



# **Helium Operators Familiarization Program**

**Unit 322 – Pressure Swing Adsorption**

**Competency Assurance and Training**

## Course Agenda

1. PSA Process Description
2. PSA Numbering
3. PSA States
4. PSA Valve Modes
5. PSA Trends
6. PSA Phase Time
7. PSA Start-Up
8. PSA Freeze
9. PSA Switch
10. PSA Troubleshooting
11. PSA Special Features
12. PSA Displays

# Course Agenda

## 1. PSA Process Description

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9. PSA Switch

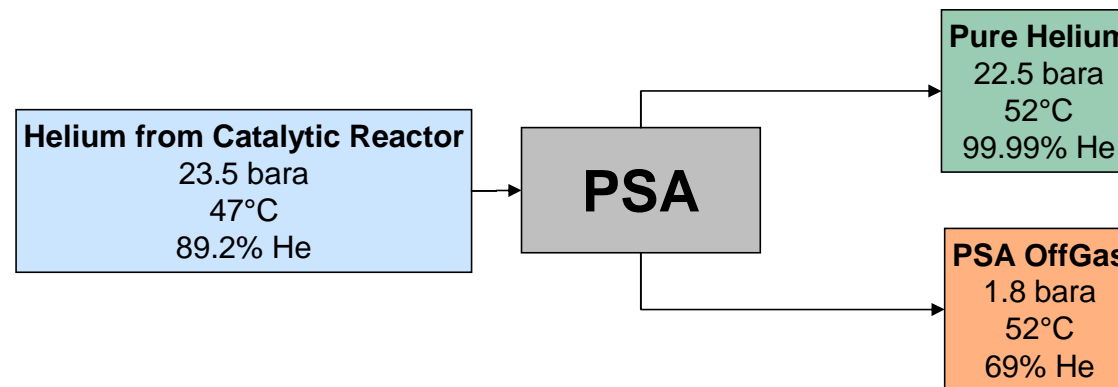
10. PSA Troubleshooting

11. PSA Special Features

12. PSA Displays

# 1.PSA Process Description

- The PSA allows pure Helium production by adsorption:
  - ▣ Adsorbed components: Nitrogen, Methane, Oxygen, Argon, Carbon Dioxide, Hydrogen and Water
  - ▣ At PSA outlet, Helium Product is 99.99% purity, and contains traces of argon, oxygen, neon and nitrogen



- Helium is weakly adsorbed:
  - ▣ Recovery rate = 73%



# 1.PSA Process Description

- Main differences between He1 and He2 PSA
  - ▣ Equalization step
    - He 1 : control valves
    - He 2 : on/off valves
  - ▣ Repressurization step
    - He 1 : 1 running valve, 1 valve in stand-by
    - He 2 : 2 running valves, 1 valve in stand-by
  - ▣ Control of the pressure ramps / Troubleshooting tests
    - He 1 : theoretical formula, correction done at the end of the ramp
    - He 2 : process formula, correction done all along the ramp
  - ▣ Switch sequences (*general improvement*)
    - He 1 : PV196A closes
    - He 2 ; PV196A closes only in case of switch p
  - ▣ Number of steps in NR & ER sequence
    - He 1 : 5 steps in NR & ER with valve motion steps (steps 2 & 4)
    - He 2 : 3 steps in NR & ER with delay opening/closing timers
  - ▣ General improvement of the control on He 2
    - He2 PSA more user friendly

# 1.PSA Process Description

- PSA Normal Run Cycle consists of the 4 following phases:

## 1. Phase 1 = Adsorption - at high pressure

P

Steps 1 to 3. While circulating in a vessel, impurities are adsorbed at adsorbent surface and pure helium is produced.

