









OWNER:  شرکت سست و موبلی توستر ایرانیاان (سهایی نیاان)	<b>BUSHEHR PETROCHEMICAL COMPANY MEG PLANT</b>						EPC CONTRACTOR:  Chagalesh-Enerchimi-Steam Joint Venture BUPC-MEG PLANT PROJECT		
	<b>CONTROL PHILOSOPHY FOR NITROGEN GAS BOOSTER</b>								
MC :  شرکت سست و موبلی توستر ایرانیاان (سهایی نیاان)	Project	Area	Phase	Unit	Dis.	Doc.	Seq.	Contract No : 52-98/445	
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# CONTROL PHILOSOPHY FOR NITROGEN GAS BOOSTER





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## GENERAL

The scope of supply is as follows

One (1) nitrogen compressor, oil free vertical 2 stage piston with motor driver (1 x 565 Nm<sup>3</sup>/h / 707 Kg/hr). Included on the base frame is a Local Pushbutton Station and a Junction Box. For starting the motor and heater there is also a Power distribution board located on the base frame.

The control is handled by the UCP which is located remotely.

## COMPRESSOR CONTROL PANELS

Please refer to Electrical schematics and panel lay-out for information concerning different lamps and operation buttons.

### Local control panel(LP-C1002-01)

The following buttons and lamps are provided on the local control panel.

Common alarm lamp (AMBER) (XL-10153)

Will blink at unacknowledged alarm(s), steady at acknowledged alarm(s).

Common trip lamp (RED) (XL-10154)

Will blink at unacknowledged trip(s), steady when at acknowledged trip(s).

Compressor Operational Lamp (GREEN) (XL-10151)

ON when compressor is ready to start and is OFF at failure.

Compressor Running Lamp (GREEN) (XL-10152)

ON when compressor is running either loading - unloading or cooling down.

Compressor start button (PB-10151)





To start the package, via PLC controlled sequence.

Compressor stop button (PB-10152)

To stop the compressor, via PLC controlled sequence.

Compressor lamptest button (PB-10154)

To test the functioning of the lamps on the Local panel

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### ESD button (PB-10153)

To stop the package in case of emergency. The complete package will stop immediately and will not follow the controlled stop sequence. ESD resetting after safe environment is obtained (after half hour) by pushing accept and reset button.

### Local /Remote select switch (HS-10151)

Local means start from Local Pushbutton Station, remote means start at distance from UCP . Selection can be changed from local to remote and vice versa without the compressor stopping.

### **Unit control panel(UCP-C1002-01)**

The following buttons and lamps are provided on the local control panel.

#### Power on Lamp (WHITE) (XL-10155)

Is on When there is power to the panel (does not operate with Lamptest)

#### Common alarm lamp (AMBER) (XL-10158)

Will blink at unacknowledged alarm(s), steady at acknowledged alarm(s).

#### Common trip lamp (RED) (XL-10159)

Will blink at unacknowledged trip(s), steady when at acknowledged trip(s).

#### Compressor Operational Lamp (GREEN) (XL-10156)

ON when compressor is ready to start and is OFF at failure.

#### Compressor Running Lamp (GREEN) (67-XL-10157)

ON when compressor is running either loading - unloading or cooling down.

#### Compressor start button (PB-10155)





To start the package, via PLC controlled sequence.

#### Compressor stop button (PB-10156)

To stop the compressor, via PLC controlled sequence.

#### Compressor lamptest button (PB-10158)

To test the functioning of the lamps on the UCP

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Compressor Accept Pushbutton (PB-10159)

To acknowledge the alarm(s) and trip(s)

Compressor Reset Pushbutton (PB-10160)

To reset alarm(s) / trip(s). Prior to reset, the alarm(s) / trip(s) acknowledgement by pushing the accept button is required.

ESD button (PB-10157)

To stop the package in case of emergency. The complete package will stop immediately and will not follow the controlled stop sequence. ESD resetting after safe environment is obtained (after half hour) by pushing accept and reset button.

Main power switches (HS-10152/3/4)

Switching on the Main and auxiliary power to the panel

**Power distribution board (PD-C-1002-01)**

Amp. Meter main motor (AM-10151)





Shows how much current is drawn from the main motor.

Motor Fault lamp (RED) (XL-10160)

Shows if the main motor has a fault/trip.

Motor Permissive lamp (Green) (XL-10161)





Shows when the motor is ready to start.

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### Signals to ESD and FCS

Most signals are send through MODBUS, these signals can be found in the MODBUS list, all hardwired signals are listed below

Signal	Function
HS-108-SD-1 (Emergency shutdown, from ESD system)	To shut-down the compressor.
XAL-108-2 (Common alarm to ESD)	Sending a signal when compressor has an alarm or is tripped
XCS-115 (Time synchronisation FCS)	Time sync. Form FCS

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## COMPRESSOR CONTROLS

The compressor Logic will be described here including, start/stop, loading/unload and pressure control.

