INTERNATIONAL INSTITUTE FOR ADVANCED TRAINING ON CONTROL & AUTOMATION

A PROJECT ON

HYPER GLASS CLEANER

PREPARED BY
MOHAMMED SALMAN AZIM

REGISTRATION NO.
QA143941

INTRODUCTION

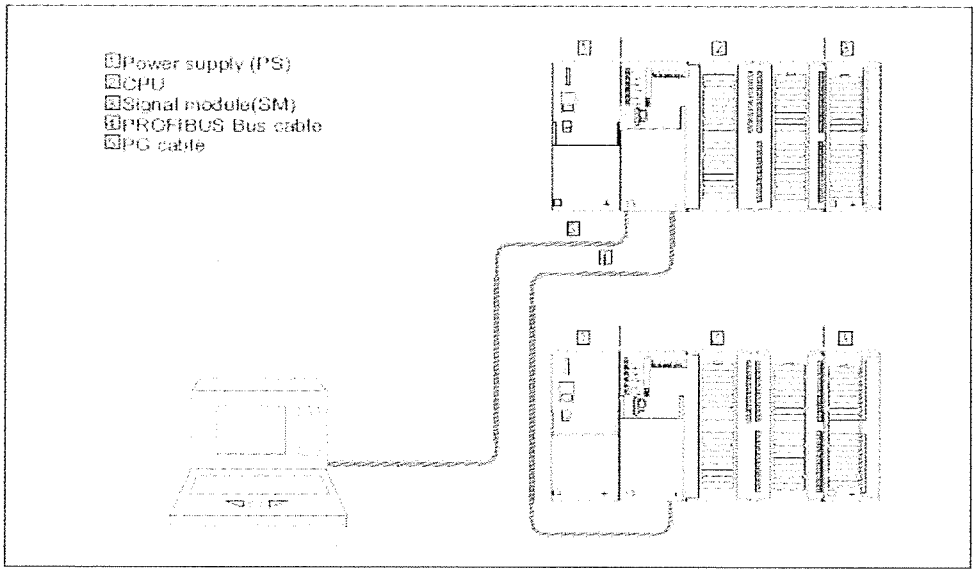
The goal of this project is to install a new automated batching system for hyper glass cleaner. Three ingredients are added in specified amount by weight to the mixing tank. After all ingredients are added to the mixing tank, the mixture is blended by running the agitator for a given time. When the blending time is complete, the finished product is pumped to the filling lines for bottling and final packaging.

Software:

# Operating System	: Microsoft Windows XP Professional Version 2002 SP3
# PLC programming	: SIMATIC STEP7 V5.4 + SP3
# SCADA programming	: SIMATIC WinCC V5.1
# Simulation	: SIMATIC S7-PLCSIM V5.2 + SP2
# Communication Protocol	: PROFIBUS [Process Field Bus]
# Communication Driver	: Via MPI Adapter
# Drawing	: AutoCAD 2008
# Documentation	: Microsoft Office 2010
# Others	: a) SIMATIC Authorsw V2.4 + SP2
	b) SIMATIC WinCC Smart Tools V5.1
	b) PDF Creator
	c) Adobe Reader 11.0.1

PLC DESCRIPTION

In this project of Hyper Glass Cleaner we have used the SIMATIC S7-300 PLC (Make: SIEMENS).
A S7-300 consists of several modules:
1. Power Supply (PS)
2. Central Processing Unit (CPU)
3. Signal Module (SM)
4. PROFIBUS Bus Cable
5. Cable for connecting a programming device (PG)
Components of an S7-300 are:



1. RAIL: This is the rack for an S7-300.

2. POWER SUPPLY: This converts the line voltage (120/230 VAC) to 24 VDC operating voltage and is used to supply the S7-300 and 24 VDC load circuits.

3. CPU: This runs the user program, provides a 5 V supply to the S7-300 backplane bus and communicates with other MPI network nodes via the MPI interface.

Additional properties of specific CPUs:
- DP master in a PROFIBUS subnet
- DP slave in a PROFIBUS subnet
- Technological functions
- Point-to-point connection

SEQUENCE OF OPERATION

To begin a new batch, the operator will verify that the system ready pilot light is on and that the mixing tank is ready to receive ingredients.

The operator will then press start batch push button to begin the batching process .no further input is required. The"SYSTEM READY" pilot light will turn off.

Automated valve AV-CW will be verified by limit switch LS-CW2. If LS-CW2 is not made within 2 second after valve was told to open, a fault will generated and system will shut down. The pilot light system fault will illuminate indicating that a fault has occurred.
Valve AV-CW will remain open until 1275 lbs. of city water is in the mixing tank. Valve AV-CWwill close. LS-CW1 will be verified by limit switch LS-CW1. If LS-CW1 is not made within 2 second after valve was told to open, a fault will generated and system will shut down.

All the valves and their respective limit switch will work in the manner described above.
After the city water has been added and limit switch LS-CW1 indicate that valve AV-CW is closed, the adding water pilot light will turn off.

Valve AV-QR will be opened. The "ADDING QR" pilot light will illuminate. After the valve position has been verified by LS-QR2, pump QR will pump 390lbs. of ingredient QR into mixing tank.

After the ingredient QR has been added and limit switch LS-QR1 indicate that valve AV-CW is closed, the adding QR pilot light will turn off.
Valve AV-KM will be opened. The "ADDING KM" pilot light will illuminate. After the valve position has been verified by LS-KM2, pump KM will pump 173 lbs. of ingredient KM into mixing tank.

After the ingredient KM has been added and limit switch LS-KM1 indicate that valve AV-KM is closed, the "ADDING KM" pilot light will turn off.

The agitator motor "MTR-MTA" will start. The"BLENDING" pilot light will illuminate. The agitator will run for three minutes.

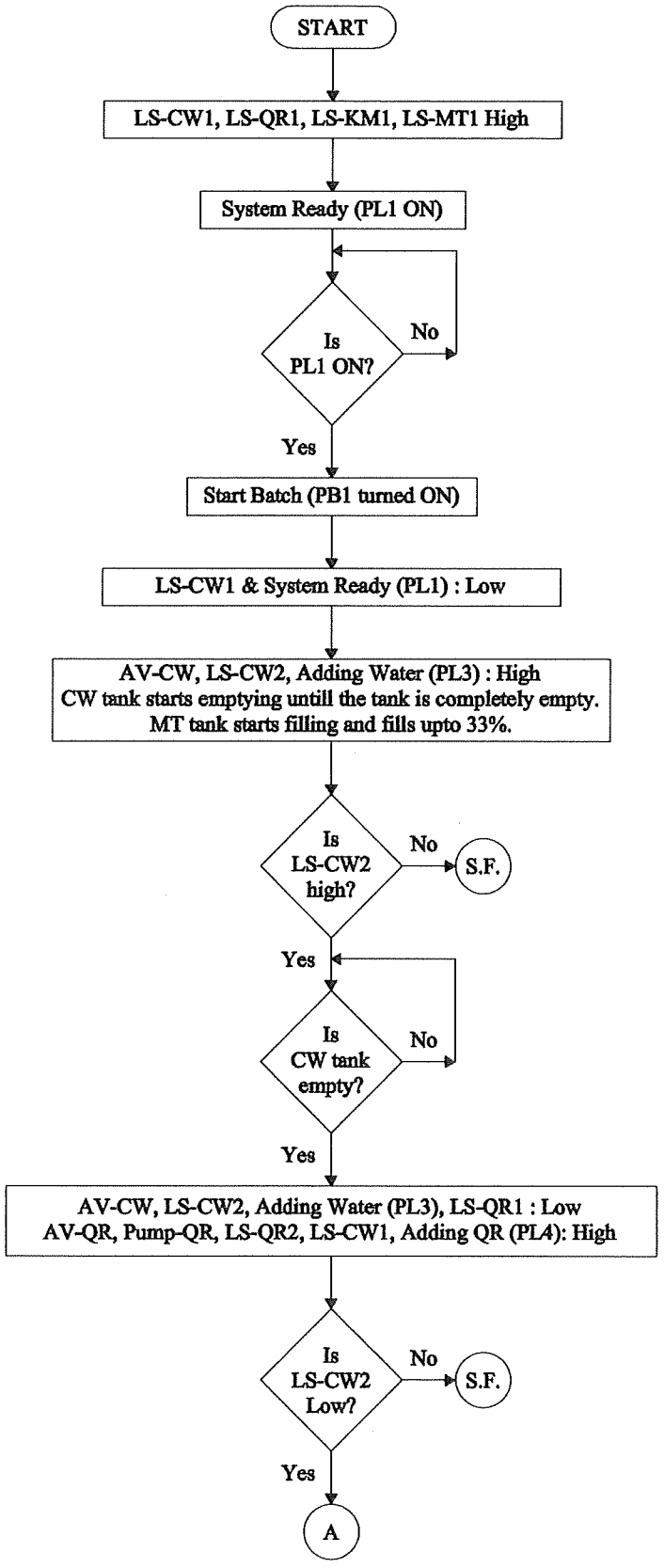
After the agitator is closed, the "BLENDING" pilot light will turn off and valve AV-MT will open. After LS-MT1 indicates the valve is open, the PUMPING TO LINES "pilot light will illuminate. PUMP- MTwill pump the entire batch to the filling lines. When the ULTRA SONIC level sensor, ULS1 indicates that the tank is empty, pump MT will turn off, valve AV-MT will close and the batching cycle is complete. The "PUMPING TO LINES"pilot light will turn off and the system ready pilot light will illuminate.