## 2. Phase 2 = Depressurization

S

Step 1. Pressure equalization with the vessel in phase 4

Step 2. Waiting

Step 3. Further depressurization, providing purge to vessel in phase 3

## 3. Phase 3 = Regeneration – at low pressure

R

Step 1 to 2. Final depressurization – *This step lasts 2 temporal units*

Step 3. Elution at LP with the purge gas provided by vessel in phase 2

## 4. Phase 4 = Repressurization

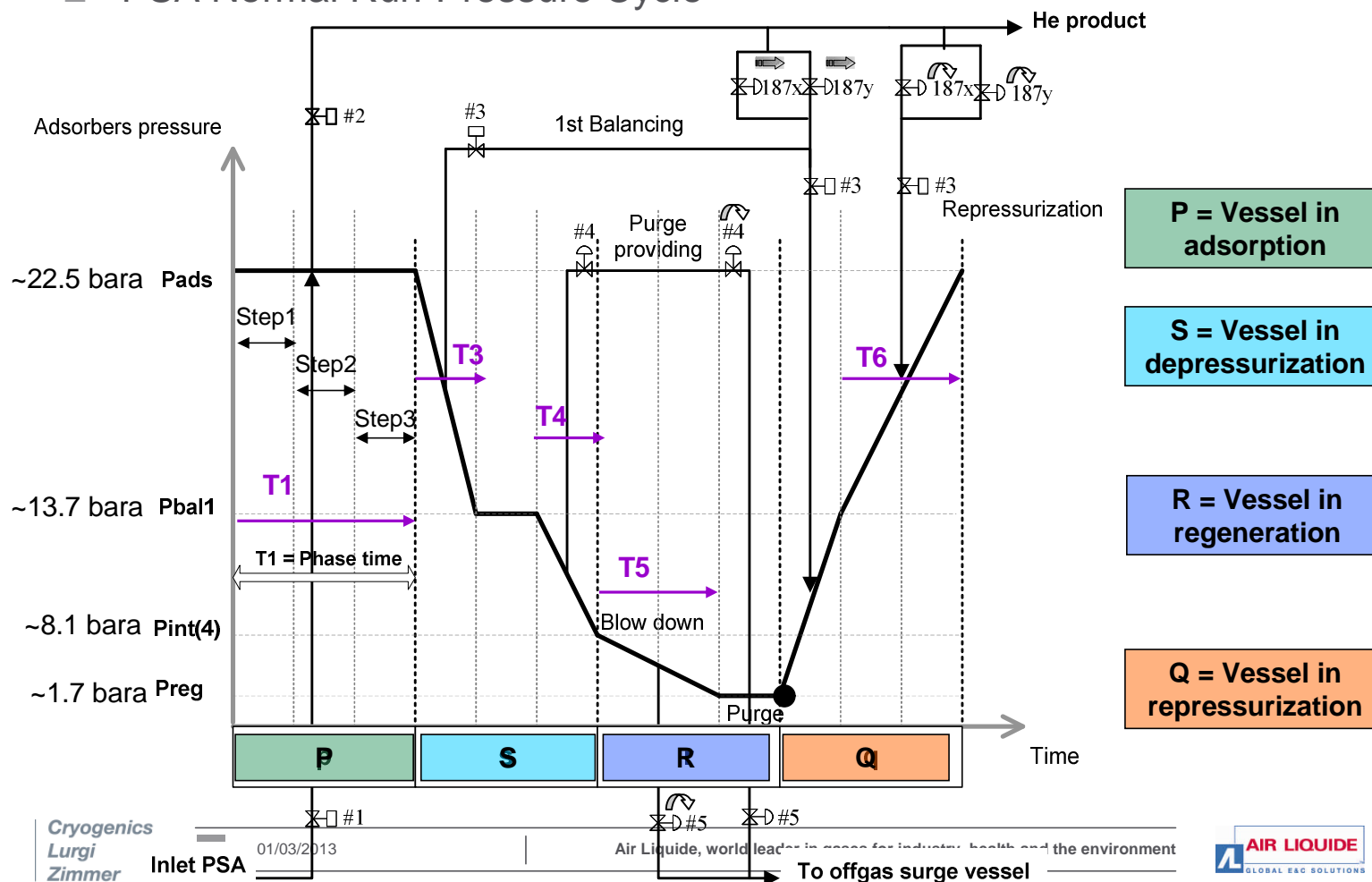
Q

