

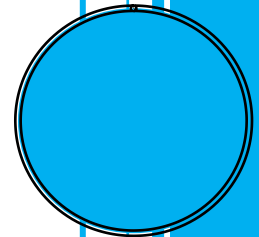


Petronas Chemical Fertilizer Sabah Sdn Bhd

Sabah Ammonia Urea (SAMUR), Sipitang, Sabah

## CONTROL & MONITORING STRATEGY FOR HVAC PANEL

- 1) Centrol Control Building (CCB)
- 2) Laboratory
- 3) Main Switch Board (MSB)
- 4) EDG House
- 5) Field Auxiliary Room 1 (FAR-1)
- 6) Field Auxiliary Room 2 (FAR-2)
- 7) Ammonia Urea Substation (AUSS)
- 8) Non Process Building Substation (NPBSS)
- 9) Jetty Operation (JOR)
- 10) Jetty Substation (JSS)
- 11) Offsite Control Room (OFFCR)
- 12) Offsite Substation (OFFSS)

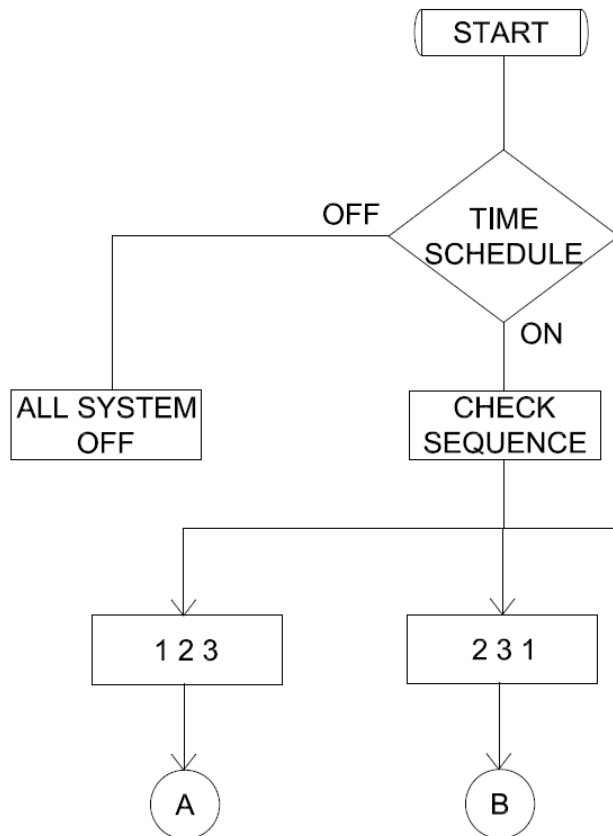


**Control Strategy for Airconditioning and Ventilation Equipment**

NO	Location	Control Equipment	Description	Remarks	Reference Chart
1	Central Control Building (CCB) Ground Floor	AHU-CCBG-01,02,03	2 Duty 1 Standby		Flowchart 1 & 2
		EF-CCB-1&2	1 Duty 1 Standby	Battery Room	Flowchart 3 & 4
		TEF-CCB-01	Time Control	Male/Female Toilet	Flowchart 7
		EH-CCB-01	3 Step control	Temp/Humidity sensor install at CCR	Flowchart 5 & 6
		EH-CCB-02		Temp/Humidity sensor install at Rack Room	
2	Central Control Building (CCB) First Floor	FCU-CCB1-23A	Time Control	Document Room,TPS	Flowchart 7
		FCU-CCB1-23B	Time Control	Corridor, Secretary	
		FCU-CCB1-23C	Time Control	Server Room	
3	Laboratory	AHU-LAB-01,02,03	2 Duty 1 Standby		Flowchart 1 & 2
		EF-LAB-01,02	1 Duty 1 Standby	Laboratory Area	Flowchart 3 & 4
		EF-LAB-03	Time Control	Pantry	Flowchart
		EH-LAB-01	3 Step control	Temp/Humidity sensor install at Chemical Room, Retain Sample and Open Area	Flowchart 5 & 6
4	Main Switch Board (MSB)	AHU-MSB-1A,1B,1C	2 Duty 1 Standby	Main Substation Building	Flowchart 1 & 2
		EF-MSB-01,02	1 Duty 1 Standby	Battery Room	Flowchart 3 & 4
		EF-MSB-03,04	1 Duty 1 Standby	Switchgear High Voltage	
		EDH-MSB-01	3 Step control	Temp/Humidity sensor install at Switchgear Low Voltage	Flowchart 5 & 6
5	EDG House	AHU-EDG-01,02	1 Duty 1 Standby	EDG Room	Flowchart 3 & 4
		EF-EDG-01A,01B	1 Duty 1 Standby	Battery Room	
6	Field Auxiliary Room-1	AHU-FAR1-01,02	1 Duty 1 Standby		Flowchart 3 & 4
		EF-FAR1-01A,01B	1 Duty 1 Standby	Battery Room	
		EF-FAR1-03	Time Control	Toilet	Flowchart 7
		EDH-FAR1-01	3 Step control	Temp/Humidity sensor install at Rack Room	Flowchart 5 & 6
7	Field Auxiliary Room-2	AHU-FAR2-01,02	1 Duty 1 Standby		Flowchart 3 & 4
		EF-FAR2-01A,01B	1 Duty 1 Standby	Battery Room	
		EF-FAR2-03	Time Control	Toilet	Flowchart 7
		EDH-FAR2-01	3 Step control	Temp/Humidity sensor install at Rack Room	Flowchart 5 & 6
8	Ammonia Urea Substation Building	AHU-AUSS-01,02	1 Duty 1 Standby		Flowchart 3 & 4
		EF-AUSS-01,02	1 Duty 1 Standby	Battery Room	
		EDH-AUSS-01	3 Step control	Temp/Humidity sensor install at Switchgear LV	Flowchart 5 & 6
9	Non Process Building SubStation	AHU-NPBSS-01,02	1 Duty 1 Standby		Flowchart 3 & 4
		EF-NPBSS-01,02	1 Duty 1 Standby	Battery Room	
		EDH-NPBSS-01	3 Step control	Temp/Humidity sensor install at Switchgear HV	Flowchart 5 & 6
10	Jetty Operation	AHU-JOR-01,02	1 Duty 1 Standby		Flowchart 3 & 4
		EF-JOR-01A,01B	1 Duty 1 Standby	Battery Room	
		EF-JOR-02	Time Control	Ablution,toilet,pantry	Flowchart 7
		EF-JOR-03	Time Control	Storage Room	
		EDH-JOR-01	3 Step control	Temp/Humidity sensor install at Rack Room	Flowchart 5 & 6
11	Jetty Substation	AHU-JSS-01,02	1 Duty 1 Standby		Flowchart 3 & 4
		EF-JSS-01A,01B	1 Duty 1 Standby	Battery Room	
		EDH-JSS-01	3 Step control	Temp/Humidity sensor install at Switchgear HV	Flowchart 5 & 6

