CHAPTER 1
INTRODUCTION

1.1 Background Study

A valve is a device that regulates the flow of a fluid (gases, liquid, fluidized solids, or slurries) by opening, closing, or partially obstructing various passageways. Emergency shut down valve (ESV) is an actuated valve installed in a pipeline. It is isolates a process unit from an upstream or downstream (gaseous or liquid) inventory upon activation of the process unit alarm and shutdown system.

To achieve safe plant operation, individual safety instrumented system (SIS) are required parallel with the overall plant control system (DCS). Especially, the ESD valves must function when the production plant is pushed into a critical situation. To ensure a high probability that the valves will function when required, the application of testing is a good solution saving both plant initial cost and running cost. Intelligent valve positioner and logic solver may be configured to provide this valve test function. [1]

There are two types of test conducted to overcome the safety performance degradation due to longer testing intervals; Full Stroke Test (FST) and Partial Stroke Test (PST). The FST requires the valve to be fully opened and fully closed during the testing. Thus, it can only be done during the plant shutdown. [2]

According to Mary Ann Lundteigen, PST has recently been introduced as a semi-automatic which means to test process shutdown valves. Normally, this type of testing does not disturb the process and can detect many of the failures that traditionally have been revealed only by functional testing. [3]

1.2 Problem Statement

Turn-arounds are being planned further apart, ranging from 3 to 5 years. The inability to conduct full stroke test within the required period, causing safety issues to arise due to ESD valves being stuck in position due to the very long period in one fixed position. A number of failures in PST around the world have given rise to concerns on the reliability of PST. The facility is meant for comparison and verification of the technology used for partial stroke test of ESV valves. The work includes the development of the controller to execute the FST and PST sequences, data mining and analysis. For this second phase, PST will be executing by using real medium flowing through the valves. However, before build up the test rig, some specifications and criteria of mini plant design need to consider first.

1.3 Objective and Scope of Study

1.3.1 Objective

The objectives of the project are:

- Modeling and verification of a Partial Stroke Test rig using HYSYS software
- Development of Partial Stroke Test procedure for FISHER Emergency Shutdown Valve.

1.3.2 Scope of Study

Generally, the scope of this project is to analyze, compare and verify the performance of PST applied to four emergency shutdown valves from four different vendors.

This research is continuation or improvement of the previous project. For this second phase, destructive testing will possibly be conducted. PETRONAS is going to upgrade the testing facility with real medium flowing through the valves during testing to permit more realistic be conducted.

The result will be utilized by PETRONAS in developing the PETRONAS Technical Standard, as well as verifying the capability of the valves and its software reliability as claimed by the vendor.

CHAPTER 2
LITERATURE REVIEW

2.1 Valves

Valves are device that controls the flow into the pipeline by opening, closing, or partially opening various passageways. Valves are categorized based on the movements of the stems; either sliding or rotary motion. The different between these two categories is the way it works when responding to control signals which is for sliding stem valve; the valve operates by sliding up and down of the stem for example gate valve and globe valve. While for rotary motion valves, they operate by rotating the disc or ball about 90°. Example of rotary valve is ball valve and butterfly valve.

Valves may be operated manually, either by a hand wheel, lever or pedal. Valves may also be automatic, driven by changes in pressure, temperature, or flow. These changes may act upon a diaphragm or a piston which in turn activates the valve, examples of this type of valve found commonly are safety valves fitted to hot water systems or boilers.

More complex control systems using valves requiring automatic control based on an external input (i.e., regulating flow through a pipe to a changing set point) require an actuator. An actuator will stroke the valve depending on its input and set-up, allowing the valve to be positioned accurately, and allowing control over a variety of requirements.

In a valve, there are two major parts which is actuator and body valve.

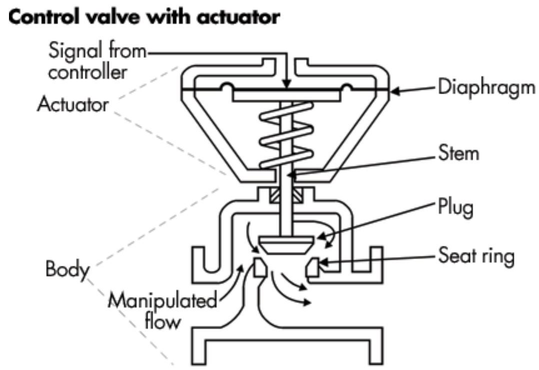


Figure 1: Typical Globe Valve with Actuator

2.2 Ball Valve

Ball valve is a valve with spherical disc, the part of the valve which controls the flow through it. The sphere has a hole, or port, through the middle so that when the port is in line with both ends of the valve, flow will occur. When the valve is closed, the hole is perpendicular to the ends of the valve, and flow is blocked.

The characteristic of ball valve allows the quickness of operation, require no lubricants and give tight sealing with low torque. Most ball valves are also equipped with soft seats that conform tightly to the surface of the ball. Thus ball valve is well-suited for tight shut-off application. [6]

Figure 2: Fisher Ball Valve

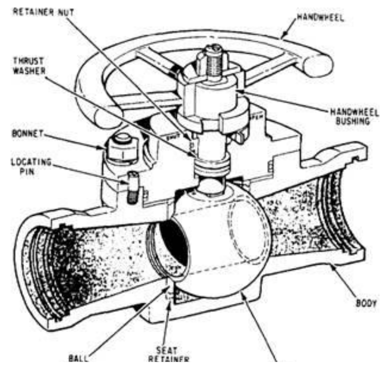


Figure 3: Cross Section Area of Ball Valve

2.3 Butterfly valve

A butterfly valve controlling device is a circular disk at the center of the pipe which is rotated 90° to open or close the flow passage. The operation is similar to ball valve which allows for quick shut off. The actuator of the valve is connected to the rod which controls the rotation of circulation disk. When the pipe rotates, it will turn the plate either parallel or perpendicular to the flow. When the valve is closed, the disc is turned parallel so that it completely blocks off the passageway while the disc is rotated a quarter turn when the valve is opened, so that it allows an almost unrestricted passage of the process fluid.

Figure 4: Example of Butterfly Valve

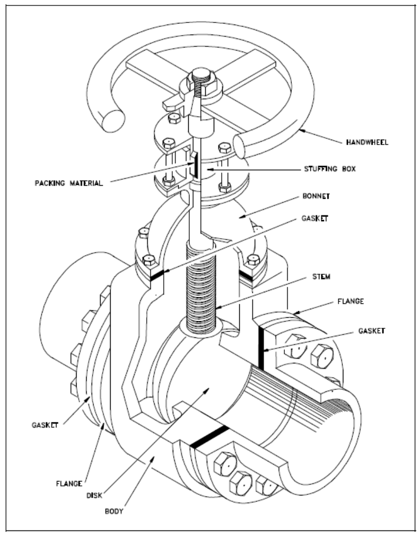


Figure 5: Cross Section Area of Butterfly Valve

2.4 Actuator

Actuator is a mechanical device for controlling or moving in the system. In a valve, actuator supplies force and motion to open and close the valve. These actuator vary power sources from pneumatic, hydraulic, or electrical. There are many actuator styles manufactured by FISHER such as diaphragm, piston, rack and pinion, electro-hydraulic, manual and electric actuator. This project used rack and pinion actuator.[4]

Figure 6: Rack and Pinion Actuator

2.5 Positioner

Positioner is a device that links to the actuator in order to controls the position of the valve in opening and closing condition by converting 4-20mA DC current signal input from process controller and converts it to pneumatic output signal to the actuator.

A valve positioner relates the input signal and the valve position, and will provide any output pressure to the actuator to satisfy this relationship, according to the requirements of the valve, and within the limitations of the maximum supply pressure. [5]

In this project, DVC6000 smart positioner is used. It communicates via Highway Addressable Remote Transducer (HART) communication protocol to provide instrument and valve diagnostic information. The smart positioner is reaaly important in Emergency Shutdown (ESD) application. It will reduce the testing time taken and manpower requirement, thus it will reduce cost. This smart positioner also reports the health of valve by diagnostic, thus reducing the need for scheduled maintenance.

Figure 7: DVC6000 Smart Positioner

2.6 Pressure Regulator

Pressure regulator is used to regulate or reduce air pressure to get the desired value. It also known as air-sets that will reduce plant air supply to valve positioner and control equipment. The common pressure of reduce air supply are 20, 35 and 60 psi. The regulator mounts integrally to the positioner or nipple-mounts or bolts to the actuator. [4] The parameters that limit adjustment control on the pressure range are the regulating and adjustment range.

Figure 8: Example of Pressure Regulator

2.7 Limit Switch

Limit switch functioned as device that will alert when a valve is at or beyond predetermined position because it shows the position of the valve stem at a particular instant of time. It operates discrete inputs to a distributed control system, signal lights, small solenoid valve, electronics relays, or alarms.

This project used VALVE TOP DXP as a limit switch. Valvetop valve controllers and switchboxes enable automated on/off valves to communicate via FOUNDATION Fieldbus, Profibus, DeviceNet, and AS-Interface. They attach to all brands of rotary and linear valves and actuators, operate in the most demanding plant conditions, and carry a variety of global certifications. [7]

Figure 9: VALVETOP DXP Limit switch

2.8 Solenoid Valve

Solenoid valve is a valve that functions to operate on/off pneumatic actuator and to interrupt the action of modulating valves by switching air of hydraulic pressure. [4]

Solenoid valve offer fast and safe switching, high reliability, long service life and good medium compatibility. Most solenoid valves are designed to be continually energized, particularly for emergency shutdown service. The solenoid valve requires power supply for it to energize. If there is no power supply, the solenoid valve will de-energized. Thus, it will affect the state of the valve whether fully open or fully close.

Figure 10: Solenoid Valve

2.9 Programmable Logic Controller

A Programmable Logic Controller (PLC) is a digital computer used for automation of electromechanical processes. PLC is designed for multiple inputs and outputs arrangements receive input signals and emit output signals according to the program logic. PLCs come in many shapes and sizes from small, self-contained, units with very limited input/output capacity to large, modular units that can be configured to provide hundreds or even thousands of input/outputs. The PLC-based system becomes the most common choice for manufacturing controls including process plant since it can cut production cost and increase quality.

2.10 ASPEN HYSYS Engineering Software

HYSYS is one of the engineering simulation tools. Basically, this software usually been used to verify the modeling plan before the build up the real plant. In industry the software is used in research, development, modeling and design. HYSYS serves as the engineering platform for modeling process such as from Upstream, through Gas Processing and Cryogen facilities, to Refining and Chemical processes.