Step 1. Pressure equalization with the vessel in phase 2

Step 2 to 3. Repressurization with PSA HP outlet

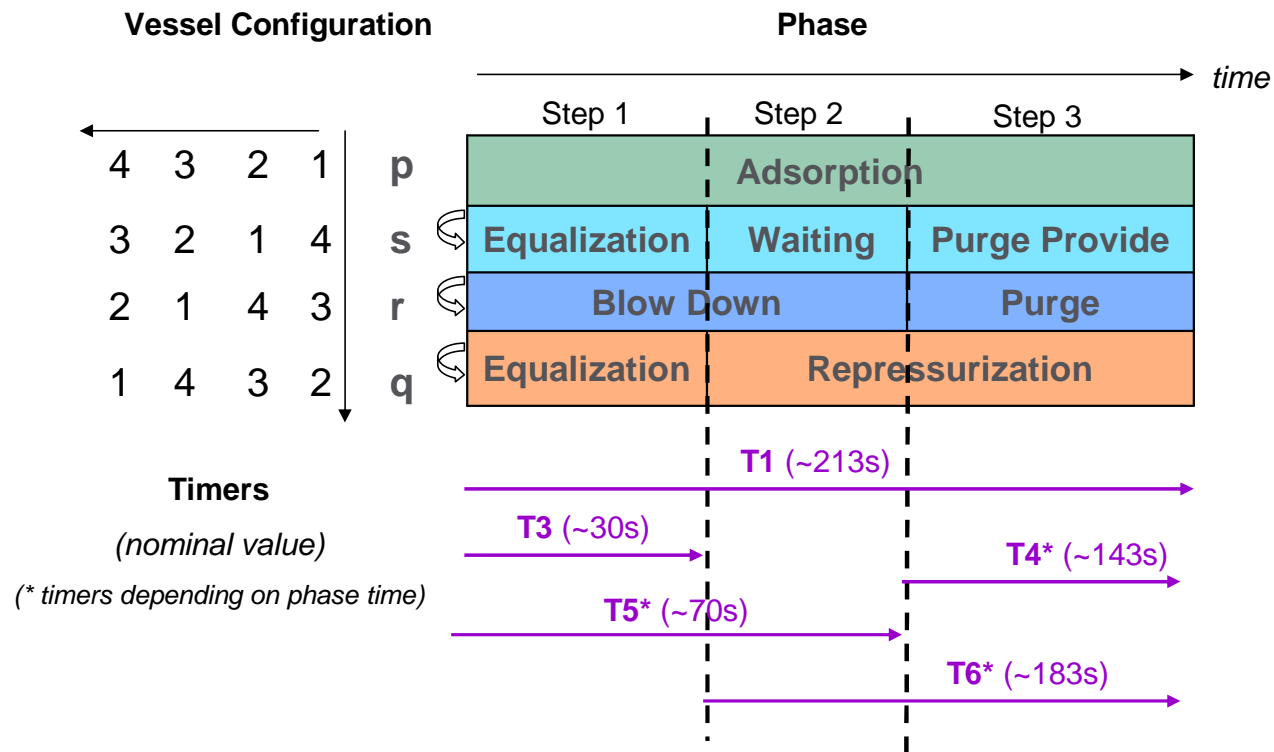
# 1.PSA Process Description

## ■ PSA Normal Run-Pressure Cycle



# 1.PSA Process Description

## ■ PSA Normal Run – Cycle Table



# 1.PSA Process Description

## ■ Valve motion steps

- He 1 : 5 steps in NR & ER with valve motion steps (steps 2 & 4)
  - Intermediate steps for the opening/closing of valves