12	Offsite Control Room	AHU-OFFCR-01,02	1 Duty 1 Standby		Flowchart 3 & 4
		EF-OFFCR-01A,01B	1 Duty 1 Standby	Battery Room	
		EF-OFFCR-02	Time Control	Ablution,toilet,pantry	Flowchart 7
		EDH-OFFCR-01	3 Step control	Temp/Humidity sensor install at Rack room	Flowchart 5 & 6
13	Offsite Substation	AHU-OFFSS-01,02	1 Duty 1 Standby		Flowchart 3 & 4
		EF-OFFSS-01A,01B	1 Duty 1 Standby	Battery Room	
		EDH-OFFSS-01	3 Step control	Temp/Humidity sensor install at Switchgear HV	Flowchart 5 & 6

Table 1 : Equipment schedule for control



Days	Running 1	Running 2	Standby
1 <sup>st</sup> to 7 <sup>th</sup>	AHU 1	AHU 2	AHU 3
8 <sup>th</sup> to 14 <sup>th</sup>	AHU 3	AHU 1	AHU 2
15 <sup>th</sup> to 21 <sup>th</sup>	AHU 2	AHU 3	AHU 1
22 <sup>th</sup> to 28 <sup>th</sup>	AHU 1	AHU 2	AHU 3
29 <sup>th</sup> to 31 <sup>th</sup>	AHU 3	AHU 1	AHU 2

