Final approval depends on HAZOP/ SIL meeting consequences specially SIL study and outcome of this study shall be incorporated in this document.

Airpack B.V. - Air Compressor – Integrated Methanol and Ammonia Plant 17735-COM Control philosophy and Interlock Description (K020)

Code 2
M.Dalakeh

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CONTENTS

1.0 GENERAL

One(1) high pressure air compressor, oil free vertical two stage piston with motor driver (1 x 35 Nm3/h at 30 bar(g)). Included is a Local Pushbutton Station and a Junction Box. The control is handled by the DCS system. The package can be operated remote and (start / stop) locally.

2.0 INSTRUMENT AIR COMPRESSOR

2.1 Local Pushbutton Station

Please refer to Electrical scheme (N-278-VD-6019-IN-DIA-0005-01, Wiring Diagram (including Terminal Diagram) for LCP Panel and Junction Box) and panel layout (N-278-VD-6019-IN-DWG-0007-01, Outline Dimensional Drawings for LCP Panel and Junction Box) for information concerning different lamps and operation buttons.

The Local Control Panel is located on the compressor package (Safe Area) and connected to the DCS with multipair cable.

2.1.1 Hardware switches and lamps LPS

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

Compressor Running Lamp (GREEN) (320ML-8201)
ON when compressor is running either loading - unloading or cooling down.

Compressor Operational Lamp (GREEN) (320YL-8202)
ON when compressor is ready to start and is OFF at failure.

Fault lamp (AMBER) (320XA-8203)
Will blink at unacknowledged alarm(s), steady at acknowledged alarm(s).

Emergency trip lamp (RED) (320UY-8204)
Will blink at unacknowledged trip(s), steady when at acknowledged trip(s).

Compressor start button (320HS-8201)
To start the package, via PLC controlled sequence.

Compressor stop button (320HS-8202)
To stop the compressor, via PLC controlled sequence.

ESD button (320HS-8203)
To shut down the package without following the controlled stop sequence.

Local / Remote select switch (320HS-8204)
To switch between start from LPS (local) or DCS (remote). Selection can be changed without the compressor stopping.

HS-8204 is not a status indication. function seems to be revised

2.1.2 SIGNALS TO/FROM DCS

Signals	Function
Start (320HS-8201)	Start Compressor
Stop (320HS-8202)	Stop Compressor
Running / stopped (320ML-8201)	Status indication of button 320HS-8201 & 320HS-8202
Local / remote (320HS-8204)	Status indication of 320SW-8201
Fault (320XA-8203)	Raised fault
Emergency trip (320UY-8204)	Raised trip
Operational (320YL-8202)	Status indication of button 320HS-8203 & 320HS-8204

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 local ESD BUTTON (101HS-03)

3.1 START-UP

The compressor can be started locally on LPS or remote from DCS, depending on the position of the local / remote switch (320HS-8204).

To initiate operating either the start button (LPS) has to be pressed or remote start from DCS has to be sent and the following starting conditions ha

section number shall be corrected

1. No trips and no ESD, 'compressor operational' lamp (320YL-8202) is on.
2. Minimum run timer is active (see section 0

to be moved to previous page, below section 3.1

3. TIMERS on page 7).
4. Start-up delay timer is not active (see section 0

section number shall be corrected

to be moved to previous page, free space between item 4 and 5 shall be removed

5. TIMERS on page 7).
6. Motor is available, which is not running (320MBR-8204) and not fault (320-MBF-8203) Signal from MCC.

After the above start conditions are met, the following functions will be enabled:

- The compressor operational lamp (320YL-8202) will go on, which means the compressor motor and fan motor are ready to start.
- The start-up delay timer is activated (see section 0

section number shall be corrected

- TIMERS on page 7). The PCV will close 20 seconds after start. The operational lamp and running lamp will turn on.
- The compressor keeps running while the pressure control valve (320PCV-8201) is closed, until the discharge pressure (320PT-8203) reaches the set-point for operation. If the compressor reach the setpoint of 30 bar(g), the PCV will slowly open and control the outlet pressure.
- When the compressor start the minimum run timer will start (see section 0

to be moved to previous page.

please add as a note. "The opened or closed status of the PCV can be seen by the operator via the feedback positioner signal in HMI"

section number shall be corrected

- TIMERS on page 7).
- The compressor keeps running until stop command is given.

to be moved to previous page.

