

Introduction

1. Background

Main pumping stations which supply water to the distribution system will be located near the water treatment facility or a potable water storage facility and will pump directly into the piping system. These pump stations may be a part of these other structures. Pumps which pump directly into transmission lines and distribution systems are sometimes called high lift pumps. Booster pumps may be located anywhere in the system to increase the pressure in the pipeline. Booster pump stations are usually located remote from the main pump station, as in hilly topography, where pressure zones are required. These pumps may be needed to handle peak flows in a distribution system which can otherwise handle the normal flow requirements [13]. Where a pump station is added to an existing installation, previous planning and design, which is based upon a total system hydraulic analysis should be consulted before the addition is designed. New or updated studies will determine station location and present and future demand requirements. Locating permanent pumps so that there will be a positive head on pump suctions will eliminate many operational problems. Site selection will be determined from evaluation of a topographic survey and flood plain analysis to determine if there are any flooding probabilities of the proposed plant site. The site must not be subject to flooding. Major planning factors are: availability of electric power, roadway access for maintenance and operation purposes, security, and adverse impact, if any, upon surrounding occupancies. Site development will depend upon a site soils analysis showing adequate support for foundations or possible ground water problems, and a grading and drainage plan of the area showing that runoff away from the structures can be obtained.

All stations shall contain at least two pumps, being a duty pump and a standby (backup) pump. Duty pump(s) shall be sized to deliver up to the maximum design demand. The standby pump is programmed to operate in the event that the duty pump fails is unavailable.

Society in its daily Endeavor's has become so dependent on automation that it is difficult to imagine life without automation engineering. Automation Engineering is a cross sectional discipline that requires proportional knowledge in Hardware and software development and their applications. In the past, automation Engineering was mainly understood as control engineering dealing with a number of electrical and electronic components. This picture has changed since computers and software have made their way into every component and element of Communications and automation.

The project managers of industrial Automation projects have significant resource constraint, considering the ever changing demands of its management, trying to adopt the rapid acceleration of the Technological changes and simultaneously trying to maintain the reliability and Unbreakable security of the plant and its instruments.

1.1 Problem statement

The traditional method used to run the plant in ALSAHAFA do not normally include any automatic control where the level of the tank observed by human operator and it is clear that such control and monitoring is not an optimum and always exposed to faults, therefore a smart autonomous control system is needed.

1.2 Proposed solution

To carry out the pre mentioned problem and find the best solution, different sensors such as level sensor ,flow meter and pressure sensor can be utilized to

measure the related data ,feed it back to monitor station (HMI) and take relevant control actions at the same time without human intervention.

1.3 Methodology

The pumping station will be controlled via inlet flow and tank's water level. The plant will be operated fully automatic through Programmable Logic Controller (PLC) which will be integrated to Engineering Work Station and Operator Work Station and proof module to communicate with the Future Remote SCADA system in the head quarter (ELMOGRAN).

The design of the hardware part will include drawings of the components. The design of the software part will be done by writing the soft logic program. In addition, some components like sensors, relays, push button switch and so on will be chosen. All design processes will include drawings and calculations and the proper components will be chosen according to standard specifications.

The simulation will be made using the technology of SCADA "WINCC Flexible2008"[4] and the (soft logic program) will be written in the form of a ladder diagram using "SIMATIC Manager step 7- 300". [8]

1.4 Objectives

1. General objectives:

The objective of this project is to design and simulate a simple, easy system to monitor and control the values of level, inlet flow, valve and pumps operation that are consciously observed and controlled to achieved an optimum operation manner with latest technology software.

2. Specific objectives:

- ✓ Minimize waste production and man power.
- ✓ Maximizing overall production rate.
- ✓ Efficient usage of energy.

- ✓ Improved safety in working condition.

1.5 Research Outline:

This research will be divided in to six chapters to provide the understanding of the whole research.

Chapter One:

Introduction to water pumping station and the types of the pumps. This chapter also explains the research objectives and methodology and discusses the problem statement.

Chapter Two:

Describe the literature review that has been studied to get information to complete the research. This study is focused especially on the concepts of process control and automation.

PLC and SCADA Architecture and languages also explained in this chapter.

Chapter Three:

Covers the simulation hardware devices, Siemens s7-300 and WINCC flexible 2008.

Chapter Four:

Covers up all the research software and system configurations.

Chapter Five:

Explains the results and discussions of the research.

Chapter Six:

Conclusion and recommendation of the research for the future development or system modification.

2. Introduction:

This Research is designed to fulfill the requirements of the industry application (full control of Al-SAHAFa pumping station with the below data:

- ✓ The operational capacity of the plant 5 pumps, one is standby [13].
- ✓ The design capacity of the pump 650 m³ / h at a pressure of 4bar.
- ✓ Storage tank capacity of $2 * (40 * 40 * 4) \text{ m}^3 = 12800 \text{ m}^3$.

Average productivity of the station:

- ✓ 88000 m³ / day at an average pressure of 3.4 bars.
- ✓ 3600 m³ / h at an average pressure of 3.4 bar

The research mainly consists of parameters monitoring, parameters storage and the HMI interface, which is one of the main features of the research in which various data like value of parameters, data and time are sent to it, also We used Programmable logic controller (PLC) as a main component of the research.

The pumping station efficiency depend significantly on finding optimum operation condition for the pumps to achieve high performance at low cost ,good quality and low power consumptions. To carry out these goals, continuous monitoring and control of these important parameters such pump status, level and pressure over rising are needed.

Proper control of plant operation is critical in pumping station (Al-SAHAFa), where high pressure and over flow of the tank are Ideal for crises to develop.

2.1 Control System:

A control system is a device or set of structures designed to manage, command, direct, or regulate the behavior of other devices or systems [15]. The entire control system can be viewed as a multivariable process that has a number of inputs and outputs that can affect the behavior of the process. Figure 2.1 shows this functional

view of control systems. This section is intended as a brief introduction to control systems.

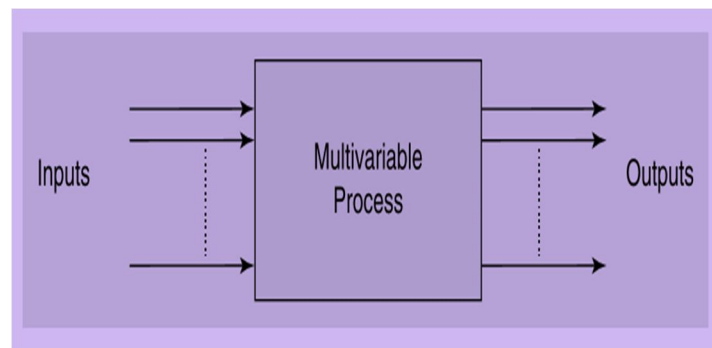


Figure 2.1 Control systems functional view

2.1.1 The Process:

In the industrial world, the word process refers to an interacting set of operations that lead to the manufacture or development of some product. In each use, and in all other cases in the process industries, the end product must have certain specified properties that depend on the conditions of the reactions and operations that produce them. The word control is used to describe the steps necessary to ensure that the regulated conditions produce the correct properties in the product.

To produce a product with the specified properties, some or all the process variables must be maintained at specific values in real time. Figure 2.2 shows free water flow through a tank. The tank acts in a way to slow the flow rate through the piping structure. The output flow rate is proportional to the water head in the tank. Water level inside the tank will rise as the input flow rate increases. At the same time, output flow rate will increase with a noticeable increase in the tank water level. Assuming a large enough tank, level stability will be reached when the flow in is equal to the flow out. This simple process has three primary variables: FLOW IN, FLOW OUT, and the tank level. All three variables can be measured and, if desired, also can be controlled. The tank level is said to be a self-regulated variable.

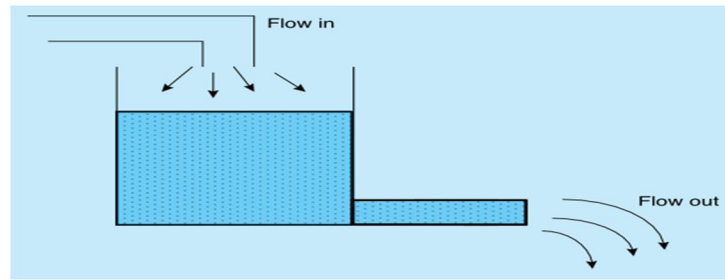


Figure 2.2 Water flow tank process.

2.1.2 Manual Control Operation:

In a manual control system, humans are involved in monitoring the process and carrying out necessary decisions to bring about desired changes in the process. As shown in Fig. 2.3, humans close the control loop and establish the connection between measured values, desired conditions, and the needed activation of the final control elements.

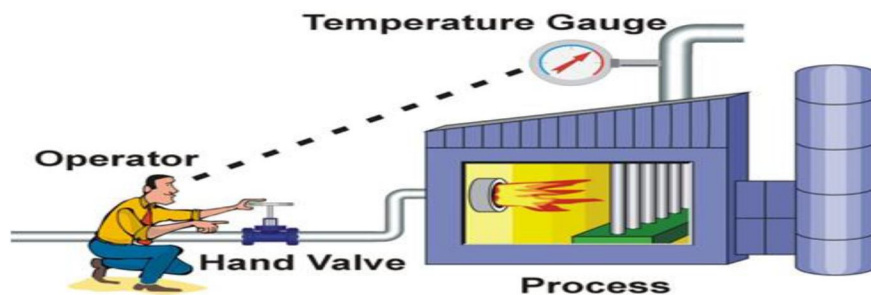


Figure 2.3 Manual control systems

Manual control is widely available and can be effective for simple and small applications. The initial cost of such systems might be relatively smaller than that of automated ones, but the long-term cost is typically much higher. It is difficult for operators to achieve the same control/quality because of varying levels of domain expertise as well as unexpected changes in the process. Most systems start by using manual control or existed previously with manual operation. System owners acquire and accumulate process-control experience over time and use this knowledge eventually to make process improvements and eventually automate the control system. A real-time system is one in which the correctness of a result

depends not only on the logical correctness of the calculation but also on the time at which the different tasks are executed.

2.1.3 AUTOMATION:

Automation is basically the delegation of human control function to technical equipment aimed towards achieving: [11].

- ✓ Higher productivity.
- ✓ Superior quality of end product.
- ✓ Efficient usage of energy and raw materials.
- ✓ Improved safety in working conditions etc.

1. TYPES OF AUTOMATION:

- ✓ Building automation
 - ✓ Office automation
 - ✓ Scientific automation
- ✓ Industrial and Light automation

2. INDUSTRIAL AUTOMATION:

- ✓ The use of computerized or robotic devices to complete manufacturing tasks.

2.1.4 Automated System Building Blocks

The closed control loop shown in Fig. 2.5 consists of the following five blocks:

- ✓ Process
- ✓ Measurement
- ✓ Error detector
- ✓ Controller and Control element

In manual control, the operator is expected to perform the task of error detection

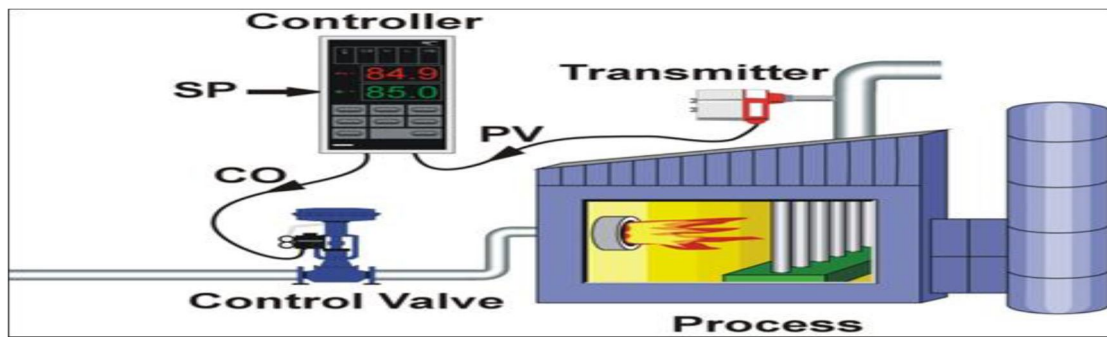


Figure 2.4 Closed-loop controls

And control. Observations and actions taken by operators can lack both consistencies and reliability.

The limitations of manual control can be eliminated through the implementation of closed-loop systems and the associated process-control strategies. Figure 2.5 shows a block diagram of a single-variable closed-loop control. The controller can be implemented using variety of technologies, including hardwired relay circuits, digital computers, and more often PLC systems. It is impossible to achieve perfect control, but in the real world, it is not needed. We can always live with small errors within our acceptable quality range. Errors in real time are used to judge the quality of the system design and its associated controller. The errors can be measured in three ways, as explained by the following definitions:

Absolute error = set point – measured value

Error as percent of set point = absolute error/set point $\times$ 100

Error as percent of range = absolute error/range $\times$ 100

Range = maximum value – minimum value

A PLC analog input module having several input slots can accommodate and process level, temperature, pressure, motor speed, viscosity, and many other measurements in exactly the same way. Later chapters will detail the PLC and SCADA hardware and software as applied to real-world industrial control applications.

2.2 The PLC

Programmable logic controllers (Figure 2.5) are now the most widely used industrial process control technology.[1].

A programmable logic controller, PLC, or programmable controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many machines, in many industries. PLCs are designed for multiple arrangements of digital and analog inputs and outputs, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery-backed-up or non-volatile memory. A PLC is an example of a "hard" real-time system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result.

Initially the PLC was used to replace relay logic, but its ever-increasing range of functions means that it is found in many and more complex applications. Because the structure of a PLC is based on the same principles as those employed in computer architecture, it is capable not only of performing relay switching tasks but also of performing other applications such as timing, counting, calculating, comparing, and the processing of analog signals.



Figure 2.5 Programmable logic controller.

Programmable controllers offer several advantages over a conventional relay type of control [2]. Relays have to be hardwired to perform a specific function. When the system requirements change, the relay wiring has to be changed or modified. In extreme cases, such as in the auto Industry, complete control panels had to be replaced since it was not economically feasible to rewire the old panels with each model changeover. The programmable controller has eliminated much of the hardwiring associated with conventional Relay control circuits (Figure 2.6).

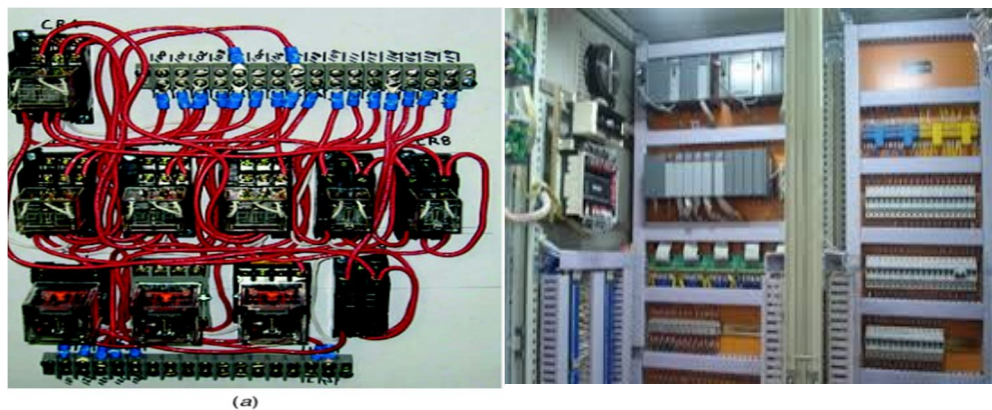


Figure 2.6 Relay- and PLC-based control panels. (a) Relay-based control panel. (b) PLC-based control panel. Source:

It is small and inexpensive compared to equivalent relay-based process control systems. Modern control systems still include relays, but these are rarely used for logic.

In addition to cost savings, PLCs provide many other benefits:

Increased Reliability: Once a program has been written and tested, it can be easily own loaded to other PLCs.

More Flexibility it is easier to create and change a program in a PLC than to wire and rewire a circuit. With a PLC the relationships between the inputs and outputs are determined by the user program instead of the manner in which they are interconnected (Figure 2.8).

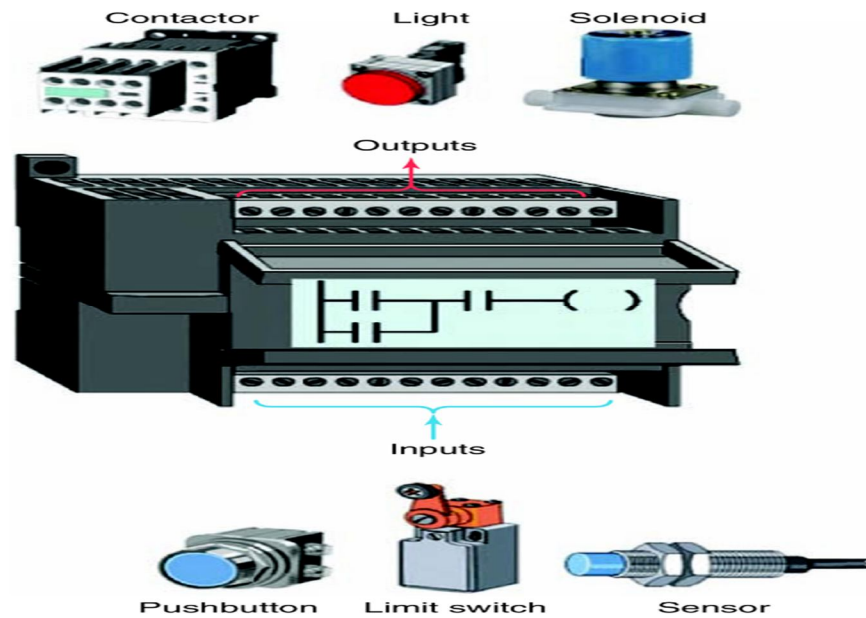


Figure 2.7 Relationships between the inputs and outputs are determined by the user program.

Original equipment manufacturers can provide system updates by simply sending out a new program. End users can modify the program in the field, or if desired, security can be provided by hardware features such as key locks and by software passwords.

Communication capability: A PLC can communicate with other controllers or computer equipment to perform such functions as supervisory control, data gathering, monitoring devices and process parameters, and download and upload of programs.

To find and fix problems, users can display the control program on a monitor and watch it in real time as it executes (Figure 2.9).

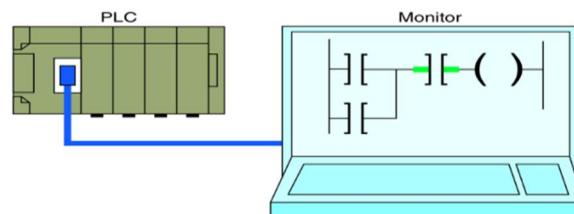


Figure 2.8 Control program can be displayed on a monitor in real time

2.2.1 PLC Architecture:

A typical PLC can be divided into parts, they are the central processing unit (CPU), the input/output (I/O) section the power supply, and the programming device. The term architecture can refer to PLC hardware, to PLC software, or to a combination of both. An open architecture design allows the system to be connected easily to devices and programs made by other manufacturers. Open architectures use off-the-shelf components that conform to approved standards. A system with a closed architecture is one whose design is proprietary, making it more difficult to connect to other systems [3].

Modular I/O is divided by compartments into which separate modules can be plugged. This feature greatly increases your options and the unit's flexibility.

You can choose from the modules available from the manufacturer and mix them any way you desire. The basic modular controller consists of a rack, power supply, processor module (CPU), input/output (I/O modules), and an operator interface for programming and monitoring. The modules plug into a rack. When a module is slid into the rack, it makes an electrical connection with a series of contacts called the backplane, located at the rear of the rack.

The PLC processor is also connected to the backplane and can communicate with all the modules in the rack. The power supply supplies DC power to other modules that plug into the rack. For large PLC systems, this power supply does not normally supply power to the field devices. With larger systems, power to field devices is provided by external alternating current (AC) or direct current (DC) supplies. For some small micro PLC systems, the power supply may be used to power field devices.

The I/O system forms the interface by which field devices are connected to the controller (Figure 2.16). The purpose of this interface is to condition the various signals received from or sent to external field devices. Input devices such as pushbuttons, limit switches, and sensors are hardwired to the input terminals. Output devices such as small motors, motor starters, solenoid valves, and indicator lights are hardwired to the output terminals. To electrically isolate the internal components from the input and output terminals, PLCs commonly employ an optical isolator, which uses light to couple the circuits together.

The external devices are also referred to as “field” or “real-world” inputs and outputs. The terms field or real world are used to distinguish actual external devices that exist and must be physically wired from the internal user program that duplicates the function of relays, timers, and counters.

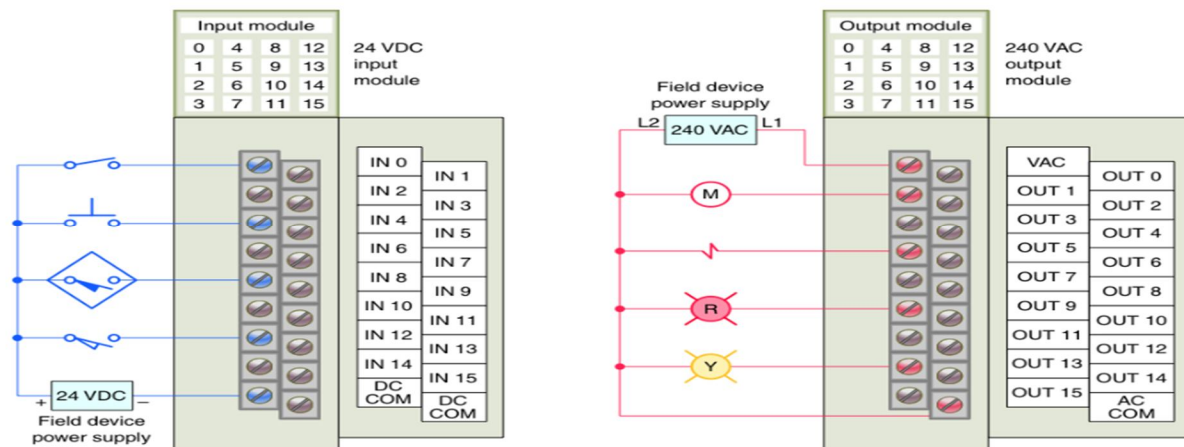


Figure 2.9 Typical PLC input/output (I/O) system connections

2.2.2 Program Scan

When a PLC executes a program, it must know in real time when external devices controlling a process are changing. During each operating cycle, the processor reads all the inputs, takes these values, and energizes or de-energizes the outputs according to the user program [19].

This process is known as a program scan cycle. Figure 2.7 illustrates a single PLC operating cycle consisting of the input scan, program scan, output scan, and housekeeping duties. Because the inputs can change at any time, it constantly repeats this cycle as long as the PLC is in the RUN mode.