Table 2 : 3 units AHU Sequence for 1 month

## Legend

A : To run program sequence 1 2 3

B : To run program sequence 2 3 1

C : To run program sequence 3 1 2

Flowchart 1 : AHU Sequence for panel CCB,Lab and MSB

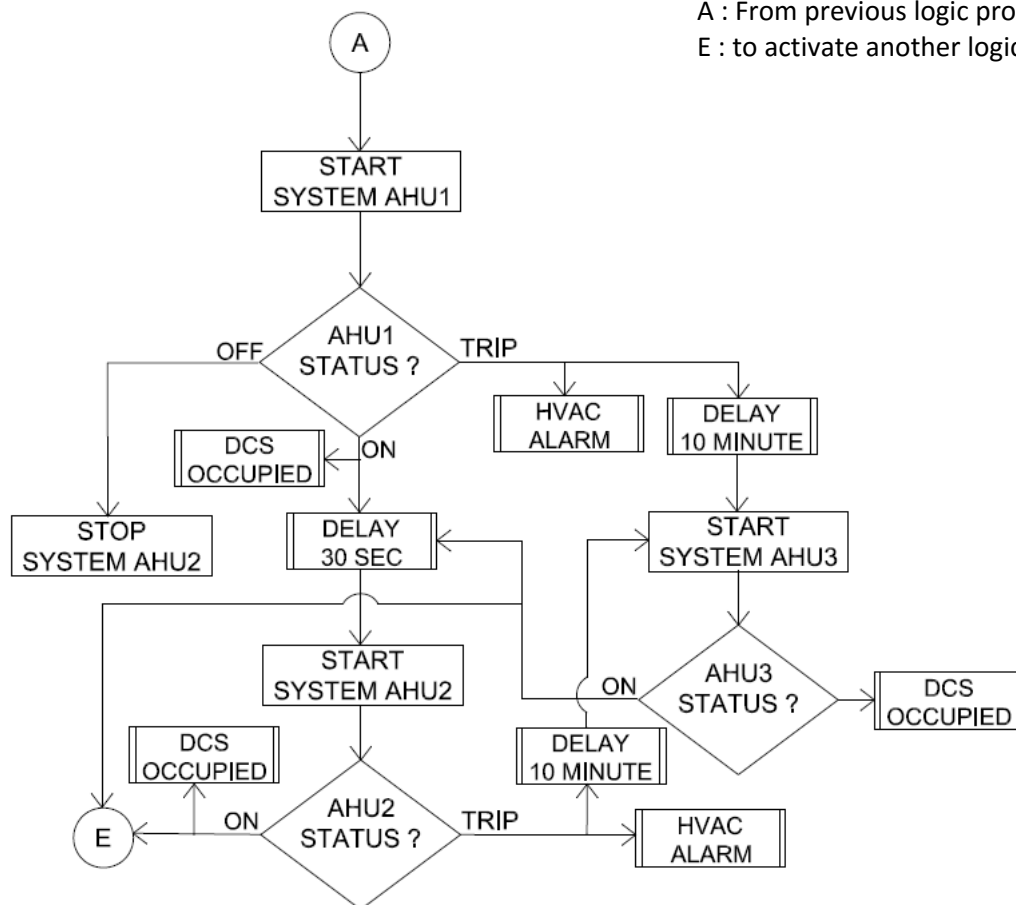
AHU/FCU/Exhaust Fan System Operation

- 1) AHU operation shall be determined by sequence running.
- 2) System will check on the Time Schedule to initiate the program.
- 3) After verifying the time schedule, system will "START" the necessary AHU according to the sequence.
- 4) System will verify the status of the AHU to be "ON" before initiating the respective PID or logic program.
- 5) The sequence will be change everyweek at 12.00 AM

**3 units AHU Operation during every sequence****SEQ 123**Legend

A : From previous logic program

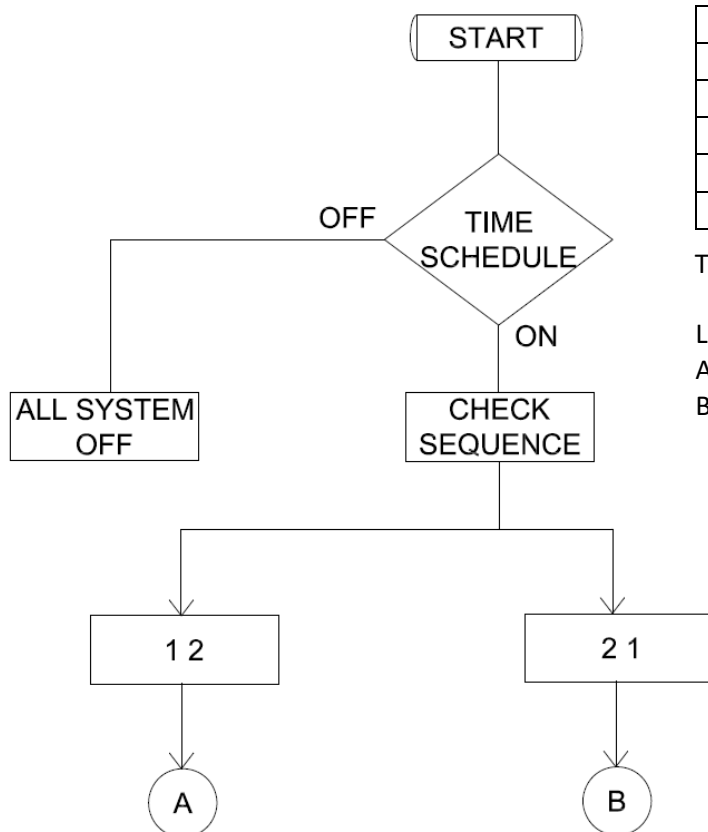
E : to activate another logic program (monitor/control)



Flowchart 2 : AHU operation during sequence 1 2 3

**Example Operation during sequence 1 2 3**

- 1) When the AHU 1 is confirm to be "ON", system will check the Status AHU 1 before initiate the time 30 sec delay to start AHU 2. PLC System will trigger "DCS OCCUPIED" to indicate system is running.
- 2) If the Status AHU 1 or AHU 2 is "TRIP", 10 minute delay time for backup AHU (System AHU 3) will be initiate. PLC system will capture any trip condition and trigger "HVAC ALARM" to inform other system for tripping mode.
- 3) AHU3 will be run until "TRIP" AHU 1 or AHU 2 is cleared.