### Note :

The load/unload (start/stop) pressure will only be used if there is no consumption at all, only for this reason it is required, as we do not want to keep the compressor running in unload conditions for a very long time, the actual condition at site will be checked and any modification that might be required to the software in order to keep it running for most of the time will be modified by Airpack service engineer. Based on Airpack experience this is always the best solution.

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**In case of emergency the compressor can always be shut down by pressing the ESD BUTTON on Local Panel or on UCP.**

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## START-UP

The compressor logic can be started locally on LCP or remote from UCP or FCS, depending on the position of the local / remote switch.

## MANUAL OPERATION





Manual operation is only used for testing and keeps the compressor running throughout, the timers will be bypassed. The Manual / Auto switch can be found on the HMI. After Manual has been selected the compressor is ready to be started.

To initiate operation either the start button LCP/UCP/FCS (Based in local/remote switch position) has to be pressed and the following starting conditions have to be met (ready to start):

1. No trips
2. No ESD
3. restart delay timer is not active

After above starting conditions have been met the following things will happen:

- The OPERATIONAL LAMP(LCP/UCP) will go on, which means the compressor main motor is ready to start.

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- The start-up delay timer is activated, the motor will start and the water valve (XV-10152) will be opened by Energizing XY-10152.
- XY-10151 will be de-energized and the PV-10151 will be closed. This means compressor is running in unload condition.
- When the start-up delay timer has passed the compressor is ready to go into load, first the outlet pressure is checked by PIT-10158. If the pressure is below 22 bar(a) the compressor will go to load by energizing XY-10151. If not, the compressor will remain unloaded until this happens. (No minimum run timer is activated)
- When the compressor is in loaded condition the Pressure control In the PIT-10158 is activated and the pressure is regulated at 22.5 bar(a) by regulating the recycle valve (PV-10151) to recycle more of Nitrogen to the inlet. When more then 75% of the valve is open for 30 minutes the compressor will go to unload.
- In during the recycling of the compressor, the outlet pressure 23 bar(a) the compressor will go to unload immediately.
- Compressor will follow above procedure and keep running until the compressor is stopped manually.

**The above-mentioned configuration for operation is to be tested in the field under the supervision of Airpack supervisor and times and set-point will be adjusted to the actual conditions at site.**

### AUTO OPERATION





Auto operation is used for Normal and automatically based on the timers. The Manual / Auto switch can be found on the HMI. After auto has been selected the compressor is ready to be started.

To initiate operation either the start button LCP/UCP/FCS (Based in local/remote switch position) has to be pressed and the following starting conditions have to be met (ready to start):

4. No trips
5. No ESD
6. restart delay timer is not active

After above starting conditions have been met the following things will happen:

- The OPERATIONAL LAMP(LCP/UCP) will go on, which means the compressor main motor is ready to start.

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- The start-up delay timer is activated, the motor will start and the water valve (XV-10152) will be opened by Energizing XY-10152.
- XY-10151 will be de-energized and the PV-10151 will be closed. This means compressor is running in unload condition.
- When the start-up delay timer has passed the compressor is ready to go into load, first the outlet pressure is checked by PIT-10158. If the pressure is below 22 bar(a) the compressor will go to load by energizing XY-10151. If not, the compressor will remain unloaded until this happens.
- minimum run timer is activated
- When the compressor is in loaded condition the Pressure control In the PIT-10158 is activated and the pressure is regulated at 22.5 bar(a) by regulating the recycle valve(PV-10151) to recycle more of Nitrogen to the inlet. When more then 75% of the valve is open for 30 minutes the compressor will go to unload.
- In during the recycling of the compressor the outlet pressure 23 bar(a) the compressor will go to unload immediately.
- Compressor will follow above procedure and keep running until the compressor is stopped manually or the minimum run timer has passed, if this is the case then the compressor will stop the next time the compressor will go to unload. After pressure drops again the compressor will restart automatically.

**The above-mentioned configuration for operation is to be tested in the field under the supervision of Airpack supervisor and times and set-point will be adjusted to the actual conditions at site.**

## SHUTDOWN

The compressor can have two shut down situations:





1. Planned shutdown
2. Unplanned shutdown

### PLANNED SHUTDOWN

To initiate planned shutdown the stop button on LCP/UCP/FCS needs to be pushed and following stop conditions have to be met:

1. MINIMUM RUN TIMER not active (see section TIMERS).

When all conditions have been met the compressor will shut down.