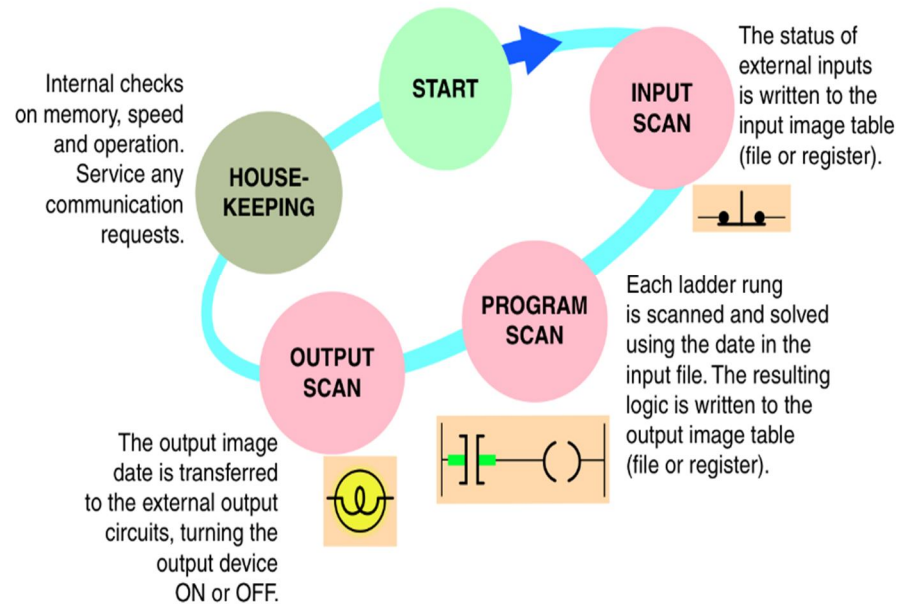


Figure 2.10 PLC program scan cycle

The time The standard IEC 61131 (Figure 2.11) was established to standardize the multiple languages associated with PLC programming by defining the following five standard languages: it takes to complete a scan cycle is called the scan cycle time and indicates how fast the controller can react to changes in inputs. The time required to make a single scan can vary from about 1 millisecond to 20 milliseconds.

If a controller has to react to an input signal that changes states twice during the scan time, it is possible that the PLC will never be able to detect this change. For example, if it takes 8 ms for the CPU to scan a program, and an input contact is

opening and closing every 4 ms, the program may not respond to the contact changing state. The CPU will detect a change if it occurs during the update of the input image table file, but the CPU will not respond to every change. The scan time is a function of the following:

- ✓ The speed of the processor module
- ✓ The length of the ladder program
- ✓ The type of instructions executed
- ✓ The actual ladder true/false conditions

The actual scan time is calculated and stored in the PLC's memory. The PLC computes the scan time each time the END instruction is executed. Scan time data can be monitored via the PLC programming. Typical scan time data include the maximum scan time and the last scan time.

2.2.3 PLC Programming Languages

The term PLC programming language refers to the method by which the user communicates information to the PLC [1].

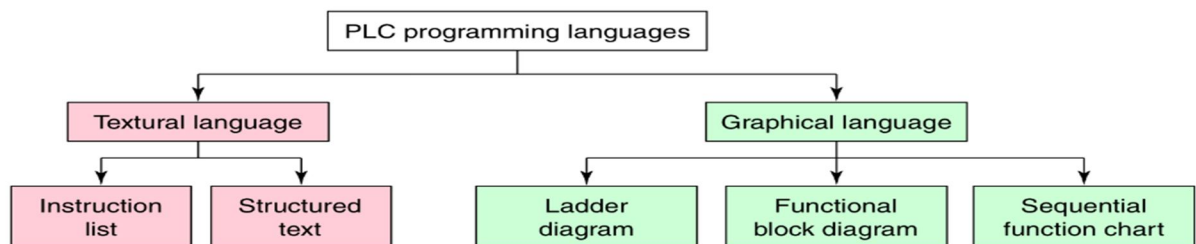


Figure 2.11 Standards IEC 61131 languages associated with PLC programming

- ✓ Ladder Diagram (LD): a graphical depiction of a process with rungs of logic, similar to the relay ladder logic schemes that were replaced by PLCs.
- ✓ Function Block diagram (FBD): a graphical depiction of process flow using simple and complex interconnecting blocks.
- ✓ Sequential Function Chart (SFC): a graphical depiction of interconnecting steps, actions, and transitions.

✓ Instruction List (IL): a low-level, text-based language that uses mnemonic instructions.

✓ A high-level: text-based language such as BASIC, C, or PASCAL

The ladder diagram is popular for those who prefer to define control actions in terms of relay contacts and coils, and other functions as block instructions.

2.3 SCADA SYSTEM:

SCADA is "supervisory control and data acquisition" – real time industrial process control system used to centrally monitor and control remote or local industrial equipment such as motor , valve, pump, relay, etc [14].

A SCADA system gathers information (such as where a leak on pipeline has occurred),transfer the information back to a central site , then alerts the home station that a leak has occurred , carrying out necessary analysis and control such as determining if the leak is critical , and displaying the information in a logical and organized fashion [16].

2.3.1 SCADA system performs four functions

✓ 1. Data acquisition

✓ 2. Networked data communication

✓ 3. Data presentation

✓ 4. Control

✓ These functions are performed by four kinds of SCADA components:

✓ Sensors (either digital or analogue) and control relays that directly interface with the managed system.

✓ Remote telemetry units (RTUs). These are small computerized units deployed in the field at specific sites and locations. RTUs serve as local collection points for gathering reports from sensors and delivering commands to control relays.

- ✓ SCADA master units. These are larger computer consoles that serve as the central processor for the SCADA system. Master units provide a human interface to the system and automatically regulate the managed system in response to sensor inputs.
- ✓ The communications network that connects the SCADA master unit to the RTUs in the field.

2.3.2 Why SCADA:

❖ Saves time and money:

- ✓ Less traveling for workers
- ✓ Reduces man –power needs
- ✓ Increase production efficiency of a company
- ✓ Cost effective for power systems and Saves energy and Reliable
- ✓ Supervisory control over a particular system (TAG'S):
- ✓ It is the address of the memory location where signals are being saved
- ✓ We defined a TAG in order to use it the SCADA software (WINCC)
- ✓ PLC-SCADA -I/O analog/digital/string tag.

2.3.3 FEATURE OF SCADA:

- ✓ Dynamic process graphic
- ✓ Real –time and historical trending
- ✓ Alarms
- ✓ Recipe management
- ✓ Security
- ✓ Device connectivity
- ✓ Script for logic development
- ✓ Database connectivity

2.3.4 SCADA Architecture:

- Hardware and Software

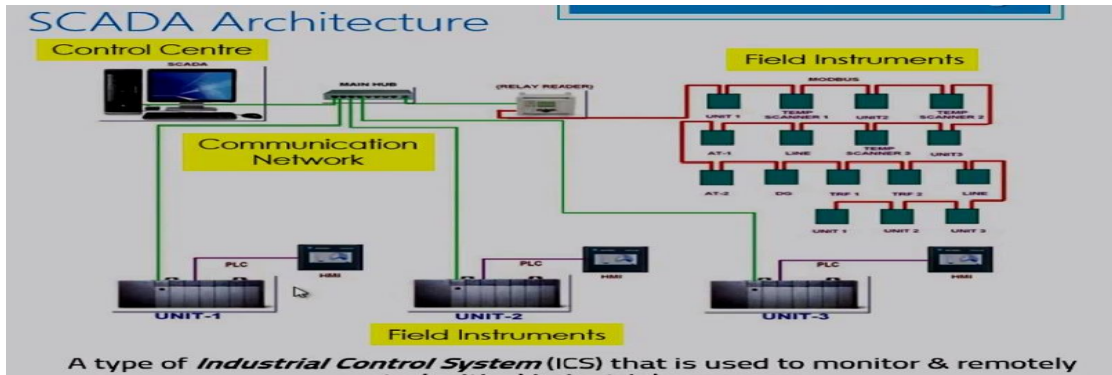


Figure 2.12 Typical hardware architecture

2.4 Previous Studies

1. REMOTE MONITORING AND CONTROL OF PUMPING STATIONS IN THE WATER SUPPLY SYSTEMS [appendix A1].

The paper describes the functioning of the pumping station remote monitoring and control system in the water supply system. The system provides the operator in the dispatch center with the visualization of control facilities with graphical and tabular presentation of relevant values and parameters. The operator can monitor the functionality of the entire building on the SCADA screen, and alarm reports assist in locating faults, which contributes to a significant increase in maintenance efficiency.

2. Automated Water Level Management System [Appendix A2].

The paper describes a proper sensing and controlling of available water resource is thus essential for the sustainability of this precious resource. The Automated Water Level Management System will monitor the water level in a main tank, and top-up water from a reserve tank when the water level in the main tank falls below half of the tank depth. Information about the water levels in the main tank and the reserve tank is monitored and sent through SMS to the user when they fall below the

critical states. Buzzers will also be activated to warn user. This paper reports on the development of a microcontroller-based system to monitor the water level, and to top-up water from the reserve tank.

3. Automation of Tank Level Using Plc and Establishment of HMI

By SCADA [AppendixA3].

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The proposed model can effectively supervise level control in multiple tanks. Three level sensors were used to provide the level data to the PLC. PLC used this data to take the required decisions and thereby turning ON and OFF a pump. A manual switch was also provided to override the automatic system. The SIMATIC S7-300 universal controller was used as the main decision making module. The system was implemented in SCADA to create the required Human Machine Interface (HMI). Modifications can be made by using float sensors model which would effectively provide the correct level but cost would increase and vibration of the sensor might disrupt the result, our model effectively counters that shortcoming.

4. PLC-BASED SCADA SYSTEM FOR OIL STORAGE AND APPLICATION

In the paper, configuration software and PLC are applied to construct SCADA System of the petroleum transportation. A petroleum storage and transportation database is created, which provide a large amount of experimental data to the research of petroleum storage and transportation and provide the basis for the promotion of new methods and new technologies.

3.1 The project description



Figure 3.1 for ALSAHAFA pumping Station (KSWC)

3.2 System Description

The system consists of five pumps, same quantity of valves , tow flow meters in addition to level meter (ultra Sonics type from E+ H Company) and tank level working under two stages (filling the water tank process and discharging water process).

The first stage is filling the water tank process which comes from SOBA water treatment plant through ultra sonic flow meter in specific reading displayed in HMI touch screen. Then discharging water process takes place after the filling process start and reach to specific point in the tank. At the second stage: The valves should be closed at first before the discharging pumps run. And the ultra sonic level sensor works as a detector for the empty and full of tank. For accuracy assurance of the process the pumps should not run unless the valves were closed in run process and after 2 second valves will open. In stop mode you should first close the valves and after tow second stop pumps. Getting to the required operation modes of the system which the operator was entered by HMI touch screen.

The system hardware comprises of Operator station and Engineering Station for both PLC and HMI from Siemens and field devices. The S7-300 controller has a modular structure. The CPU is designed as a backplane to which various modules

power supply units, Ethernet or field bus modules can be attached in line with the application.

On the field bus side, modules for PROFIBUS-DP/AP, are openly published as part of IEC 61158, is available.

The field bus line and the connected field devices are entirely configured and parameterized using the engineering tool s7-300. Field bus and device configuration can be performed offline without connection to the field devices.

Each of the hardware components is discussed in detail in this chapter.

3.3 The Central Processing Unit (CPU)

The central processing unit (CPU) is built into single unit fixed PLCs while modular rack types typically use a plug-in module. CPU, controller, and processor are all terms used by different manufacturers to denote the same module that performs basically the same functions. Processors vary in processing speed and memory options. A processor module can be divided into two sections: the CPU section and the memory section (Figure 3.1a). The CPU section executes program and makes the decisions needed by the PLC to operate and communicate with other modules. The memory section electronically stores the PLC program along with other retrievable digital information

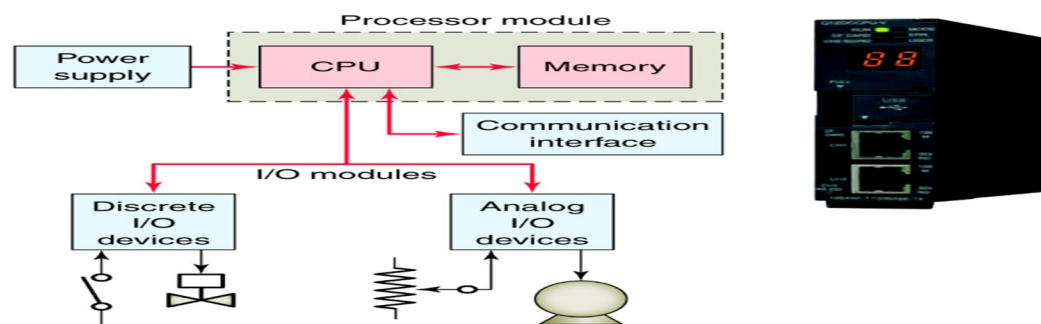


Figure 3.2a Sections of a PLC processor module

The main controller of the system is the plc type s7315-2PN/DP

The technical specification of the cpu315-2PN/DP

Technical specifications	
Dimensions and weight	
Dimensions W x H x D (mm)	80 x 125 x 120
Weight	800 g
Input parameters	
Input voltage • Rated value	120/230 VAC (automatic switching)
Mains frequency • Rated value • Permitted range	50 Hz or 60 Hz 47 Hz to 63 Hz
Rated input current • at 230 V • at 120 V	1.9 A 4.2 A
Inrush current (at 25 °C)	55 A
I ² t (at inrush current)	3.3 A ² s
Output parameters	
Output voltage • Rated value • Permitted range • Rampup time	24 VDC 24 V ± 3 %, open circuit-proof max. 2.5 s
Output current • Rated value	10 A, parallel wiring is available

Technical specifications	
Short-circuit protection	electronic, non-latching 1.1 to 1.3 × I _N
Residual ripple	max. 150 mV _{pp}
Characteristics	
Safety class to IEC 536 (DIN VDE 0106, Part 1)	I, with protective conductor
Isolation rating - Rated isolation voltage (24 V to L1) - Test voltage	AC 250 V DC 4200 V
Safety isolation	SELV circuit
Buffering of power supply failure (at 93 V or 187 V) Repeat rate	Min. 20 ms min 1 s
Efficiency	90 %
Power consumption	267 W
Power loss	typ. 27 W
Diagnostics	
"Output voltage present" display	yes, green LED

The CPU contains the similar type of microprocessor found in a personal computer. The difference is that the program used with the microprocessor is designed to facilitate industrial control rather than provide general purpose computing. The CPU executes the operating system, manages memory, monitors inputs, evaluates the user logic, and turns on the appropriate outputs [17].

Associated with the processor unit will be a number of status LED indicators to provide system diagnostic information to the operator (Figure 3.1b). Also, a key switch may be provided that allows you to select one of the following three modes of operation: RUN, PROG, and REM.

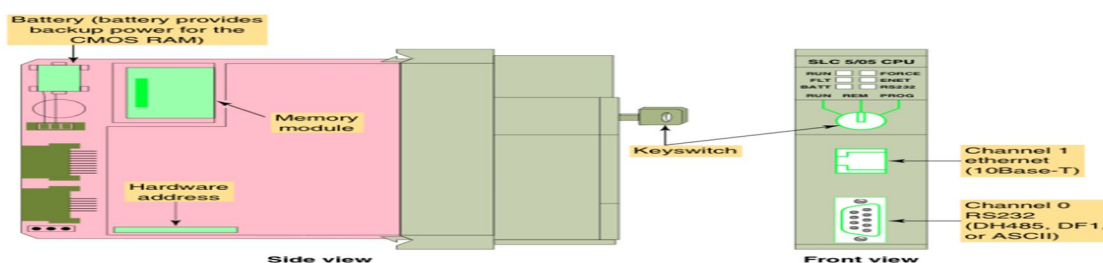


Figure 3.2b typical processor modules

3.4 Power supply module PS 307; 10 A; (6ES7307-1KA02-0AA0)

Order number

6ES7307-1KA02-0AA0

Properties

Properties of the PS 307; 10 A power supply module:

- ✓ Output current 10 A
- ✓ Output voltage 24 VDC; short circuit-proof, open circuit-proof
- ✓ Connection to single phase AC mains (rated input voltage 120/230 VAC 50/60 Hz).
- ✓ Safety isolation to EN 60 950.
- ✓ May be used as load power supply.

The PLC power supply provides the necessary power (typically 5 VDC) to the processor and I/O modules plugged into the backplane of the rack (Figure 3.2a).

Power supplies are available for most voltage sources encountered. The power supply converts 115 VAC or 230 VAC into the usable DC voltage required by the CPU, memory, and I/O electronic circuitry. PLC power supplies are normally designed to withstand momentary losses of power without affecting the operation of the PLC. Holdup time, which is the length of time a PLC can tolerate a power loss, typically ranges from 10 milliseconds to 3 seconds [8].

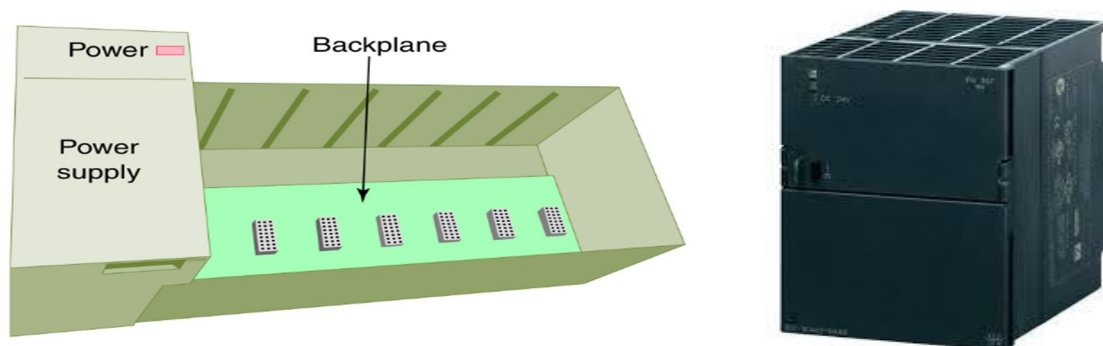


Figure 3.3 plc power supply

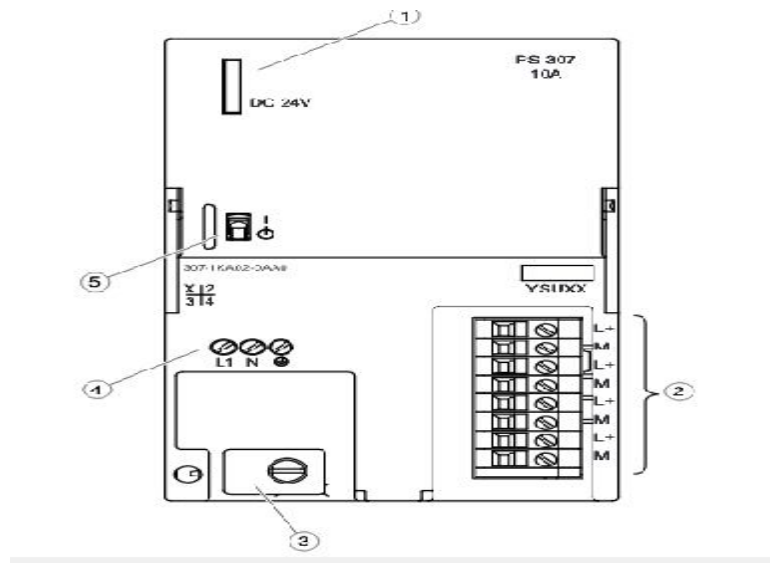


Figure 3.4 Wiring diagram of PS 307; 10 A

1. Display for "Output voltage DC 24 V present"
2. Terminals for 24 VDC output voltage
3. Strain-relief
4. Mains and protective conductor terminals
5. 24 VDC On/Off switch

Block diagram PS 307; 10 A

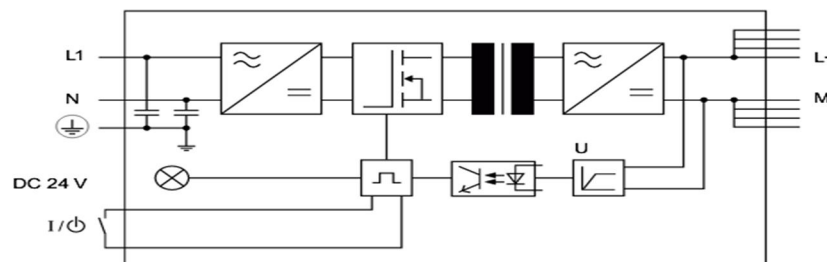


Figure 3.5 shows block diagram of ps 307; 10A

The processor module also contains circuitry to communicate with the programming device. Somewhere on the module you will find a connector that allows the PLC to be connected to an external programming device. The decision-making capabilities of PLC processors go far beyond simple logic processing. The processor performs other functions such as timing, counting, latching, comparing, Motion control and complex math functions.

3.5 the I/O Section

The input/output (I/O) section of a PLC is the section to which all field devices are connected and provides the interface between them and the CPU. Input/output arrangements are built into a fixed PLC while modular types use external I/O modules that plug into the PLC [17].

Figure 3.5 illustrates a rack-based I/O section made up of individual I/O modules. Input interface modules accept signals from the machine or process devices and convert them into signals that can be used by the controller.

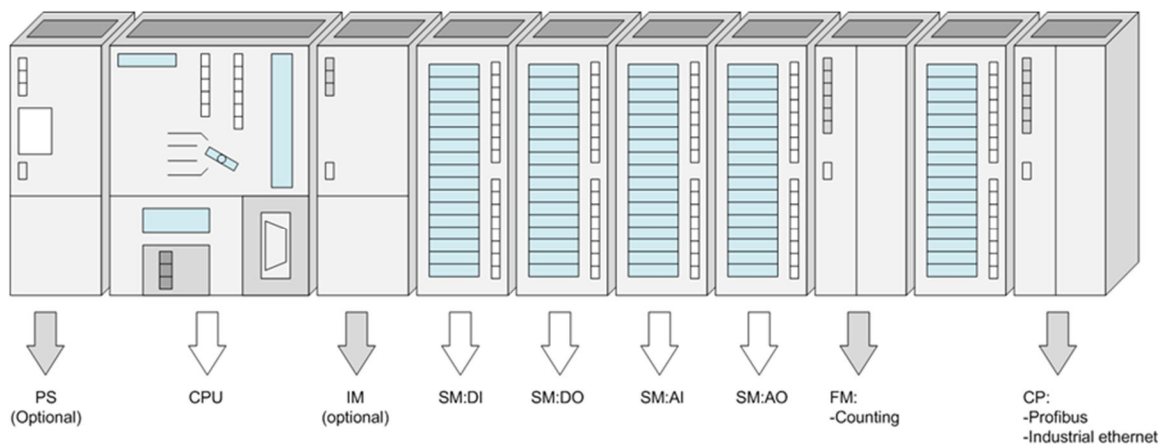


Figure 3.5 Rack-based I/O section

Output interface modules convert controller signals into external signals used to control the machine or process. A typical PLC has room for several I/O modules, allowing it to be customized for particular application by selecting the appropriate modules. Each slot in the rack is capable of accommodating any type of I/O module.

