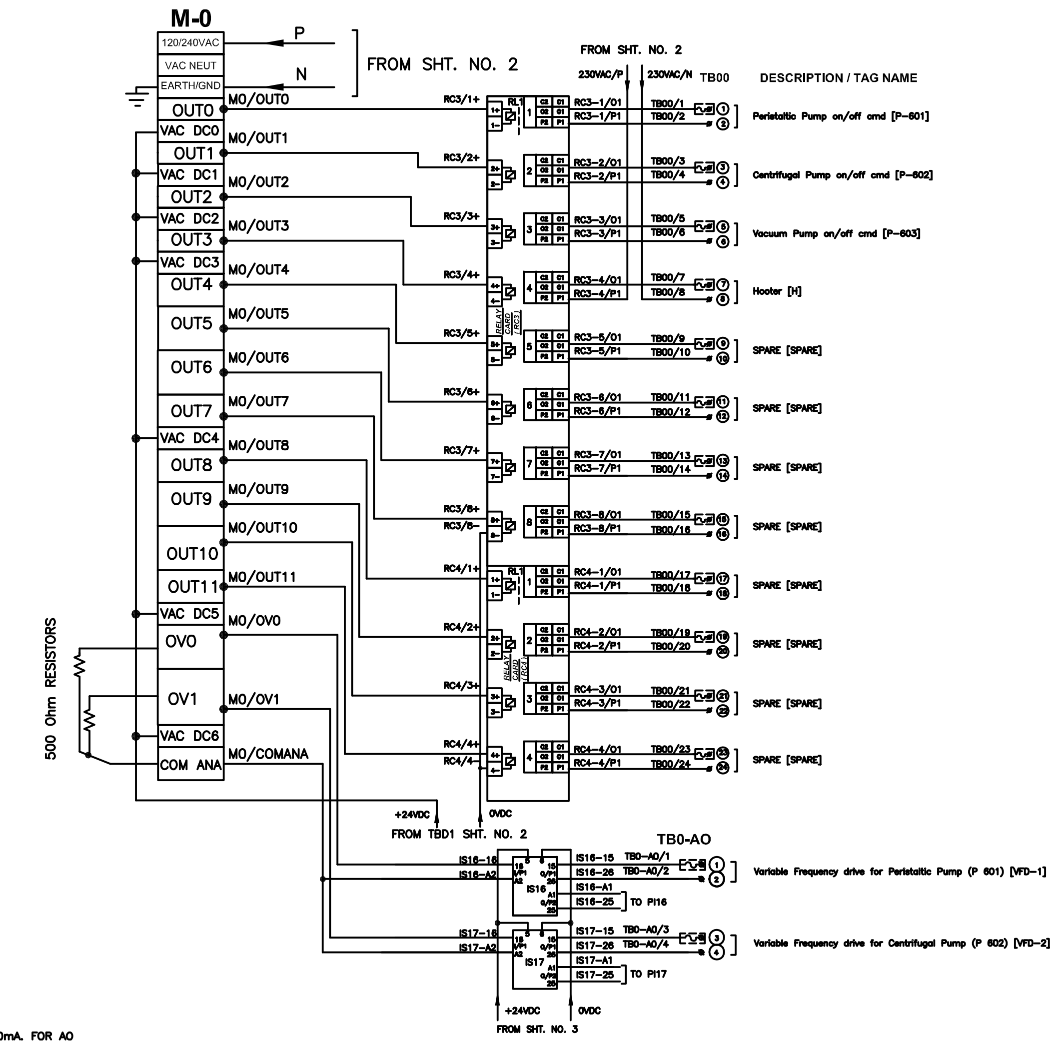
NOTE – FUSE RATING – 1A.

1 ...... 40, 1 ...... 8 STANDS FOR TERMINAL NO.

PLC PANEL

				SCALE : NTS	CHK.BY : KKZ	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :4/11		PROJECT : EVAPORATOR PROJECT REV: 0	DRG.NO.2012-13/037/WD1

1766-L32BWAA ML-1400 DIGITAL O/P. WIRING DIAGRAM

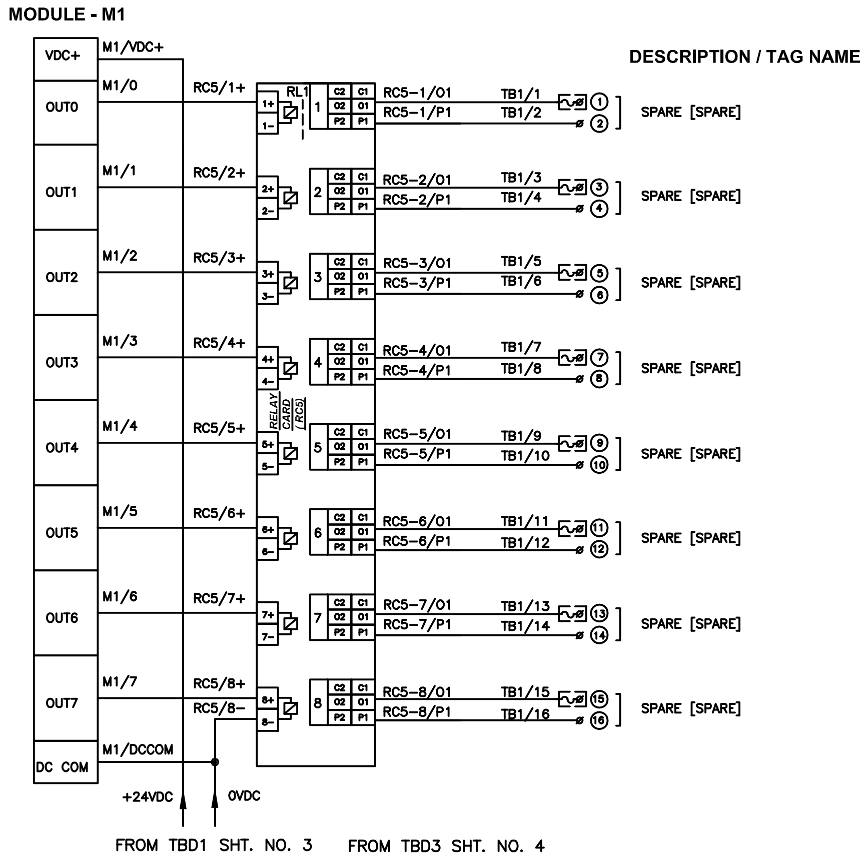


NOTE − FUSE RATING−1A FOR DO, 100mA. FOR AO

1—24 1—4 STANDS FOR TERMINAL NO.

				SCALE : NTS	CHK.BY : KKZ	TITLE : SCHEMATIC WIRING DIAGRAM		LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE		
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : −−		ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :5/11		PROJECT : EVAPORATOR PROJECT	REV: 0	DRG.NO.2012−13/037/WD1

1762 - OB8 DIGITAL OUTPUT WIRING DIAGRAM.

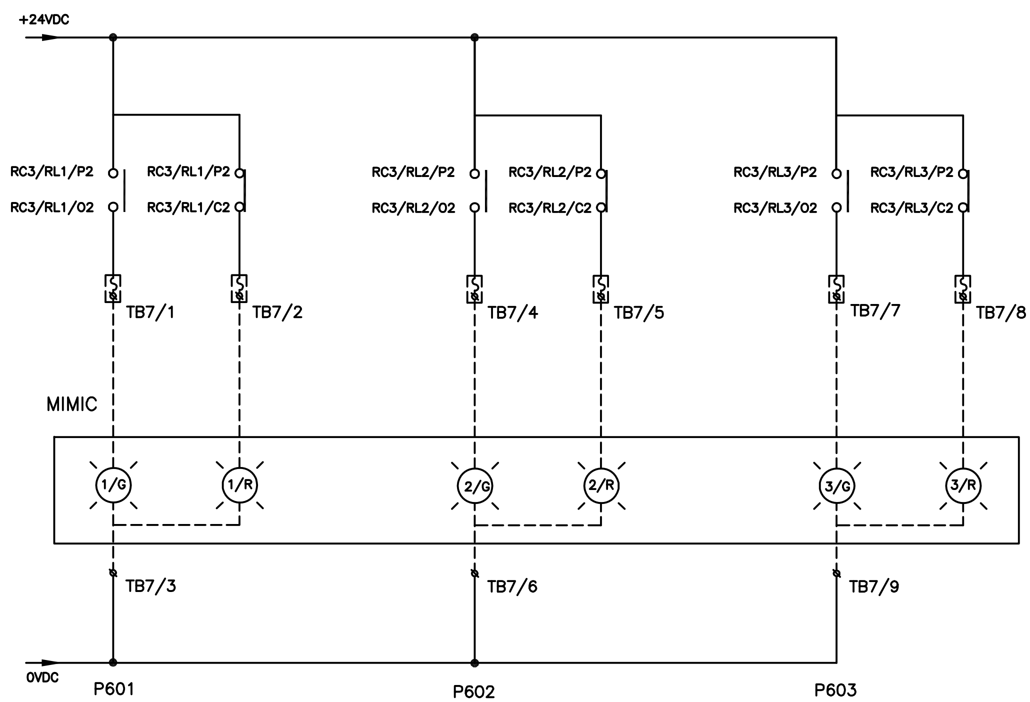


NOTE − FUSE RATING−1A

(1)........ (16) STANDS FOR TERMINAL NO.

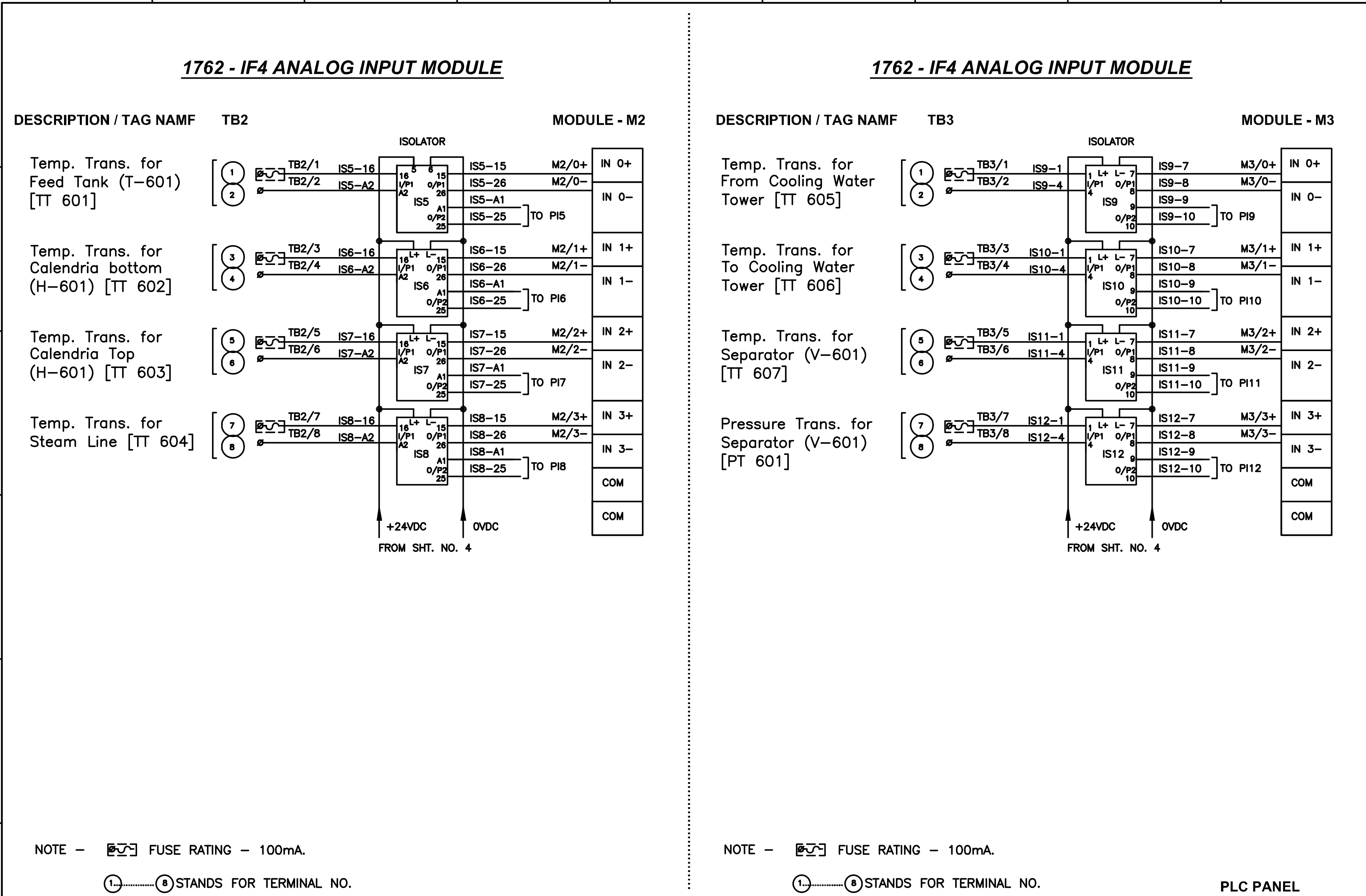
PLC PANEL

				SCALE : NTS	CHK.BY : KKZ	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : −−	ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :6/11		PROJECT : EVAPORATOR PROJECT REV: 0	DRG.NO.2012−13/037/WD1



PLC PANEL

REV.	DESCRIPTION	DATE	BY				
0	ORIGINAL ISSUE	01/10/2012		SCALE : NTS	CHK.BY : KKZ	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB	APD.BY : SBA	CUSTOMER : COLLEGE OF ENGINEERING PUNE	ALL DIMENSIONS ARE IN MM
				DATE:01/10/2012		CONSULTANT : --	
				SHEET NO :7/11		PROJECT : EVAPORATOR PROJECT	REV: 0
							DRG.NO.2012-13/037/WD1



REV.	DESCRIPTION	DATE	BY			
0	ORIGINAL ISSUE	01/10/2012		SCALE : NTS	CHK.BY : KKZ	TITLE : SCHEMATIC WIRING DIAGRAM
				DRAWN : PJB	APD.BY : SBA	CUSTOMER : COLLEGE OF ENGINEERING PUNE
				DATE:01/10/2012		CONSULTANT : ––
				SHEET NO :8/11		PROJECT : EVAPORATOR PROJECT

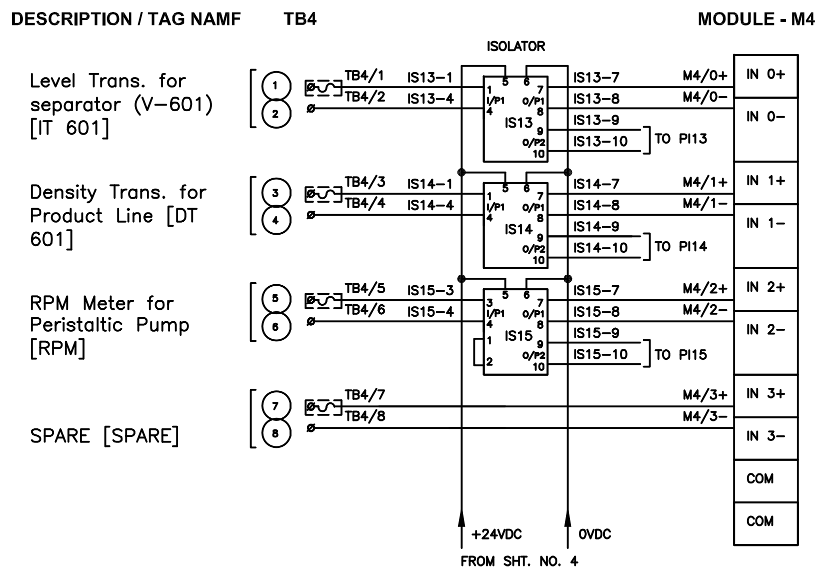
REV: 0

LOGICON TECHNOSOLUTIONS PVT.LTD.

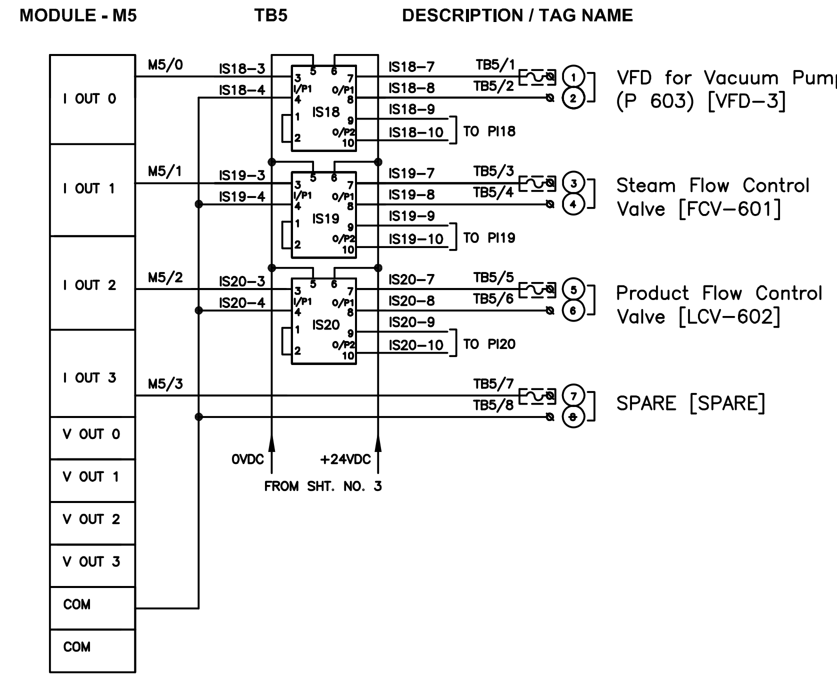
ALL DIMENSIONS ARE IN MM

DRG.NO.2012–13/037/WD1

1762 - IF4 ANALOG INPUT MODULE



1762 OF4 - 4 POINT ANALOG OUTPUT MODULE



NOTE – FUSE RATING – 100mA.

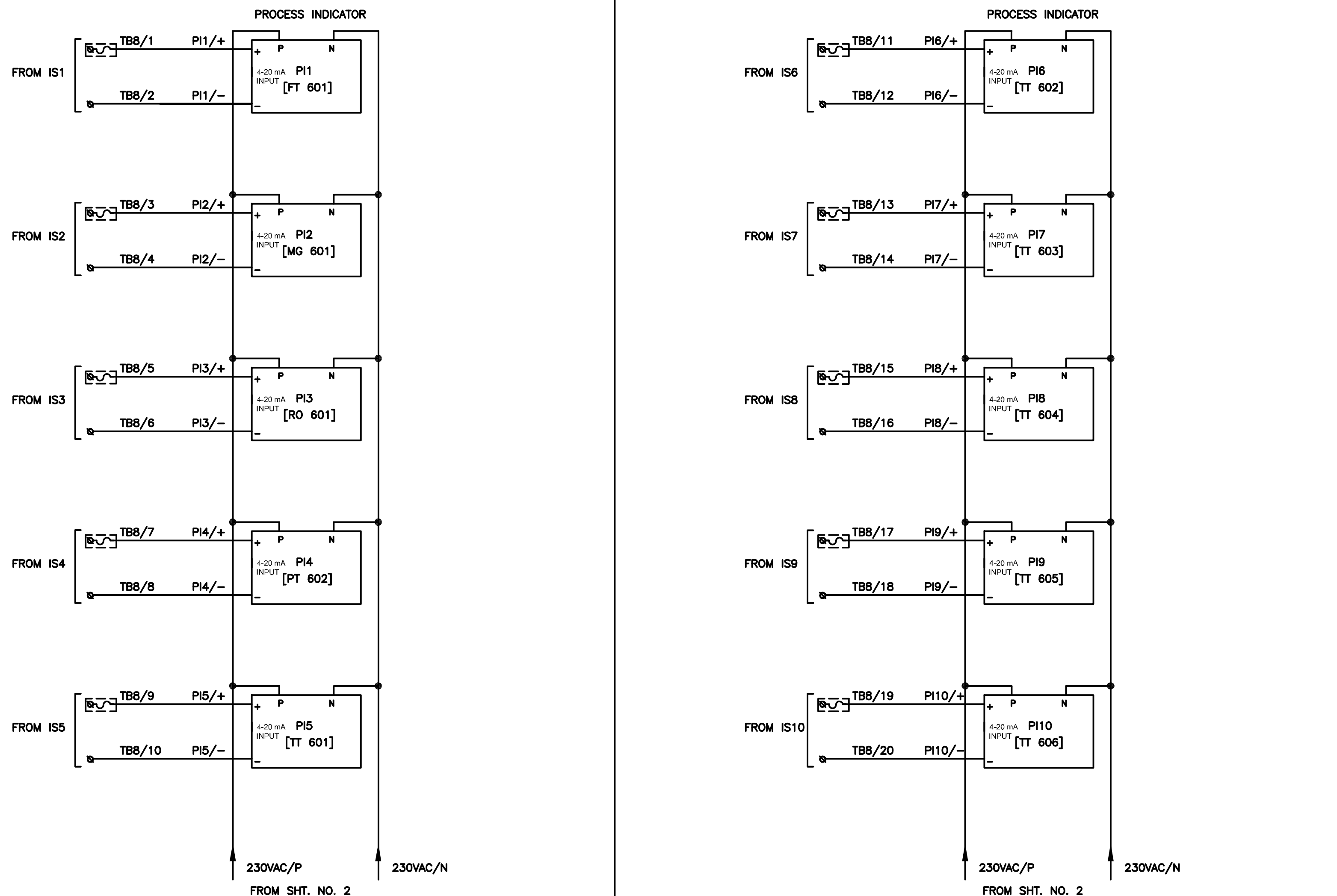
1 .... 8 STANDS FOR TERMINAL NO.

NOTE – FUSE RATING–100mA

1 .... 8 STANDS FOR TERMINAL NO.

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
				SCALE : NTS	CHK.BY : KKZ	TITLE : SCHEMATIC WIRING DIAGRAM	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE	
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --	ALL DIMENSIONS ARE IN MM
				SHEET NO :9/11		PROJECT : EVAPORATOR PROJECT · REV: 0	DRG.NO.2012-13/037/WD1



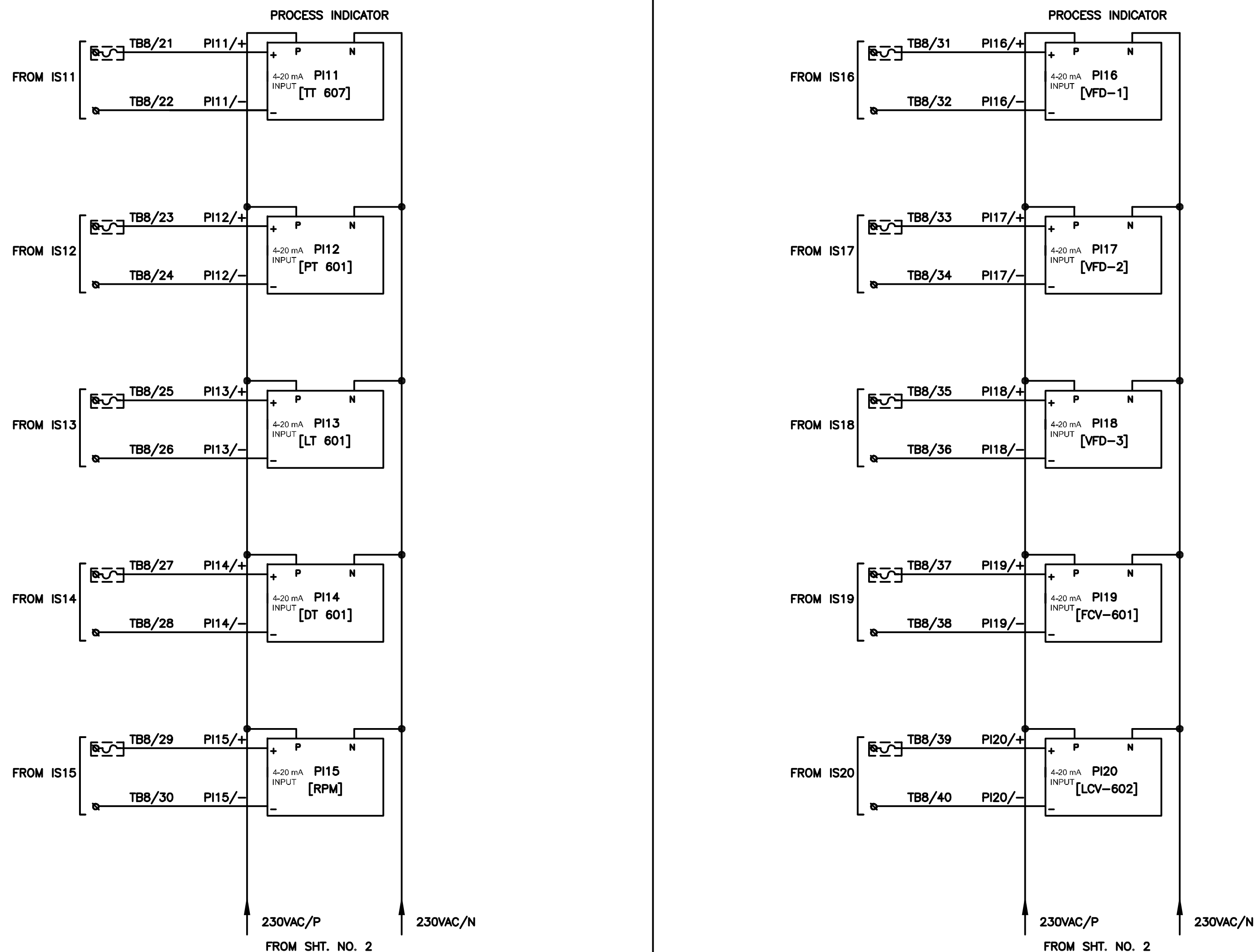
PLC PANEL

REV.	DESCRIPTION	DATE	BY
0	ORIGINAL ISSUE	01/10/2012	

SCALE : NTS
DRAWN : PJB
DATE:01/10/2012
SHEET NO :10/11
CHK.BY : KKZ
APD.BY : SBA

TITLE : SCHEMATIC WIRING DIAGRAM
CUSTOMER : COLLEGE OF ENGINEERING PUNE
CONSULTANT : ——
PROJECT : EVAPORATOR PROJECT
REV: 0

LOGICON TECHNOSOLUTIONS PVT.LTD.
ALL DIMENSIONS ARE IN MM
DRG.NO.2012–13/037/WD1



PLC PANEL

				SCALE : NTS	CHK.BY : KKZ	TITLE : SCHEMATIC WIRING DIAGRAM
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : −−
REV.	DESCRIPTION	DATE	BY	SHEET NO :11/11		PROJECT : EVAPORATOR PROJECT

REV: 0

LOGICON TECHNOSOLUTIONS PVT.LTD.

ALL DIMENSIONS ARE IN MM

DRG.NO.2012−13/037/WD1

TITLE	- ***WIRING SPECIFICATION FOR PLC PANEL***
CUSTOMER	- ***COLLEGE OF ENGINEERING PUNE***
PROJECT	- ***EVAPORATOR PROJECT***
PROJ. NO.	- ***LTPL/2012-13/037***
CONSULTANT	- --

PLC PANEL

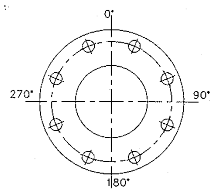
				SCALE : NTS	CHK.BY : KKZ	TITLE : WIRING SPECIFICATION		LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB		CUSTOMER : COLLEGE OF ENGINEERING PUNE		
0	ORIGINAL ISSUE	01/10/2012		DATE:01/10/2012	APD.BY : SBA	CONSULTANT : --		ALL DIMENSIONS ARE IN MM
REV.	DESCRIPTION	DATE	BY	SHEET NO :1/2		PROJECT : EVAPORATOR PROJECT	REV: 0	DRG.NO.2012-13/037/WS1

WIRING SPECIFICATION

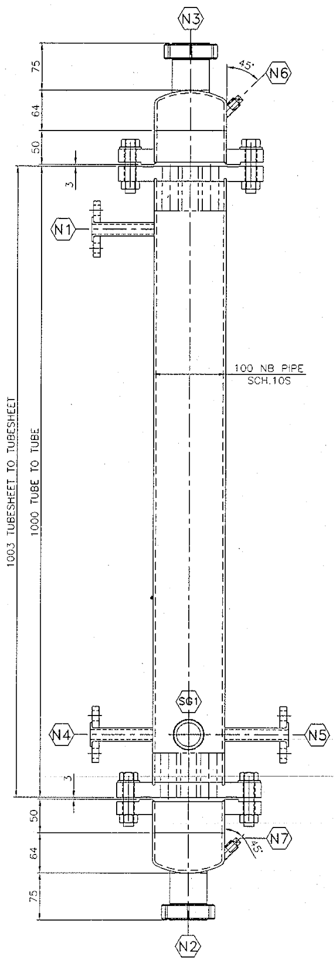
230V AC SUPPLY	PHASE (UPTO DISTRIBUTION TB)	RED	4 mm^2
	NEUTRAL (UPTO DISTRIBUTION TB)	BLACK	4 mm^2
	PHASE (AFTER DISTRIBUTION TB)	RED	1.5 mm^2
	NEUTRAL (AFTER DISTRIBUTION TB)	BLACK	1.5 mm^2
110V AC SUPPLY	PHASE (UPTO DISTRIBUTION TB)	RED	4 mm^2
	NEUTRAL (UPTO DISTRIBUTION TB)	BLACK	4 mm^2
	PHASE (AFTER DISTRIBUTION TB)	RED	1.5 mm^2
	NEUTRAL (AFTER DISTRIBUTION TB)	BLACK	1.5 mm^2
24V DC +VE	UPTO BUSBAR	BLUE	1.5 mm^2
	AFTER BUSBAR	BLUE	1.0 mm^2
24V DC –VE	UPTO BUSBAR	WHITE	1.5 mm^2
	AFTER BUSBAR	WHITE	1.0 mm^2
D/I WIRING		GREY	0.5 mm^2
D/O WIRING	MODULE TO RELAY COIL	GREY	0.5 mm^2
	RELAY CONTACT TO TERMINALS (PF)	BROWN	1.0 mm^2
	RELAY CONTACT TO TERMINALS (24VDC)	BLUE (+), WHITE (–)	1.0 mm^2
	RELAY CONTACT TO TERMINALS (230/110V AC)	RED (P), BLACK (N)	1.0 mm^2
A/I WIRING		ORANGE (+), WHITE (–)	0.5 mm^2
A/O WIRING		YELLOW (+), WHITE (–)	0.5 mm^2
EARTH	POWER	GREEN/YELLOW	2.5 mm^2
	INSTRUMENT	GREEN	1.5 mm^2

PLC PANEL

REV.	DESCRIPTION	DATE	BY				
0	ORIGINAL ISSUE	01/10/2012		SCALE : NTS	CHK.BY : KKZ	TITLE : WIRING SPECIFICATION	LOGICON TECHNOSOLUTIONS PVT.LTD.
				DRAWN : PJB	APD.BY : SBA	CUSTOMER : COLLEGE OF ENGINEERING PUNE	ALL DIMENSIONS ARE IN MM
				DATE:01/10/2012		CONSULTANT : ––	
				SHEET NO :2/2		PROJECT : EVAPORATOR PROJECT	REV: 0
							DRG.NO.2012–13/037/WS1



ORIENTATION PLAN (HOLD)



ELEVATION

NOZZLE	SIZE	SERVICE	ORIENTATION	ELEVATION
N1	15 NB	STEAM INLET	--	--
N2	50.8 OD x 2 THK	RECYCLE LIQUID INLET	--	--
N3	50.8 OD x 2 THK	RECYCLE LIQUID OUTLET	--	--
N4	15 NB	NON CONDENSABLE OUTLET	--	--
N5	15 NB	CONDNESABLE OUTLET	--	--
N6	1/2" NPT	SOCKET WITH PLUG	--	--
N7	1/2" NPT	SOCKET WITH PLUG	--	--
SG1	50.8 OD x 2 THK	SIGHT GLASS	--	--

REV. NO.	DESCRIPTION	DRAWN	CHKD.	APPD.	DATE
0	FOR FABRICATION	M.M.Z	R.A.M.	S.A.M.	01.10.12

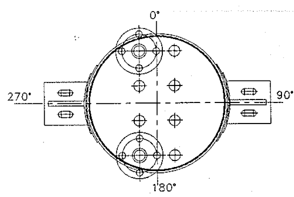
CLIENT :
PLANT :
LOCATION :

THIS DWG. IS THE PROPERTY OF RAJ PROCESS EQUIPMENTS & SYSTEMS PVT.LTD & SHOULD NOT BE REPRODUCED WITHOUT WRITTEN CONSENT FROM
RAJ PROCESS EQUIPMENTS & SYSTEMS PVT. LTD.
JAI GANESH VISION, 'B' WING,3rd FLOOR AKURDI PUNE-411035.

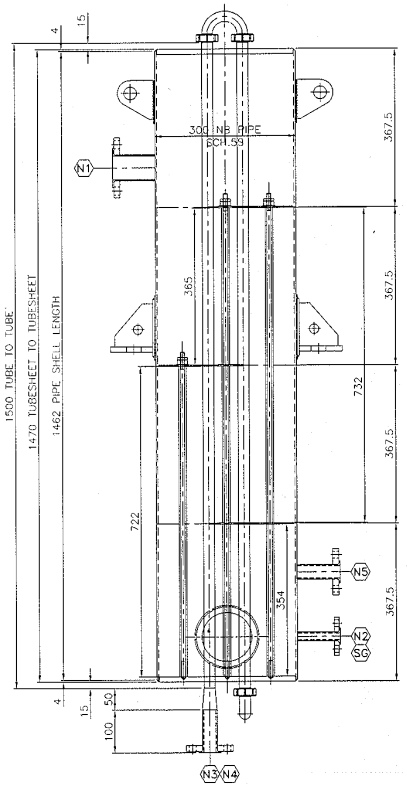
TITLE :

FALLING FILM EFFECT-1 (H-601)

I.D. NO. –
JOB NO RP/12/105
SCALE NTS
CAD FILE NAME –
DWG. NO. RP/12/105-A3-EVP-H-601-01
SHEET 1 OF 1
REV. 0



ORIENTATION PLAN (HOLD)



ELEVATION
SACLE-1:2

NOZZLE	SIZE	SERVICE	ORIENTATION	ELEVATION
N1	50 NB	VAPOUR INLET	--	--
N2	15 NB	CONDENSATE OUTLET	--	--
N3	25 NB	COOLING WATER INLET	--	--
N4	25 NB	COOLING WATER OUTLET	--	--
N5	25 NB	NON CONDENSABLE OUTLET	--	--
SG1	101.6 OD x 2 THK	SIGHT GLASS	--	--

REV. NO.	DESCRIPTION	DRAWN	CHKD.	APPD.	DATE
0	FOR FABRICATION	M.M.Z	R.A.M.	S.A.M.	01.10.12

CLIENT :
PLANT :
LOCATION :

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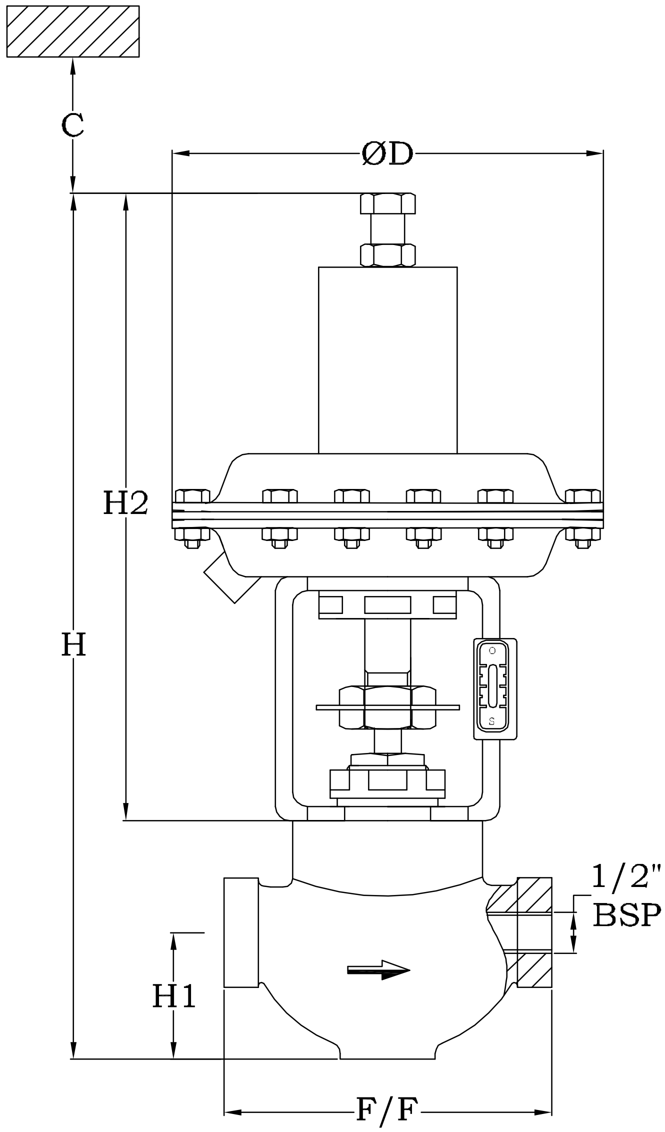
RAJ PROCESS EQUIPMENTS & SYSTEMS PVT. LTD.
JAI GANESH VISION, 'B' WING,3rd FLOOR AKURDI PUNE-411035.