Days	Running	Standby
1 <sup>st</sup> to 7 <sup>th</sup>	AHU 1	AHU 2
8 <sup>th</sup> to 14 <sup>th</sup>	AHU 2	AHU 1
15 <sup>th</sup> to 21 <sup>th</sup>	AHU 1	AHU 2
22 <sup>th</sup> to 28 <sup>th</sup>	AHU 2	AHU 1
29 <sup>th</sup> to 31 <sup>th</sup>	AHU 1	AHU 2

Table 3 : 2 units AHU Sequence for 1 month

## Legend

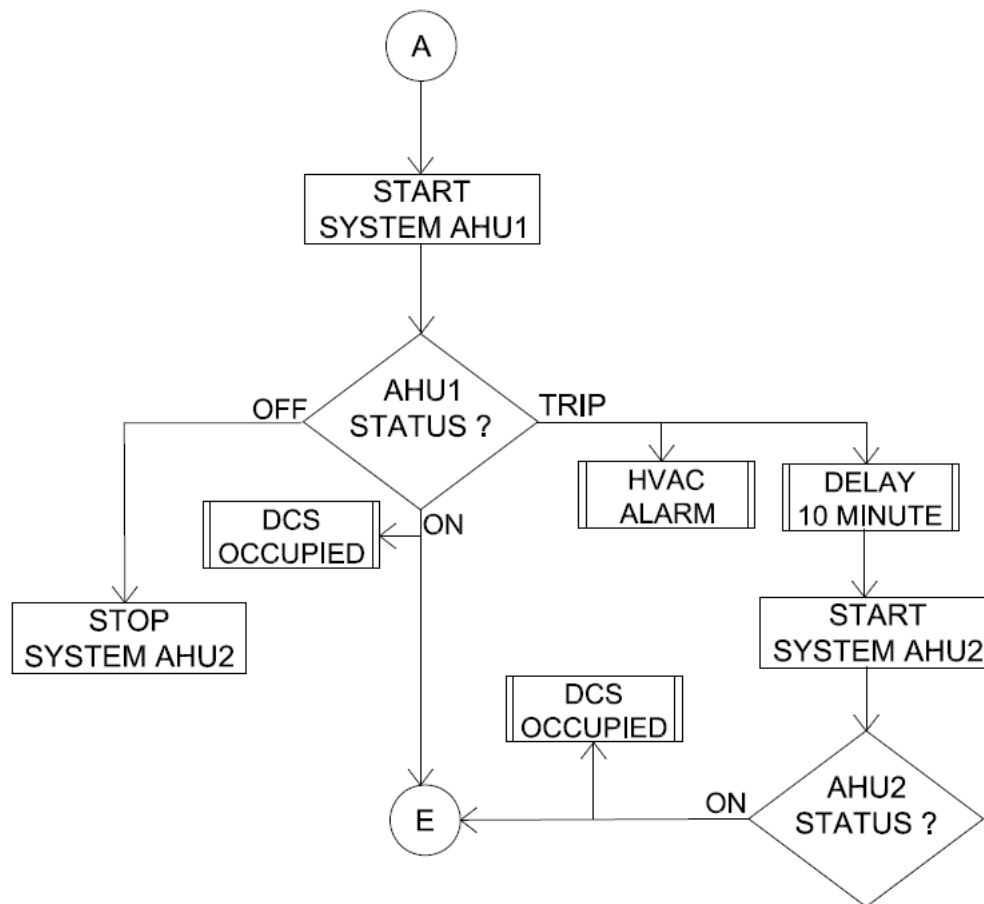
A : To run program sequence 1 2

B : To run program sequence 2 1

Flowchart 3 : AHU Sequence for panel EDG, FAR-1, FAR-2, AUSS, Jetty Operation, NPBSS, Offsite Control Room, Offsite Substation

AHU/Exhaust Fan System Operation

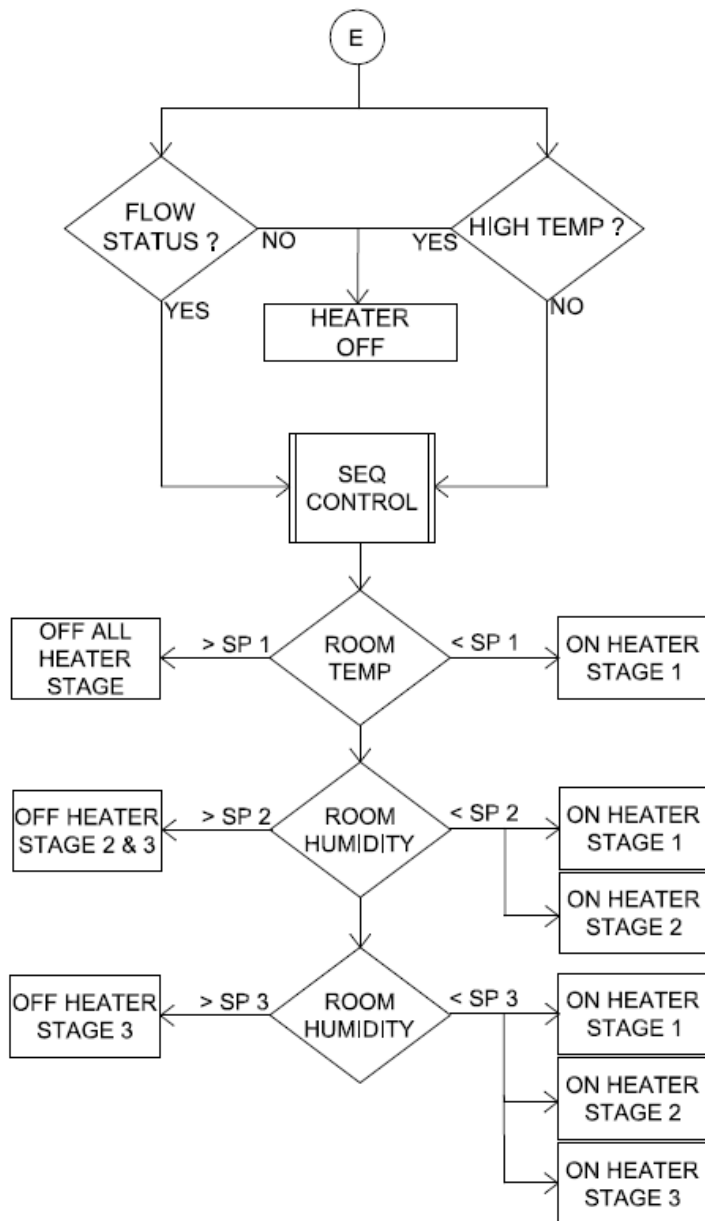
- 1) AHU/Exhaust Fan operation shall be determined by sequence running.
- 2) System will check on the Time Schedule to initiate the program.
- 3) After verifying the time schedule, system will "START" the necessary AHU/EF according to the sequence.
- 4) System will verify the status of the AHU to be "ON" before initiating the respective PID or logic program.
- 5) The sequence will be change everyweek at 12.00 AM