The I/O system provides an interface between the hardwired components in the field and the CPU. The input interface allows status information regarding processes to be communicated to the CPU, and thus allows the CPU to

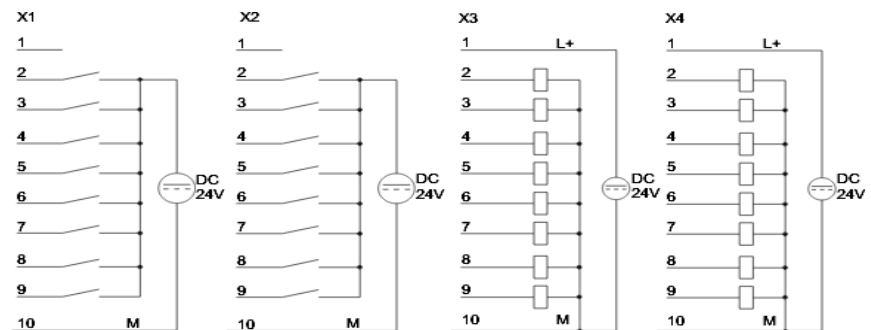
communicate operating signals through the output interface to the process devices under its control.

I/O modules can be 8, 16, 32, or 64 point cards (Figure 3.6). The number refers to the number of inputs or outputs available. The standard I/O module has eight inputs or outputs. A high-density module may have up to 64 inputs or outputs. The advantage with the high-density module is that it is possible to install up to 64 inputs or outputs in one slot for greater space savings. The only disadvantage is that the high-density output modules cannot handle as much current per output. Below are the modules which I had used in the research:

✓ DI 16xDC 24v /0.5A

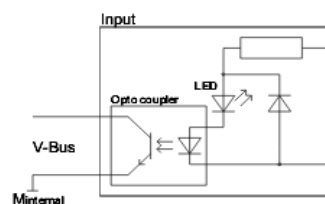
✓ DO 16xDC 24v /0.5A

Circuit diagram



Schematic diagram

Input section



Output section

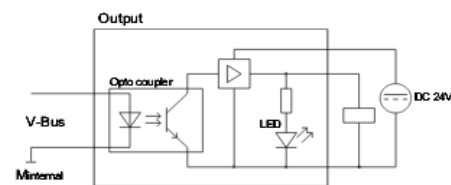


Figure (3.6) 16xdc24v, /0.5A I/O modules

3.6 IM 365 (Overview)

The IM 365 is the low-cost expansion for an ER. IM stands for interface module with following features: [8]

- ✓ One of the two IM 365 modules is inserted in the CC, the other into the ER. The modules are connected by a fixed cable 1 m in length.
- ✓ For connecting mounting racks in multi-tier somatic s7-300 configuration.
- ✓ IM 365: For design of central controller and max. 1 expansion unit.
- ✓ Limited use of modules in the expansion unit (e.g. no CPs or FMs)



Figure 3.7 shows IM configuration

All interfaces have the following common features Compact configuration:

- ✓ The rugged plastics housing contains the interfaces for the connecting cables.
- ✓ Simple mounting: The interface modules are mounted on the DIN rail (slot 3) and connected to the I/O modules via a bus connector just like any other module.
- ✓ Problem-free configuration: The interface modules are self-configuring. Address assignment is not required.
- ✓ Status and fault LEDs.
- ✓ IM 360/IM 361 and IM 365 modules support a multitier configuration of the S7300 automation system (CPU 313C, CPU 314 or later), consisting of a central controller (CC) and up to three expansion racks (ERs) just like my research

(ALSAHAFA). The individual racks are interconnected via the interface modules.

3.7 HMI (Human Machine Interface)



Figure 3.8 the HMI

HMI stands for Human machine interface.

HMI's are used as an operator control panel instead of using an excessive amount of hardware and also provides almost unlimited control and status of a fully automated machine cell.

3.7.1 HMI (USAGE)

- ✓ Process of visualization and operator control.
- ✓ Archiving process values and displaying alarms
- ✓ Process values and alarms log.

3.7.2 Siemens HMI Family

- ✓ Micro Panels
- ✓ Mobile Panels
- ✓ Touch& Operating panels
- ✓ Panel Pcs and Pc(SCADA)

3.7.3 PC Adapter USB

The PC Adapter USB is compatible with USB V1.1 and satisfies the requirements for "Low-Powered "USB devices. The SIMATIC PC Adapter USB supports the energy saving mode (hibernate mode).

3.7.4 Functions

The SIMATIC PC Adapter USB connects a PC to the MPI/DP interface of an S7/M7/C7 system via USB. A slot is not required in the PC, which means that the adapter can also be used for non-expandable PCs such as notebook.



Figure 3.9 PC adapters for downloading and uploading

3.8 SCADA SYSTEM ARCHITECTURE

The automation system in this research is consisting of SIMATIC s7-300 for plc (the controller) and WINCC flexible 2008 for the HMI (monitoring and visualization) and field devices [4].

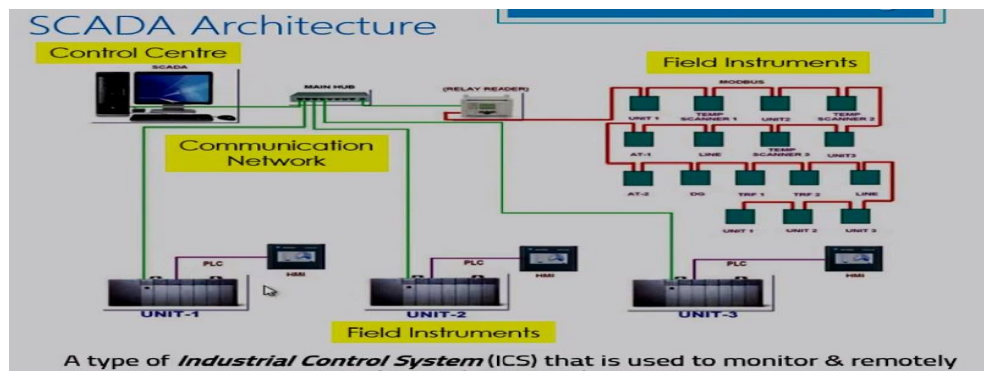


Figure 3.10 SCADA structure

3.8.1 SIMATIC S7-300 Architecture



Figure 3.11 shows s7-300 architecture

SIMATIC S7-300: The modular controller for innovative system solutions in the manufacturing industry SIMATIC S7-300 is the best-selling controller of the Totally Integrated Automation spectrum with a host of successful reference applications worldwide from the most varied industrial sectors, such as:

- ✓ Manufacturing engineering
- ✓ Automotive industry such as water pumping station.
- ✓ General machine construction
- ✓ Special-purpose machine manufacturing
- ✓ Standard mechanical equipment manufacture, OEMs plastics processing
- ✓ Packaging industry, food beverages and tobacco industries
- ✓ Process engineering such as water and waste water.

The SIMATIC S7-300 has been designed for innovative system solutions with the focus on manufacturing engineering, and as a universal automation system, it represents an optimal solution for applications in centralized and distributed configurations:

- ✓ The ability to integrate powerful CPUs with Industrial Ethernet/PROFINET interface, integrated technological functions, or fail-safe designs makes additional investments unnecessary.
- ✓ The Micro Memory Card as a data and program memory makes a backup battery superfluous and saves maintenance costs. In addition, an associated project, including symbols and comments, can be stored on this memory card to facilitate service calls.
- ✓ The Micro Memory Card also enables simple program firmware updates without a programming device also the Micro Memory Card can also be used during operation for storing and accessing data, e.g. for measured value archiving or recipe processing.

- ✓ In addition to standard automation, safety technology and motion control can also be integrated in an S7-300.
- ✓ Many of the S7-300 components are also available in a SIPLUS extreme version for extreme environmental conditions, e.g. extended temperature range (-40/-25 ... +60/+70 °C) and for use where there is corrosive atmosphere/condensation.

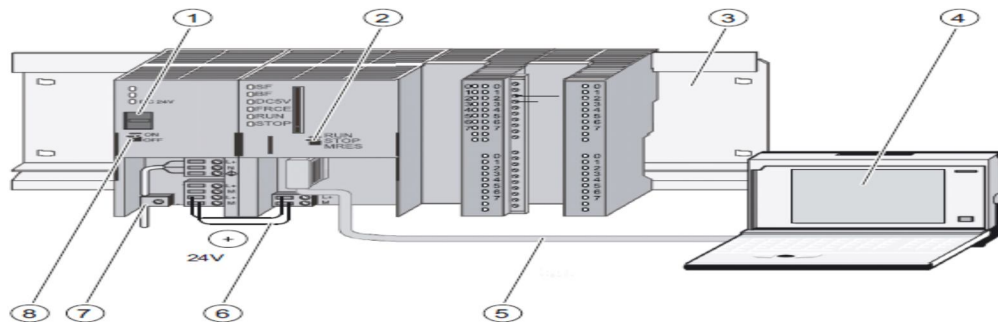


Figure 3.12 SIMATIC S7-300: The modular controller

- (1) For setting the line voltage
- (2) Mode selector
- (3) Mounting rail
- (4) Programming device with STEP 7 software
- (5) PG cable
- (6) Connecting cable
- (7) Clamp for strain relief
- (8) Power supply ON/OFF

3.8.2 WINCC flexible system overview

WINCC flexible 2008 provides an operator station and a process station

3.8.3 WINCC flexible engineering system

The WINCC flexible engineering system is the software for handling all your essential configuring tasks. The WINCC flexible edition determines which HMI devices in the SIMATIC HMI spectrum can be configured [4].

3.8.4 WINCC flexible Run time

WINCC flexible runtime is your software for process visualization. You execute the project in process mode in Runtime.

3.8.5 WINCC flexible option

The WINCC flexible option allows you to expand the standard functionality of WINCC Flexible.

Separate license is needed for each option.

3.9 Field devices

3.9 .1 Basic Measurement System

A basic instrument/measurement system consists of three elements: [7]

- ✓ Transducer/sensor: The transducer is the part of the measurement system that initially converts the controlled variable into another form suitable for the next stage. In most cases, conversion will be from the actual variable into some form of electrical signal, although there is often an intermediate form, such as pneumatic.
- ✓ Signal conditioning: In computer process control, signal conditioning is used to adjust the measurement signal to interface properly with the A/D conversion system.
- ✓ Transmitter: The transmitter has the function of propagating measurement information from the site of measurement to the control room. A simplified block diagram of a basic measurement system is shown in Figure 3.13

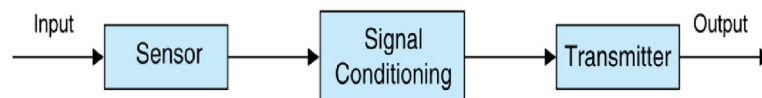


Figure 3.13 Instrument block diagram.

Most modern analog instruments use the following standard signal ranges:

- ✓ Electric current of 4 to 20 mA
- ✓ Electric voltage of 0 to 10 V
- ✓ Pneumatic pressure of 0.2 to 1.0 bars (The bar is a unit of pressure equal to 100 kPa and roughly equal to the atmospheric pressure on earth at sea level.)
- ✓ Digital with a built-in binary digital encoder so as to provide a binary digital
- ✓ Output. Having a standard instrument range or using digital signals greatly contributed to the advancement of digital process control and the evolution of modern PLCs.

The following are a few of the primary advantages of such instruments:

- ✓ All instruments can be easily calibrated.
- ✓ The signal produced is independent of the physical measurement. For example the minimum signal (e.g., temperature, speed, force, pressure, and many other measurements) is represented by 4 mA or 0.2 bars, and the maximum signal is represented by 20 mA or 1.0 bar.
- ✓ The same PLC hardware-interface modules are used for all measurements.
- ✓ Users can select instruments from a large number of competing vendors; all must comply with universal standards.

Below are the instruments used in the project:

1. Two Level sensors.
2. Two flow meters.
3. Five pumps.
4. Five motorized valves.

3.9.2 Level Measurement

Level sensors detect the level of liquids and other fluids and fluidized solids. The substance to be measured inside the reservoir .The level measurement is

continuous. Continuous level sensors measure level within a specified range and determine the exact amount of substance in a certain place. As with other type of sensors, Level Transmitter Figure 3.14 is available or can be designed using variety of sensing principles.



Figure 3.14 Level Transmitter

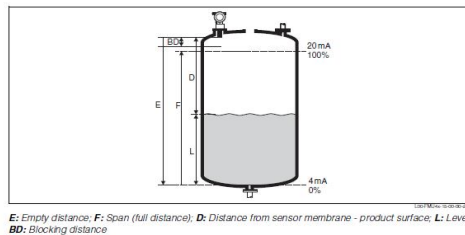


Figure 3.15 Function and system design

3.9 .3 Flow Measurement

We used an ultra sonic flow meter; from E+H company flow can be measured in a variety of ways. The PROLINE PROSONIC flow 91 w ultrasonic flow meter is a Device with automatic frequency scan for max. Measuring performance and cost-effective transmitter the PROSONIC flow w clamp –on sensor is specially designed for water and wastewater applications. Combined with the cost-effective PROSONIC Flow 91 transmitter with push buttons, PROSONIC Flow 91W is ideally suited for flow monitoring in the water industry.



Figure 3.16 PROLINE PROSONIC flow 91W ultra sonic flow meter.

3.9 .4 Pump

A pump Figure 3.7.4 is a device that moves fluids (liquids, water and gases), or sometimes slurries, by mechanical action.

Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps.



Figure 3.17 Pump

3.9.5 Motor Operated Valve

Motor Operated Valve (MOV) Figure 3.25 are often called as On-Off valves as the motors serve the purpose of fully opening or fully closing valves in pipelines. These valves are not used for throttling purposes as they serve mainly On-Off service application.

For this MOV, motor operated with actuator control from local panel or, from control room is required. There is a requirement of co-ordination among Piping-Electrical-Instrumentation-Process.



Figure 3.18 Motor Operated Valves

4. Introduction:

Siemens system uses two software SIMATIC Manager, s7 300 for controller (plc) Software and WINCC flexible 2008 for control, monitoring and visualizing Software (SCADA). We integrated WINCC flexible throughout SIMATIC manager.

4.1 SIMATIC MANAGER

The creation of the project is typically comprises of four different phases: (figure 4.1 shows a research creation)

- ✓ Software Implantation and configuration
- ✓ Soft ware Implementation and module test.
- ✓ Software Testing and commissioning.
- ✓ Software Operation and maintenance.

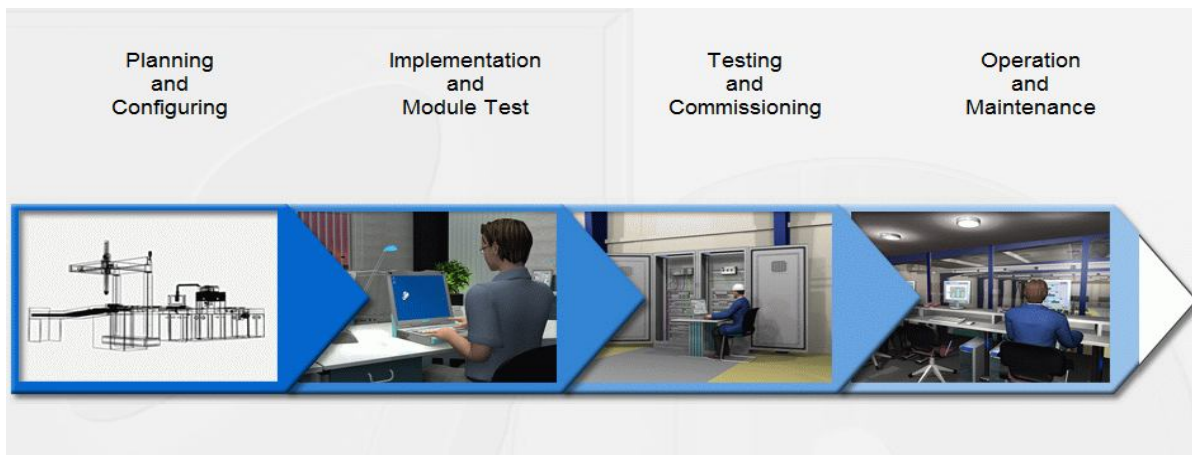


Figure 4.1 shows the steps of the plant creation

The optional interaction of all programming tools and functions involved in the research enables a high plant and manufacturing quality as well as reducing the commissioning and operating cost, the basic is the SIMATIC Software which supports you in all phases of the project. (Figure 4.2 shows the SIMATIC support all phases).The ideal case would be a SIMATIC programming device, with all the

desired SIMATIC software readily installed instant use to accompany me throughout the research. And of course the system environment for the software was also standard PC.

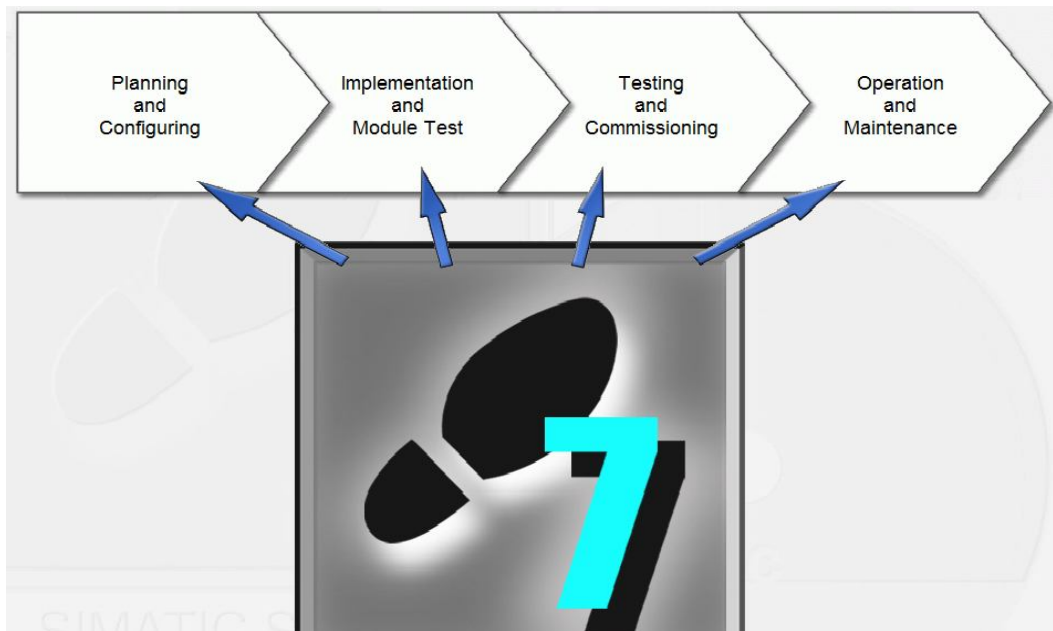


Figure 4.2 supporting of s7 for all phases above

Depending on the size and the automation components used in the plant and the automation task in hand, the programming tools was combined from a wide range of available software packages.

The SIMATIC step-7 professional engineering environment contains a sizeable package for dealing with complex automation projects.

The engineering suit can be expanded by optional software package, for instance the configuration of operator control and monitoring system, or for dealing with technological tasks.

Integrating smoothly into this suite, The SIMATIC manager supported me in Progressing my project by integrating all these tools and functions into consistent development environment.

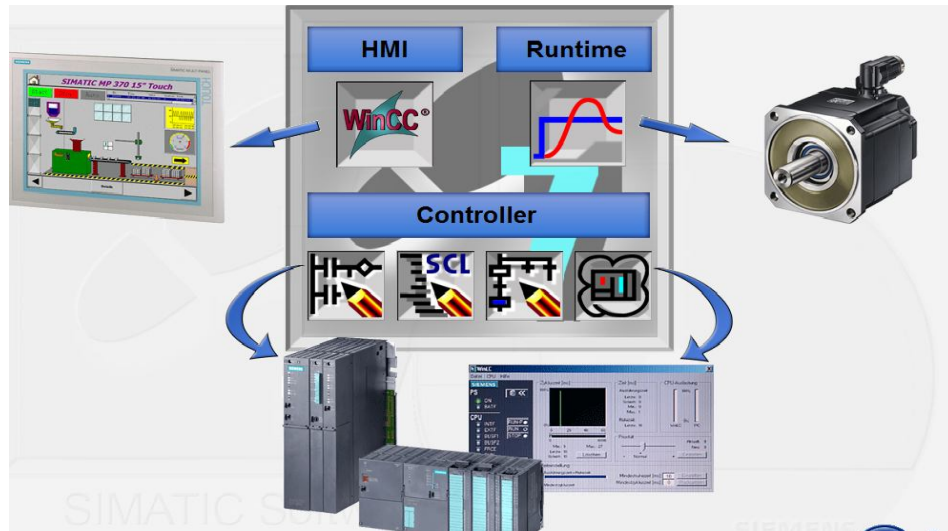


Figure4.3 the necessary software packages

4.2 WINCC Flexible2008

SIMATIC WINCC flexible_2008 the proven HMI software for flexible implementation in the plant process stood for configuration efficiency. The WINCC flexible Engineering Software was used in this research to configure SIMATIC operator devices of the 170 and 177 series (figure 4.3) from small Micro Panels to powerful Multi Panels as well as PC-based HMI with WINCC flexible Runtime SW. for building the system of the project the two software integrated together. (S7-300 and WINCC flexible 2008)

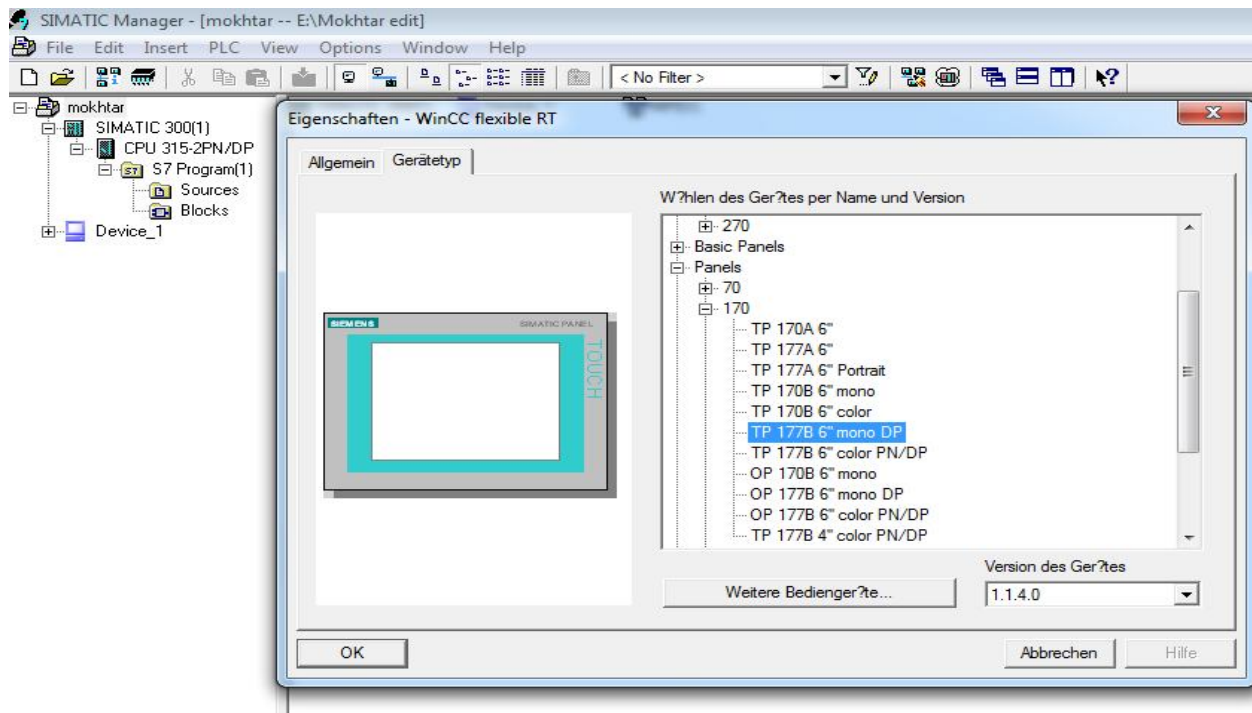


Figure 4.4 WINCC flexible panel chosen in the project

4.3 System Configuration

Structurally the SIMATIC manager consists of number of powerful tools for my project processing such as:

- ✓ The hardware configuration
- ✓ The network configuration.
- ✓ Editing the symbol.