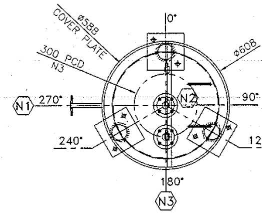
TITLE : SURFACE CONDENSER (H-602)	I.D. NO. –	JOB NO RP/12/105
	SCALE NTS	CAD FILE NAME –
DWG. NO. RP/12/105-A3-EVP-H-602-01	SHEET 1 OF 1	REV. 0



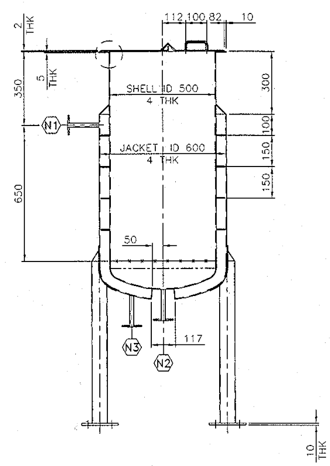
DESCRIPTION					MOUNTING DIMENSIONS (mm.)					
VALVE Sr.No.	TAG No.	VALVE SIZE	ACTUATOR MODEL	FLANGE RATING	F/F	H	H1	H2	C	D
30869	-	1/2"	PDC-012	150#	114	341	44	258	200	150

REV. No.	DATE	REVISION	SIGN

CUSTOMER	Date Process Control Instruments Pvt.Ltd.	PNEUCON VALVES PVT LTD	DRAWN: L.G; CHECKED: D.M.G; APPROVED: J.N.C; DATE: 18.12.2012
P. O. No.	-		
W.O. No.	PVW-1213-1158	DRG. No: PVW/1213/1158/01	SCALE: N.T.S.
CONSULTANT	-	Drg.Code.No: GA19015151C61	
PROJECT	-	SUBJECT: G.A. DRAWING - 1/2" X 150# GLOBE-2 WAY CONTROL VALVE (SERIES-119)	



ORIENTATION PLAN



ELEVATION

NOZZLE SCHEDULE

NOZZLE	SIZE	SERVICE	ORIENTATION	ELEVATION
N1	15 NB	STEAM INLET	270°	ON JACKET
N2	15 NB	FEED OUTLET	CENTER	BOTTOM DISH
N3	15 NB	CONDENSATE OUTLET	180°	JACKET DISH

REV. NO.	DESCRIPTION	DRAWN	CHKD.	APPD.	DATE
0	FOR FABRICATION	M.M.Z	D.C.M.	S.A.M.	28.09.12

CLIENT :
PLANT :
LOCATION :

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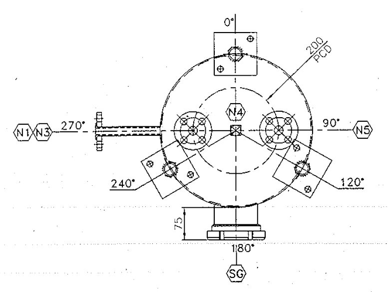
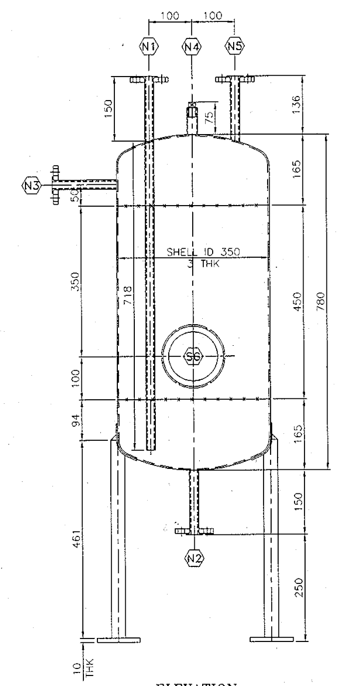
RAJ PROCESS EQUIPMENTS & SYSTEMS PVT. LTD.
JAI GANESH VISION, 'B' WING,3rd FLOOR AKURDI PUNE-411035.

TITLE :
FEED TANK (T-601)

I.D. NO. –	JOB NO RP/12/105	
SCALE NTS	CAD FILE NAME –	
DWG. NO. RP/12/105-A3-EVP-T-601-01	SHEET 1 OF 1	REV. 0



ORIENTATION PLAN



ELEVATION

NOZZLE SCHEDULE

NOZZLE	SIZE	SERVICE	ORIENTATION	ELEVATION
N1	15 NB	CONDENSATE INLET	270°	TOP CAP
N2	15 NB	CONDENSATE OUTLET	CENTER	BOTTOM CAP
N3	15 NB	VACUUM BREAKER	270°	TOP CAP
N4	1/2" NPT	SOCKET WITH PLUG	CENTER	TOP CAP
N5	15 NB	BALANCING LINE	90°	TOP CAP
SG	101.6 OD x 2 THK	SIGHT GLASS	180°	ON SHELL

REV. NO.	DESCRIPTION	DRAWN	CHKD.	APPD.	DATE
0	FOR FABRICATION	M.M.Z	D.G.M.	S.A.M.	28.09.12

CLIENT :
PLANT :
LOCATION :

THIS DWG. IS THE PROPERTY OF RAJ PROCESS EQUIPMENTS & SYSTEMS PVT.LTD & SHOULD NOT BE REPRODUCED WITHOUT WRITTEN CONSENT FROM

RAJ PROCESS EQUIPMENTS & SYSTEMS PVT. LTD.
JAI GANESH VISION, 'B' WING,3rd FLOOR AKURDI PUNE-411035.

TITLE : CONDENSATE TANK (T-601)	I.D. NO. –	JOB NO RP/12/105
	SCALE NTS	CAD FILE NAME –
DWG. NO. RP/12/105-A3-EVP-T-602-01	SHEET 1 OF 1	REV. 0

Appendix E

Micrologix Programming

E.1 Evaporator Programming

RSLogix 500 Project Report

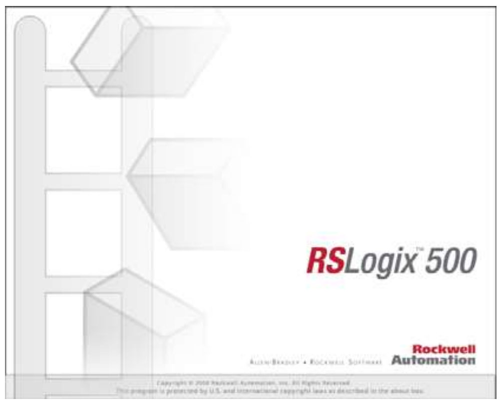


Table Of Contents

Processor Type: Bul.1766   MicroLogix 1400 Series A

Processor Name: UNTITLED

Total Memory Used: 1072 Instruction Words Used - 1316 Data Table Words Used

Total Memory Left: 11362 Instruction Words Left

Program Files: 14

Data Files: 22

Program ID: 9d9a

I/O Configuration

0	Bul.1766	MicroLogix 1400 Series A
1	1762-OB8	8-Output (TRANS-SRC) 10/50 VDC
2	1762-IF4	Analog 4 Chan. Input
3	1762-IF4	Analog 4 Chan. Input
4	1762-IF4	Analog 4 Chan. Input
5	1762-OF4	4-Channel Analog I/V Output Module
6		
7		

```
CHANNEL 0 (SYSTEM) - Driver: Modbus RTU Slave
   CHANNEL 0 (SYSTEM) - Driver: Modbus RTU Slave Edit Resource/Owner Timeout:  60
   CHANNEL 0 (SYSTEM) - Driver: Modbus RTU Slave Passthru Link ID:  1
   CHANNEL 0 (SYSTEM) - Driver: Modbus RTU Slave Write Protected:  No
   CHANNEL 0 (SYSTEM) - Driver: Modbus RTU Slave Comms Servicing Selection:  Yes
   CHANNEL 0 (SYSTEM) - Driver: Modbus RTU Slave Message Servicing Selection:  Yes
   CHANNEL 0 (SYSTEM) - Driver: Modbus RTU Slave 1st AWA Append Character:  \d
   CHANNEL 0 (SYSTEM) - Driver: Modbus RTU Slave 2nd AWA Append Character:  \a

   Node :  2 (decimal)
   Baud: 19200
   Parity:  NONE
   File Number for Coils:  29
   File Number for Contacts:  30
   File Number for Input Registers:  31
   File Number for Holding Registers:  34
   Expanded:  No
   Control Line :  No Handshaking
   InterCharacter Timeout(x1 ms):  0
   Pre Transmit Delay(x1 ms):  0


CHANNEL 1 (SYSTEM) - Driver: Ethernet
   CHANNEL 1 (SYSTEM) - Driver: Ethernet Edit Resource/Owner Timeout:  60
   CHANNEL 1 (SYSTEM) - Driver: Ethernet Passthru Link ID:  1
   CHANNEL 1 (SYSTEM) - Driver: Ethernet Write Protected:  No
   CHANNEL 1 (SYSTEM) - Driver: Ethernet Comms Servicing Selection:  Yes
   CHANNEL 1 (SYSTEM) - Driver: Ethernet Message Servicing Selection:  Yes

   Hardware Address:  00:1D:9C:A3:51:10
   IP Address:  192.168.1.225
   Subnet Mask:  255.255.255.0
   Gateway Address:  0.0.0.0
   Msg Connection Timeout (x 1mS):  15000
   Msg Reply Timeout (x mS):  3000
   Inactivity Timeout (x Min):  30
   Bootp Enable:  No
   Dhcp Enable  No
   SMTP Enable:  No
   SNMP Enable:  Yes
   HTTP Enable:  Yes
   Auto Negotiate Enable:  Yes
   Port Speed Enable:  10/100 Mbps Full Duplex/Half Duplex
   Contact:
   Location:


CHANNEL 2 (SYSTEM) - Driver: Modbus RTU Slave
   CHANNEL 2 (SYSTEM) - Driver: Modbus RTU Slave Edit Resource/Owner Timeout:  60
   CHANNEL 2 (SYSTEM) - Driver: Modbus RTU Slave Passthru Link ID:  1
   CHANNEL 2 (SYSTEM) - Driver: Modbus RTU Slave Write Protected:  No
   CHANNEL 2 (SYSTEM) - Driver: Modbus RTU Slave Comms Servicing Selection:  Yes
   CHANNEL 2 (SYSTEM) - Driver: Modbus RTU Slave Message Servicing Selection:  Yes
   CHANNEL 2 (SYSTEM) - Driver: Modbus RTU Slave 1st AWA Append Character:  \d
   CHANNEL 2 (SYSTEM) - Driver: Modbus RTU Slave 2nd AWA Append Character:  \a

   Node :  2 (decimal)
   Baud: 19200
   Parity:  NONE
   File Number for Coils:  29
   File Number for Contacts:  30
   File Number for Input Registers:  31
   File Number for Holding Registers:  33
   Expanded:  No
   Control Line :  No Handshaking
   InterCharacter Timeout(x1 ms):  0
   Pre Transmit Delay(x1 ms):  0
```

Program File List

Name	Number	Type	Rungs	Debug	Bytes
[SYSTEM]	0	SYS	0	No	0
	1	SYS	0	No	0
	2	LADDER	12	No	130
	3	LADDER	17	No	1587
	4	LADDER	7	No	556
	5	LADDER	21	No	349
	6	LADDER	20	No	307
	7	LADDER	8	No	221
	8	LADDER	13	No	387
	9	LADDER	26	No	647
	11	LADDER	9	No	180
	12	LADDER	14	No	1288
	13	LADDER	13	No	1165
	14	LADDER	15	No	1185

Data File List

Name	Number	Type	Scope	Debug	Words	Elements	Last
OUTPUT	0	O	Global	No	33	11	O:10
INPUT	1	I	Global	No	93	31	I:30
STATUS	2	S	Global	No	0	66	S:65
BINARY	3	B	Global	No	20	20	B3:19
TIMER	4	T	Global	No	3	1	T4:0
COUNTER	5	C	Global	No	3	1	C5:0
CONTROL	6	R	Global	No	3	1	R6:0
INTEGER	7	N	Global	No	52	52	N7:51
FLOAT	8	F	Global	No	180	90	F8:89
	9	F	Global	No	60	30	F9:29
	10	N	Global	No	9	9	N10:8
	11	PD	Global	No	230	10	PD11:9
	12	F	Global	No	16	8	F12:7
	16	PD	Global	No	230	10	PD16:9
	23	N	Global	No	23	23	N23:22
	24	N	Global	No	40	40	N24:39
	29	N	Global	No	30	30	N29:29
	30	N	Global	No	13	13	N30:12
	31	N	Global	No	1	1	N31:0
	32	N	Global	No	77	77	N32:76
	33	N	Global	No	100	100	N33:99
	34	N	Global	No	100	100	N34:99

Ladder Table of Contents

File	Rung	Page Title	Page

0000 JSR Jump To Subroutine SBR File Number U:3

0001 JSR Jump To Subroutine SBR File Number U:4

0002 JSR Jump To Subroutine SBR File Number U:5

0003 JSR Jump To Subroutine SBR File Number U:6

0004 REMOTE/(LOCAL=1) N7:9 0 — EMERGENCY STOP N7:19 0 — JSR Jump To Subroutine SBR File Number U:8

0005 REMOTE/(LOCAL=1) N7:9 0 — EMERGENCY STOP N7:19 0 — JSR Jump To Subroutine SBR File Number U:9

0006 JSR Jump To Subroutine SBR File Number U:7

0007 JSR Jump To Subroutine SBR File Number U:12

0008 JSR Jump To Subroutine SBR File Number U:11

0009 JSR Jump To Subroutine SBR File Number U:13

0010 JSR Jump To Subroutine SBR File Number U:14

0011 END

0000

STEAM FLOW
LES
Less Than (A<B)
Source A I:0.4
825<
Source B 819
819<

STEAM FLOW
MOV
Move
Source 819
819<
Dest I:0.4
825<

STEAM FLOW
GRT
Greater Than (A>B)
Source A I:0.4
825<
Source B 4096
4096<

STEAM FLOW
MOV
Move
Source 4096
4096<
Dest I:0.4
825<

STEAM FLOW
SCP
Scale w/Parameters
Input I:0.4
825<
Input Min. 819.0
819.0<
Input Max. 4096.0
4096.0<
Scaled Min. F8:0
0.0<
Scaled Max. F8:1
30.0<
Output F8:2
0.05492829<

0001

CIRCULATION FLOW
LES
Less Than (A<B)
Source A I:0.5
2289<
Source B 819
819<

CIRCULATION FLOW
MOV
Move
Source 819
819<
Dest I:0.5
2289<

CIRCULATION FLOW
GRT
Greater Than (A>B)
Source A I:0.5
2289<
Source B 4096
4096<

CIRCULATION FLOW
MOV
Move
Source 4096
4096<
Dest I:0.5
2289<

CIRCULATION FLOW
SCP
Scale w/Parameters
Input I:0.5
2289<
Input Min. 819.0
819.0<
Input Max. 4096.0
4096.0<
Scaled Min. F8:5
0.0<
Scaled Max. F8:6
10000.0<
Output F8:7
4501.068<

0002

LES
Less Than (A<B)
Source A I:0.6
819<
Source B 819
819<

MOV
Move
Source 819
819<
Dest I:0.6
819<

GRT
Greater Than (A>B)
Source A I:0.6
819<
Source B 4096
4096<

MOV
Move
Source 4096
4096<
Dest I:0.6
819<

SCP
Scale w/Parameters
Input I:0.6
819<
Input Min. 819.0
819.0<
Input Max. 4096.0
4096.0<
Scaled Min. F8:10
0.0<
Scaled Max. F8:11
100.0<
Output F8:12
0.0<

0003

STEAM PRESSURE
LES
Less Than (A<B)
Source A I:0.7
819<
Source B 819
819<

STEAM PRESSURE
MOV
Move
Source 819
819<
Dest I:0.7
819<

STEAM PRESSURE
GRT
Greater Than (A>B)
Source A I:0.7
819<
Source B 4096
4096<

STEAM PRESSURE
MOV
Move
Source 4096
4096<
Dest I:0.7
819<

STEAM PRESSURE
SCP
Scale w/Parameters
Input I:0.7
819<
Input Min. 819.0
819.0<
Input Max. 4096.0
4096.0<
Scaled Min. F8:15
0.0<
Scaled Max. F8:16
5.0<
Output F8:17
0.0<

0004

TEMP FEED TANK
LES
Less Than (A<B)
Source A I:2.0
0<
Source B 0
0<

TEMP FEED TANK
MOV
Move
Source 0
0<
Dest I:2.0
0<

TEMP FEED TANK
GRT
Greater Than (A>B)
Source A I:2.0
0<
Source B 16383
16383<

TEMP FEED TANK
MOV
Move
Source 16383
16383<
Dest I:2.0
0<

TEMP FEED TANK
SCP
Scale w/Parameters
Input I:2.0
0<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. F8:20
0.0<
Scaled Max. F8:21
200.0<
Output F8:22
0.0<

0005

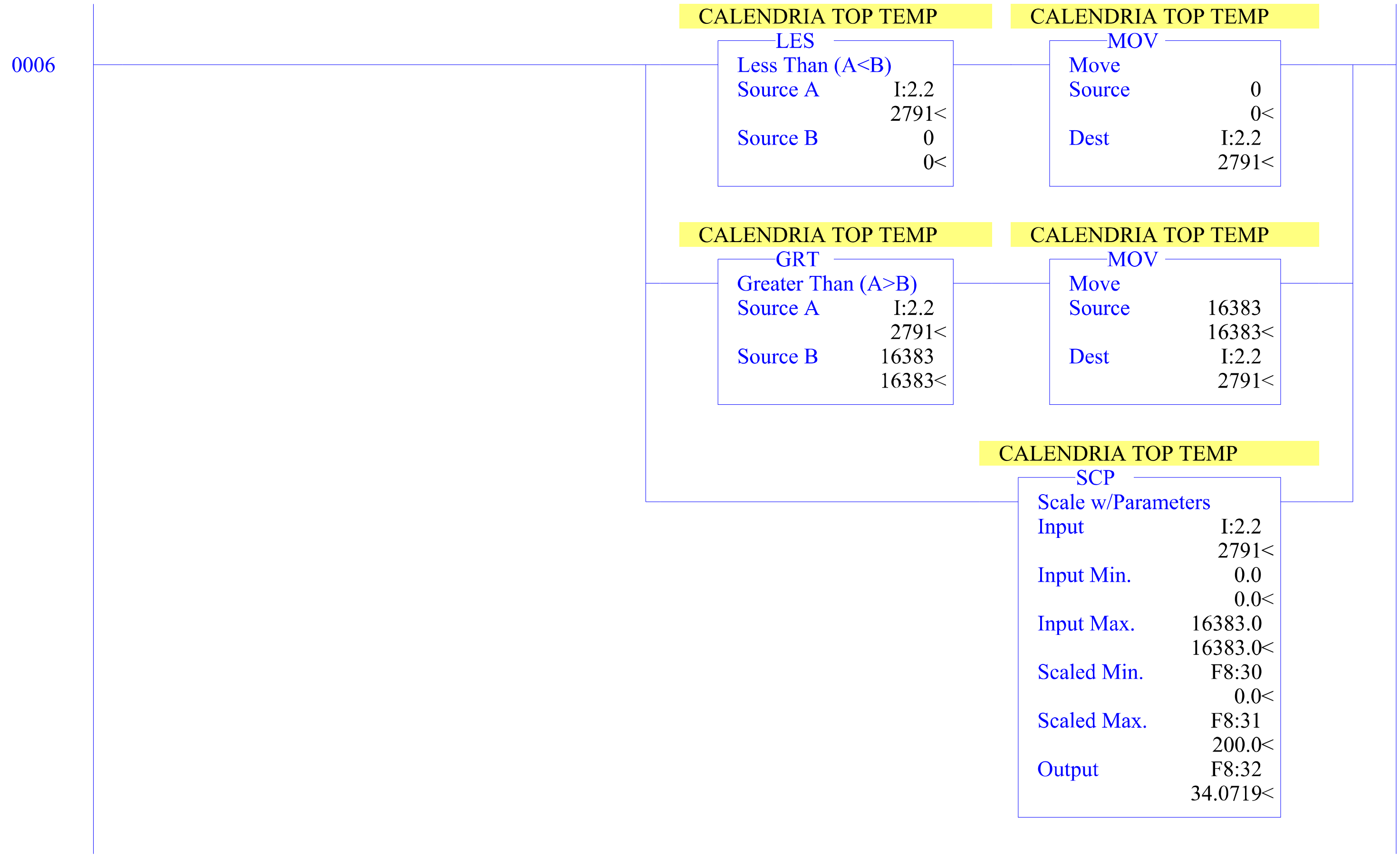
CALENDRIA BTM TEMP
LES
Less Than (A<B)
Source A I:2.1
2734<
Source B 0
0<

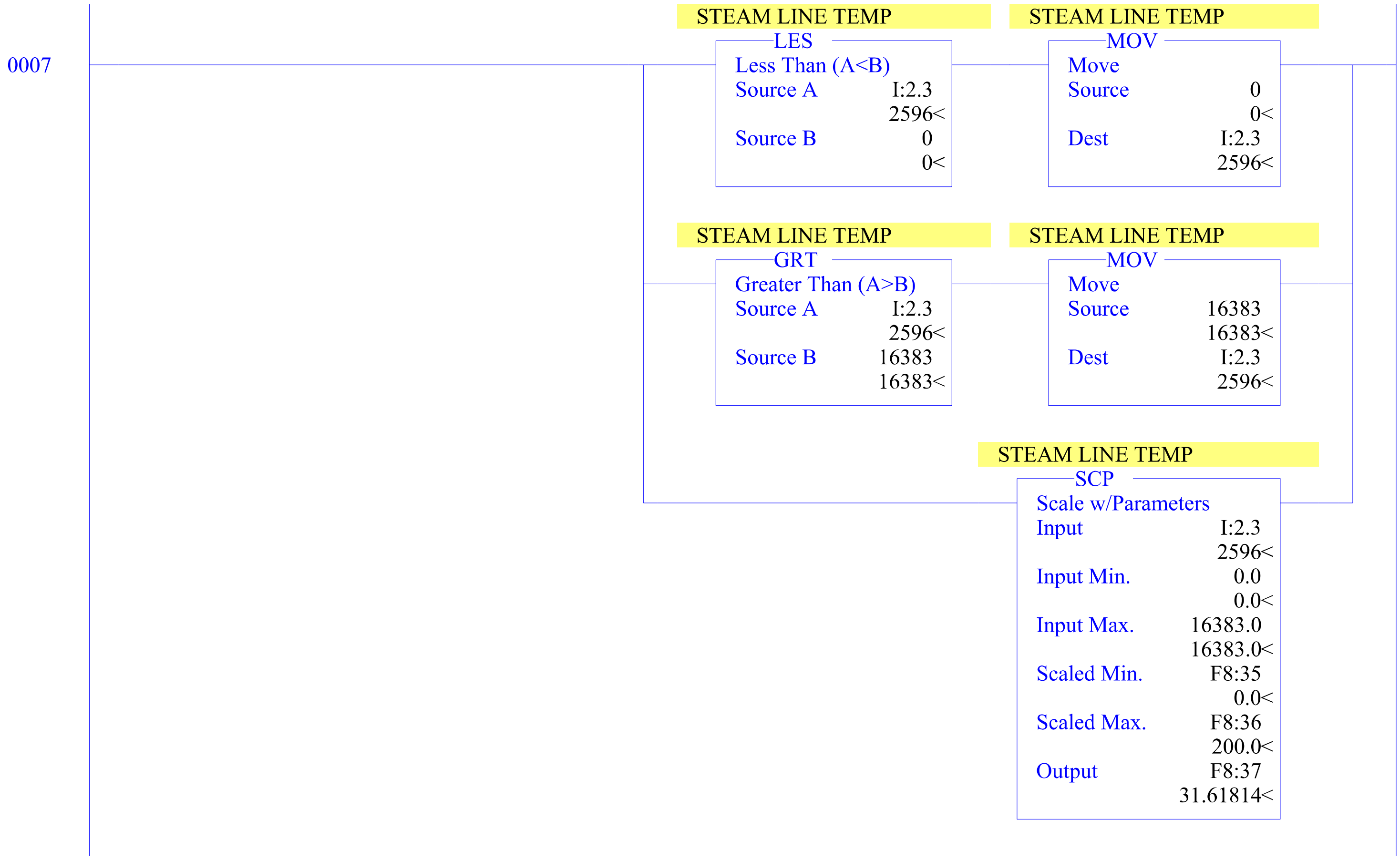
CALENDRIA BTM TEMP
MOV
Move
Source 0
0<
Dest I:2.1
2734<

CALENDRIA BTM TEMP
GRT
Greater Than (A>B)
Source A I:2.1
2734<
Source B 16383
16383<

CALENDRIA BTM TEMP
MOV
Move
Source 16383
16383<
Dest I:2.1
2734<

CALENDRIA BTM TEMP
SCP
Scale w/Parameters
Input I:2.1
2734<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. F8:25
0.0<
Scaled Max. F8:26
200.0<
Output F8:27
33.37606<


0006
CALENDRIA TOP TEMP
LES
Less Than (A<B)
Source A I:2.2
2791<
Source B 0
0<
CALENDRIA TOP TEMP
MOV
Move
Source 0
0<
Dest I:2.2
2791<
CALENDRIA TOP TEMP
GRT
Greater Than (A>B)
Source A I:2.2
2791<
Source B 16383
16383<
CALENDRIA TOP TEMP
MOV
Move
Source 16383
16383<
Dest I:2.2
2791<
CALENDRIA TOP TEMP
SCP
Scale w/Parameters
Input I:2.2
2791<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. F8:30
0.0<
Scaled Max. F8:31
200.0<
Output F8:32
34.0719<


0007
STEAM LINE TEMP
LES
Less Than (A<B)
Source A I:2.3
2596<
Source B 0
0<
STEAM LINE TEMP
MOV
Move
Source 0
0<
Dest I:2.3
2596<
STEAM LINE TEMP
GRT
Greater Than (A>B)
Source A I:2.3
2596<
Source B 16383
16383<
STEAM LINE TEMP
MOV
Move
Source 16383
16383<
Dest I:2.3
2596<
STEAM LINE TEMP
SCP
Scale w/Parameters
Input I:2.3
2596<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. F8:35
0.0<
Scaled Max. F8:36
200.0<
Output F8:37
31.61814<

0008

COOLING WATR INLET TEMP

LES
Less Than (A<B)
Source A I:3.0
2632<
Source B 0
0<

COOLING WATR INLET TEMP

MOV
Move
Source 0
0<
Dest I:3.0
2632<

COOLING WATR INLET TEMP

GRT
Greater Than (A>B)
Source A I:3.0
2632<
Source B 16383
16383<

COOLING WATR INLET TEMP

MOV
Move
Source 16383
16383<
Dest I:3.0
2632<

COOLING WATR INLET TEMP

SCP
Scale w/Parameters
Input I:3.0
2632<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. F8:40
0.0<
Scaled Max. F8:41
200.0<
Output F8:42
32.13087<

0009

COOLING WATR OUTLET TEMP
LES
Less Than (A<B)
Source A I:3.1
0<
Source B 0
0<

COOLING WATR OUTLET TEMP
MOV
Move
Source 0
0<
Dest I:3.1
0<

COOLING WATR OUTLET TEMP
GRT
Greater Than (A>B)
Source A I:3.1
0<
Source B 16383
16383<

COOLING WATR OUTLET TEMP
MOV
Move
Source 16383
16383<
Dest I:3.1
0<

COOLING WATR OUTLET TEMP
SCP
Scale w/Parameters
Input I:3.1
0<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. F8:45
0.0<
Scaled Max. F8:46
200.0<
Output F8:47
0.0<

0010

SEPERATOR TEMP
LES
Less Than (A<B)
Source A I:3.2
2689<
Source B 0
0<

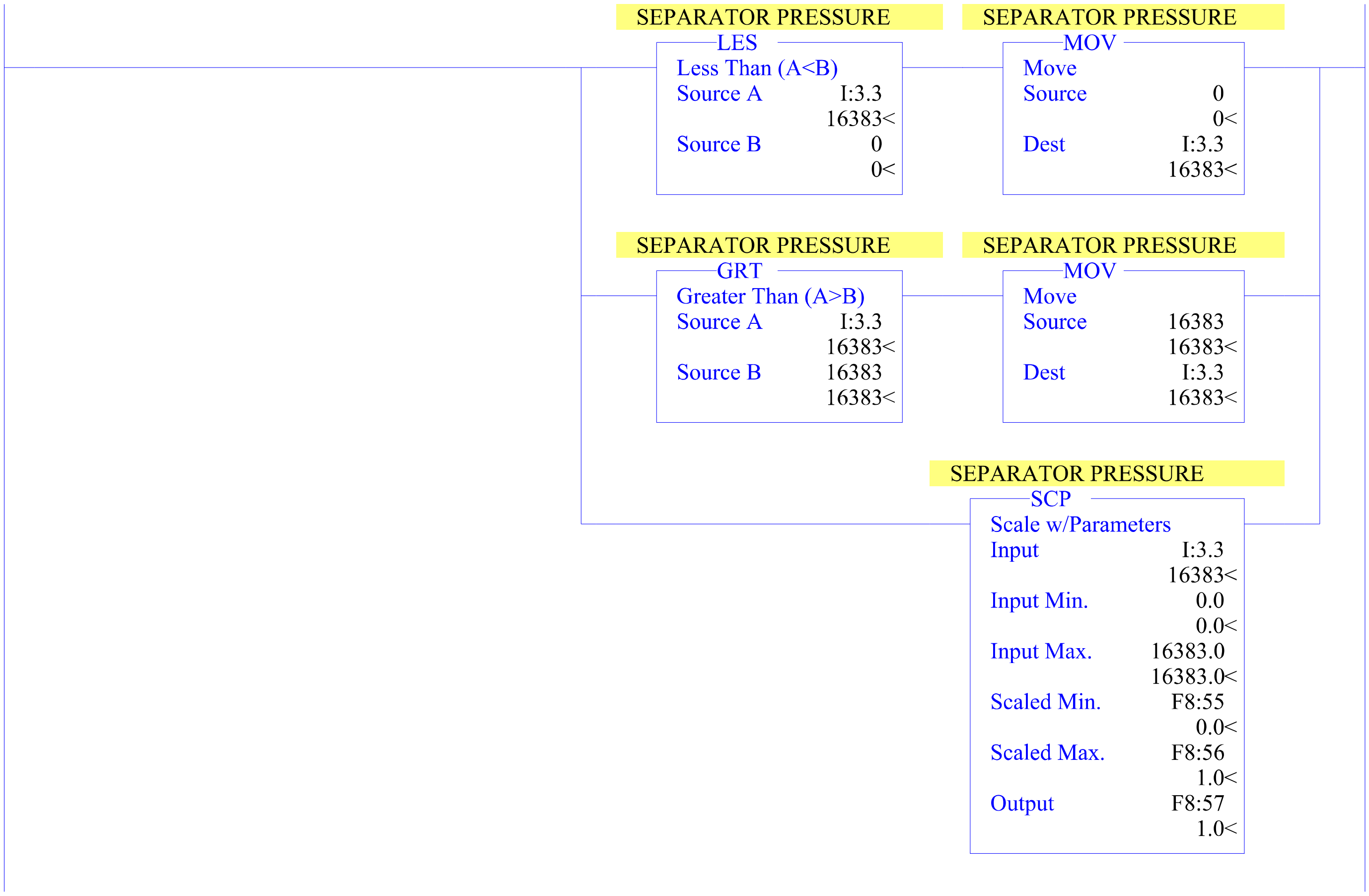
SEPERATOR TEMP
MOV
Move
Source 0
0<
Dest I:3.2
2689<

SEPERATOR TEMP
GRT
Greater Than (A>B)
Source A I:3.2
2689<
Source B 16383
16383<

SEPERATOR TEMP
MOV
Move
Source 16383
16383<
Dest I:3.2
2689<

SEPERATOR TEMP
SCP
Scale w/Parameters
Input I:3.2
2689<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. F8:50
0.0<
Scaled Max. F8:51
200.0<
Output F8:52
32.8145<

0011


SEPARATOR PRESSURE
LES
Less Than (A<B)
Source A I:3.3
16383<
Source B 0
0<
SEPARATOR PRESSURE
MOV
Move
Source 0
0<
Dest I:3.3
16383<
SEPARATOR PRESSURE
GRT
Greater Than (A>B)
Source A I:3.3
16383<
Source B 16383
16383<
SEPARATOR PRESSURE
MOV
Move
Source 16383
16383<
Dest I:3.3
16383<
SEPARATOR PRESSURE
SCP
Scale w/Parameters
Input I:3.3
16383<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. F8:55
0.0<
Scaled Max. F8:56
1.0<
Output F8:57
1.0<

0012

SEPARATOR LEVEL
LES
Less Than (A<B)
Source A I:4.0
5821<
Source B 0
0<

SEPARATOR LEVEL
MOV
Move
Source 0
0<
Dest I:4.0
5821<

SEPARATOR LEVEL
GRT
Greater Than (A>B)
Source A I:4.0
5821<
Source B 16383
16383<

SEPARATOR LEVEL
MOV
Move
Source 16383
16383<
Dest I:4.0
5821<

SEPARATOR LEVEL
SCP
Scale w/Parameters
Input I:4.0
5821<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. F8:60
0.0<
Scaled Max. F8:61
100.0<
Output F8:62
35.58567<

0013

DENSITY TRSMTR
LES
Less Than (A<B)
Source A I:4.1
10776<
Source B 0
0<

DENSITY TRSMTR
MOV
Move
Source 0
0<
Dest I:4.1
10776<

DENSITY TRSMTR
GRT
Greater Than (A>B)
Source A I:4.1
10776<
Source B 16383
16383<

DENSITY TRSMTR
MOV
Move
Source 16383
16383<
Dest I:4.1
10776<

DENSITY TRSMTR
SCP
Scale w/Parameters
Input I:4.1
10776<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. F8:65
0.0<
Scaled Max. F8:66
100.0<
Output F8:67
65.7816<

0014

LES
Less Than (A<B)
Source A F9:6
12557.0<
Source B 0.0
0.0<

MOV
Move
Source 0.0
0.0<
Dest F9:6
12557.0<

GRT
Greater Than (A>B)
Source A F9:6
12557.0<
Source B 16383.0
16383.0<

MOV
Move
Source 16383.0
16383.0<
Dest F9:6
12557.0<

SCP
Scale w/Parameters
Input F9:6
12557.0<
Input Min. 0.0
0.0<
Input Max. 100.0
100.0<
Scaled Min. F8:75
0.0<
Scaled Max. F8:76
100.0<
Output F8:72
12494.0<

0015

LES
Less Than (A<B)
Source A I:4.3
0<
Source B 0
0<

MOV
Move
Source 0
0<
Dest I:4.3
0<

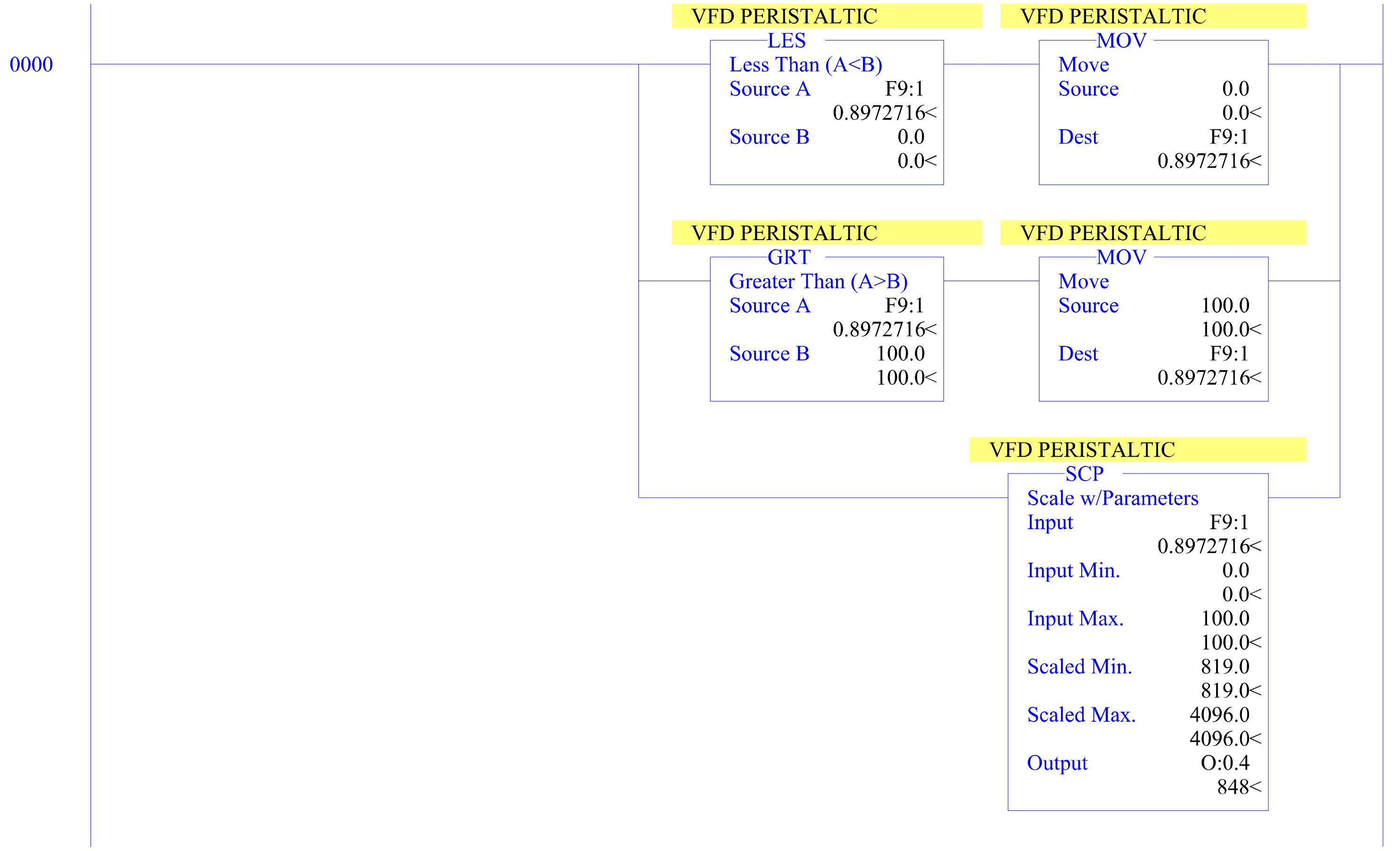
GRT
Greater Than (A>B)
Source A I:4.3
0<
Source B 16383
16383<