**2 units AHU Operation during every sequence****SEQ 12**

Flowchart 4 : AHU operation during sequence 1 2

**Example Operation during sequence 1 2**

- 1) When the AHU1 is confirm to be "ON", system will check the Status AHU1 before initiate the time 30 sec delay to start AHU 2. PLC System will trigger "DCS OCCUPIED" to indicate system is running.
- 2) If the Status AHU 1 is "TRIP", 10 minute delay time for backup AHU (System AHU 2) will be initiate. PLC system will capture any trip condition and trigger "HVAC ALARM" to inform other system in tripping mode.
- 3) AHU2 will be run until "TRIP" AHU 1 is cleared.

**Heater Control Operation**

Flowchart 5 : Electric Duct Heater operation

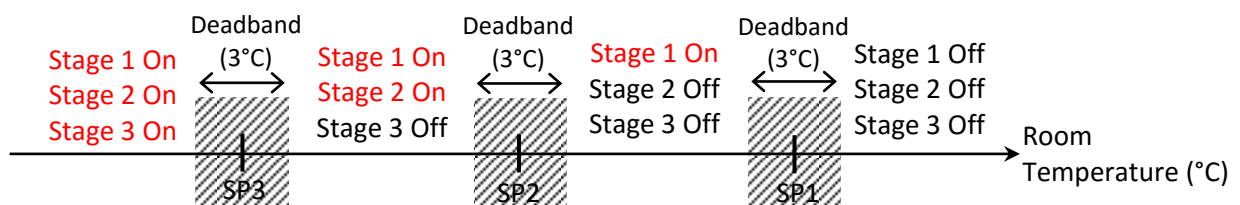
- 1) After AHU is confirm ON, PLC will check the FLOW STATUS and HIGH TEMPERATURE (feedback from Electric Duct Heater system) to ensure motor is running. If No flow status or High Temperature is Yes, PLC will command to off all the heater logic control stage for safety protection.
  - 2) After Flow Status is confirmed ON and No High Temperature detected, PLC will measure the Room Temperature (°C) inside the room.
  - 3) If the Setpoint 1 < Room Temperature, system will trigger to ON heater stage 1 to increase Room Temperature value.
  - 4) If the Setpoint 1 and 2 < Room Temperature system will trigger to ON heater stage 1 & 2.
  - 5) If the Setpoint 1, 2 and 3 < Room Temperature, system will trigger to ON all heater stage.
  - 6) All heater stage will be totally OFF if the Room Temperature value is greater than Setpoint 1.
- Setpoint Room Temperature for heater operation is user configurable but limited to authorize person only.
  - Setpoint (SP) for Room Temperature must be follow this condition :-  
Setpoint 1 > Setpoint 2 > Setpoint 3
  - Deadband for heater operation is 3°C

Example :