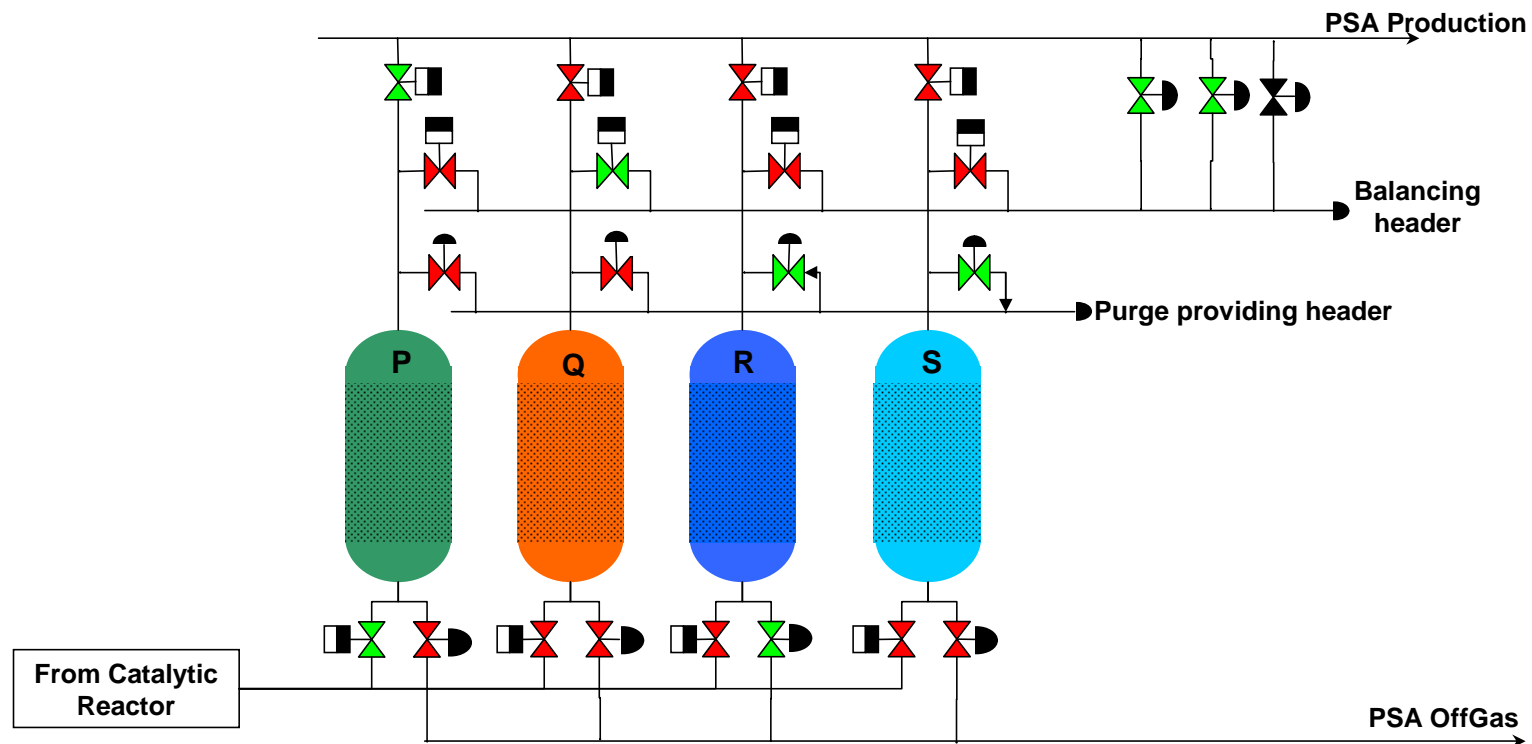
## ■ Delay opening/closing timers

- He 2 : 3 steps in NR & ER with delay opening/closing timers
  - ▣ During the time T(O) no signal is sent to the valve in order to keep it closed
  - ▣ During the time T(C) a signal is sent to the valve to keep it open
  - ▣ Once the timer is elapsed valve is no longer forced closed

# 1.PSA Process Description

## ■ Phase 1

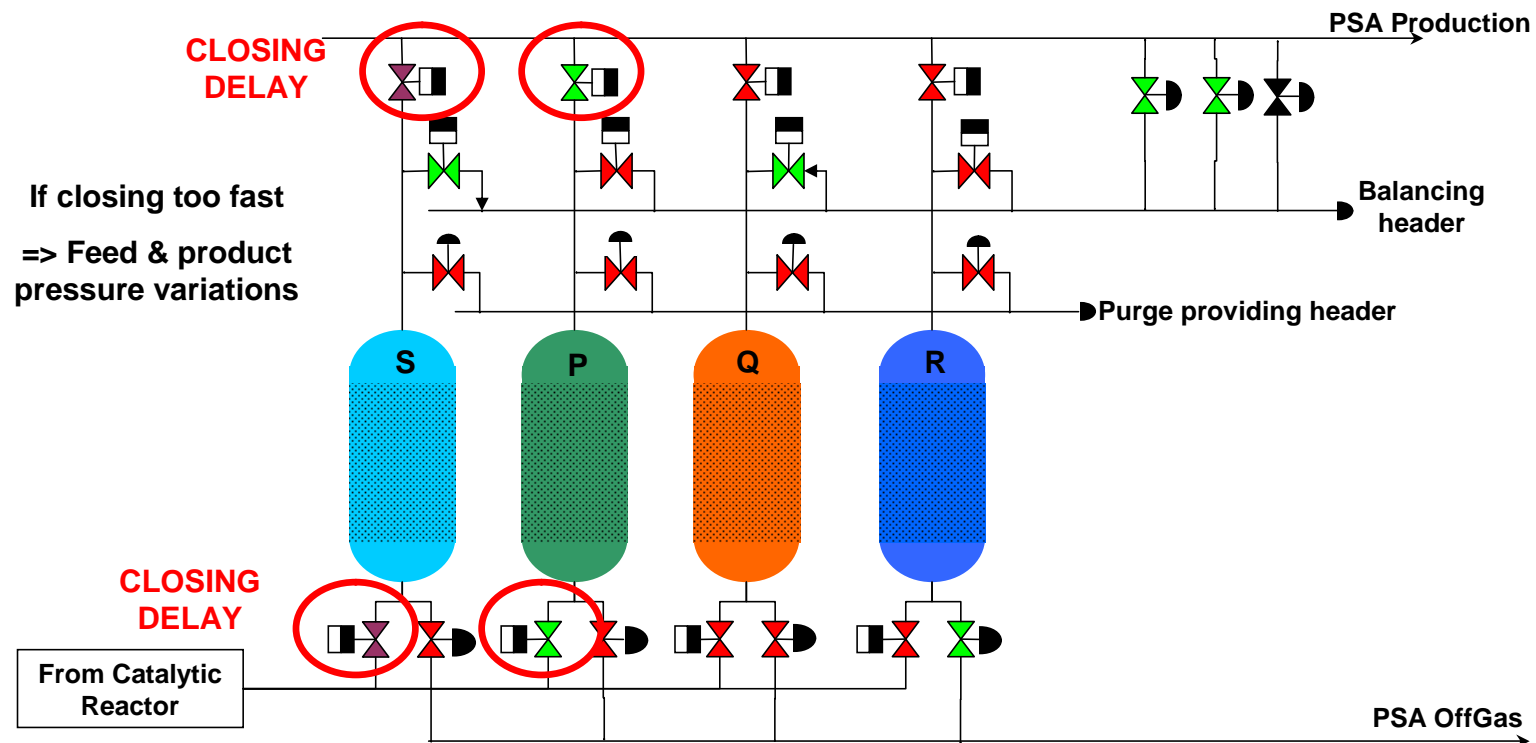
- Third temporal unit: S provides purge to R