One of the advantages by using HYSYS is, it can improve efficiency and productivity through automation of workflow from conceptual to detailed design by integrating Aspen HYSYS with rigorous heat exchanger calculations comprehensive cost estimations, and engineering data management.

HYSYS also serves the agility for model-based decision making and engineering design workflow by integrating Microsoft Excel spreadsheets and Aspen HYSYS models – without programming skills – through Aspen Simulation Workbook.

CHAPTER 3
METHODOLOGY

3.1 Project planning

- Preliminary survey / literature review of ESD valve.
- Shut-down issue in plant
- Familiarization of PST
- Controller / PLC programming
- Testing requirement/ schedule
- Testing / Practiced
- Analysis Results
- Documentation

The flow chart representation of the procedure undertaken in the execution of this project that has been involved during this study is shown in Chart 1. The Gantt chart (refer to Appendix A) shows the time taken to finish the project within two semester.

3.2 Project Process Flow

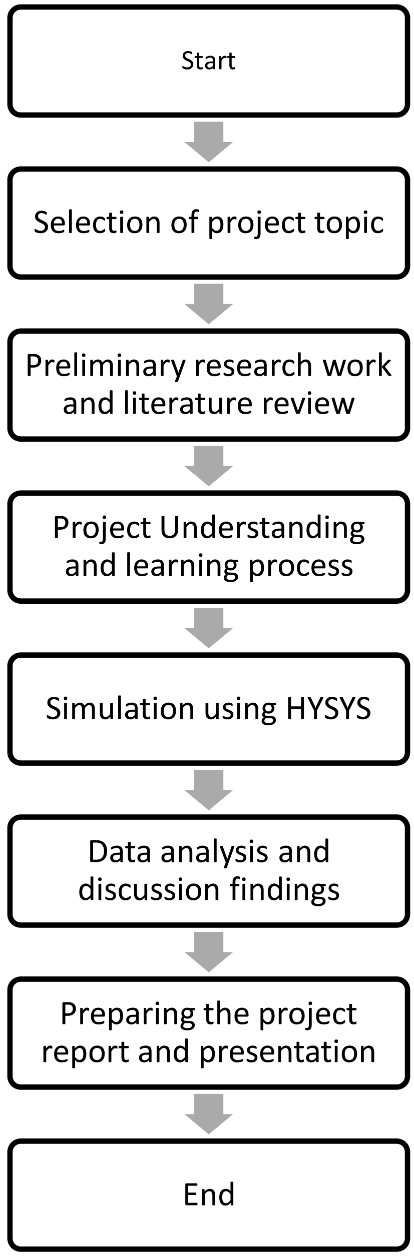


Chart 1: Project process flow

3.3 Tools and Equipment

3.3.1 Hardware

The hardware requirements for this project are:

1. Valves

There are two types of valves use for this project. These valves are from different manufacturers; Fisher, Metso and Masoneilan. Table 1 below shows the general specification for each valve.

Table 1: General Specifications for Valves

Manufacturers	**Valves**	Size (inch)	Input	Minimum Pressure (psi)	Operational Temperature (°C)
FISHER	Ball	6	24 VDC	5	-40 - +80
	Butterfly	4	4-20 mA	5	-40 - +80
METSO	Ball	6	4-20 mA	36	-40 - +80
	Butterfly	6	4-20 mA	36	-40 - +80
MASONEILAN	Ball	6	24 VDC	3	-40 - +80
	Butterfly	6	4-20 mA	3	-40 - +80

2. Yokogawa FA-M3 Controller

The specifications of Yokogawa FA-M3 Controller are:

Table 2: General Specifications of Yokogawa FA-M3 Controller

	Item	Specifications
1	Supply Voltage	24 VDC
2	Leakage Cyrrent	-
3	Operational Temperature	0 - +55°C
4	Operating environment	Free of corrosive and flammable gases, or heavy dust
5	Cooling Method	Natural-air cooled

3. Personal Computer

4. 24 VDC Power Supply

5. Pressure supply

3.3.2 Software(Testing)

Software used in this project are Winfield and ValveLink. Other types of software for different vendors are displayed in Table 3 below:

Table 3: Software Used in This Project

	Software	Vendor	Application
1	WideField2	Yokogawa	Yokogawa FA-M3 Controller
2	ValveLink	Fisher	Fisher Ball Valve and Butterfly Valve
3	FieldCare	Metso	Metso Ball Valve and Butterfly Valve
4	Valvue ESD	Masoneilan	Masoneilan Ball Valve and Butterfly Valve

3.3.3 Software (Simulink)

-ASPEN HYSYS Engineering

3.4 Hardware Setup

There are 6 valves from different manufacturers in this project. The valves will be controlled by PLC and Personal Computer (PC). The PLC is needed to trigger the demand and execute the FST according to the project requirements. Thus, it is important to develop the right hardware system between input and output devices. A complete wiring connection will ensure the communications between each device are successful.

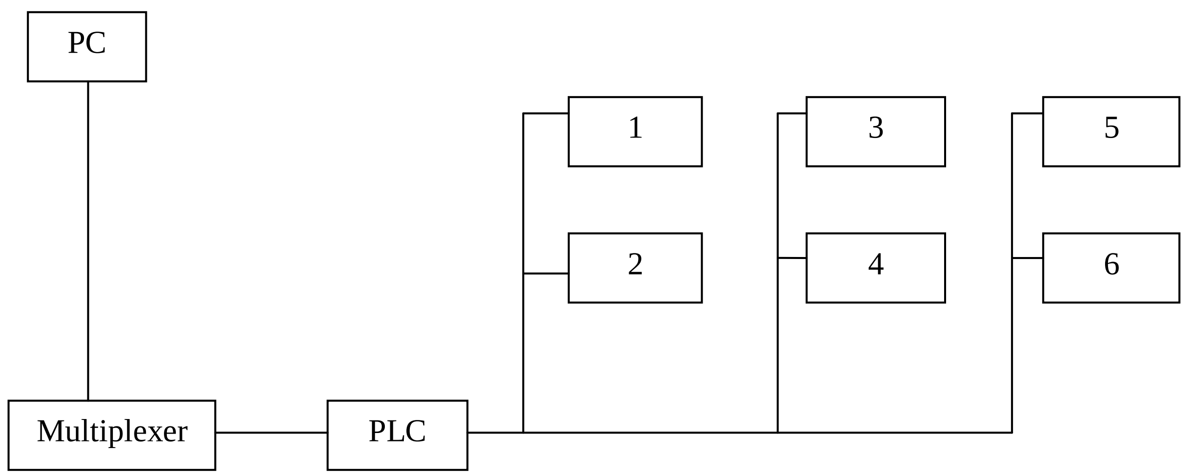


Figure 11: Hardware Connections

1. FISHER Ball Valve
2. FISHER Butterfly Valve
3. Metso Ball Valve
4. Metso Butterfly Valve
5. Masoneilan Ball Valve
6. Masoneilan Butterfly Valve

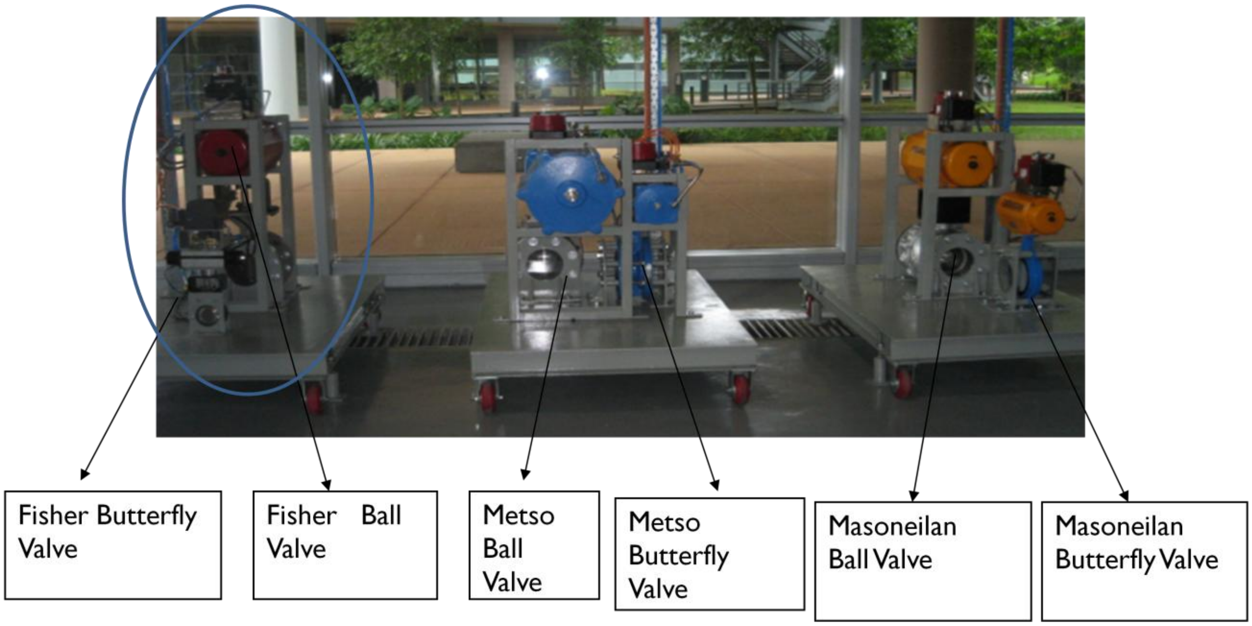


Figure 12: Current Valves Arrangement of the Project

CHAPTER 4
RESULT AND DISCUSSION

4.1 Plant design

Before implement the second phase of this project, some specifications of design will be considered. One of them is upgrading of PST test rig in the lab. The details of the design as below:

4.1.1 Design Objective:

To proposed the sketch design. To proposed the tank size and the pump capacity.

4.1.2 Description:

Initially is to estimate the biggest volume flow of the piping. This must be known because we want to calculate the required size of the tank. The biggest volume will be the flow through the four 6” valves. Using the known information about the size of valves, and the assumption to use a 45 liter/min pump (available commercially), the proposal is to have the size of the tank (r=radius and h=height) to be **r=0.25m** and **h=1m**. The calculation is as below.