Setpoint 1 : 25 °C

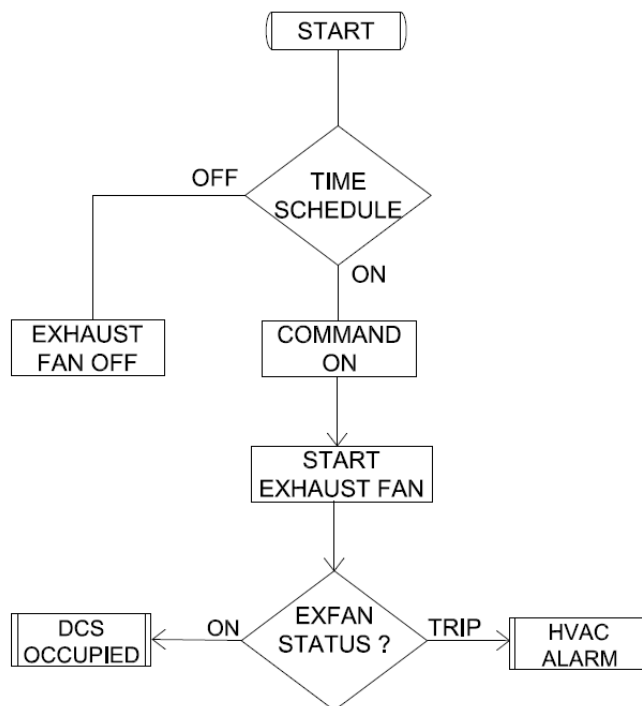
Setpoint 2 : 20 °C

Setpoint 3 : 15 °C



Flowchart 6 : Heater Stage Control Operation

## CONTROL STRATEGY FOR EXHAUST FAN TIME SCHEDULE



### Exhaust Fan System Operation

- 1) Exhaust Fan operation shall be determined by Time Schedule.
- 2) System will check on the Time Schedule to initiate the program.
- 3) After verifying the time schedule, system will "START" the necessary Exhaust Fan..
- 4) System will verify the status of the AHU to be "ON" before trigger DCS OCCUPIED.
- 5) If system detect Trip, HVAC ALARM will be trigger to inform DCS.

Flowchart 7 : Exhaust Fan operation using time schedule

### Monitoring Strategy for Airconditioning and Ventilation Equipment

NO	Location	Monitoring Equipment	Description	Remarks	Reference Chart
1	Central Control Building (CCB) Ground Floor	AHU-CCBG-01,02,03	Status, Trip, Mode Belt Status Fire,Gas,Smoke Detection Buzzer Status		Flowchart 10 Flowchart 12 Flowchart 13
		EF-CCB-1&2	Status	Battery Room	Flowchart 12 Flowchart 13
		TEF-CCB-01	Trip Mode	Male/Female Toilet	
		EF-CCB-7A,7B,08	Status Trip	Rack Room UPS Room	
		EH-CCB-01 & 02	On Status Flow Status High Temperature	CCR , Rack Room	Flowchart 14
		MD-CCBG-01,02,03,04 MD-EF-CCB-07A,07B,08	Open Close	Motorized Damper	Flowchart 9
		MFD-CCB-01 ~ 10	Open Close	Motorized Fire Damper	Flowchart 8
2	Central Control Building (CCB) First Floor	FCU-CCB1-23A	Status	Document Room,TPS	Flowchart 12 Flowchart 13
		FCU-CCB1-23B	Trip	Corridor, Secretary	
		FCU-CCB1-23C	Mode	Server Room	



3	Laboratory	AHU-LAB-01,02,03	Status, Trip, Mode Belt Status Fire,Gas,Smoke Detection Buzzer Status	Laboratory Area	Flowchart 10 Flowchart 12 Flowchart 13
		EF-LAB-01,02,03	Status Trip Mode	Laboratory Area	Flowchart 12 Flowchart 13
		EH-LAB-01	On Status Flow Status High Temperature	Chemical Room, Retain Sample,Open Area	Flowchart 14
		MD-LAB-01,02,03,04	Open Close	Motorized Damper	Flowchart 9
4	Main Switch Board (MSB)	AHU-MSB-1A,1B,1C	Status, Trip, Mode Belt Status Fire,Gas,Smoke Detection Buzzer Status	Main Substation Building	Flowchart 10 Flowchart 12 Flowchart 13
		EF-MSB-01,02,03,04	Status Trip Mode	Battery Room Switchgear High Voltage	Flowchart 12 Flowchart 13
		EDH-MSB-01	On Status Flow Status High Temperature	Switchgear Low Voltage	Flowchart 14
		MD-MSB-01A, 01B, 01C, 01D MD-EF-MSB-01E, 01F	Open Close	Motorized Damper	Flowchart 9
		MFD-MSB-01 ~ 09	Open Close	Motorized Fire Damper	Flowchart 8
5	EDG House	AHU-EDG-01,02	Status, Trip, Mode Belt Status Fire,Gas,Smoke Detection Buzzer Status	EDG Room	Flowchart 10 Flowchart 12 Flowchart 13
		EF-EDG-01A,01B	Status Trip Mode	Battery Room	Flowchart 12 Flowchart 13
		EF-EDG-02	Status Trip	Local Panel Room	
		MD-EDG-01A, 01B MD-EF-EDG-02	Open Close	Motorized Damper	Flowchart 9
		MFD-EDG-01, 02, 03	Open Close	Motorized Fire Damper	Flowchart 8
6	Field Auxiliry Room-1	AHU-FAR1-01,02	Status, Trip, Mode Belt Status Fire,Gas,Smoke Detection Buzzer Status		Flowchart 10 Flowchart 12 Flowchart 13
		EF-FAR1-01A, 01B, 03	Status Trip Mode	Battery Room Toilet	Flowchart 12 Flowchart 13
		EF-FAR1-02	Status Trip	UPS Room	
		EDH-FAR1-01	On Status Flow Status High Temperature	Rack Room	Flowchart 14
		MD-FAR1-01A,01B,01C MD-EF-FAR1-02	Open Close	Motorized Damper	Flowchart 9
		MFD-FAR1-01 ~ 06	Open Close	Motorized Fire Damper	Flowchart 8