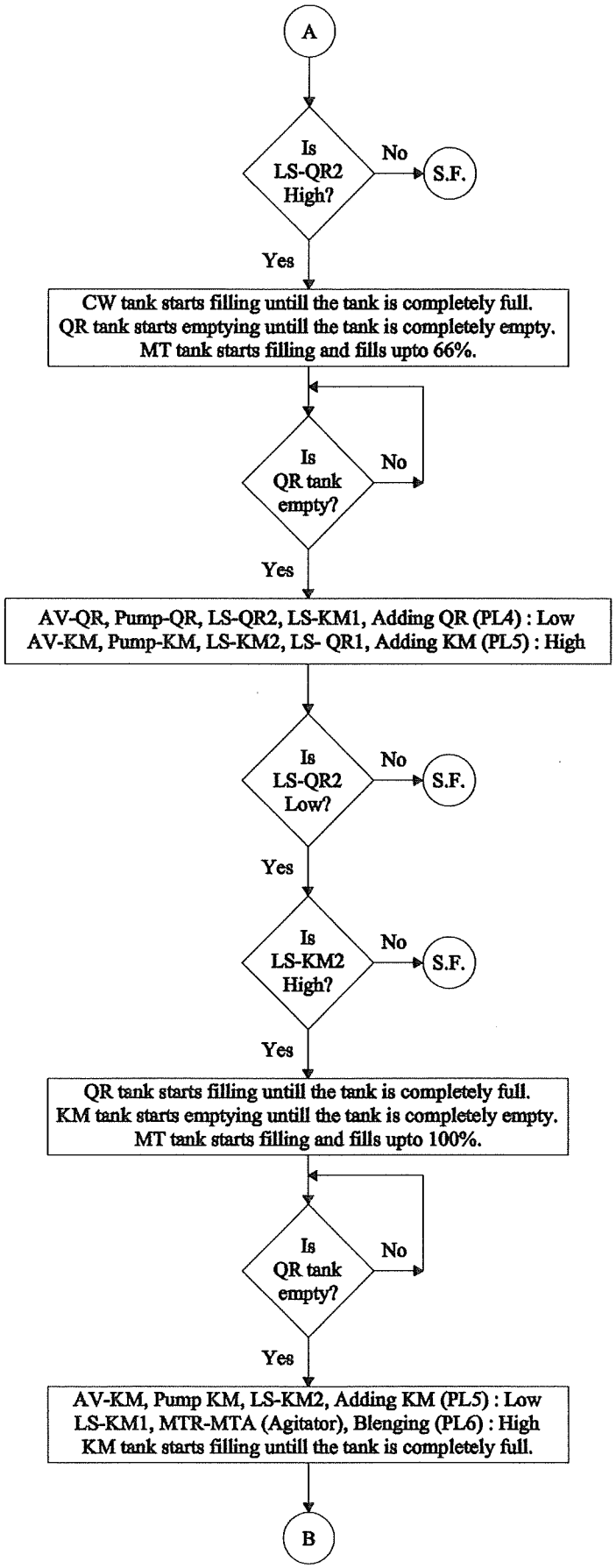
During every phase of batching process, the liquid level must be monitored by the plc. If the level rises above 95% of the mixing tank's capacity, the system will generate a fault and the batching process must be halted.

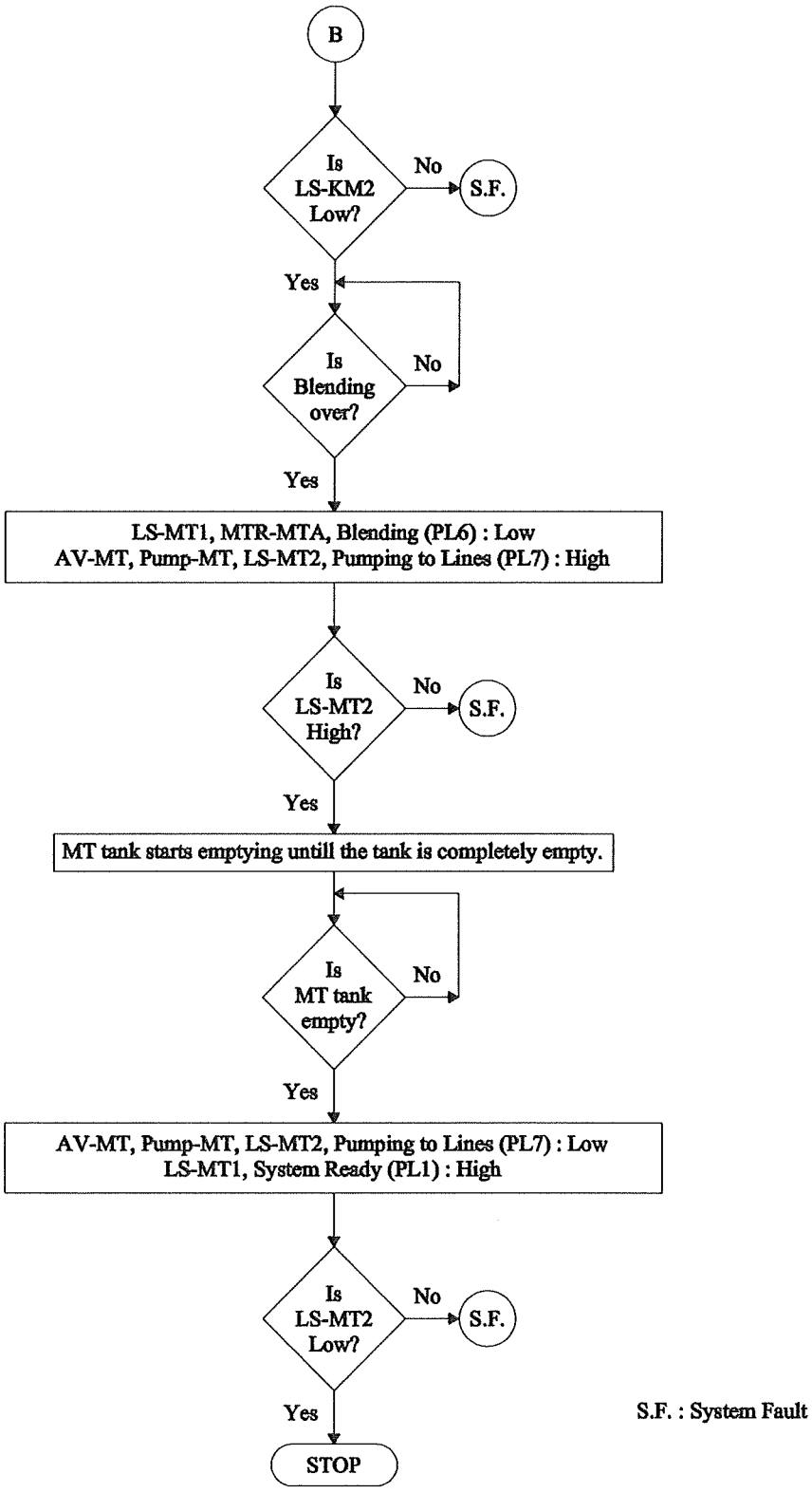
OPERATOR PANEL:

Components	Function
❖ SYSTEM READYPILOT LIGHT PL1	: Indicates that system is ready for batching.
❖ SYSTEM READY PILOT LIGHT PL2	: Indicates that the system has a fault and is Stopped.
❖ START BATCH PUSHBUTTON SWITCH PB1	: Start a new batch.
❖ STOP BATCH PUSHBUTTON SWITCH PB2	: Stop the batching process.
❖ ADDING WATER PILOT LIGHT PL3	: Indicates that the system is adding water to The mixing tank.
❖ ADDING QR PILOT LIGHT PL4	: Indicates that system is adding ingredient QR to the mixing tank.
❖ ADDING KM PILOT LIGHT PL5	: Indicates that system is adding ingredient KM to the mixing tank.
❖ BLENDING PILOT LIGHT PL6	: Indicates that the system is blending the ingredients.
❖ PUMPING TO LINES PILOT LIGHT PL7	: Indicates that the system is pumping the batch to the filling lines.
❖ E-STOP PUSHBUTTON PB3	: Immediately stop the entire process.