SIMATIC software was readily installed instant use to accompany me throughout the various testing and commissioning function as well as archiving the project data.

Furthermore, the SIMATIC manager manages me for program generation as well as the optional software packages such as the programming language.

SIMATIC software readily installed instant use to accompany me throughout Operating and monitoring systems. Decisive factor for a time-optimized configuration process, in addition to comfortable operation of the software tools

and functions, is clear and consistent data management throughout the configuration.

This means in practice that I run one tool after the other as the project evolves, and uses a continuously growing data base in process.

The tool used can access this data base at any time, so that project data, such as symbol used in a project, can be used by all tools once they have been entered. In this way, double data input and inconsistencies are avoided. I presented that the project data look like in the SIMATIC manager. The entire automation system is organized in a hierarchically structured project whose function is the organized storage of all data and programs generated.

All objects handled by the SIMATIC manager have an equivalent in the real objects of the plant.

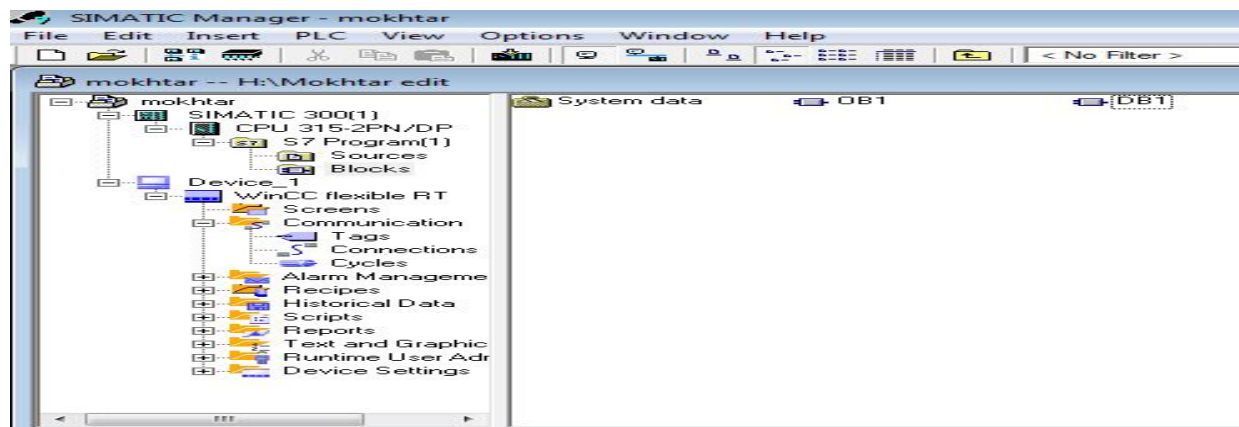


Figure 4.5 the research data

In the SIMATIC manager my project comprises mainly the flowing hierarchically structured objects: as shown in figure 4.6

One or more station containing all data of a controller, this on one hand, including the configuration data with the station hardware structure and parameters of the module used, and on the other hand user program data contained in the CPU object. The CPU object has the connection of the CPU assigned to it, and the s7 program contained in the CPU. As to the s7 program object, it contains symbol

table, the program source folder and a folder containing the user program blocks with the executable code. By means of hierarchical project structure the data generated in different areas of the project are assigned clearly and easily to the associated objects. These can of course be changed on demand. In multi user mode .multiple user can edit a project at the same time.

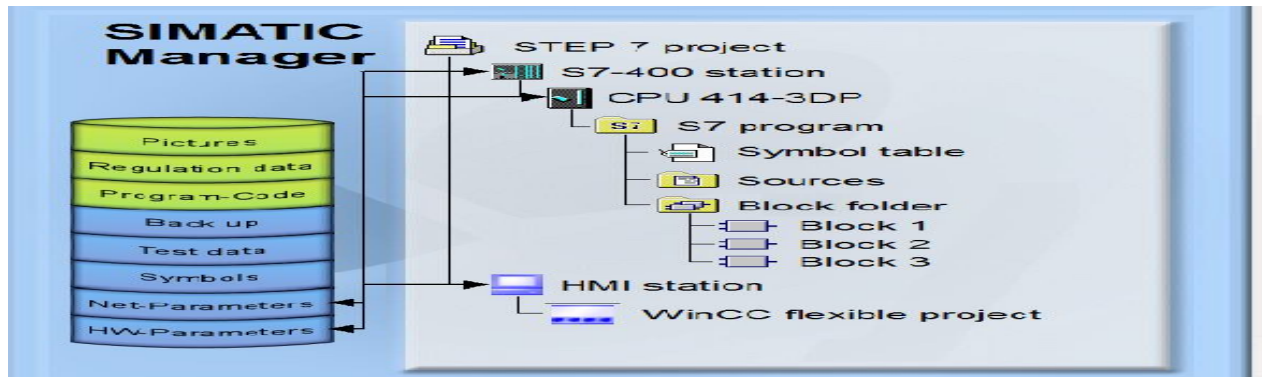


Figure 4.6 the s7software hierarchal

4.3.1 Software Planning and configuration

The project created containing a station, (as in figure 4.7) which first set up the hard ware and configured the connection by generating a new project via the “file” menu, started with the storage location and the project name.

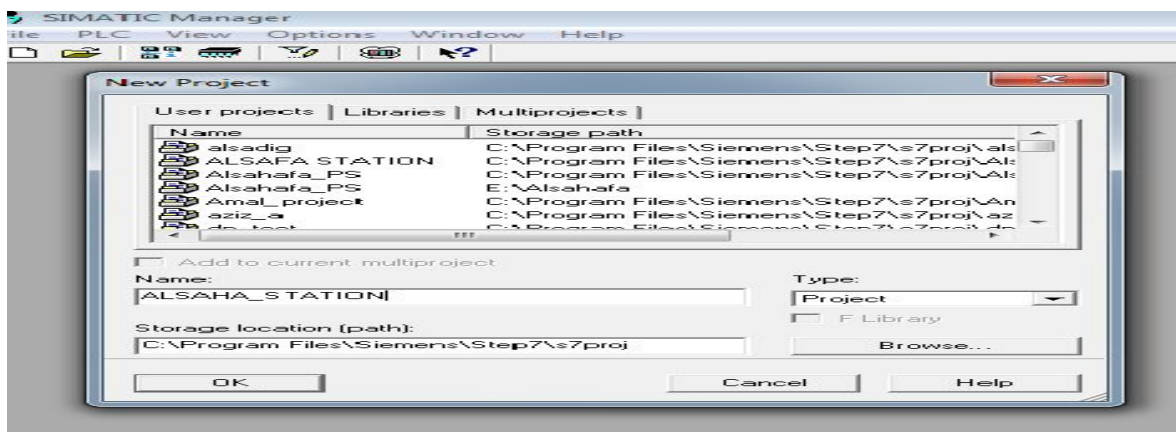


Figure 4.7 start programming of a project

Then I added a station, in our case a SIMATIC s7-300 station. The station contains a hardware object, which we opened by the double clicking, starting the hard ware

configuration tool. In this tool the hardware is configured to reflect the actual hardware structure. Figure (4.8).

All available modules are contained in the hardware catalog, which can be updated through the internet if required. Even third –party modules can be integrated into the catalog by means of manufacturer –supplied GSD file.

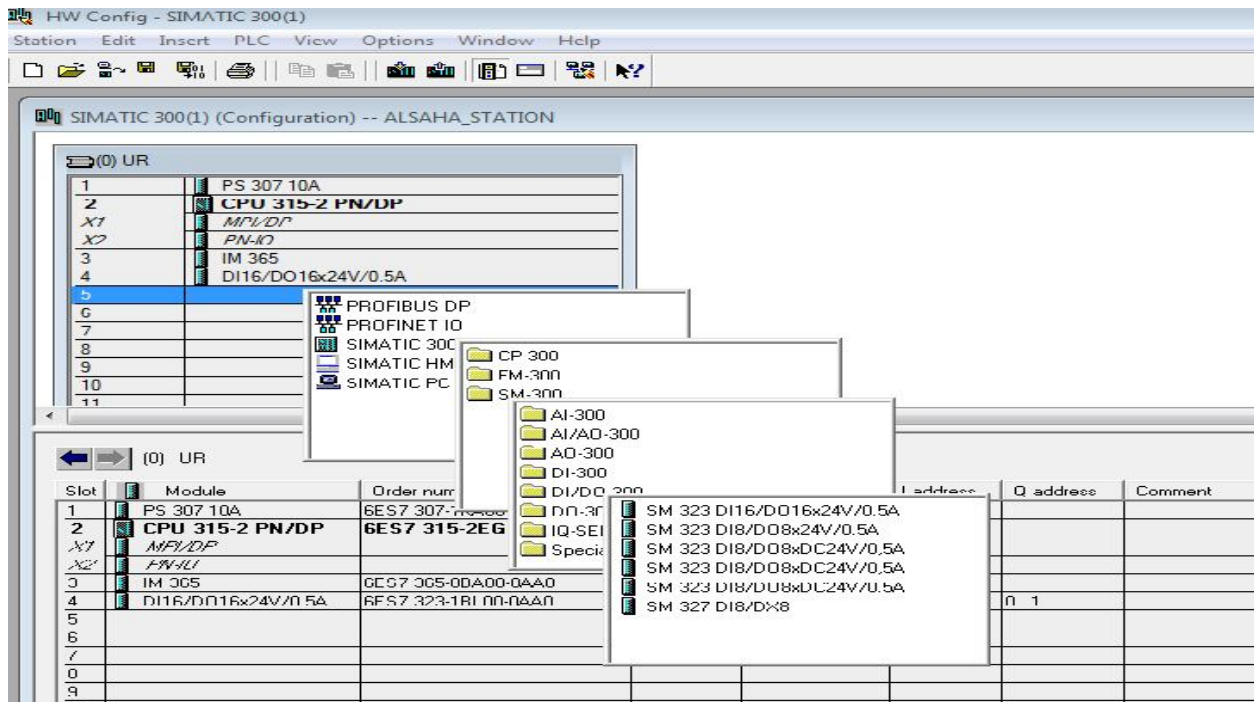


Figure 4.8 H.W configurations for ALSAHAF A pumping station

The hardware configuration process had assigned to each module slot, a unique address and parameters. Figure 4.9

All these are manually assigned, so the SIAMTIC Manager checked the module address and parameters for plausibility and consistency. The basic of all communication within this plant is a configured network. The network configuration tool represented all configured connections graphically and allowed creating and configuring new connection. This was applied both for communication with the distributed I/O and for communication between the SIMATIC stations.

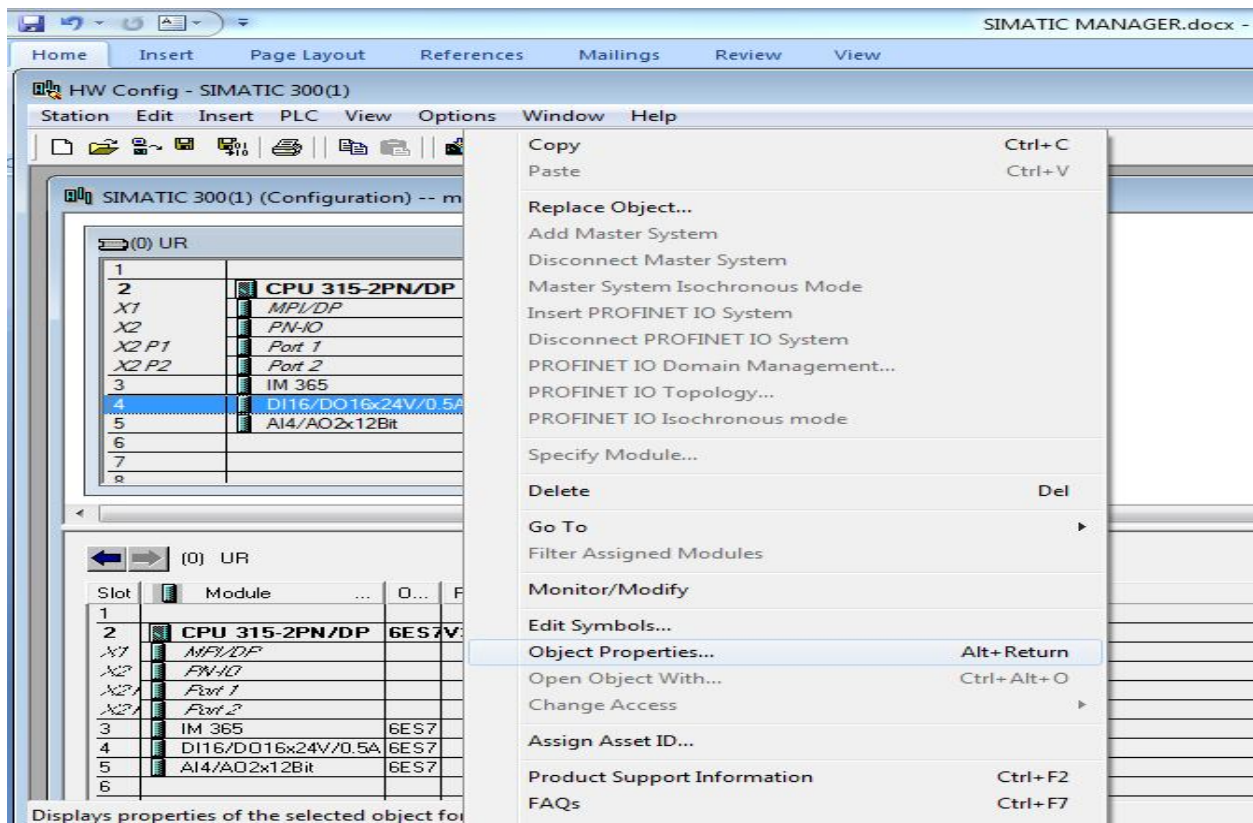


Figure 4.9 H.W Process assigning each module

4.3.2 Software Implementation and module test

I created the symbols, developed the control program, test it for the first time module by module, and configured the visualization function it was done in the plant really. First of all, each operand used is assigned in the symbol table a comprehensible name that matches the task. This symbolic name is used in the program, which made it much easier to understand. The name was used by the operator control and monitoring software. Furthermore, comments added to each symbol to describe its Task in more detail. (figure4.10) and the symbol table can be updated at any time as program evolves; the block folder contains the user program. This includes, for instant, the system data with the configuration and communication data, as well as executable blocks containing control program and the user data. The resulting user program was composed of the individual program blocks.

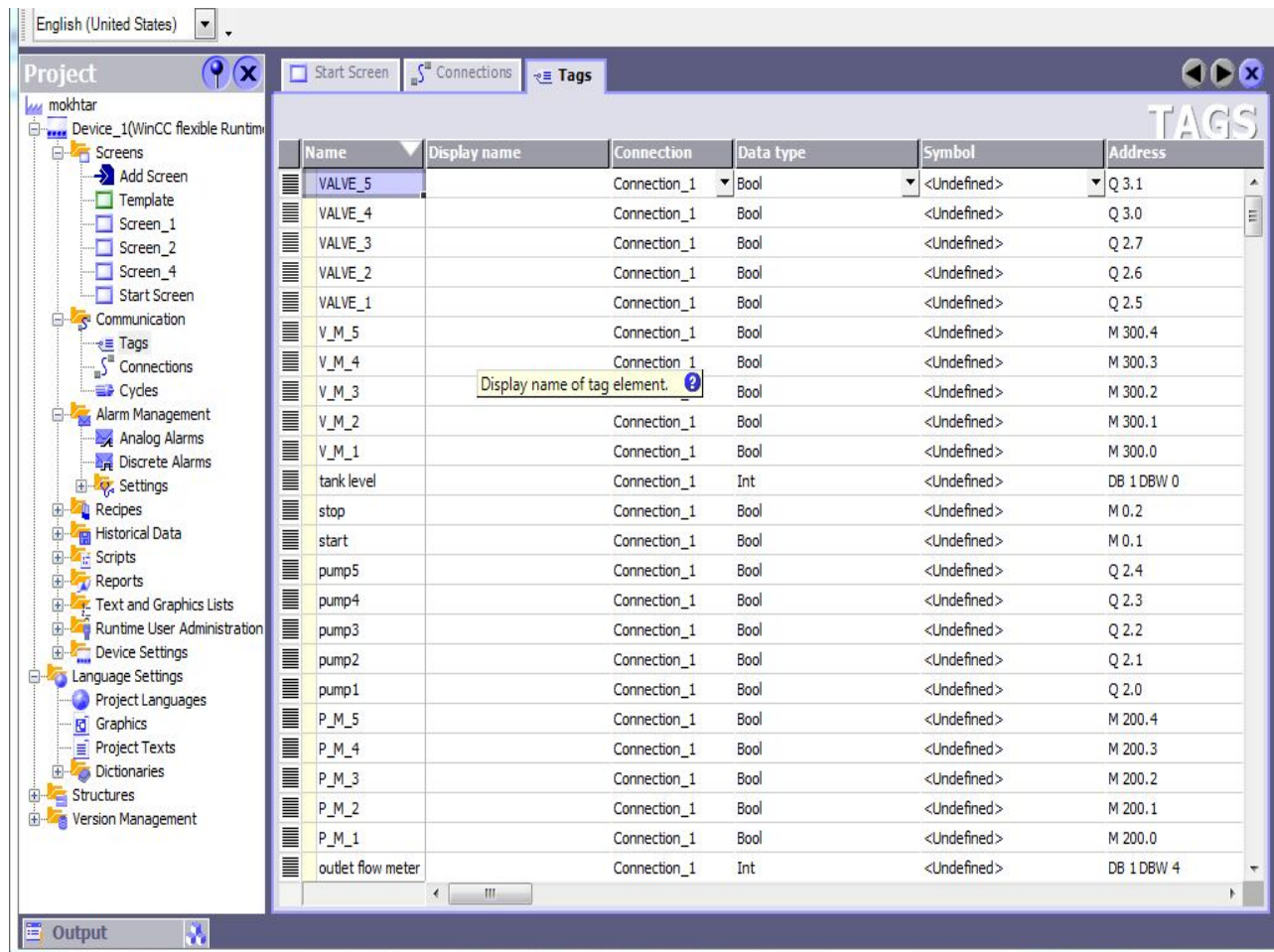


Figure 4.10 Project cross reference data

Each block had been selected the programming language that is best suited to the task in hand. The appropriate editor is started automatically. For the module test, the S7-PLCSIM simulation software was available; it allows testing the user program off-line, without having to transfer it to the real –life plant. S7-PLCSIM simulates to a certain extend the station configured in the project, this modules, for instant, loading the user program into the CPU. The result was read, for instance, at the simulated output modules. This allowed me to check the correct functioning of most of the program without leaving the office. Likewise, the development environment of the operator control and monitoring system, for instance WINCC flexible, was integrated throughout into the SIMATIC Manager. (figure4.10) like all other integrated tools, the configuration software for the visualization function is started from the SIMATIC Manager. It accesses the central data pool of the

SIMATIC manager and stores its own visualization data in that pool, so that they are available for the other tool.

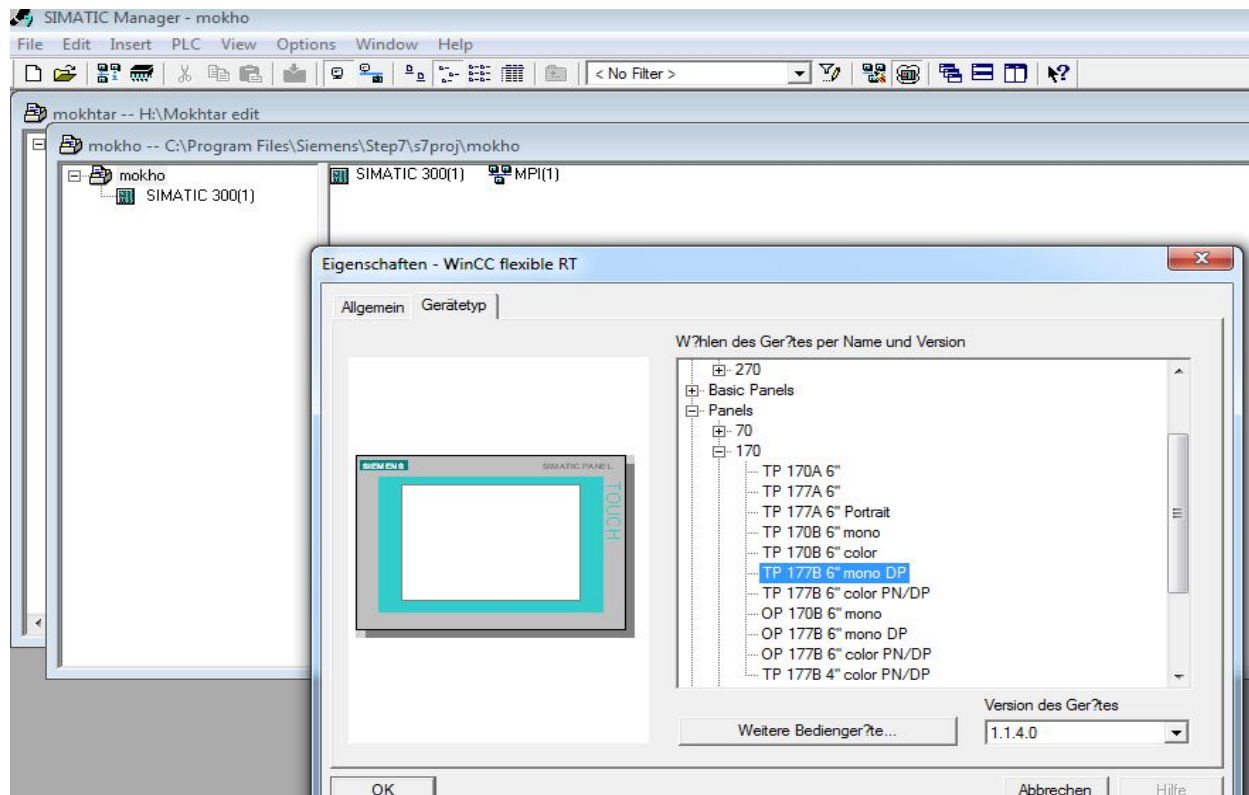


Figure 4.11 WINCC flexible throughout SIMATIC manager

4.3.3 Software testing and commissioning

This step Included loading the program into the controller, testing it during operation, archiving and backup of the project after built up the connection between the programming device and station. We loaded the user program into the CPU. As shown in the figure4.12

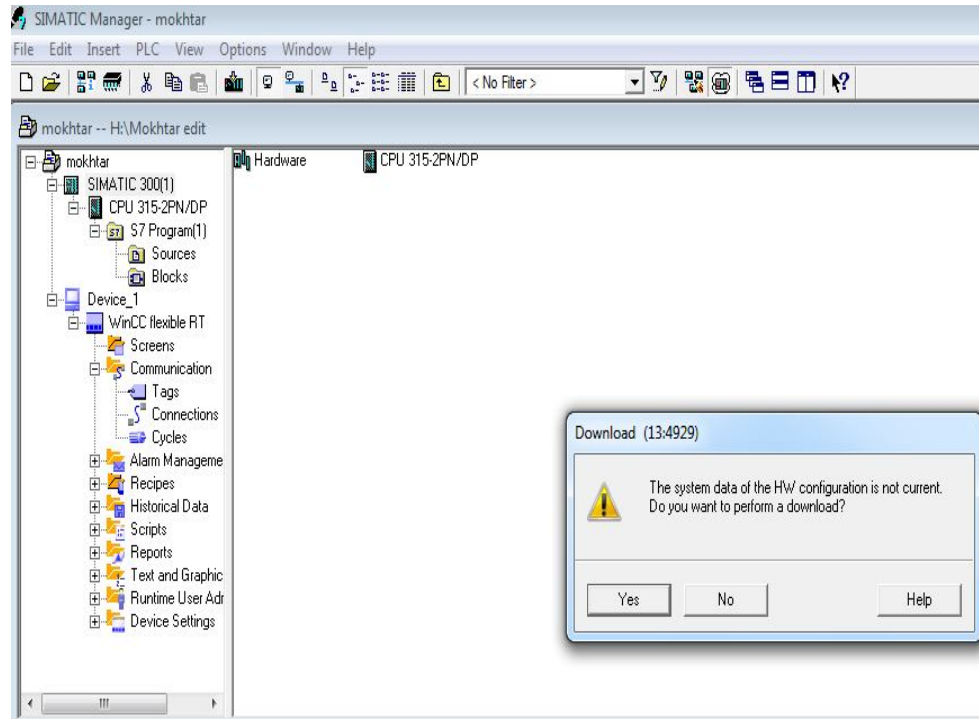


Figure4.12 loading the programming

With one click the SIMATIC manager showed us the CPU online program.