# 1.PSA Process Description

## ■ Phase 2

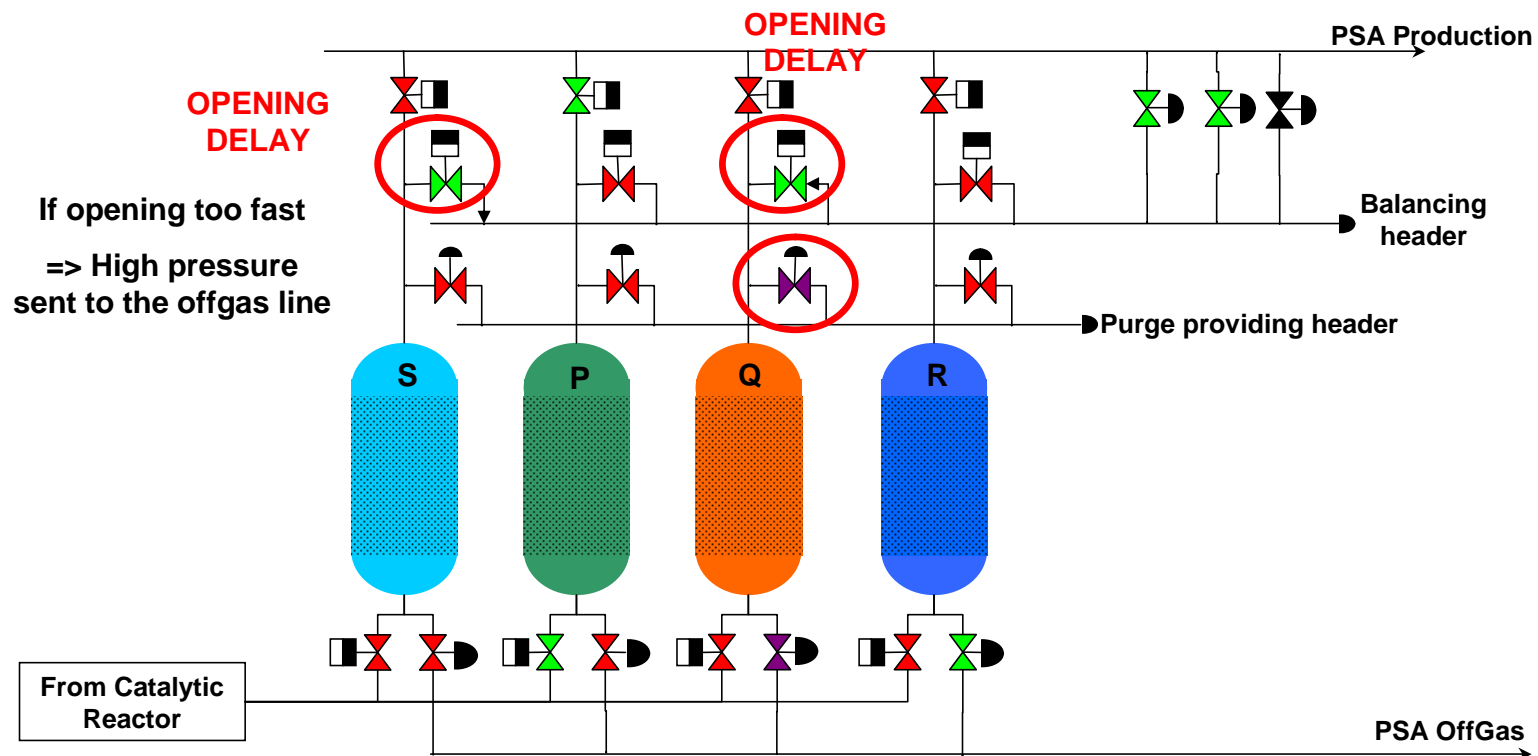
- First temporal unit: pressure balance between Q and S



# 1.PSA Process Description

## ■ Phase 2

- First temporal unit: pressure balance between Q and S





# 1.PSA Process Description

- PSA Exceptional Run Cycle (*1 vessel isolated*) consists of the 3 following phases:

## 1. Phase 1 = Adsorption - at high pressure

i

Steps 1 to 3. While circulating in a vessel, impurities are adsorbed at adsorbent surface and pure helium is produced.