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 (320HS-8202) on LPS needs to be pushed to receive stop signal (320MBW-8202) or 'compressor stop' signal from DCS via hardwire signal (320MBW-8205) need to be received.

The below stop conditions have to be met:

- Minimum run timer is not active (see section 0

section number shall be corrected

- TIMERS on page 7).
- Cool down timer is not active (see section 0

Process Comment: Shut down sequence (e.g PCV opening and cool down procedure) shall be added
Vendor Reply: Shut down sequence is in the document logic diagram.
Process Reply: Please described here as well

- TIMERS on page 7).

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 (320XA-8204) will go on, MINIMUM RUN TIMER and COOL DOWN TIMER are cancelled.

After any shutdown, a RESTART DELAY TIMER (see section 0

section number shall be corrected

TIMERS on page 7) 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. This button to reset the alarms should be programmed in the DCS HMI where all the alarms and trips are listed.

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: 20 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 are two (2) motors for the compressor which require starting, the main motor and cooling fan motor. These motors are protected in MCC by client.

Both the main and fan motor have the following sequence for starting / stopping:

- The PLC in DCS is sending a START signal to Motor Starter Panel (MCC) to start the fan motor except main motor.
- The MCC is returning a RUNNING signal to start main motor.
- The main motor starter of MCC is returning healthy signal to the PLC in the DCS within two seconds. If not, the PLC in DCS will generate a trip.
- In case there is a fault in MCC, the MCC will send a TRIPPED signal to compressor PLC in DCS to trip the compressor.
- The PLC in DCS is sending a STOP signal to MCC to stop the motor.
- IN case of a trip for the running compressor the PLC in DCS will send a TRIP signal to trip each motor.

When the compressor is started , the fan motor is started, and in sequence the main motor is started. When the compressor is stopped or tripped both the fan and main motor are stopped, or tripped. If fan or main motor is tripped the complete compressor package is tripped.

3.5 COMMON ALARM AND COMMON TRIP

3.5.1 COMMON ALARM

All alarm and sensor failure 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 ACKNOWLEDGE BUTTON in DCS and necessary maintenance must be done according to the maintenance MANUAL. If ACKNOWLEDGE BUTTON in DCS 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 trip and sensor failure 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 as described in 3.2.2

Process Comment: Not found in PID
Vendor Reply: Refered to ESD button on the DCS control panel. (safe area). This should be added on the DCS panel.
The package can be started / stopped locally on the package or remote from the DCS. At both control places an ESD button should be located
Process Reply: Start from DCS in not allowed and there is no HS for start from DCS.
HS for stop from DCS is considered.
Please clarify "ESD button" means HS for Emergency stop shall be considered from DCS?

acknowledged by the ACKNOWLEDGE
be done according to the maintenance
ssed the COMMON TRIP LAMP will be on
e RESET BUTTON in DCS can be pressed,
is still present, the COMMON TRIP LAMP
ackage will stop immediately, all timers
ed.

e monitored by DCS.

An emergency stop can be activated by pressing the local ESD BUTTON (320HS-8203) on compressor LPS or by activation of ESD TRIP SIGNAL (320HS-8206) in DCS.
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 (320HS-8203)	LPS	Trip	Healthy
ESD trip signal (320SW-8206)	DCS	Trip	Healthy

3.6 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 0,5 bar(g).

When compressor is started the oil pressure trip will be bypassed for 20 seconds (START-UP DELAY TIMER as mentioned in chapter 0

TIMERS on page 7).

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 (320H-8201) will be controlled by a thermostat to prevent mechanical damage to compressor.

3.7 COMPRESSOR AIR COOLING SYSTEM

The compressor is supplied with two water-cooled coolers:

- Inter cooler (320KE-020-001)
- After cooler (320KE-020-002)

3.8 COMPRESSOR RECYCLE VALVE

Capacity control of the compressor is done through 320PCV-8201. The PCV will open and close on exact customer compressed air demand of 30 bar(g)

Set point 30 bar(g) is derived from the outlet pressure transmitter (320PT-8203).