AUTOMATIC HVAC SYSTEM

FINAL PROJECT REPORT

Prepared for:

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Confederation College

EL-431Automation Control System-I

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&
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____*ARUL & NEEP*_____
Name

Confederation COLLEGE

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Instructor's Signature

Date:__16/04/2023_____

EL431

FINAL PROJECT **AUTOMATIC HVAC SYSTEM**

TABLE OF CONTENT

INTRODUCTION:

An AHU (Air Handling Unit) in an HVAC (Heating, Ventilation, and Air Conditioning) system is a central component that handles the air and circulates it throughout the building using Return Air Fan (RAF). It is responsible for mixing, heating, cooling, and cleaning the air before it is distributed to various rooms and spaces through ductwork. The AHU consists of an air blower, heating or cooling coil, filters, and control system. AHU and RAF will start only if the Supply Air Damper (SAD) and Return Air Damper (RAD) are open. And based on the temperature selector switch (TSH/TSL) cooling water is supplied from a chiller unit by opening the chiller pump flow valve for the TSH position and hot water is supplied from a boiler unit after opening the boiler pump flow valve for the TSL position of the selector switch. Both the Chiller water pump (CPM) and Boiler water pump (BPM) cannot run at the same time. Once the AHU and RAF stop after a short period of time both the chiller and boiler water pump should stop. In case of emergency if the E_Stop button is pressed then all machines operating should come to a stop immediately.

AHU/Return Air Fan Operation:

The AHU/Return Air FAN will operate in Hand mode or Auto Mode:

In Hand:

1. AHU/RAF Cannot start until the CPM/BPN has run for at least 7 seconds (permissive).
2. A green indicator light will blink showing a “ready to start” status if permissive (RAD/SAD Open) and interlocks (CPM/BPM) are satisfied.
3. AHU/RAF will start if the operator presses Start at this point.
4. Upon starting, the same green light will go solid.
5. Will stop if the E-stop is pressed or an interlock is lost. (ie CPM/BPM stops)

In Auto:

1. The AHU/RAF cannot start until the CPM/BPN has run for at least 7 seconds.
2. While CPM/BPM is running from 0-10 seconds a green indicator light will blink indicating AHU/RAF is about to start in auto.
3. AHU/RAF run as soon as permissive (RAD/SAD Open) and interlocks (CPM/BPM) are satisfied with an AUTO_START tag.
4. Upon starting, the same green light will go solid.
5. Will stop if the E-stop is pressed or an interlock is lost. (ie CPM/BPM stops)

Chiller pump (CPM) / Boiler Pump (BPM) Operation:

The CPM/BPM Pump can operate in Hand mode or Auto Mode and dictates if the AHU/RAF is in Hand or Auto.

In Hand:

1. The CPM/BPM will start to run if the start PB is pressed.
2. If CPM is running BPM cannot be started and if BPM is running CPM cannot be started (interlock)
3. Upon starting, a red light will go on.
4. If the AHU/RAF starts, then stops:
    a. The red light will begin to blink after 5 seconds of the AHU/RAF stopping.
    b. Continue to blink until the CPM/BPM is turned off by the OFF on the HOA.

In Auto:

1. Once in Auto, the CPB/BPM will start if FV_CPM/FV_BPM (chiller pump/ boiler pump valve) is ON (permissive) and the Operator selects the Temp High/ Low switch.
2. Upon starting, a red light will go on.
3. Once the AHU/RAF is stopped;
    a. The CPM/BPM continues to run for 5 seconds and then stops.
    b. The red light will blink until the CPM/BPM Pump is stopped.

PROCEDURES INVOLVED IN DEVELOPING THE PROJECT:

PART A: Creating P&ID

1. With the provided P&ID legend, using all standard ISO symbols of blowers, filters, pumps, damper valves, and flow valves we created an ISO standard P&ID (attached in this report).

PART B: Completing the Schematic:

1. Using the PID, we created schematics for CPM, PBM, AHU & RAF and assigned the proper addresses for all equipment involved in the project.
2. With the help of the below table created all wiring involved in the project is checked:

EQUIPMENT TAG	IO ADDRESS	WIRE CHECK
AHU_080_FDBK	%Q00013	X
AHU_080_HOA	%I00018	X
AHU_080_RUN_XL	%Q00007	X
AHU_080_START	%I00011	X
AHU_080_STOP	%I00015	X
BPM_080_FDBK	%I00019	X
BPM_080_RUN	%Q00020	X
BPM_080_RUN_XL	%Q00006	X
BPM_080_START	%I00010	X
BPM_080_STOP	%I00014	X
CPM_080_FDBK	%I00021	X
CPM_080_RUN	%Q00021	X
CPM_080_RUN_INDI	%Q00005	X
CPM_080_START	%I00009	X
CPM_080_STOP	%I00013	X
DPSH_083	%I00004	X
DPSHA_080_XL	%Q00004	X
ESTOP	%I00023	X
FV_081_CPM	%I00005	X
FV_081_CPM_XL	%Q00009	X
FV_082_BPM	%I00006	X
FV_082_BPM_XL	%Q00010	X
RAD_080_ON	%I00007	X
RAF_080_RUN	%Q00011	X
RAF_080_RUN_XL	%Q00008	X
SAD_080_ON	%I00003	X
SAD_080_XL	%Q00003	X
TSH_080	%I00001	X
TSH_080_XL	%Q00001	X
TSL_080	%I00002	X
TSL_080_XL	%Q00002	X

PART C: Developing the Logic:

3. Developed 11 Ladder Diagram Blocks as follows,

    a. CPM_080
        i. This routine will contain all rungs for controlling and indicating the CPM pump is running, including permissive, interlocks, and indications.
    b. BPM_080
        i. This routine will contain all rungs for controlling and indicating the BPM pump is running, including permissive interlocks and indications.
    c. AHU_080
        i. This routine will contain all rungs for controlling and indicating the AHU Fan is running, including permissive interlocks and indications.
    d. RAF_080
        i. This routine will contain all rungs for controlling and indicating the RAF Fan is running.

    e. DPSH_080
        i. This routine will contain all rungs for controlling differential pressure switch with a TON timer and indicating the differential pressure high alarm.

    f. FLASHER
        i. This routine will contain all rungs for flashing lights to indicate a system is ready.
    g. FV_CPM_080
        i. This routine will contain a rung for controlling the FV_CPM switch and an ON indication.

    h. FV_BPM_080
        i. This routine will contain a rung for controlling the FV_BPM switch and an ON indication.
    i. SAD_080
        i. This routine will contain a rung for controlling the Supply air damper switch and an ON indication.
    j. RAD_080
        i. This routine will contain a rung for controlling the Return air damper switch and an ON indication.
    k. TSH_080
        i. This routine will contain two rungs for controlling the Temperature switch high and low an ON indications for both high and low.

4. To design the ladder logic in the PLC program to run this schematic.

5. To demonstrate the working system.

6. To Lockout buckets, unplug all items and clean up the workstation after the demonstration.

TAG LIST:

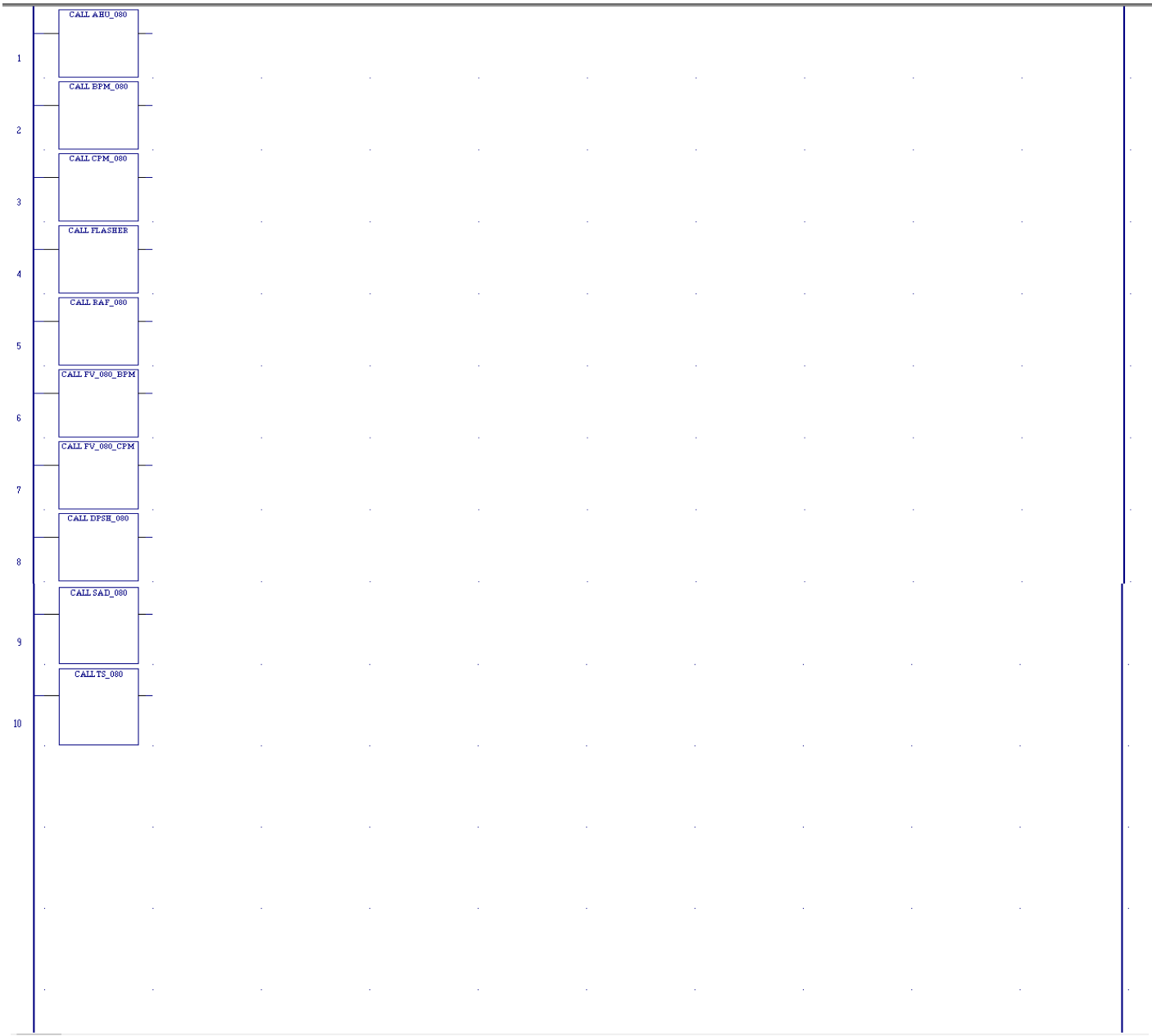
Name	DataType	Description	IOAddress
AHU_080_FDBK	BOOL	AHU_080 RUN FDBK	%Q00013
AHU_080_HOA	BOOL	AHU_080 HOA =0	%I00018
AHU_080_INTLK	BOOL	AHU_080 RUN INTERLOCK	<Symbolic>
AHU_080_PERM	BOOL	AHU_080 RUN PERMISSIVE	<Symbolic>
AHU_080_RUN_XL	BOOL	AHU_080 RUN INDICATION	%Q00007
AHU_080_START	BOOL	AHU_080 START PB	%I00011
AHU_080_STOP	BOOL	AHU_080 STOP PB	%I00015
BPM_080.BPM_STOP_TMR	TOF		<Symbolic>
BPM_080.BPM_STOP_TMR.IN	BOOL		<Symbolic>
BPM_080.BPM_STOP_TMR.PT	DINT		<Symbolic>
BPM_080.BPM_STOP_TMR.Q	BOOL		<Symbolic>
BPM_080.BPM_STOP_TMR.ET	DINT		<Symbolic>
BPM_080.BPM_STOP_TMR.ENO	BOOL		<Symbolic>
BPM_080.BPM_STOP_TMR.TI	BOOL		<Symbolic>
BPM_080.BPM_test	TON		<Symbolic>
BPM_080.BPM_test.IN	BOOL		<Symbolic>
BPM_080.BPM_test.PT	DINT		<Symbolic>
BPM_080.BPM_test.Q	BOOL		<Symbolic>
BPM_080.BPM_test.ET	DINT		<Symbolic>
BPM_080.BPM_test.ENO	BOOL		<Symbolic>
BPM_080.BPM_test.TI	BOOL		<Symbolic>
BPM_080.BPM_TON	TON		<Symbolic>
BPM_080.BPM_TON.IN	BOOL		<Symbolic>
BPM_080.BPM_TON.PT	DINT		<Symbolic>
BPM_080.BPM_TON.Q	BOOL		<Symbolic>
BPM_080.BPM_TON.ET	DINT		<Symbolic>
BPM_080.BPM_TON.ENO	BOOL		<Symbolic>
BPM_080.BPM_TON.TI	BOOL		<Symbolic>
BPM_080_FDBK	BOOL	BPM_080 RUN FDBK	%I00019
BPM_080_INLK	BOOL	BPM_080 RUN INTERLOCK	<Symbolic>
BPM_080_PERM	BOOL	BPM_080 RUN PERMISSIVE	<Symbolic>
BPM_080_RUN	BOOL	BPM_080 RUN COMMAND	%Q00020
BPM_080_RUN_XL	BOOL	BPM_080 RUN INDICATION	%Q00006
BPM_080_START	BOOL	BPM_080 START PB	%I00010
BPM_080_STOP	BOOL	BPM_080 STOP PB	%I00014
BPM_080_STOP_5s	BOOL	BPM_080 STOP TMR 5s	<Symbolic>
BPM_080_STOP_7s	BOOL	BPM_080 STOP TMR 7s	<Symbolic>
BPM_080_XL	BOOL	BPM_080 RUN INDICATION	<Symbolic>
BPM_STOP_TMR_et	DINT		<Symbolic>
CPM_080.CPM_TON_TMR	TON		<Symbolic>
CPM_080.CPM_TON_TMR.IN	BOOL		<Symbolic>
CPM_080.CPM_TON_TMR.PT	DINT		<Symbolic>
CPM_080.CPM_TON_TMR.Q	BOOL		<Symbolic>

CPM_080.CPM_TON_TMR.ET	DINT		<Symbolic>
CPM_080.CPM_TON_TMR.ENO	BOOL		<Symbolic>
CPM_080.CPM_TON_TMR.TI	BOOL		<Symbolic>
CPM_080_FDBK	BOOL	CPM_080 RUN FEEDBACK	%I00021
CPM_080_INTLK	BOOL	CPM_080 RUN INTERLOCK	<Symbolic>
CPM_080_PERM	BOOL	CPM_080 RUN PERMISSIVE	<Symbolic>
CPM_080_RUN	BOOL	CPM_080 RUN COMMAND	%Q00021
CPM_080_RUN_INDI	BOOL	CPM_080 RUN INDICATION	%Q00005
CPM_080_START	BOOL	CPM_080 START PB	%I00009
CPM_080_STOP	BOOL	CPM_080 STOP PB	%I00013
CPM_080_STOP_5s	BOOL	CPM_080 STOP TMR 5s	<Symbolic>
DPSH_080.TON_DSP	TON		<Symbolic>
DPSH_080.TON_DSP.IN	BOOL		<Symbolic>
DPSH_080.TON_DSP.PT	DINT		<Symbolic>
DPSH_080.TON_DSP.Q	BOOL		<Symbolic>
DPSH_080.TON_DSP.ET	DINT		<Symbolic>
DPSH_080.TON_DSP.ENO	BOOL		<Symbolic>
DPSH_080.TON_DSP.TI	BOOL		<Symbolic>
DPSH_083	BOOL	DIFF PRESSURE SWITCH	%I00004
DPSHA_080_XL	BOOL	DIFF PRESSURE SWITCH ALARM INDICATION	%Q00004
ESTOP	BOOL	EMERGENCY STOP	%I00023
FLASH	BOOL	FLASHER BIT	<Symbolic>
FLASHER.FSH_RESET	TON		<Symbolic>
FLASHER.FSH_RESET.IN	BOOL		<Symbolic>
FLASHER.FSH_RESET.PT	DINT		<Symbolic>
FLASHER.FSH_RESET.Q	BOOL		<Symbolic>
FLASHER.FSH_RESET.ET	DINT		<Symbolic>
FLASHER.FSH_RESET.ENO	BOOL		<Symbolic>
FLASHER.FSH_RESET.TI	BOOL		<Symbolic>
FLASHER.Timer_off	TOF		<Symbolic>
FLASHER.Timer_off.IN	BOOL		<Symbolic>
FLASHER.Timer_off.PT	DINT		<Symbolic>
FLASHER.Timer_off.Q	BOOL		<Symbolic>
FLASHER.Timer_off.ET	DINT		<Symbolic>
FLASHER.Timer_off.ENO	BOOL		<Symbolic>
FLASHER.Timer_off.TI	BOOL		<Symbolic>
FV_081_CPM	BOOL	FV_081 CPM ON SWITCH	%I00005
FV_081_CPM_XL	BOOL	FV_081_CPM ON INDICATION	%Q00009
FV_082_BPM	BOOL	FV_082 BPM ON SWITCH	%I00006
FV_082_BPM_XL	BOOL	FV_082_BPM ON INDICATION	%Q00010
RAD_080_ON	BOOL	RAD_080 ON SWITCH	%I00007
RAF_080_RUN	BOOL	RAF_080 RUN COMMAND	%Q00011
RAF_080_RUN_XL	BOOL	RAF_080_RUN INDICATION	%Q00008
RESET_FLASH	BOOL	RESET FLASHER	<Symbolic>