## 2. Phase 2 = Depressurization-Beginning of regeneration

k

Step 1. Waiting

Step 2. Pressure equalization with the vessel in phase 3

Step 3. Final depressurization

## 3. Phase 3 = Regeneration & Repressurization

j

Step 1. Elution at LP, purge is provided by PSA HP outlet

Step 2. Pressure equalization with the vessel in phase 2

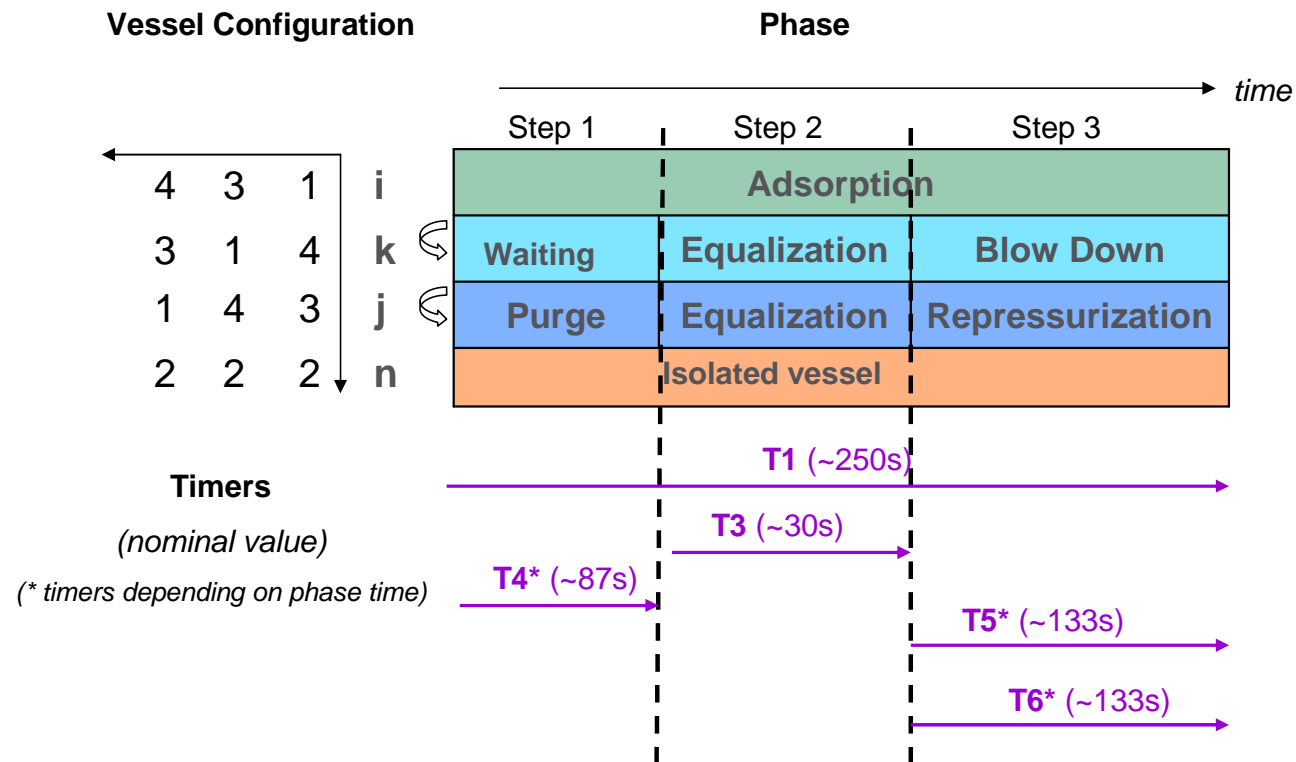
Step 3. Repressurization with PSA HP outlet