PROCESS FLOW CHART FOR HYPER GLASS CLEANER




A
Is LS-QR2 High?
No
S.F.
Yes
CW tank starts filling untill the tank is completely full.
QR tank starts emptying untill the tank is completely empty.
MT tank starts filling and fills upto 66%.
Is QR tank empty?
No
Yes
AV-QR, Pump-QR, LS-QR2, LS-KM1, Adding QR (PL4) : Low
AV-KM, Pump-KM, LS-KM2, LS- QR1, Adding KM (PL5) : High
Is LS-QR2 Low?
No
S.F.
Yes
Is LS-KM2 High?
No
S.F.
Yes
QR tank starts filling untill the tank is completely full.
KM tank starts emptying untill the tank is completely empty.
MT tank starts filling and fills upto 100%.
Is QR tank empty?
No
Yes
AV-KM, Pump KM, LS-KM2, Adding KM (PL5) : Low
LS-KM1, MTR-MTA (Agitator), Blenging (PL6) : High
KM tank starts filling untill the tank is completely full.
B



S.F. : System Fault

OB1 - <offline>

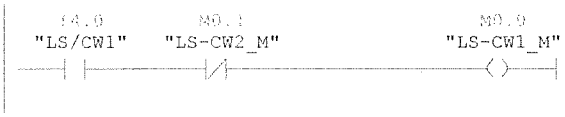
""

Name: **Family:**
Author: **Version:** 0.1
Block version: 2
Time stamp Code: 8/14/2014 1:39:53 PMPM
Interface: 2/15/1996 4:51:12 PMPM
Lengths (block/logic/data): 00702 00530 00020

Name	Data Type	Address	Comment
TEMP		0.0	
OB1_EV_CLASS	Byte	0.0	Bits 0-3 = 1 (Coming event), Bits 4-7 = 1 (Event class 1)
OB1_SCAN_1	Byte	1.0	1 (Cold restart scan 1 of OB 1), 3 (Scan 2-n of OB 1)
OB1_PRIORITY	Byte	2.0	Priority of OB Execution
OB1_OB_NUMBR	Byte	3.0	1 (Organization block 1, OB1)
OB1_RESERVED_1	Byte	4.0	Reserved for system
OB1_RESERVED_2	Byte	5.0	Reserved for system
OB1_PREV_CYCLE	Int	6.0	Cycle time of previous OB1 scan (milliseconds)
OB1_MIN_CYCLE	Int	8.0	Minimum cycle time of OB1 (milliseconds)
OB1_MAX_CYCLE	Int	10.0	Maximum cycle time of OB1 (milliseconds)
OB1_DATE_TIME	Date_And_Time	12.0	Date and time OB1 started

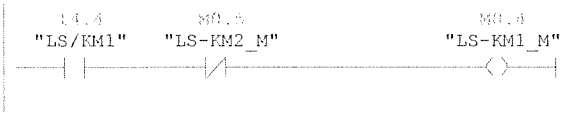
Block: OB1 "Main Program Sweep (Cycle)"

Network: 1



Network: 2

Network: 3



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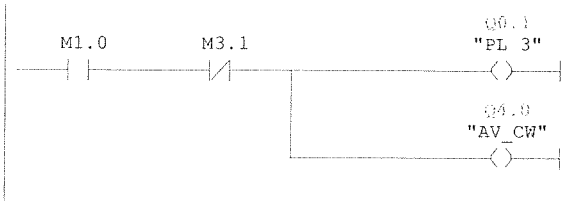

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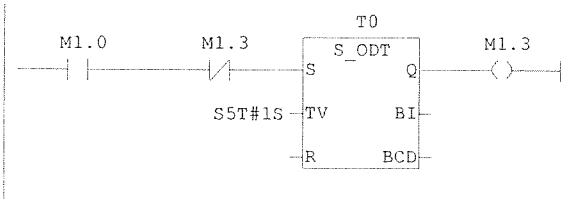
Network: 11



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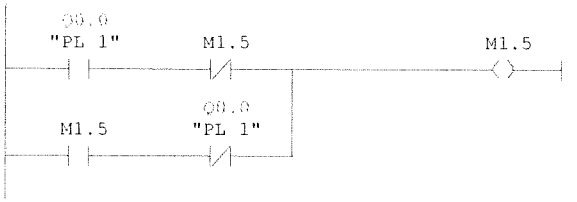

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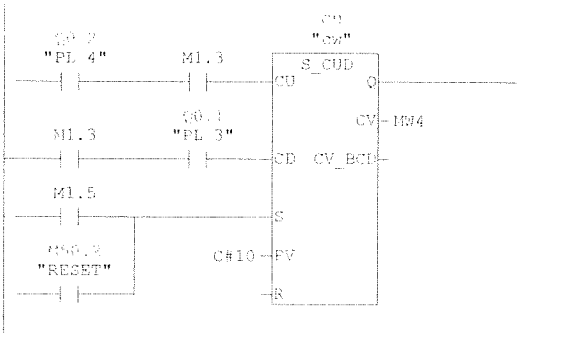

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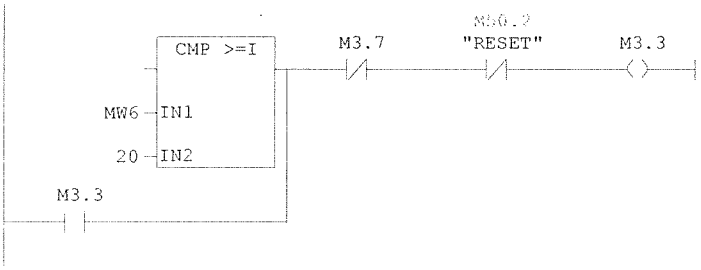
Network: 18



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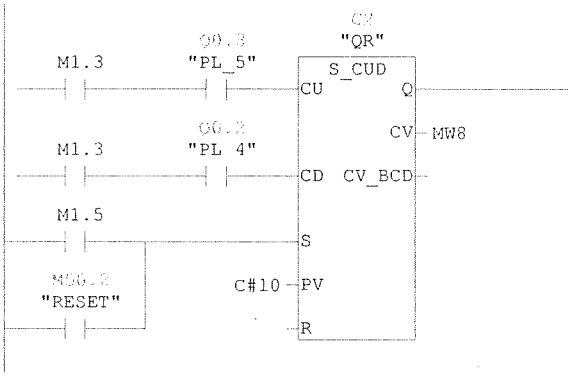

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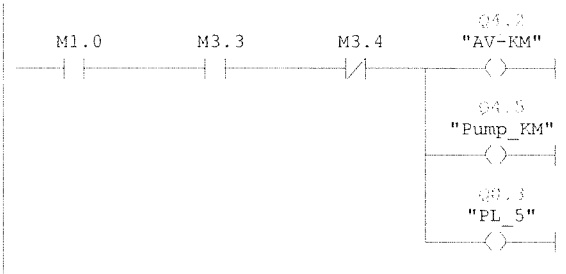