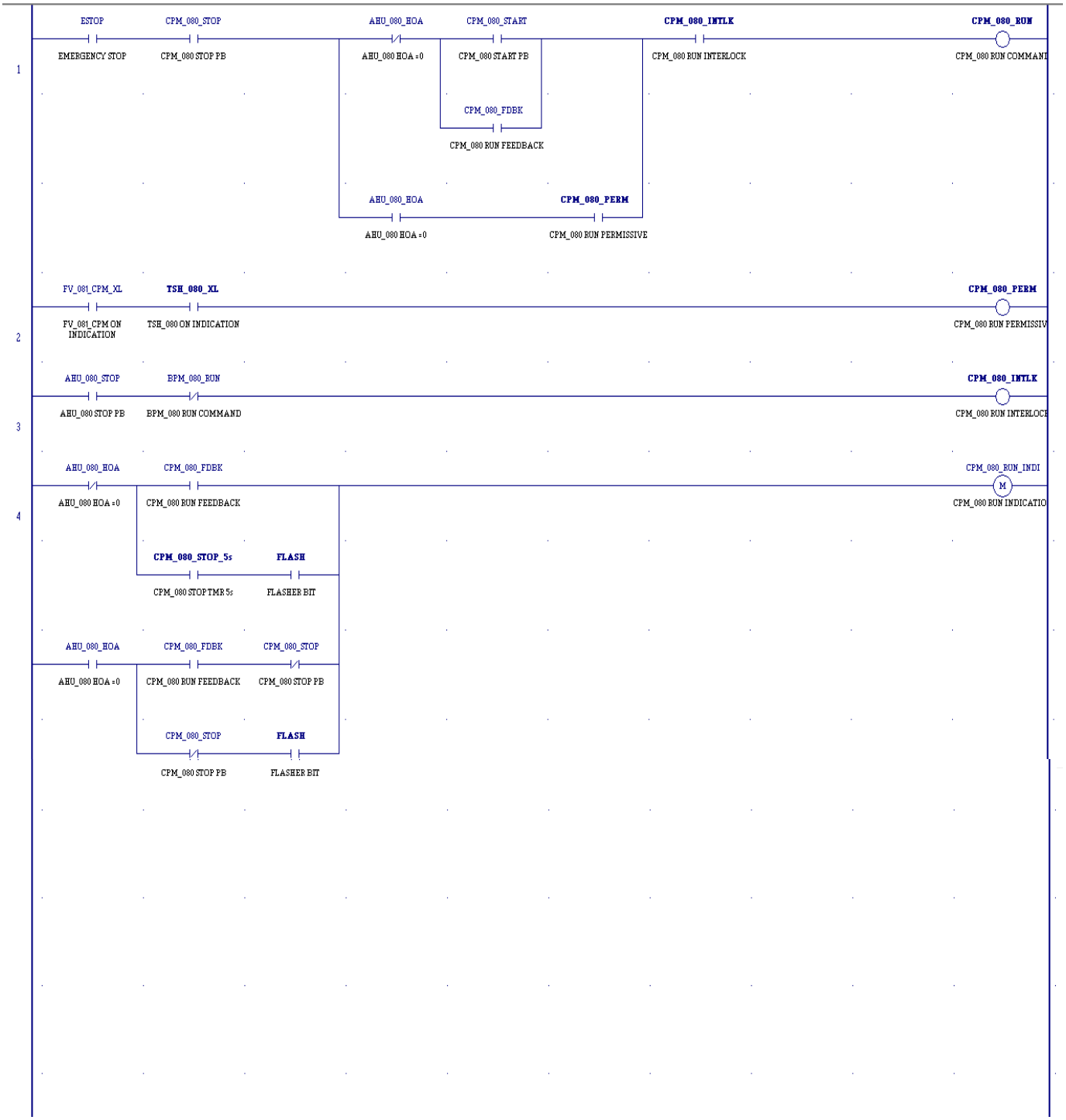
SAD_080_ON	BOOL	SAD_080 ON SWITCH	%I00003
SAD_080_XL	BOOL	SAD_080 ON INDICATION	%Q00003
TSH_080	BOOL	TSH_080 ON SWITCH	%I00001
TSH_080_XL	BOOL	TSH_080 ON INDICATION	%Q00001
TSL_080	BOOL	TSL_080 ON SWITCH	%I00002
TSL_080_XL	BOOL	TSL_080 ON INDICATION	%Q00002

LADDER LOGIC:

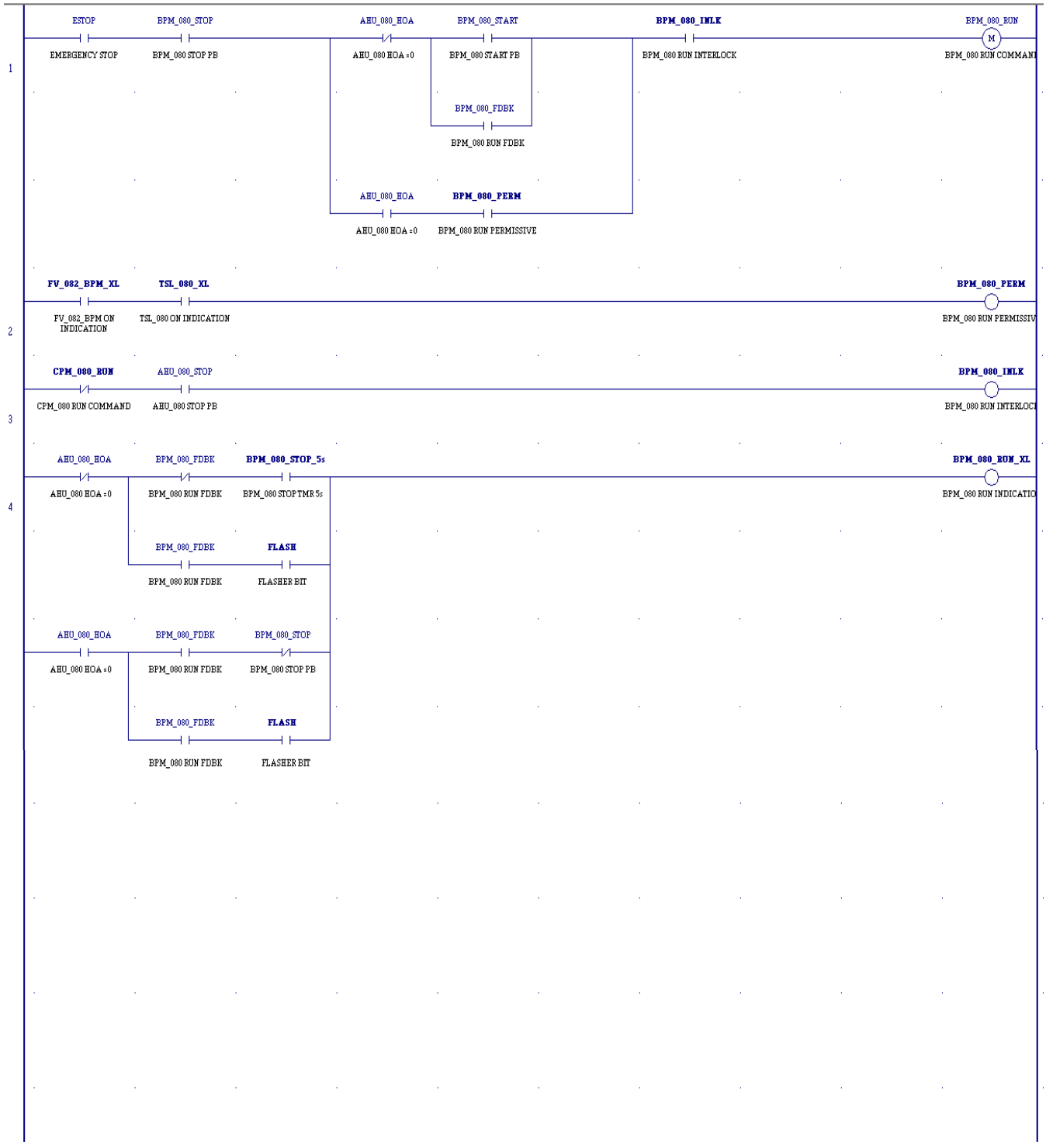
MAIN:



CPM_080_ROUTINE:



BPM_080_ROUTINE:



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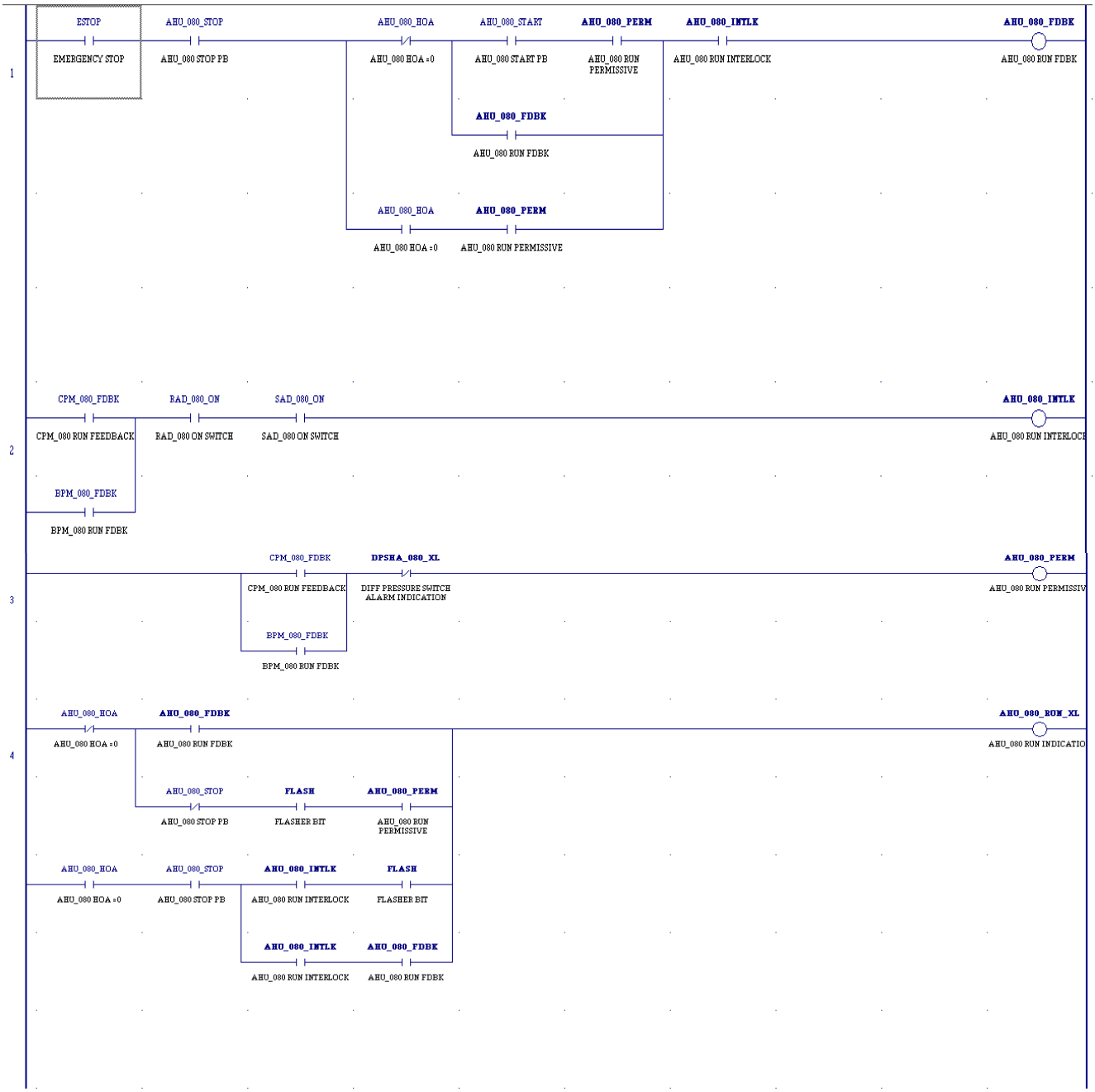
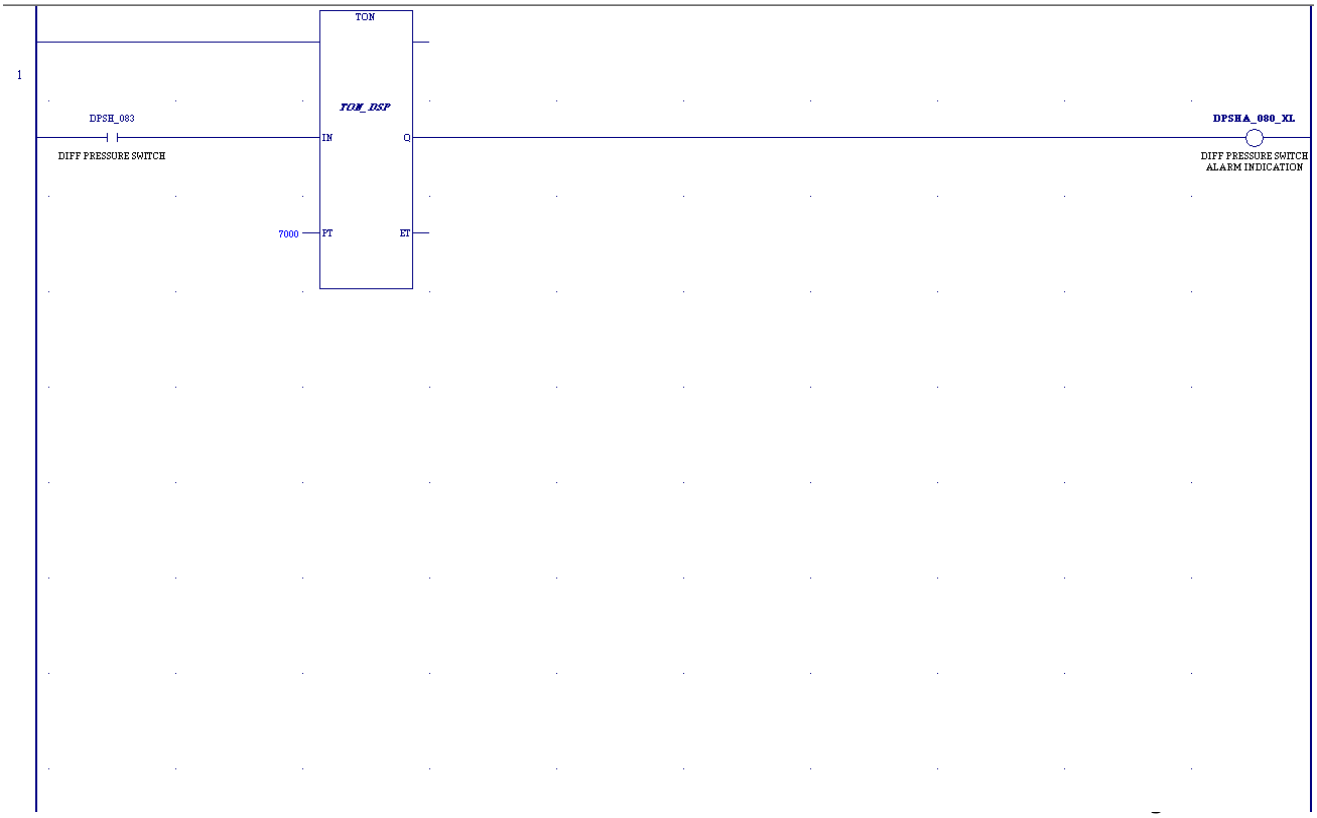
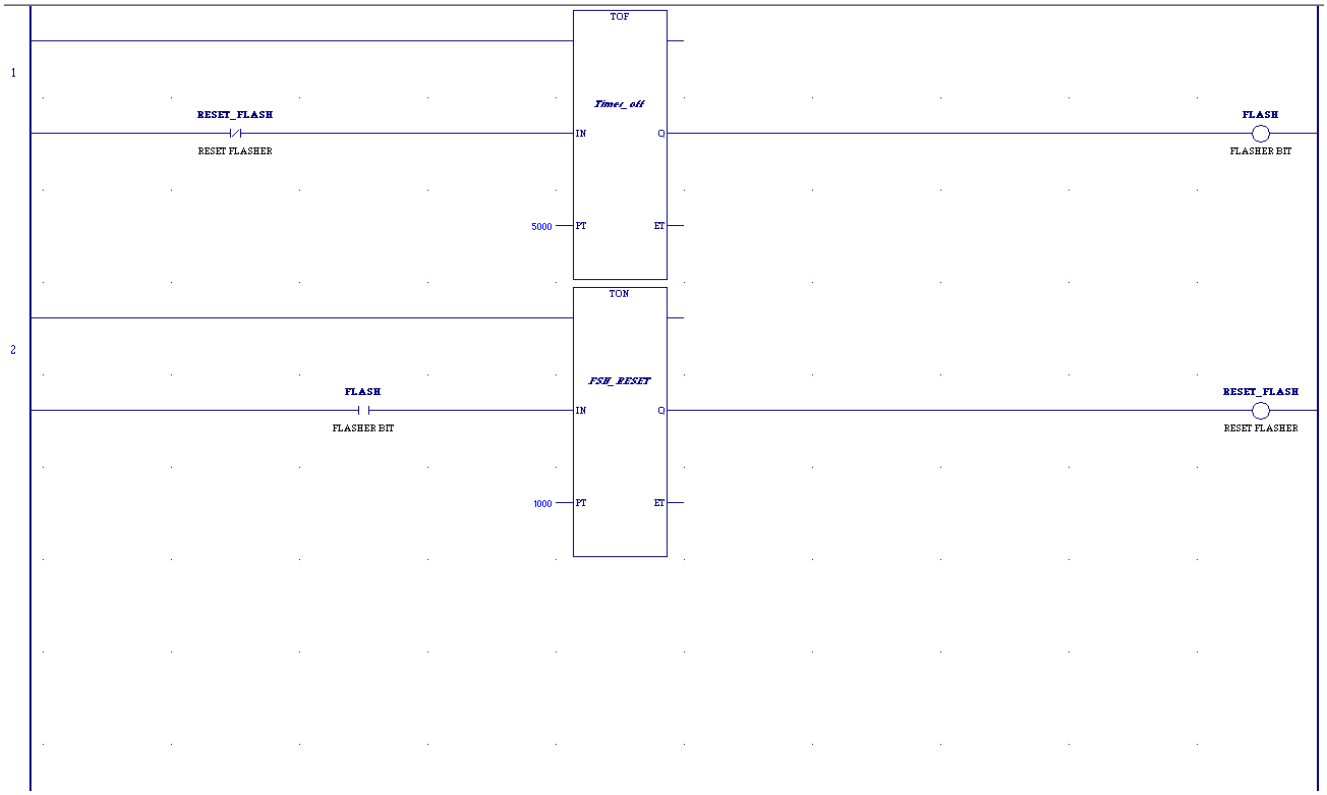