■ PSA Exceptional Run – Pressure Cycle



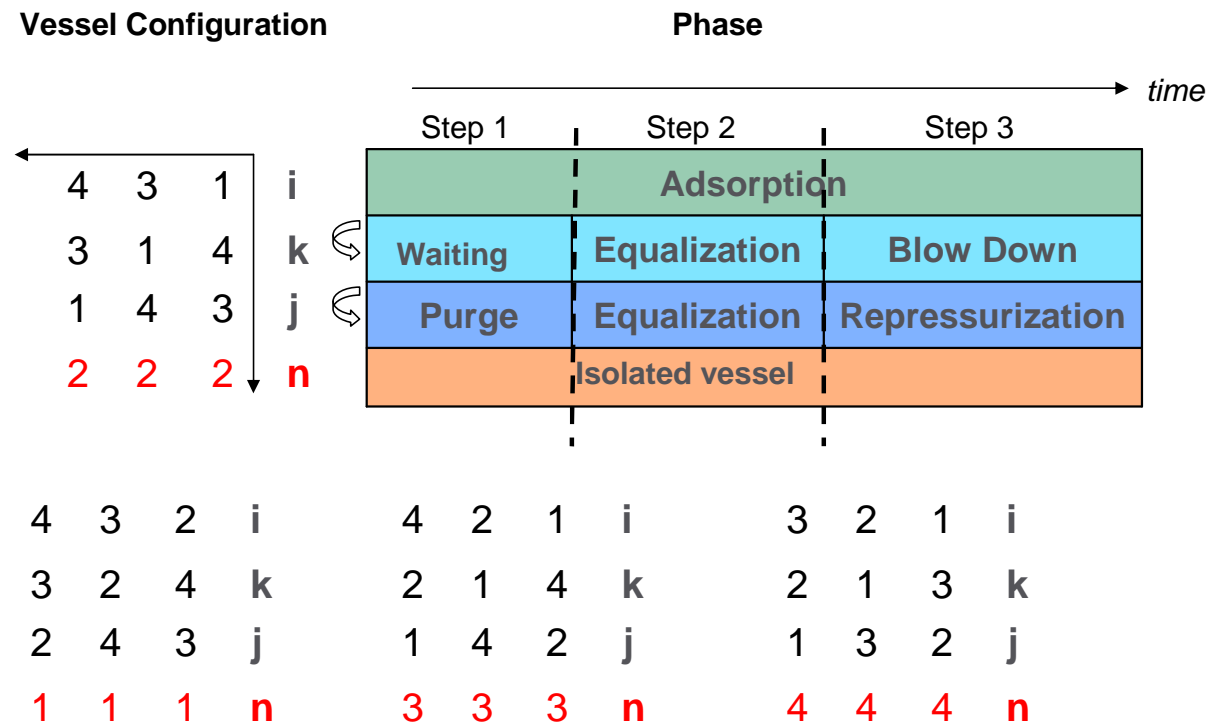
# 1.PSA Process Description

## ■ PSA Exceptional Run – Cycle Table



# 1.PSA Process Description

## ■ PSA Exceptional Run – Cycle Table



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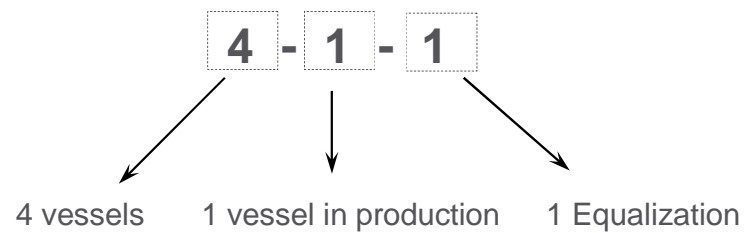
11. PSA Special Features