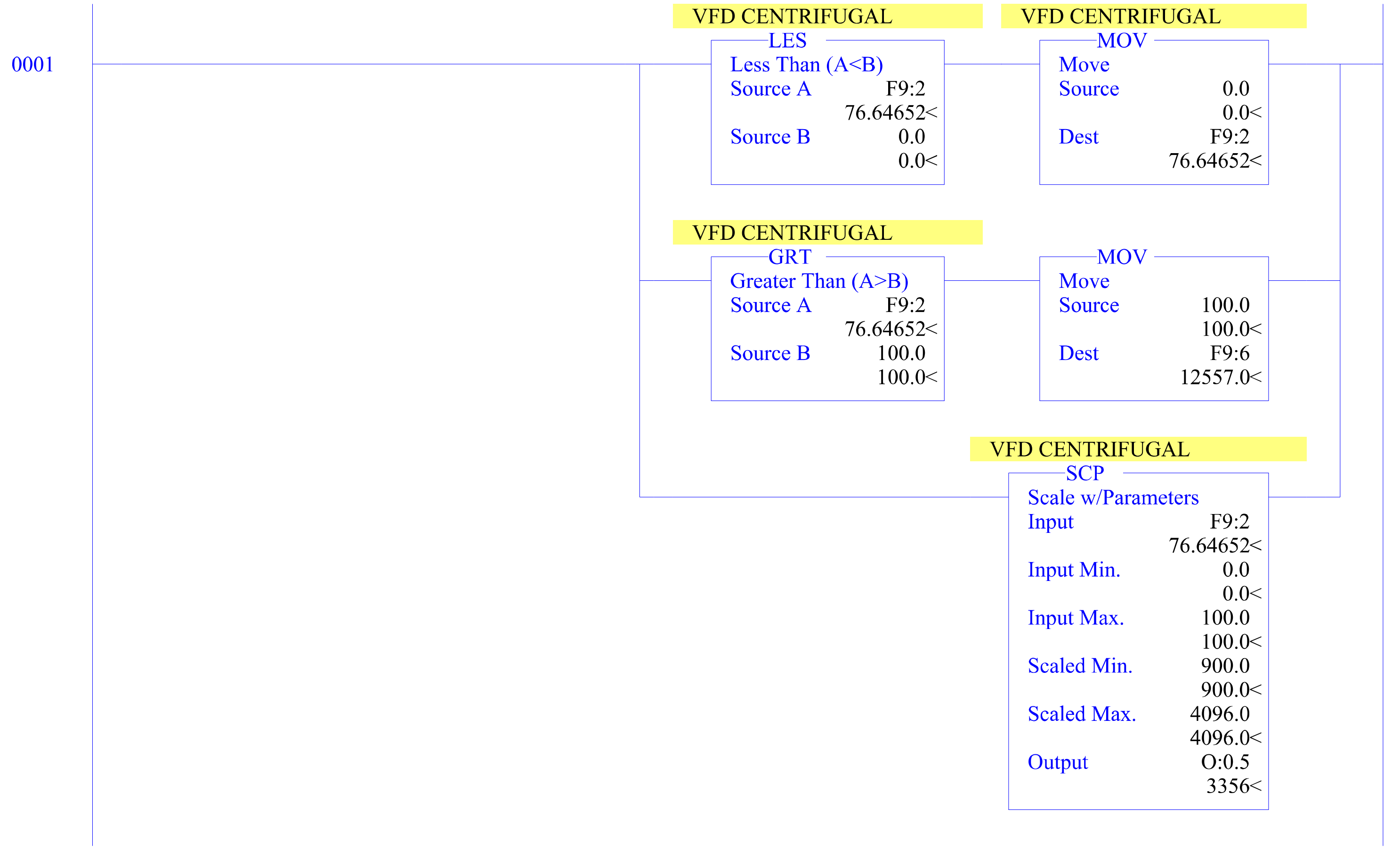
MOV
Move
Source 16383
16383<
Dest I:4.3
0<

SCP
Scale w/Parameters
Input I:4.3
0<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. F8:75
0.0<
Scaled Max. F8:76
100.0<
Output F8:77
0.0<

0016

END


0000
VFD PERISTALTIC
LES
Less Than (A<B)
Source A F9:1
0.8972716<
Source B 0.0
0.0<
VFD PERISTALTIC
MOV
Move
Source 0.0
0.0<
Dest F9:1
0.8972716<
VFD PERISTALTIC
GRT
Greater Than (A>B)
Source A F9:1
0.8972716<
Source B 100.0
100.0<
VFD PERISTALTIC
MOV
Move
Source 100.0
100.0<
Dest F9:1
0.8972716<
VFD PERISTALTIC
SCP
Scale w/Parameters
Input F9:1
0.8972716<
Input Min. 0.0
0.0<
Input Max. 100.0
100.0<
Scaled Min. 819.0
819.0<
Scaled Max. 4096.0
4096.0<
Output O:0.4
848<


0001
VFD CENTRIFUGAL
LES
Less Than (A<B)
Source A F9:2
76.64652<
Source B 0.0
0.0<
VFD CENTRIFUGAL
MOV
Move
Source 0.0
0.0<
Dest F9:2
76.64652<
VFD CENTRIFUGAL
GRT
Greater Than (A>B)
Source A F9:2
76.64652<
Source B 100.0
100.0<
MOV
Move
Source 100.0
100.0<
Dest F9:6
12557.0<
VFD CENTRIFUGAL
SCP
Scale w/Parameters
Input F9:2
76.64652<
Input Min. 0.0
0.0<
Input Max. 100.0
100.0<
Scaled Min. 900.0
900.0<
Scaled Max. 4096.0
4096.0<
Output O:0.5
3356<

0002

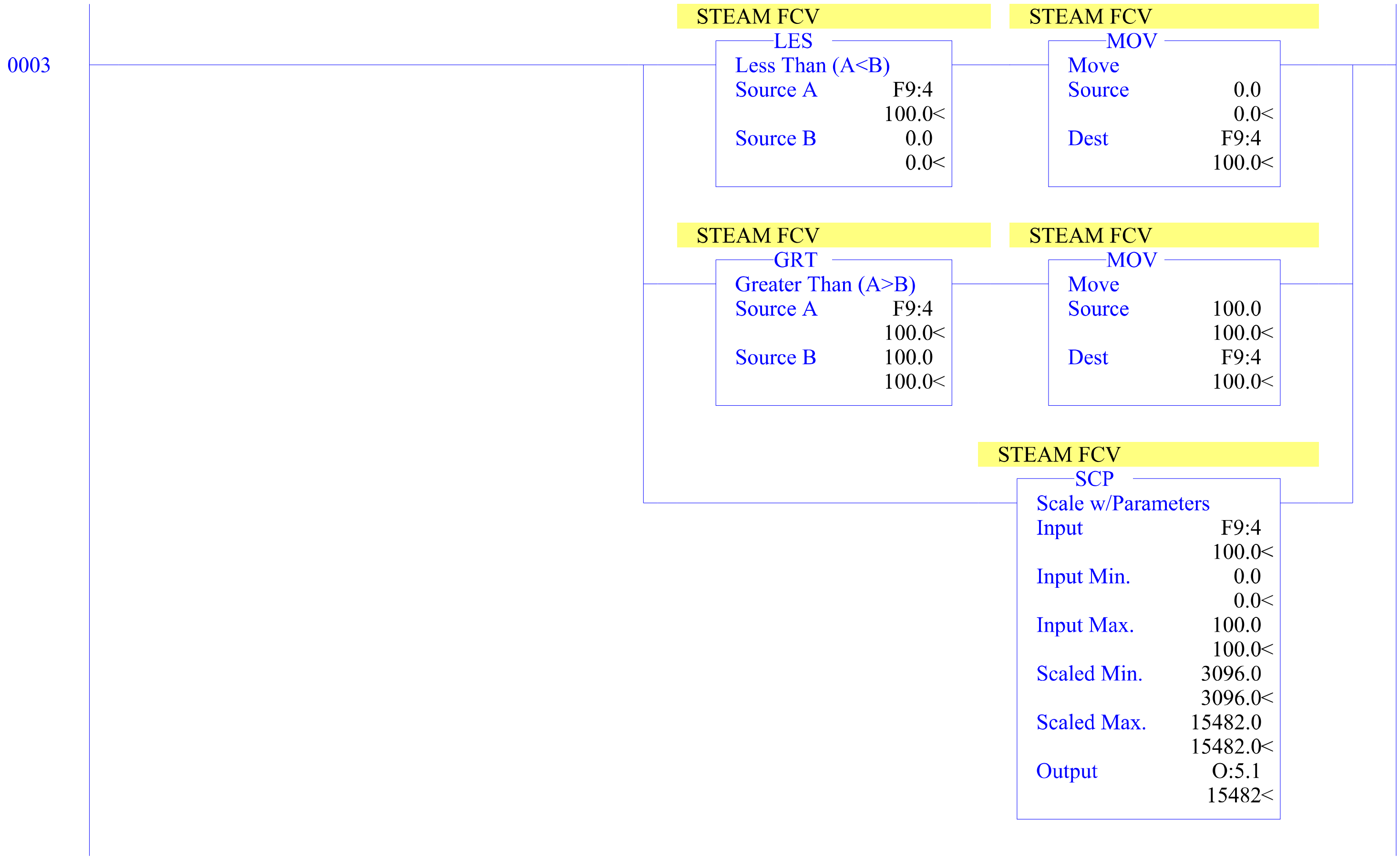
VFD VACCUM
LES
Less Than (A<B)
Source A F9:3
100.0<
Source B 0.0
0.0<

VFD VACCUM
MOV
Move
Source 0.0
0.0<
Dest F9:3
100.0<

VFD VACCUM
GRT
Greater Than (A>B)
Source A F9:3
100.0<
Source B 100.0
100.0<

VFD VACCUM
MOV
Move
Source 100.0
100.0<
Dest F9:3
100.0<

VFD VACCUM
SCP
Scale w/Parameters
Input F9:3
100.0<
Input Min. 0.0
0.0<
Input Max. 100.0
100.0<
Scaled Min. 3096.0
3096.0<
Scaled Max. 15482.0
15482.0<
Output O:5.0
15482<


0003
STEAM FCV
LES
Less Than (A<B)
Source A F9:4
100.0<
Source B 0.0
0.0<
STEAM FCV
MOV
Move
Source 0.0
0.0<
Dest F9:4
100.0<
STEAM FCV
GRT
Greater Than (A>B)
Source A F9:4
100.0<
Source B 100.0
100.0<
STEAM FCV
MOV
Move
Source 100.0
100.0<
Dest F9:4
100.0<
STEAM FCV
SCP
Scale w/Parameters
Input F9:4
100.0<
Input Min. 0.0
0.0<
Input Max. 100.0
100.0<
Scaled Min. 3096.0
3096.0<
Scaled Max. 15482.0
15482.0<
Output O:5.1
15482<

0004

PRODUCT FCV
LES
Less Than (A<B)
Source A F9:5
0.0<
Source B 0.0
0.0<

PRODUCT FCV
MOV
Move
Source 0.0
0.0<
Dest F9:5
0.0<

PRODUCT FCV
GRT
Greater Than (A>B)
Source A F9:5
0.0<
Source B 100.0
100.0<

PRODUCT FCV
MOV
Move
Source 100.0
100.0<
Dest F9:5
0.0<

PRODUCT FCV
SCP
Scale w/Parameters
Input F9:5
0.0<
Input Min. 0.0
0.0<
Input Max. 100.0
100.0<
Scaled Min. 3096.0
3096.0<
Scaled Max. 15482.0
15482.0<
Output O:5.2
3096<

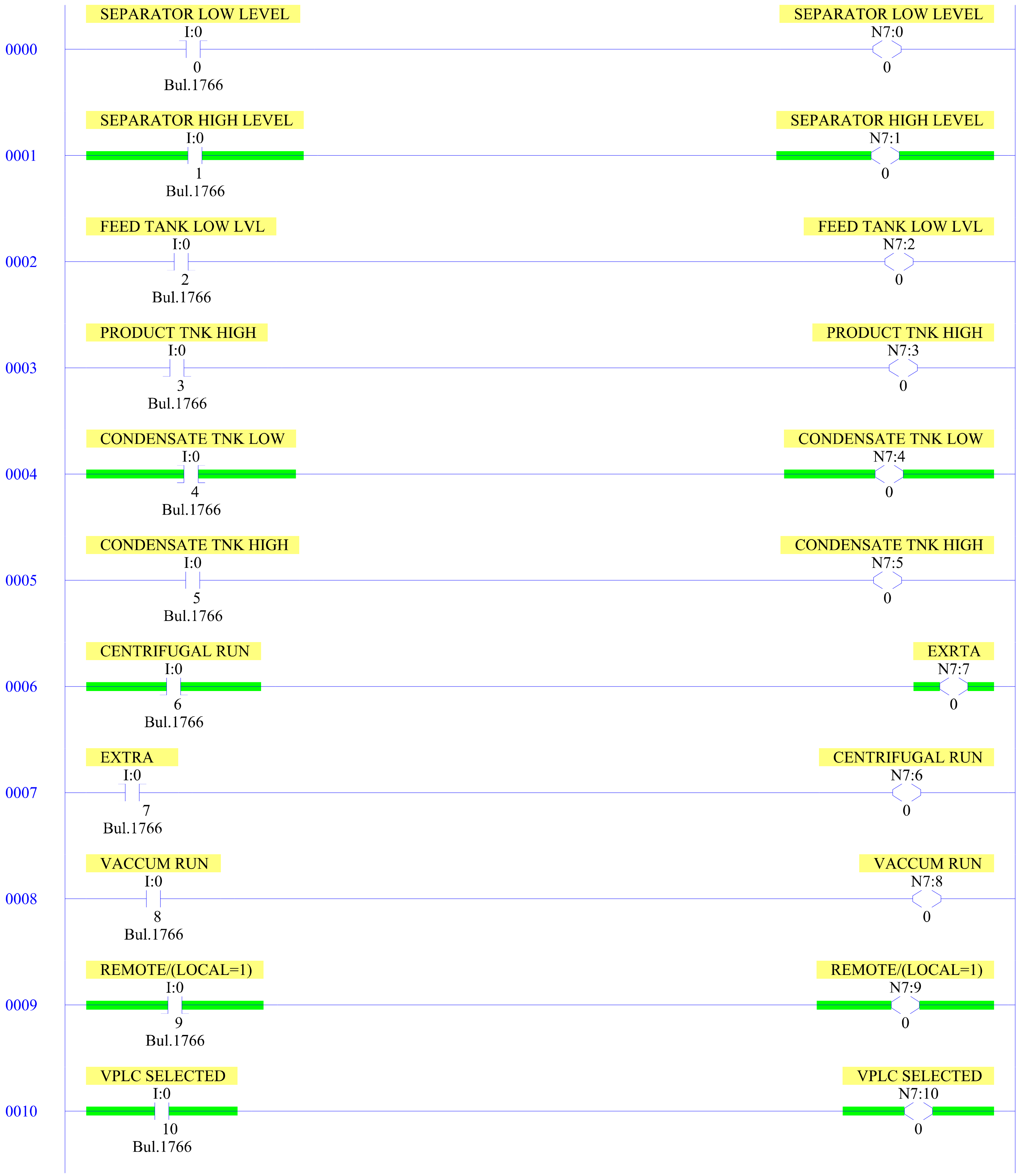
0005

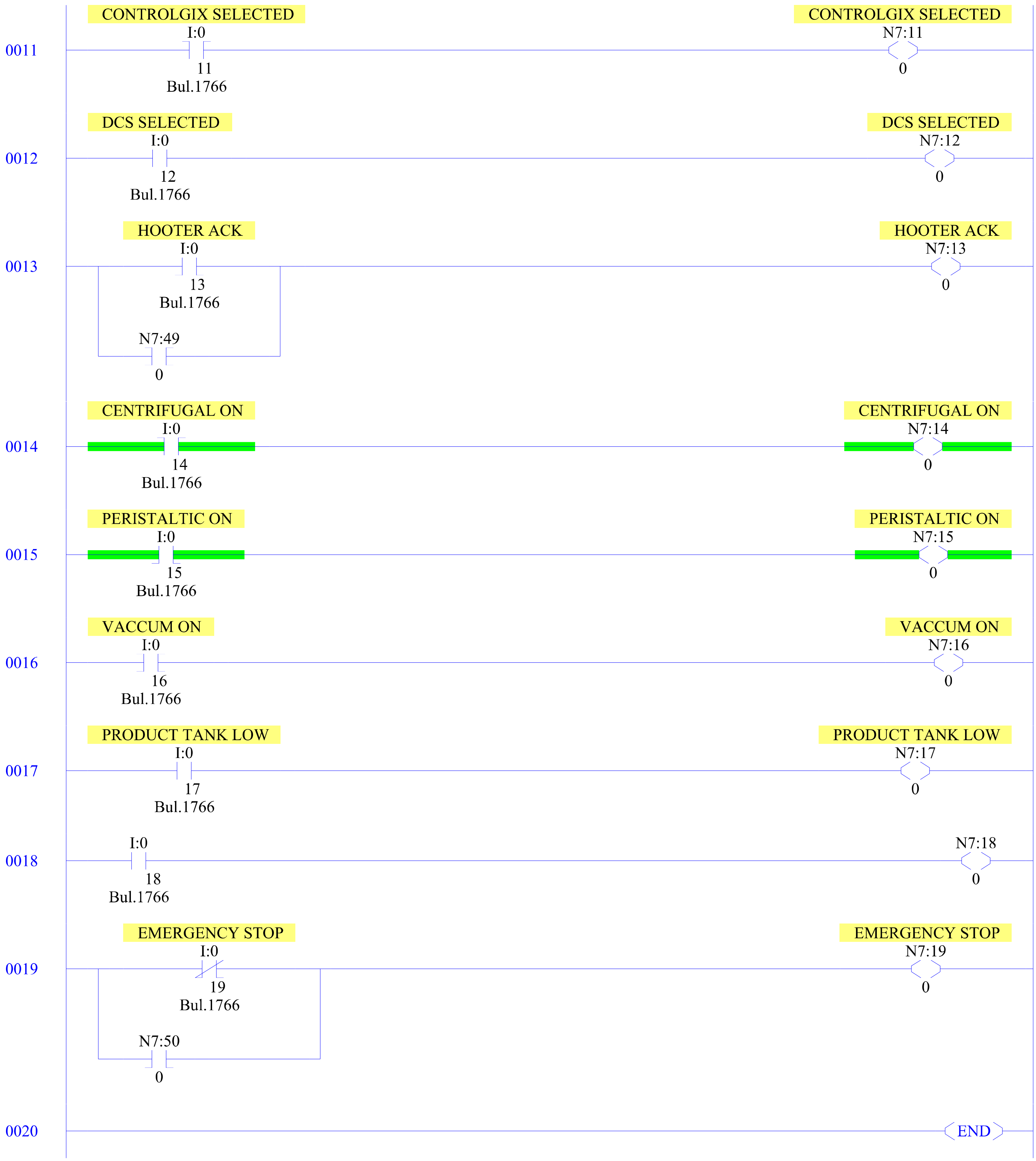
MOV
Move
Source F9:1
0.8972716<
Dest F9:6
12557.0<

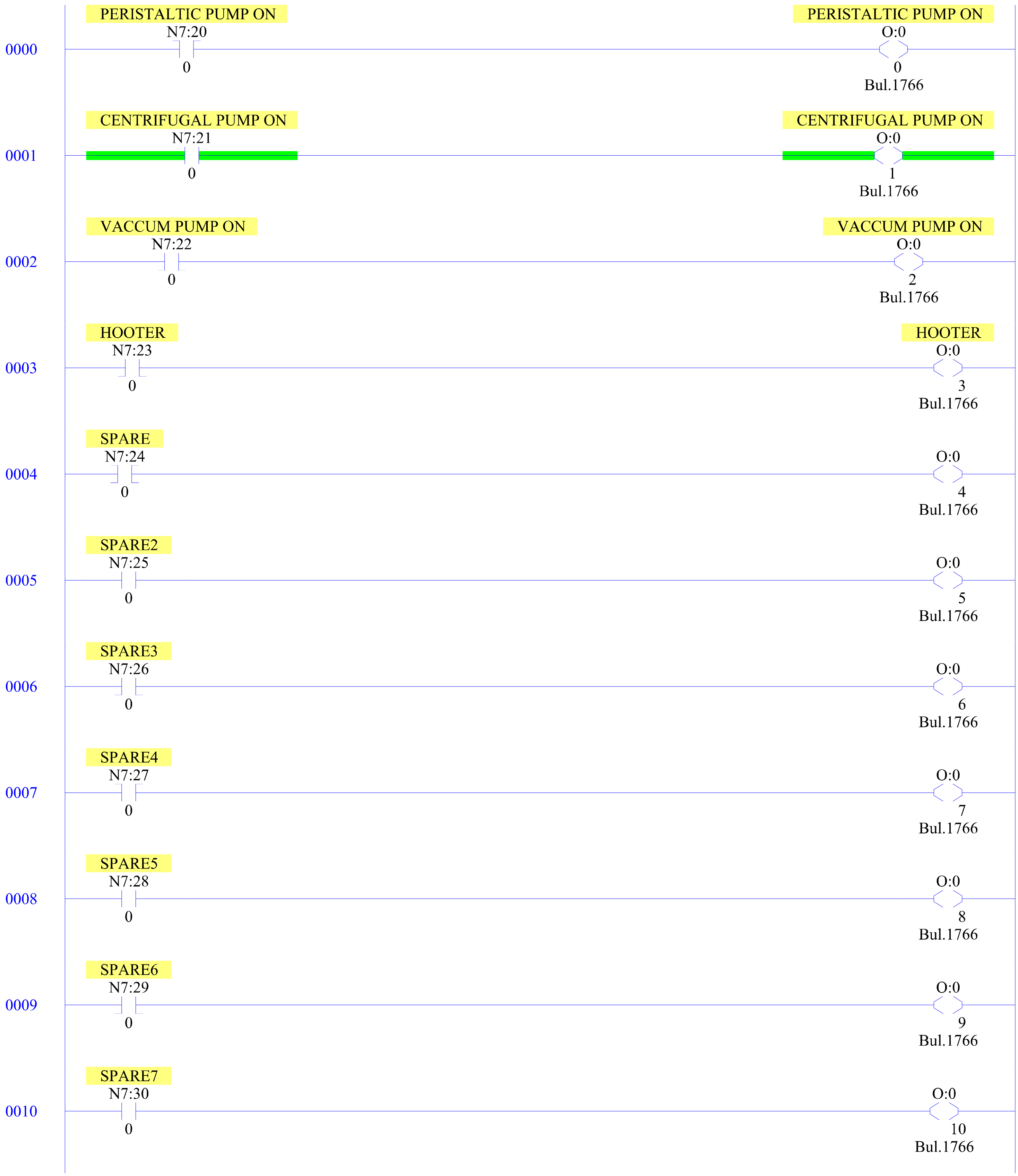
SCP
Scale w/Parameters
Input F9:6
12557.0<
Input Min. 0.0
0.0<
Input Max. 100.0
100.0<
Scaled Min. 3096.0
3096.0<
Scaled Max. 15482.0
15482.0<
Output O:5.3
3207<

0006

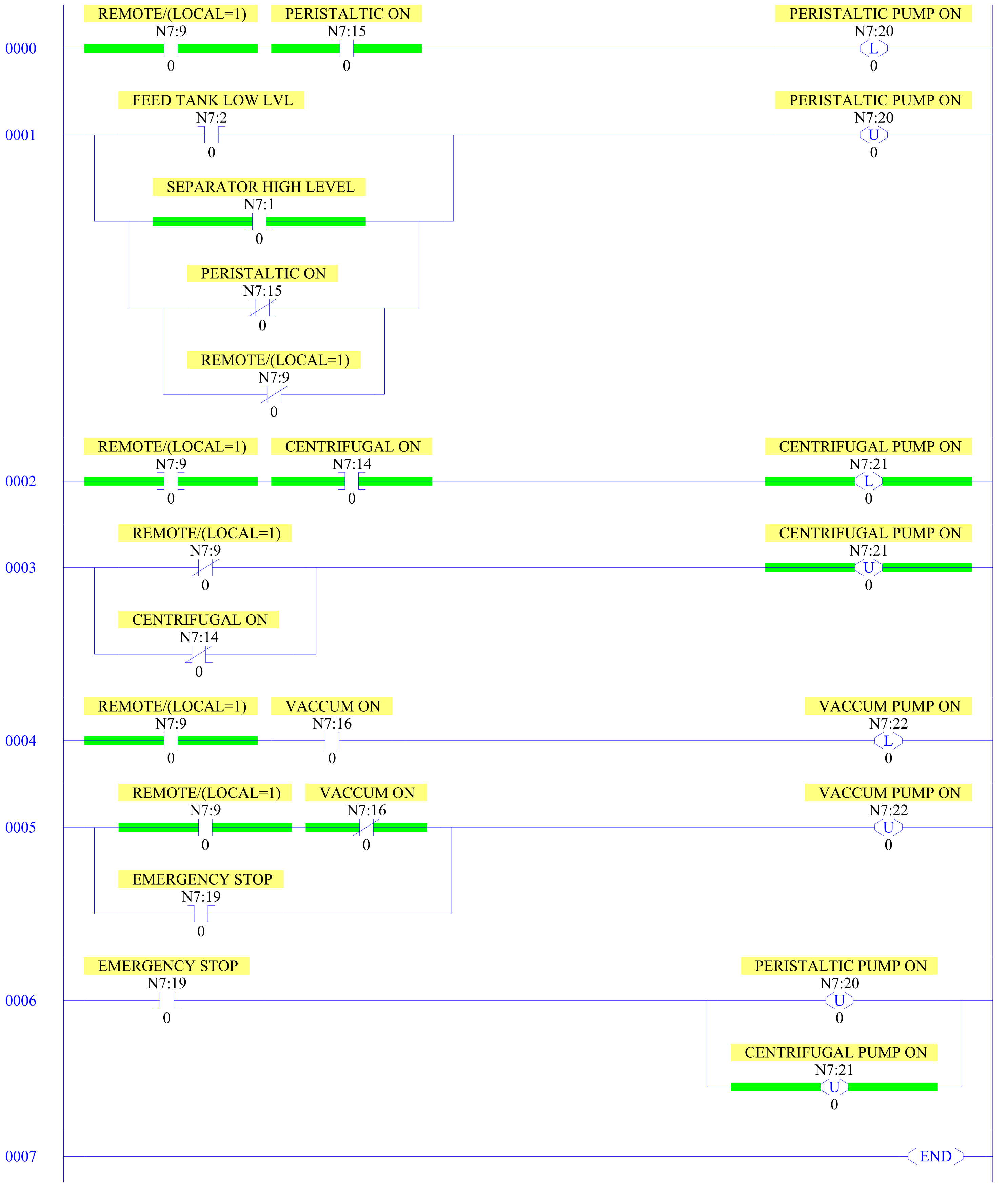
END


0000
SEPARATOR LOW LEVEL
I:0
0
Bul.1766
SEPARATOR LOW LEVEL
N7:0
0
0001
SEPARATOR HIGH LEVEL
I:0
1
Bul.1766
SEPARATOR HIGH LEVEL
N7:1
0
0002
FEED TANK LOW LVL
I:0
2
Bul.1766
FEED TANK LOW LVL
N7:2
0
0003
PRODUCT TNK HIGH
I:0
3
Bul.1766
PRODUCT TNK HIGH
N7:3
0
0004
CONDENSATE TNK LOW
I:0
4
Bul.1766
CONDENSATE TNK LOW
N7:4
0
0005
CONDENSATE TNK HIGH
I:0
5
Bul.1766
CONDENSATE TNK HIGH
N7:5
0
0006
CENTRIFUGAL RUN
I:0
6
Bul.1766
EXRTA
N7:7
0
0007
EXTRA
I:0
7
Bul.1766
CENTRIFUGAL RUN
N7:6
0
0008
VACCUM RUN
I:0
8
Bul.1766
VACCUM RUN
N7:8
0
0009
REMOTE/(LOCAL=1)
I:0
9
Bul.1766
REMOTE/(LOCAL=1)
N7:9
0
0010
VPLC SELECTED
I:0
10
Bul.1766
VPLC SELECTED
N7:10
0


0011
CONTROLGIX SELECTED
I:0
11
Bul.1766
CONTROLGIX SELECTED
N7:11
0
0012
DCS SELECTED
I:0
12
Bul.1766
DCS SELECTED
N7:12
0
0013
HOOTER ACK
I:0
13
Bul.1766
N7:49
0
HOOTER ACK
N7:13
0
0014
CENTRIFUGAL ON
I:0
14
Bul.1766
CENTRIFUGAL ON
N7:14
0
0015
PERISTALTIC ON
I:0
15
Bul.1766
PERISTALTIC ON
N7:15
0
0016
VACCUM ON
I:0
16
Bul.1766
VACCUM ON
N7:16
0
0017
PRODUCT TANK LOW
I:0
17
Bul.1766
PRODUCT TANK LOW
N7:17
0
0018
I:0
18
Bul.1766
N7:18
0
0019
EMERGENCY STOP
I:0
19
Bul.1766
N7:50
0
EMERGENCY STOP
N7:19
0
0020
END


0000
PERISTALTIC PUMP ON
N7:20
0
PERISTALTIC PUMP ON
O:0
0
Bul.1766
0001
CENTRIFUGAL PUMP ON
N7:21
0
CENTRIFUGAL PUMP ON
O:0
1
Bul.1766
0002
VACCUM PUMP ON
N7:22
0
VACCUM PUMP ON
O:0
2
Bul.1766
0003
HOOTER
N7:23
0
HOOTER
O:0
3
Bul.1766
0004
SPARE
N7:24
0
O:0
4
Bul.1766
0005
SPARE2
N7:25
0
O:0
5
Bul.1766
0006
SPARE3
N7:26
0
O:0
6
Bul.1766
0007
SPARE4
N7:27
0
O:0
7
Bul.1766
0008
SPARE5
N7:28
0
O:0
8
Bul.1766
0009
SPARE6
N7:29
0
O:0
9
Bul.1766
0010
SPARE7
N7:30
0
O:0
10
Bul.1766

0011	SPARE8 N7:31 0	O:0 11 Bul.1766
0012	SPARE9 N7:32 0	O:1 0 1762-OB8
0013	SPARE10 N7:33 0	O:1 1 1762-OB8
0014	SPARE11 N7:34 0	O:1 2 1762-OB8
0015	N7:35 0	O:1 3 1762-OB8
0016	N7:36 0	O:1 4 1762-OB8
0017	N7:38 0	O:1 5 1762-OB8
0018	N7:39 0	O:1 6 1762-OB8
0019		END


0000
REMOTE/(LOCAL=1)
N7:9
0
PERISTALTIC ON
N7:15
0
PERISTALTIC PUMP ON
N7:20
L
0
0001
FEED TANK LOW LVL
N7:2
0
PERISTALTIC PUMP ON
N7:20
U
0
SEPARATOR HIGH LEVEL
N7:1
0
PERISTALTIC ON
N7:15
0
REMOTE/(LOCAL=1)
N7:9
0
0002
REMOTE/(LOCAL=1)
N7:9
0
CENTRIFUGAL ON
N7:14
0
CENTRIFUGAL PUMP ON
N7:21
L
0
0003
REMOTE/(LOCAL=1)
N7:9
0
CENTRIFUGAL PUMP ON
N7:21
U
0
CENTRIFUGAL ON
N7:14
0
0004
REMOTE/(LOCAL=1)
N7:9
0
VACCUM ON
N7:16
0
VACCUM PUMP ON
N7:22
L
0
0005
REMOTE/(LOCAL=1)
N7:9
0
VACCUM ON
N7:16
0
VACCUM PUMP ON
N7:22
U
0
EMERGENCY STOP
N7:19
0
0006
EMERGENCY STOP
N7:19
0
PERISTALTIC PUMP ON
N7:20
U
0
CENTRIFUGAL PUMP ON
N7:21
U
0
0007
END

0000

SCP
Scale w/Parameters
Input F8:7
4501.068<
Input Min. 0.0
0.0<
Input Max. 10000.0
10000.0<
Scaled Min. 0.0
0.0<
Scaled Max. 16383.0
16383.0<
Output N29:10
7409<

0001

STARTCIRCULATION/VCC
M
B3:0
0

STOPCIRCULATION
B3:2
11

PID
PID
PID File PD11:0
Process Variable N29:10
Control Variable N29:11
Setup Screen <

0002

MOV
Move
Source N29:11
12508<
Dest F9:6
12557.0<

0003

VFD CENTRIFUGAL
SCP
Scale w/Parameters
Input F9:6
12557.0<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. 0.0
0.0<
Scaled Max. 100.0
100.0<
Output F9:2
76.64652<

0004

SCP
Scale w/Parameters
Input F8:57
1.0<
Input Min. 0.0
0.0<
Input Max. 0.8
0.8<
Scaled Min. 0.0
0.0<
Scaled Max. 16383.0
16383.0<
Output N29:4
20479<

0005
STARTCIRCULATION/VCCM B3:0 0 — STOPCIRCULATION B3:2 11

PID
PID
PID File PD11:1
Process Variable N29:4
Control Variable N29:5
Setup Screen <

0006
MOV
Move
Source N29:5
16383<
Dest F9:8
16383.0<

0007
VFD VACCUM
SCP
Scale w/Parameters
Input F9:8
16383.0<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. 0.0
0.0<
Scaled Max. 100.0
100.0<
Output F9:3
100.0<

0008
SCP
Scale w/Parameters
Input F8:52
32.8145<
Input Min. 0.0
0.0<
Input Max. 200.0
200.0<
Scaled Min. 0.0
0.0<
Scaled Max. 16383.0
16383.0<
Output N29:8
2688<

0009
STARTCIRCULATION/VCCM B3:0 0 — STOPCIRCULATION B3:2 11

PID
PID
PID File PD11:2
Process Variable N29:8
Control Variable N29:9
Setup Screen <

0010
MOV
Move
Source N29:9
16383<
Dest F9:9
16383.0<

0011

STEAM FCV

SCP
Scale w/Parameters

Input	F9:9	
	16383.0<	
Input Min.	0.0	
	0.0<	
Input Max.	16383.0	
	16383.0<	
Scaled Min.	0.0	
	0.0<	
Scaled Max.	100.0	
	100.0<	
Output	F9:4	
	100.0<	

0012

END

0000

SCP
Scale w/Parameters
Input F8:62
35.58567<
Input Min. 0.0
0.0<
Input Max. 100.0
100.0<
Scaled Min. 0.0
0.0<
Scaled Max. 16383.0
16383.0<
Output N29:14
5833<

0001

START
N29:20
0

FEEDTNKLOWLEVEL
B3:2
14

PID
PID
PID File PD16:0
Process Variable N29:14
Control Variable N29:16
Setup Screen <