4.1.3 Detail Calculation:

<u>Volume for 2” pipe radius</u>

$r = 1'' = 0.0254 \text{ m}$

$$\text{l} = 0.5 + 0.5 + 0.25 + 0.7 + 0.7 + 4 + 1 + 1.4 + 1 = 10.05\text{m}$$

$$\text{A} = \pi\text{r}^2 = \pi(0.0254)^2 = 0.00203\text{m}^2$$

$$\text{V} = \text{Al} = 0.00203\text{x}10.05 = 0.0204\text{m}^3$$

<u>Volume for 6” pipe radius</u>

$r = 3'' = 0.0762$

$l = 3.75$

$A = \pi r^2 = \pi(0.0762)^2 = 0.01824m^2$

$V = Al = 0.01824x3.75 = 0.0684m^3$

$V_{total} = V_{2''} + V_{6''} = 0.0204 + 0.0684 = 0.0888m^3$

The output discharge of the available pump is $45\ {}^{l}/_{min} = \ 0.045\ {}^{m^3}/_{min}$

$$\therefore Volumetric\ flow\ rate, \dot{V}$$

$$\dot{V} = \frac{V}{t}$$

$$t = \frac{V}{\dot{V}} = \frac{0.0888}{0.045} = 1.97min = 118.4s \approx 120s$$

$$t_{testing} = 80s$$

#Total time required = $t + t_{testing} = 120 + 80 = 200s = 3.333min$

$\therefore minimum\ volume\ tank\ required = V_{piping} = 0.045\, m^3/min \times 3.333min = 0.15m^3$

#Note: By using hand valves at beginning and ending of each branch, the ***Total time has been reduced*** since the flow is directed to either of the branches depending on the location of the valve to be tested. This is because only one valve will be tested at one time.

Check back the volume of the tank with the specified *r* and *h*

$$V_{tank} = \pi r^2 h = \pi \times 0.25^2 \times 1 = 0.196m^3$$

Thus the size of the tank is valid because

$$V_{tank} > V_{piping}$$

$$0.196m^3 > 0.15m^3$$

Therefore, the summary of the final draft is:

1. Minimum volume tank required = 0.14985
2. Tank size proposed = 0.1963 m^3 (1 m in height and 0.25 m in radius)
3. Water pump rating = 45 ℓ / min = 0.045 m^3 / min

4.1.4 Final Draft of Mini Plant

For the final draft, the mini plant design is more or less the same with the previous design but it has been decided to have lesser valves in one single loop. After having discussion with PETRONAS, the amount of valves which is four in one loop has been decreased to two valves in one loop for the final draft. Thus, there are four different loops in the final draft of the mini plant design. By having lesser valves in single loop, we can decrease the constraint for the water flow thus lessen the pressure drop in the pipeline which will then decrease the percentage of having low volumetric flow rate inside the pipeline when the water reaches the end of the loop.

The same concept like in the previous draft, at one operation time only one loop of valve will be operated, thus if one valve in that particular loop let say Loop A is having problem only another valve's operation is affected which compare to second draft, if one valve is having problem in that loop it will affected another three valves operation. Therefore, by having the new design, the probability of one valve cannot be operated has been reduced.

For the final draft, same design criteria like previous draft are used such as the pump rating is 45 ℓ / min equivalent to 0.045 m^3 / min which is possible to be purchased, the gap between each ESD valve is 1 m each and there are two size of pipeline which are 2 inch and 6 inch diameter pipe.

The water tank size proposed id 0.1963 m^3 which it is 1 m in height and 0.25 m in radius and it is coincidentally the same with second draft. Detailed calculation for the final draft has been done before determining the water tank size and is shown below. While doing the calculation, the same concept is used which is the longest path used for the water to flow during the testing is taking into concerned since if the water in the tank is enough to test the valve located in the farthest location, it should be more than enough to supply water for valve located at closer location from the water tank. This assumption can be made since only one valve can be tested at one time.

First step in the calculation, the biggest volume of the water flow in pipeline which referred to the longest path taken by the water to flow in pipeline is calculated first as bench mark. Since we know the output discharge of water pump, the time taken for the water to fill the pipeline is then calculated and the testing time is estimated. The total time required is then estimated.

After that, the minimum volume of water tank required to sustain water to flow fully in the pipeline for that particular time is determined. Then, volume of tank obtained from calculation is compared with the minimum volume of tank required. From the calculation, it is proven that the water tank size proposed for the final draft is reasonable.

For safety purpose, a pressure gauge, a flow transmitter and an on/off valve (safety valve) will be installed in the loop. Whenever the pressure gauge senses any excessive pressure inside the impulse line, it will send signal to safety valve to open in order to avoid back pressure to the pump which can damage it. On the other hand, if the flow transmitter measure low flow rate in the pumping without any flow through it, it will also damage the pump.

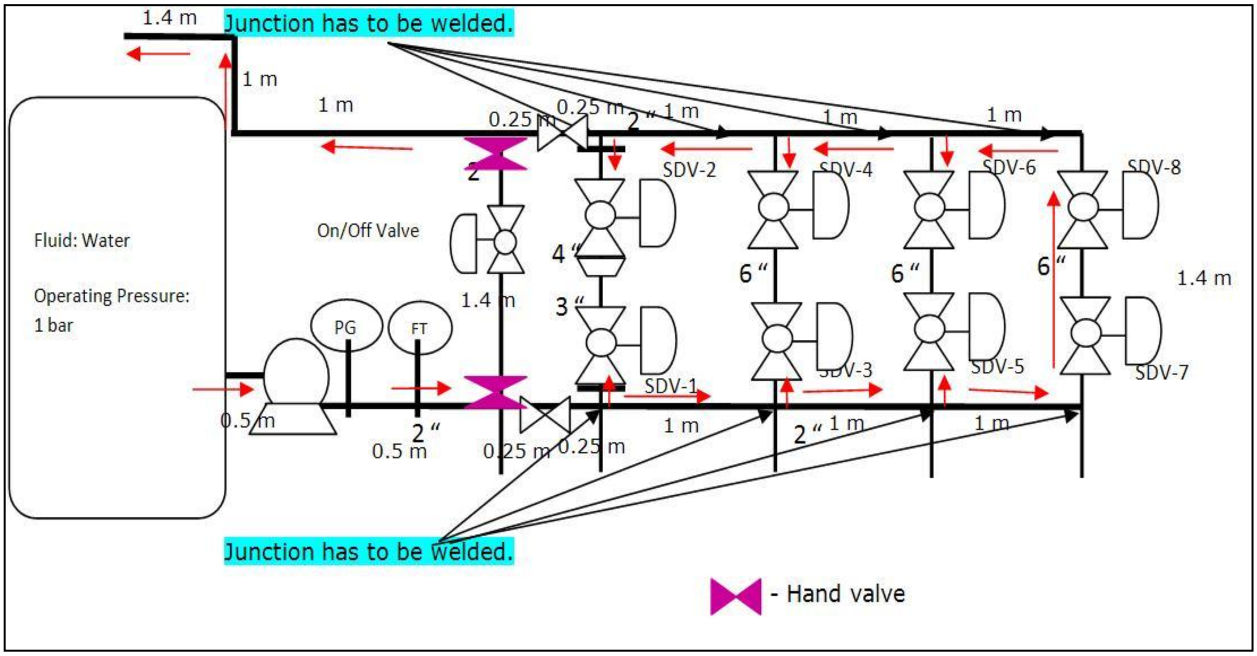


Figure 13: Sketch Plant Design

4.2 Modeling and Verification of Process Plant Design

4.2.1 Simulation Objective

To analyze and finalize the sketch plant design using HYSYS software. To run the simulation and compare the sketch design with simulation design.

4.2.2 Simulation Design Description

The simulation design using HYSYS bit different from the sketch plant design. There are some data that has to assume such as temperature and pressure of each stream. Based on the design in HYSYS software, each of the valves have different pressure drop according to size of Ball Valves and Butterfly Valves. Small size of the valve gives high pressure drop while big size of the valve gives low pressure drop.

The previous calculation shows the volumetric flow satisfied all the components and equipment in the process. However, we will focus more on the pressure in this HYSYS Software.

After running the simulation, there are some pressure drops when the streams pass through these eight valves.

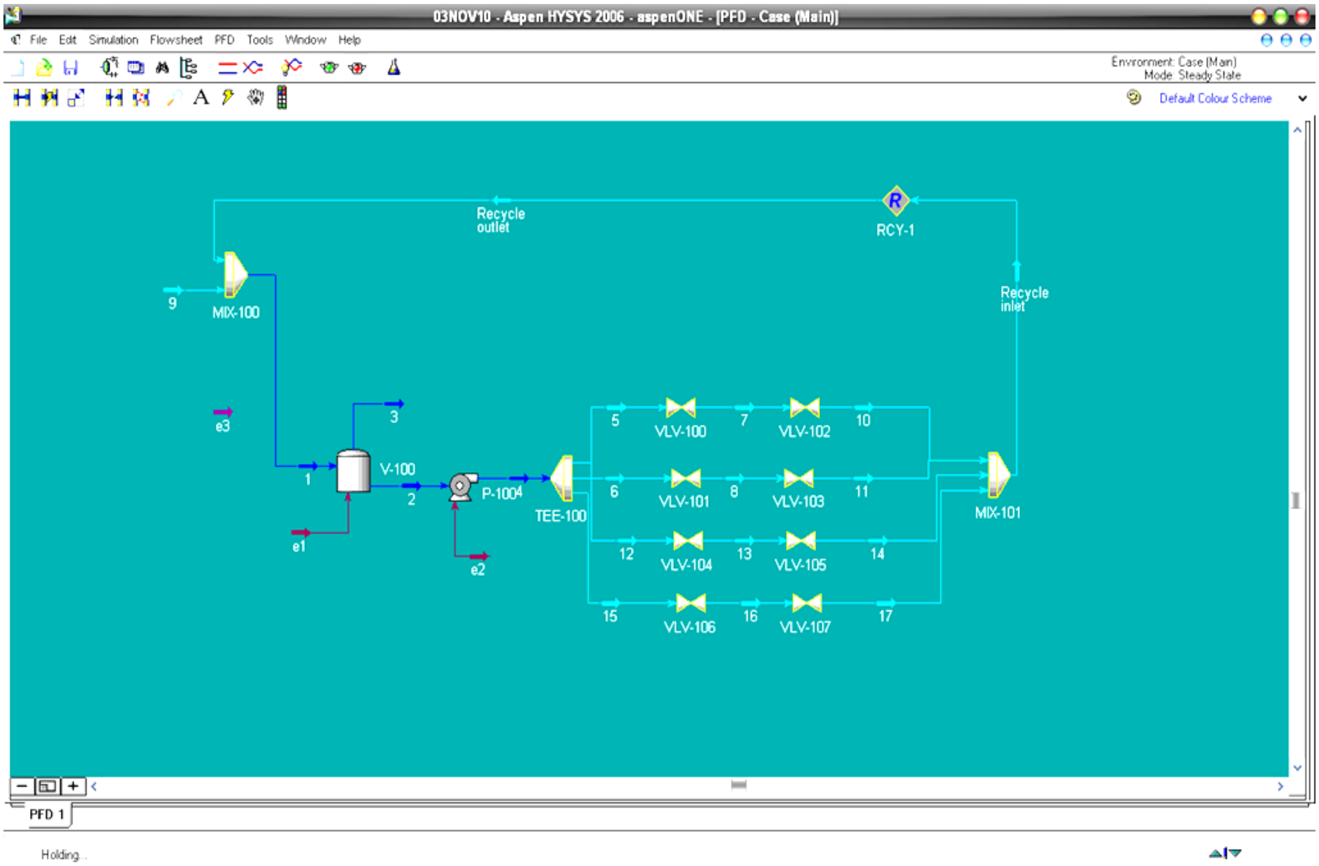


Figure 14: Simulation Design using HYSYS

From Figure 14, some labels indicate:

V-100: Tank

P-100[4]: Pump

MIX-100 and MIX-101: Mixer

VLV-100 and VLV-102: FISHER Valves

VLV-101 and VLV-103: MASONEILAN Valves

VLV-104 and VLV-105: METSO Valves

VLV-106 and VLV-107: ROTOK Valves

The temperature and pressure of each stream have been assumed to:

Temperature: 25°C

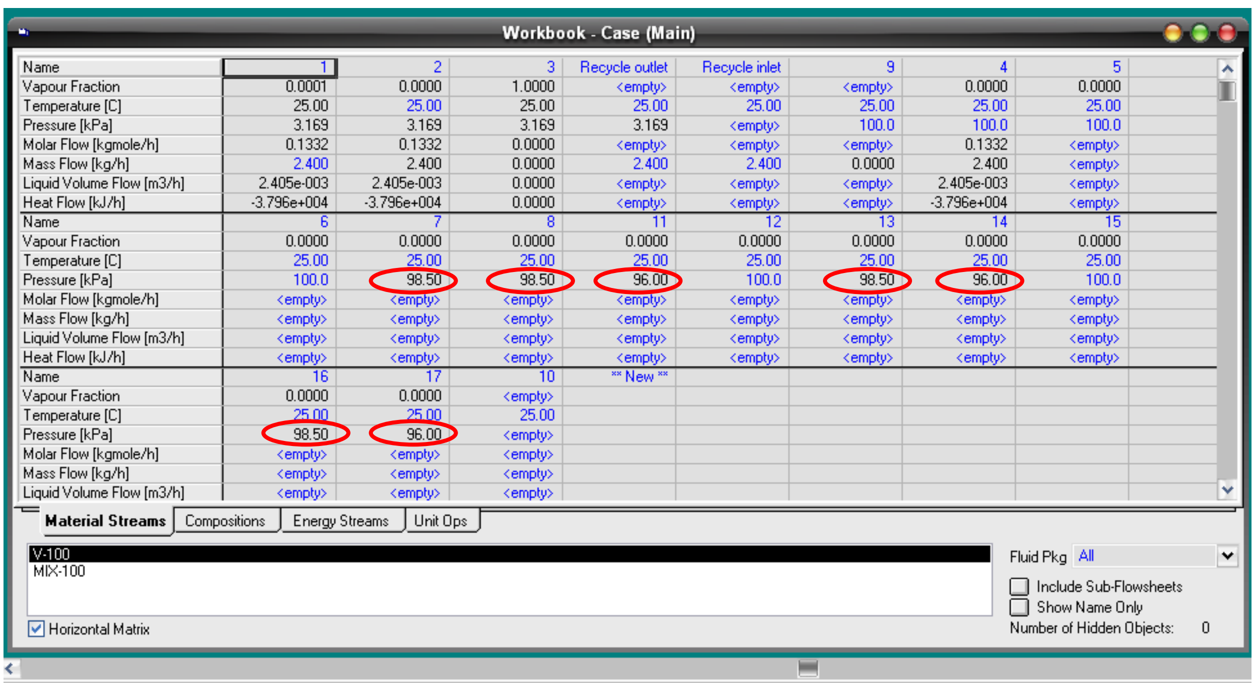
Pressure: 100 kPa

Each of the valves have different pressure drop according to size of Ball Valves and Butterfly Valves. Small size of the valve gives high pressure drop while big size of the valve gives low pressure drop.

When running the HYSYS, there is some pressure drop when these streams passes all the valves.

4.2.3 Simulation Result

The pressure drop of the valves can be proved in the figure below.



Name	1	2	3	Recycle outlet	Recycle inlet	9	4	5
Vapour Fraction	0.0001	0.0000	1.0000	<empty>	<empty>	<empty>	0.0000	0.0000
Temperature [C]	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Pressure [kPa]	3.169	3.169	3.169	3.169	<empty>	100.0	100.0	100.0
Molar Flow [kgmole/h]	0.1332	0.1332	0.0000	<empty>	<empty>	<empty>	0.1332	<empty>
Mass Flow [kg/h]	2.400	2.400	0.0000	2.400	2.400	0.0000	2.400	<empty>
Liquid Volume Flow [m3/h]	2.405e-003	2.405e-003	0.0000	<empty>	<empty>	<empty>	2.405e-003	<empty>
Heat Flow [kJ/h]	-3.796e+004	-3.796e+004	0.0000	<empty>	<empty>	<empty>	-3.796e+004	<empty>
Name	6	7	8	11	12	13	14	15
Vapour Fraction	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Temperature [C]	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Pressure [kPa]	100.0	98.50	98.50	96.00	100.0	98.50	96.00	100.0
Molar Flow [kgmole/h]	<empty>	<empty>	<empty>	<empty>	<empty>	<empty>	<empty>	<empty>
Mass Flow [kg/h]	<empty>	<empty>	<empty>	<empty>	<empty>	<empty>	<empty>	<empty>
Liquid Volume Flow [m3/h]	<empty>	<empty>	<empty>	<empty>	<empty>	<empty>	<empty>	<empty>
Heat Flow [kJ/h]	<empty>	<empty>	<empty>	<empty>	<empty>	<empty>	<empty>	<empty>
Name	16	17	10	** New **				
Vapour Fraction	0.0000	0.0000	<empty>					
Temperature [C]	25.00	25.00	25.00					
Pressure [kPa]	98.50	96.00	<empty>					
Molar Flow [kgmole/h]	<empty>	<empty>	<empty>					
Mass Flow [kg/h]	<empty>	<empty>	<empty>					
Liquid Volume Flow [m3/h]	<empty>	<empty>	<empty>					

Figure 15: Workbook of data

From the Figure 15, all the temperature has been assumed to 25°C while the pressure of the stream of the tank is about 3.169 kPa. However, we want the pressure streams that go to the inlet of the valves is 100 kPa. So the pump has been used to increase the pressure. The other value can be ignored since there are not affect the values of pressure.

When the stream passes through all the valves, the pressure drop of the valves has been showed. Bigger size of valves gives smaller pressure drop while smaller size of valves gives bigger pressure drop.

Stream 7,8,13, and 16 that passes bigger valves give lower pressure drop makes the pressure of these stream when passes the valves does not drop too much. While it is different with stream 11, 14, and 17 that passes smaller valves give higher pressure drop and the pressure of the process reduce to 96 kPa.

Based from sketch design, some modification and changes need to focus more. Instead of using small tank, bigger tank will be considered since it will give higher pressure than smaller tank. This can be proved by this calculation:

$$P = \rho\ h\ g\ RD$$

If h increases, P also will increase

Another modification that must be highlight about is the valves. From the sketch design (*refer to Figure 13*), there are many valves have been used including hand valves and control valves. All of these valves need to be reduce because more valves give more pressure drop. In this process, lesser pressure drop is better.

4.2.4 Procedure to run HYSYS

Starting with HYSYS

Before running any simulation of plant modeling in this software, the component and fluid package has been selected first. This had been started by creating a new simulation.

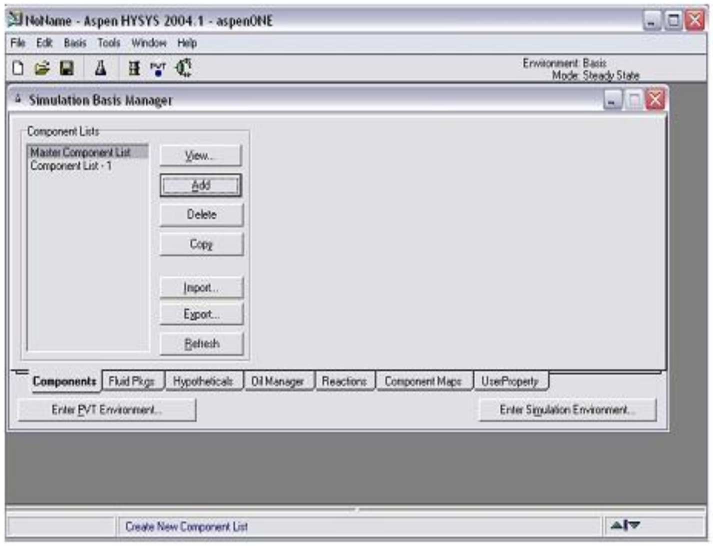


Figure 16: Creating new simulation

After that, the components added to the simulation and for this simulation, the component that has been used is water.

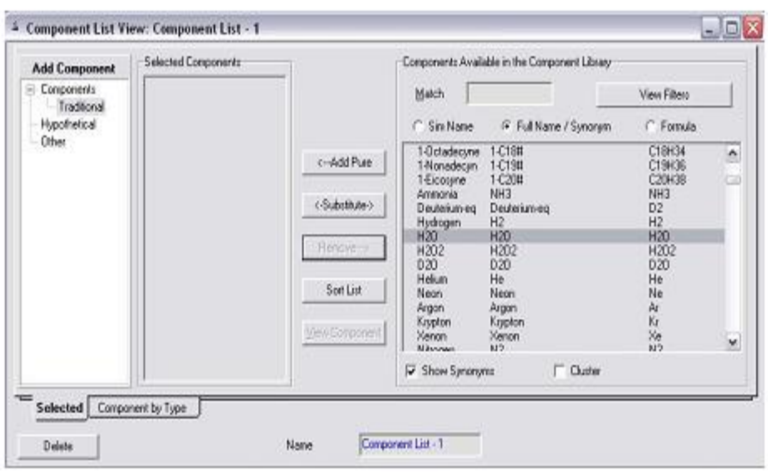


Figure 17: The component that been used

Simulation Environment

The fluid package of components hast been selected first before enter any simulation environment. The fluid package was used to calculate the fluid/thermodynamics properties of the components in the simulation. Since the component used is water, the fluid package properties that been selected are NRTL.

