Vendor	ABT 360 KT/Y PP PLANT			Owner
Airpack Netherlands	Control Philosophy			سراج گستران رجال SERAJ GOSTARAN REJAL (سهامی خاص)
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REV.	DATE	Description	Prepared by	Checked by	Approved by	Authorized by

Vendor	ABT 360 KT/Y PP PLANT		Contractor (DEC)	Owner
	Control Philosophy			
	Vendor's Doc. No.: 2 3 2 4 9 - 2 1	Rev.: 00		
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Contents

1.0 GENERAL

This document describes the operating and control narrative of the gas booster compressor as described below.

One (1) gas horizontal booster compressor (PK-6801), 2 stage piston motor driven. Outlet capacity 1100-1200 kg/h at 21 bar(g).

There are two different inlet gas compositions;

Component	**Case 1 (%)**	**Case 2 (%)**
Propylene	77.0	70.2
Propane	23.0	26.2
Ethylene	–	3.3
Ethane	–	0.3

Included is,

- One (1) Unit control panel (UCP) with control PLC, tag number UCP-PK6801-01
- One (1) Local Pushbutton Station (LPS), tag number LCP-PK6801-001
- One (1) Analog Junction Box (JB), tag number JIAP-PK6801-01.

2.0 GAS BOOSTER COMPRESSOR

2.1 Unit control panel

The Unit control Panel is located in the control room (safe area) and connected to the compressor LPS and JB with multipair cables.

2.1.1 Hardware switches and lamps UCP

The following buttons and lamps are provided on the Unit Control Panel.

Main power switch (one for each power supply)
To switch of the main power supply to the package.
Hour meter (PK-6801-HM-603201)
Counts compressor running hours, six digits, non-resettable, to confirm maintenance times.
Compressor power on lamp (WHITE) (XL-PK-6801-05)
To confirm that the power to the package is ON.
ESD button (HS-PK-6801-05)
To shut down the package without following the controlled stop sequence.

2.1.2 HMI switches and indications UCP

The below is shown on the HMI;

P&ID
A simplification of the P&ID, with process values and indication of which transmitters have alarm and trip, which valves are open and closed etc.
HMI settings
Here you can make the general changes to the settings of the HMI, like brightness, HMI status, etc.
Alarm and trip list (with first up alarm)
A list with all the active alarm and trips, with time stamp as per time synchronization.

2.2 Local Pushbutton Station

The Local Control Panel is located on the compressor package (hazardous area) and connected to the UCP with multipair cable.

2.2.1 Hardware switches and lamps LPS

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

Common alarm lamp (AMBER) (XL-PK-6801-01)
Will blink at unacknowledged alarm(s), steady at acknowledged alarm(s).
Common trip lamp (RED) (XL-PK-6801-02)
Will blink at unacknowledged trip(s), steady when at acknowledged trip(s).
Compressor Operational Lamp (GREEN) (XL-PK-6801-03)
ON when compressor is ready to start and is OFF at failure.
Compressor Running Lamp (GREEN) (XL-PK-6801-04)
ON when compressor is running either loading - unloading or cooling down.
Common Lamp test button (HS-PK-6801-04)
To test if alarm, trip, operational and running lamps are glowing.
Compressor start button (HS-PK-6801-01)
To start the package, via PLC controlled sequence.
Compressor stop button (HS-PK-6801-02)
To stop the compressor, via PLC controlled sequence.
Local / OFF / Remote select switch (SW-PK-6801-01)
To switch between start from LPS (local) or UCP and DCS (remote). Selection can be changed without the compressor stopping.
ESD button (HS-PK-6801-03)
To shut down the package without following the controlled stop sequence.

3.0 COMPRESSOR CONTROLS

The start and stop logic for the compressor will be described in this block, including all timers and the starting and stopping of the motor.

In case of emergency the compressor can always be shut down by pressing the ESD BUTTON on the LPS (HS-PK-6801-03) or on the UCP (HS-PK-6801-05).