0002

MOV
Move
Source N29:16
147<
Dest F9:7
147.0<

0003

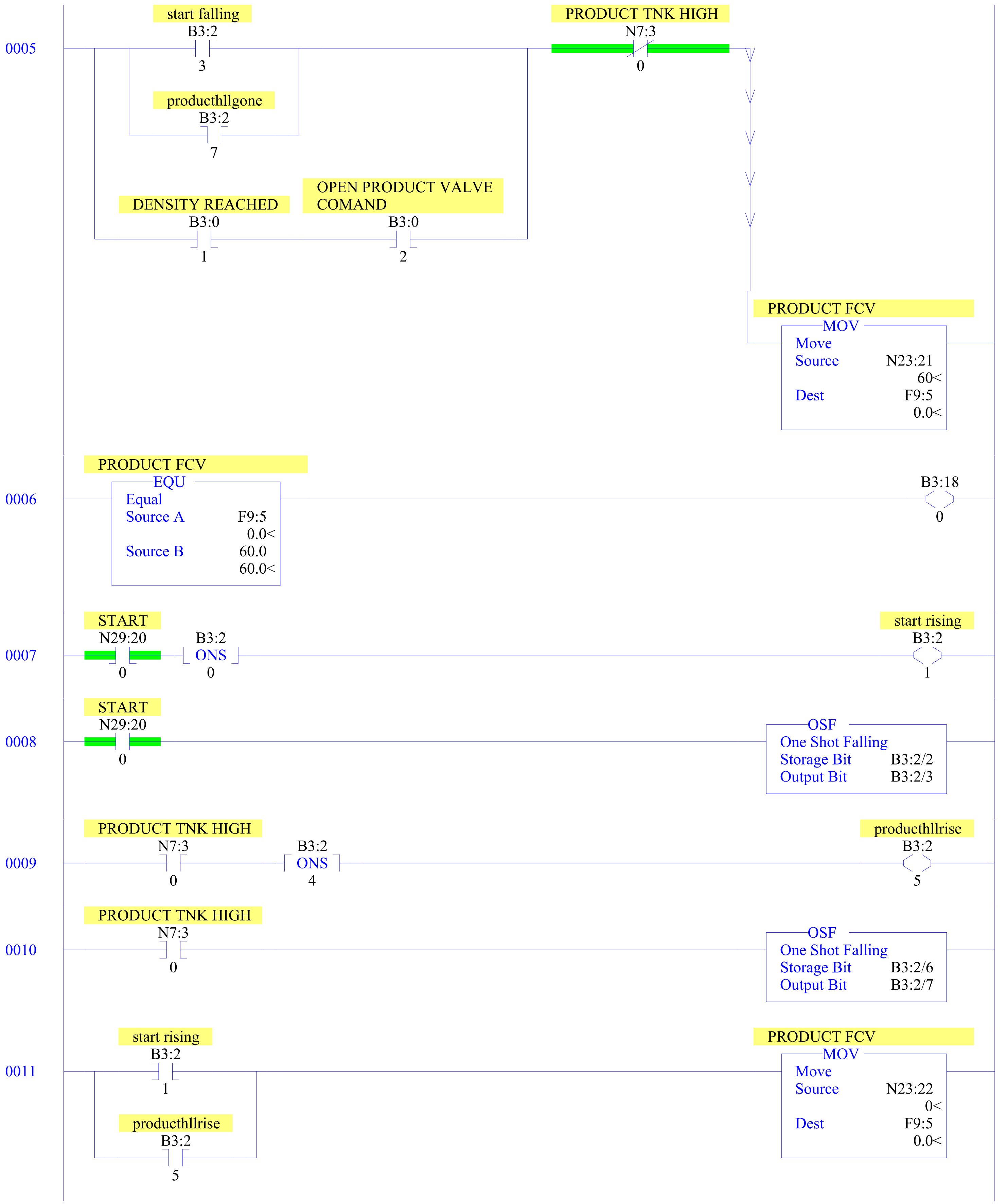
VFD PERISTALTIC
SCP
Scale w/Parameters
Input F9:7
147.0<
Input Min. 0.0
0.0<
Input Max. 16383.0
16383.0<
Scaled Min. 0.0
0.0<
Scaled Max. 100.0
100.0<
Output F9:1
0.8972716<

0004

START
N29:20
0

SEPARATOR LEVEL
GEQ
Grtr Than or Eql (A>=B)
Source A F8:62
35.58567<
Source B 26.0
26.0<

STARTCIRCULATION/VCC
M
B3:0
0


0005
start falling
B3:2
3
producthllgone
B3:2
7
DENSITY REACHED
B3:0
1
OPEN PRODUCT VALVE COMAND
B3:0
2
PRODUCT TNK HIGH
N7:3
0
PRODUCT FCV
MOV
Move
Source N23:21
60<
Dest F9:5
0.0<
0006
PRODUCT FCV
EQU
Equal
Source A F9:5
0.0<
Source B 60.0
60.0<
B3:18
0
0007
START
N29:20
0
B3:2
ONS
0
start rising
B3:2
1
0008
START
N29:20
0
OSF
One Shot Falling
Storage Bit B3:2/2
Output Bit B3:2/3
0009
PRODUCT TNK HIGH
N7:3
0
B3:2
ONS
4
producthllrise
B3:2
5
0010
PRODUCT TNK HIGH
N7:3
0
OSF
One Shot Falling
Storage Bit B3:2/6
Output Bit B3:2/7
0011
start rising
B3:2
1
producthllrise
B3:2
5
PRODUCT FCV
MOV
Move
Source N23:22
0<
Dest F9:5
0.0<

0012
start falling B3:2 3 — PROCSSTOPCKLEVEL B3:2 (L) 8

0013
FEED TANK LOW LVL N7:2 0 — B3:2 ONS 12 — FEDDLLRISE B3:2 ( ) 13

0014
FEDDLLRISE B3:2 13 — FEEDTNKLOWLEVEL B3:2 (L) 14

0015
FEED TANK LOW LVL N7:2 0 —
OSF
One Shot Falling
Storage Bit B3:0/3
Output Bit B3:0/4

0016
FEDLLFALL B3:0 4 — FEEDTNKLOWLEVEL B3:2 (U) 14

0017
PROCSSTOPCKLEVEL B3:2 8
FEDDLLRISE B3:2 13
MOV
Move
Source N23:22
0<
Dest N29:16
147<

0018
PROCSSTOPCKLEVEL B3:2 8 —
MOV
Move
Source N23:22
0<
Dest N29:5
16383<

0019
PROCSSTOPCKLEVEL B3:2 8 — SEPARATOR LEVEL
LEQ
Less Than or Eql (A<=B)
Source A F8:62
35.58567<
Source B 20.0
20.0<
— DRAINCOMPLETED B3:2 ( ) 9

0020
DRAINCOMPLETED B3:2 9 — B3:2 ONS 10 — STOPCIRCULATION B3:2 (L) 11

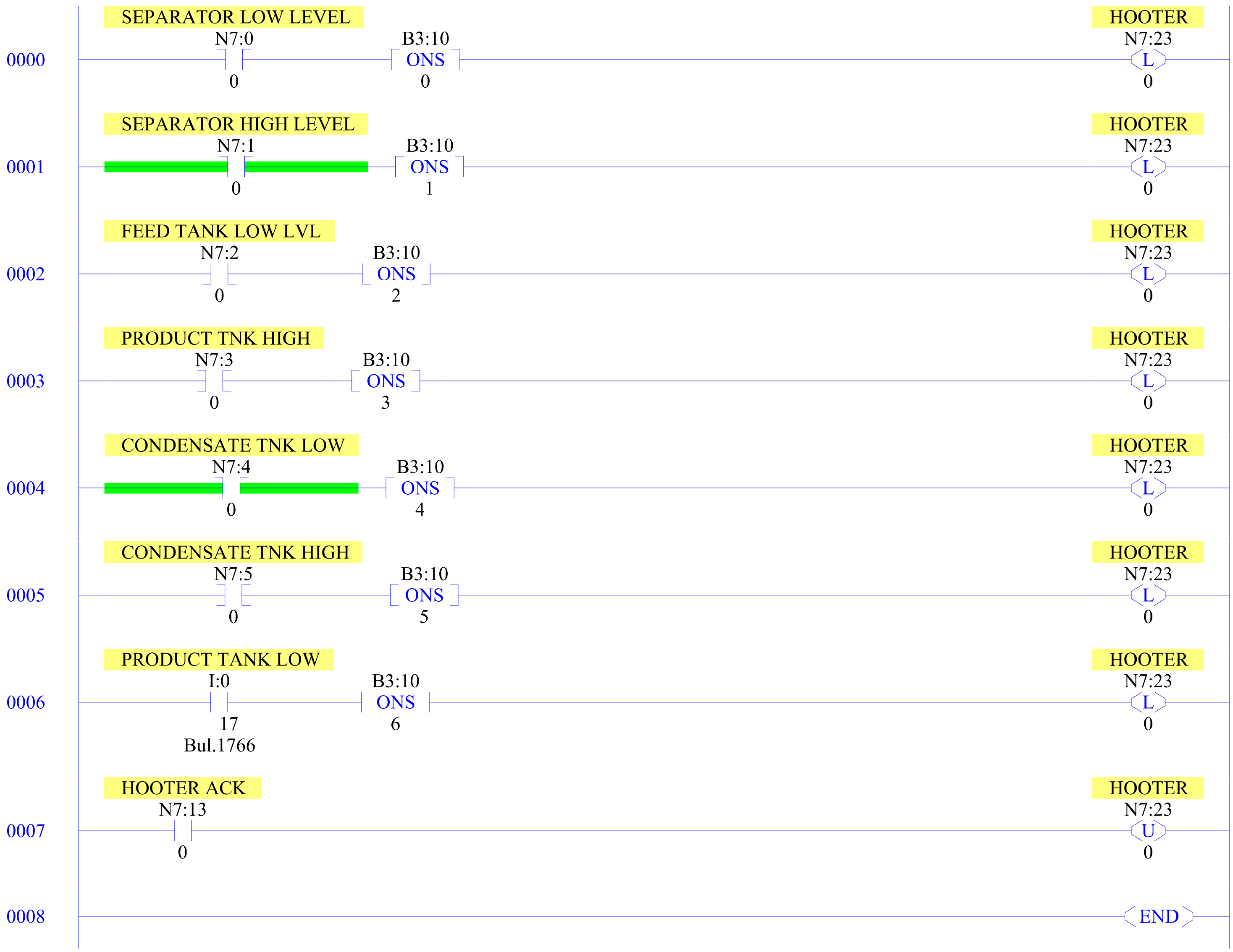
0021
STOPCIRCULATION B3:2 11 —
MOV
Move
Source N23:22
0<
Dest N29:11
12508<

0022 start rising B3:2 1 — PROCSSTOPCKLEVEL B3:2 U 8

0023 start rising B3:2 1 — STOPCIRCULATION B3:2 U 11

0024 STOPCIRCULATION B3:2 11 — MOV Move Source N23:22 0< Dest N29:9 16383<

0025 END


0000
SEPARATOR LOW LEVEL
N7:0
0
B3:10
ONS
0
HOOTER
N7:23
L
0
0001
SEPARATOR HIGH LEVEL
N7:1
0
B3:10
ONS
1
HOOTER
N7:23
L
0
0002
FEED TANK LOW LVL
N7:2
0
B3:10
ONS
2
HOOTER
N7:23
L
0
0003
PRODUCT TNK HIGH
N7:3
0
B3:10
ONS
3
HOOTER
N7:23
L
0
0004
CONDENSATE TNK LOW
N7:4
0
B3:10
ONS
4
HOOTER
N7:23
L
0
0005
CONDENSATE TNK HIGH
N7:5
0
B3:10
ONS
5
HOOTER
N7:23
L
0
0006
PRODUCT TANK LOW
I:0
17
Bul.1766
B3:10
ONS
6
HOOTER
N7:23
L
0
0007
HOOTER ACK
N7:13
0
HOOTER
N7:23
U
0
0008
END

0000

MOV
Move
Source N7:9
1<
Dest N33:20
1<

MOV
Move
Source N7:10
1<
Dest N33:21
1<

MOV
Move
Source N7:11
0<
Dest N33:22
0<

MOV
Move
Source N7:12
0<
Dest N33:23
0<

0001

REMOTE/(LOCAL=1) N7:9 0

VPLC SELECTED N7:10 0

MOV	Source	Source value	Dest	Dest value
Move	N7:0	0<	N33:11	0<
Move	N7:1	1<	N33:12	1<
Move	N7:2	0<	N33:13	0<
Move	N7:3	0<	N33:14	0<
Move	N7:4	1<	N33:15	1<
Move	N7:5	0<	N33:16	0<
Move	N7:6	0<	N33:17	0<

MOV
Move
Source N7:7
1<
Dest N33:18
1<

MOV
Move
Source N7:8
0<
Dest N33:19
0<

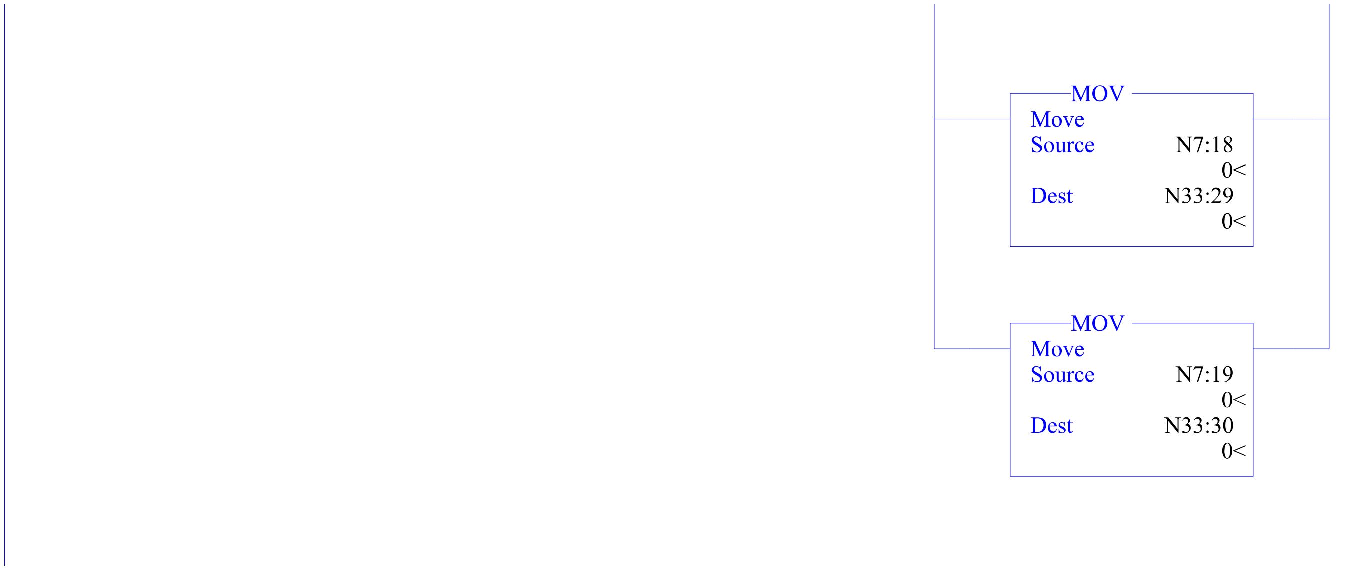
MOV
Move
Source N7:13
0<
Dest N33:24
0<

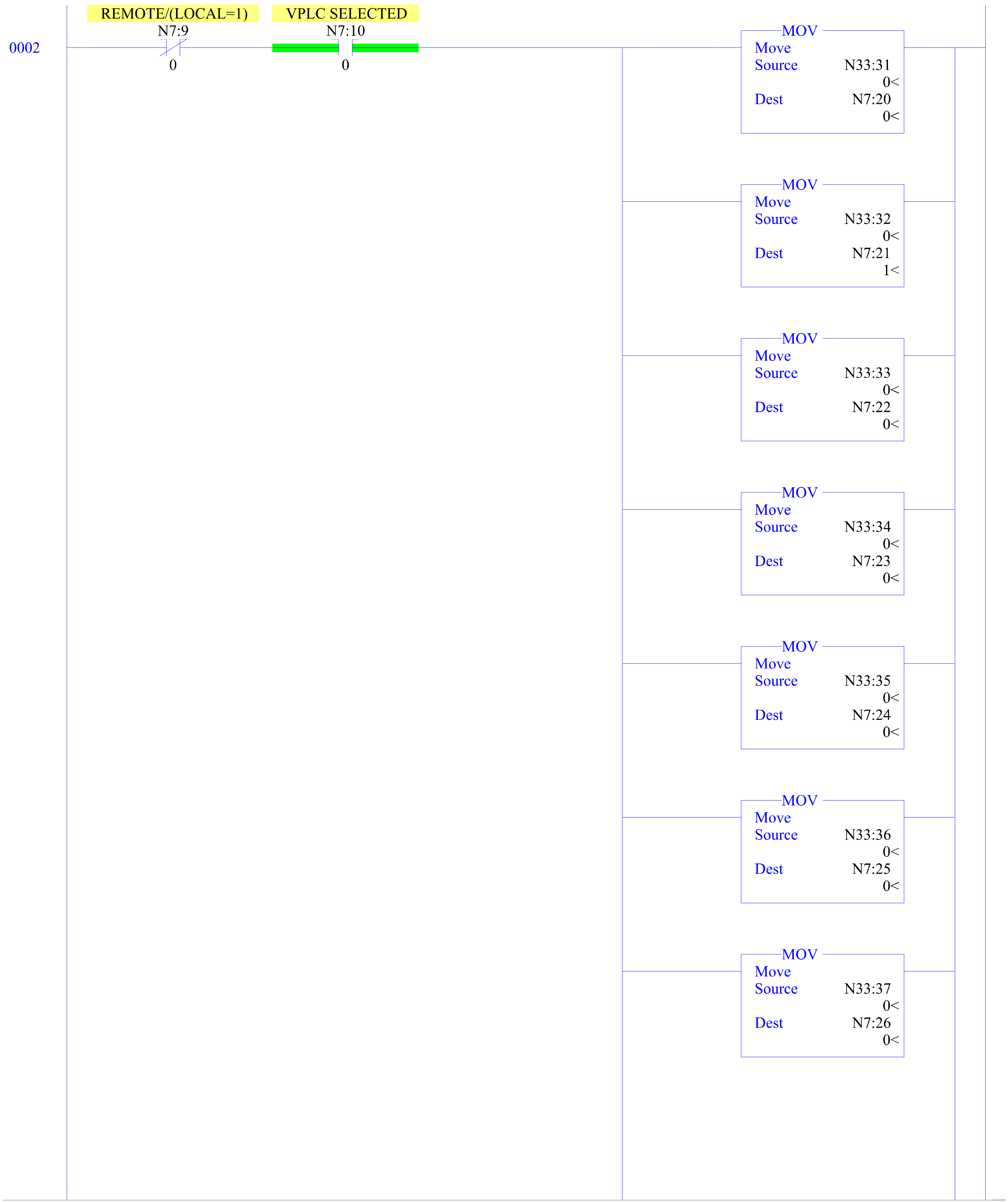
MOV
Move
Source N7:14
1<
Dest N33:25
1<

MOV
Move
Source N7:15
1<
Dest N33:26
1<

MOV
Move
Source N7:16
0<
Dest N33:27
0<

MOV
Move
Source N7:17
0<
Dest N33:28
1<


MOV
Move
Source N7:18
0<
Dest N33:29
0<
MOV
Move
Source N7:19
0<
Dest N33:30
0<


0002
REMOTE/(LOCAL=1)
N7:9
0
VPLC SELECTED
N7:10
0
MOV
Move
Source N33:31
0<
Dest N7:20
0<
MOV
Move
Source N33:32
0<
Dest N7:21
1<
MOV
Move
Source N33:33
0<
Dest N7:22
0<
MOV
Move
Source N33:34
0<
Dest N7:23
0<
MOV
Move
Source N33:35
0<
Dest N7:24
0<
MOV
Move
Source N33:36
0<
Dest N7:25
0<
MOV
Move
Source N33:37
0<
Dest N7:26
0<

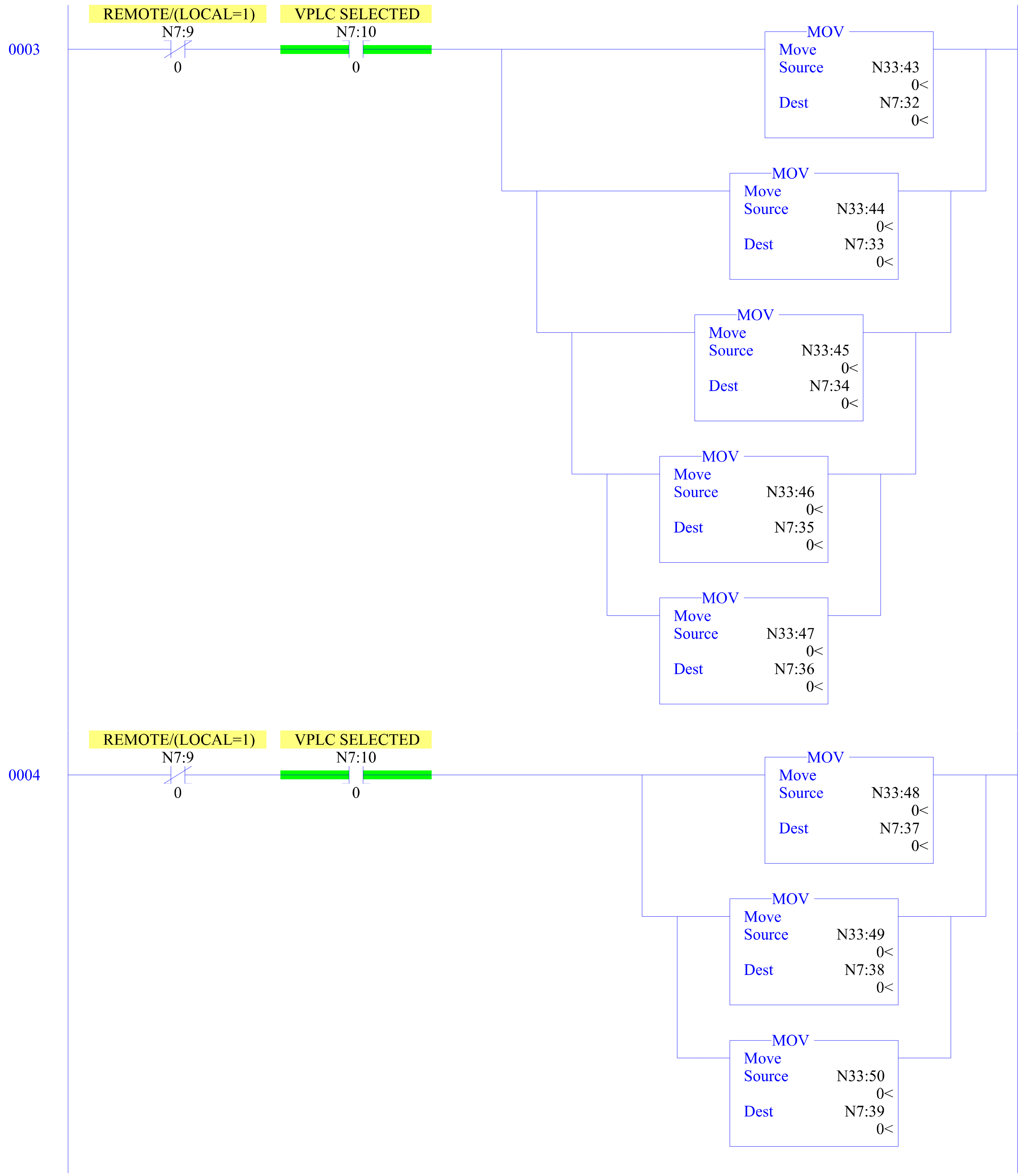
MOV
Move
Source N33:38
0<
Dest N7:27
0<

MOV
Move
Source N33:39
0<
Dest N7:28
0<

MOV
Move
Source N33:40
0<
Dest N7:29
0<

MOV
Move
Source N33:41
0<
Dest N7:30
0<

MOV
Move
Source N33:42
0<
Dest N7:31
0<


0003
REMOTE/(LOCAL=1)
N7:9
0
VPLC SELECTED
N7:10
0
MOV
Move
Source N33:43
0<
Dest N7:32
0<
MOV
Move
Source N33:44
0<
Dest N7:33
0<
MOV
Move
Source N33:45
0<
Dest N7:34
0<
MOV
Move
Source N33:46
0<
Dest N7:35
0<
MOV
Move
Source N33:47
0<
Dest N7:36
0<
0004
REMOTE/(LOCAL=1)
N7:9
0
VPLC SELECTED
N7:10
0
MOV
Move
Source N33:48
0<
Dest N7:37
0<
MOV
Move
Source N33:49
0<
Dest N7:38
0<
MOV
Move
Source N33:50
0<
Dest N7:39
0<

0005

REMOTE/(LOCAL=1)
N7:9
0

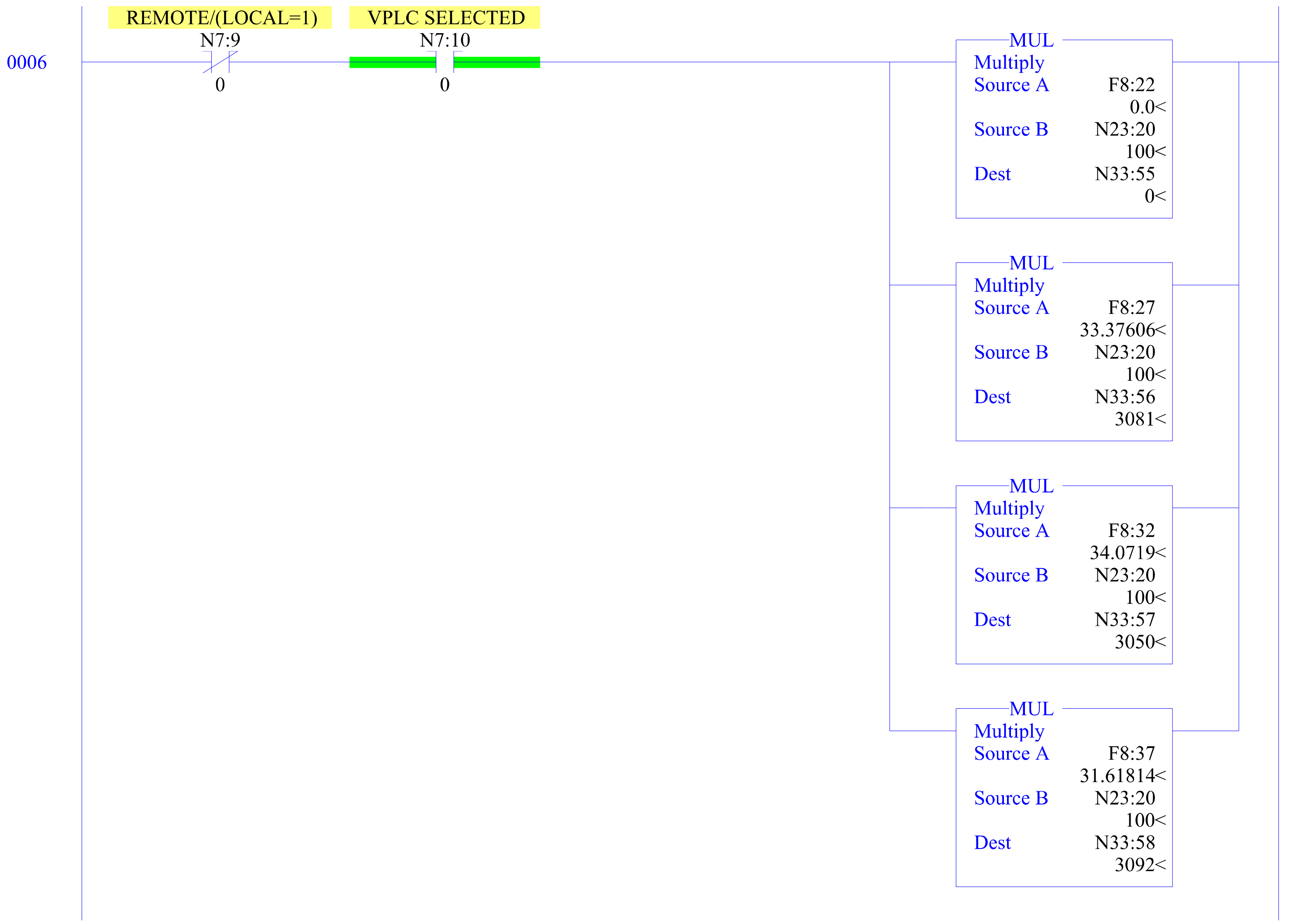
VPLC SELECTED
N7:10
0

MUL
Multiply
Source A F8:2
0.05492829<
Source B N23:20
100<
Dest N33:51
8<

MUL
Multiply
Source A F8:7
4501.068<
Source B N23:20
100<
Dest N33:52
0<

MUL
Multiply
Source A F8:12
0.0<
Source B N23:20
100<
Dest N33:53
0<

MUL
Multiply
Source A F8:17
0.0<
Source B N23:20
100<
Dest N33:54
2<


0006
REMOTE/(LOCAL=1)
N7:9
0
VPLC SELECTED
N7:10
0
MUL
Multiply
Source A F8:22
0.0<
Source B N23:20
100<
Dest N33:55
0<
MUL
Multiply
Source A F8:27
33.37606<
Source B N23:20
100<
Dest N33:56
3081<
MUL
Multiply
Source A F8:32
34.0719<
Source B N23:20
100<
Dest N33:57
3050<
MUL
Multiply
Source A F8:37
31.61814<
Source B N23:20
100<
Dest N33:58
3092<

0007

REMOTE/(LOCAL=1)
N7:9
0

VPLC SELECTED
N7:10
0

MUL
Multiply
Source A F8:42
32.13087<
Source B N23:20
100<
Dest N33:59
3148<

MUL
Multiply
Source A F8:47
0.0<
Source B N23:20
100<
Dest N33:60
0<

MUL
Multiply
Source A F8:52
32.8145<
Source B N23:20
100<
Dest N33:61
3122<

MUL
Multiply
Source A F8:57
1.0<
Source B N23:20
100<
Dest N33:62
10000<

0008
REMOTE/(LOCAL=1)
N7:9
0
VPLC SELECTED
N7:10
0

MUL
Multiply
Source A F8:62
35.58567<
Source B N23:20
100<
Dest N33:63
4807<

MUL
Multiply
Source A F8:67
65.7816<
Source B N23:20
100<
Dest N33:64
6601<

MUL
Multiply
Source A F8:72
12494.0<
Source B N23:20
100<
Dest N33:65
0<

MUL
Multiply
Source A F8:77
0.0<
Source B N23:20
100<
Dest N33:66
0<

0009
REMOTE/(LOCAL=1)
N7:9
0
VPLC SELECTED
N7:10
0

VFD PERISTALTIC
DIV
Divide
Source A N33:71
0<
Source B N23:20
100<
Dest F9:1
0.8972716<

0010
REMOTE/(LOCAL=1)
N7:9
0
VPLC SELECTED
N7:10
0

VFD CENTRIFUGAL
DIV
Divide
Source A N33:72
0<
Source B N23:20
100<
Dest F9:2
76.64652<

0011
CLR
Clear
Dest S:5
0<

0012

REMOTE/(LOCAL=1)
N7:9
0

VPLC SELECTED
N7:10
0

VFD VACCUM
DIV
Divide
Source A N33:73
0<
Source B N23:20
100<
Dest F9:3
100.0<

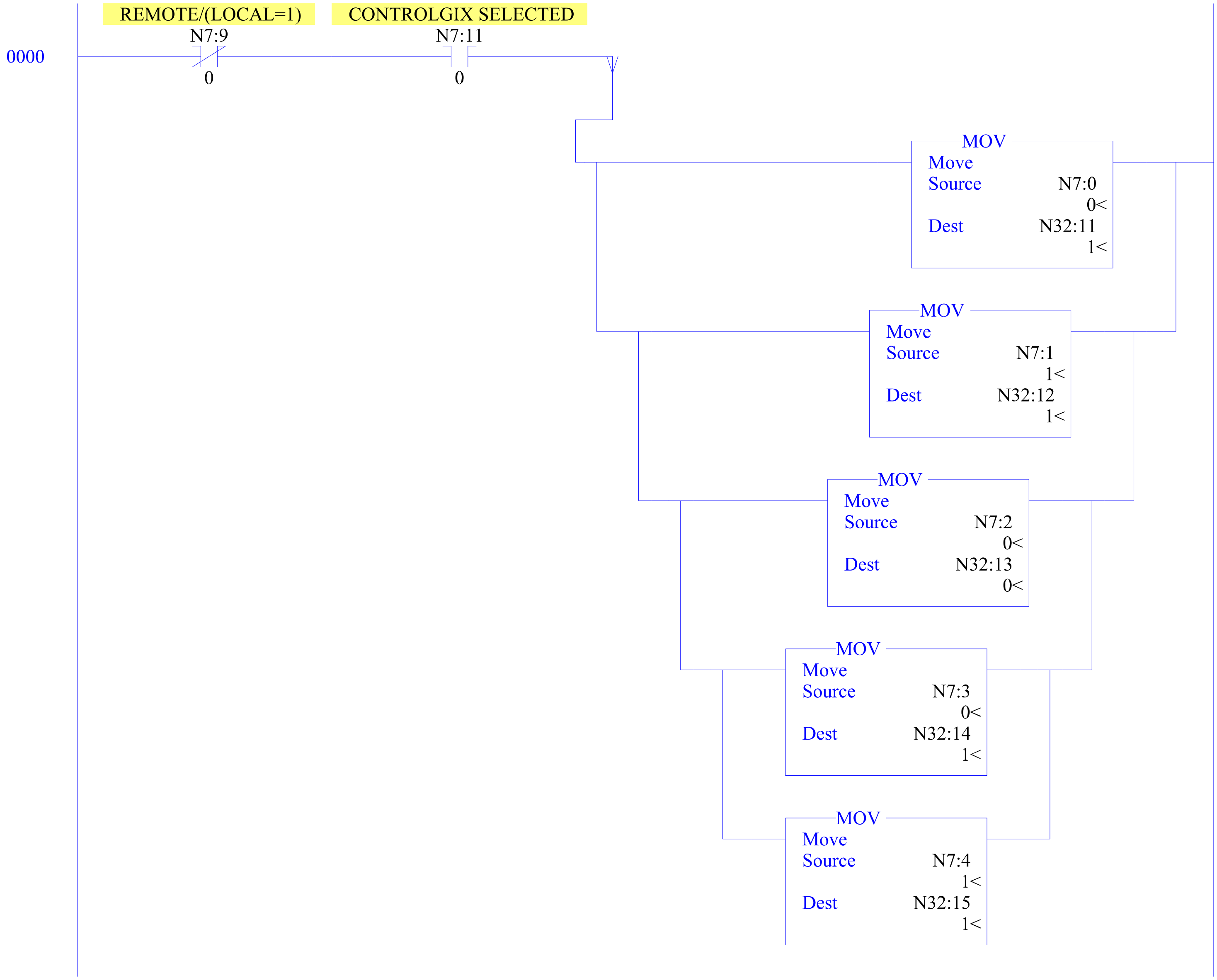
STEAM FCV
DIV
Divide
Source A N33:74
0<
Source B N23:20
100<
Dest F9:4
100.0<

PRODUCT FCV
DIV
Divide
Source A N33:75
0<
Source B N23:20
100<
Dest F9:5
0.0<

DIV
Divide
Source A N33:76
0<
Source B N23:20
100<
Dest F9:6
12557.0<

0013

END


0000
REMOTE/(LOCAL=1)
N7:9
0
CONTROLGIX SELECTED
N7:11
0
MOV
Move
Source N7:0
0<
Dest N32:11
1<
MOV
Move
Source N7:1
1<
Dest N32:12
1<
MOV
Move
Source N7:2
0<
Dest N32:13
0<
MOV
Move
Source N7:3
0<
Dest N32:14
1<
MOV
Move
Source N7:4
1<
Dest N32:15
1<

0001

REMOTE/(LOCAL=1)
N7:9
0

CONTROLGIX SELECTED
N7:11
0

MOV
Move
Source N7:5
0<
Dest N32:16
0<

MOV
Move
Source N7:6
0<
Dest N32:17
0<

MOV
Move
Source N7:7
1<
Dest N32:18
0<

MOV
Move
Source N7:8
0<
Dest N32:19
0<

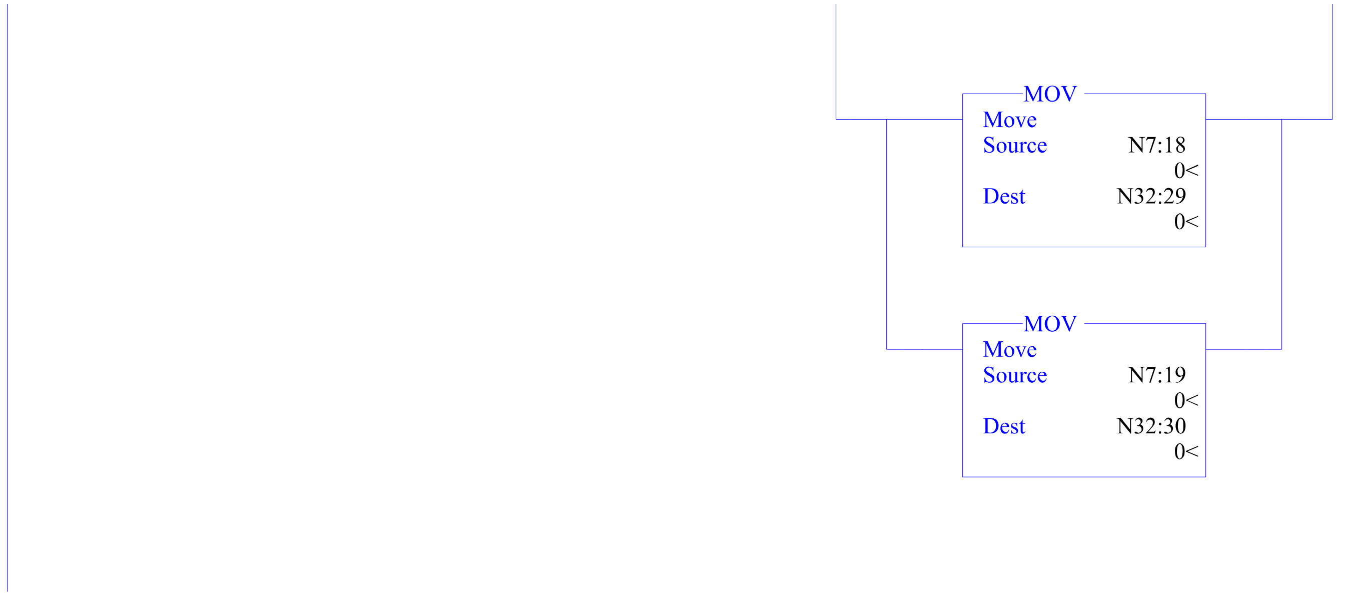
MOV
Move
Source N7:9
1<
Dest N32:20
0<

MOV
Move
Source N7:10
1<
Dest N32:21
0<

0002

REMOTE/(LOCAL=1) N7:9 0 — CONTROLGIX SELECTED N7:11 0

MOV	Move	Source		Dest	
MOV	Move	N7:11	0<	N32:22	1<
MOV	Move	N7:12	0<	N32:23	0<
MOV	Move	N7:13	0<	N32:24	0<
MOV	Move	N7:14	1<	N32:25	1<
MOV	Move	N7:15	1<	N32:26	1<
MOV	Move	N7:16	0<	N32:27	0<
MOV	Move	N7:17	0<	N32:28	1<