A wide range of a test tools was available for quick and comfortable commissioning, including: monitoring, control of variables, forcing variables, program status, and single stop mode with stop points.

These tools provided by SIMATIC manager allowed me to modify the program during operation and to see immediately what impact my corrections have on it after commissioning also in between to back up the data, I compressed and archive the entire project with its entire program and data. And also was stored in the CPU in this format.

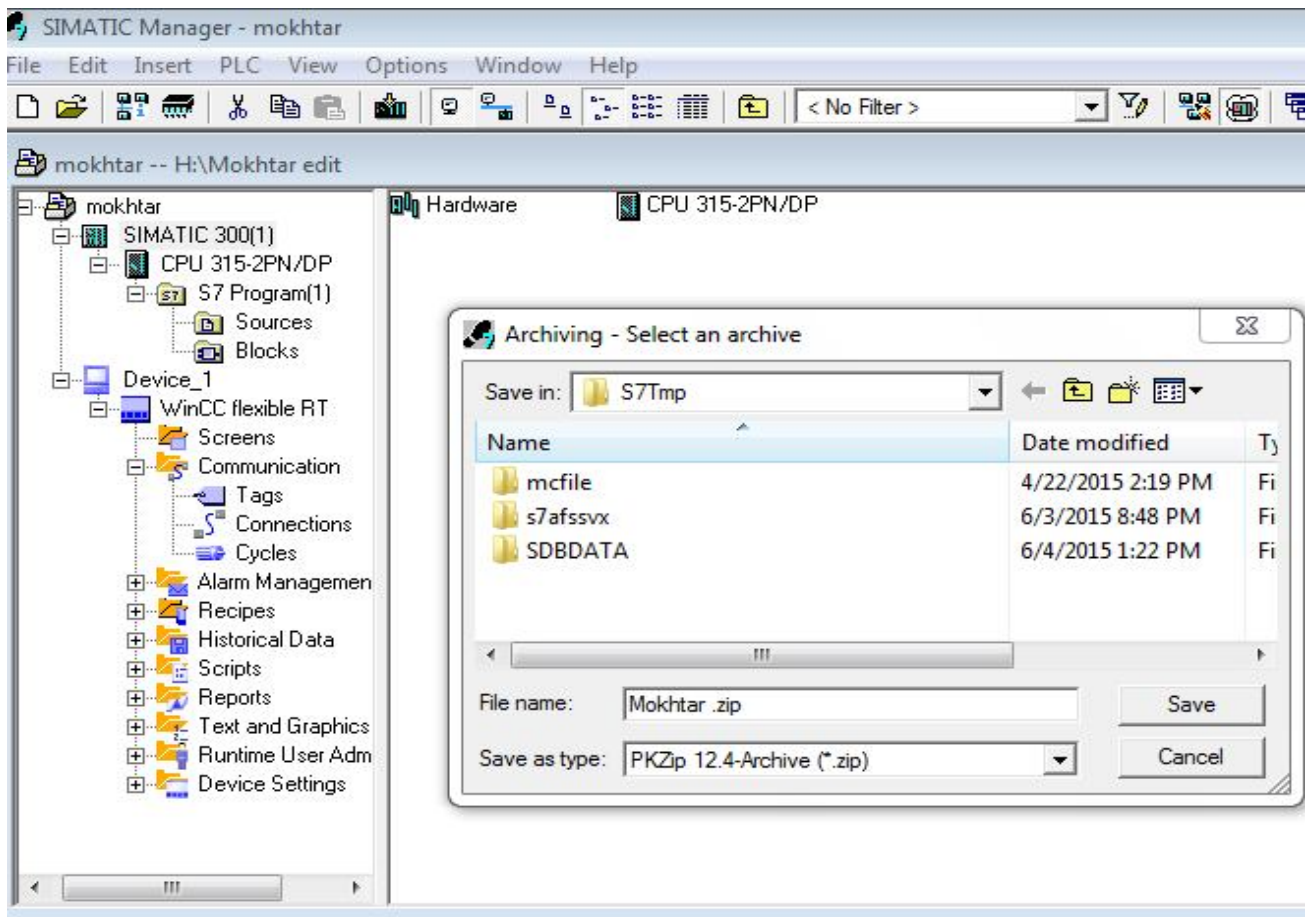


Figure4.13 archiving data

4.3.4 Software Operation and maintenance

Here the SIMATIC manager was assisted me, for instance, with its some tool. I gave an overview of how the SIMATIC manager accompanies me throughout all phases of an automation project. In planning and configuration phase, I created a project and configured hardware of the automation device, using the hardware configuration and network configuration tool. In the implementation and module phase I used the various programming language and simulation software, to generate my program and run a preliminary test on it. Testing and commissioning are performed reliably and good time using the extensive test and diagnostic in the generation and maintenance phase.

4.4 Process Description

4.4 .1 Levels and Pressure Monitoring

Monitoring the level of water Tank can be accomplished through the use of a level transmitter. By turning a pump ON or OFF we can control the level.

The mode operation of pump can be programmed as follows:

In manual Mode the pump will start first and after 2 second valve will open but before that the valve must be closed, checked the pressure and the water in the Tank is at any level except low.

In automatic Mode if the level of water in the Tank reaches a 25% of the full, the pump will start automatically and after 2 second, valve open with same constrain in manual mode. So that water can be discharge from the Tank, thus each increasing in the water amount, the pumps starting running consequently.

When the water level decreasing by 25% pumps will stop also consequently.

On the discharge side of the pump pressure is monitored by pressure indicator.

To ensure pumps are operating within the normal process operating range, and also to ensure they are not operated outside their allowable envelope.

When the pressure measuring device initiate (in discharging) very low value pressure alarm the system start shutting down the specific pump.

High pressure set points should be provided to initiate an alarm condition and showing that demand is low or less consumption, pressure set points will initiate pump shut down. One by one with specific time adjusted depending on pressure reading in the indicators. And if the tank is full and the pressure in the Network is very high the system will close the inlet valve and shut down the pumps with same sequence mentioned above.

4.4 .2 Flow Monitoring

Flow monitoring provided on the inlet and discharge side of the tank and pumps. Flow monitoring should indicate flow rate in and out in percentage.

4.4.3 Graphic View

The hardware structure graphic view features several views with different information within their detailed levels. Figure 4.14

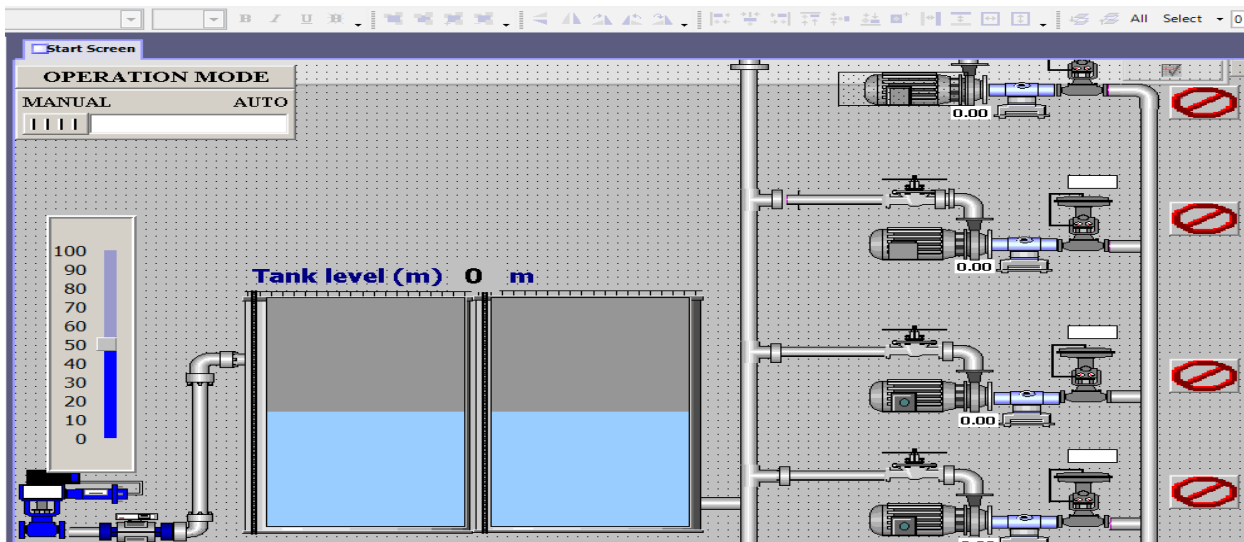


figure 4.14 the project system graphic

4.5 Simulation

System checkout and troubleshooting are critical tasks before the final deployment and commissioning of any process-control/automation system. These tasks must be performed according to well-established rules and documented procedures.

These rules/procedures are designed carefully to prevent any potential problems that might cause personnel injuries or damage to resources or compromise any of the predefined process/end-product qualities. Simulation and emulation techniques are used throughout the implementation phases of the project prior to the final checkout. Simulation tools allow designers to examine system-performance

situations under varying scenarios before or aside from the actual implementation. These steps also can be used to efficiently verify design concepts prior to the commitment of resources. Emulation phases are accommodated in PLC software-development tools that allow the user to emulate I/O hardware, HMIs, control logic, and communication facilities. The initial phase of emulation checks only the control logic, whereas the second phase includes actual and simulated hardware/interfaces. The final emulation phase uses actual system hardware, interfaces, and communication resources. Simulation of the program Figure 4.15 using the SCADA simulator. The program is running according to the process description.

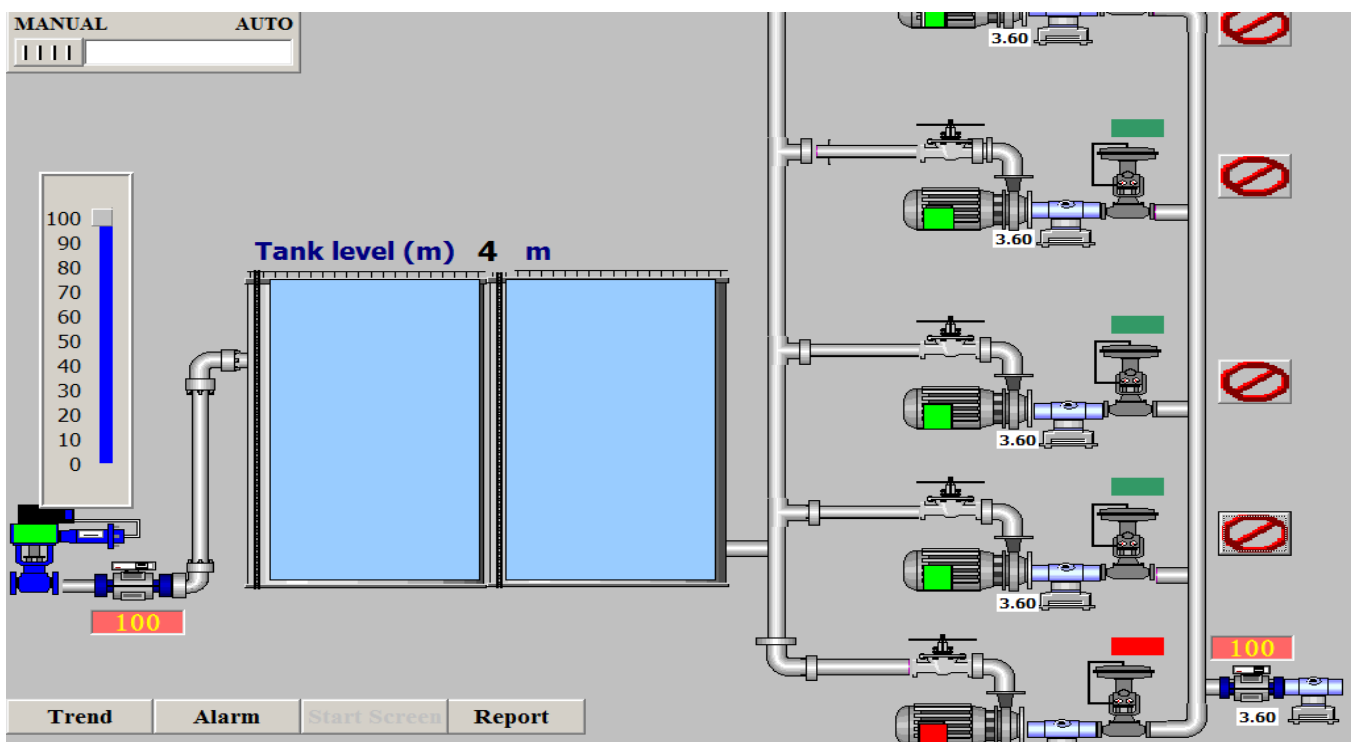


Figure 4.15 Simulation of the ALSAHAFA pumping station

5.1 Result

The various results obtained in the research are presented here. Using PLC and SCADA various sensors are connected in the developed system. The following tables indicate the number of inputs and outputs as well as alarms and trends.

Table 5.1 Inputs

Input	Data type
Start	BOOLEAN
Stop	BOOLEAN
Tank Level	BOOLEAN
Inlet flow meter	WORD
Pressure p1	Real
Pressure p2	Real
Pressure p3	Real
Pressure p4	Real
Pressure p5	Real
slider inlet less than 25	BOOLEAN
slider inlet less than 50	BOOLEAN
slider inlet less than 75	BOOLEAN
slider inlet less than 100	BOOLEAN

Table 5.1 Output:

Output	Data type
Open / close valve 1 manual	BOOLEAN
Open / close valve 2 manual	BOOLEAN
Open / close valve 3 manual	BOOLEAN
Open / close valve 4 manual	BOOLEAN
Open / close valve 5 manual	BOOLEAN
Open / close valve 5 manual	BOOLEAN
Open/close VALVE_1 auto	BOOLEAN

Open/close VALVE_2 auto	BOOLEAN
Open/close VALVE_3 auto	BOOLEAN
Open/close VALVE_4 auto	BOOLEAN
Open/close VALVE_5 auto	BOOLEAN
pump 1 manual discharge	BOOLEAN
pump 1 manual discharge	BOOLEAN
pump 1 manual discharge	BOOLEAN
pump 1 manual discharge	BOOLEAN
pump 1 manual discharge	BOOLEAN
Outlet flow= 25	BOOLEAN
Outlet flow= 50	BOOLEAN
Outlet flow= 75	BOOLEAN
Outlet flow = 100	BOOLEAN
Pressure outlet	Real
run 1 pump auto	BOOLEAN
run 2 pumps auto	BOOLEAN
run 3 pumps auto	BOOLEAN
run 4 pumps auto	BOOLEAN
replace pump 1	BOOLEAN
replace pump 2	BOOLEAN
replace pump 3	BOOLEAN
replace pump 4	BOOLEAN
replace pumps	BOOLEAN

Table 5.3 Output Alarming

Output	Data Type
disable pump 1	BOOLEAN
disable pump 2	BOOLEAN
disable pump 3	BOOLEAN
disable pump 4	BOOLEAN
Outlet pressure high	BOOLEAN
Tank full	BOOLEAN
pump 1 pressure 0	BOOLEAN
pump 2 pressure 0	BOOLEAN
pump 3 pressure 0	BOOLEAN

5.2 Discussion

- The plant switched off from classic control to automatic control operation and all inputs and outputs associated with the process-control system and must be listed in the I/O table along with the associated instrumentation.
- On commissioning an engineering project from the generation to the operation of the plant is generally composed of the four phases. The SIMATIC software has given optimum support in the testing and commissioning phase with testing and diagnostic functions with commissioning process. LD language the program is displayed in the same way as in configuration except that in commissioning mode the program cannot be modified structurally.
- Real value in table 5.1 is initially displayed directly with their Real number Boolean values (binary values) are initially displayed directly with their logical state of 1 or 0.

Logical 1 true

Logical 0 false

- Most PLC system faults occur in the field wiring and devices.
- Mechanical switches can wear out or be damaged during normal operation.
- Input and output field devices must be compatible with the I/O module to ensure proper operation.
- When a problem occurs, the best way to proceed is to try to logically identify the devices or connections that could be causing the problem rather than arbitrarily checking every connection.
- First, observe the system in operation and try to describe the problem. Using these observations and the description of the control system, you should identify the possible sources of trouble. Compare the logic status of the hardwired inputs and outputs to their actual state. Any disagreements indicate malfunctions as well as their approximate location.
- Some of troubleshooting can be accomplished by interpreting the status indicators on the I/O modules. The key is to know whether the status indicators are telling you that there is a fault or that the system is normal.
- . Define the basic system architecture, identifying and explaining any deviations from standard models.
- All alarms must be latched until the Operator has acknowledged them; Valve and equipment status should use a consistent method of symbols and colors, whether the status is indicated through lamps or on a color computer screen. The color-coding scheme should be consistent with any existing equipment displays elsewhere in the plant.
- The range the pressure transmitter should be chosen so that it will normally operate at specific number the pressure sensor should not be zero value. This will provide some safety margin for the pumps.

- Monitoring of the system discharge flow can be useful in identifying possible problems in the discharge piping or force main and in monitoring pump performance. The pressure-metering device should be connected to the each pump.
- The flow metering element should be selected carefully to ensure that there are no obstructions.

6.1 CONCLUSION

- In this research an automation system of process parameters in ALSAHAF water pumping station was developed using WINCC flexible to start run time of the system and PLC S7-300 as controller.
- The WINCC flexible run time was used to develop the simulation design of the system; a Programmable logic controller from Siemens s7-300 was used as main brain for the system and the resulting was very satisfying. Several factors should be considered when developing a plan for the instrumentation and controls. Instrumentation and control requirements will also depend on the size of the plant, and as each process has its own set of conditions to be monitored and controlled there will be different technical requirements to be met. In general, instrumentation and control should provide efficient and safe automatic and manual operation of all plant systems with a minimum of operator effort.
- The PL|C&SCADA based system is a multipurpose system with extensive scope for modification. The plant status, alarms, motor starters, and all parameters are all wired into input/output cards located in what are called racks. The racks may be mounted separately or placed in specific plant areas to reduce wiring costs. Changes can generally be made relatively easily by modification of or addition to the PLC controller programs.
- PLC control systems have been designed to be easily installed and maintained. Troubleshooting is simplified by the use of fault indicators and messaging displayed on the programmer screen. Input/output modules for connecting the field devices are easily connected and replaced.

6.2 RECOMMENDATIONS

For further future development of this system, the following recommendation could be considered:

- Adding self checking feature for the hardware by choosing some smart CPUs may serve quite intelligence to the system and more reliability (possible faults and failure by mean self diagnosis).
- In operation and maintenance phase provision for installing Tele service tool station in online telephone connection with a plant allowing you to perform remote diagnosis and capability of changing the user program at any time.
- Provision for adding positioners for each valve for smooth opening and closing.

The communication protocol must meet the following requirements:

- It must include error checking and reporting, to ensure that data is correctly transferred from one component to another;
- The components of the system must detect the failure of the communication system (either between individual components of the system or between the system and the operator); and
- It must be compatible with a variety of manufacturer's instruments and equipment, in order to allow for expansion of the system.
- Provision for mimic board (that the operator interface may consist of a local hard wired control panel, character based input/output panel, personal computer or workstation depending on system size, process complexity, control system functions and operator interface manufacturer.

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APPENDICES

This appendices details the steps needed to create a project and simulate it using the WINCC flexible 2008, SIMATIC MANAGER and development software as well as previous studies.

It can help through the detailed tasks involved in the implementation, simulation, and testing of typical industrial automation tasks. The focus here is on the graphical user interface, including both command and status.

Appendix A: previous studies:

1. UDC 621.225.4

Slavic Prvulović¹, ragiša Tolmač¹, Ljubiša Josimović², Jasna Tolmač¹ Technical Faculty "Mihajlo Pupin" Zrenjanin, University of Novi Sad, Serbia
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derricktiew001@unisim.edu.sg.