7	Field Auxiliry Room-2	AHU-FAR2-01,02	Status, Trip, Mode Belt Status Fire,Gas,Smoke Detection Buzzer Status		Flowchart 10 Flowchart 12 Flowchart 13
		EF-FAR2-01A,01B, 03	Status Trip Mode	Battery Room	Flowchart 12 Flowchart 13
		EF-FAR2-02	Status Trip	UPS Room	
		EDH-FAR2-01	On Status Flow Status High Temperature	Rack Room	Flowchart 14
		MD-FAR2-01A,01B,01C MD-EF-FAR2-02	Open Close	Motorized Damper	Flowchart 9
		MFD-FAR2-01 ~ 06	Open Close	Motorized Fire Damper	Flowchart 8
8	Ammonia Urea Substation Building	AHU-AUSS-01,02	Status, Trip, Mode Belt Status Fire,Gas,Smoke Detection Buzzer Status		Flowchart 10 Flowchart 12 Flowchart 13
		EF-AUSS-01,02	Status Trip Mode	Battery Room	Flowchart 12 Flowchart 13
		EF-AUSS-03,04	Status Trip	Switchgear HV	
		EDH-AUSS-01	On Status Flow Status High Temperature	Switchgear LV	Flowchart 14
		MD-AUSS-01,02,03 MD-EF-FAR2-02	Open Close	Motorized Damper	Flowchart 9
		MFD-AUSS-01 ~ 09	Open Close	Motorized Fire Damper	Flowchart 8
9	Non Process Building SubStation	AHU-NPBSS-01,02	Status, Trip, Mode Belt Status Fire,Gas,Smoke Detection Buzzer Status		Flowchart 10 Flowchart 12 Flowchart 13
		EF-NPBSS-01,02	Status Trip Mode	Battery Room	Flowchart 12 Flowchart 13
		EF-NPBSS-03	Status Trip	Switchgear HV	
		EDH-NPBSS-01	On Status Flow Status High Temperature	Switchgear HV	Flowchart 14
		MD-NPBSS-01A,01B,01C MD-EF-NPBSS-01D	Open Close	Motorized Damper	Flowchart 9
		MFD-NPBSS-01 ~ 10	Open Close	Motorized Fire Damper	Flowchart 8

10	Jetty Operation	AHU-JOR-01,02	Status, Trip, Mode Belt Status Fire,Gas,Smoke Detection Buzzer Status		Flowchart 10 Flowchart 12 Flowchart 13
		EF-JOR-01A,01B EF-JOR-02 EF-JOR-03	Status Trip Mode	Battery Room Ablution,toilet,pantry Storage Room	Flowchart 12 Flowchart 13
		EF-JOR-04A,04B EF-JOR-05	Status Trip	Rack Room Ups Room	
		EDH-JOR-01	On Status Flow Status High Temperature	Rack Room	Flowchart 14
		MD-JOR-01A,01B,01C MD-JOR-02A,02B MD-JOR-03A	Open Close	Motorized Damper	Flowchart 9
		MFD-JOR-01 ~ 07	Open Close	Motorized Fire Damper	Flowchart 8
11	Jetty Substation	AHU-JSS-01,02	Status, Trip, Mode Belt Status Fire,Gas,Smoke Detection Buzzer Status		Flowchart 10 Flowchart 12 Flowchart 13
		EF-JSS-01A,01B	Status Trip Mode	Battery Room	Flowchart 12 Flowchart 13
		EF-JSS-02	Status Trip	Switchgear HV	
		EDH-JSS-01	On Status Flow Status High Temperature	Switchgear HV	Flowchart 14
		MD-JSS-01A,01B,01C,01D	Open Close	Motorized Damper	Flowchart 9
		MFD-JSS-01 ~ 09	Open Close	Motorized Fire Damper	Flowchart 8
12	Offsite Control Room	AHU-OFFCR-01,02	Status, Trip, Mode Belt Status Fire,Gas,Smoke Detection Buzzer Status		Flowchart 10 Flowchart 12 Flowchart 13
		EF-OFFCR-01A,01B	Status Trip Mode	Battery Room	Flowchart 12 Flowchart 13
		EF-OFFCR-02	Status Trip Mode	Ablution,toilet,pantry	
		EF-OFFCR-03A, 03B EF-OFFCR-04A, 04B	Status Trip	UPS Room Rack Room	
		EDH-OFFCR-01	On Status Flow Status High Temperature	Rack room	Flowchart 14
		MD-OFFCR-01A,01B,01C MD-OFFCR-02A,02B,03A,03B	Open Close	Motorized Damper	Flowchart 9
		MFD-OFFCR-01 ~ 07	Open Close	Motorized Fire Damper	Flowchart 8