MOV
Move
Source N7:18
0<
Dest N32:29
0<
MOV
Move
Source N7:19
0<
Dest N32:30
0<

0003

N7:9	REMOTE/(LOCAL=1)	0
N7:11	CONTROLGIX SELECTED	0

	Source		Dest	
MOV Move	N32:31	0<	N7:20	0<
MOV Move	N32:32	0<	N7:21	1<
MOV Move	N32:33	0<	N7:22	0<
MOV Move	N32:34	0<	N7:23	0<
MOV Move	N32:35	0<	N7:24	0<
MOV Move	N32:36	0<	N7:25	0<
MOV Move	N32:37	0<	N7:26	0<

MOV
Move
Source N32:38
0<
Dest N7:27
0<

MOV
Move
Source N32:39
0<
Dest N7:28
0<

0004

REMOTE/(LOCAL=1) N7:9 0

CONTROLGIX SELECTED N7:11 0

MOV
Move
Source N32:40 0<
Dest N7:29 0<

MOV
Move
Source N32:41 0<
Dest N7:30 0<

MOV
Move
Source N32:42 0<
Dest N7:31 0<

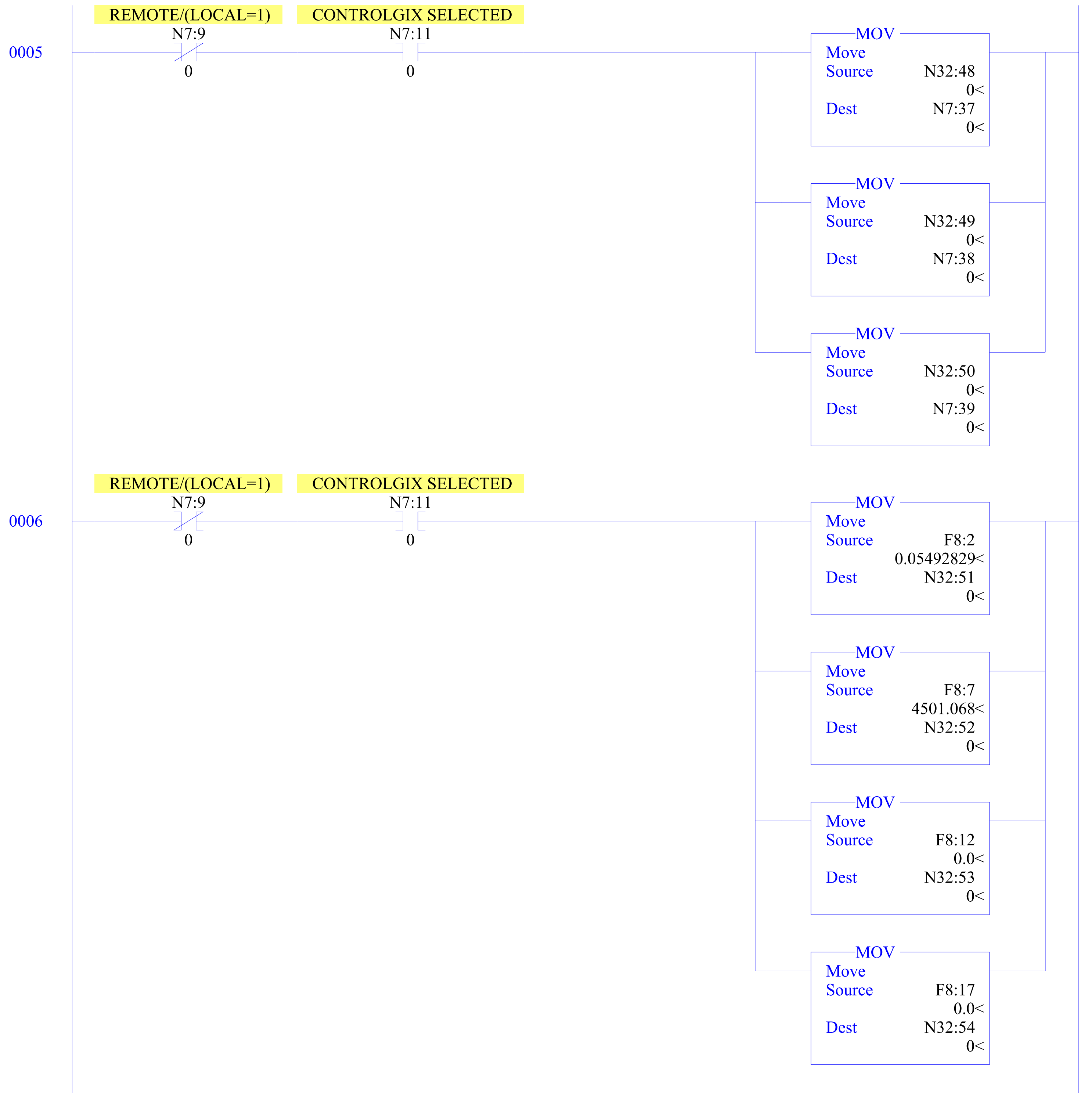
MOV
Move
Source N32:43 0<
Dest N7:32 0<

MOV
Move
Source N32:44 0<
Dest N7:33 0<

MOV
Move
Source N32:45 0<
Dest N7:34 0<

MOV
Move
Source N32:46 0<
Dest N7:35 0<

MOV
Move
Source N32:47 0<
Dest N7:36 0<


0005
REMOTE/(LOCAL=1)
N7:9
0
CONTROLGIX SELECTED
N7:11
0
MOV
Move
Source N32:48
0<
Dest N7:37
0<
MOV
Move
Source N32:49
0<
Dest N7:38
0<
MOV
Move
Source N32:50
0<
Dest N7:39
0<
0006
REMOTE/(LOCAL=1)
N7:9
0
CONTROLGIX SELECTED
N7:11
0
MOV
Move
Source F8:2
0.05492829<
Dest N32:51
0<
MOV
Move
Source F8:7
4501.068<
Dest N32:52
0<
MOV
Move
Source F8:12
0.0<
Dest N32:53
0<
MOV
Move
Source F8:17
0.0<
Dest N32:54
0<

0007

REMOTE/(LOCAL=1) N7:9 0

CONTROLGIX SELECTED N7:11 0

MOV
Move
Source F8:22
0.0<
Dest N32:55
0<

MOV
Move
Source F8:27
33.37606<
Dest N32:56
34<

MOV
Move
Source F8:32
34.0719<
Dest N32:57
35<

MOV
Move
Source F8:37
31.61814<
Dest N32:58
34<

0008

REMOTE/(LOCAL=1) N7:9 0

CONTROLGIX SELECTED N7:11 0

MOV
Move
Source F8:42
32.13087<
Dest N32:59
34<

MOV
Move
Source F8:47
0.0<
Dest N32:60
0<

MOV
Move
Source F8:52
32.8145<
Dest N32:61
35<

MOV
Move
Source F8:57
1.0<
Dest N32:62
0<

0009

REMOTE/(LOCAL=1)
N7:9
0

CONTROLGIX SELECTED
N7:11
0

MOV
Move
Source F8:62
35.58567<
Dest N32:63
52<

MOV
Move
Source F8:67
65.7816<
Dest N32:64
0<

MOV
Move
Source F8:72
12494.0<
Dest N32:65
0<

MOV
Move
Source F8:77
0.0<
Dest N32:66
0<

0010

REMOTE/(LOCAL=1)
N7:9
0

CONTROLGIX SELECTED
N7:11
0

VFD PERISTALTIC
MOV
Move
Source N32:71
0<
Dest F9:1
0.8972716<

VFD CENTRIFUGAL
MOV
Move
Source N32:72
0<
Dest F9:2
76.64652<

0011

REMOTE/(LOCAL=1) N7:9 0

CONTROLGIX SELECTED N7:11 0

VFD VACCUM
MOV
Move
Source N32:73
0<
Dest F9:3
100.0<

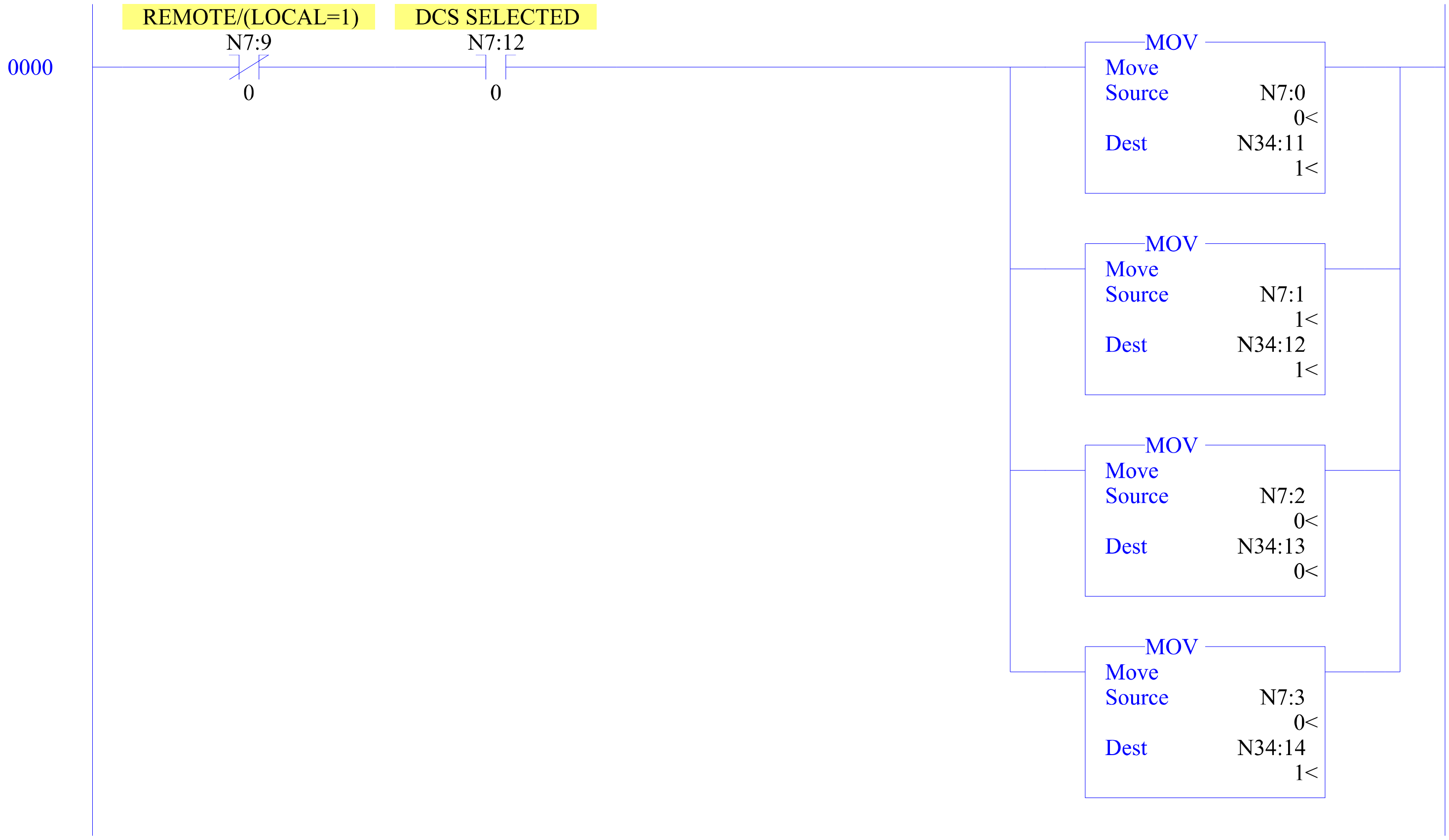
STEAM FCV
MOV
Move
Source N32:74
0<
Dest F9:4
100.0<

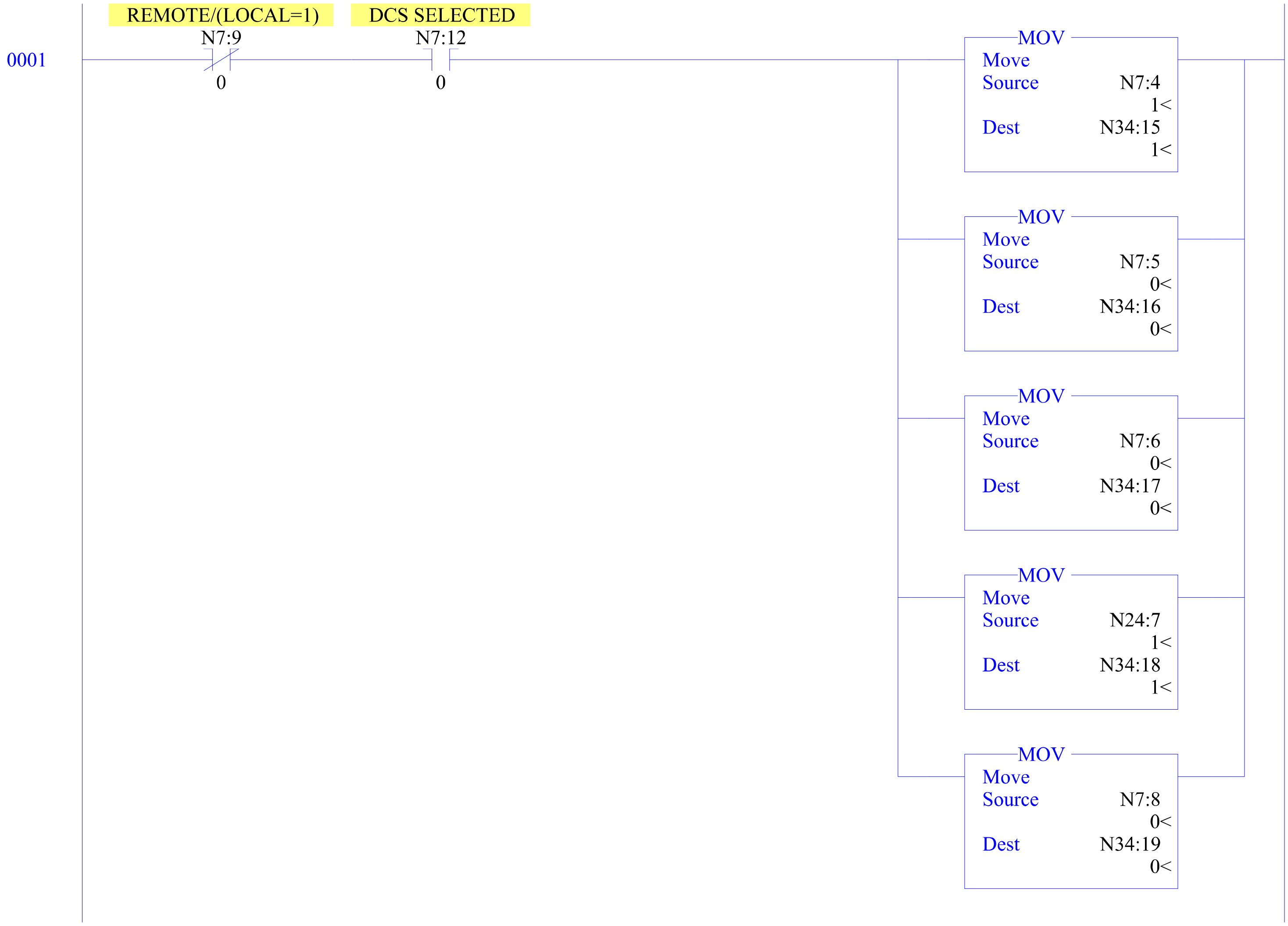
PRODUCT FCV
MOV
Move
Source N32:75
0<
Dest F9:5
0.0<

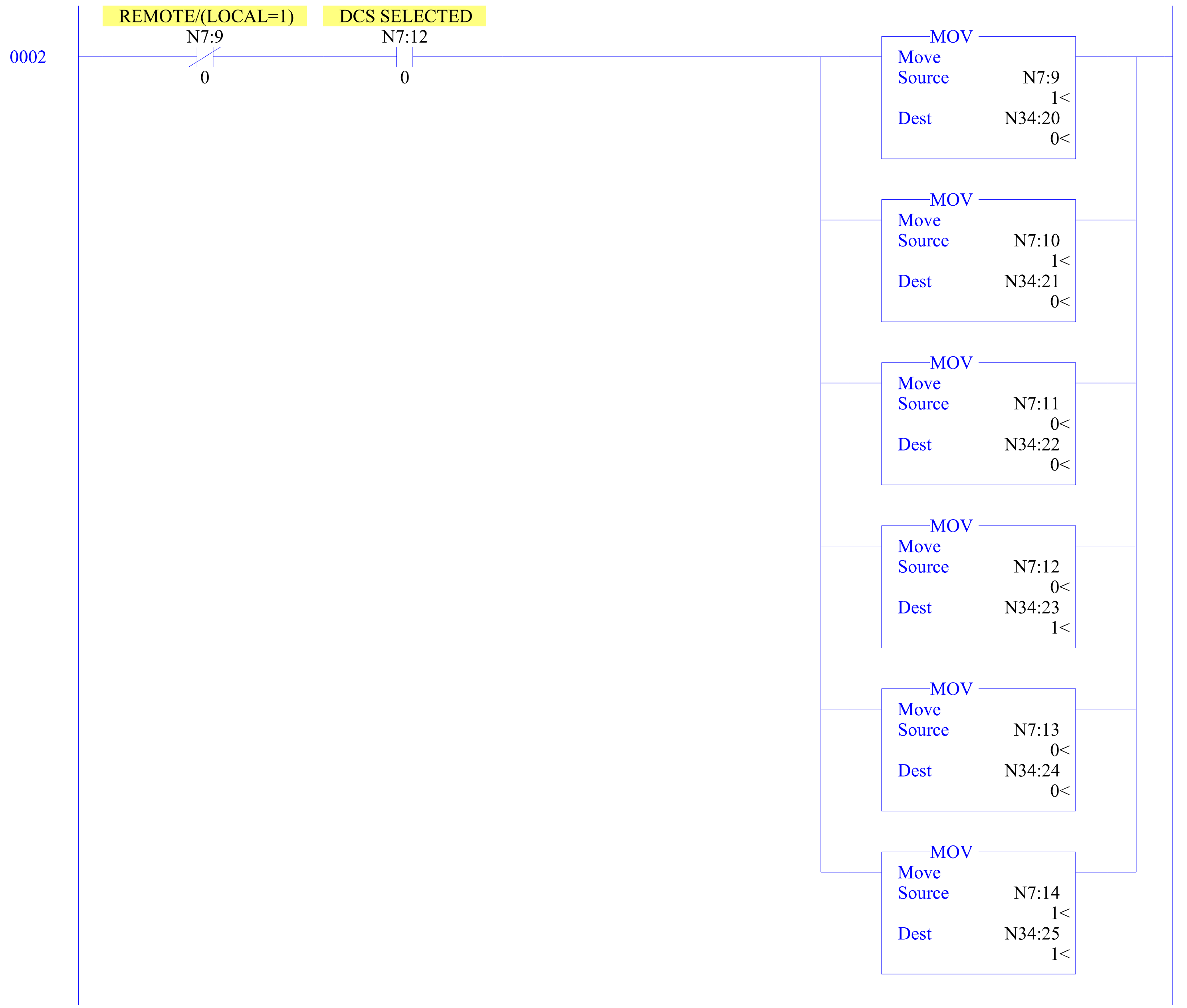
MOV
Move
Source N32:76
0<
Dest F9:6
12557.0<

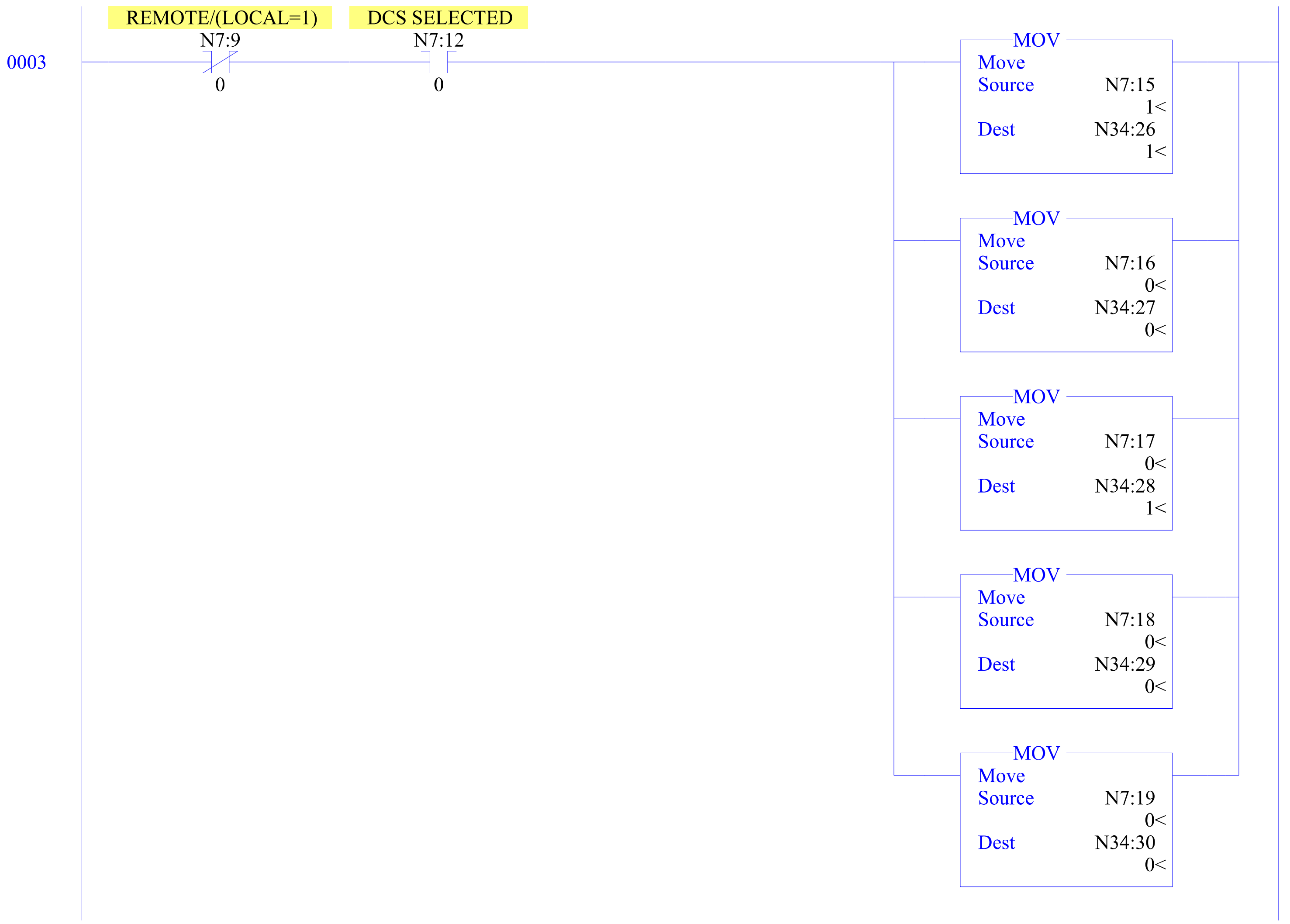
0012

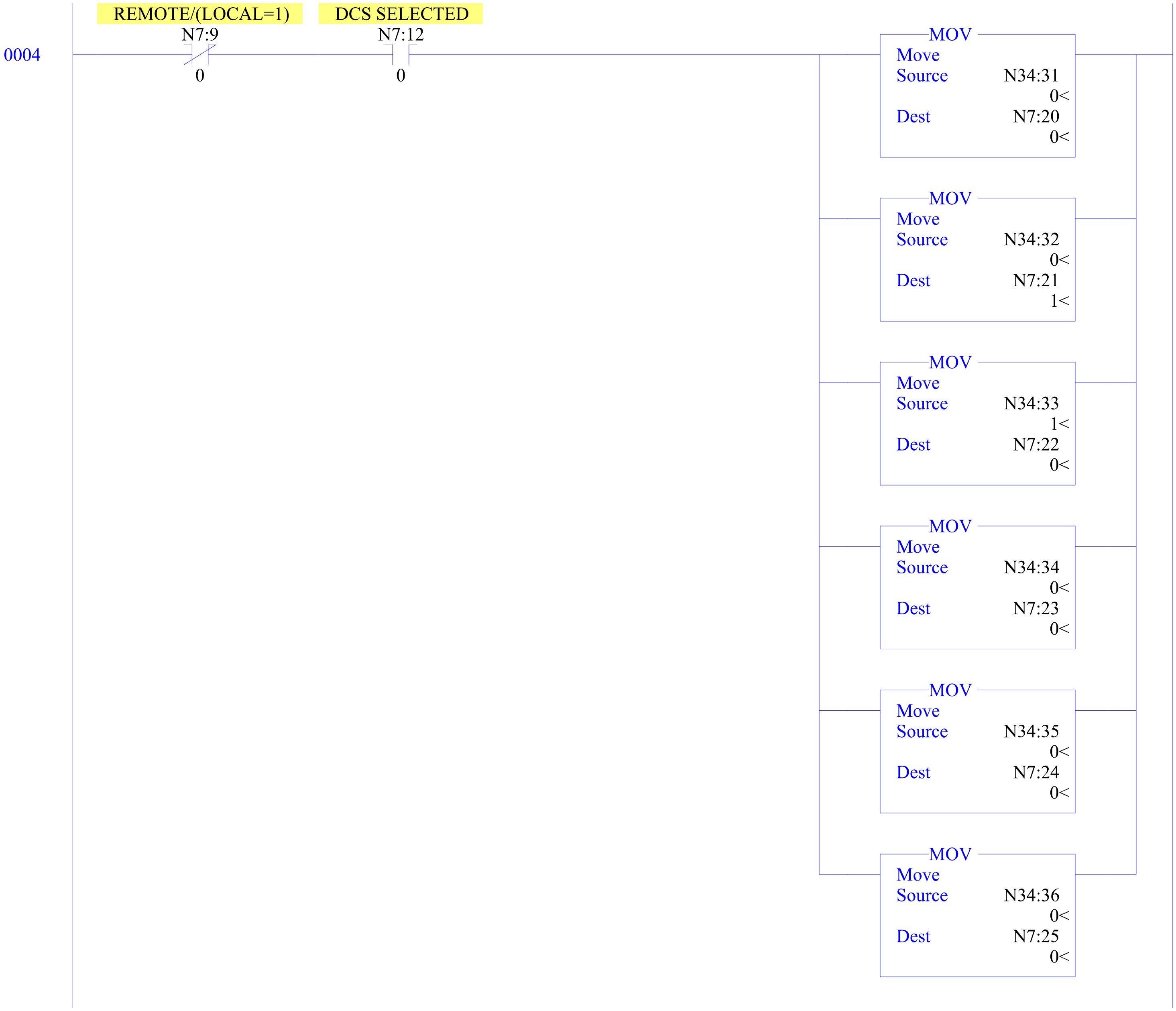
END


0000
REMOTE/(LOCAL=1)
N7:9
0
DCS SELECTED
N7:12
0
MOV
Move
Source N7:0
0<
Dest N34:11
1<
MOV
Move
Source N7:1
1<
Dest N34:12
1<
MOV
Move
Source N7:2
0<
Dest N34:13
0<
MOV
Move
Source N7:3
0<
Dest N34:14
1<


0001
REMOTE/(LOCAL=1)
N7:9
0
DCS SELECTED
N7:12
0
MOV
Move
Source N7:4
1<
Dest N34:15
1<
MOV
Move
Source N7:5
0<
Dest N34:16
0<
MOV
Move
Source N7:6
0<
Dest N34:17
0<
MOV
Move
Source N24:7
1<
Dest N34:18
1<
MOV
Move
Source N7:8
0<
Dest N34:19
0<


0002
REMOTE/(LOCAL=1)
N7:9
0
DCS SELECTED
N7:12
0
MOV
Move
Source N7:9
1<
Dest N34:20
0<
MOV
Move
Source N7:10
1<
Dest N34:21
0<
MOV
Move
Source N7:11
0<
Dest N34:22
0<
MOV
Move
Source N7:12
0<
Dest N34:23
1<
MOV
Move
Source N7:13
0<
Dest N34:24
0<
MOV
Move
Source N7:14
1<
Dest N34:25
1<


0003
REMOTE/(LOCAL=1)
N7:9
0
DCS SELECTED
N7:12
0
MOV
Move
Source N7:15
1<
Dest N34:26
1<
MOV
Move
Source N7:16
0<
Dest N34:27
0<
MOV
Move
Source N7:17
0<
Dest N34:28
1<
MOV
Move
Source N7:18
0<
Dest N34:29
0<
MOV
Move
Source N7:19
0<
Dest N34:30
0<


0004
REMOTE/(LOCAL=1)
N7:9
0
DCS SELECTED
N7:12
0
MOV
Move
Source N34:31
0<
Dest N7:20
0<
MOV
Move
Source N34:32
0<
Dest N7:21
1<
MOV
Move
Source N34:33
1<
Dest N7:22
0<
MOV
Move
Source N34:34
0<
Dest N7:23
0<
MOV
Move
Source N34:35
0<
Dest N7:24
0<
MOV
Move
Source N34:36
0<
Dest N7:25
0<

0005

REMOTE/(LOCAL=1)	DCS SELECTED
N7:9 (XIO)	N7:12 (XIC)
0	0

Instruction	Source	Source value	Dest	Dest value
MOV Move	N34:37	0<	N7:26	0<
MOV Move	N34:38	0<	N7:27	0<
MOV Move	N34:39	0<	N7:28	0<
MOV Move	N34:40	0<	N7:29	0<
MOV Move	N34:41	0<	N7:30	0<
MOV Move	N34:42	0<	N7:31	0<

0006

REMOTE/(LOCAL=1) N7:9 0 — DCS SELECTED N7:12 0

MOV		
Move		
Source	N34:43	0<
Dest	N7:32	0<

MOV		
Move		
Source	N34:44	0<
Dest	N7:33	0<

MOV		
Move		
Source	N34:45	0<
Dest	N7:34	0<

MOV		
Move		
Source	N34:46	0<
Dest	N7:35	0<

MOV		
Move		
Source	N34:47	0<
Dest	N7:36	0<

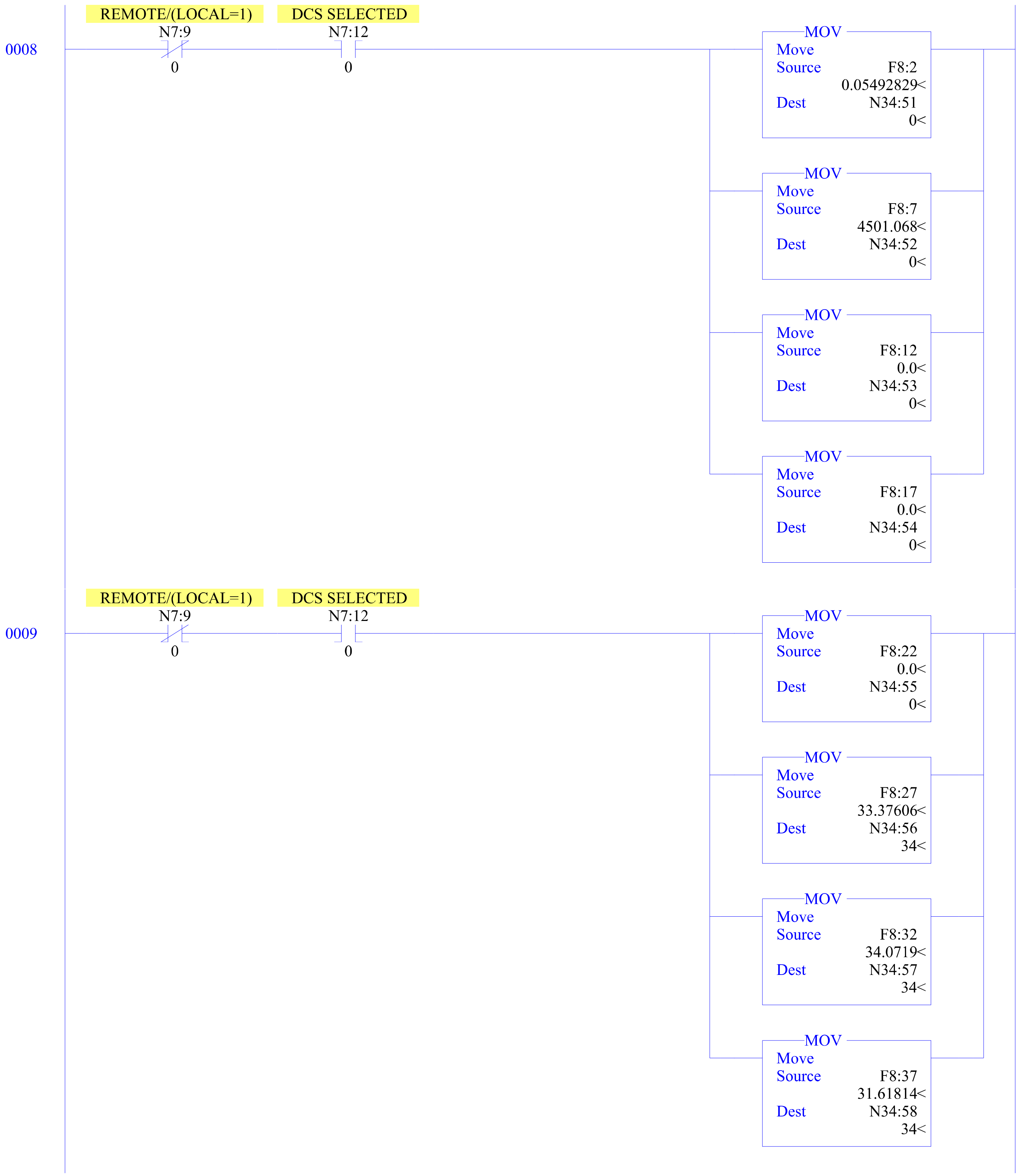
0007

REMOTE/(LOCAL=1) N7:9 0 — DCS SELECTED N7:12 0

MOV		
Move		
Source	N34:48	0<
Dest	N7:37	0<

MOV		
Move		
Source	N34:49	0<
Dest	N7:38	0<

MOV		
Move		
Source	N34:50	0<
Dest	N7:39	0<


0008
REMOTE/(LOCAL=1)
N7:9
0
DCS SELECTED
N7:12
0
MOV
Move
Source F8:2
0.05492829<
Dest N34:51
0<
MOV
Move
Source F8:7
4501.068<
Dest N34:52
0<
MOV
Move
Source F8:12
0.0<
Dest N34:53
0<
MOV
Move
Source F8:17
0.0<
Dest N34:54
0<
0009
REMOTE/(LOCAL=1)
N7:9
0
DCS SELECTED
N7:12
0
MOV
Move
Source F8:22
0.0<
Dest N34:55
0<
MOV
Move
Source F8:27
33.37606<
Dest N34:56
34<
MOV
Move
Source F8:32
34.0719<
Dest N34:57
34<
MOV
Move
Source F8:37
31.61814<
Dest N34:58
34<