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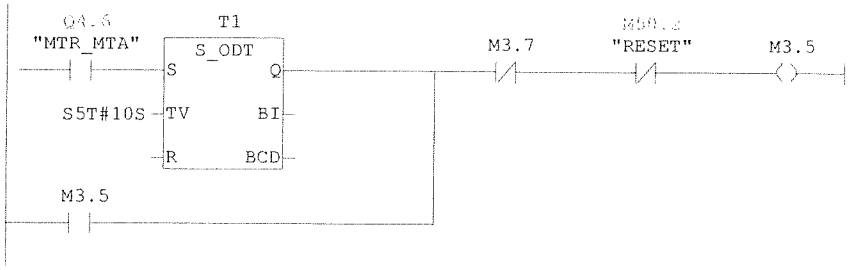

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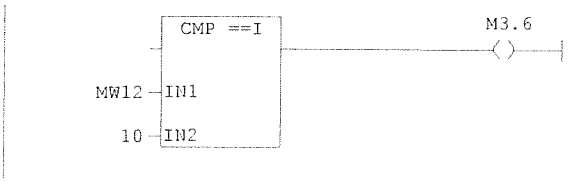

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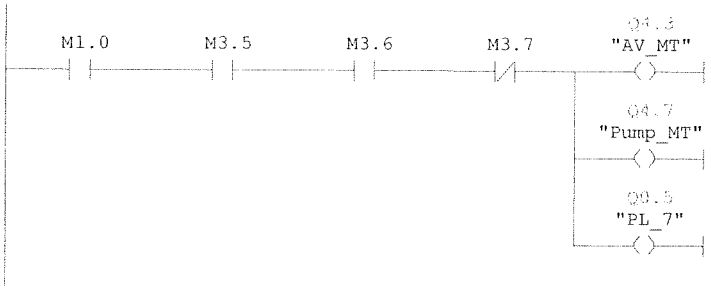
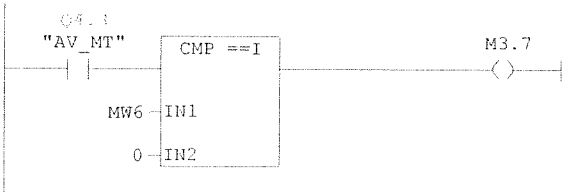
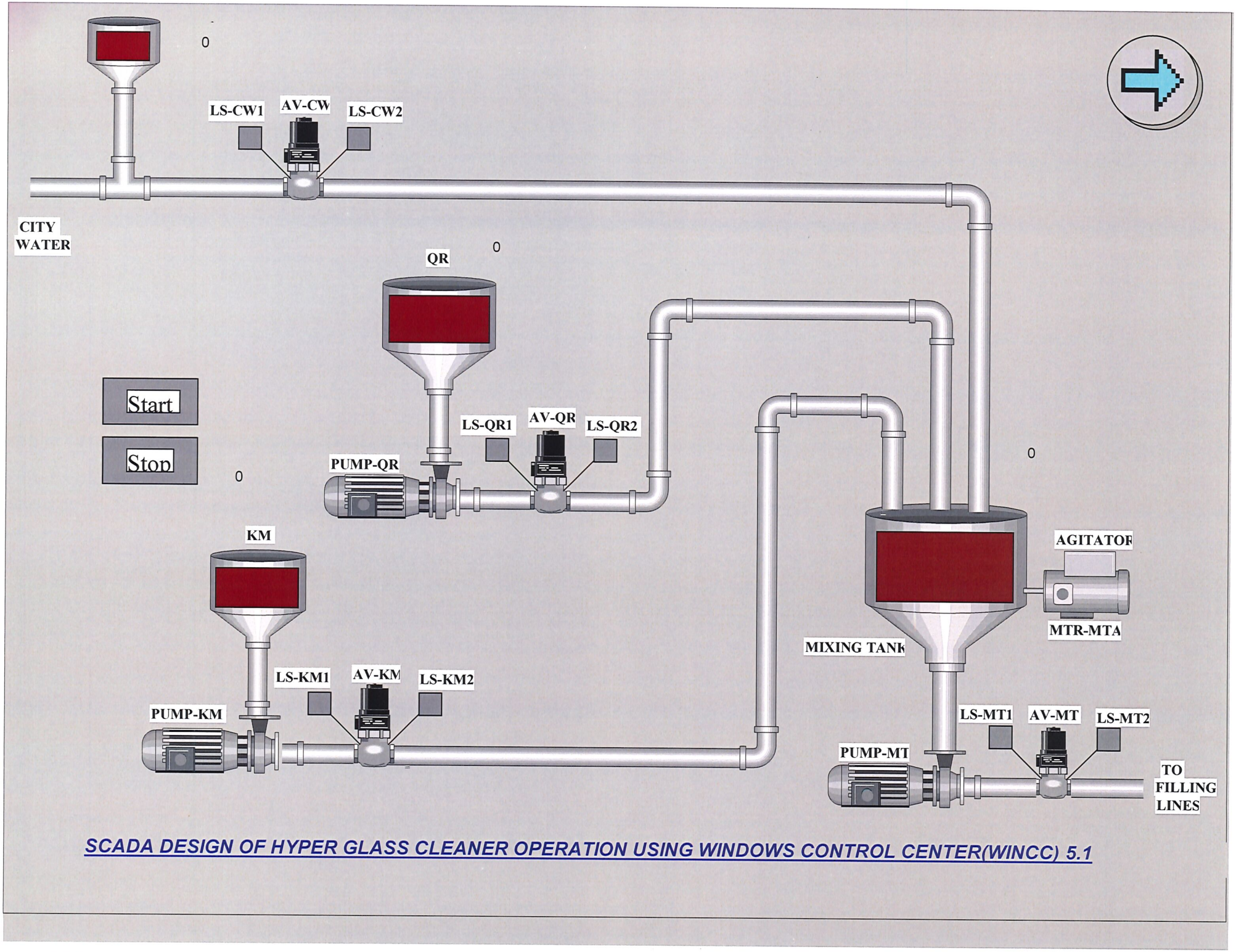