RAF_080_ROUTINE:

DPSH_080_ROUTINE:



FLASHER_080_ROUTINE:



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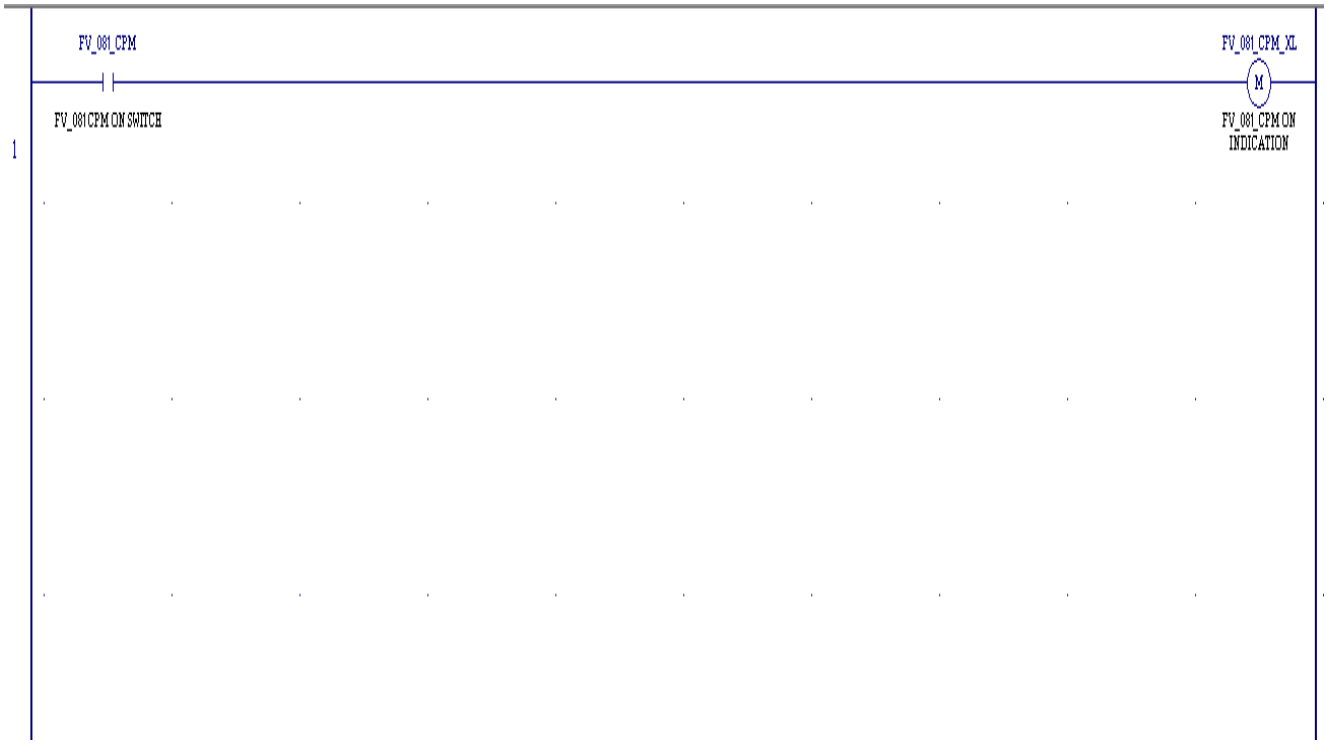

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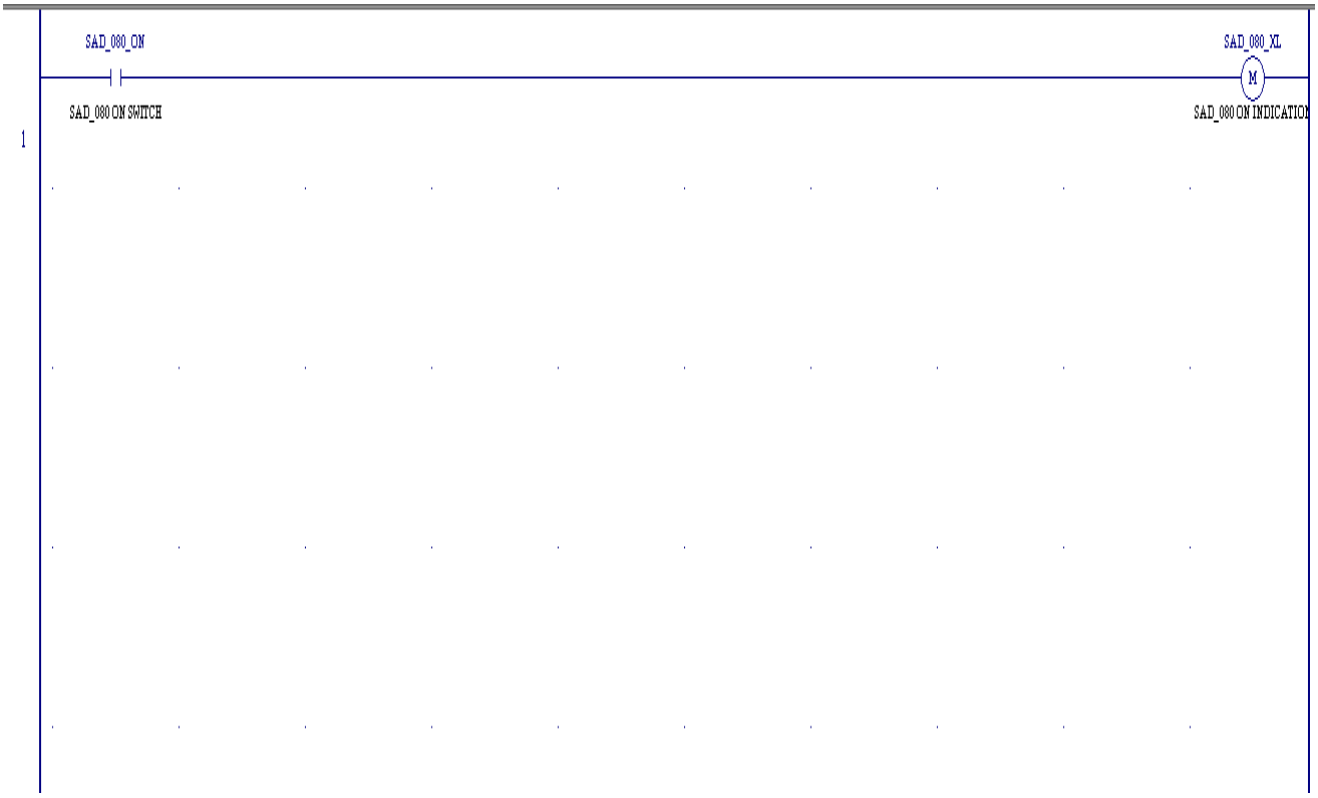
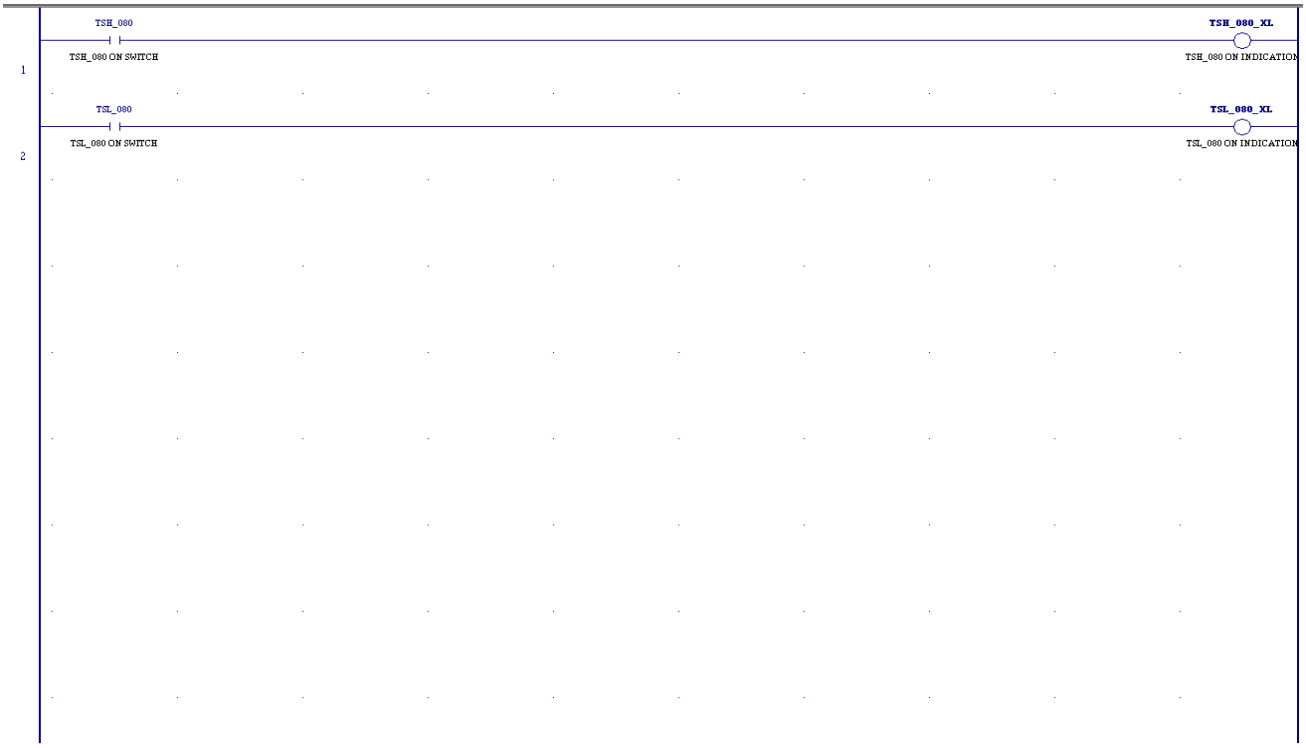