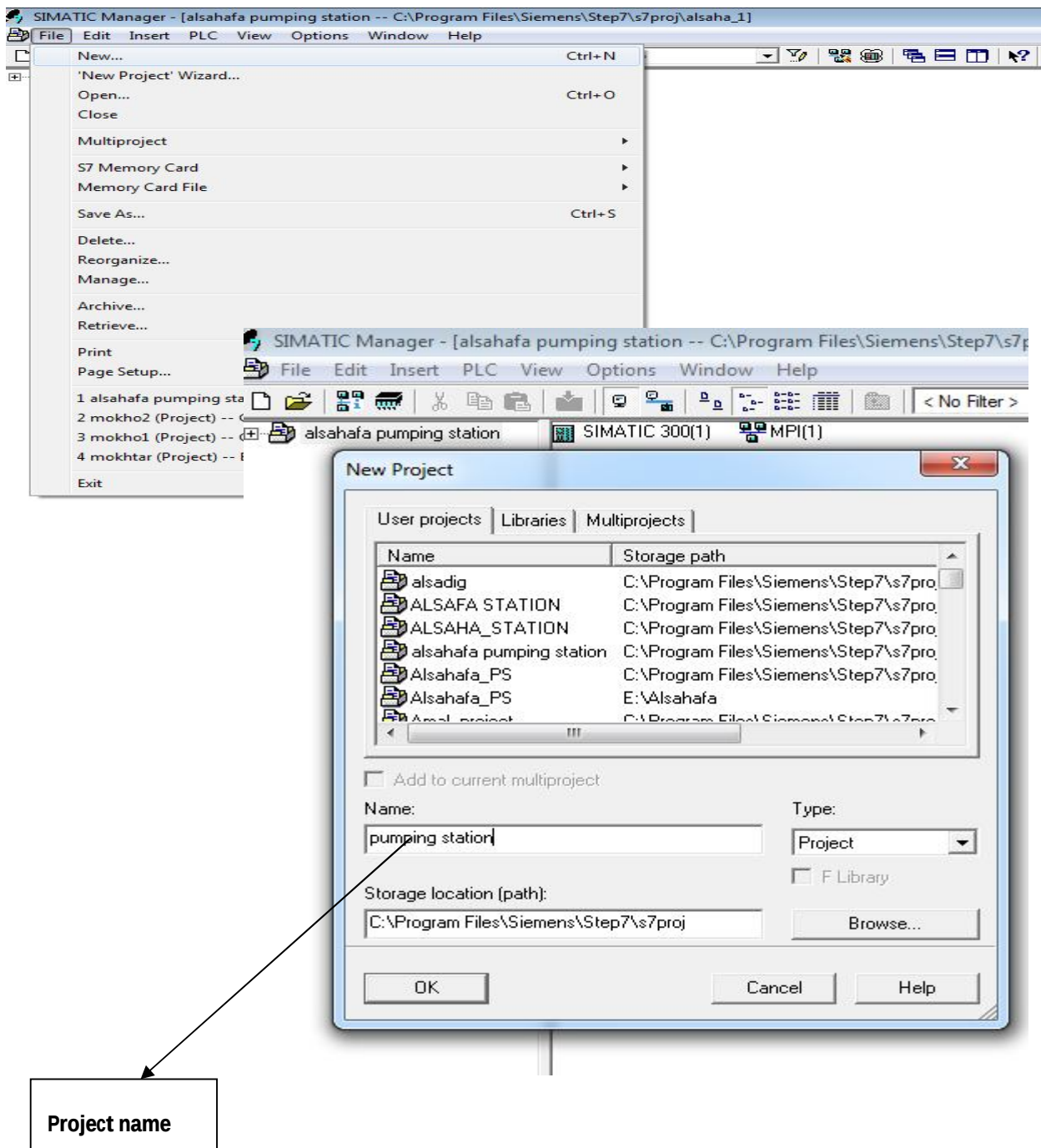
3. IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE)e-
ISSN: 22781676,p-ISSN: 2320-3331, Volume 7, Issue 2 (Jul. -Aug. 2013),
PP 61-67

www.iosrjournals.org.

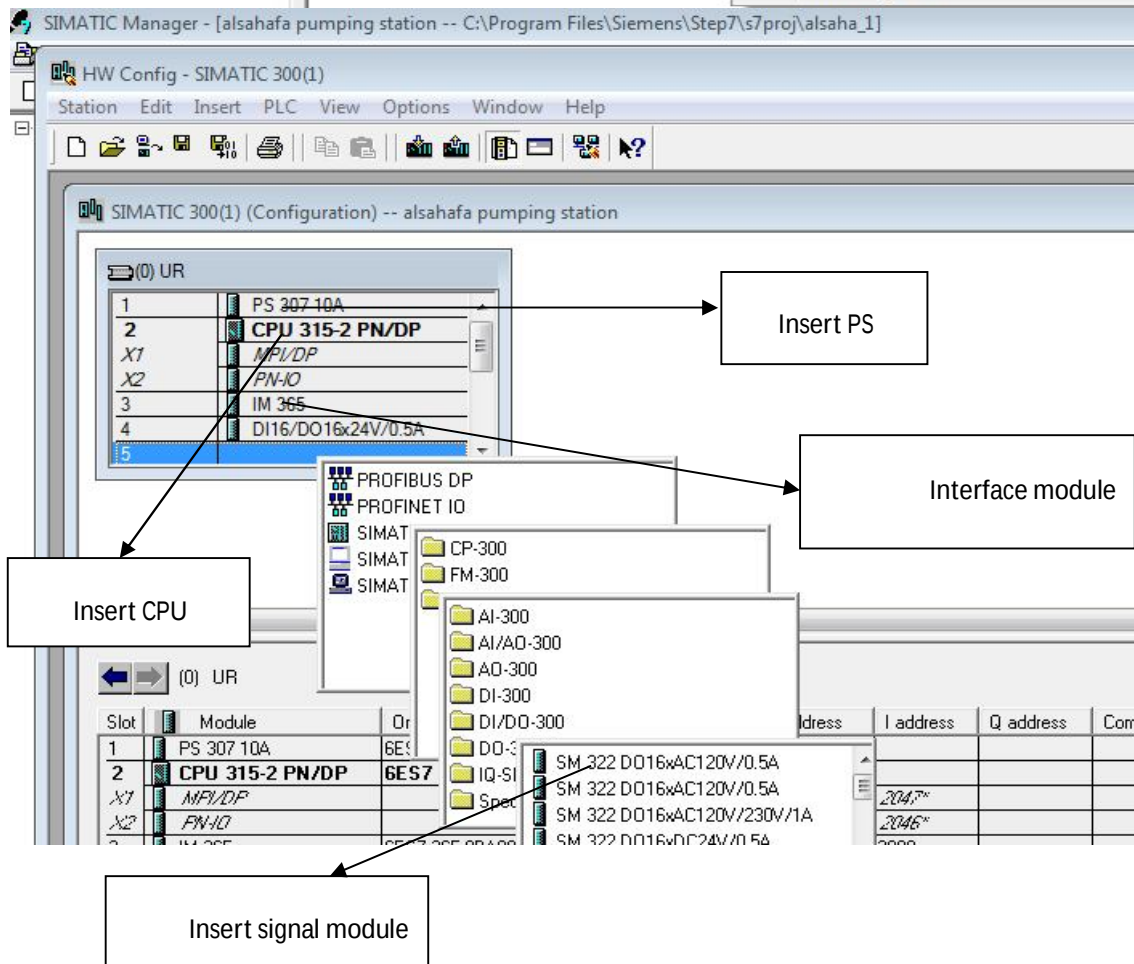
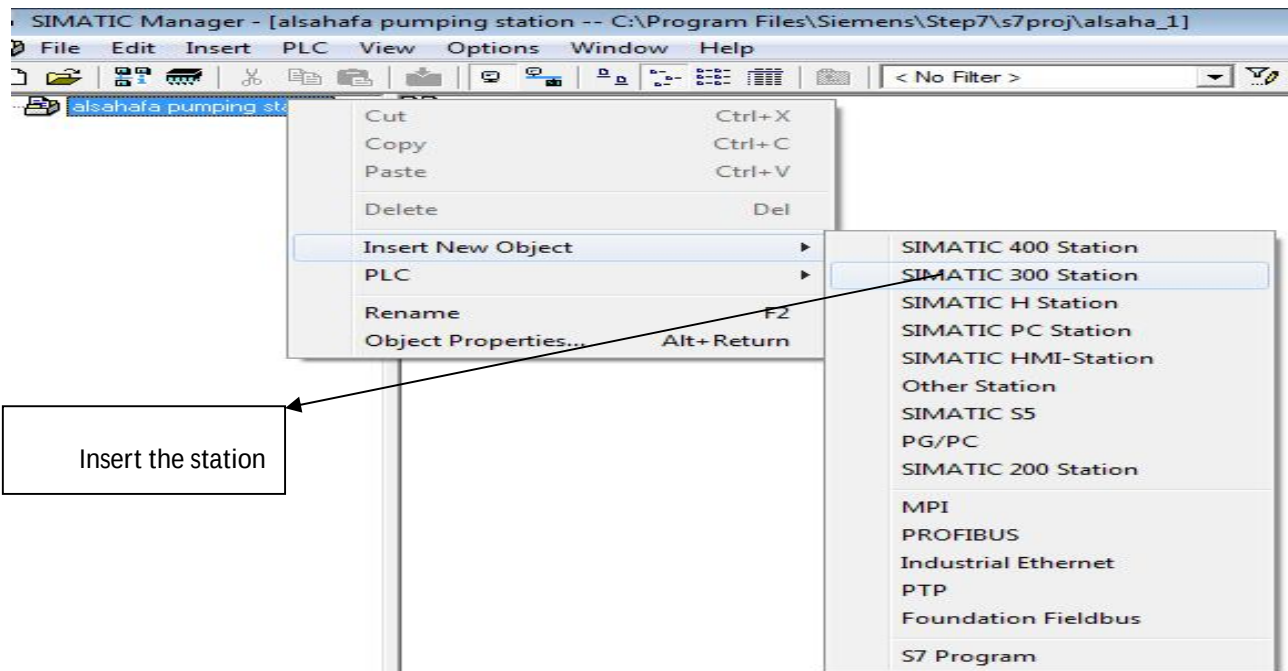
4. Wang Xibin

Proceedings of the 2012 Second International Conference on Electric Information and Control Engineering - Volume 02; 04/2012

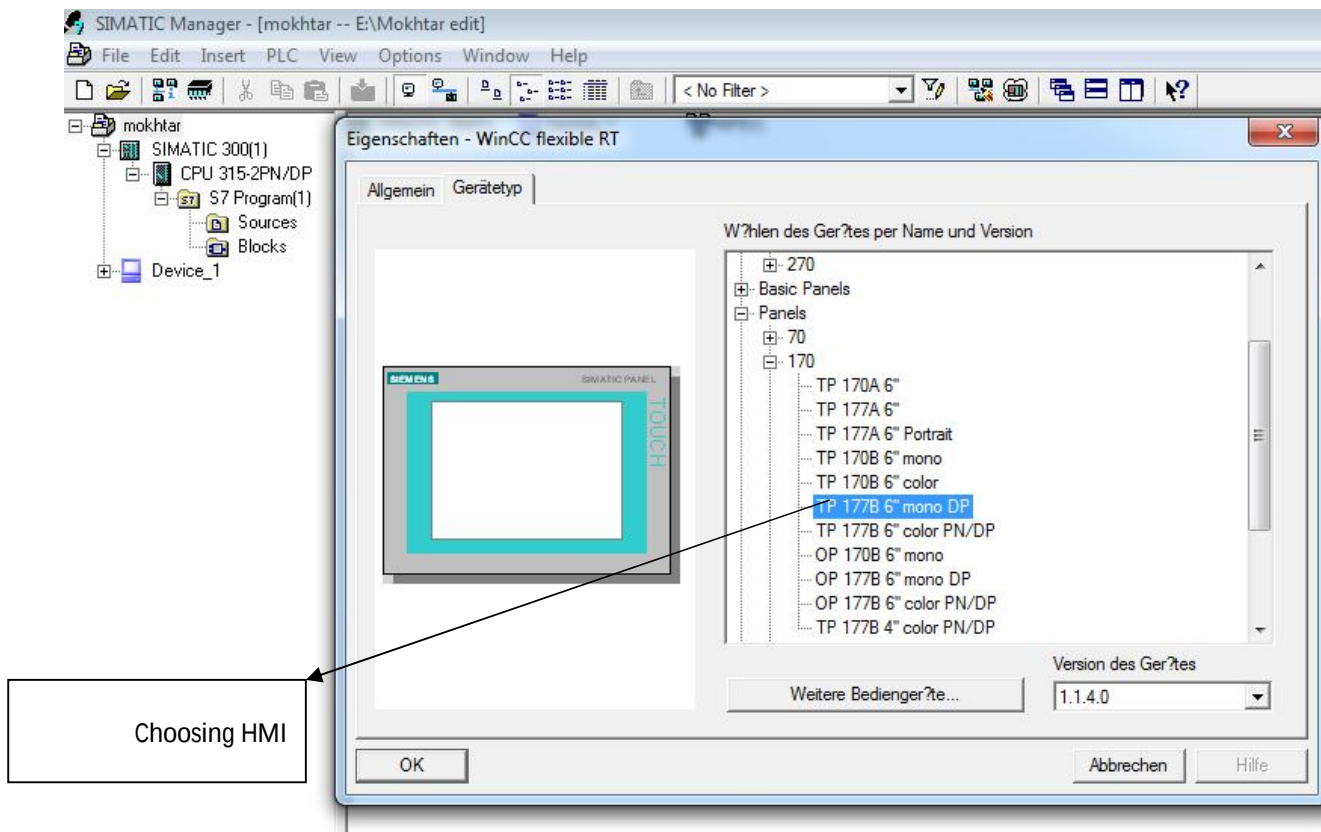
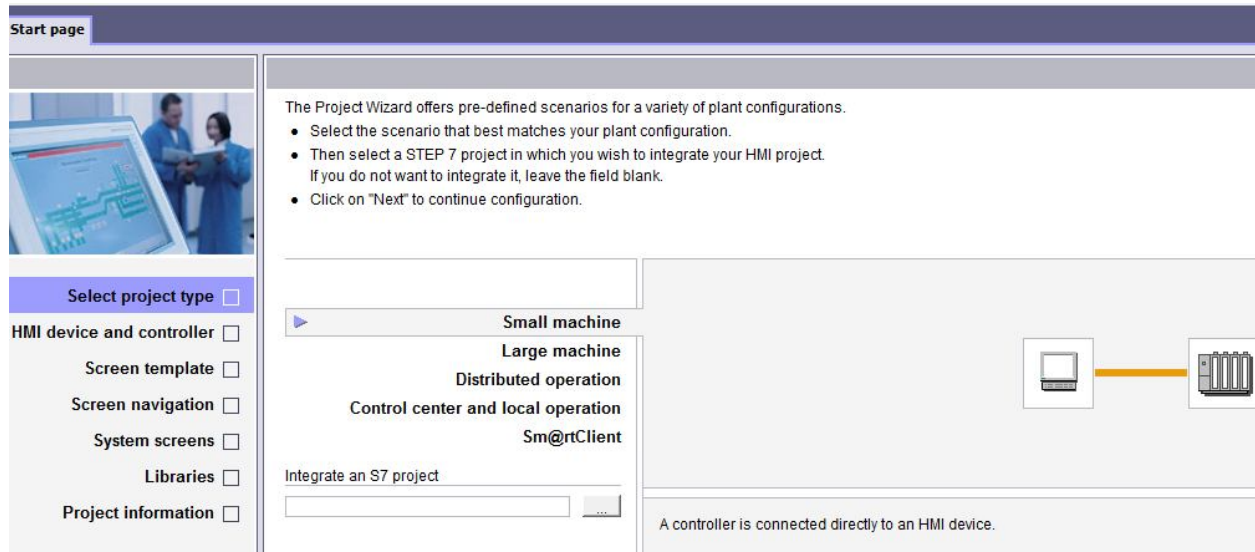
Appendix B: creating new project

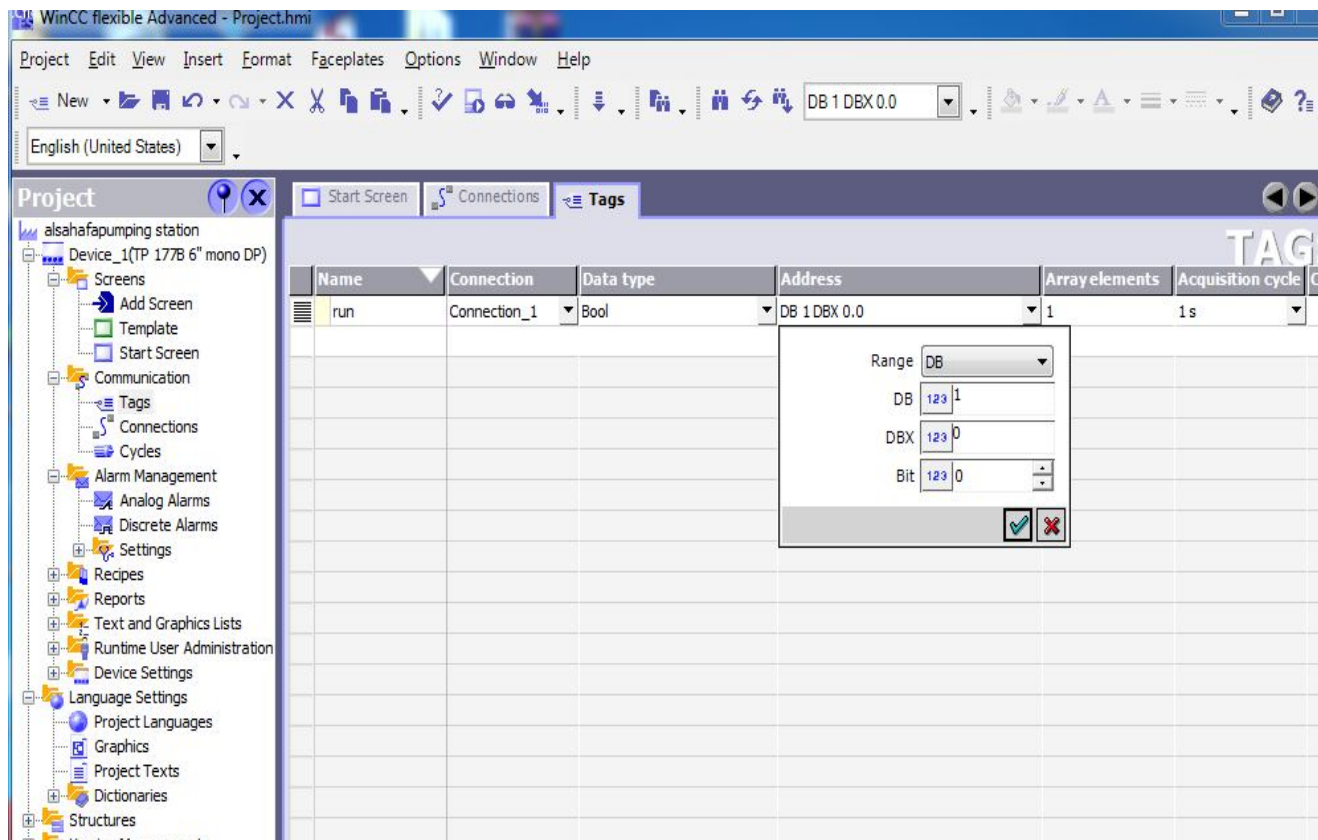
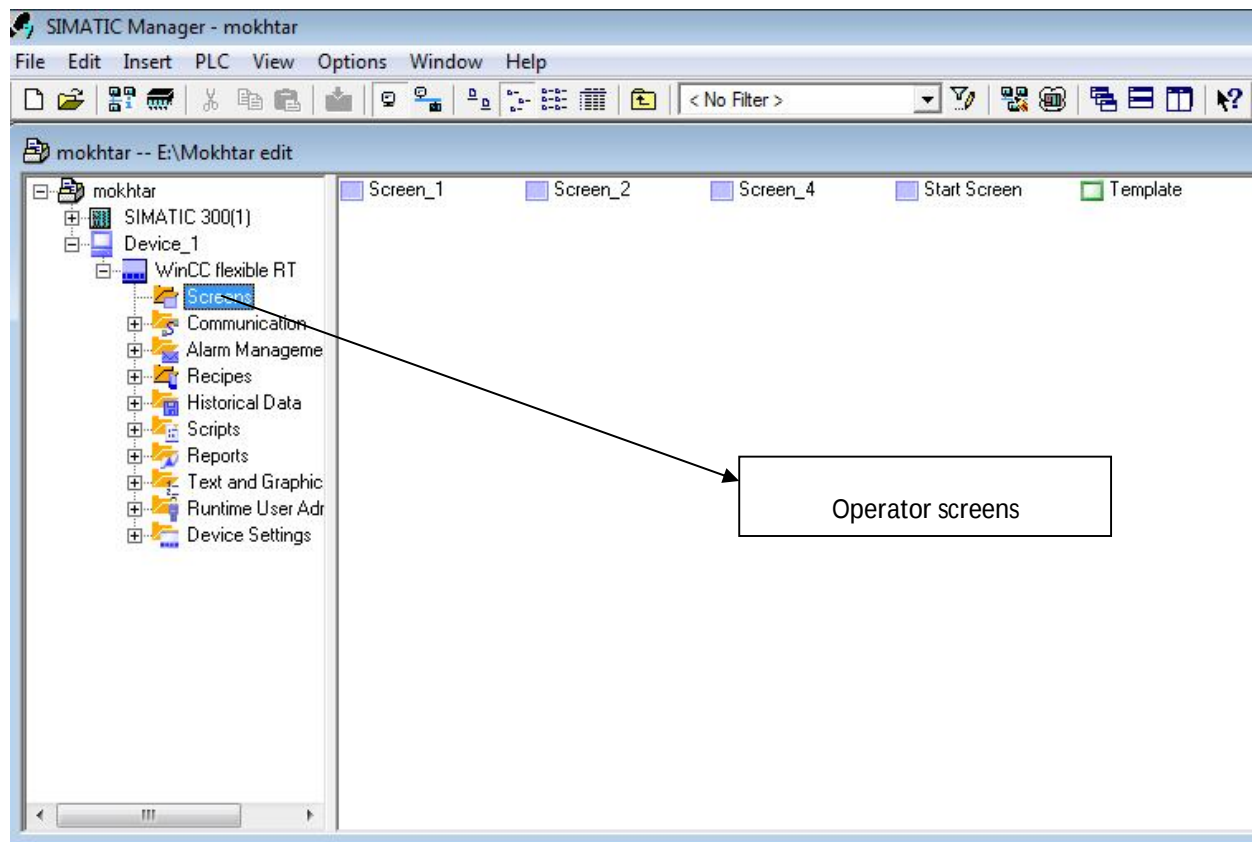


Appendix C: Starting the Project H.W Config.