After that, the simulation environment was created.

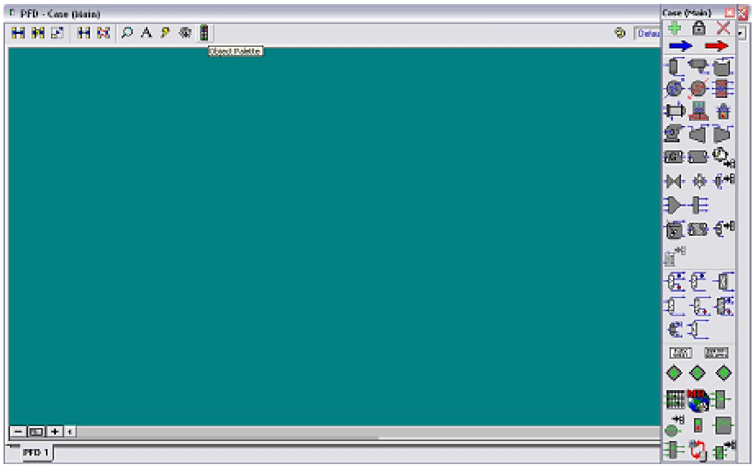


Figure 18: New simulation environment

Adding Material Stream

Material Stream was used to transport the material components from process units in the simulation. The information of each of the material stream has been added when double clicked on that stream. Figure 4 showed the list of information that need to fill for the stream.

Figure 19: List of information of stream

Running HYSYS

Once all the information has been entered, HYSYS calculated the remaining properties and data provided it has enough information from the rest of the flowsheet. Once a stream has enough information to be completely characterized, a green message bars will be appeared at the bottom of the window indicating that there was no error occur of the information. If there is an error, a yellow message will be appeared at the bottom of the window.

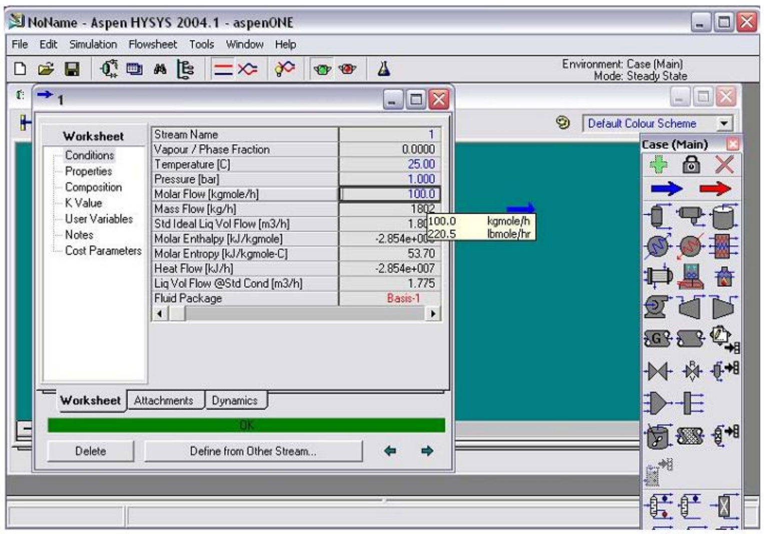


Figure 20: Complete information

Type of Valves

The valves that have been used in this simulation are FISHER Valves.

4.3 Procedure to Perform PST for FISHER Valve

1. Check instrument air supply to the valve is in open condition.
2. To start using the program.

   Select and double click on WideField2 Icon at PC desktop, to start using PLC program-WideField Software by Yokogawa
3. Select and click "Open Project" tab to open existing project file
4. Select folder "FISHER PST" and click open
5. Then, Select "FISHER" folder and click open
6. Select and double click on "Component Definition"

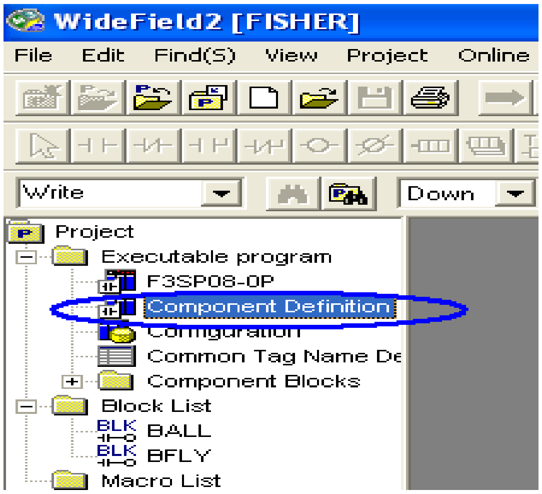


Figure 21: Component Definition

7. a) To test Fisher Ball Valve:

   - Select "BALL" from "Block List", click "Select" (which will appear under "Block Name") and then click "OK"

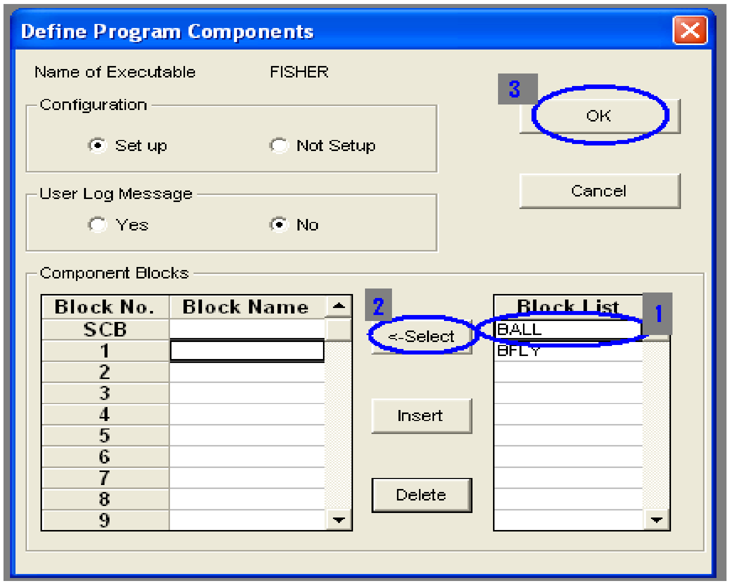


Figure 22: Ball Valve Selection

b) To test Fisher Butterfly Valve:

- Select “BFLY” from “Block List”, click “Select” (which will appear under “Block Name”) and then click “OK”

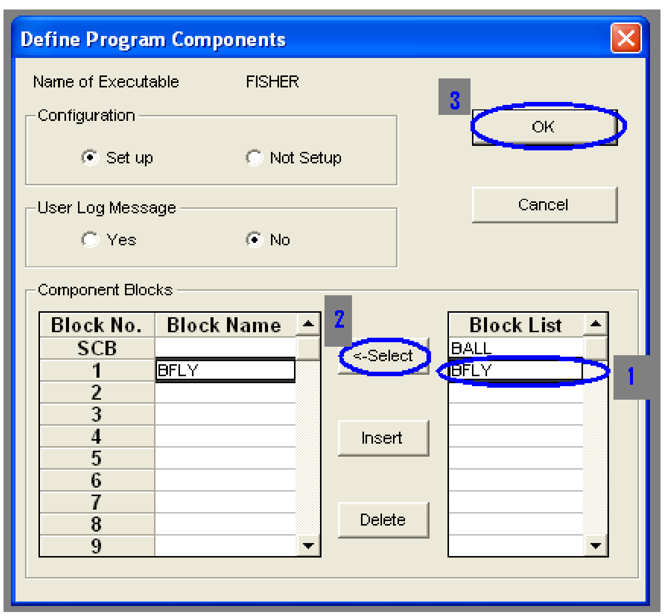


Figure 23: Butterfly Valve Selection

8. To download project file. Go to “Online”, select “Download” and click on “Project”
9. The following prompt will appear and select “YES” and next prompt also select “YES”
10. Next, to start program monitor. Go to “Online” and select “Program Monitor”.

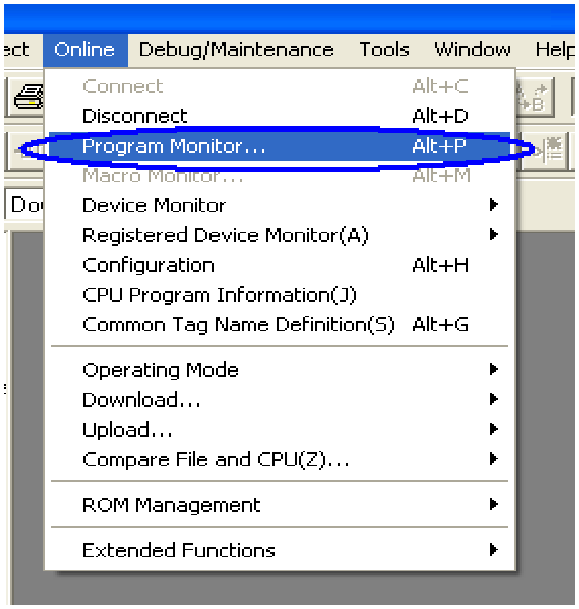


Figure 24: Program Monitor

11. Next, the following block will appear.

a) For testing of Ball Valve: Double click on "BALL" to upload the ladder diagram.

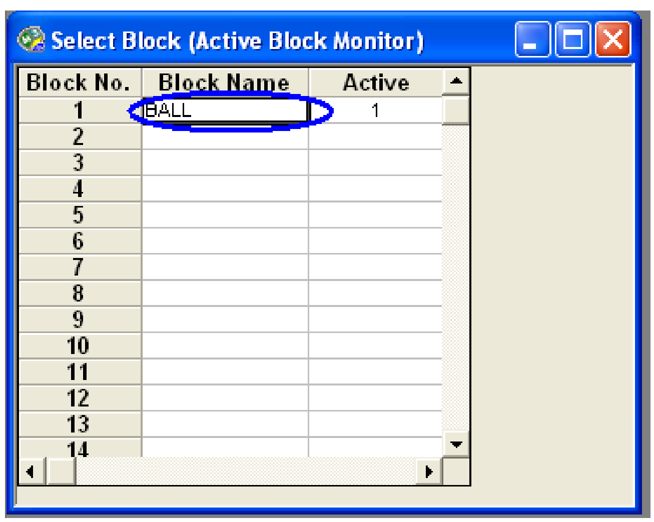


Figure 25: Ball Valve Test

b) For testing of Butterfly valve: Double click on "BFLY" to upload the ladder diagram.