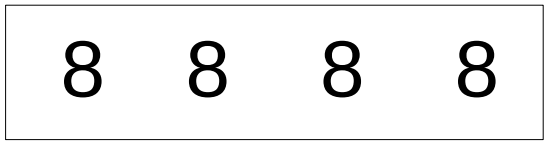
RAD_080_ROUTINE:

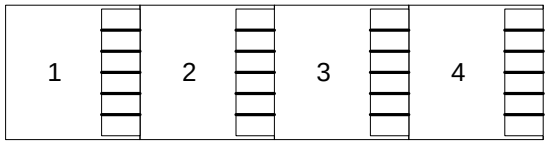
TSH_080_ROUTINE:



Operator Console Room 229

standard I/O assignments





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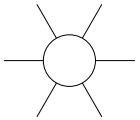
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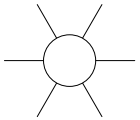
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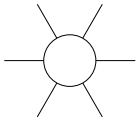
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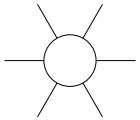
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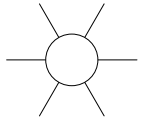
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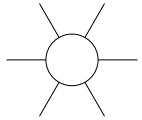
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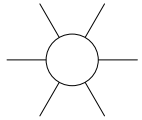
RAD_XL

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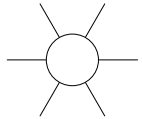
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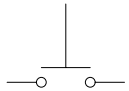
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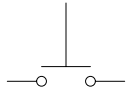
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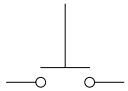
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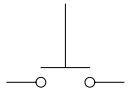
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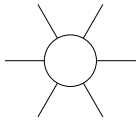
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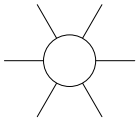
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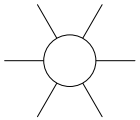
AHU_XL

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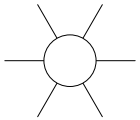
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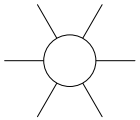
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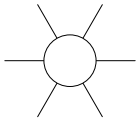
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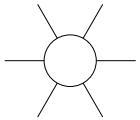
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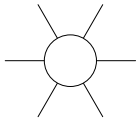
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FV_CPM

%I0005

FV_BPM

%I0006

RAD_0

%I0007


%I0008

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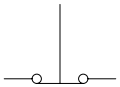
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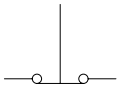
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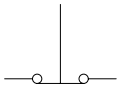
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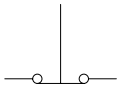
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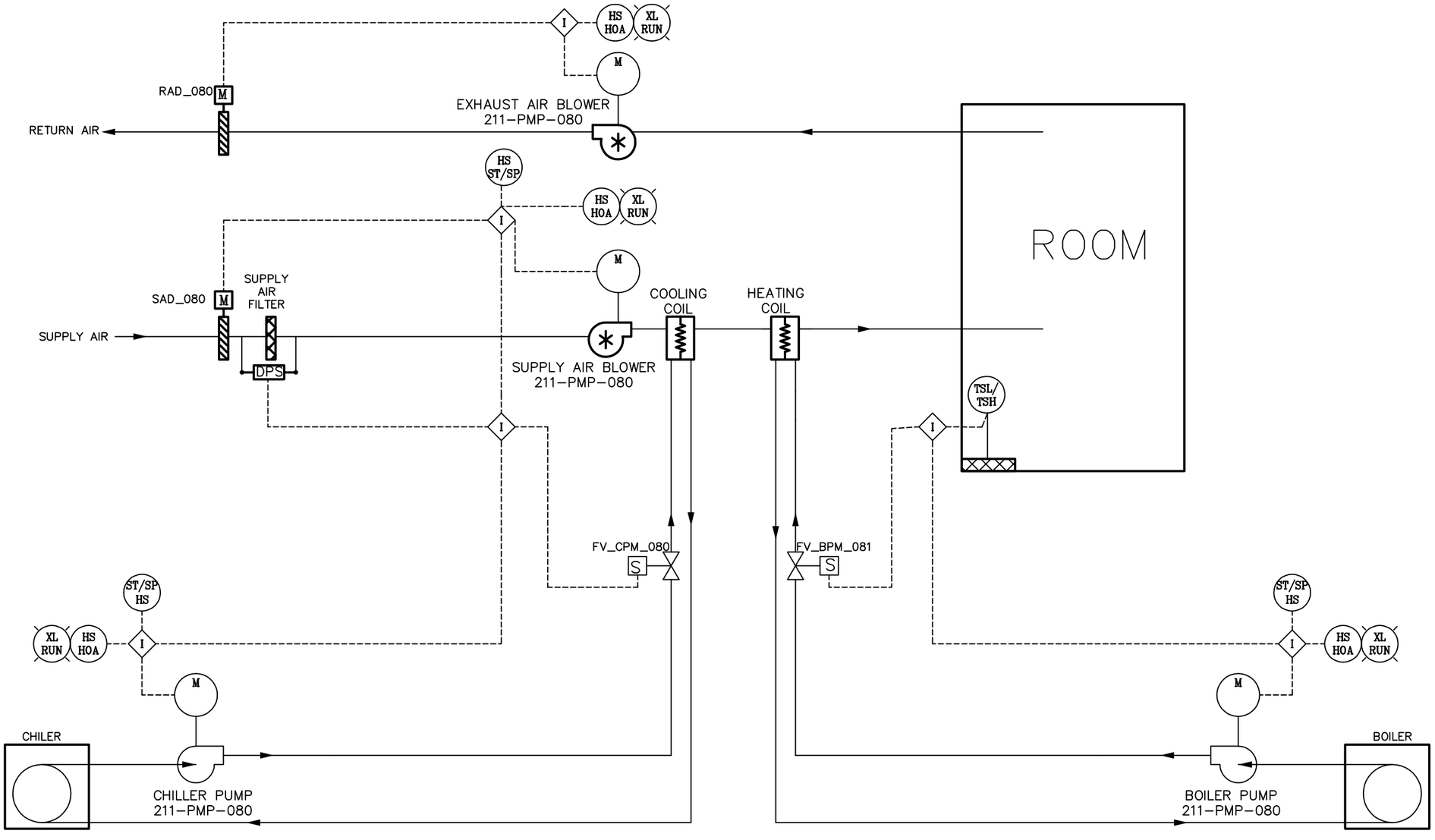
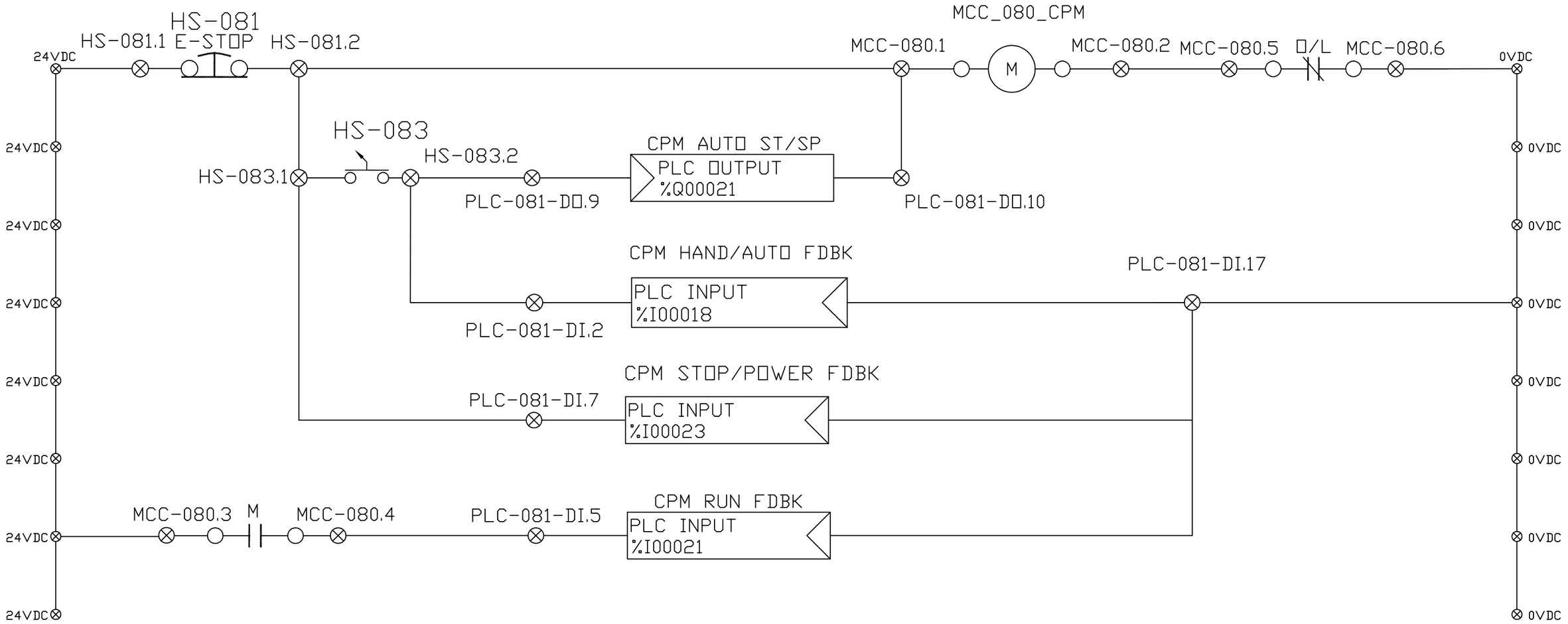