0010

REMOTE/(LOCAL=1) N7:9 0 — DCS SELECTED N7:12 0

MOV		
Move		
Source	F8:42	32.13087<
Dest	N34:59	35<

MOV		
Move		
Source	F8:47	0.0<
Dest	N34:60	0<

MOV		
Move		
Source	F8:52	32.8145<
Dest	N34:61	35<

MOV		
Move		
Source	F8:57	1.0<
Dest	N34:62	0<

0011

REMOTE/(LOCAL=1) N7:9 0 — DCS SELECTED N7:12 0

MOV		
Move		
Source	F8:62	35.58567<
Dest	N34:63	53<

MOV		
Move		
Source	F8:67	65.7816<
Dest	N34:64	0<

MOV		
Move		
Source	F8:72	12494.0<
Dest	N34:65	0<

MOV		
Move		
Source	F8:77	0.0<
Dest	N34:66	0<

0012

REMOTE/(LOCAL=1) N7:9 0 | DCS SELECTED N7:12 0

VFD PERISTALTIC
MOV
Move
Source N34:71
0<
Dest F9:1
0.8972716<

VFD CENTRIFUGAL
MOV
Move
Source N34:72
0<
Dest F9:2
76.64652<

0013

REMOTE/(LOCAL=1) N7:9 0 | DCS SELECTED N7:12 0

VFD VACCUM
MOV
Move
Source N34:73
0<
Dest F9:3
100.0<

STEAM FCV
MOV
Move
Source N34:74
0<
Dest F9:4
100.0<

PRODUCT FCV
MOV
Move
Source N34:75
0<
Dest F9:5
0.0<

MOV
Move
Source N34:76
0<
Dest F9:6
12557.0<

0014

END

Data File O0 (bin) -- OUTPUT

Offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
O:0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	Bul.1766 MicroLogix 1400 Series A
O:0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Bul.1766 MicroLogix 1400 Series A
O:0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Bul.1766 MicroLogix 1400 Series A
O:0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Bul.1766 MicroLogix 1400 Series A
O:0.4	0	0	0	0	0	0	1	1	0	1	0	1	0	0	0	0	Bul.1766 MicroLogix 1400 Series A-Analog (
O:0.5	0	0	0	0	1	1	0	1	0	0	0	1	1	1	0	0	Bul.1766 MicroLogix 1400 Series A-Analog (
O:1.0									0	0	0	0	0	0	0	0	1762-OB8 - 8-Output (TRANS-SRC) 10/50 VDC
O:5.0	0	0	1	1	1	1	0	0	0	1	1	1	1	0	1	0	1762-OF4 - 4-Channel Analog I/V Output Module
O:5.1	0	0	1	1	1	1	0	0	0	1	1	1	1	0	1	0	1762-OF4 - 4-Channel Analog I/V Output Module
O:5.2	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	1762-OF4 - 4-Channel Analog I/V Output Module
O:5.3	0	0	0	0	1	1	0	0	1	0	0	0	0	1	1	1	1762-OF4 - 4-Channel Analog I/V Output Module

Data File I1 (bin) -- INPUT

Offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
I:0.0	1	1	0	0	0	1	1	0	0	1	0	1	0	0	1	0	Bul.1766 MicroLogix 1400 Series A
I:0.1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	Bul.1766 MicroLogix 1400 Series A
I:0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Bul.1766 MicroLogix 1400 Series A
I:0.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Bul.1766 MicroLogix 1400 Series A
I:0.4	0	0	0	0	0	0	1	1	0	0	1	1	1	0	0	1	Bul.1766 MicroLogix 1400 Series A-Analog
I:0.5	0	0	0	0	1	0	0	0	1	1	1	1	0	0	0	1	Bul.1766 MicroLogix 1400 Series A-Analog
I:0.6	0	0	0	0	0	0	1	1	0	0	1	1	0	0	1	1	Bul.1766 MicroLogix 1400 Series A-Analog
I:0.7	0	0	0	0	0	0	1	1	0	0	1	1	0	0	1	1	Bul.1766 MicroLogix 1400 Series A-Analog
I:2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1762-IF4 - Analog 4 Chan. Input
I:2.1	0	0	0	0	1	0	1	0	1	0	1	0	1	1	1	0	1762-IF4 - Analog 4 Chan. Input
I:2.2	0	0	0	0	1	0	1	0	1	1	1	0	0	1	1	1	1762-IF4 - Analog 4 Chan. Input
I:2.3	0	0	0	0	1	0	1	0	0	0	1	0	0	1	0	0	1762-IF4 - Analog 4 Chan. Input
I:2.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1762-IF4 - Analog 4 Chan. Input
I:2.5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1762-IF4 - Analog 4 Chan. Input
I:2.6	1	0	1	0	1	1	0	0	1	1	0	0	1	0	1	1	1762-IF4 - Analog 4 Chan. Input
I:3.0	0	0	0	0	1	0	1	0	0	1	0	0	1	0	0	0	1762-IF4 - Analog 4 Chan. Input
I:3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1762-IF4 - Analog 4 Chan. Input
I:3.2	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	1762-IF4 - Analog 4 Chan. Input
I:3.3	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1762-IF4 - Analog 4 Chan. Input
I:3.4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1762-IF4 - Analog 4 Chan. Input
I:3.5	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1762-IF4 - Analog 4 Chan. Input
I:3.6	1	0	1	0	1	1	0	0	0	0	1	1	0	1	1	1	1762-IF4 - Analog 4 Chan. Input
I:4.0	0	0	0	1	0	1	1	0	1	0	1	1	1	1	0	1	1762-IF4 - Analog 4 Chan. Input
I:4.1	0	0	1	0	1	0	1	0	0	0	0	1	1	0	0	0	1762-IF4 - Analog 4 Chan. Input
I:4.2	1	1	1	1	1	1	1	1	0	1	1	0	0	1	1	0	1762-IF4 - Analog 4 Chan. Input
I:4.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1762-IF4 - Analog 4 Chan. Input
I:4.4	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1762-IF4 - Analog 4 Chan. Input
I:4.5	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1762-IF4 - Analog 4 Chan. Input
I:4.6	1	0	1	0	1	0	1	1	0	1	1	1	0	1	1	1	1762-IF4 - Analog 4 Chan. Input
I:5.0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1762-OF4 - 4-Channel Analog I/V Output Module
I:5.1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1762-OF4 - 4-Channel Analog I/V Output Module

Main

Processor Mode S:1/0 - S:1/4 = Remote Run
On Power up Go To Run (Mode Behavior) S:1/12 = 0
First Pass S:1/15 = No
Free Running Clock S:4 = 0000-1110-0111-0000

Proc

OS Catalog Number S:57 = 1400
OS Series S:58 = B
OS FRS S:59 =
Processor Catalog Number S:60 =
Processor Series S:61 = B
Processor FRN S:62 =

User Program Type S:63 = 9001h
Compiler Revision Number S:64 =

Scan Times

Maximum (x10 ms) S:22 = 64
Watchdog (x10 ms) S:3 (high byte) = 10
Last 100 uSec Scan Time S:35 = 52
Scan Toggle Bit S:33/9 = 0

Math

Math Overflow Selected S:2/14 = 0
Overflow Trap S:5/0 = 0
Carry S:0/0 = 0
Overflow S:0/1 = 0
Zero Bit S:0/2 = 1
Sign Bit S:0/3 = 0

Math Register (lo word) S:13 = 0
Math Register (high word) S:14-S:13 = 0
Math Register (32 Bit) S:14-S:13 = 0

Chan 0

Processor Mode S:1/0- S:1/4 = Remote Run
Node Address S:15 (low byte) = 0
Baud Rate S:15 (high byte) = ?
Channel Mode S:33/3 = 0
Comms Active S:33/4 = 0
Incoming Cmd Pending S:33/0 = 0
Msg Reply Pending S:33/1 = 0

Outgoing Msg Cmd Pending S:33/2 = 0

Debug

Suspend Code S:7 = 0
Suspend File S:8 = 0

Errors

Fault Override At Power Up S:1/8 = 0
Startup Protection Fault S:1/9 = 0
Major Error Halt S:1/13 = 0
Overflow Trap S:5/0 = 0
Control Register Error S:5/2 = 0
Major Error Executing User
Fault Rtn. S:5/3 = 0
Battery Low S:5/11 = 0
Input Filter Selection Modified S:5/13 = 0
ASCII String Manipulation error S:5/15 = 0

Fault Routine S:29 = 0
Major Error S:6 = 0h

Error Description:

Protection

Deny Future Access S:1/14 = No
Data File Overwrite Protection Lost S:36/10 = False

Mem Module

Memory Module Loaded On Boot S:5/8 = 0
Password Mismatch S:5/9 = 0
Load Memory Module On Memory Error S:1/10 = 0
Load Memory Module Always S:1/11 = 0
On Power up Go To Run (Mode Behavior) S:1/12 = 0
Program Compare S:2/9 = 0
Data File Overwrite Protection Lost S:36/10 = 0

Mem Module

Memory Module Loaded On Boot S:5/8 = 0
Password Mismatch S:5/9 = 0
Load Memory Module On Memory Error S:1/10 = 0
Load Memory Module Always S:1/11 = 0
On Power up Go To Run (Mode Behavior) S:1/12 = 0
Program Compare S:2/9 = 0
Data File Overwrite Protection Lost S:36/10 = 0

Forces

Forces Enabled S:1/5 = Yes
Forces Installed S:1/6 = No

Offset	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	(Symbol) Description
B3:0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
B3:1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	
B3:2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	
B3:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:10	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	
B3:11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
B3:19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Data File T4 -- TIMER

Offset	EN	TT	DN	BASE	PRE	ACC	(Symbol) Description
T4:0	0	0	0	.01 sec	0	0	

Data File C5 -- COUNTER

Offset	CU	CD	DN	OV	UN	UA	PRE	ACC	(Symbol) Description
C5:0	0	0	0	0	0	0	0	0	

Data File R6 -- CONTROL

Offset	EN	EU	DN	EM	ER	UL	IN	FD	LEN	POS	(Symbol) Description
R6:0	0	0	0	0	0	0	0	0	0	0	

Data File N7 (dec) -- INTEGER

Offset	0	1	2	3	4	5	6	7	8	9
N7:0	0	1	0	0	1	0	0	1	0	1
N7:10	1	0	0	0	1	1	0	0	0	0
N7:20	0	1	0	0	0	0	0	0	0	0
N7:30	0	0	0	0	0	0	0	0	0	0
N7:40	0	0	0	0	0	0	0	0	0	0
N7:50	0	10								

Data File F8 -- FLOAT

Offset	0	1	2	3	4
F8:0	0	30	0.05492829	0	59.99992
F8:5	0	10000	4501.068	60	0
F8:10	0	100	0	0.02439024	0
F8:15	0	5	0	7.629395e-05	1.214525
F8:20	0	200	0	1.860828e-06	32.4971
F8:25	0	200	33.37606	0	32.37502
F8:30	0	200	34.0719	0	32.48489
F8:35	0	200	31.61814	0	31.97217
F8:40	0	200	32.13087	0	32.27736
F8:45	0	200	0	0	32.32619
F8:50	0	200	32.8145	100	31.44723
F8:55	0	1	1	0	0
F8:60	0	100	35.58567	0	0
F8:65	0	100	65.7816	0	0
F8:70	0	819	12494	0	0
F8:75	0	100	0	0	0
F8:80	100	0	0	0	0
F8:85	30	10	0	0	0

Data File F9

Offset	0	1	2	3	4
F9:0	0	0.8972716	76.64652	100	100
F9:5	0	12557	147	16383	16383
F9:10	0	0	0	0	0
F9:15	0	0	0	0	0
F9:20	0	0	0	0	0
F9:25	0	0	0	0	0

Data File N10 (dec)

Offset	0	1	2	3	4	5	6	7	8	9
N10:0	60	1	60	60	250	10250	101	0	0	

Data File PD11

Offset	TM	AM	CM	OL	RG	SC	TF	DA	DB	UL	LL	SP	PV	DN	EN	SPS	KC	Ti	TD	MAXS	MINS	ZCD
PD11:0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	4500	14	5	1	10000	0	0
PD11:1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	8	14	5	1	10	0	0
PD11:2	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	40	18	5	1	200	0	0
PD11:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	14	1	1	100	0	0
PD11:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PD11:5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PD11:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PD11:7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PD11:8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PD11:9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Data File F12

Offset	0	1	2	3	4
F12:0	0	0	0	0	0
F12:5	0	0	0		

Offset	TM	AM	CM	OL	RG	SC	TF	DA	DB	UL	LL	SP	PV	DN	EN	SPS	KC	Ti	TD	MAXS	MINS	ZCD
PD16:0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	35	50	1	2	100	0	0
PD16:1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	14	1	1	100	0	0
PD16:2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PD16:3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PD16:4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PD16:5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PD16:6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PD16:7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PD16:8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PD16:9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Data File N23 (dec)

Offset	0	1	2	3	4	5	6	7	8	9
N23:0	0	0	0	0	0	0	0	0	0	0
N23:10	0	0	0	0	0	0	0	0	0	0
N23:20	100	60	0							

Data File N24 (dec)

Offset	0	1	2	3	4	5	6	7	8	9
N24:0	1	0	0	0	1	0	0	1	0	1
N24:10	1	0	0	0	0	1	0	0	0	0
N24:20	0	0	0	0	0	0	0	0	0	0
N24:30	0	0	0	0	0	0	0	0	0	0

Data File N29 (dec)

Offset	0	1	2	3	4	5	6	7	8	9
N29:0	0	16383	0	16383	20479	16383	0	0	2688	16383
N29:10	7409	12508	0	0	5833	16383	147	100	0	0
N29:20	1	0	0	0	0	0	0	0	0	0

Data File N30 (dec)

Offset	0	1	2	3	4	5	6	7	8	9
N30:0	0	0	0	0	0	0	0	0	0	0
N30:10	0	0	0							

Data File N31 (dec)

Offset	0	1	2	3	4	5	6	7	8	9
N31:0	0									

Data File N32 (dec)

Offset	0	1	2	3	4	5	6	7	8	9
N32:0	0	0	0	0	0	0	0	0	0	0
N32:10	0	1	1	0	1	1	0	0	0	0
N32:20	0	0	1	0	0	1	1	0	1	0
N32:30	0	0	0	0	0	0	0	0	0	0
N32:40	0	0	0	0	0	0	0	0	0	0
N32:50	0	0	0	0	0	0	34	35	34	34
N32:60	0	35	0	52	0	0	0	0	0	0
N32:70	0	0	0	0	0	0	0			

Data File N33 (dec)

Offset	0	1	2	3	4	5	6	7	8	9
N33:0	0	0	0	0	0	0	0	0	0	0
N33:10	0	0	1	0	0	1	0	0	1	0
N33:20	1	1	0	0	0	1	1	0	1	0
N33:30	0	0	0	0	0	0	0	0	0	0
N33:40	0	0	0	0	0	0	0	0	0	0
N33:50	0	8	0	0	2	0	3081	3050	3092	3148
N33:60	0	3122	10000	4807	6601	0	0	0	0	0
N33:70	0	0	0	0	0	0	0	0	0	0
N33:80	0	0	0	0	0	0	0	0	0	0
N33:90	0	0	0	0	0	0	0	0	0	0

Data File N34 (dec)

Offset	0	1	2	3	4	5	6	7	8	9
N34:0	0	0	0	0	0	0	0	0	0	0
N34:10	0	1	1	0	1	1	0	0	1	0
N34:20	0	0	0	1	0	1	1	0	1	0
N34:30	0	0	0	1	0	0	0	0	0	0
N34:40	0	0	0	0	0	0	0	0	0	0
N34:50	0	0	0	0	0	0	34	34	34	35
N34:60	0	35	0	53	0	0	0	0	0	0
N34:70	0	0	0	0	0	0	0	0	0	0
N34:80	0	0	0	0	0	0	0	0	0	0
N34:90	0	0	0	0	0	0	0	0	0	0

Appendix F

Contrologix Programming Boiler & Heat Exchanger

General			
Vendor:	Allen-Bradley	Mode:	Remote Run
Revision:	16.3	Key Switch Position:	REM
Chassis Type:	1756-A10 10-Slot ControlLogix Chassis	Created:	10/9/2013 7:12:06 PM
Slot:	0	Edited:	6/23/2014 3:54:38 PM
Serial Port			
Mode:	System	Control Line:	No Handshake
Baud Rate:	19200	RTS Send Delay:	0 (x20 ms)
Date Bits:	8	RTS Off Delay:	0 (x20 ms)
Parity:	None	DCD Wait Delay:	0 (x1 sec)
Stop Bits:	1		
System Protocol - DF1 Master			
Station Address:	0	Polling Mode:	Message Based (slave can initiate messages)
Transmit Retries:	3	Error Detection:	BCC
ACK Timeout:	50 (x20 ms)	Enable Duplicate Detection:	Yes
Relay Message Wait:	5 (x20 ms)		
System Protocol - DF1 Point to Point (Current)			
Station Address:	0	Embedded Responses:	Autodetect
NAK Receive Limit:	3	Error Detection:	BCC
ENQ Transmit Limit:	3	Enable Duplicate Detection:	Yes
ACK Timeout:	50 (x20 ms)		
System Protocol - DF1 Radio Modem			
Station Address:	0	Error Detection:	BCC
Store and Foward:	No		
System Protocol - DF1 Slave			
Station Address:	0	EOT Suppression:	No
Transmit Retries:	3	Error Detection:	BCC
Slave Poll Timeout:	3000 (x20 ms)	Enable Duplicate Detection:	Yes
System Protocol - DH485			
Station Address:	0	Token Hold Factor:	1
Max Station Address:	31	Error Detection:	CRC
User Protocol - ASCII			
Read/Write Buffer Size:	82 bytes	Append Character 2:	'$l'
Termination Character 1:	'$r'	XON/XOFF:	No
Termination Character 2:	'$FF'	Echo Mode:	No
Append Character 1:	'$r'	Delete Mode:	Ignore
Date/Time			
Date and Time:	1/2/1998 6:58:42 PM		
Time Zone:	(GMT+00:00)		
Daylight Saving (+01:00):	No		
CST Master:	No		
Is Master:	Off	Duplicate Master Detected:	Off
Synchronized with Master:	Off	Timer Hardware Faulted:	Off
Advanced			
Controller Fault Handler:	<none>	Security:	No Protection
Power-Up Handler:	<none>	Match Project To Controller:	No
System Overhead Time Slice:	20 %	Serial Number:	00356A6C
During unused System Overhead Time Slice:	Run Continuous Task		
SFC Execution			
Execution Control:	Execute current active steps only	Last Scan of Active Step:	Don't scan
Restart Position:	Restart at most recently executed step		
Nonvolatile Memory			
<Empty>			
Memory			
Memory Option:	1756-L60M03SE/A		
I/O Memory			
Total Memory:	505,856 bytes	Max Used:	37,616 bytes
Free Memory:	468,240 bytes	Largest Block Free:	466,072 bytes
Used Memory:	37,616 bytes		
Data and Logic Memory			

Total Memory:	768,000 bytes	Max Used:	89,500 bytes
Free Memory:	679,140 bytes	Largest Block Free:	678,344 bytes
Used Memory:	88,860 bytes		

Name	Value	Data Type	Scope
AI		REAL[13]	cpu
*AI[0] - MainProgram/COMMUNICATION - *0(MSG)*			
AI[0] - MainProgram/IOINTERFACE - 0(MOV)			
AI[10] - MainProgram/IOINTERFACE - 10(MOV)			
AI[11] - MainProgram/IOINTERFACE - 11(MOV)			
AI[1] - MainProgram/IOINTERFACE - 1(MOV)			
AI[2] - MainProgram/IOINTERFACE - 2(MOV)			
AI[3] - MainProgram/IOINTERFACE - 3(MOV)			
AI[4] - MainProgram/IOINTERFACE - 4(MOV)			
AI[5] - MainProgram/IOINTERFACE - 5(MOV)			
AI[6] - MainProgram/IOINTERFACE - 6(MOV)			
AI[7] - MainProgram/IOINTERFACE - 7(MOV)			
AI[8] - MainProgram/IOINTERFACE - 8(MOV)			
AI[9] - MainProgram/IOINTERFACE - 9(MOV)			
AM	1	BOOL	cpu
*AM - MainProgram/MainRoutine - *4(OTE)*			
AO1		REAL[10]	cpu
AO1[0] - MainProgram/COMMUNICATION - 1(MSG)			
*AO1[0] - MainProgram/IOINTERFACE - *12(MOV)*			
*AO1[1] - MainProgram/IOINTERFACE - *13(MOV)*			
*AO1[2] - MainProgram/IOINTERFACE - *14(MOV)*			
*AO1[3] - MainProgram/IOINTERFACE - *15(MOV)*			
*AO1[4] - MainProgram/IOINTERFACE - *16(MOV)*			
*AO1[5] - MainProgram/IOINTERFACE - *17(MOV)*			
AS	0	BOOL	cpu
*AS - MainProgram/MAINLOGIC - *18(ONS)*			
AUTO	0	BOOL	cpu
AUTO - MainProgram/MainRoutine - 3(XIC)			
CLDPSTRT	0	BOOL	cpu
*CLDPSTRT - MainProgram/MAINLOGIC - *14(OTE), 15(XIC), 17(XIC)*			
COLD	30.0	REAL	cpu
COLD - MainProgram/MAINLOGIC - 16(MOV)			
CONTROLOSEL	0	BOOL	cpu
*CONTROLOSEL - MainProgram/IOINTERFACE - *33(OTE)*			
DCSSEL	1	BOOL	cpu
*DCSSEL - MainProgram/IOINTERFACE - *32(OTE)*			
DI		INT[32]	cpu
*DI[0] - MainProgram/COMMUNICATION - *2(MSG)*			
DI[0].0 - MainProgram/IOINTERFACE - 18(XIC)			
DI[10].0 - MainProgram/IOINTERFACE - 28(XIC)			
DI[11].0 - MainProgram/IOINTERFACE - 29(XIC)			
DI[12].0 - MainProgram/IOINTERFACE - 30(XIC)			
DI[13].0 - MainProgram/IOINTERFACE - 31(XIC)			
DI[14].0 - MainProgram/IOINTERFACE - 32(XIC)			
DI[15].0 - MainProgram/IOINTERFACE - 33(XIC)			
DI[16].0 - MainProgram/IOINTERFACE - 34(XIC)			
DI[1].0 - MainProgram/IOINTERFACE - 19(XIC)			
DI[2].0 - MainProgram/IOINTERFACE - 20(XIC)			
DI[3].0 - MainProgram/IOINTERFACE - 21(XIC)			
DI[4].0 - MainProgram/IOINTERFACE - 22(XIC)			
DI[5].0 - MainProgram/IOINTERFACE - 23(XIC)			
DI[6].0 - MainProgram/IOINTERFACE - 24(XIC)			
DI[7].0 - MainProgram/IOINTERFACE - 25(XIC)			

DI (Continued)
DI[8].0 - MainProgram/IOINTERFACE - 26(XIC)
DI[9].0 - MainProgram/IOINTERFACE - 27(XIC)

DISPLAY	0	BOOL	cpu

DISPLAY - MainProgram/MAINLOGIC - 0(XIO), 1(XIO), 10(XIO), 11(XIO), 12(XIO), 13(XIO), 14(XIO), 15(XIO), 16(XIO), 17(XIO), 18(XIO), 19(XIO), 2(XIO), 20(XIO), 3(XIO), 4(XIO), 5(XIO), 6(XIC), 7(XIO), 8(XIO), 9(XIO)
*DISPLAY - MainProgram/MainRoutine - *3(OTE), 4(XIO), 5(XIC), 6(XIO), 7(XIO), 8(XIO), 9(XIO)*

DO1		INT[10]	cpu

DO1[0] - MainProgram/COMMUNICATION - 3(MSG)
*DO1[0].0 - MainProgram/IOINTERFACE - *35(OTE)*
*DO1[1].0 - MainProgram/IOINTERFACE - *36(OTE)*
*DO1[2].0 - MainProgram/IOINTERFACE - *37(OTE)*
*DO1[3].0 - MainProgram/IOINTERFACE - *38(OTE)*
*DO1[4].0 - MainProgram/IOINTERFACE - *39(OTE)*

FCV1	0.0	REAL	cpu

*FCV1 - MainProgram/HEAT_EXCHANGER_TEMP_CONTROL - *0(PID)*
FCV1 - MainProgram/IOINTERFACE - 17(MOV)
*FCV1 - MainProgram/MAINLOGIC - *1(MOV), *20(MOV)*

fic1		PID	cpu

*fic1 - MainProgram/LEVELCONTROL - *5(PID)*
fic1.OUT - MainProgram/LEVELCONTROL - 6(MOV)
*fic1.SP - MainProgram/LEVELCONTROL - *4(MOV)*

FRT	0	BOOL	cpu

*FRT - MainProgram/MAINLOGIC - *6(OTE)*

fsp	0.0	REAL	MainProgram

*fsp - MainProgram/LEVELCONTROL - *3(DIV), 4(MOV)*

FT1	0.0	REAL	cpu

*FT1 - MainProgram/IOINTERFACE - *10(MOV)*
FT1 - MainProgram/LEVELCONTROL - 5(PID)
FT1 - MainProgram/PID_test - 1-B1(IREF,FT1), 1-B1(PIDE,PIDE_01.PV)
FT1 - MainProgram/pidsqyare - 0(PID)

FT2	0.0	REAL	cpu

*FT2 - MainProgram/IOINTERFACE - *9(MOV)*

FT3	0.0	REAL	cpu

*FT3 - MainProgram/IOINTERFACE - *8(MOV)*
FT3 - MainProgram/LEVELCONTROL - 0(MOV)

HEATER	0	BOOL	cpu

HEATER - MainProgram/IOINTERFACE - 37(XIC)
*HEATER - MainProgram/MAINLOGIC - *13(OTE)*

HETRSCADA	0	BOOL	cpu

HETRSCADA - MainProgram/MAINLOGIC - 13(XIC)

HOOTER	0	BOOL	cpu

HOOTER - MainProgram/IOINTERFACE - 39(XIC)

HOOTERACK	0	BOOL	cpu

*HOOTERACK - MainProgram/IOINTERFACE - *34(OTE)*

hr	0	BOOL	cpu

*hr - MainProgram/MAINLOGIC - *8(OSF)*

HXT		PID	cpu

HXT (Continued)
*HXT - MainProgram/HEAT_EXCHANGER_TEMP_CONTROL - *0(PID)*

J	0	BOOL	cpu

*J - MainProgram/MAINLOGIC - *0(OSR)*

le	0	BOOL	cpu

*le - MainProgram/MAINLOGIC - *4(OTE), 7(XIC)*

level		PID	cpu

*level - MainProgram/LEVELCONTROL - *2(PID)*
*level - MainProgram/pidsqyare - *3(PID)*
*level.BIAS - MainProgram/LEVELCONTROL - *1(MOV)*
*level.OUT - MainProgram/LEVELCONTROL - *2(PID), 3(DIV)*

leveltune	0	BOOL	cpu

leveltune - MainProgram/pidsqyare - 0(XIC), 1(XIC), 2(XIC)

LSH201	1	BOOL	cpu

*LSH201 - MainProgram/IOINTERFACE - *22(OTE)*

LSH301	0	BOOL	cpu

*LSH301 - MainProgram/IOINTERFACE - *24(OTE)*

LSL101	0	BOOL	cpu

*LSL101 - MainProgram/IOINTERFACE - *21(OTE)*
LSL101 - MainProgram/MAINLOGIC - 3(XIO)

LSL201	0	BOOL	cpu

*LSL201 - MainProgram/IOINTERFACE - *23(OTE)*

LSL301	0	BOOL	cpu

*LSL301 - MainProgram/IOINTERFACE - *25(OTE)*

LSL401	0	BOOL	cpu

*LSL401 - MainProgram/IOINTERFACE - *18(OTE)*
LSL401 - MainProgram/MAINLOGIC - 13(XIO)

LT1	86.39443	REAL	cpu

*LT1 - MainProgram/IOINTERFACE - *0(MOV)*
LT1 - MainProgram/LEVELCONTROL - 2(PID), 7(PID)
LT1 - MainProgram/MAINLOGIC - 12(GRT), 4(GRT)
LT1 - MainProgram/pidsqyare - 3(PID)

msg_ai		MESSAGE	cpu

*msg_ai - MainProgram/COMMUNICATION - *0(MSG)*

msg_ao		MESSAGE	cpu

*msg_ao - MainProgram/COMMUNICATION - *1(MSG)*

msg_D0		MESSAGE	cpu

*msg_D0 - MainProgram/COMMUNICATION - *3(MSG)*

msg_DI		MESSAGE	cpu

*msg_DI - MainProgram/COMMUNICATION - *2(MSG)*

msg_spai		MESSAGE	cpu

*msg_spai - MainProgram/SprayDryerTest - *0(MSG)*

MSV1	0.0	REAL	cpu

MSV1 - MainProgram/IOINTERFACE - 15(MOV)

MSV2	0.0	REAL	cpu

MSV2 (Continued)
MSV2 - MainProgram/IOINTERFACE - 16(MOV)

onecontrol		PID	cpu

*onecontrol - MainProgram/LEVELCONTROL - *7(PID)*
onecontrol.OUT - MainProgram/LEVELCONTROL - 8(MOV)

out	0	DINT	cpu

out - MainProgram/pidsqyare - 1(MOV)
*out - MainProgram/squar_wav - *1(MOV), *3(MOV)*

P101	0	BOOL	cpu

P101 - MainProgram/IOINTERFACE - 35(XIC)
*P101 - MainProgram/MAINLOGIC - *3(OTE)*

P101R	0	BOOL	cpu

*P101R - MainProgram/IOINTERFACE - *26(OTE)*

p101scada	0	BOOL	cpu

p101scada - MainProgram/MAINLOGIC - 3(XIC)

P101T	0	BOOL	cpu

*P101T - MainProgram/IOINTERFACE - *27(OTE)*

P301	0	BOOL	cpu

P301 - MainProgram/IOINTERFACE - 36(XIC)
*P301 - MainProgram/MAINLOGIC - *15(OTE), 16(XIC)*

P301R	0	BOOL	cpu

*P301R - MainProgram/IOINTERFACE - *28(OTE)*

P301T	0	BOOL	cpu

*P301T - MainProgram/IOINTERFACE - *29(OTE)*

PEM	0.024415553	REAL	cpu

*PEM - MainProgram/IOINTERFACE - *11(MOV)*

PHTEX	0	BOOL	cpu

*PHTEX - MainProgram/MAINLOGIC - *17(OTE), 18(XIC)*

PIC		PID	cpu

*PIC - MainProgram/BOILER_PRESSURE - *0(PID)*

PIDE_01		PID_ENHANCED	MainProgram

*PIDE_01 - MainProgram/PID_test - *1-A2(IREF,SP), *1-B1(IREF,FT1), *1-B1(PIDE,PIDE_01), *1-C1(OREF,VFD101)*

PIDHX	0	BOOL	cpu

PIDHX - MainProgram/HEAT_EXCHANGER_TEMP_CONTROL - 0(XIC)
*PIDHX - MainProgram/MAINLOGIC - *18(OTL), *19(OTU)*

pidsq		PID	cpu

*pidsq - MainProgram/pidsqyare - *0(PID)*
pidsq.OUT - MainProgram/pidsqyare - 2(MOV)
*pidsq.SP - MainProgram/pidsqyare - *1(MOV)*

PS	0	BOOL	cpu

PS - MainProgram/LEVELCONTROL - 7(XIC), 8(XIC)
*PS - MainProgram/MAINLOGIC - *2(OTL), *9(OTU), 12(XIC), 14(XIC), 17(XIC), 3(XIC)*

PSH401	0	BOOL	cpu

*PSH401 - MainProgram/IOINTERFACE - *20(OTE)*
PSH401 - MainProgram/MAINLOGIC - 13(XIO)

PT1	0.0	REAL	cpu

PT1 - MainProgram/BOILER_PRESSURE - 0(PID)
*PT1 - MainProgram/IOINTERFACE - *1(MOV)*
PT1 - MainProgram/MAINLOGIC - 14(GRT), 17(GRT)

ref	87.0	REAL	cpu

ref - MainProgram/MAINLOGIC - 4(GRT)

REMOTELOCAL	0	BOOL	cpu

*REMOTELOCAL - MainProgram/IOINTERFACE - *30(OTE)*

reslt	0.0	REAL	MainProgram

*reslt - MainProgram/LEVELCONTROL - *0(MOV), 1(MOV)*

SCR	100.0	REAL	cpu

*SCR - MainProgram/BOILER_PRESSURE - *0(PID)*
SCR - MainProgram/IOINTERFACE - 14(MOV)

SOV201	0	BOOL	cpu

SOV201 - MainProgram/IOINTERFACE - 38(XIC)

SP	0.0	REAL	cpu

SP - MainProgram/PID_test - 1-A2(IREF,SP), 1-B1(PIDE,PIDE_01.SPProg)

SPAI		REAL[20]	cpu

*SPAI[0] - MainProgram/SprayDryerTest - *0(MSG)*

STARTHEATER	0	BOOL	cpu

*STARTHEATER - MainProgram/MAINLOGIC - *12(OTE), 13(XIC)*

stp	0	BOOL	cpu

*stp - MainProgram/MAINLOGIC - *8(OSF), 10(XIC), 19(XIC), 20(XIC), 9(XIC)*

STPING	0	BOOL	cpu

*STPING - MainProgram/MAINLOGIC - *10(OTL), *11(OTU), 15(XIC)*

STRT	0	BOOL	cpu

STRT - MainProgram/MAINLOGIC - 0(XIC), 8(XIC)

STRTRISE	0	BOOL	cpu

*STRTRISE - MainProgram/MAINLOGIC - *0(OSR), 1(XIC), 11(XIC), 2(XIC)*

t1		TIMER	MainProgram

*t1 - MainProgram/squar_wav - *0(TON)*
t1.DN - MainProgram/squar_wav - 2(XIC)
t1.TT - MainProgram/squar_wav - 1(XIC)

t123		TIMER	cpu

*t123 - MainProgram/MainRoutine - *5(TON)*
t123.DN - MainProgram/MainRoutine - 2(XIO)

t2		TIMER	MainProgram

*t2 - MainProgram/squar_wav - *2(TON)*
t2.DN - MainProgram/squar_wav - 0(XIO)
t2.TT - MainProgram/squar_wav - 3(XIC)

te	0	BOOL	cpu

*te - MainProgram/MAINLOGIC - *5(OTE), 7(XIC)*

threeelement	0	BOOL	cpu

threeelement - MainProgram/LEVELCONTROL - 0(XIC), 1(XIC), 2(XIC), 3(XIC), 4(XIC), 5(XIC), 6(XIC), 7(XIO), 8(XIO)
*threeelement - MainProgram/MAINLOGIC - *7(OTE)*

Timer01		TIMER	cpu

*Timer01 - MainProgram/COMMUNICATION - *4(TON)*
*Timer01 - MainProgram/SprayDryerTest - *1(TON)*
Timer01.DN - MainProgram/COMMUNICATION - 0(XIC), 1(XIC), 2(XIC), 3(XIC), 4(XIO)
Timer01.DN - MainProgram/SprayDryerTest - 0(XIC), 1(XIO)

TRE	0	BOOL	cpu

*TRE - MainProgram/MAINLOGIC - *6(ONS)*

TSH401	0	BOOL	cpu

*TSH401 - MainProgram/IOINTERFACE - *19(OTE)*
TSH401 - MainProgram/MAINLOGIC - 13(XIO)

TT1	41.079166	REAL	cpu

*TT1 - MainProgram/IOINTERFACE - *2(MOV)*
TT1 - MainProgram/MAINLOGIC - 5(GRT)

TT2	28.639442	REAL	cpu

*TT2 - MainProgram/IOINTERFACE - *3(MOV)*

TT3	27.45529	REAL	cpu

TT3 - MainProgram/HEAT_EXCHANGER_TEMP_CONTROL - 0(PID)
*TT3 - MainProgram/IOINTERFACE - *4(MOV)*

TT4	27	DINT	cpu

*TT4 - MainProgram/IOINTERFACE - *5(MOV)*

TT5	27.50412	REAL	cpu

*TT5 - MainProgram/IOINTERFACE - *6(MOV)*

TT6	27.601782	REAL	cpu

*TT6 - MainProgram/IOINTERFACE - *7(MOV)*

VFD101	0.0	REAL	cpu

VFD101 - MainProgram/IOINTERFACE - 12(MOV)
*VFD101 - MainProgram/LEVELCONTROL - *5(PID), *6(MOV), *7(PID), *8(MOV)*
*VFD101 - MainProgram/PID_test - *1-C1(OREF,VFD101), 1-B1(PIDE,PIDE_01.CVEU)*
*VFD101 - MainProgram/pidsqyare - *0(PID), *2(MOV), *3(PID)*

VFD301	0.0	REAL	cpu

VFD301 - MainProgram/IOINTERFACE - 13(MOV)
*VFD301 - MainProgram/MAINLOGIC - *16(MOV)*

VPLCSEL	0	BOOL	cpu

*VPLCSEL - MainProgram/IOINTERFACE - *31(OTE)*

0

PID
Proportional Integral Derivative

PID	PIC ...
Process Variable	PT1
Tieback	0
Control Variable	SCR
PID Master Loop	0
Inhold Bit	0
Inhold Value	0
Setpoint	1.5
Process Variable	0.0
Output %	100.0

1

RET
Return from Subroutine

(End)