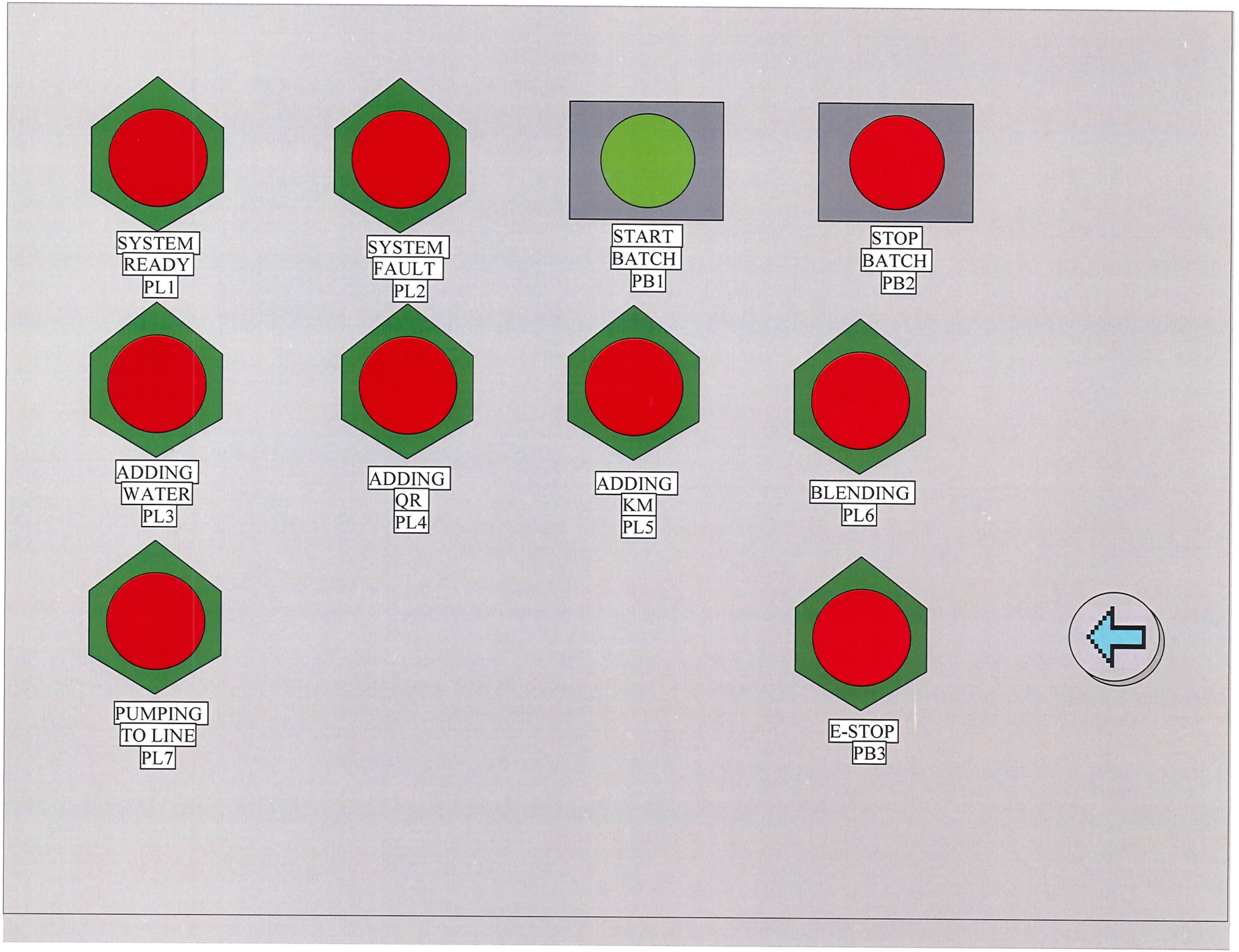
Network: 28

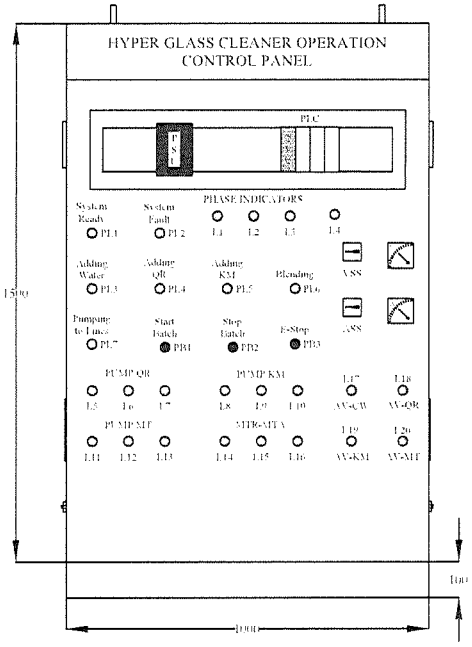
Network: 29



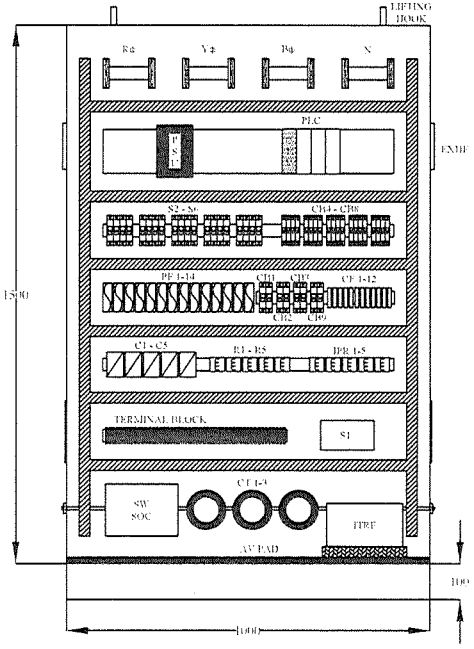


SCADA DESIGN OF HYPER GLASS CLEANER OPERATION USING WINDOWS CONTROL CENTER(WINCC) 5.1

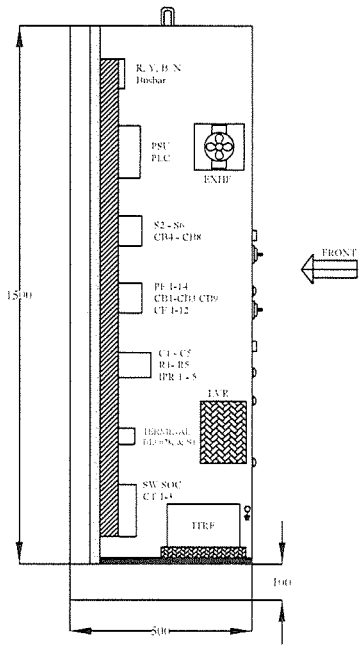

SYSTEM
READY
PL1
SYSTEM
FAULT
PL2
START
BATCH
PB1
STOP
BATCH
PB2
ADDING
WATER
PL3
ADDING
QR
PL4
ADDING
KM
PL5
BLENDING
PL6
PUMPING
TO LINE
PL7
E-STOP
PB3