REFERENCE			REVISIONS							REVISIONS							MANAGEMENT RELEASE:		SCALE (A1): NTS		DATE	LOC.	MCT 211
																			DESIGNED:	ARUL/NEEP	28/03/2023	AREA	211-WKB-080
																			DRAWN:	ARUL/NEEP	28/03/2023	TITLE	EL431 FINAL PROJECT AUTOMATIC HVAC SYSTEM PIPING AND INSTRUMENTATION DIAGRAM
																			CHECKED:	J.D.L			
																			DESIGN LEAD APPROVAL:				
	DWG No.	DESCRIPTION		No.	DATE	DESCRIPTION	BY	DES. LEAD APPL.	DES. AUTH. APPL.		No.	DATE	DESCRIPTION	BY	DES. LEAD APPL.	DES. AUTH. APPL.			DESIGN AUTH. APPROVAL:			DWG. No.	EL431_FINAL PROJECT	REV A

CPM WIRING SCHEMATIC



REFERENCE DWGS:	BREAKER	HP:	RPM:	FRAME: ---	STARTER: ---	CONTROL XFMR VA:

NOTES:

SYMBOL LEGEND:

- ⬣ CONTROL CONSOLE
- ▲ NEAR MOTOR
- ▼ PLC CABINET
- □ TERMINAL BLOCK IN PLC
- ✳ STARTER DOOR
- ○ TERMINAL BLOCK IN STARTER
- ⊗ TERMINALS ON WORKBENCH

REV.	DATE	DESCRIPTION	DWN.	CKD.	APP.	CERT.
A	23/04/14	ISSUED FOR REVIEW	AP			

Confederation COLLEGE

SCALE:	N.T.S.		
DR:	J.L.D.	DATE	22/09/01
CK:	S.C.		22/09/01
APP:	T.T.		22/09/01

DEPARTMENT	CLASSIFICATION	A.F.E. NO.
211		

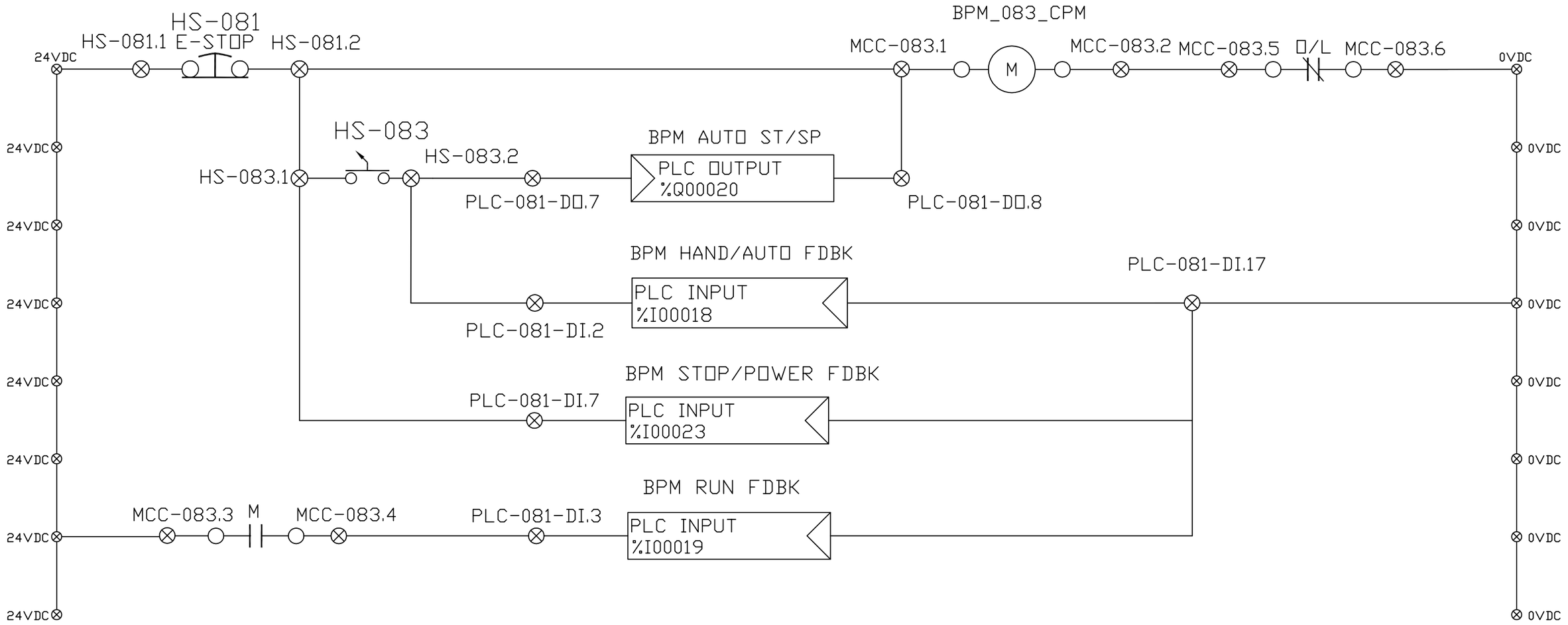
PROJECT: MCT-211 ELECTRICAL LAB

TITLE: WORKBENCH PANEL 080
CPM WIRING SCHEMATIC
DRAWING

DWG NO. 211-XXX-XXX

REV. A

BPM WIRING SCHEMATIC



REFERENCE DWGS:	BREAKER	HP:	RPM:	FRAME: ---	STARTER: ---	CONTROL XFMR VA:

NOTES:

SYMBOL LEGEND:

- ⬣ CONTROL CONSOLE
- ▲ NEAR MOTOR
- ▼ PLC CABINET
- □ TERMINAL BLOCK IN PLC
- ✳ STARTER DOOR
- ○ TERMINAL BLOCK IN STARTER
- ⊗ TERMINALS ON WORKBENCH