Appendix D: Create Operator Station





SIMATIC Manager - mokhtar

File Edit Insert PLC View Options Window Help

WinCC flexible Advanced - mokhtar - Device_1

Project Edit View Insert Format Faceplates Options Window Help

English (United States)

Project

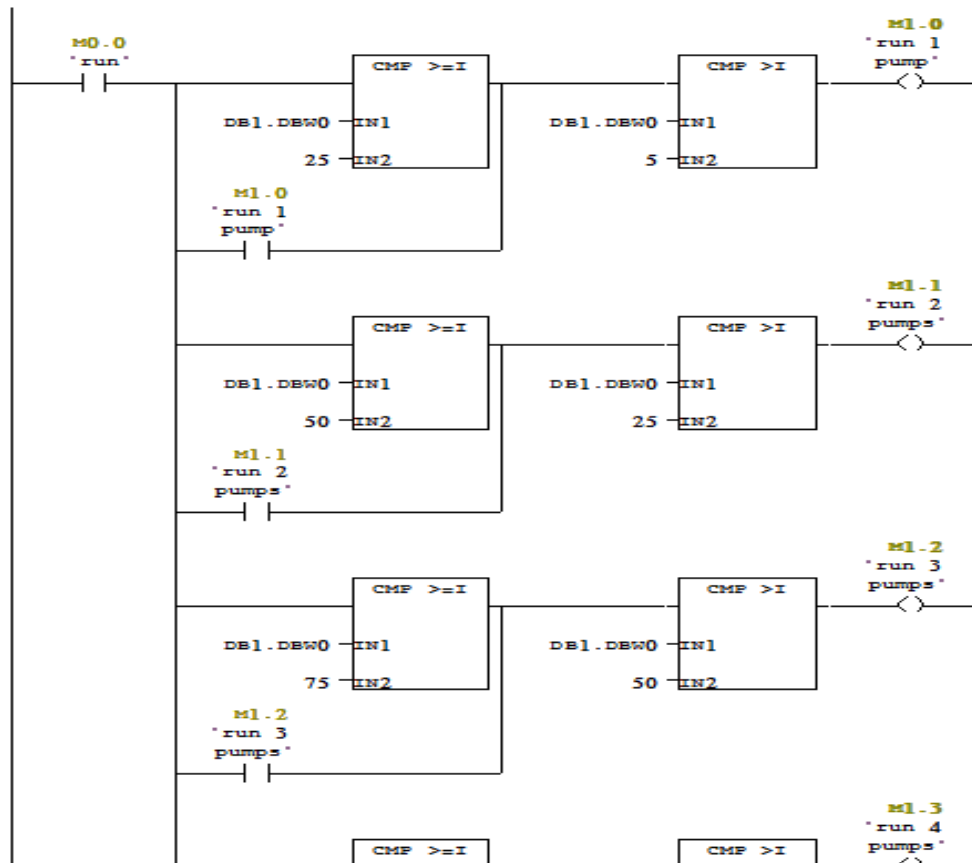
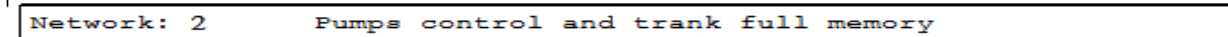
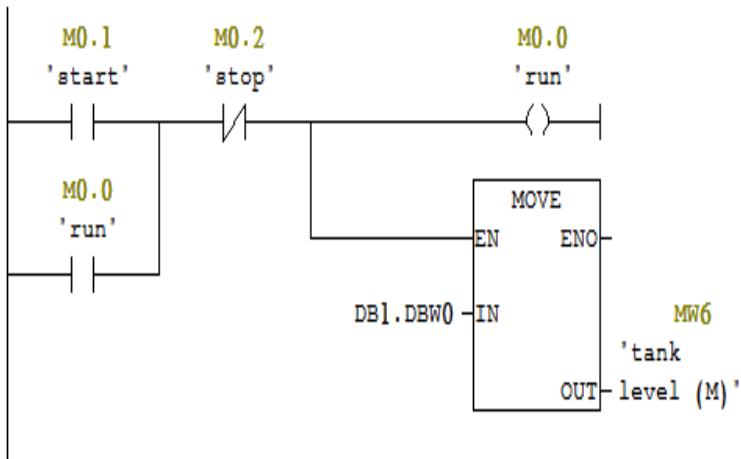
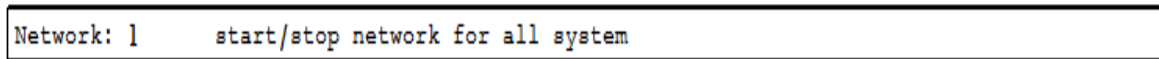
Start Screen Discrete Alarms

DISCRETE A

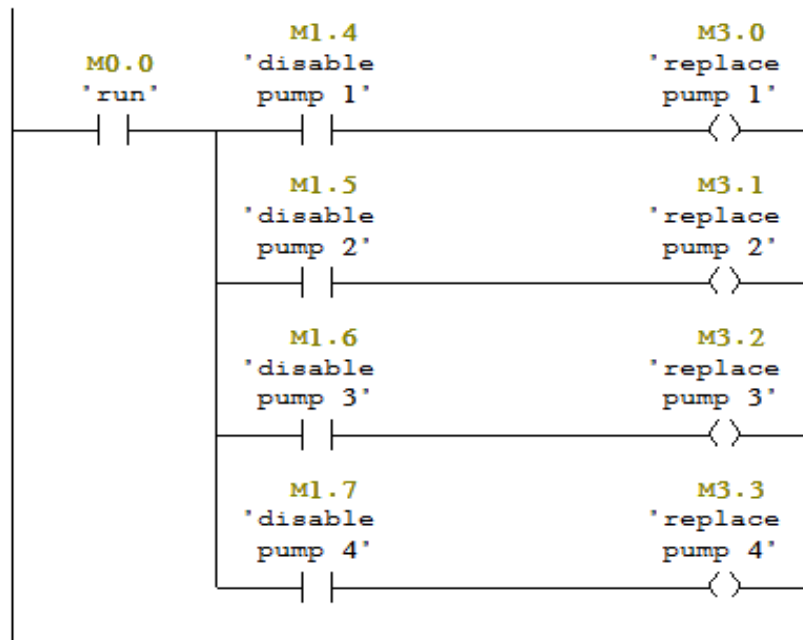
Text	Number	Class	Trigger
Pump 1 fault check pump 1	1	Errors	alarms
Pump 2 fault check pump 2	2	Errors	alarms
Pump 3 fault check pump 3	3	Errors	alarms
Pump 4 fault check pump 4	4	Errors	alarms
pump 1 pressure= 0 no water or check pump	5	Errors	alarms
pump 2 pressure= 0 no water or check pump	6	Errors	alarms
pump 3 pressure =0 no water or check pump	7	Errors	alarms
pump 4 pressure =0 no water or check pump	8	Errors	alarms
pump 5 pressure= 0 no water or check pump	9	Errors	alarms
outlet pressure is upnormal	10	Errors	alarms

Alarm management

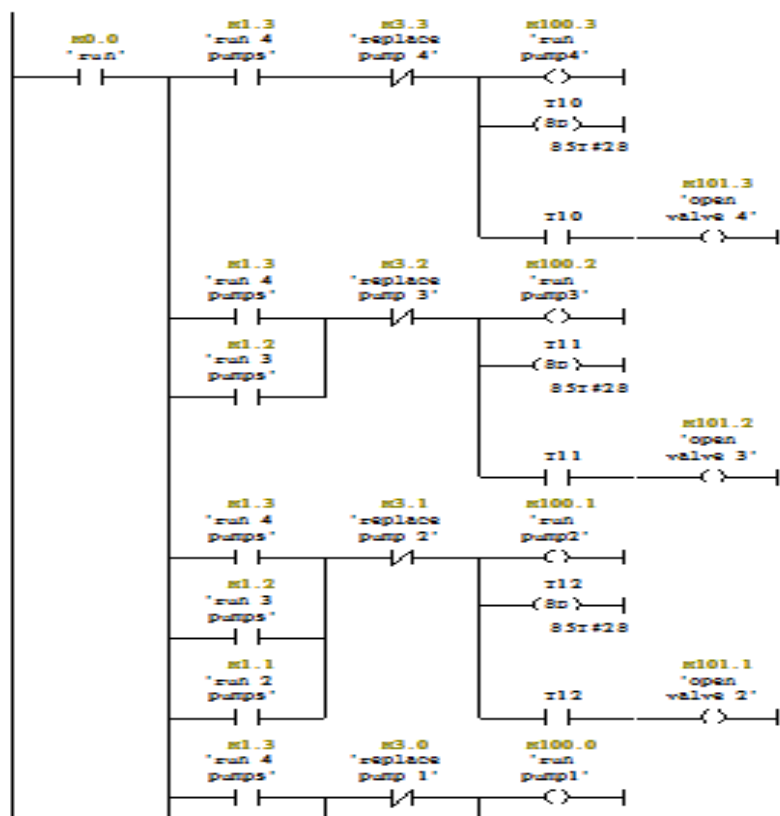
Appendix E: System Code (ladder diagram)

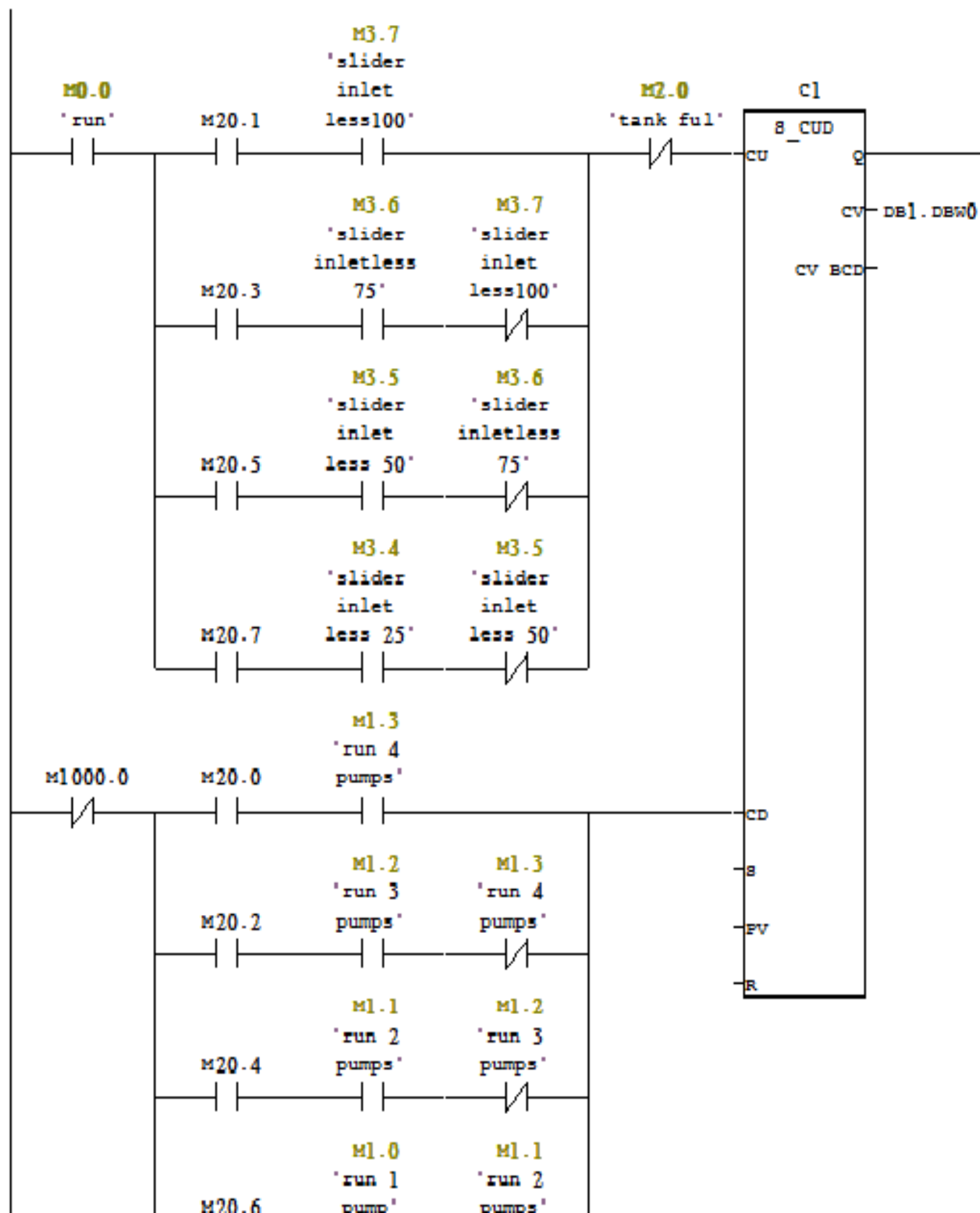


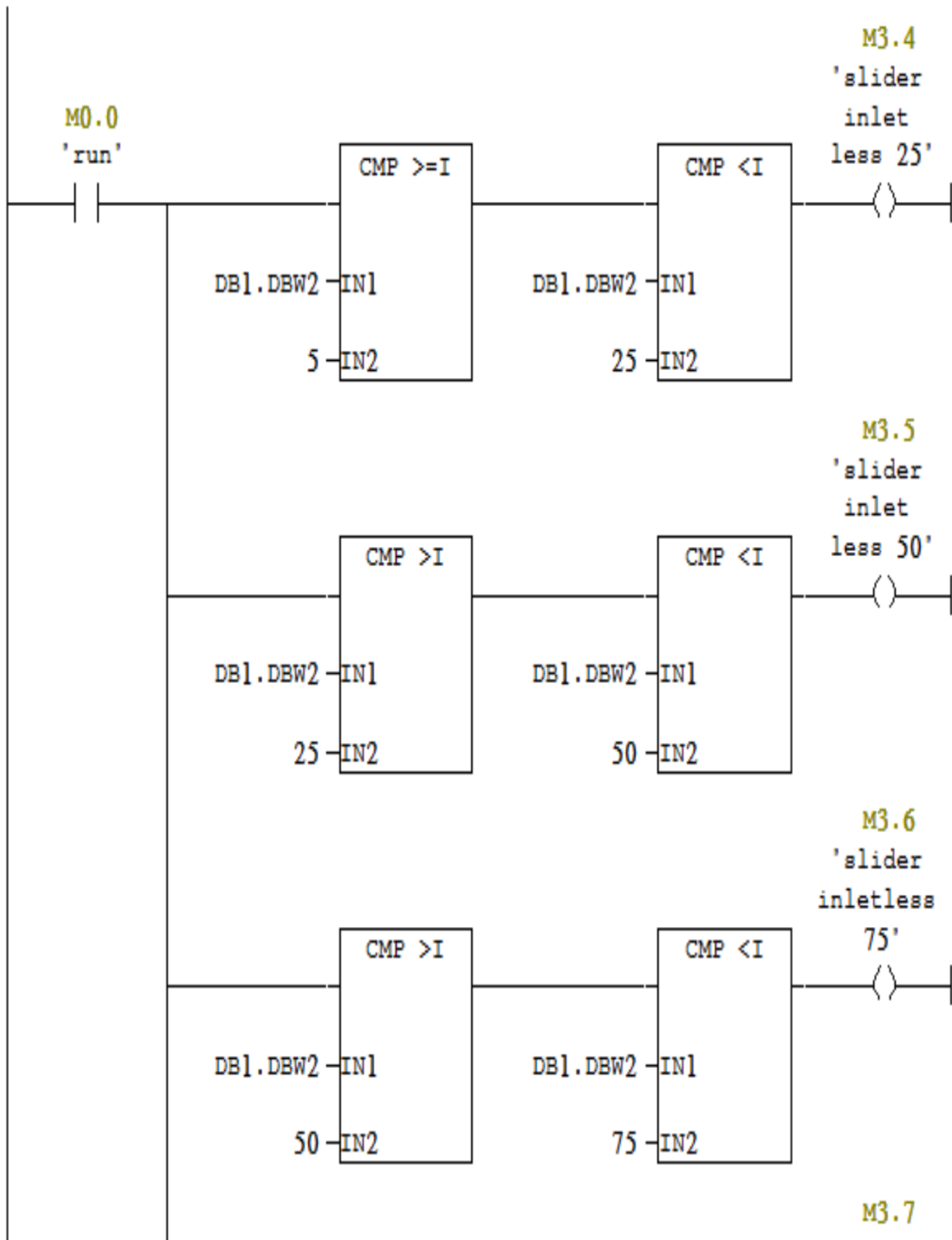
Network: 3 when any pump disable activate replace pump memor



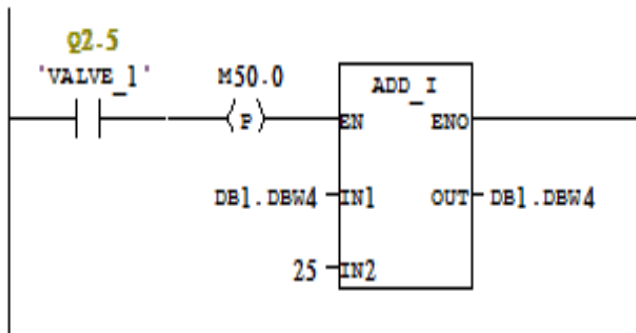
Network: 4 any pump energized in case of tank level and valve control



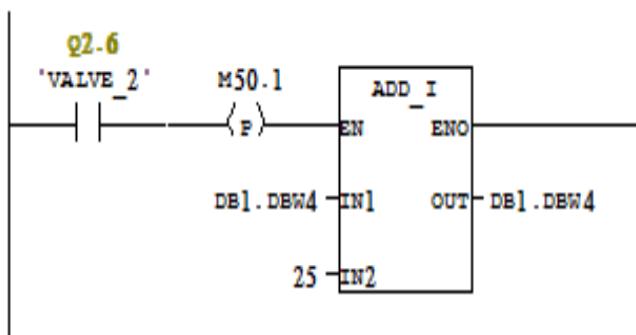




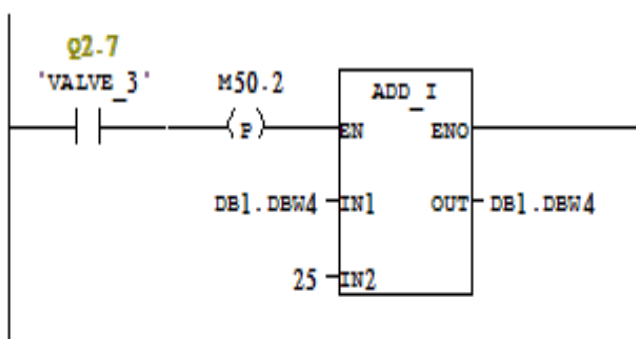
Network: 7 add pump 1 flow rate after valve 1 open



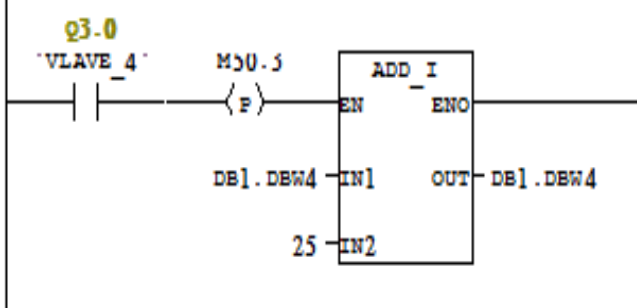
Network: 8 add pump 2 flow rate after valve 2 open



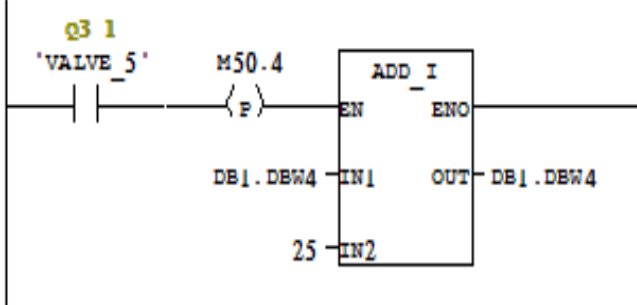
Network: 9 add pump 3 flow rate after valve 3 open



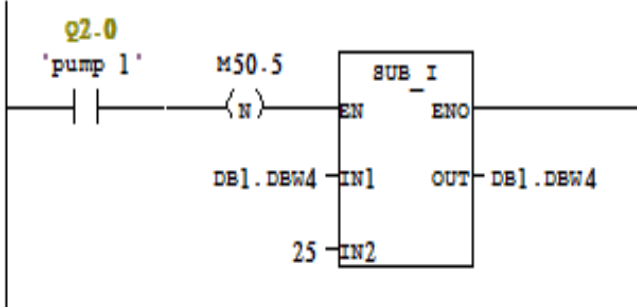
Network: 10 add pump 4 flow rate after valve 4 open



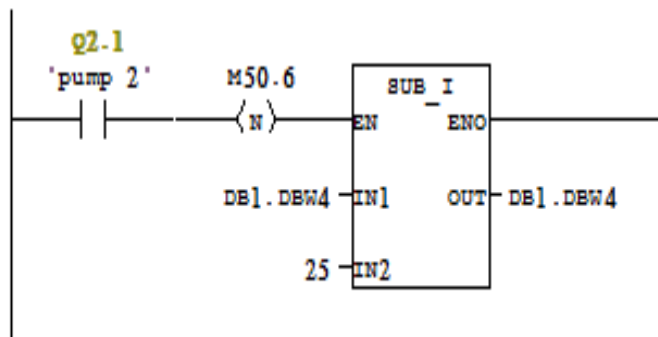
Network: 11 add pump 5 flow rate after valve 5 open



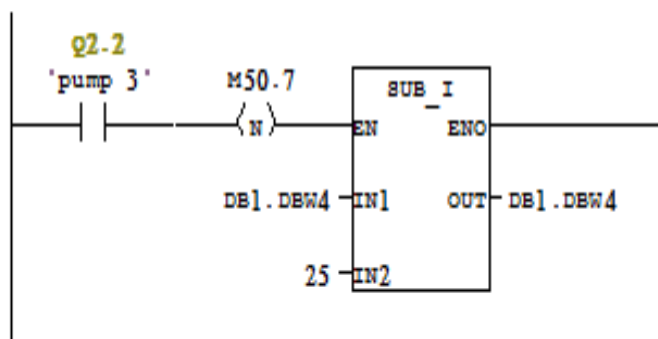
Network: 12 SUB pump 1 flow rate after valve 1 open



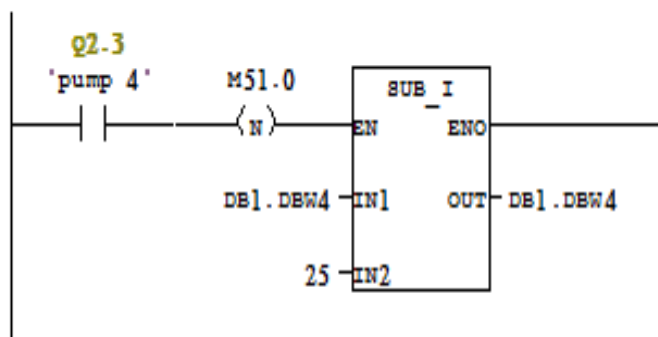
Network: 13 SUB pump 2 flow rate after valve 2 open



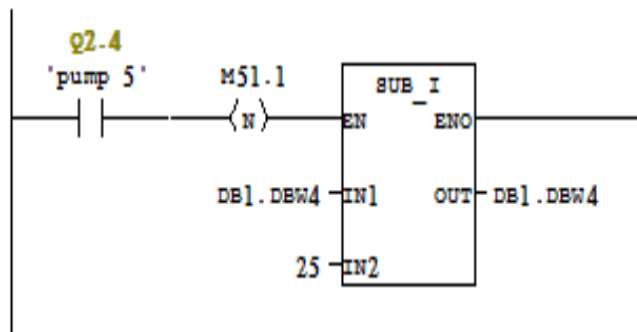
Network: 14 SUB pump 3 flow rate after valve 3 open



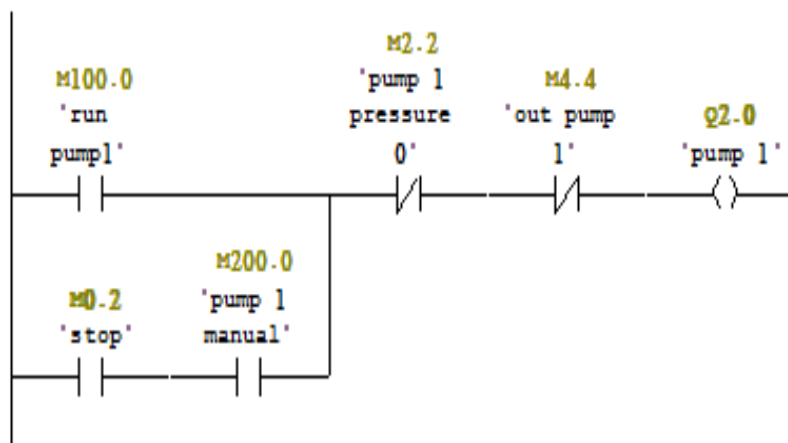
Network: 15 SUB pump 4 flow rate after valve 4 open