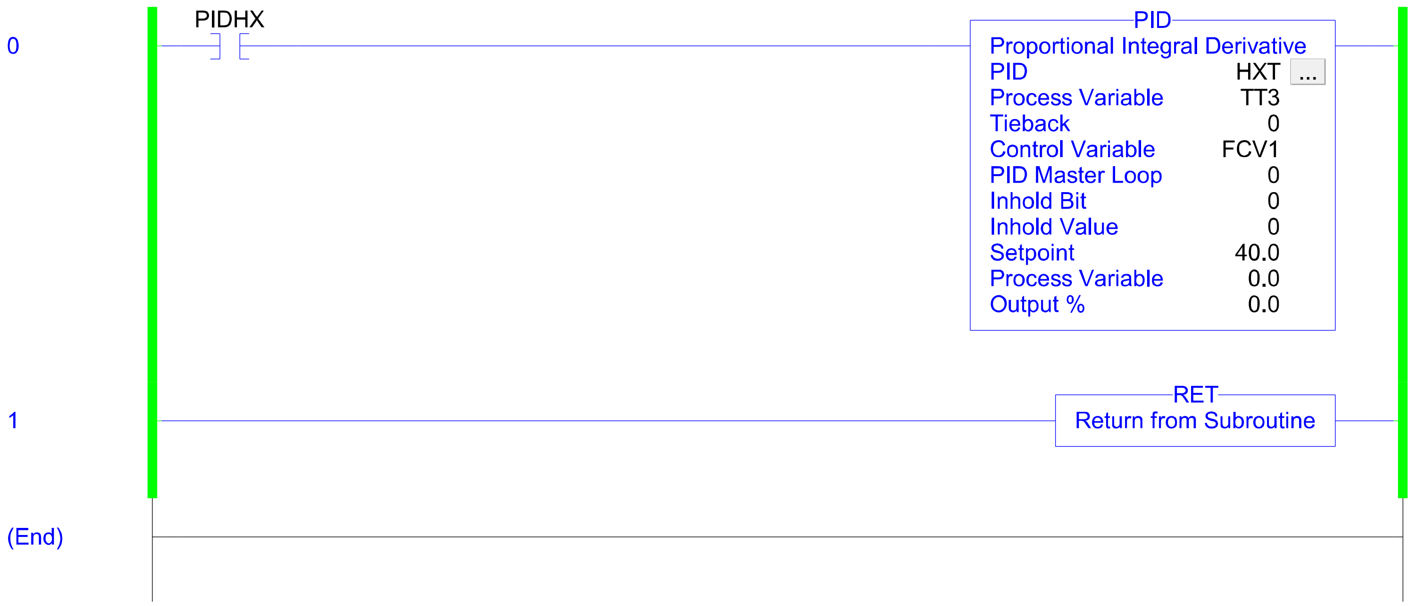
Name	Value	Data Type	Scope
PIC		PID	cpu
*PIC - MainProgram/BOILER_PRESSURE - *0(PID)*			
PT1	0.0	REAL	cpu
PT1 - MainProgram/BOILER_PRESSURE - 0(PID)			
*PT1 - MainProgram/IOINTERFACE - *1(MOV)*			
PT1 - MainProgram/MAINLOGIC - 14(GRT), 17(GRT)			
SCR	100.0	REAL	cpu
*SCR - MainProgram/BOILER_PRESSURE - *0(PID)*			
SCR - MainProgram/IOINTERFACE - 14(MOV)			


0
Timer01.DN
MSG
Message
Message Control msg_ai ...
EN
DN
ER
1
Timer01.DN
MSG
Message
Message Control msg_ao ...
EN
DN
ER
2
Timer01.DN
MSG
Message
Message Control msg_DI ...
EN
DN
ER
3
Timer01.DN
MSG
Message
Message Control msg_D0 ...
EN
DN
ER
4
Timer01.DN
/
TON
Timer On Delay
Timer Timer01
Preset 100
Accum 78
EN
DN
5
RET
Return from Subroutine
(End)

Name	Value	Data Type	Scope
AI		REAL[13]	cpu
*AI[0] - MainProgram/COMMUNICATION - *0(MSG)*			
AI[0] - MainProgram/IOINTERFACE - 0(MOV)			
AI[10] - MainProgram/IOINTERFACE - 10(MOV)			
AI[11] - MainProgram/IOINTERFACE - 11(MOV)			
AI[1] - MainProgram/IOINTERFACE - 1(MOV)			
AI[2] - MainProgram/IOINTERFACE - 2(MOV)			
AI[3] - MainProgram/IOINTERFACE - 3(MOV)			
AI[4] - MainProgram/IOINTERFACE - 4(MOV)			
AI[5] - MainProgram/IOINTERFACE - 5(MOV)			
AI[6] - MainProgram/IOINTERFACE - 6(MOV)			
AI[7] - MainProgram/IOINTERFACE - 7(MOV)			
AI[8] - MainProgram/IOINTERFACE - 8(MOV)			
AI[9] - MainProgram/IOINTERFACE - 9(MOV)			
AO1		REAL[10]	cpu
AO1[0] - MainProgram/COMMUNICATION - 1(MSG)			
*AO1[0] - MainProgram/IOINTERFACE - *12(MOV)*			
*AO1[1] - MainProgram/IOINTERFACE - *13(MOV)*			
*AO1[2] - MainProgram/IOINTERFACE - *14(MOV)*			
*AO1[3] - MainProgram/IOINTERFACE - *15(MOV)*			
*AO1[4] - MainProgram/IOINTERFACE - *16(MOV)*			
*AO1[5] - MainProgram/IOINTERFACE - *17(MOV)*			
DI		INT[32]	cpu
*DI[0] - MainProgram/COMMUNICATION - *2(MSG)*			
DI[0].0 - MainProgram/IOINTERFACE - 18(XIC)			
DI[10].0 - MainProgram/IOINTERFACE - 28(XIC)			
DI[11].0 - MainProgram/IOINTERFACE - 29(XIC)			
DI[12].0 - MainProgram/IOINTERFACE - 30(XIC)			
DI[13].0 - MainProgram/IOINTERFACE - 31(XIC)			
DI[14].0 - MainProgram/IOINTERFACE - 32(XIC)			
DI[15].0 - MainProgram/IOINTERFACE - 33(XIC)			
DI[16].0 - MainProgram/IOINTERFACE - 34(XIC)			
DI[1].0 - MainProgram/IOINTERFACE - 19(XIC)			
DI[2].0 - MainProgram/IOINTERFACE - 20(XIC)			
DI[3].0 - MainProgram/IOINTERFACE - 21(XIC)			
DI[4].0 - MainProgram/IOINTERFACE - 22(XIC)			
DI[5].0 - MainProgram/IOINTERFACE - 23(XIC)			
DI[6].0 - MainProgram/IOINTERFACE - 24(XIC)			
DI[7].0 - MainProgram/IOINTERFACE - 25(XIC)			
DI[8].0 - MainProgram/IOINTERFACE - 26(XIC)			
DI[9].0 - MainProgram/IOINTERFACE - 27(XIC)			
DO1		INT[10]	cpu
DO1[0] - MainProgram/COMMUNICATION - 3(MSG)			
*DO1[0].0 - MainProgram/IOINTERFACE - *35(OTE)*			
*DO1[1].0 - MainProgram/IOINTERFACE - *36(OTE)*			
*DO1[2].0 - MainProgram/IOINTERFACE - *37(OTE)*			
*DO1[3].0 - MainProgram/IOINTERFACE - *38(OTE)*			
*DO1[4].0 - MainProgram/IOINTERFACE - *39(OTE)*			
msg_ai		MESSAGE	cpu
*msg_ai - MainProgram/COMMUNICATION - *0(MSG)*			
msg_ao		MESSAGE	cpu
*msg_ao - MainProgram/COMMUNICATION - *1(MSG)*			
msg_D0		MESSAGE	cpu
*msg_D0 - MainProgram/COMMUNICATION - *3(MSG)*			
msg_DI		MESSAGE	cpu

msg_DI (Continued)
*msg_DI - MainProgram/COMMUNICATION - *2(MSG)*

Timer01 TIMER cpu
*Timer01 - MainProgram/COMMUNICATION - *4(TON)*
*Timer01 - MainProgram/SprayDryerTest - *1(TON)*
Timer01.DN - MainProgram/COMMUNICATION - 0(XIC), 1(XIC), 2(XIC), 3(XIC), 4(XIO)
Timer01.DN - MainProgram/SprayDryerTest - 0(XIC), 1(XIO)


0
PIDHX
PID
Proportional Integral Derivative
PID HXT ...
Process Variable TT3
Tieback 0
Control Variable FCV1
PID Master Loop 0
Inhold Bit 0
Inhold Value 0
Setpoint 40.0
Process Variable 0.0
Output % 0.0
1
RET
Return from Subroutine
(End)

Name	Value	Data Type	Scope
FCV1	0.0	REAL	cpu
*FCV1 - MainProgram/HEAT_EXCHANGER_TEMP_CONTROL - *0(PID)*			
FCV1 - MainProgram/IOINTERFACE - 17(MOV)			
*FCV1 - MainProgram/MAINLOGIC - *1(MOV), *20(MOV)*			
HXT		PID	cpu
*HXT - MainProgram/HEAT_EXCHANGER_TEMP_CONTROL - *0(PID)*			
PIDHX	0	BOOL	cpu
PIDHX - MainProgram/HEAT_EXCHANGER_TEMP_CONTROL - 0(XIC)			
*PIDHX - MainProgram/MAINLOGIC - *18(OTL), *19(OTU)*			
TT3	27.45529	REAL	cpu
TT3 - MainProgram/HEAT_EXCHANGER_TEMP_CONTROL - 0(PID)			
*TT3 - MainProgram/IOINTERFACE - *4(MOV)*			

Rung	Instruction	Source	Source value	Dest	Dest value
0	MOV Move	AI[0]	86.39443	LT1	86.39443
1	MOV Move	AI[1]	0.0	PT1	0.0
2	MOV Move	AI[2]	41.079166	TT1	41.079166
3	MOV Move	AI[3]	28.639442	TT2	28.639442
4	MOV Move	AI[4]	27.45529	TT3	27.45529
5	MOV Move	AI[5]	27.174511	TT4	27
6	MOV Move	AI[6]	27.50412	TT5	27.50412
7	MOV Move	AI[7]	27.601782	TT6	27.601782

Rung	Instruction		
8	MOV Move	Source	AI[8] 0.0
		Dest	FT3 0.0
9	MOV Move	Source	AI[9] 0.0
		Dest	FT2 0.0
10	MOV Move	Source	AI[10] 0.0
		Dest	FT1 0.0
11	MOV Move	Source	AI[11] 0.024415553
		Dest	PEM 0.024415553
12	MOV Move	Source	VFD101 0.0
		Dest	AO1[0] 0.0
13	MOV Move	Source	VFD301 0.0
		Dest	AO1[1] 0.0
14	MOV Move	Source	SCR 100.0
		Dest	AO1[2] 100.0
15	MOV Move	Source	MSV1 0.0
		Dest	AO1[3] 0.0


16
MOV
Move
Source MSV2
0.0
Dest AO1[4]
0.0
17
MOV
Move
Source FCV1
0.0
Dest AO1[5]
0.0
18
DI[0].0
LSL401
19
DI[1].0
TSH401
20
DI[2].0
PSH401
21
DI[3].0
LSL101
22
DI[4].0
LSH201
23
DI[5].0
LSL201
24
DI[6].0
LSH301
25
DI[7].0
LSL301
26
DI[8].0
P101R
27
DI[9].0
P101T
28
DI[10].0
P301R
29
DI[11].0
P301T


30
DI[12].0
REMOTELOCAL
31
DI[13].0
VPLCSEL
32
DI[14].0
DCSSEL
33
DI[15].0
CONTROLOSEL
34
DI[16].0
HOOTERACK
35
P101
DO1[0].0
36
P301
DO1[1].0
37
HEATER
DO1[2].0
38
SOV201
DO1[3].0
39
HOOTER
DO1[4].0
40
RET
Return from Subroutine
(End)

Name	Value	Data Type	Scope
AI		REAL[13]	cpu
*AI[0] - MainProgram/COMMUNICATION - *0(MSG)*			
AI[0] - MainProgram/IOINTERFACE - 0(MOV)			
AI[10] - MainProgram/IOINTERFACE - 10(MOV)			
AI[11] - MainProgram/IOINTERFACE - 11(MOV)			
AI[1] - MainProgram/IOINTERFACE - 1(MOV)			
AI[2] - MainProgram/IOINTERFACE - 2(MOV)			
AI[3] - MainProgram/IOINTERFACE - 3(MOV)			
AI[4] - MainProgram/IOINTERFACE - 4(MOV)			
AI[5] - MainProgram/IOINTERFACE - 5(MOV)			
AI[6] - MainProgram/IOINTERFACE - 6(MOV)			
AI[7] - MainProgram/IOINTERFACE - 7(MOV)			
AI[8] - MainProgram/IOINTERFACE - 8(MOV)			
AI[9] - MainProgram/IOINTERFACE - 9(MOV)			
AO1		REAL[10]	cpu
AO1[0] - MainProgram/COMMUNICATION - 1(MSG)			
*AO1[0] - MainProgram/IOINTERFACE - *12(MOV)*			
*AO1[1] - MainProgram/IOINTERFACE - *13(MOV)*			
*AO1[2] - MainProgram/IOINTERFACE - *14(MOV)*			
*AO1[3] - MainProgram/IOINTERFACE - *15(MOV)*			
*AO1[4] - MainProgram/IOINTERFACE - *16(MOV)*			
*AO1[5] - MainProgram/IOINTERFACE - *17(MOV)*			
CONTROLOSEL	0	BOOL	cpu
*CONTROLOSEL - MainProgram/IOINTERFACE - *33(OTE)*			
DCSSEL	1	BOOL	cpu
*DCSSEL - MainProgram/IOINTERFACE - *32(OTE)*			
DI		INT[32]	cpu
*DI[0] - MainProgram/COMMUNICATION - *2(MSG)*			
DI[0].0 - MainProgram/IOINTERFACE - 18(XIC)			
DI[10].0 - MainProgram/IOINTERFACE - 28(XIC)			
DI[11].0 - MainProgram/IOINTERFACE - 29(XIC)			
DI[12].0 - MainProgram/IOINTERFACE - 30(XIC)			
DI[13].0 - MainProgram/IOINTERFACE - 31(XIC)			
DI[14].0 - MainProgram/IOINTERFACE - 32(XIC)			
DI[15].0 - MainProgram/IOINTERFACE - 33(XIC)			
DI[16].0 - MainProgram/IOINTERFACE - 34(XIC)			
DI[1].0 - MainProgram/IOINTERFACE - 19(XIC)			
DI[2].0 - MainProgram/IOINTERFACE - 20(XIC)			
DI[3].0 - MainProgram/IOINTERFACE - 21(XIC)			
DI[4].0 - MainProgram/IOINTERFACE - 22(XIC)			
DI[5].0 - MainProgram/IOINTERFACE - 23(XIC)			
DI[6].0 - MainProgram/IOINTERFACE - 24(XIC)			
DI[7].0 - MainProgram/IOINTERFACE - 25(XIC)			
DI[8].0 - MainProgram/IOINTERFACE - 26(XIC)			
DI[9].0 - MainProgram/IOINTERFACE - 27(XIC)			
DO1		INT[10]	cpu
DO1[0] - MainProgram/COMMUNICATION - 3(MSG)			
*DO1[0].0 - MainProgram/IOINTERFACE - *35(OTE)*			
*DO1[1].0 - MainProgram/IOINTERFACE - *36(OTE)*			
*DO1[2].0 - MainProgram/IOINTERFACE - *37(OTE)*			
*DO1[3].0 - MainProgram/IOINTERFACE - *38(OTE)*			
*DO1[4].0 - MainProgram/IOINTERFACE - *39(OTE)*			
FCV1	0.0	REAL	cpu
*FCV1 - MainProgram/HEAT_EXCHANGER_TEMP_CONTROL - *0(PID)*			
FCV1 - MainProgram/IOINTERFACE - 17(MOV)			
*FCV1 - MainProgram/MAINLOGIC - *1(MOV), *20(MOV)*			

FT1	0.0	REAL	cpu

*FT1 - MainProgram/IOINTERFACE - *10(MOV)*
FT1 - MainProgram/LEVELCONTROL - 5(PID)
FT1 - MainProgram/PID_test - 1-B1(IREF,FT1), 1-B1(PIDE,PIDE_01.PV)
FT1 - MainProgram/pidsqyare - 0(PID)

FT2	0.0	REAL	cpu

*FT2 - MainProgram/IOINTERFACE - *9(MOV)*

FT3	0.0	REAL	cpu

*FT3 - MainProgram/IOINTERFACE - *8(MOV)*
FT3 - MainProgram/LEVELCONTROL - 0(MOV)

HEATER	0	BOOL	cpu

HEATER - MainProgram/IOINTERFACE - 37(XIC)
*HEATER - MainProgram/MAINLOGIC - *13(OTE)*

HOOTER	0	BOOL	cpu

HOOTER - MainProgram/IOINTERFACE - 39(XIC)

HOOTERACK	0	BOOL	cpu

*HOOTERACK - MainProgram/IOINTERFACE - *34(OTE)*

LSH201	1	BOOL	cpu

*LSH201 - MainProgram/IOINTERFACE - *22(OTE)*

LSH301	0	BOOL	cpu

*LSH301 - MainProgram/IOINTERFACE - *24(OTE)*

LSL101	0	BOOL	cpu

*LSL101 - MainProgram/IOINTERFACE - *21(OTE)*
LSL101 - MainProgram/MAINLOGIC - 3(XIO)

LSL201	0	BOOL	cpu

*LSL201 - MainProgram/IOINTERFACE - *23(OTE)*

LSL301	0	BOOL	cpu

*LSL301 - MainProgram/IOINTERFACE - *25(OTE)*

LSL401	0	BOOL	cpu

*LSL401 - MainProgram/IOINTERFACE - *18(OTE)*
LSL401 - MainProgram/MAINLOGIC - 13(XIO)

LT1	86.39443	REAL	cpu

*LT1 - MainProgram/IOINTERFACE - *0(MOV)*
LT1 - MainProgram/LEVELCONTROL - 2(PID), 7(PID)
LT1 - MainProgram/MAINLOGIC - 12(GRT), 4(GRT)
LT1 - MainProgram/pidsqyare - 3(PID)

MSV1	0.0	REAL	cpu

MSV1 - MainProgram/IOINTERFACE - 15(MOV)

MSV2	0.0	REAL	cpu

MSV2 - MainProgram/IOINTERFACE - 16(MOV)

P101	0	BOOL	cpu

P101 - MainProgram/IOINTERFACE - 35(XIC)
*P101 - MainProgram/MAINLOGIC - *3(OTE)*

P101R	0	BOOL	cpu

*P101R - MainProgram/IOINTERFACE - *26(OTE)*

P101T	0	BOOL	cpu

P101T (Continued)
*P101T - MainProgram/IOINTERFACE - *27(OTE)*

P301	0	BOOL	cpu

P301 - MainProgram/IOINTERFACE - 36(XIC)
*P301 - MainProgram/MAINLOGIC - *15(OTE), 16(XIC)*

P301R	0	BOOL	cpu

*P301R - MainProgram/IOINTERFACE - *28(OTE)*

P301T	0	BOOL	cpu

*P301T - MainProgram/IOINTERFACE - *29(OTE)*

PEM	0.024415553	REAL	cpu

*PEM - MainProgram/IOINTERFACE - *11(MOV)*

PSH401	0	BOOL	cpu

*PSH401 - MainProgram/IOINTERFACE - *20(OTE)*
PSH401 - MainProgram/MAINLOGIC - 13(XIO)

PT1	0.0	REAL	cpu

PT1 - MainProgram/BOILER_PRESSURE - 0(PID)
*PT1 - MainProgram/IOINTERFACE - *1(MOV)*
PT1 - MainProgram/MAINLOGIC - 14(GRT), 17(GRT)

REMOTELOCAL	0	BOOL	cpu

*REMOTELOCAL - MainProgram/IOINTERFACE - *30(OTE)*

SCR	100.0	REAL	cpu

*SCR - MainProgram/BOILER_PRESSURE - *0(PID)*
SCR - MainProgram/IOINTERFACE - 14(MOV)

SOV201	0	BOOL	cpu

SOV201 - MainProgram/IOINTERFACE - 38(XIC)

TSH401	0	BOOL	cpu

*TSH401 - MainProgram/IOINTERFACE - *19(OTE)*
TSH401 - MainProgram/MAINLOGIC - 13(XIO)

TT1	41.079166	REAL	cpu

*TT1 - MainProgram/IOINTERFACE - *2(MOV)*
TT1 - MainProgram/MAINLOGIC - 5(GRT)

TT2	28.639442	REAL	cpu

*TT2 - MainProgram/IOINTERFACE - *3(MOV)*

TT3	27.45529	REAL	cpu

TT3 - MainProgram/HEAT_EXCHANGER_TEMP_CONTROL - 0(PID)
*TT3 - MainProgram/IOINTERFACE - *4(MOV)*

TT4	27	DINT	cpu

*TT4 - MainProgram/IOINTERFACE - *5(MOV)*

TT5	27.50412	REAL	cpu

*TT5 - MainProgram/IOINTERFACE - *6(MOV)*

TT6	27.601782	REAL	cpu

*TT6 - MainProgram/IOINTERFACE - *7(MOV)*

VFD101	0.0	REAL	cpu

VFD101 - MainProgram/IOINTERFACE - 12(MOV)
*VFD101 - MainProgram/LEVELCONTROL - *5(PID), *6(MOV), *7(PID), *8(MOV)*
*VFD101 - MainProgram/PID_test - *1-C1(OREF,VFD101), 1-B1(PIDE,PIDE_01.CVEU)*

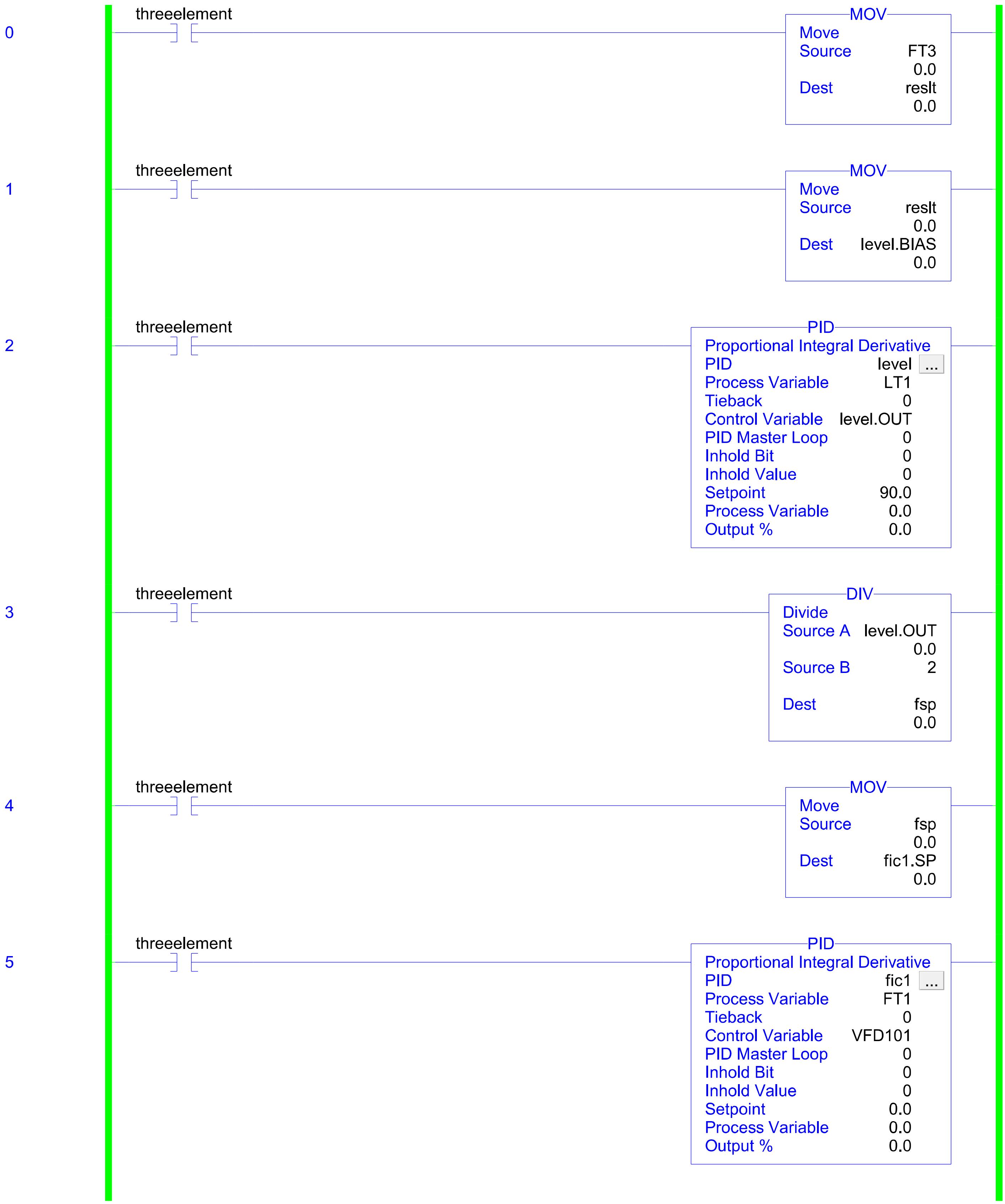
VFD101 (Continued)
*VFD101 - MainProgram/pidsqyare - *0(PID), *2(MOV), *3(PID)*

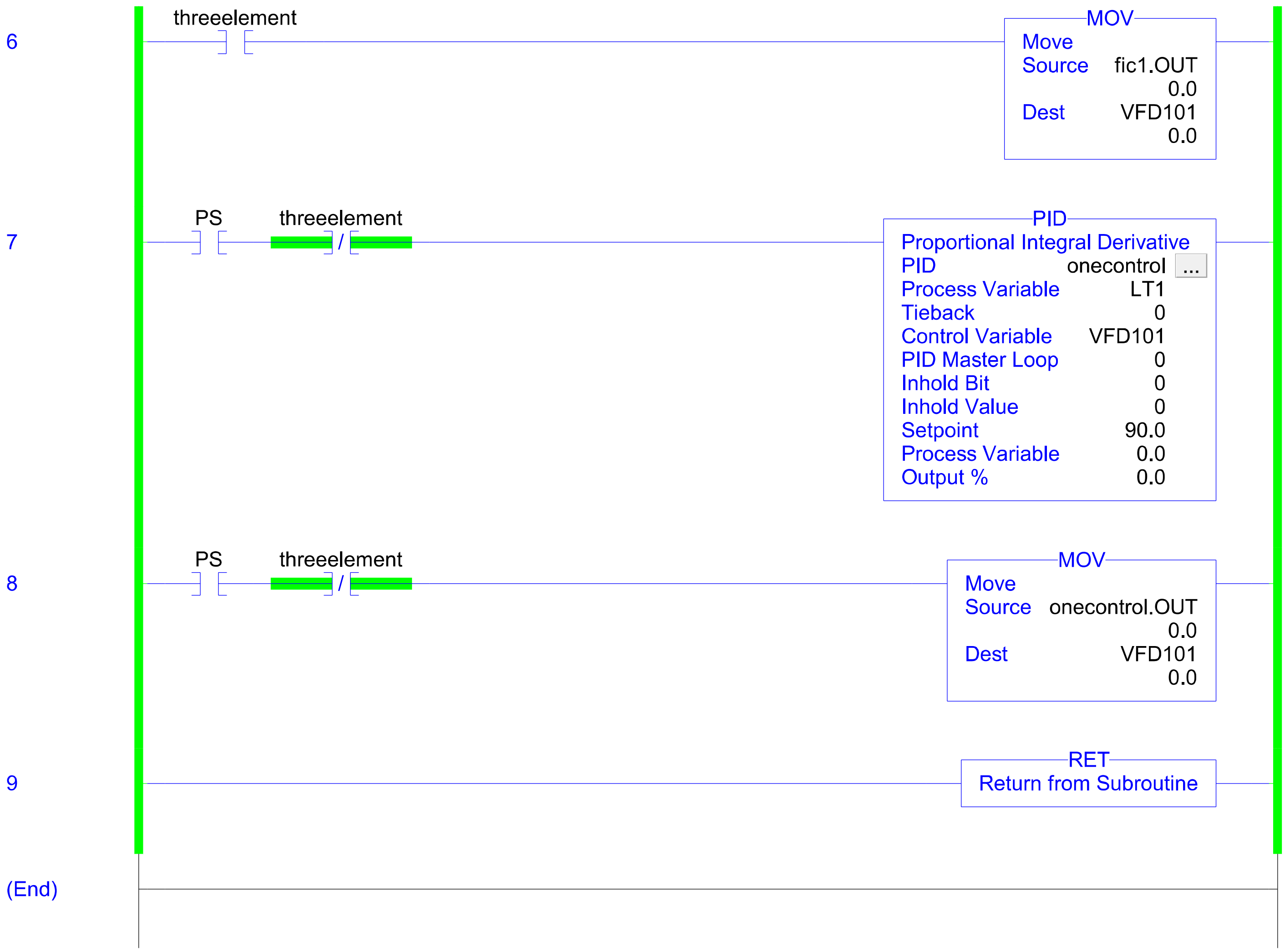
VFD301	0.0	REAL	cpu

VFD301 - MainProgram/IOINTERFACE - 13(MOV)
*VFD301 - MainProgram/MAINLOGIC - *16(MOV)*

VPLCSEL	0	BOOL	cpu

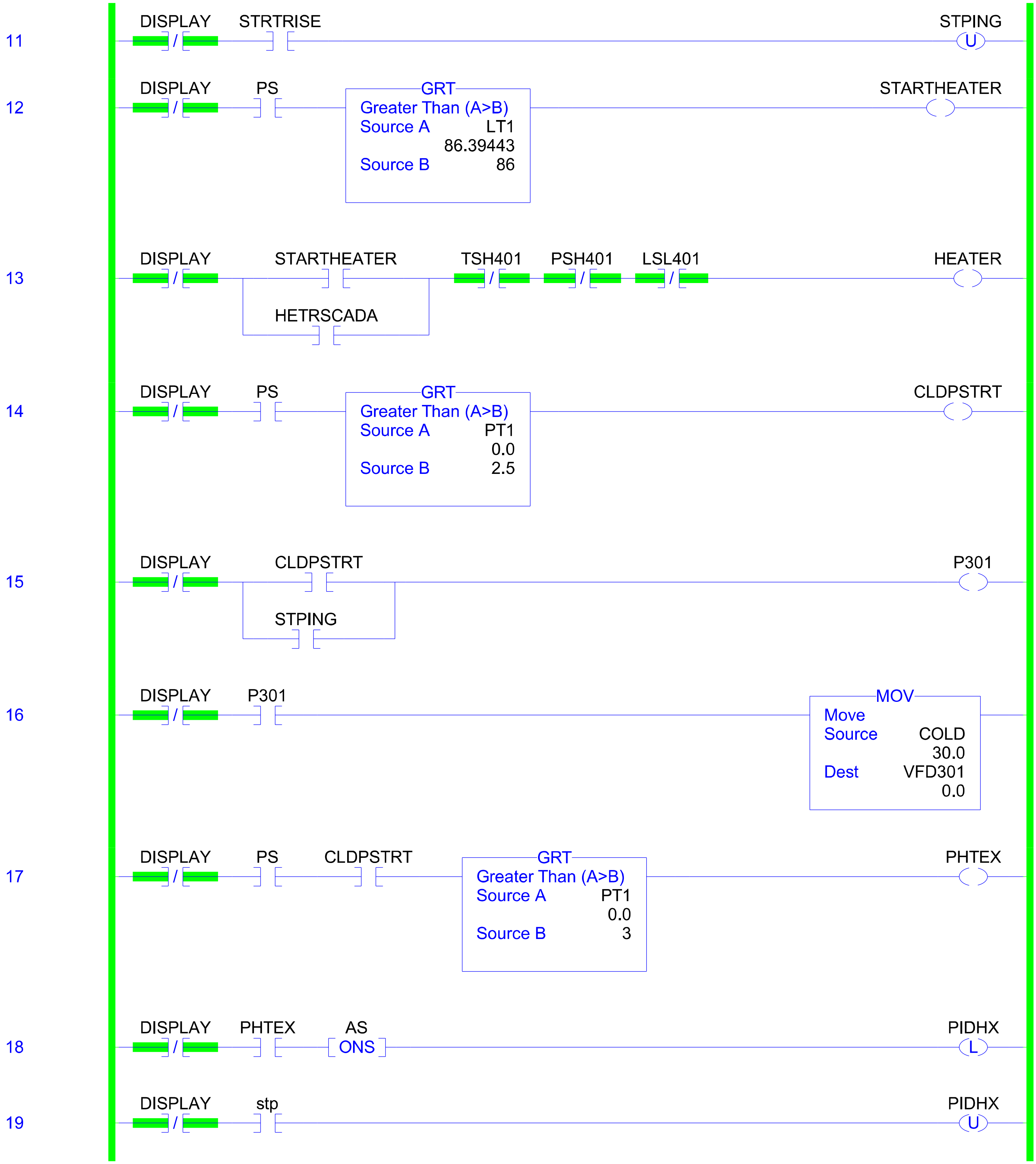
*VPLCSEL - MainProgram/IOINTERFACE - *31(OTE)*

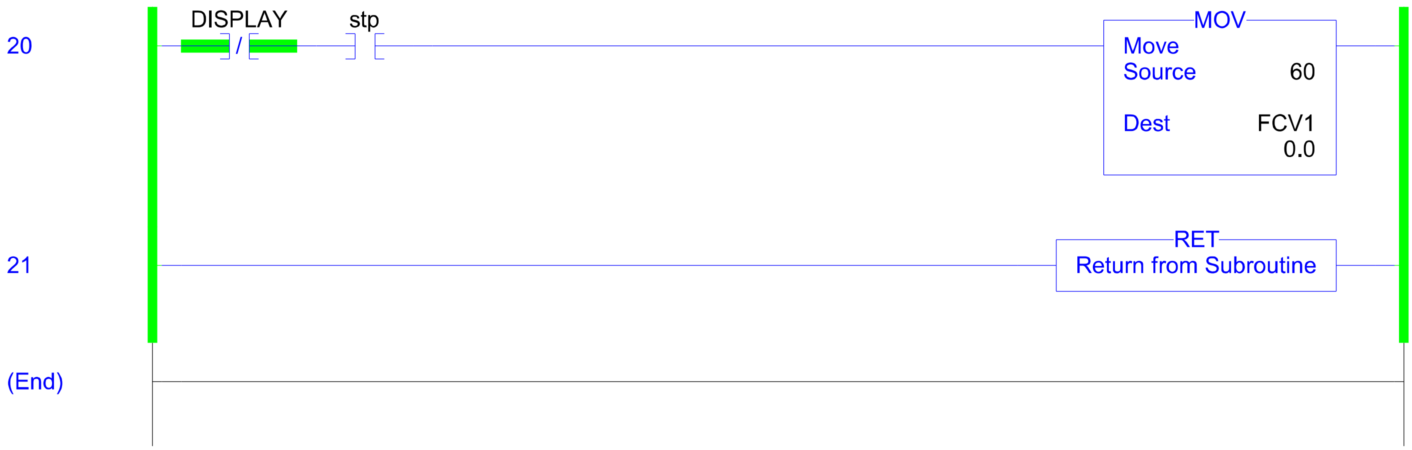

0
threeelement
MOV
Move
Source FT3
0.0
Dest reslt
0.0
1
threeelement
MOV
Move
Source reslt
0.0
Dest level.BIAS
0.0
2
threeelement
PID
Proportional Integral Derivative
PID level ...
Process Variable LT1
Tieback 0
Control Variable level.OUT
PID Master Loop 0
Inhold Bit 0
Inhold Value 0
Setpoint 90.0
Process Variable 0.0
Output % 0.0
3
threeelement
DIV
Divide
Source A level.OUT
0.0
Source B 2
Dest fsp
0.0
4
threeelement
MOV
Move
Source fsp
0.0
Dest fic1.SP
0.0
5
threeelement
PID
Proportional Integral Derivative
PID fic1 ...
Process Variable FT1
Tieback 0
Control Variable VFD101
PID Master Loop 0
Inhold Bit 0
Inhold Value 0
Setpoint 0.0
Process Variable 0.0
Output % 0.0


6
threeelement
MOV
Move
Source fic1.OUT
0.0
Dest VFD101
0.0
7
PS
threeelement
PID
Proportional Integral Derivative
PID onecontrol ...
Process Variable LT1
Tieback 0
Control Variable VFD101
PID Master Loop 0
Inhold Bit 0
Inhold Value 0
Setpoint 90.0
Process Variable 0.0
Output % 0.0
8
PS
threeelement
MOV
Move
Source onecontrol.OUT
0.0
Dest VFD101
0.0
9
RET
Return from Subroutine
(End)