3.1 START-UP

The compressor can be started locally by pressing start button (HS-PK-6801-01) and receiving 'Compressor start' signal (PK-6801-HS-603101) from LPS. Or compressor can be started by receiving remote start signal from DCS via hardwire signal PK-6801-XA-603205.
To start the operation, the following start conditions must first be met (ready to start):

- No trips and no ESD, 'compressor operational' lamp (XL-PK-6801-03) is on.
- Minimum run timer is active (see section 3.3 TIMERS on page 8).
- Start-up delay timer is not active (see section 3.3 TIMERS on page 8).
- Motor is available, which is not running (PK-6801-XA-603201) and not fault (PK-6801-XA-603202) Signal from MCC.

After the above start conditions are met, the start button on the compressor LPS is pressed or the remote start signal is received from UCP/DCS. Then the following functions will be enabled:

- The start-up delay timer is activated. (see section 3.3 TIMERS on page 8)
- After start, the 'compressor running' lamp (XL-PK-6801-04) will turn on.
- If the pressure in the nitrogen network is above load set point (measured by PK-6801-PT-603002), the compressor will start loading condition.
- If the pressure in the nitrogen network is above load set point (measured by PK-6801-PT-603002) and lower than the unload set point, the compressor will remain in loading condition.
- If the pressure in the air network is above unload set point (measured by PK-6801-PT-603002), the compressor will start unloading condition. The compressor switches back to load condition when the pressure drops below the unload setpoint.
- Compressor keeps running in LOAD or UNLOAD until stop command is given. When in UNLOAD and minimum run timer (see section 3.3 TIMERS on page 8) is not active compressor will shut down.

3.2 SHUTDOWN

The compressor can have two shut down situations:

1. Planned shutdown.
2. Unplanned shutdown

3.2.1 PLANNED SHUTDOWN

To initiate planned shutdown the 'compressor stop' button (HS-PK-6801-02) on LPS needs to be pushed to receive signal PK-6801-HS-603102 or 'compressor stop' signal from DCS via hardwire signal PK-6801-XA-603206 need to be received.
The below stop conditions have to be met:

- Minimum run timer is not active (see section 3.3 TIMERS on page 8).
- Cool down timer is not active (see section 3.3 TIMERS on page 8).

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

3.2.2 UNPLANNED SHUTDOWN

In case of a trip or emergency stop button pressure, the compressor motor will shut down immediately, common trip lamp (XL-PK-6801-02) will go on, MINIMUM RUN TIMER and COOL DOWN TIMER are cancelled.

After any shutdown, a RESTART DELAY TIMER (see section 3.3 TIMERS on page 8) 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. Please be aware that the alarm reset button (HMI) needs to be pressed to restart the compressor after any trip or ESD.

3.3 TIMERS

MINIMUM RUN TIMER:

- Minimum running time after initial start
- To protect the motor by preventing more than 3 starts per hour
- Duration: 30 minutes

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.

COOL DOWN TIMER:

- Keeps the compressor running unloaded for a certain time after stop
- To equalize pressure to inlet pressure and cool down of the compressor
- Duration: 3 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

3.4 MOTOR CONTROL

There is one (1) motor which require starting, this is the main motor. The motor is protected in MCC (client scope).

The main motor has the following sequence for starting / stopping:

- The MCC is not sending 'main motor fault'(PK-6801-XA-603202) and not sending 'main motor running' (PK-6801-XA-603201), which means motor is available and ready to start.
- The UCP (PLC) is sending signal 'main motor start' (PK-6801-XA-603203) to the MCC, which is starting the motor.
- Within 2 second the 'main motor running' signal (PK-6801-XA-603201) is received by the UCP from the MCC, If not, the PLC in DCS will generate a trip.
- When stopping the motor, by trip or normal, the 'main motor stop' signal (PK-6801-XA-603204) is sent from the UCP to the MCC to stop the motor.

When the compressor is started, main motor is started. When the compressor is stopped or tripped the main motor will stop. When the main motor is tripped the complete compressor package is tripped.