REV.	DATE	DESCRIPTION	DWN.	CKD.	APP.	CERT.
A	23/04/14	ISSUED FOR REVIEW	NP			

Confederation COLLEGE

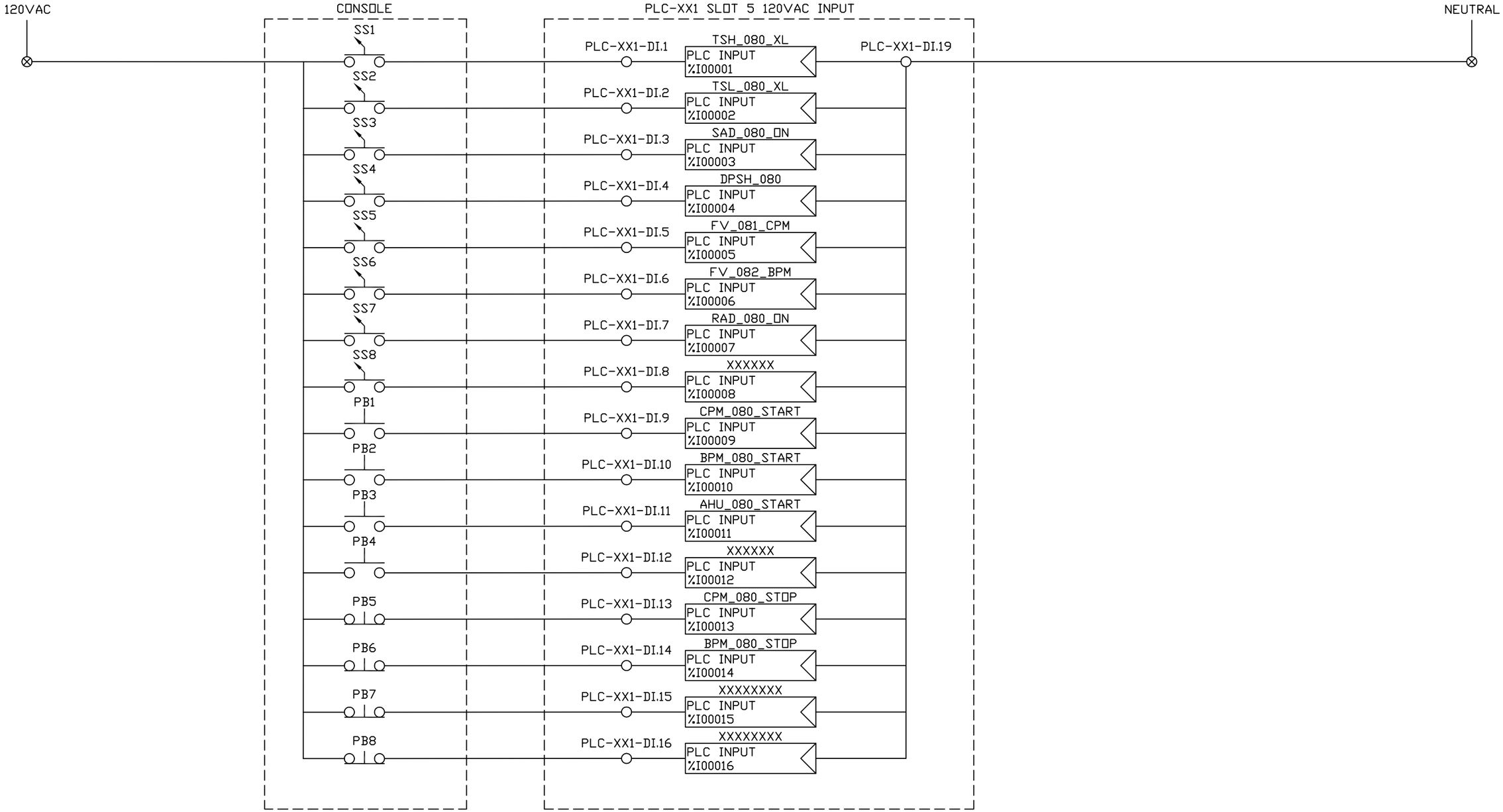
SCALE:	N.T.S.		
DR:	J.L.D.	DATE	22/09/01
CK:	S.C.		22/09/01
APP:	T.T.		22/09/01

DEPARTMENT	CLASSIFICATION	A.F.E. NO.
211		

PROJECT: MCT-211 ELECTRICAL LAB

TITLE: WORKBENCH PANEL 080
BPM WIRING SCHEMATIC
DRAWING

DWG NO. 211-08X-08X REV. A



REFERENCE DWGS:	BREAKER	HP:	RPM:	FRAME: ---	STARTER: ---	CONTROL XFMR VA:

NOTES:

SYMBOL LEGEND:

- ⬣ CONTROL CONSOLE
- ▲ NEAR MOTOR
- ▼ PLC CABINET
- □ TERMINAL BLOCK IN PLC
- ✳ STARTER DOOR
- ○ TERMINAL BLOCK IN STARTER
- ⊗ TERMINALS ON WORKBENCH

REV.	DATE	DESCRIPTION	DWN.	CKD.	APP.	CERT.
A	23/04/14	ISSUED FOR REVIEW	AP			

Confederation COLLEGE

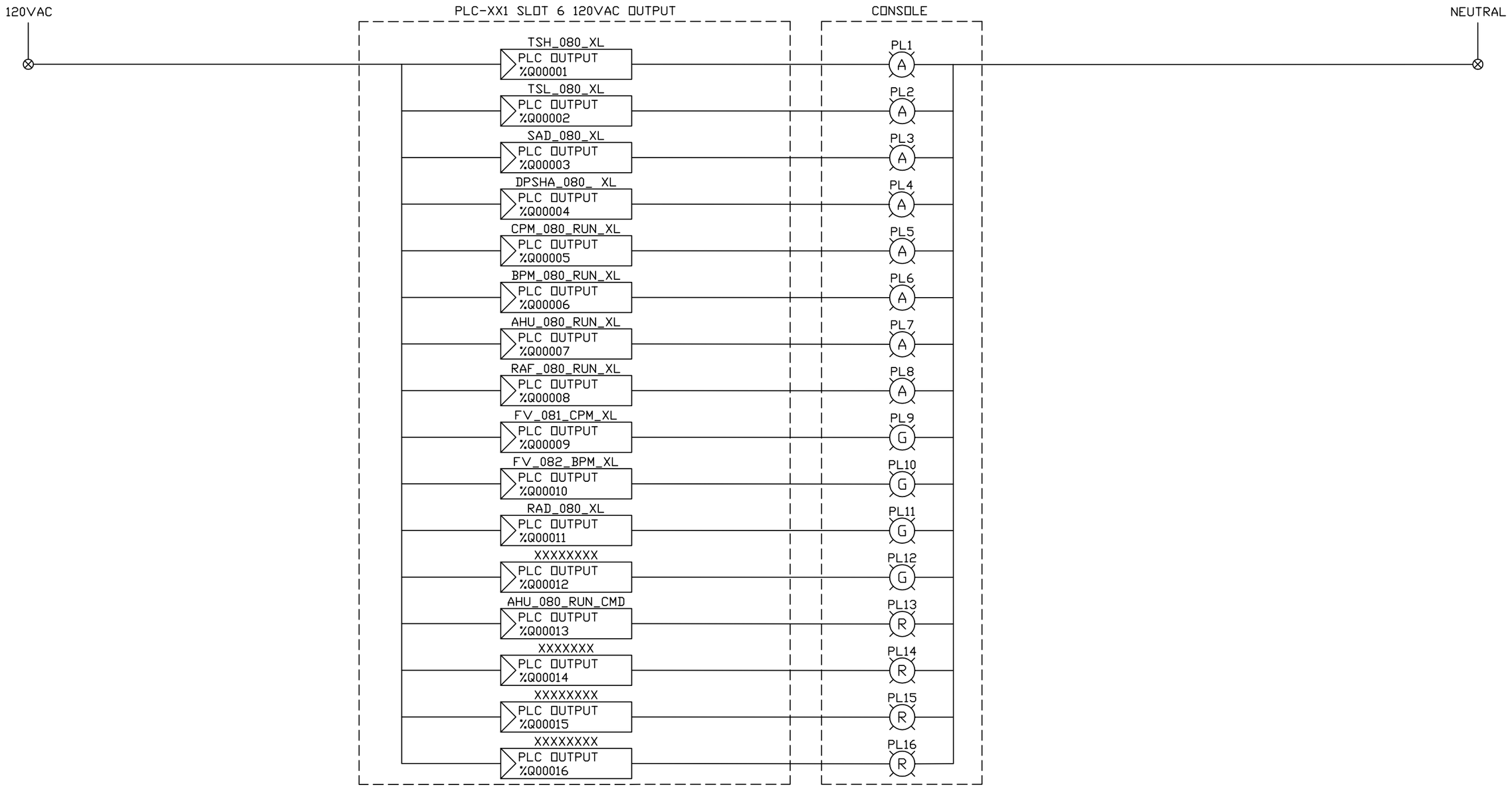
		DATE
SCALE:	N.T.S.	
DR:	J.L.D.	22/09/01
CK:	S.C.	22/09/01
APP:	T.T.	22/09/01

DEPARTMENT	CLASSIFICATION	A.F.E. NO.
211		

PROJECT: MCT-211 ELECTRICAL LAB

TITLE: WORKBENCH PANEL 080
PLC 081 CONSOLE WIRING
DRAWING

DWG NO. 211-CNSLE-XXX-SH1 REV. A



REFERENCE DWGS:	BREAKER	HP:	RPM:	FRAME: ---	STARTER: ---	CONTROL XFMR VA:

NOTES:

SYMBOL LEGEND:

- ⬣ CONTROL CONSOLE
- ▲ NEAR MOTOR
- ▼ PLC CABINET
- □ TERMINAL BLOCK IN PLC
- ✳ STARTER DOOR
- ○ TERMINAL BLOCK IN STARTER
- ⊗ TERMINALS ON WORKBENCH

REV.	DATE	DESCRIPTION	DWN.	CKD.	APP.	CERT.
A	23/04/14	ISSUED FOR REVIEW	NP			

Confederation COLLEGE

SCALE:	N.T.S.		
DR:	J.L.D.	DATE	22/09/01
CK:	S.C.		22/09/01
APP:	T.T.		22/09/01

DEPARTMENT	CLASSIFICATION	A.F.E. NO.
211		

PROJECT MCT-211 ELECTRICAL LAB

TITLE
WORKBENCH PANEL 080
PLC 081 CONSOLE WIRING
DRAWING

DWG NO. 211-CNSLE-XXX-SH2 REV. A