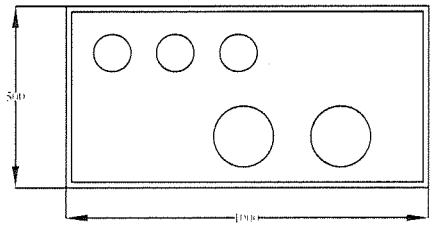
FRONT VIEW



INSIDE FRONT VIEW



SIDE VIEW

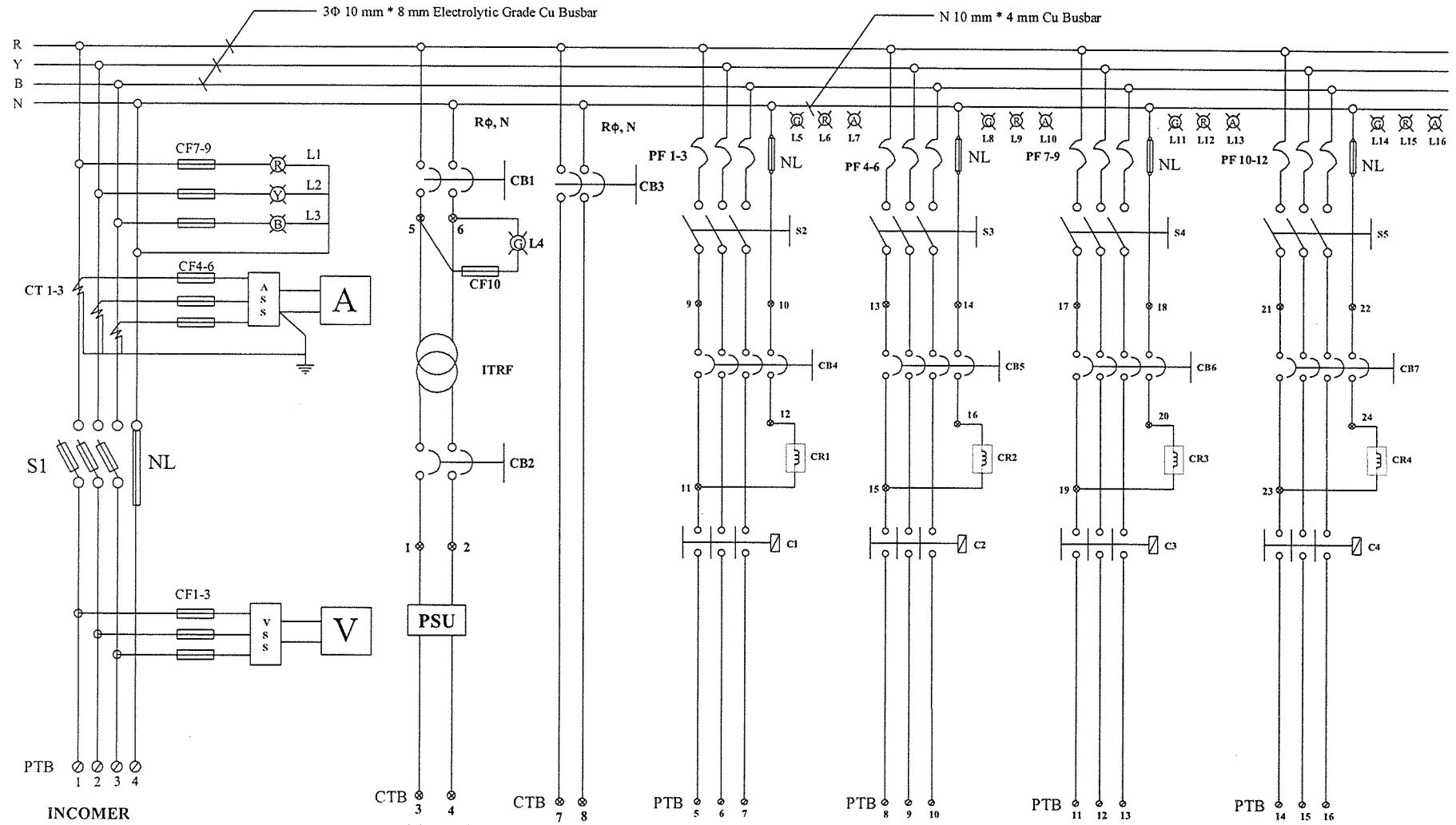


BASE VIEW

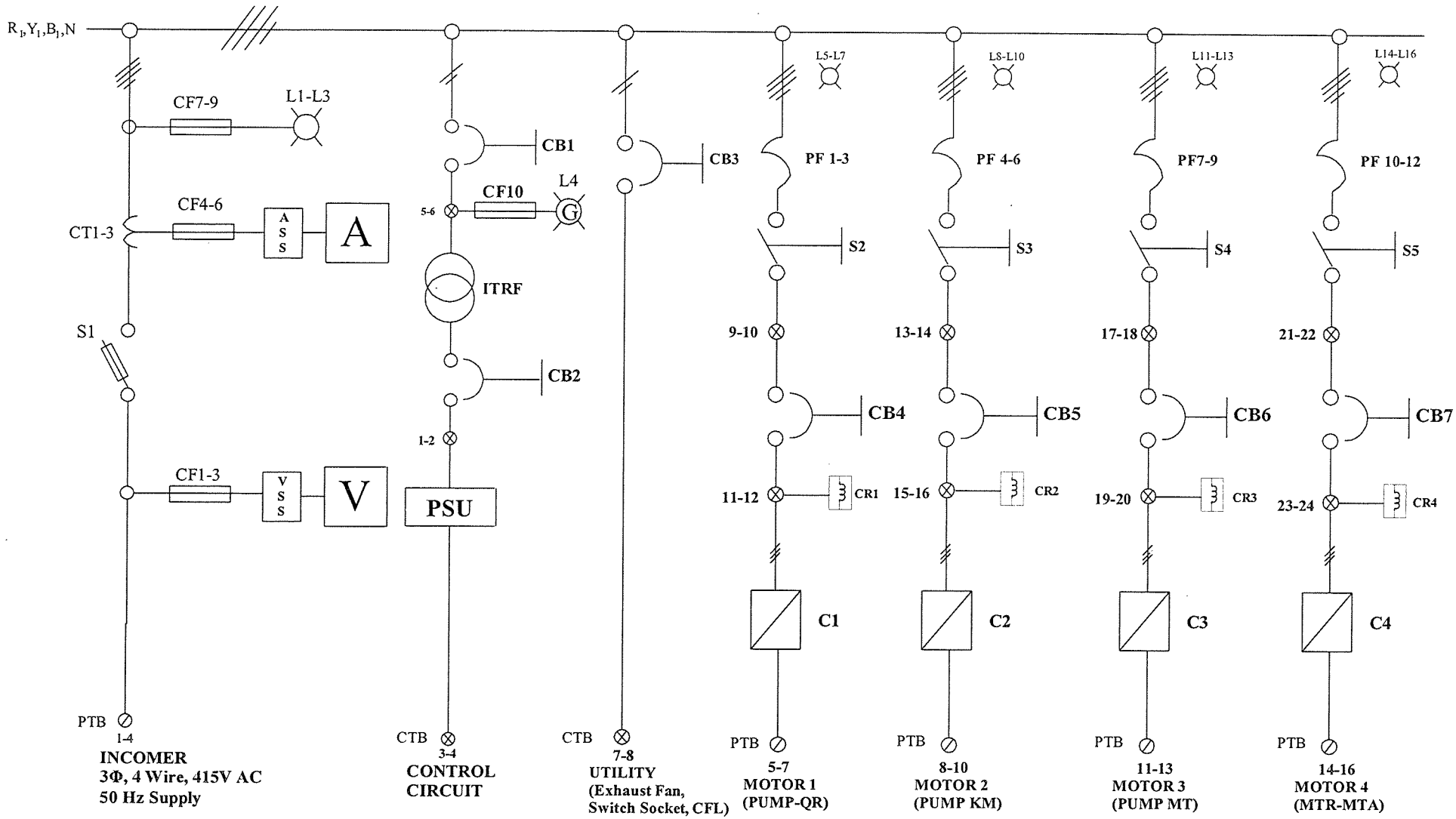
ALL DIMENSIONS ARE IN MM.

PROJECT NAME: HYPER GLASS CLEANER	INTERNATIONAL INSTITUTE FOR ADVANCED TRAINING ON CONTROL & AUTOMATION DA 169, SALT LAKE, KOLKATA - 700 064	
	GENERAL ARRANGEMENT OF CONTROL PANEL	PROJECTION
	COURSE PLAN : QUALIFIED AUTOMATION PROFESSIONAL	SCALE 1:10
DRG. NO.: QAP/HGC/GA	DRG. DATE: 25.1.2014 REV.:0	SHEET 01 OF 01

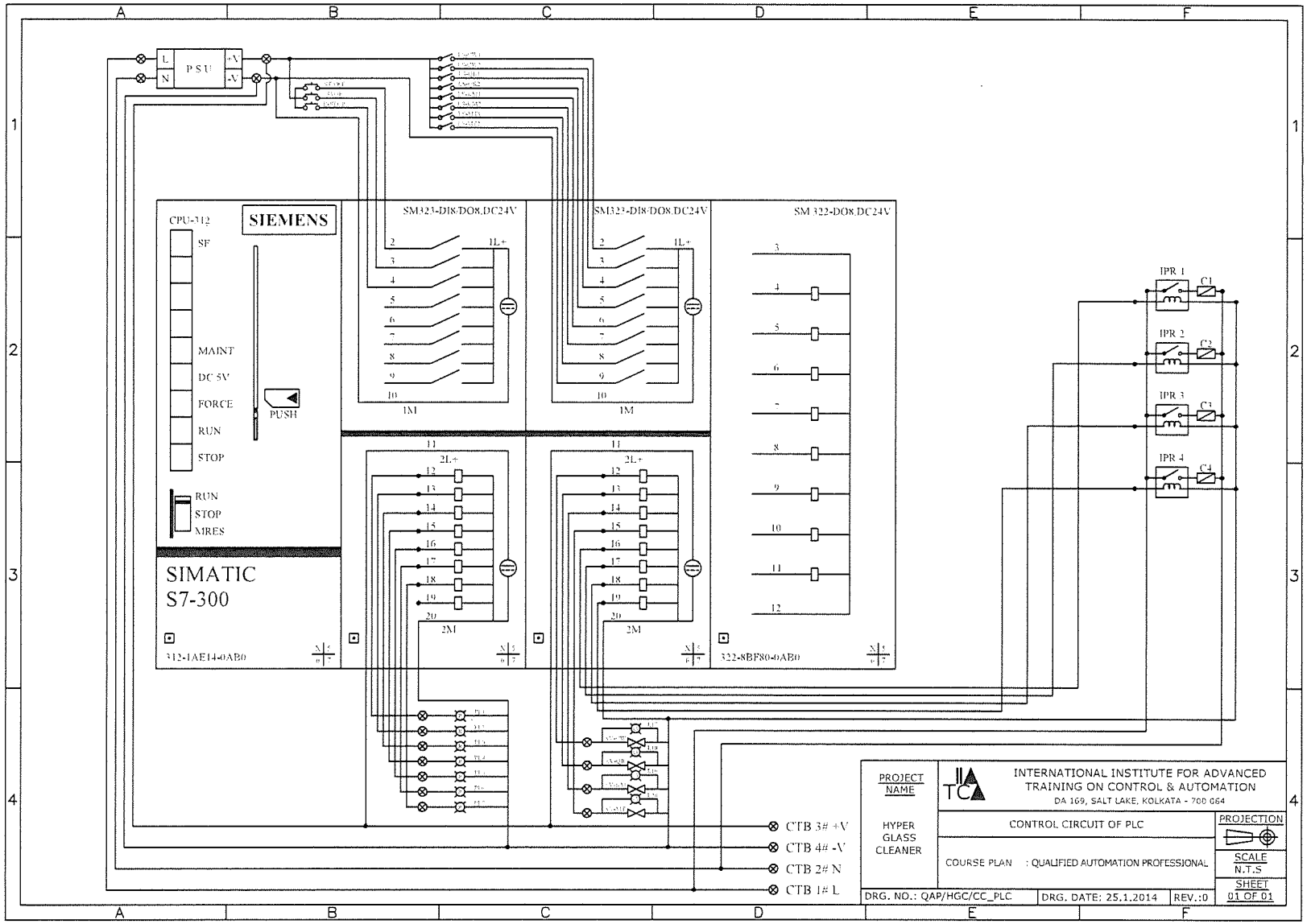
LEGEND DETAILS					
SL. NO.	TAG	MATERIAL DESCRIPTION	RANGE, RATING &TYPE	MAKE	QTY
1	PLC	PROGRAMMABLE LOGIC CONTROLLER	SIMATIC S7-300, CPU 312, 312-1AE14-0AB0	SIEMENS	1
2		EXTERNAL I/0 MODULE	SM323-DI8XDO8/DC24V	SIEMENS	2
			SM322-DO8/DC24V		1
3		PC-PLC COMM. HARDWARE	MPI ADAPTER	SIEMENS	1
4	PSU	POWER SUPPLY UNIT	I/P: 110V/220V AC, O/P: 24V DC, 5A	SIEMENS	1
5	S1	TPN SFU	100A	L&T	1
6	S2-S6	ICTP SWITCH	16A	L&T	5
7	CB1-CB3, CB9	DP MCB	10A, C CURVE	L&T	4
8	CB4-CB8	TPN MCB	16A, C CURVE	L&T	5
9	C1-C5	POWER CONTACTOR	12A, AC3 DUTY WITH (1NO+1NC) AUX CONTACT	TELEMECHANIQUE	5
10	R1-R5	CONTROL RELAY	230V AC, 2C/O, (2NO+2NC) AUX CONTACT	PLA	5
11	IPR1-IPR5	INTERPOSING RELAY	24V DC, 2C/O, POTENTIAL FREE CONTACT	PLA	5
12	L1-L20 PL1-PL7	INDICATING LAMP	230V AC, 24V DC, (RED, GREEN, YELLOW, BLUE, AMBER) FILAMENT TYPE	SIEMENS	27
13	a,b,c,d	PUSHBUTTONS WITH ELEMENT	2 NO, 2 NC (GREEN & RED)	SIEMENS	4
14	PF1-PF14	POWER FUSE	16A, HRC WITH MTG BASE	GEC	14
15	CF1-CF12	CONTROL FUSE	2A, WITH MTG BASE	GEC	12
16	CT1-3	CURRENT TRANSFORMER	CTR: 100:1, CLASS 1, 5VA	KAPPA	3
17	A	AMMETER	0-500A, ANALOG TYPE, 76mm^2, 5A	MECO	1
18	ASS	AMMETER SELECTOR SWITCH	6A, 4 POSITION WITH OFF	KAYCEE	1
19	V	VOLTMETER	0-500A, ANALOG TYPE, 76mm^2, 5A	MECO	1