3.5 COMMON ALARM AND COMMON TRIP

3.5.1 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 common alarm is transmitted also to DCS via MODBUS TCP/IP feedback signal. 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 ACKNOWLEDGE BUTTON (HMI) and necessary maintenance must be done according to the maintenance MANUAL. If ACKNOWLEDGE BUTTON (HMI)) is pressed the COMMON ALARM LAMP will be on steady. If maintenance has been carried out the RESET BUTTON (HMI) can be pressed, COMMON ALARM LAMP should turn off, unless an alarm is still present, the COMMON ALARM LAMP will start blinking again.

3.5.2 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 common trip is transmitted also to DCS via MODBUS TCP/IP feedback signal. The package will stop immediately as described in 3.2.2 UNPLANNED SHUTDOWN on page 8.
If the COMMON TRIP LAMP blinks it needs to be acknowledged by the ACKNOWLEDGE BUTTON (HMI) and necessary maintenance must be done according to the maintenance MANUAL. If ACKNOWLEDGE BUTTON (HMI) is pressed the COMMON TRIP LAMP will be on steady. If maintenance has been carried out the RESET BUTTON (HMI)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.

NOTE
Cable fractures and over range/sensor failure of transmitters will be separately programmed as a trip, but not shown on display.

3.5.3 EMERGENCY STOP FUNCTIONS

An emergency stop can be activated by pressing the local ESD BUTTON (HS-PK-6801-03) on compressor LPS or by pressing the remote ESD BUTTON (HS-PK-6801-05) on the UCP.
An Emergency stop signal activates an ESD relay inside the panel, the ESD relay sends a trip signal to the PLC, causing the compressor to trip. Separately the ESD relay also disconnects power to all the solenoid valves as well as activating the motor shutdown signals, forcing the motor to stop.

3.5.4 ESD SIGNALS

Please find below all ESD signals:

Service	Source	Value 0	Value 1
ESD pushbutton (HS-PK-6801-03)	LPS	Trip	Operational
ESD pushbutton (HS-PK-6801-05)	UCP	Trip	Operational
ESD signal (PK-6801-ESD-603205 / 603206)	ESD	Trip	Operational

3.6 DISPLAY CONTROL

All signals that are coming from or going to the display are collected here. All signals are put in one block to be transferred to the display.

The following information will be available on the display as a minimum:

- Running status
- Alarms and trips
- Process values
- Duty/Stand-by

3.7 COMPRESSOR OIL SYSTEM

The compressor oil system consists of a crank driven rotary oil pump. As soon as compressor starts oil will be supplied. Normal oil pressure will be around 2 bar(g).

When compressor is started the oil pressure trip will be bypassed for 20 seconds (START-UP DELAY TIMER as mentioned in chapter 3.3 TIMERS on page 8).

Oil level can be checked by reading the level gauge (PK-6801-LG-603001) on the oil sump. The system is fully mechanical.

The compressor will trip when the oil pressure drops below 1,5 bar(g).

3.8 LOADING / UNLOADING INLET VALVE REGULATION

Loading / unloading of the compressor is done by energizing and de-energizing the load / unload solenoid valve (PK-6801-XY-603001) between the stages of the compressor. After start up relay has become active the solenoid valve (PK-6801-XY-603001) is energized the compressor suction valve is pressurized, which causes the suction valve to open and compressor to go into load. If the solenoid valve (PK-6801-XY-603001) is de-energized the suction valve will be de-pressurized, which causes the suction valve to close and the compressor to go to unload. The capacity control is either fully loaded or fully unloaded (0 or 100%).

Load / unload set points (20 / 21 bar(g)) are derived from the pressure transmitter (PK-6801-PT0603002), located in package nitrogen outlet.
The loading / unloading set point of the compressor will be checked by Airpack service manager during commissioning to be within the allowable cycle : (10) ten times per hour and is based on pressure differential setting and buffer volume.

When the compressor is running in UNLOAD and the minimum run timer is not active the compressor will shut down and cool down timer is active.