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**When compressor is in Manual the compressor will stop immediately.**

### UNPLANNED SHUTDOWN

In case of pressing ESD button, sending and ESD from the ESD system or an occurring trip, the compressor motor and the heater will shut down immediately, MINIMUM RUN TIMER is cancelled. The COMMON TRIP LAMP will go on in LCP and FCS.

Please be aware that an unplanned shutdown should only be used in case of emergency.

After any shutdown, a RESTART DELAY TIMER (see section TIMERS) will be active. This is to prevent the motor from starting directly after a stop. The compressor needs to get to a complete standstill before starting it again.

### TIMERS

#### MINIMUM RUN TIMER:

- Minimum running time after initial start
- To protect the motor by preventing more than 3 starts per hour
- Duration: 20 minutes





#### START-UP DELAY TIMER:

- To prevent high start current until full speed of the motor, and low oil pressure trip during start-up
- Duration: 20 seconds





#### RESTART DELAY TIMER:

- To let the compressor come to a complete stop
- Prevents the compressor from restarting until a certain time after stopping
- Duration: 1 minute for normal shutdown.

#### CONTROL VALVE MINIMUM RUN TIMER:

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- After 30 minutes this timer will expire and the compressor will automatically stop running.

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## MOTOR CONTROL

The main motor for the compressor is started through the power distribution panel

The Motor has the following sequence for starting / stopping:

- The UCP send a start signal to the Power distribution panel
- The Motor is started and running signal is send back to the UCP
- If the signal is not received within 2 seconds the motor will trip
- There also a motor fault signal, this indicates to the UCP that there is a problem with the Motor and it is not ready to start.
- When the UCP sends a start signal to the power distribution panel the motor is stopped and the running feedback signal will turn off.

## COMMON ALARM AND COMMON TRIP

In this chapter described is what happen when an alarm or trip occurs in the UCP, the cause of the ALARM or TRIP will be shown with time on the HMI and below will happen to the lamps on the UCP and LCP.

For a complete list of alarm and trip and effect please check the cause and effect chart as well as the alarm and trip list for more details.





### COMMON ALARM

All alarms will be collected here and put into one common alarm block, if this common alarm is active the COMMON ALARM LAMP will blink, this means that a new alarm is present and the cause should be investigated. The package will continue to run with the alarm, however the cause of the alarm should be investigated by the operator.

If the COMMON ALARM LAMP blinks it needs to be acknowledged by the ACCEPT BUTTON the UCP and necessary maintenance has to be done. If ACCEPT BUTTON is pressed the COMMON ALARM LAMP will be on steady. If maintenance has been carried out the RESET BUTTON can be pressed, COMMON ALARM LAMP should turn off, unless an alarm is still present, the COMMON ALARM LAMP will start blinking again.

### COMMON TRIP

All trips will be collected here and put into one common trip block, if this common trip is active the COMMON TRIP LAMP will blink, this means that a new trip is present and the cause should be investigated. The package will stop immediately.

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If the COMMON TRIP LAMP blinks it needs to be acknowledged by the ACCEPT BUTTON the UCP and necessary maintenance has to be done. If ACCEPT BUTTON is pressed the COMMON TRIP LAMP will be on steady. If maintenance has been carried out the RESET BUTTON can be pressed, COMMON TRIP LAMP should turn off, unless a trip is still present, the COMMON TRIP LAMP will start blinking again. In case of a trip the package will stop immediately, all timers (MINIMUM RUN and COOLDOWN) will be cancelled.

### COMPRESSOR OIL SYSTEM

The compressor oil system consists of a shaft driven oil pump. As soon as compressor starts oil will be supplied. Normal oil pressure will be around 1,7 kg/cm<sup>2</sup>(a). When compressor is started the oil pressure trip will be bypassed for 20 seconds (START-UP DELAY TIMER as mentioned in chapter TIMERS).

Oil level can be checked by reading the sight glass (SG) on the oil sump integrated into compressor. If the compressor is not running, oil heater will be controlled by a thermostat to prevent mechanical damage to the compressor.

### COMPRESSOR WATER COOLING SYSTEM

The compressor is supplied with two water-cooled coolers, the water for these coolers is supplied by the client. As soon as the compressor starts the cooling water inlet valve ( XV-10152) by energizing solenoid valve XY-10152.

When the compressor stops or trips this valve will be closed.

### COMPRESSOR RECYCLE VALVE AND LOAD / UNLOAD VALVE

Capacity control of the compressor is done through PV-10151. The PCV will open and close on exact customer compressed air demand of 22.5 bar(a).

The control is supplemented by the Load / unload valve on the compressor. The Load / unload valve is activated by energizing XY-10151, making the compressor to go to load. This valve is only used during start-up and shut-down, capacity control is done by PV-10151.

Exact detail can be found in the start-up chapter.

Set point is derived from the outlet pressure transmitter (PT-10158).