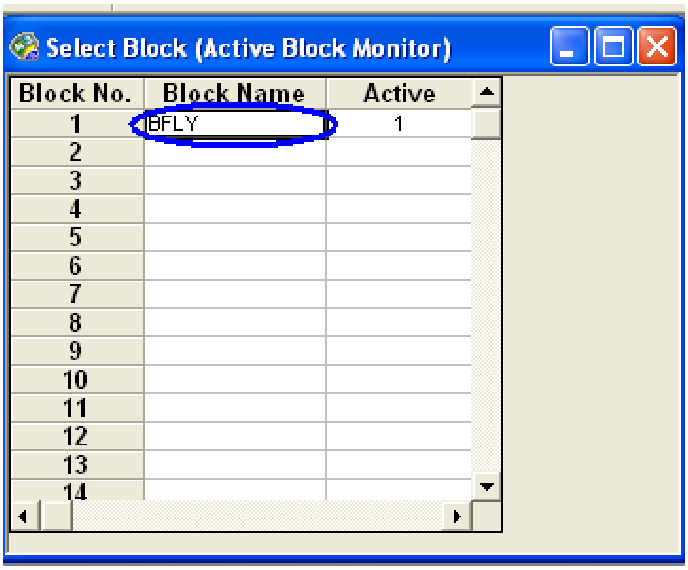


Figure 26: Butterfly Valve Test

12. Upon successful uploading the ladder diagram will be displayed.

<u>For Ball Valve as follows:</u>

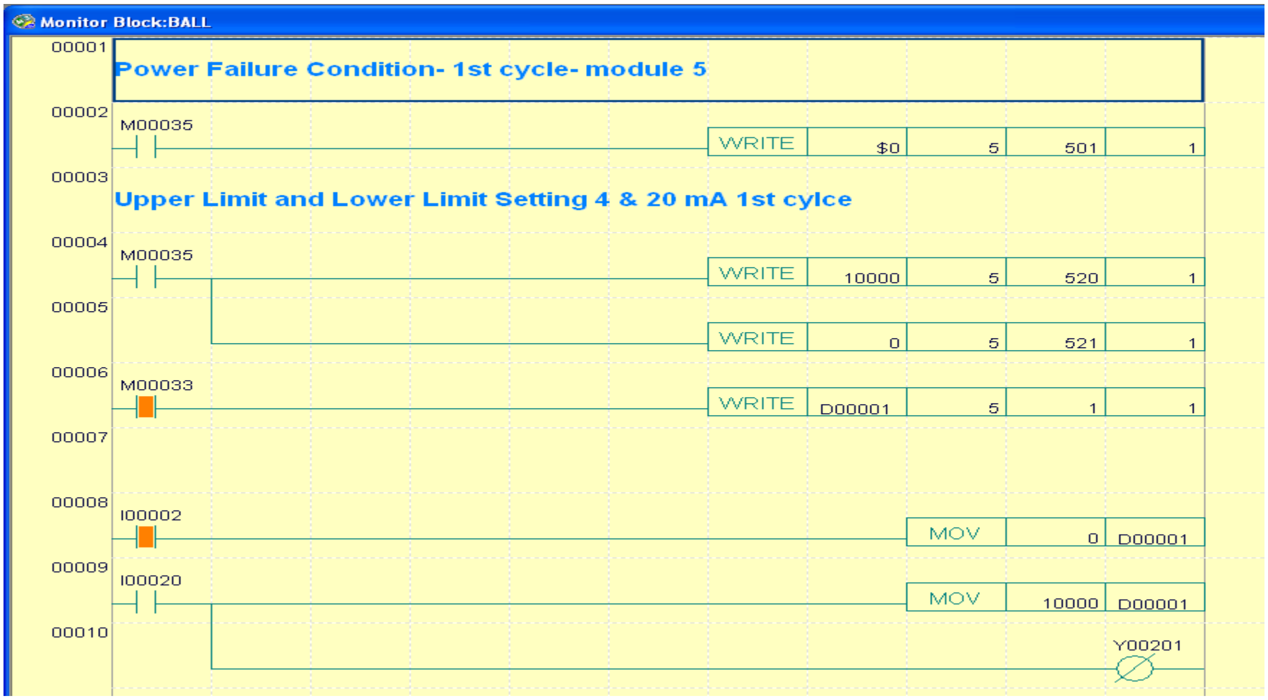


Figure 27: Ball Valve Ladder Diagram

For Butterfly Valve as follows:

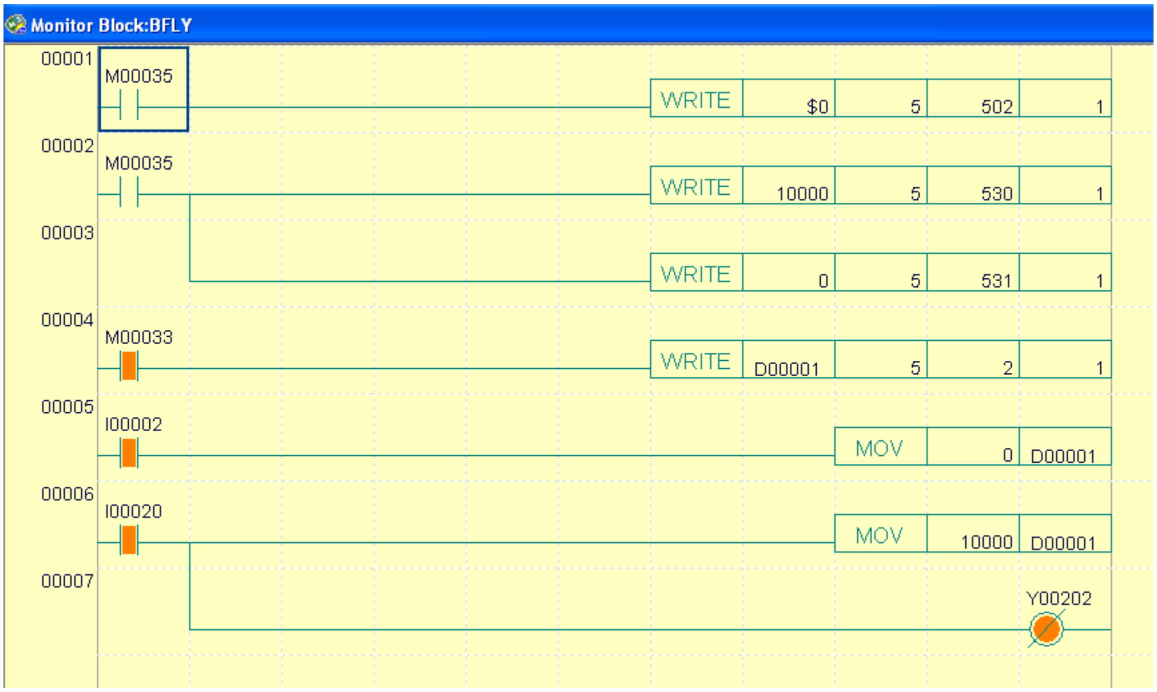


Figure 28: Butterfly Valve Ladder Diagram

13. Ensure M00033 and I00002 are forced set. The symbol for set and reset is as follows:

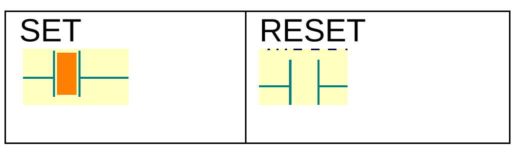


Figure 29: Set and Reset Symbols

14. To do full stroke testing click on I00020. Then, select “Forced Set” to initiate closure of valve.

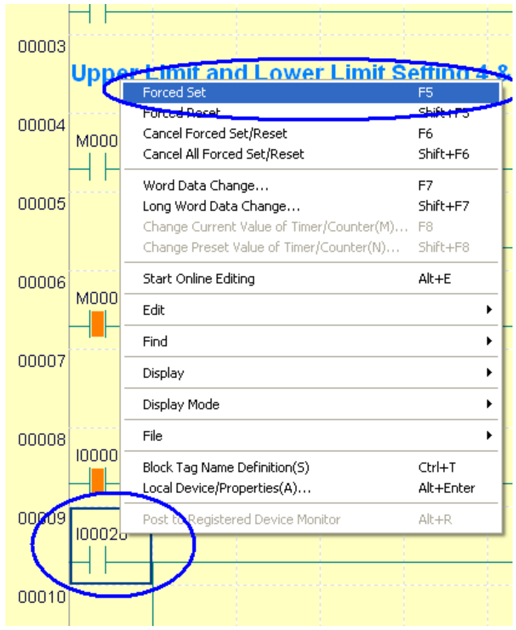


Figure 30: Forced Set Selection

15. For Partial Stroke Testing, initiate opening of the valve by clicking on I00020. Then, select "Forced Reset" to initiate opening of valve.