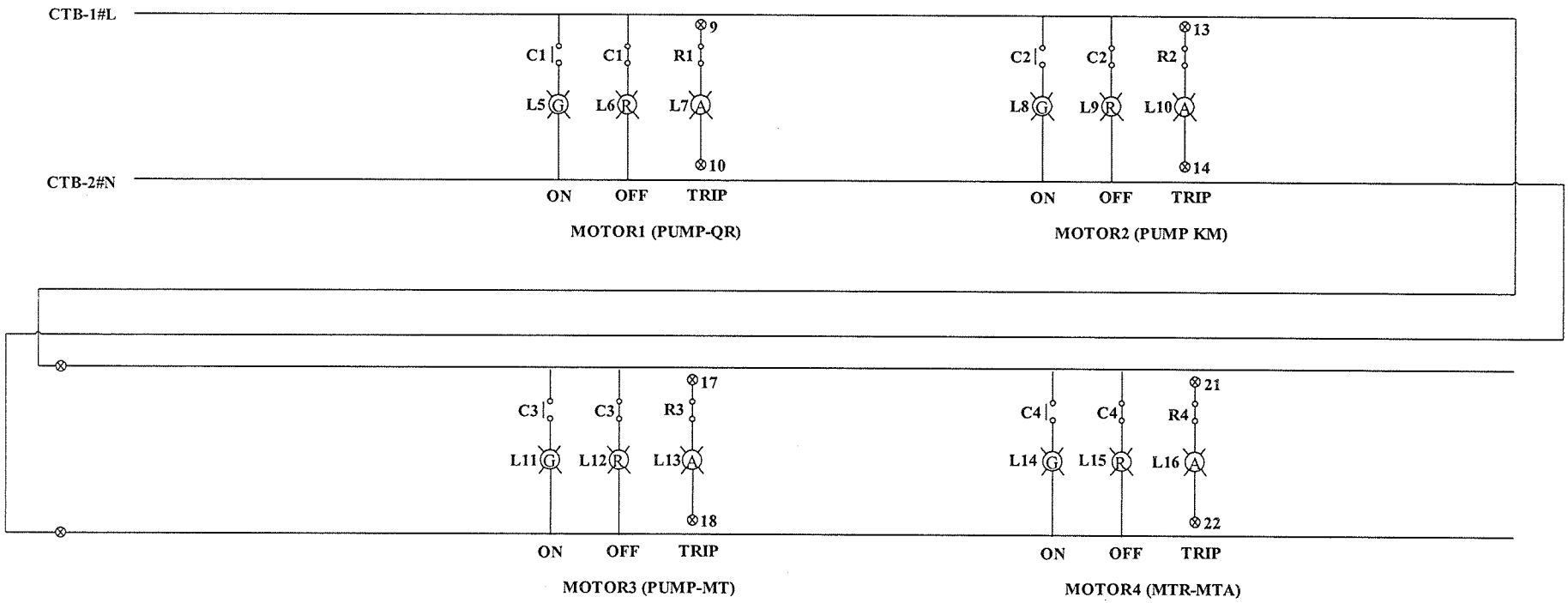
PROJECT NAME: HYPER GLASS CLEANER	INTERNATIONAL INSTITUTE FOR ADVANCED TRAINING ON CONTROL & AUTOMATION, DA 169, SALT LAKE, KOLKATA - 700 064	PROJECTION
	POWER CIRCUIT OF MOTOR	SCALE: N.T.S
	NAME : MD. SALMAN AZIM COURSE PLAN : QUALIFIED AUTOMATION PROFESSIONAL REG. No. : QA143941	SHEET: 01 OF 01
DRG. NO.: QAP/HGC/PC_M	DRG. DATE: 16.08.2014	REV.:0

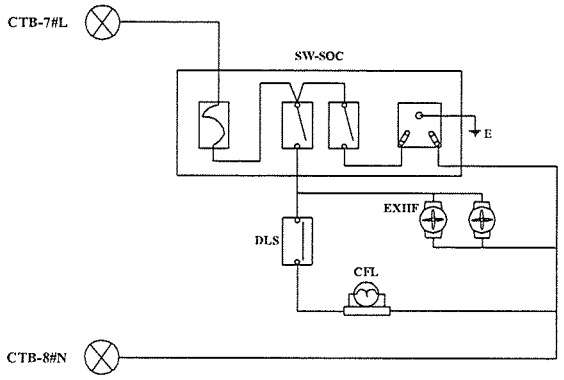


PROJECT NAME: HYPER GLASS CLEANER	INTERNATIONAL INSTITUTE FOR ADVANCED TRAINING ON CONTROL & AUTOMATION, DA 169, SALT LAKE, KOLKATA - 700 064	
	SINGLE LINE DIAGRAM OF MOTOR	PROJECTION
	NAME : MD. SALMAN AZIM COURSE PLAN : QUALIFIED AUTOMATION PROFESSIONAL REG. No. : QA143941	SCALE N.T.S
DRG. NO.: QAP/HGC/PC_M	DRG. DATE: 16.08.2014 REV.:0	SHEET 01 OF 01