13	Offsite Substation	AHU-OFFSS-01,02	Status, Trip, Mode Belt Status Fire,Gas,Smoke Detection Buzzer Status		Flowchart 10 Flowchart 12 Flowchart 13
		EF-OFFSS-01A,01B	Status Trip Mode	Battery Room	Flowchart 12 Flowchart 13
		EF-OFFSS-02A,02B	Status Trip	Switchgear LV	
		EDH-OFFSS-01	On Status Flow Status High Temperature	Switchgear HV	Flowchart 14
		MD-OFFSS-01A,01B,01C MD-OFFSS-01D,01E	Open Close	Motorized Damper	Flowchart 9
		MFD-OFFSS-01 ~ 09	Open Close	Motorized Fire Damper	Flowchart 8

Table 4 : Equipment schedule for monitor

**MONITORING ALGORITHM FOR MOTORIZED FIRE DAMPER**

Flowchart 8 : Monitoring for Motorized Fire Damper

- 1) PLC system always monitor the status (open/close) Motorized Fire Damper at building. This damper will be activated by fire alarm system.

**MONITORING ALGORITHM FOR MOTORIZED DAMPER**

Flowchart 9 : Monitoring for Motorized Damper

- 2) PLC system always monitor the status (open/close) Motorized Damper at AHU ducting. This damper will be activated by AHU panel.

**MONITORING ALGORITHM FOR SMOKE/FIRE/GAS DETECTION**

Flowchart 10 : Monitoring for Smoke, Fire and Gas Detector

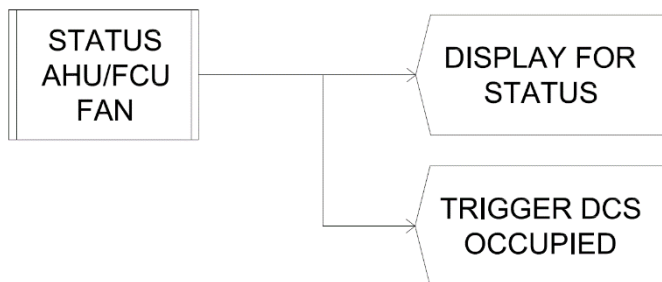
- 3) PLC system monitor the status Smoke, Fire and Gas Detection. This signal shall be received from Fire/Gas/Smoke detection system via voltage free contact relay.

**MONITORING ALGORITHM FOR EXHAUST FAN**

Flowchart 11 : Monitoring for Exhaust Fan control by push button

- 4) PLC system monitor the status of the Exhaust Fan that manually activated by Push Button Switch Emergency Purging Fan inside CCR

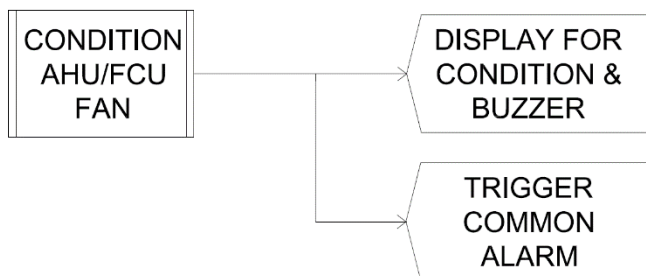
### MONITORING STATUS FOR AHU/FCU/EXFAN



Flowchart 12 : Monitoring for status AHU, FCU and Exhaust Fan

- 5) PLC system will trigger DCS Occupied relay when Status (on) for any AHU,FCU and Exhaust Fan is received.
- 6) This signal is used to inform DCS the status of panel ( Occupied or Unnoccupied)
- 7) At same time, PLC will be display the status at monitor.

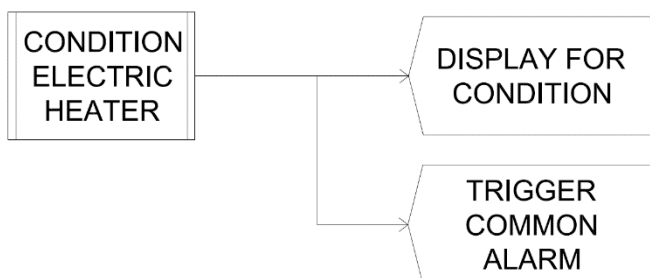
### MONITORING CONDITION FOR AHU/FCU/EXFAN



Flowchart 13 : Monitoring for condition AHU, FCU and Exhaust Fan

- 8) PLC system will trigger Common Alarm relay when Condition (Trip) for any AHU,FCU and Exhaust Fan is received.
- 9) This signal will be send out to DCS to inform the condition of the panel.
- 10) At the same time, Buzzer alarm will be activated by AHU/FCU/ExFan panel to indicate the panel in alarm condition.

### MONITORING STATUS FOR ELECTRIC DUCT HEATER



Flowchart 14 : Monitoring for Condition Electric Duct Heater

- 11) Electric Duct Heater is used to control humidity for specific room/area. PLC will control and monitor the heater stage.
- 12) If any alarm occurred ( High Temperature ) , PLC system will trigger common alarm relay to inform DCS the condition of the panel.