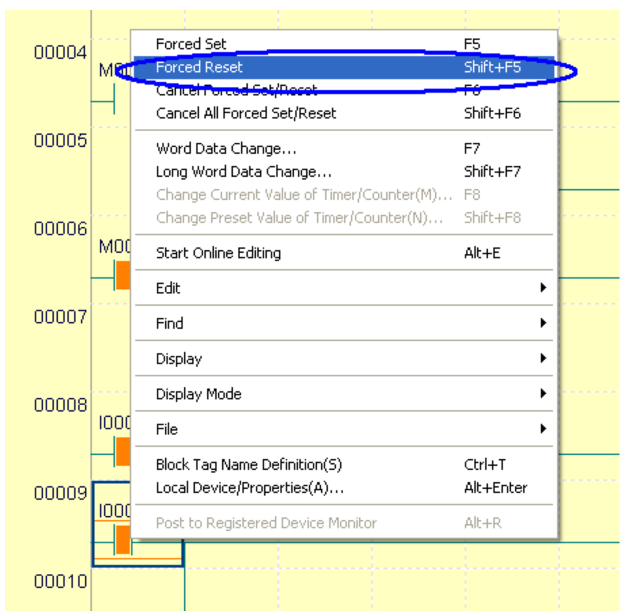


Figure 31: Forced Reset Selection

16. The valve should be in open condition (Forced Reset)

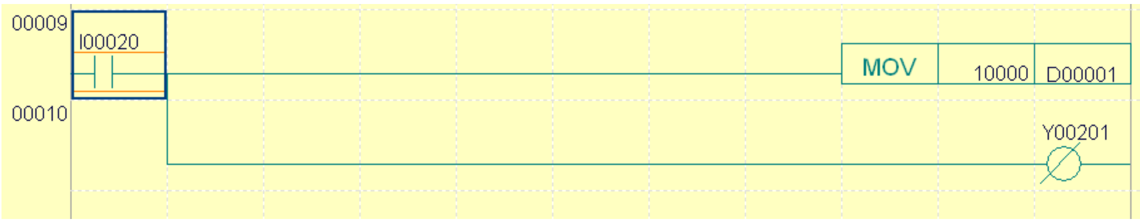


Figure 32: Forced Reset Open Condition

17. Then proceed to open Valvelink Software. To start using the program, select and double click on “ValveLink” Icon. Enter following details:

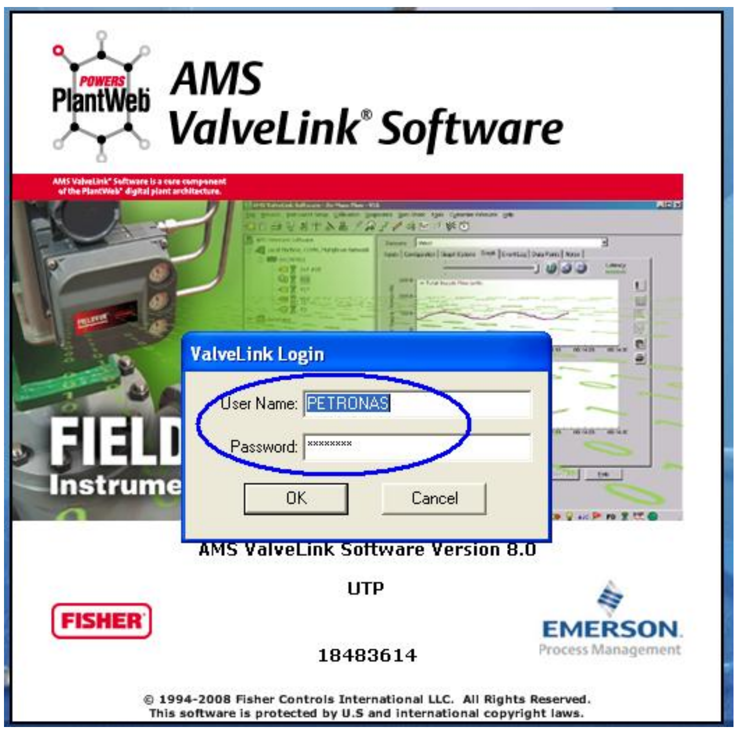


Figure 33: Username and Password

18. The software layout will be as follows:

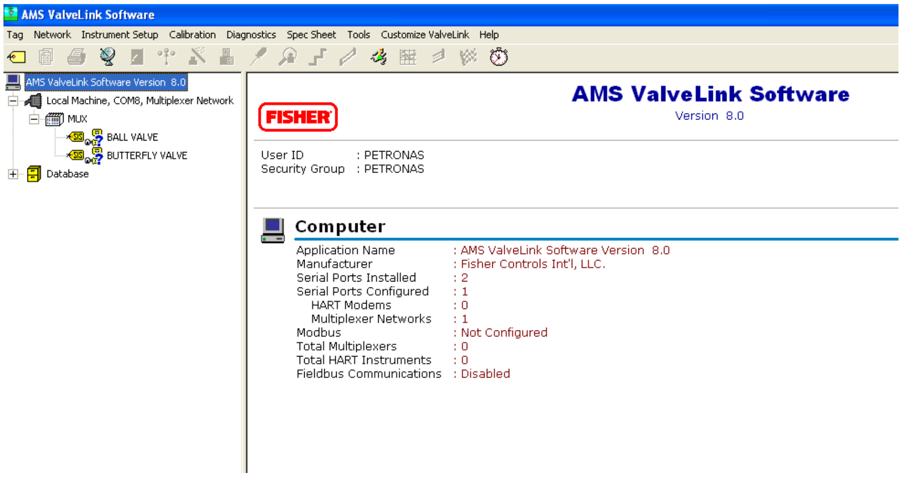


Figure 34: Valvelink Software Layout

19. Double click on the chosen valve to run the PST.

<u>For Ball Valve as follows:</u>

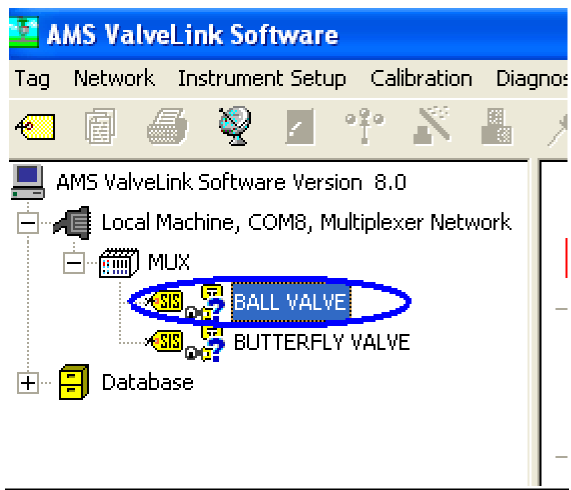


Figure 35: Ball Valve Selection

For Butterfly Valve as follows:

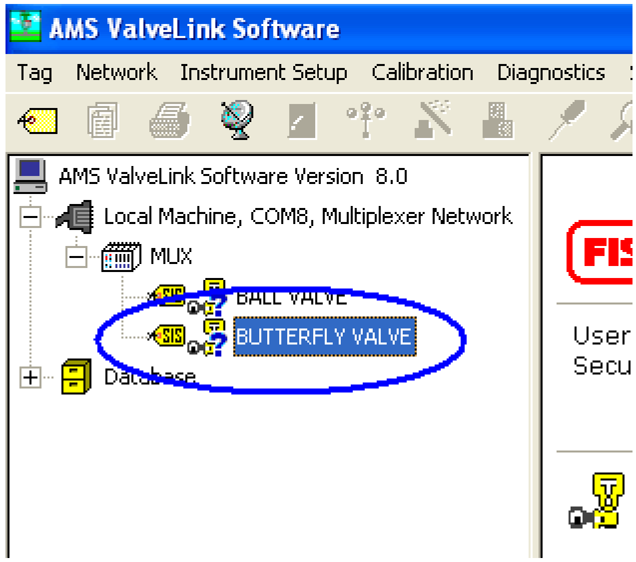


Figure 36: Butterfly Valve Selection

20. At Status page, tick on "Auto stop after Next Complete Read". Then, click on "Start Monitoring",

21. Program will start to monitor valve condition at site. Wait until data is displayed and "Save Dataset" tab is enabled as follows. Click "Save Dataset" tab to save the data.