PROJECT NAME	INTERNATIONAL INSTITUTE FOR ADVANCED TRAINING ON CONTROL & AUTOMATION DA 169, SALT LAKE, KOLKATA - 700 064		
HYPER GLASS CLEANER	CONTROL CIRCUIT OF PLC		PROJECTION
	COURSE PLAN : QUALIFIED AUTOMATION PROFESSIONAL		SCALE N.T.S
DRG. NO.: QAP/HGC/CC_PLC	DRG. DATE: 25.1.2014	REV.:0	SHEET 01 OF 01





PROJECT NAME: HYPER GLASS CLEANER	INTERNATIONAL INSTITUTE FOR ADVANCED TRAINING ON CONTROL & AUTOMATION, DA 169, SALT LAKE, KOLKATA - 700 064	PROJECTION
	TYPICAL CONTROL CIRCUIT OF LED's	
	NAME : MD. SALMAN AZIM COURSE PLAN : QUALIFIED AUTOMATION PROFESSIONAL REG. No. : QA143941	SCALE N.T.S
DRG. NO.: QAP/HGC/PC_M	DRG. DATE: 16.08.2014 REV.:0	SHEET 01 OF 01

BILL OF MATERIALS

SL. NO.	MATERIAL DESCRIPTION	RANGE, RATING &TYPE	MAKE	QTY
1	PROGRAMMABLE LOGIC CONTROLLER	SIMATIC S7-300, CPU 312, 312-1AE14-0AB0	SIEMENS	1
2	EXTERNAL I/0 MODULE	SM323-DI8XDO8/DC24V	SIEMENS	2
		SM322-DO8/DC24V		1
3	PC-PLC COMM. HARDWARE	MPI ADAPTER	SIEMENS	1
4	POWER SUPPLY UNIT	I/P: 110V/220V AC, O/P: 24V DC, 5A	SIEMENS	1
5	TPN SFU	100A	L&T	1
6	ICTP SWITCH	16A	L&T	5
7	DP MCB	10A, C CURVE	L&T	4
8	TPN MCB	16A, C CURVE	L&T	5
9	POWER CONTACTOR	12A, AC3 DUTY WITH (1NO+1NC) AUX CONTACT	TELEMECHANIQUE	5
10	CONTROL RELAY	230V AC, 2C/O, (2NO+2NC) AUX CONTACT	PLA	5
11	INTERPOSING RELAY	24V DC, 2C/O, POTENTIAL FREE CONTACT	PLA	5
12	INDICATING LAMP	230V AC, 24V DC, (RED, GREEN, YELLOW, BLUE, AMBER) FILAMENT TYPE	SIEMENS	27
13	PUSHBUTTONS WITH ELEMENT	2 NO, 2 NC (GREEN & RED)	SIEMENS	4
14	POWER FUSE	16A, HRC WITH MTG BASE	GEC	14
15	CONTROL FUSE	2A, WITH MTG BASE	GEC	12
16	CURRENT TRANSFORMER	CTR: 100:1, CLASS 1, 5VA	KAPPA	3
17	AMMETER	0-500A, ANALOG TYPE, 76mm^2, 5A	MECO	1
18	AMMETER SELECTOR SWITCH	6A, 4 POSITION WITH OFF	KAYCEE	1
19	VOLTMETER	0-500A, ANALOG TYPE, 76mm^2, 5A	MECO	1

COST ANALYSIS

SL. NO.	MATERIAL DESCRIPTION	RANGE, RATING &TYPE	MAKE	QTY	COST/UNIT	TOTAL COST
1	PROGRAMMABLE LOGIC CONTROLLER	SIMATIC S7-300, CPU 312, 312-1AE14-0AB0	SIEMENS	1	25,000.00	25,000.00
2	EXTERNAL I/0 MODULE	SM323-DI8XDO8/DC24V	SIEMENS	2	15,000.00	45,000.00
		SM322-DO8/DC24V		1		
3	PC-PLC COMM. HARDWARE	MPI ADAPTER	SIEMENS	1	22,000.00	22,000.00
4	POWER SUPPLY UNIT	I/P: 110V/220V AC, O/P: 24V DC, 5A	SIEMENS	1	1,500.00	1,500.00
5	TPN SFU	100A	L&T	1	2,500.00	2,500.00
6	ICTP SWITCH	16A	L&T	5	600.00	3,000.00
7	DP MCB	10A, C CURVE	L&T	4	350.00	1,400.00
8	TPN MCB	16A, C CURVE	L&T	5	450.00	2,250.00
9	POWER CONTACTOR	12A, AC3 DUTY WITH (1NO+1NC) AUX CONTACT	TELEMECHANIQUE	5	650.00	3,250.00
10	CONTROL RELAY	230V AC, 2C/O, (2NO+2NC) AUX CONTACT	PLA	5	150.00	750.00
11	INTERPOSING RELAY	24V DC, 2C/O, POTENTIAL FREE CONTACT	PLA	5	150.00	750.00
12	INDICATING LAMP	230V AC, 24V DC, (RED, GREEN, YELLOW, BLUE, AMBER) FILAMENT TYPE	SIEMENS	27	100.00	2,700.00
13	PUSHBUTTONS WITH ELEMENT	2 NO, 2 NC (GREEN & RED)	SIEMENS	4	100.00	400.00
14	POWER FUSE	16A, HRC WITH MTG BASE	GEC	14	200.00	2,800.00
15	CONTROL FUSE	2A, WITH MTG BASE	GEC	12	25.00	300.00
16	CURRENT TRANSFORMER	CTR: 100:1, CLASS 1, 5VA	KAPPA	3	300.00	900.00
17	AMMETER	0-500A, ANALOG TYPE, 76mm^2, 5A	MECO	1	650.00	650.00
18	AMMETER SELECTOR SWITCH	6A, 4 POSITION WITH OFF	KAYCEE	1	150.00	150.00
19	VOLTMETER	0-500A, ANALOG TYPE, 76mm^2, 5A	MECO	1	650.00	650.00

SHEET METAL CALCULATION

Dimensions of the Control Panel Body:
Height = 1.5m, Width = 1m, Depth = 0.5m.

Dimensions of the Mounting Plate:
Height = 1.4m, Width = 0.95m.

Dimensions of the Channel Base
Height = 0.1m, Width = 0.1m, Depth = 0.06m
Material of Construction: CRCA Sheet, TISCO.

Sheet metal required for the outside body of the control panel
= 2 [1.5 x 1 + 1 x 0.5 + 0.5 x 1.5] m_2
= 2 [1.5 + 0.5 + 0.75] m_2 = 5.5 m_2

Sheet metal required for the mounting plate
= (1.4 x 0.95) m_2 = 1.33 m_2

Sheet metal required for the channel base
Length of the channel base required = 2 (1m + 0.5m) = 3m
Breadth of the channel base is = 0.2m
Thus, area of the sheet metal required = 3m x 0.2m = 0.6m_2

Thus, the total weight of sheet metal used
= (5.5 x 16 + 1.33 x 20 + 0.6 x 48) kg = 143.4 kg
[Since weight of the sheet metal for:

- Body of the Control Panel (2mm thickness) = 16 kg/m_2
- Mounting Plate (2.5mm thickness) = 20 kg/m_2
- Channel Base (6mm thickness) = 48 kg/m_2]

Price of sheet metal = Rs.120/kg

Cost of sheet metal required
= Rs. (143.4 x 120) = Rs. 17208/-
Total Cost required
= **Rs. 30000/-** (Including Fabrication & Transportation charge)

CONCLUSION

Completing this project I have got a clear picture about Automated processes for Water Treatment Process Plant.

An overview of this project is in my knowledge now; Functions of various components and different steps involved in Treatment of water are very clear to me. I have learned several topics with this project; for example selection of particular PLC module, I/O requirements, external I/O module etc. In PLC programming part use of NO or NC contacts, pulse generation, use of timers, counters, timer or counter reset become very clear than before. Not only that I am now conceptually strong than earlier with the idea of associated control components selection based on the needs of the application (contactors, relays, cables, fuses, circuit breakers etc.), evaluation the project costing including Bill of Material(B.O.M) by collecting the market prices of the selected items used in the total process etc. I have cultured AutoCAD 2008 to design general arrangement of panel, schematic wiring diagram. This very software was totally unknown to me. But at present I am little bit familiar with AutoCAD. I got this superb opportunity with this project.

My greetings to the IIATCA authorities who structured the Qualified Automation Professional course plan with this project. It gave me great pleasure to introduce with Hyper Glass Cleaning Automation process.