Name	Value	Data Type	Scope
fic1		PID	cpu
*fic1 - MainProgram/LEVELCONTROL - *5(PID)* *fic1.OUT - MainProgram/LEVELCONTROL - 6(MOV)* *fic1.SP - MainProgram/LEVELCONTROL - *4(MOV)*			
fsp	0.0	REAL	MainProgram
*fsp - MainProgram/LEVELCONTROL - *3(DIV), 4(MOV)*			
FT1	0.0	REAL	cpu
*FT1 - MainProgram/IOINTERFACE - *10(MOV)* *FT1 - MainProgram/LEVELCONTROL - 5(PID)* *FT1 - MainProgram/PID_test - 1-B1(IREF,FT1), 1-B1(PIDE,PIDE_01.PV)* *FT1 - MainProgram/pidsqyare - 0(PID)*			
FT3	0.0	REAL	cpu
*FT3 - MainProgram/IOINTERFACE - *8(MOV)* *FT3 - MainProgram/LEVELCONTROL - 0(MOV)*			
level		PID	cpu
*level - MainProgram/LEVELCONTROL - *2(PID)* *level - MainProgram/pidsqyare - *3(PID)* *level.BIAS - MainProgram/LEVELCONTROL - *1(MOV)* *level.OUT - MainProgram/LEVELCONTROL - *2(PID), 3(DIV)*			
LT1	86.39443	REAL	cpu
*LT1 - MainProgram/IOINTERFACE - *0(MOV)* *LT1 - MainProgram/LEVELCONTROL - 2(PID), 7(PID)* *LT1 - MainProgram/MAINLOGIC - 12(GRT), 4(GRT)* *LT1 - MainProgram/pidsqyare - 3(PID)*			
onecontrol		PID	cpu
*onecontrol - MainProgram/LEVELCONTROL - *7(PID)* *onecontrol.OUT - MainProgram/LEVELCONTROL - 8(MOV)*			
PS	0	BOOL	cpu
PS - MainProgram/LEVELCONTROL - 7(XIC), 8(XIC) *PS - MainProgram/MAINLOGIC - *2(OTL), *9(OTU), 12(XIC), 14(XIC), 17(XIC), 3(XIC)*			
reslt	0.0	REAL	MainProgram
*reslt - MainProgram/LEVELCONTROL - *0(MOV), 1(MOV)*			
threeelement	0	BOOL	cpu
threeelement - MainProgram/LEVELCONTROL - 0(XIC), 1(XIC), 2(XIC), 3(XIC), 4(XIC), 5(XIC), 6(XIC), 7(XIO), 8(XIO) *threeelement - MainProgram/MAINLOGIC - *7(OTE)*			
VFD101	0.0	REAL	cpu
VFD101 - MainProgram/IOINTERFACE - 12(MOV) *VFD101 - MainProgram/LEVELCONTROL - *5(PID), *6(MOV), *7(PID), *8(MOV)* *VFD101 - MainProgram/PID_test - *1-C1(OREF,VFD101), 1-B1(PIDE,PIDE_01.CVEU)* *VFD101 - MainProgram/pidsqyare - *0(PID), *2(MOV), *3(PID)*			


0
DISPLAY
STRT
OSR
One Shot Rising
Storage Bit J
Output Bit STRTRISE
SB
OB
1
DISPLAY
STRTRISE
MOV
Move
Source 0
Dest FCV1
0.0
2
DISPLAY
STRTRISE
PS
L
3
DISPLAY
PS
LSL101
P101
p101scada
4
DISPLAY
GRT
Greater Than (A>B)
Source A LT1
86.39443
Source B ref
87.0
le
5
DISPLAY
GRT
Greater Than (A>B)
Source A TT1
41.079166
Source B 110
te
6
DISPLAY
TRE
ONS
FRT
7
DISPLAY
le
te
threeelement
8
DISPLAY
STRT
OSF
One Shot Falling
Storage Bit hr
Output Bit stp
SB
OB
9
DISPLAY
stp
PS
U
10
DISPLAY
stp
STPING
L


11
DISPLAY
STRTRISE
STPING
U
12
DISPLAY
PS
GRT
Greater Than (A>B)
Source A LT1
86.39443
Source B 86
STARTHEATER
13
DISPLAY
STARTHEATER
HETRSCADA
TSH401
PSH401
LSL401
HEATER
14
DISPLAY
PS
GRT
Greater Than (A>B)
Source A PT1
0.0
Source B 2.5
CLDPSTRT
15
DISPLAY
CLDPSTRT
STPING
P301
16
DISPLAY
P301
MOV
Move
Source COLD
30.0
Dest VFD301
0.0
17
DISPLAY
PS
CLDPSTRT
GRT
Greater Than (A>B)
Source A PT1
0.0
Source B 3
PHTEX
18
DISPLAY
PHTEX
AS
ONS
PIDHX
L
19
DISPLAY
stp
PIDHX
U


20
DISPLAY
/
stp
MOV
Move
Source 60
Dest FCV1
0.0
21
RET
Return from Subroutine
(End)

Name	Value	Data Type	Scope
AS	0	BOOL	cpu
*AS - MainProgram/MAINLOGIC - *18(ONS)*			
CLDPSTRT	0	BOOL	cpu
*CLDPSTRT - MainProgram/MAINLOGIC - *14(OTE), 15(XIC), 17(XIC)*			
COLD	30.0	REAL	cpu
COLD - MainProgram/MAINLOGIC - 16(MOV)			
DISPLAY	0	BOOL	cpu
DISPLAY - MainProgram/MAINLOGIC - 0(XIO), 1(XIO), 10(XIO), 11(XIO), 12(XIO), 13(XIO), 14(XIO), 15(XIO), 16(XIO), 17(XIO), 18(XIO), 19(XIO), 2(XIO), 20(XIO), 3(XIO), 4(XIO), 5(XIO), 6(XIC), 7(XIO), 8(XIO), 9(XIO) *DISPLAY - MainProgram/MainRoutine - *3(OTE), 4(XIO), 5(XIC), 6(XIO), 7(XIO), 8(XIO), 9(XIO)*			
FCV1	0.0	REAL	cpu
*FCV1 - MainProgram/HEAT_EXCHANGER_TEMP_CONTROL - *0(PID)* *FCV1 - MainProgram/IOINTERFACE - 17(MOV)* *FCV1 - MainProgram/MAINLOGIC - *1(MOV), *20(MOV)*			
FRT	0	BOOL	cpu
*FRT - MainProgram/MAINLOGIC - *6(OTE)*			
HEATER	0	BOOL	cpu
HEATER - MainProgram/IOINTERFACE - 37(XIC) *HEATER - MainProgram/MAINLOGIC - *13(OTE)*			
HETRSCADA	0	BOOL	cpu
HETRSCADA - MainProgram/MAINLOGIC - 13(XIC)			
hr	0	BOOL	cpu
*hr - MainProgram/MAINLOGIC - *8(OSF)*			
J	0	BOOL	cpu
*J - MainProgram/MAINLOGIC - *0(OSR)*			
le	0	BOOL	cpu
*le - MainProgram/MAINLOGIC - *4(OTE), 7(XIC)*			
LSL101	0	BOOL	cpu
*LSL101 - MainProgram/IOINTERFACE - *21(OTE)* *LSL101 - MainProgram/MAINLOGIC - 3(XIO)*			
LSL401	0	BOOL	cpu
*LSL401 - MainProgram/IOINTERFACE - *18(OTE)* *LSL401 - MainProgram/MAINLOGIC - 13(XIO)*			
LT1	86.39443	REAL	cpu
*LT1 - MainProgram/IOINTERFACE - *0(MOV)* *LT1 - MainProgram/LEVELCONTROL - 2(PID), 7(PID)* *LT1 - MainProgram/MAINLOGIC - 12(GRT), 4(GRT)* *LT1 - MainProgram/pidsqyare - 3(PID)*			
P101	0	BOOL	cpu
P101 - MainProgram/IOINTERFACE - 35(XIC) *P101 - MainProgram/MAINLOGIC - *3(OTE)*			
p101scada	0	BOOL	cpu
p101scada - MainProgram/MAINLOGIC - 3(XIC)			
P301	0	BOOL	cpu
P301 - MainProgram/IOINTERFACE - 36(XIC) *P301 - MainProgram/MAINLOGIC - *15(OTE), 16(XIC)*			

PHTEX	0	BOOL	cpu

*PHTEX - MainProgram/MAINLOGIC - *17(OTE), 18(XIC)*

PIDHX	0	BOOL	cpu

PIDHX - MainProgram/HEAT_EXCHANGER_TEMP_CONTROL - 0(XIC)
*PIDHX - MainProgram/MAINLOGIC - *18(OTL), *19(OTU)*

PS	0	BOOL	cpu

PS - MainProgram/LEVELCONTROL - 7(XIC), 8(XIC)
*PS - MainProgram/MAINLOGIC - *2(OTL), *9(OTU), 12(XIC), 14(XIC), 17(XIC), 3(XIC)*

PSH401	0	BOOL	cpu

*PSH401 - MainProgram/IOINTERFACE - *20(OTE)*
PSH401 - MainProgram/MAINLOGIC - 13(XIO)

PT1	0.0	REAL	cpu

PT1 - MainProgram/BOILER_PRESSURE - 0(PID)
*PT1 - MainProgram/IOINTERFACE - *1(MOV)*
PT1 - MainProgram/MAINLOGIC - 14(GRT), 17(GRT)

ref	87.0	REAL	cpu

ref - MainProgram/MAINLOGIC - 4(GRT)

STARTHEATER	0	BOOL	cpu

*STARTHEATER - MainProgram/MAINLOGIC - *12(OTE), 13(XIC)*

stp	0	BOOL	cpu

*stp - MainProgram/MAINLOGIC - *8(OSF), 10(XIC), 19(XIC), 20(XIC), 9(XIC)*

STPING	0	BOOL	cpu

*STPING - MainProgram/MAINLOGIC - *10(OTL), *11(OTU), 15(XIC)*

STRT	0	BOOL	cpu

STRT - MainProgram/MAINLOGIC - 0(XIC), 8(XIC)

STRTRISE	0	BOOL	cpu

*STRTRISE - MainProgram/MAINLOGIC - *0(OSR), 1(XIC), 11(XIC), 2(XIC)*

te	0	BOOL	cpu

*te - MainProgram/MAINLOGIC - *5(OTE), 7(XIC)*

threeelement	0	BOOL	cpu

threeelement - MainProgram/LEVELCONTROL - 0(XIC), 1(XIC), 2(XIC), 3(XIC), 4(XIC), 5(XIC), 6(XIC), 7(XIO), 8(XIO)
*threeelement - MainProgram/MAINLOGIC - *7(OTE)*

TRE	0	BOOL	cpu

*TRE - MainProgram/MAINLOGIC - *6(ONS)*

TSH401	0	BOOL	cpu

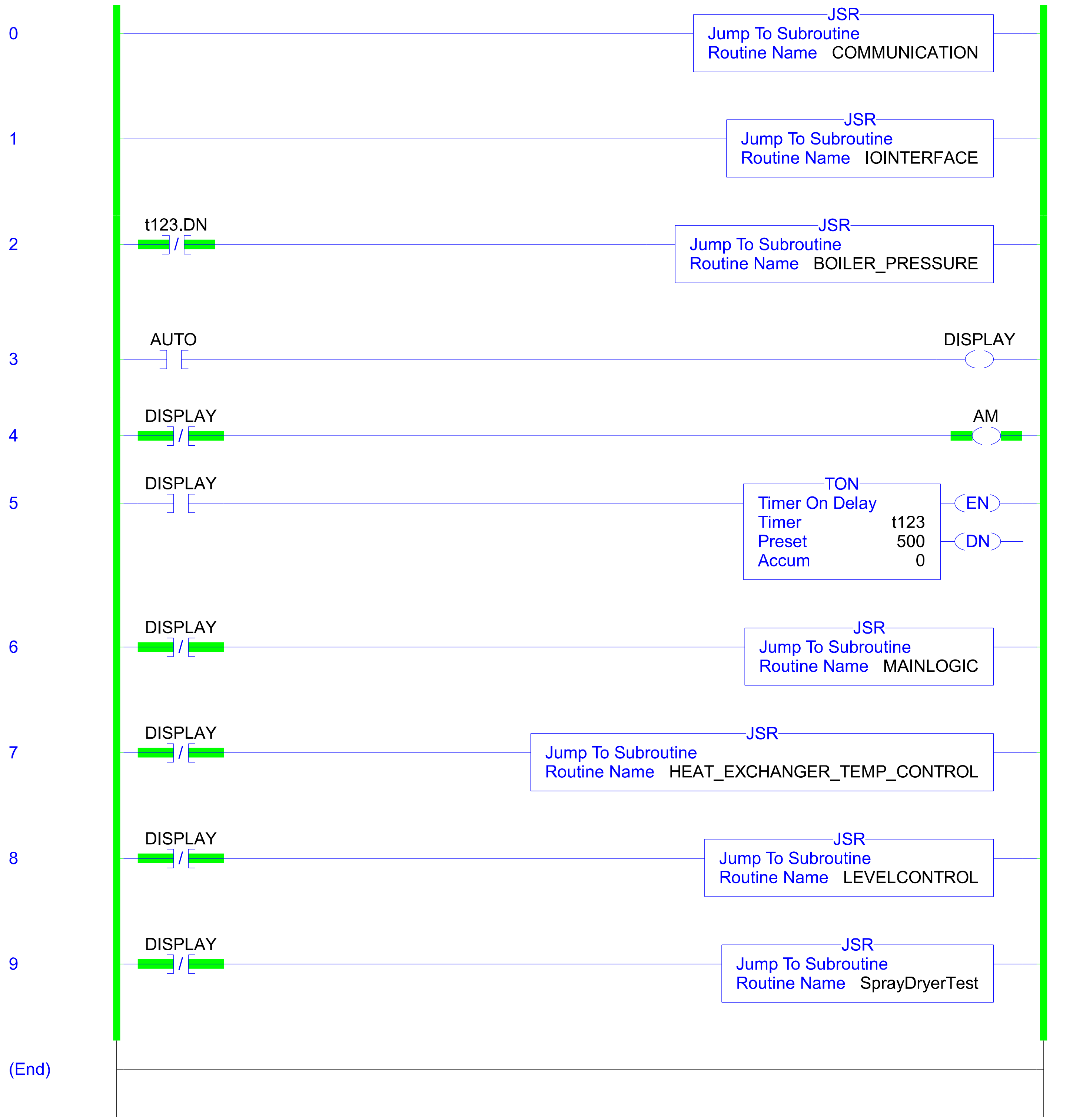
*TSH401 - MainProgram/IOINTERFACE - *19(OTE)*
TSH401 - MainProgram/MAINLOGIC - 13(XIO)

TT1	41.079166	REAL	cpu

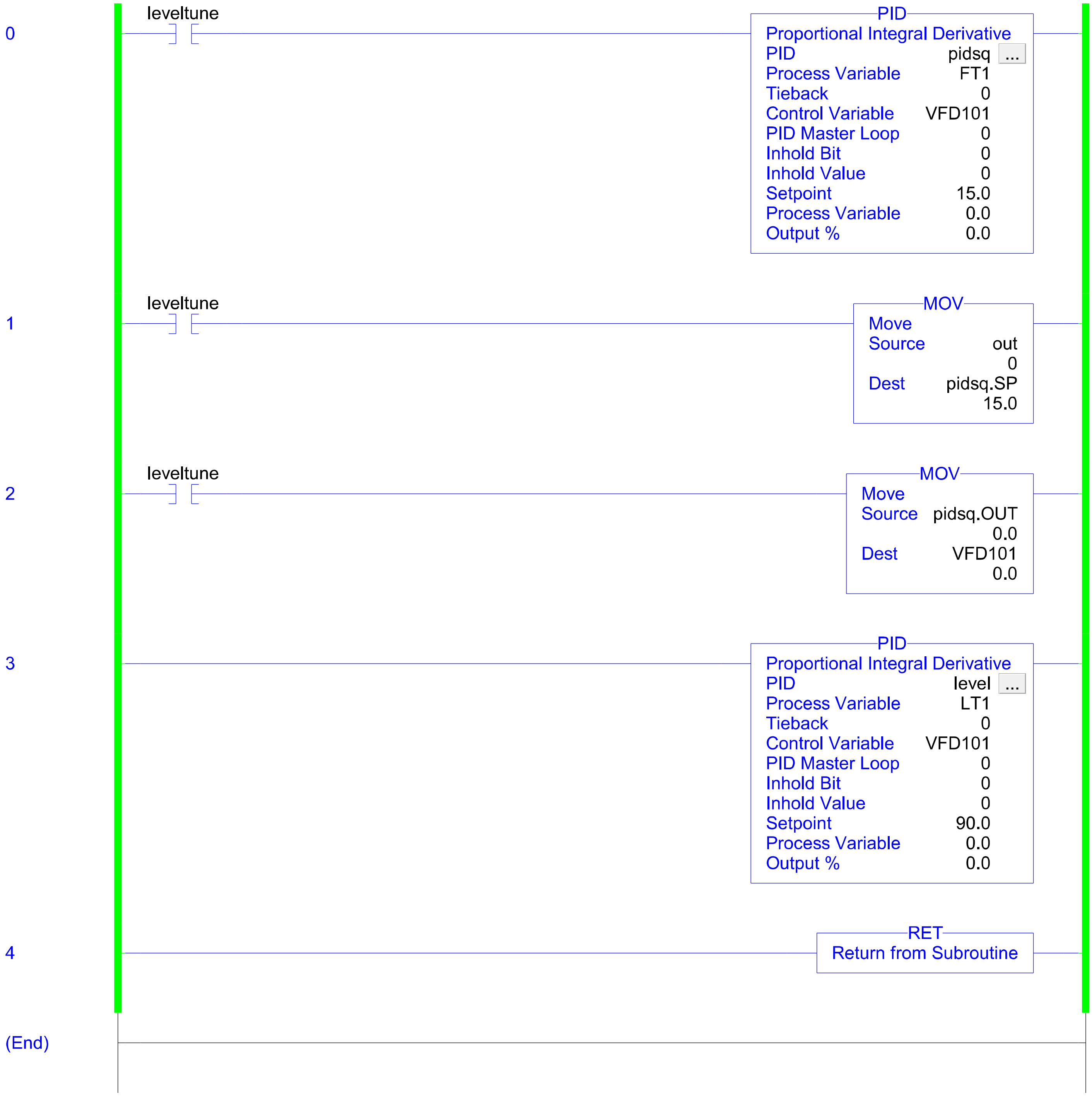
*TT1 - MainProgram/IOINTERFACE - *2(MOV)*
TT1 - MainProgram/MAINLOGIC - 5(GRT)

VFD301	0.0	REAL	cpu

VFD301 - MainProgram/IOINTERFACE - 13(MOV)
*VFD301 - MainProgram/MAINLOGIC - *16(MOV)*


0
JSR
Jump To Subroutine
Routine Name COMMUNICATION
1
JSR
Jump To Subroutine
Routine Name IOINTERFACE
2
t123.DN
JSR
Jump To Subroutine
Routine Name BOILER_PRESSURE
3
AUTO
DISPLAY
4
DISPLAY
AM
5
DISPLAY
TON
Timer On Delay
Timer t123
Preset 500
Accum 0
EN
DN
6
DISPLAY
JSR
Jump To Subroutine
Routine Name MAINLOGIC
7
DISPLAY
JSR
Jump To Subroutine
Routine Name HEAT_EXCHANGER_TEMP_CONTROL
8
DISPLAY
JSR
Jump To Subroutine
Routine Name LEVELCONTROL
9
DISPLAY
JSR
Jump To Subroutine
Routine Name SprayDryerTest
(End)

Name	Value	Data Type	Scope
AM	1	BOOL	cpu
*AM - MainProgram/MainRoutine - *4(OTE)*			
AUTO	0	BOOL	cpu
AUTO - MainProgram/MainRoutine - 3(XIC)			
DISPLAY	0	BOOL	cpu
DISPLAY - MainProgram/MAINLOGIC - 0(XIO), 1(XIO), 10(XIO), 11(XIO), 12(XIO), 13(XIO), 14(XIO), 15(XIO), 16(XIO), 17(XIO), 18(XIO), 19(XIO), 2(XIO), 20(XIO), 3(XIO), 4(XIO), 5(XIO), 6(XIC), 7(XIO), 8(XIO), 9(XIO) *DISPLAY - MainProgram/MainRoutine - *3(OTE), 4(XIO), 5(XIC), 6(XIO), 7(XIO), 8(XIO), 9(XIO)*			
t123		TIMER	cpu
*t123 - MainProgram/MainRoutine - *5(TON)* *t123.DN - MainProgram/MainRoutine - 2(XIO)*			


0
leveltune
PID
Proportional Integral Derivative
PID pidsq ...
Process Variable FT1
Tieback 0
Control Variable VFD101
PID Master Loop 0
Inhold Bit 0
Inhold Value 0
Setpoint 15.0
Process Variable 0.0
Output % 0.0
1
leveltune
MOV
Move
Source out
0
Dest pidsq.SP
15.0
2
leveltune
MOV
Move
Source pidsq.OUT
0.0
Dest VFD101
0.0
3
PID
Proportional Integral Derivative
PID level ...
Process Variable LT1
Tieback 0
Control Variable VFD101
PID Master Loop 0
Inhold Bit 0
Inhold Value 0
Setpoint 90.0
Process Variable 0.0
Output % 0.0
4
RET
Return from Subroutine
(End)

Name	Value	Data Type	Scope
FT1	0.0	REAL	cpu

*FT1 - MainProgram/IOINTERFACE - *10(MOV)*
FT1 - MainProgram/LEVELCONTROL - 5(PID)
FT1 - MainProgram/PID_test - 1-B1(IREF,FT1), 1-B1(PIDE,PIDE_01.PV)
FT1 - MainProgram/pidsqyare - 0(PID)

Name	Value	Data Type	Scope
level		PID	cpu

*level - MainProgram/LEVELCONTROL - *2(PID)*
*level - MainProgram/pidsqyare - *3(PID)*
*level.BIAS - MainProgram/LEVELCONTROL - *1(MOV)*
*level.OUT - MainProgram/LEVELCONTROL - *2(PID), 3(DIV)*

Name	Value	Data Type	Scope
leveltune	0	BOOL	cpu

leveltune - MainProgram/pidsqyare - 0(XIC), 1(XIC), 2(XIC)

Name	Value	Data Type	Scope
LT1	86.39443	REAL	cpu

*LT1 - MainProgram/IOINTERFACE - *0(MOV)*
LT1 - MainProgram/LEVELCONTROL - 2(PID), 7(PID)
LT1 - MainProgram/MAINLOGIC - 12(GRT), 4(GRT)
LT1 - MainProgram/pidsqyare - 3(PID)

Name	Value	Data Type	Scope
out	0	DINT	cpu

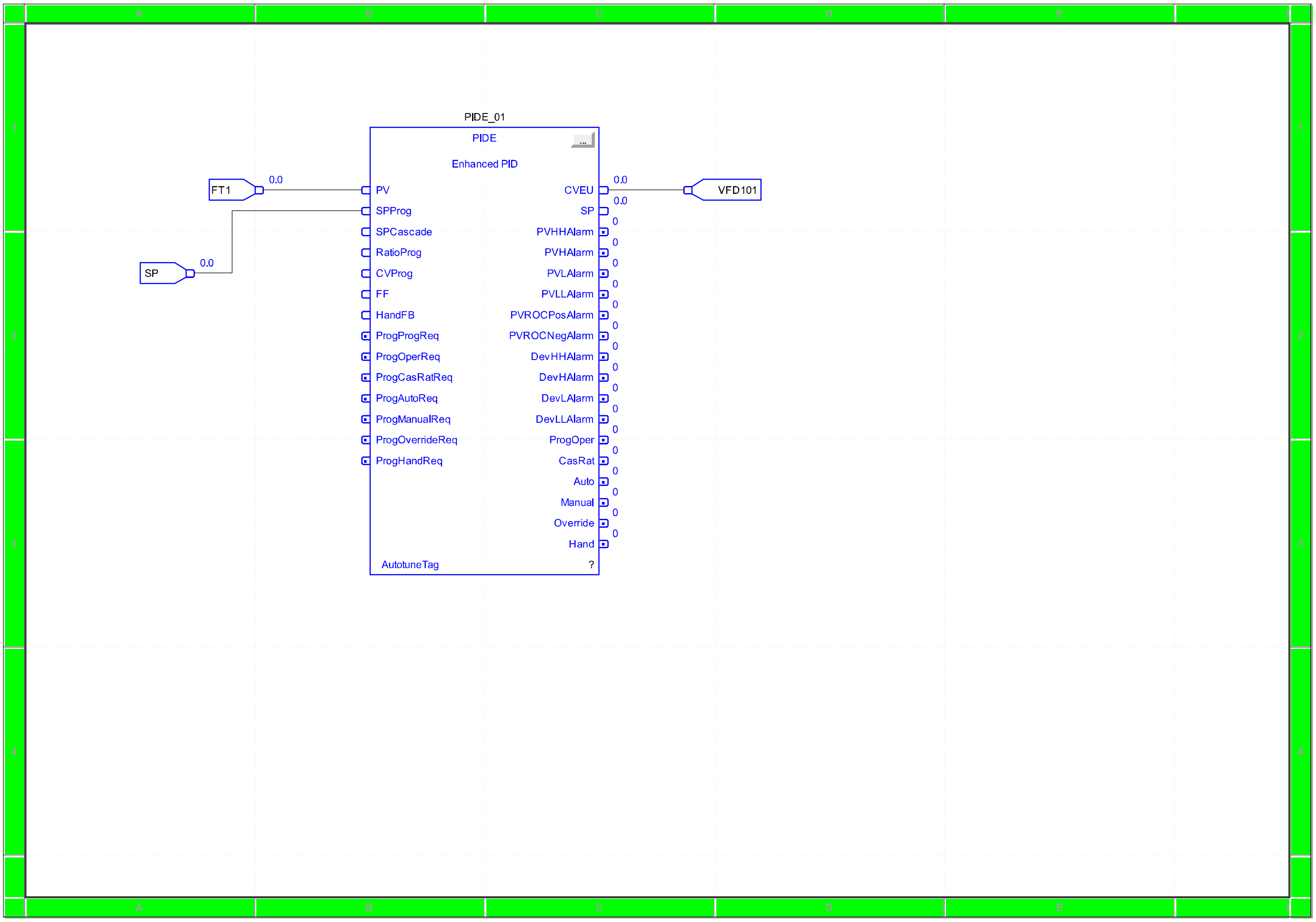
out - MainProgram/pidsqyare - 1(MOV)
*out - MainProgram/squar_wav - *1(MOV), *3(MOV)*

Name	Value	Data Type	Scope
pidsq		PID	cpu

*pidsq - MainProgram/pidsqyare - *0(PID)*
pidsq.OUT - MainProgram/pidsqyare - 2(MOV)
*pidsq.SP - MainProgram/pidsqyare - *1(MOV)*

Name	Value	Data Type	Scope
VFD101	0.0	REAL	cpu

VFD101 - MainProgram/IOINTERFACE - 12(MOV)
*VFD101 - MainProgram/LEVELCONTROL - *5(PID), *6(MOV), *7(PID), *8(MOV)*
*VFD101 - MainProgram/PID_test - *1-C1(OREF,VFD101), 1-B1(PIDE,PIDE_01.CVEU)*
*VFD101 - MainProgram/pidsqyare - *0(PID), *2(MOV), *3(PID)*


PIDE_01
PIDE
Enhanced PID
FT1
0.0
SP
0.0
PV
SPProg
SPCascade
RatioProg
CVProg
FF
HandFB
ProgProgReq
ProgOperReq
ProgCasRatReq
ProgAutoReq
ProgManualReq
ProgOverrideReq
ProgHandReq
AutotuneTag
?
CVEU
0.0
SP
0.0
PVHHAlarm
PVHAlarm
PVLAlarm
PVLLAlarm
PVROCPosAlarm
PVROCNegAlarm
DevHHAlarm
DevHAlarm
DevLAlarm
DevLLAlarm
ProgOper
CasRat
Auto
Manual
Override
Hand
VFD101

Name	Value	Data Type	Scope
FT1	0.0	REAL	cpu

*FT1 - MainProgram/IOINTERFACE - *10(MOV)*
FT1 - MainProgram/LEVELCONTROL - 5(PID)
FT1 - MainProgram/PID_test - 1-B1(IREF,FT1), 1-B1(PIDE,PIDE_01.PV)
FT1 - MainProgram/pidsqyare - 0(PID)

Name	Value	Data Type	Scope
PIDE_01		PID_ENHANCED	MainProgram

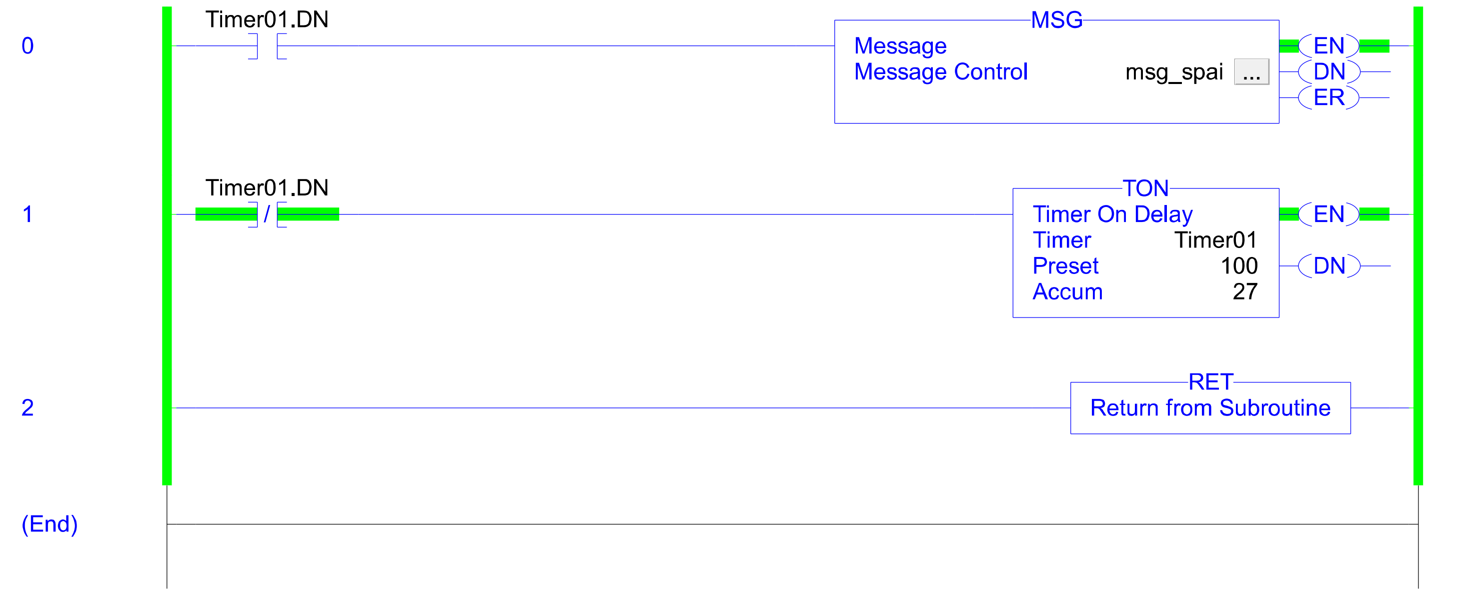
*PIDE_01 - MainProgram/PID_test - *1-A2(IREF,SP), *1-B1(IREF,FT1), *1-B1(PIDE,PIDE_01), *1-C1(OREF,VFD101)*

Name	Value	Data Type	Scope
SP	0.0	REAL	cpu

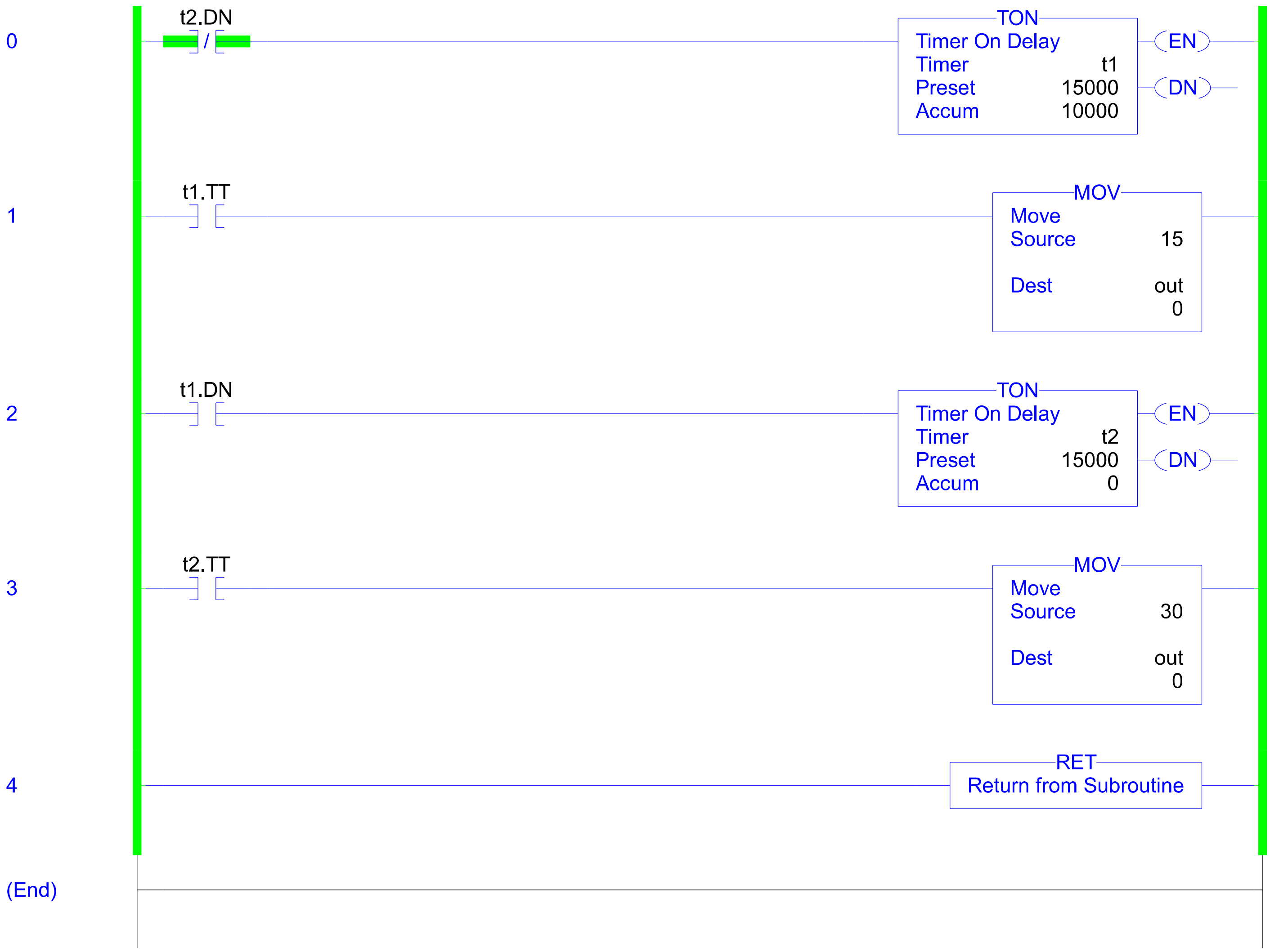
SP - MainProgram/PID_test - 1-A2(IREF,SP), 1-B1(PIDE,PIDE_01.SPProg)

Name	Value	Data Type	Scope
VFD101	0.0	REAL	cpu

VFD101 - MainProgram/IOINTERFACE - 12(MOV)
*VFD101 - MainProgram/LEVELCONTROL - *5(PID), *6(MOV), *7(PID), *8(MOV)*
*VFD101 - MainProgram/PID_test - *1-C1(OREF,VFD101), 1-B1(PIDE,PIDE_01.CVEU)*
*VFD101 - MainProgram/pidsqyare - *0(PID), *2(MOV), *3(PID)*


0
Timer01.DN
MSG
Message
Message Control msg_spai ...
EN
DN
ER
1
Timer01.DN
TON
Timer On Delay
Timer Timer01
Preset 100
Accum 27
EN
DN
2
RET
Return from Subroutine
(End)

Name	Value	Data Type	Scope
msg_spai		MESSAGE	cpu
*msg_spai - MainProgram/SprayDryerTest - *0(MSG)*			
SPAI		REAL[20]	cpu
*SPAI[0] - MainProgram/SprayDryerTest - *0(MSG)*			
Timer01		TIMER	cpu
*Timer01 - MainProgram/COMMUNICATION - *4(TON)*			
*Timer01 - MainProgram/SprayDryerTest - *1(TON)*			
Timer01.DN - MainProgram/COMMUNICATION - 0(XIC), 1(XIC), 2(XIC), 3(XIC), 4(XIO)			
Timer01.DN - MainProgram/SprayDryerTest - 0(XIC), 1(XIO)			


0
t2.DN
TON
Timer On Delay
Timer t1
Preset 15000
Accum 10000
EN
DN
1
t1.TT
MOV
Move
Source 15
Dest out
0
2
t1.DN
TON
Timer On Delay
Timer t2
Preset 15000
Accum 0
EN
DN
3
t2.TT
MOV
Move
Source 30
Dest out
0
4
RET
Return from Subroutine
(End)

Name	Value	Data Type	Scope
out	0	DINT	cpu
out - MainProgram/pidsqyare - 1(MOV)			
*out - MainProgram/squar_wav - *1(MOV), *3(MOV)*			
t1		TIMER	MainProgram
*t1 - MainProgram/squar_wav - *0(TON)*			
t1.DN - MainProgram/squar_wav - 2(XIC)			
t1.TT - MainProgram/squar_wav - 1(XIC)			
t2		TIMER	MainProgram
*t2 - MainProgram/squar_wav - *2(TON)*			
t2.DN - MainProgram/squar_wav - 0(XIO)			
t2.TT - MainProgram/squar_wav - 3(XIC)			

Data type Name: STRING

Description:

Size 88 byte(s)

Name	Data Type	Style	Description
LEN	DINT	Decimal	
DATA	SINT[82]	ASCII	

Appendix G

References

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