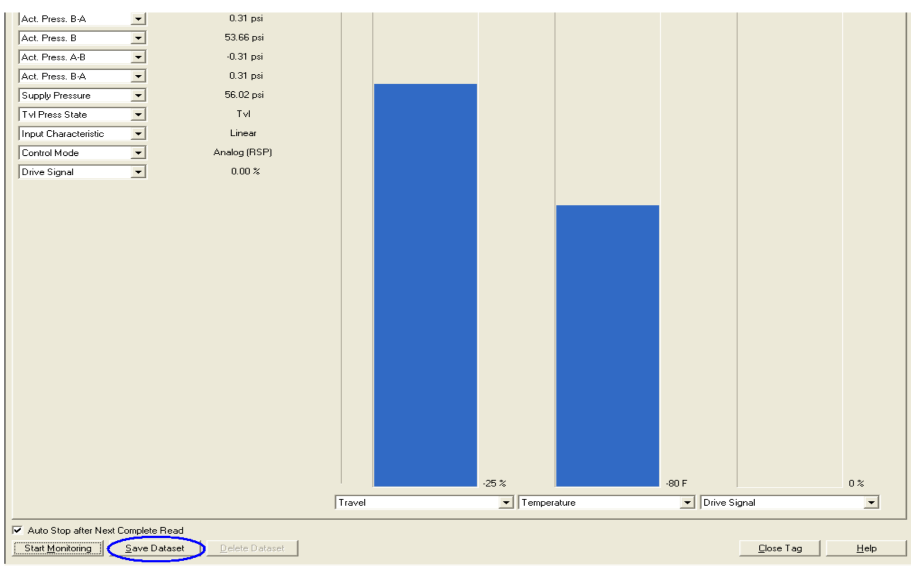


Figure 37: Status Page

22. Next, to start Partial Stroke Testing Diagnostic, click Partial Stroke Ramp icon

23. All the parameters have been set. These parameters need to be set only once. Next, click "Run Diagnostic".

24. The Partial Stroke Testing progress window will be as follows:

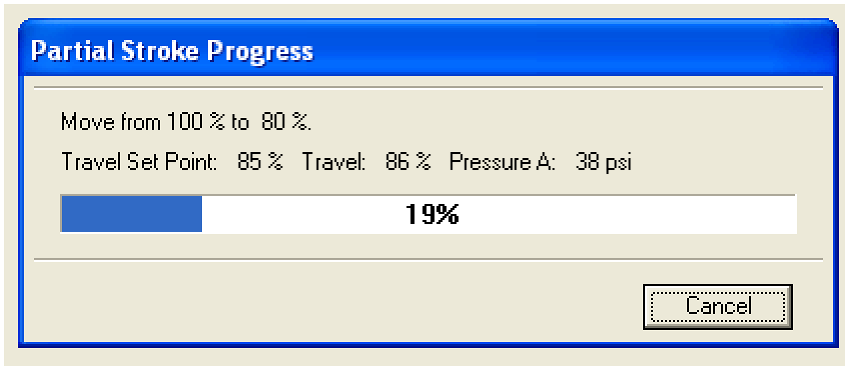


Figure 38: PST progress window

25. Upon completion of testing. Select Analyzed tab. The data record will be shown as follows:

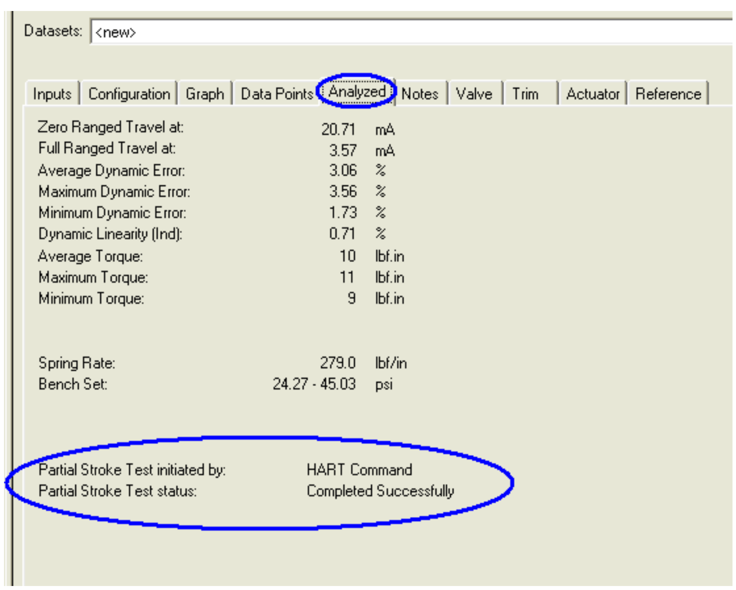


Figure 39: Data Record

26. Next, select Graph tab. The Valve Signature will be shown as follows:

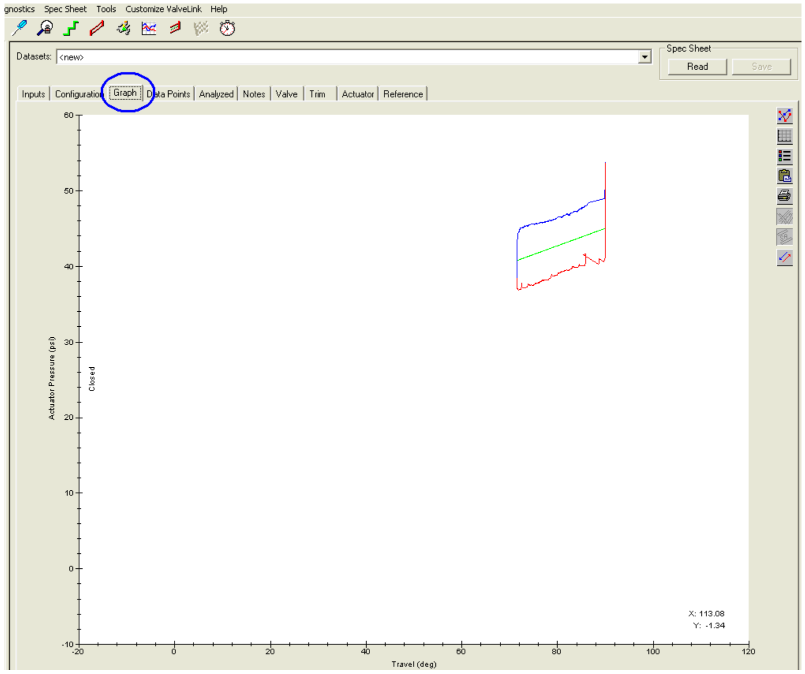


Figure 40: Valve Signature

27. Save dataset and run diagnostic again to repeat PST and review new data set.
28. To perform FST while PST being run. Initiate FST from WideField when the travel reached 90% by initiating “Forced Set” the I00020.
29. The valve should go to full close position and Partial Stroke Testing should abort.
30. To generate report: Select “Tag”, “Reports” and “Custom Reports”
31. Select the applicable valve and selected tag for report to be generated. Example: Select “Butterfly Valve” under “Tags Found” and Select tag “Partial Stroke”. Then, click “ADD”
32. Then click generate report.
33. Option pop-up will appear. Choose where to save the generate report. Then click “OK”.

4.4 Example Result of Partial Stroke Test

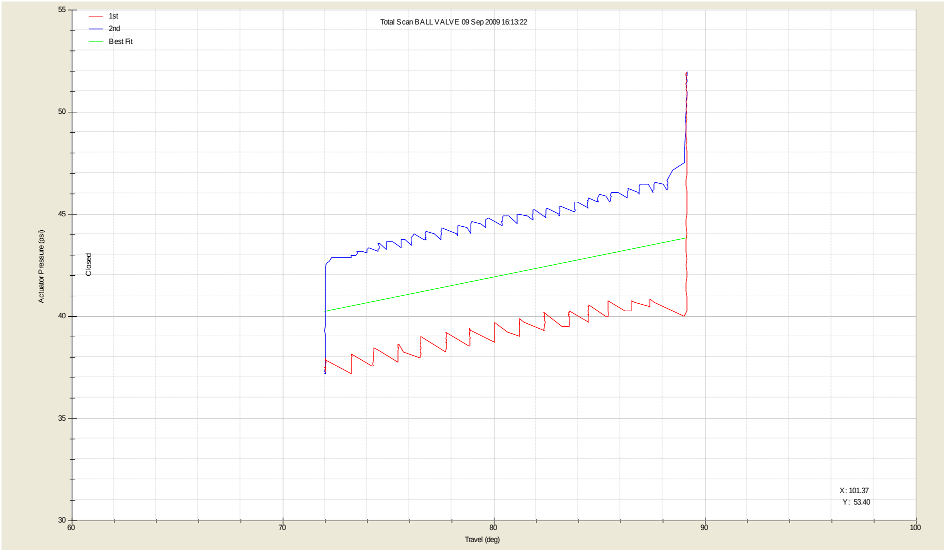


Figure 41: Ball Valve Signature of Partial Stroke Test

4.5 Example Result of Full Stroke Test

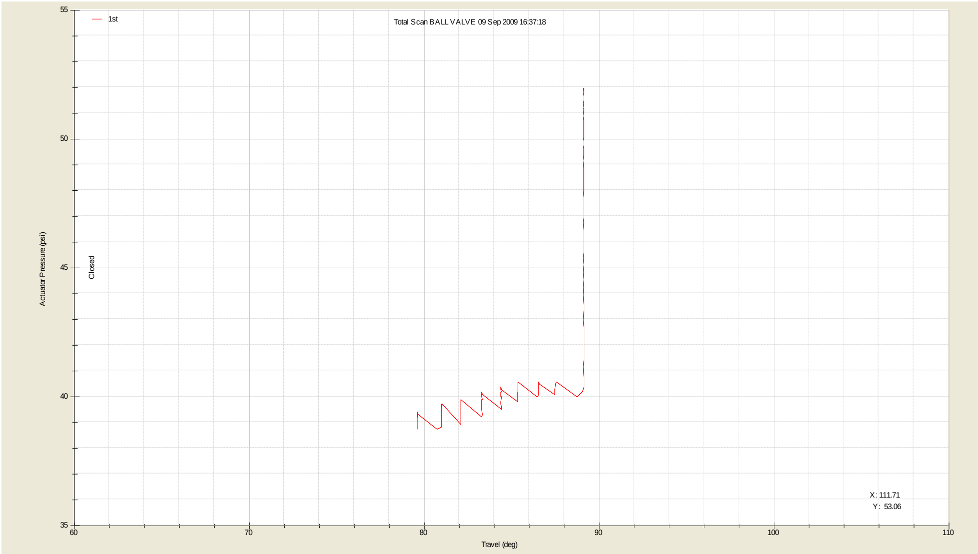


Figure 42: Ball Valve Signature of Full Stroke Test

4.6 Expected Result of Partial Stroke Test and Override by Full Stroke Test

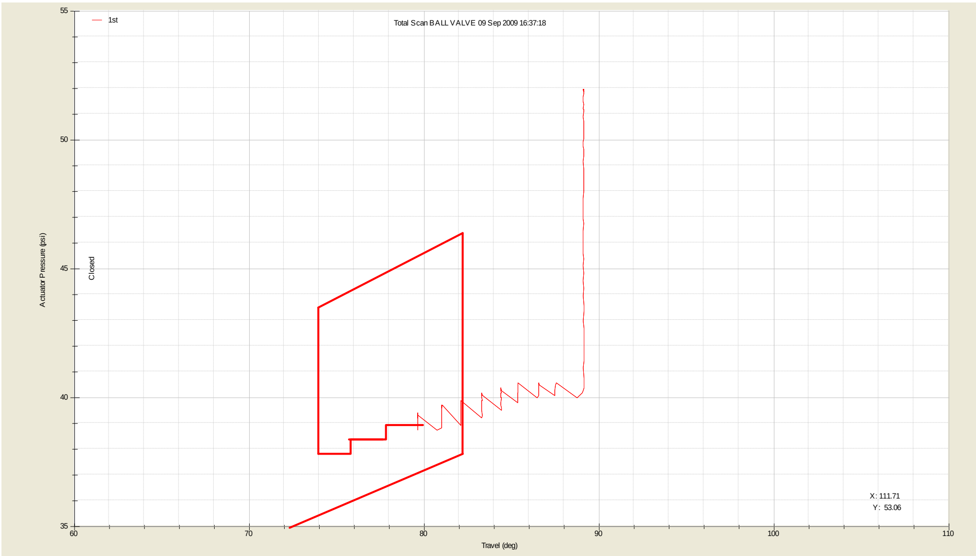


Figure 43: Ball Valve Signature of Partial Stroke Test with Full Stroke Test

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

As a conclusion, a justification of the previous design using a simulation by HYSYS Software had been done. It was produced some data which is the pressure drop when all the stream passes through all the valves.

From this project, some differences can be seen between the valve vendors. FISHER has advantage of detail analysis of the data captured in HYSYS Software. The procedure of using WinField2 and ValveLink Software is more easily compared to other software.

Partial Stroke Testing (PST) is a good platform to enhance the knowledge and understanding in control system and PLC implementation. This project can compare the performance of PST of different vendors in order to come out with a confirmation on which vendor’s system is reliable to be used. . It is very useful for the PETRONAS to adopt PST strategy in their plant nationwide.

The development of the Programmable Logic Controller as a controller for PST is expected to reduce the Performance Failure Demand and enhance the plant reliability.

This project has the purpose for PETRONAS to evaluate and compare the performance of PST reliability between the different vendors which are FISHER, METSO, MASONEILAN and ROTARK, as well as verifying the capability of the valves and the software as claimed by the vendors.

5.2 Recommendation

There are some recommendations in order to improve on this project in term of efficiency, data analysis, performance as well as the presentation.

5.2.1 Recommendations of the HYSYS design

- Use bigger tank size to get high pressure so that, the pressure will be enough for the valves and for each of the streams in the process.
- Reduce the valves to avoid more pressure drop in the process.

5.2.1 Recommendation of PST

- Release pressure if the pressure getting high and over the pressure limit.
- Reduce the length of pipe to avoid too much pressure loss in the process.

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