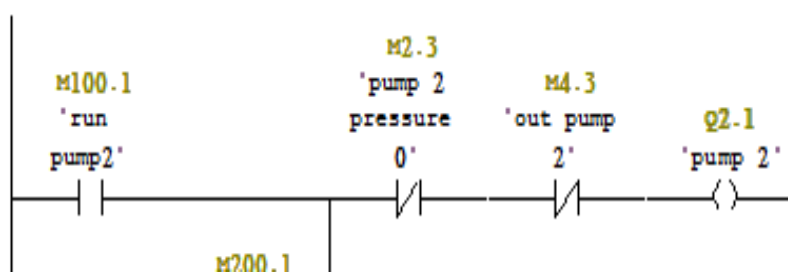
Network: 16 SUB pump 5 flow rate after valve 5 open



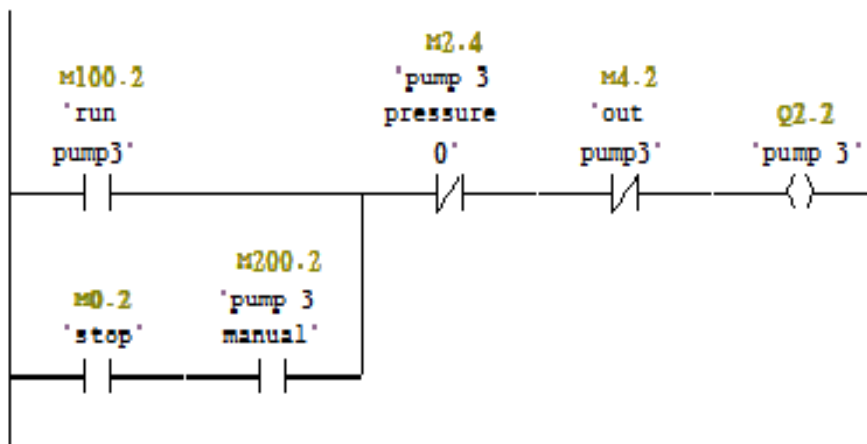
Network: 17 run pump 1 output auto/ manual



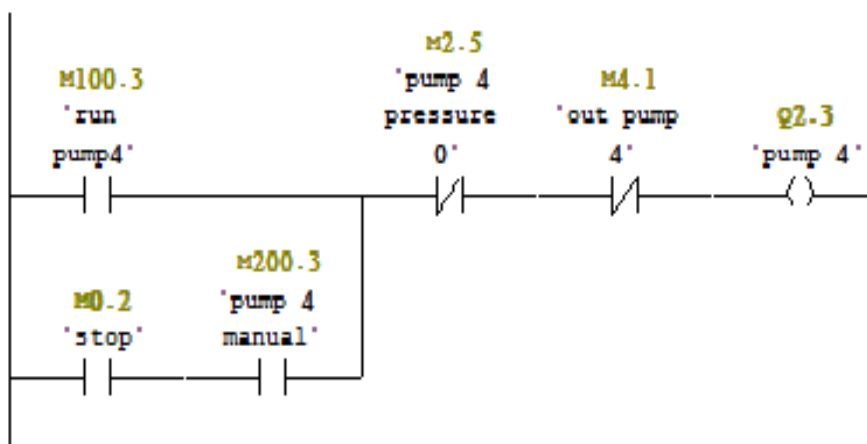
Network: 18 run pump 2 output auto/ manual



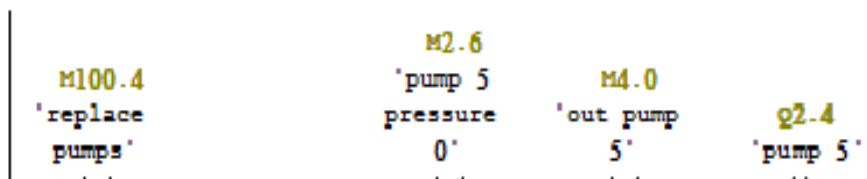
Network: 19 run pump 3 output auto/ manual

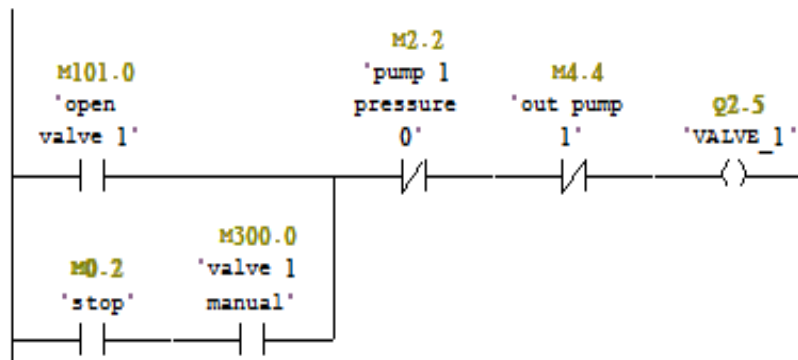
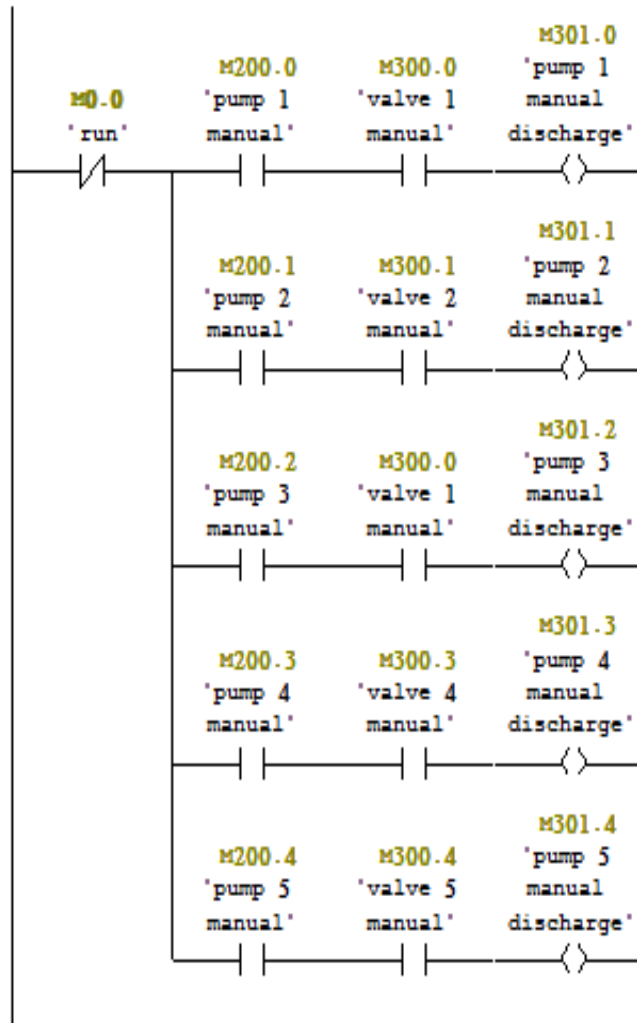


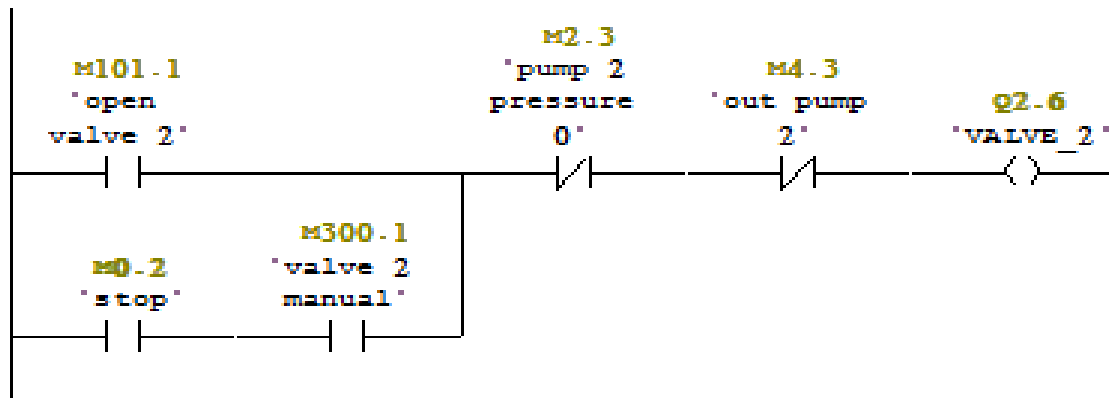
Network: 20 run pump 4 output auto/ manual



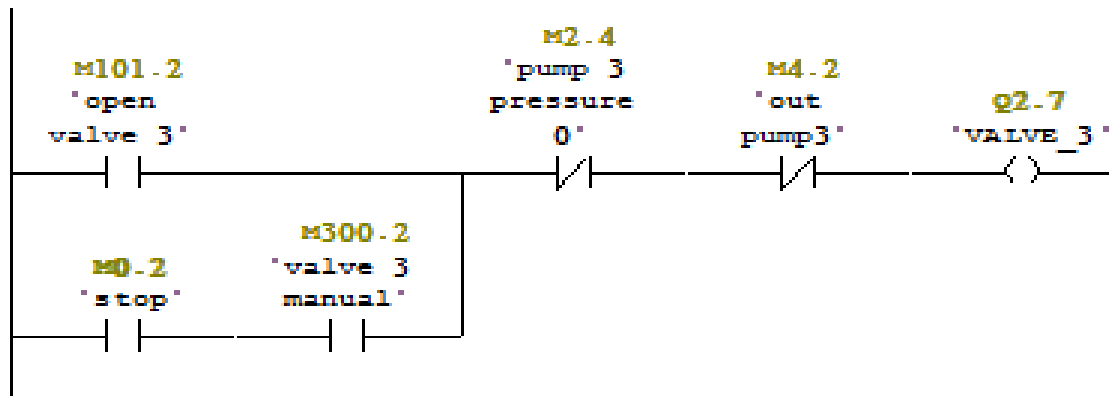
Network: 21 run pump 5 output auto/ manual



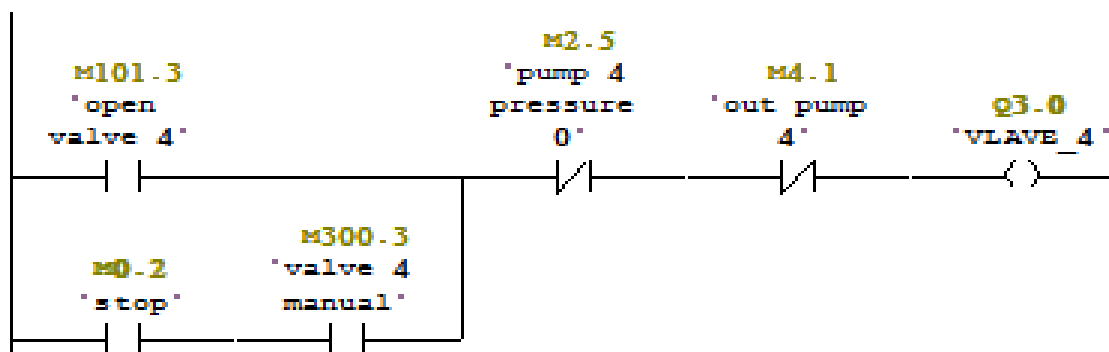




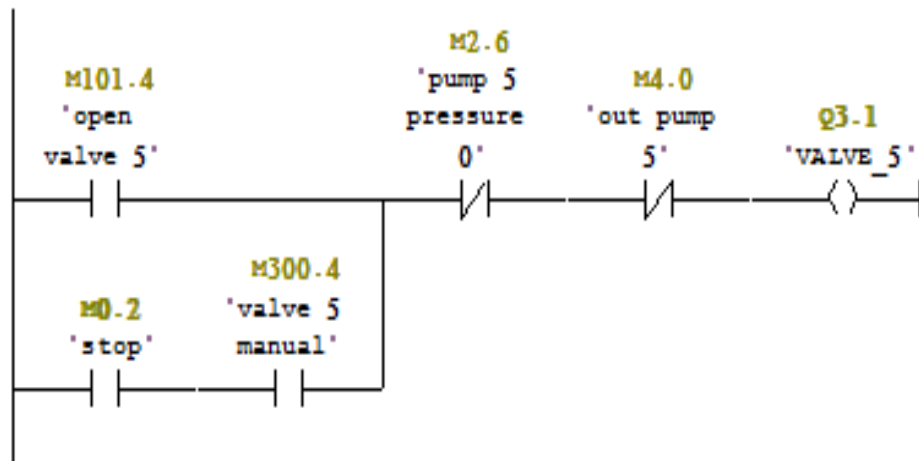
Network: 25 open valve 3 auto/ manual



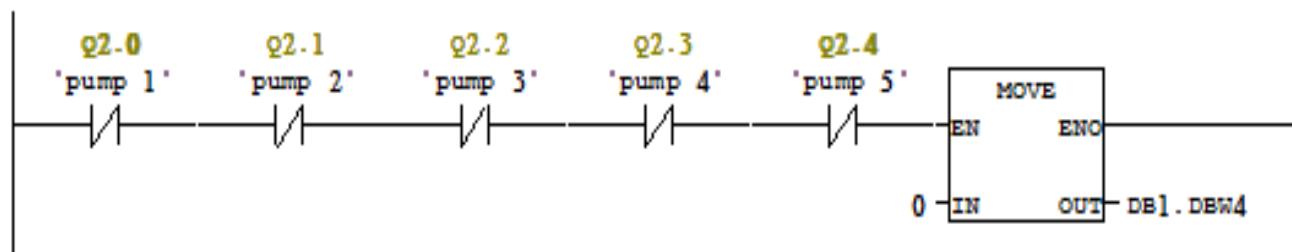
Network: 26 open valve 4 auto/ manual



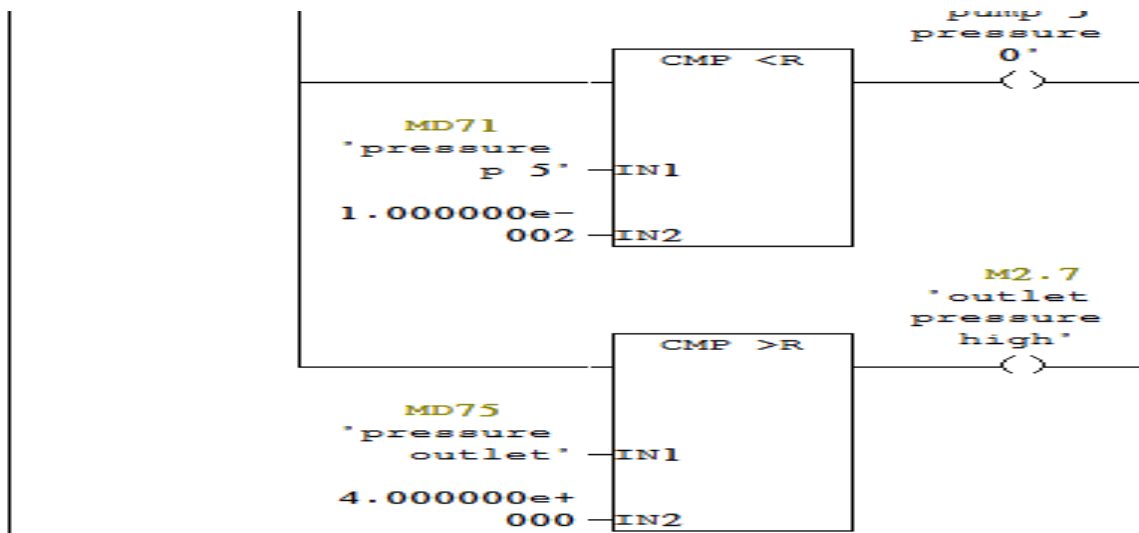
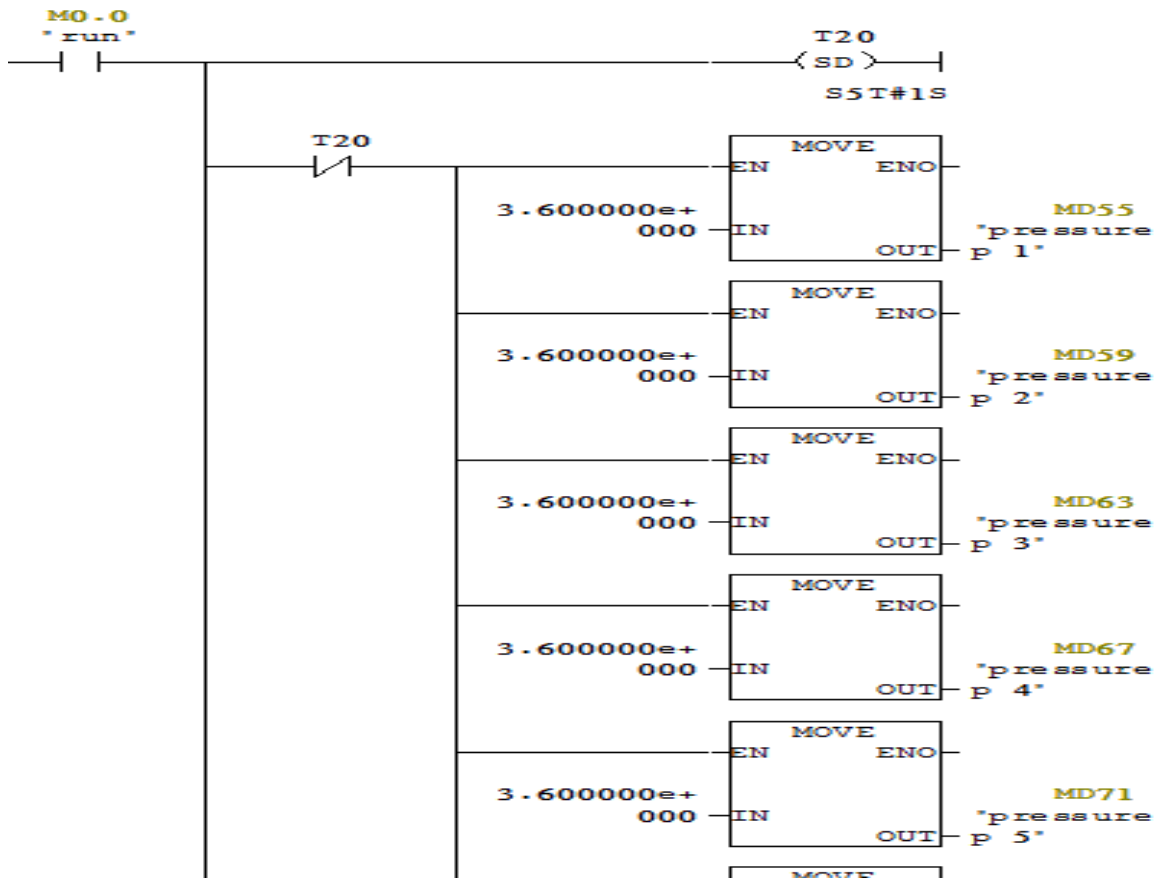
Network: 27 open valve 5 auto/ manual



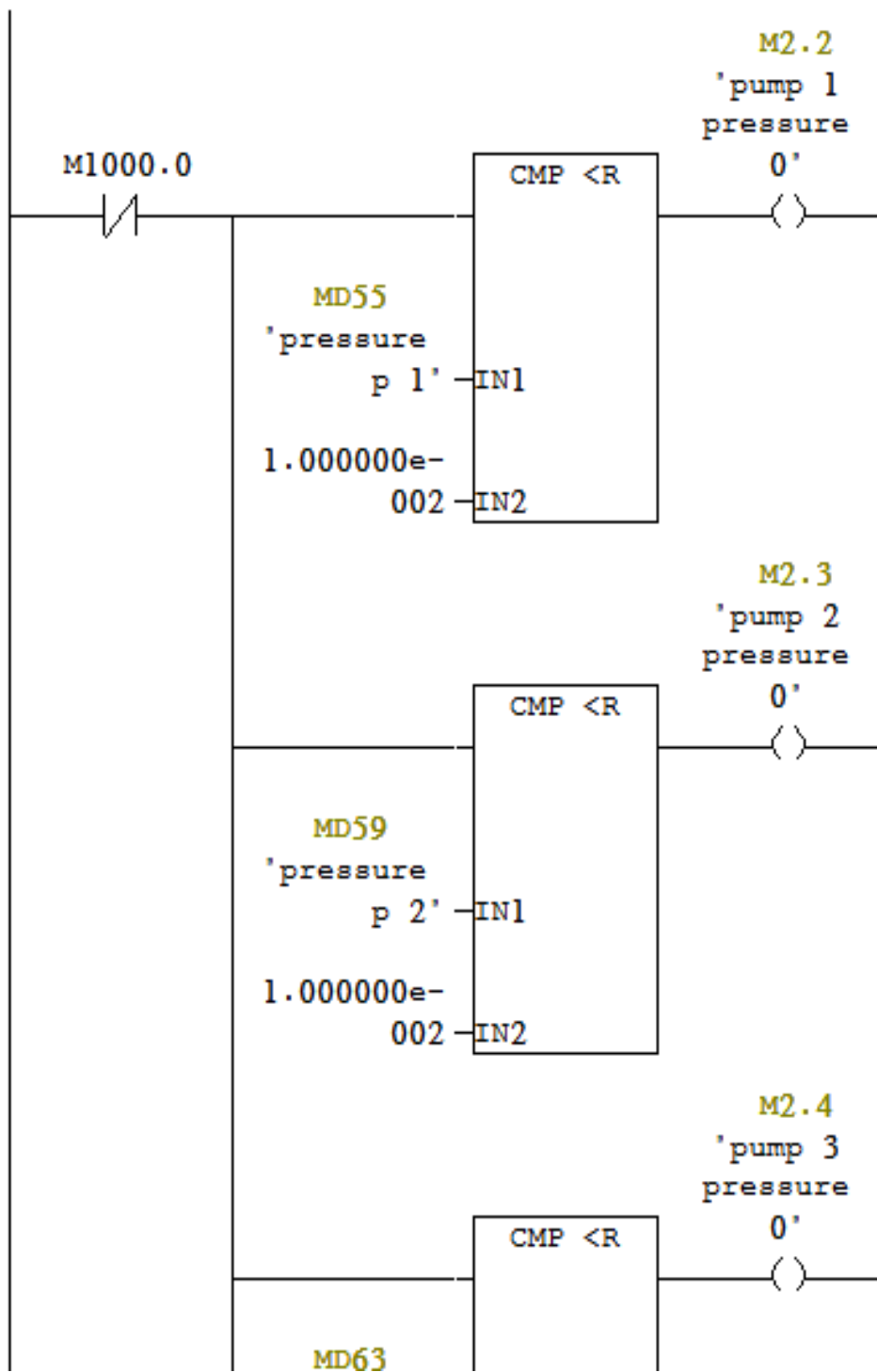
Network: 28



t default pressure for all pumps



pump pressure check + outlet pressure ckeck



The flow chart