12. PSA Displays

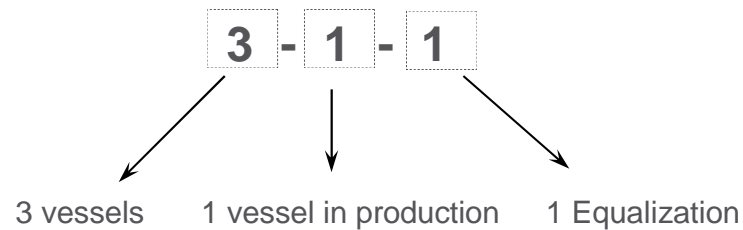
## 2. PSA NUMBERING

### ■ CYCLES

#### ■ 4 VESSELS RUN:



#### ■ 3 VESSELS RUN:



## 2. PSA NUMBERING

### ■ CYCLES

#### ■ 4 VESSELS RUN:

p	s	r	q
1	4	3	2
2	1	4	3
3	2	1	4
4	3	2	1

**P = Vessel in production**

**S = Vessel in 1st depress. step**

**R = Vessel in 2d depress. step  
and regeneration**

**Q = Vessel in repressurization**

## 2. PSA NUMBERING

### ■ CYCLES

#### ■ 3 VESSELS RUN

*Case : Vessel 1 isolated*

i	k	j	n
2	4	3	1
3	2	4	1
4	3	2	1

*Case : Vessel 2 isolated*

i	k	j	n
1	4	3	2
3	1	4	2
4	3	1	2

*Case : Vessel 3 isolated*

i	k	j	n
1	4	2	3
2	1	4	3
4	2	1	3

*Case : Vessel 4 isolated*

i	k	j	n
1	3	2	4
2	1	3	4
3	2	1	4

**n = Isolated vessel**

**j = Vessel in  
regeneration/repressurization**

**i = Vessel in production**

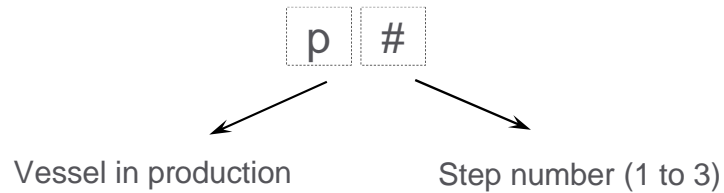
**k = Vessel in depressurization**



## 2. PSA NUMBERING

### ■ STEPS NUMBERING

#### ■ 4 Vessels Run

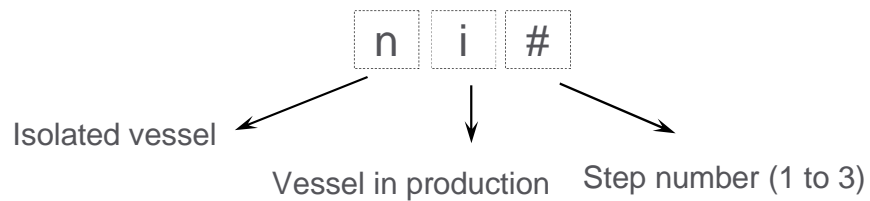


Example :

**Step 23** : Vessel 2 in production  
– step 3

**Step 42** : Vessel 4 in production  
–step 2

#### ■ 3 Vessels Run



Example :

**Step 411** : Vessel 4 isolated  
– Vessel 1 in production step 1

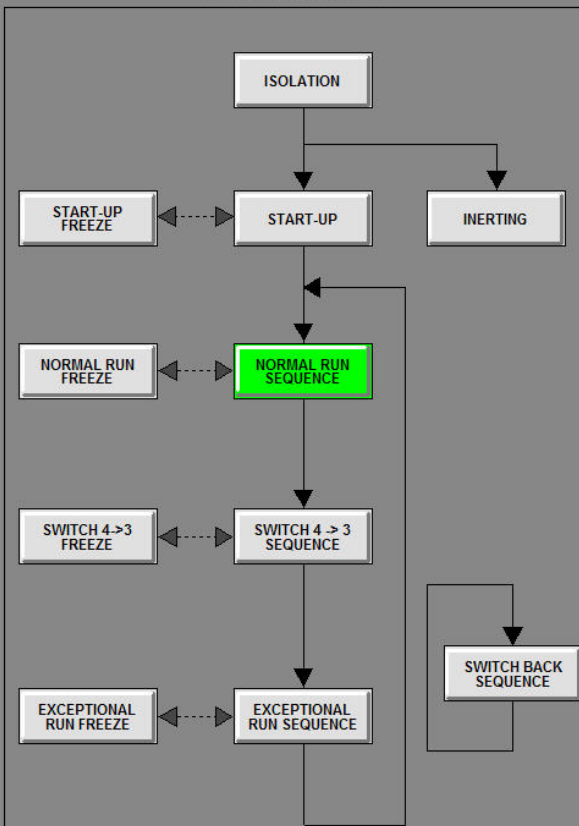
**Step 342** : Vessel 3 isolated  
-Vessel 4 in production –step 2

## 2. PSA NUMBERING

### U322- PSA SEQUENCE OVERVIEW

PSA ALARMS

#### SEQUENCES OVERVIEW



#### DETAILED SEQUENCE

##### Normal Run Sequence



p=1  
Vessel 1 in  
production – step 1

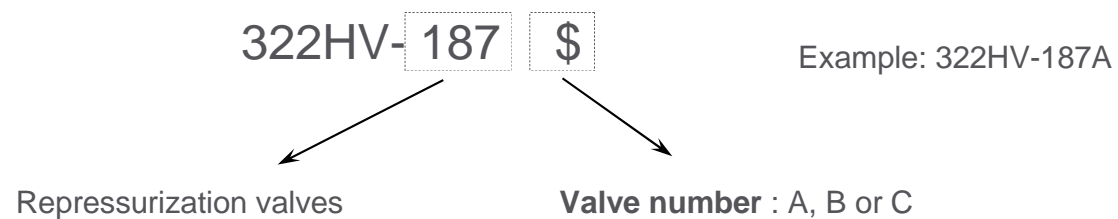
#### VALVES

XV-111	●
XV-121	●
XV-131	●
XV-141	●
XV-112	●
XV-122	●
XV-132	●
XV-113	●
XV-123	●
XV-133	●
XV-143	●
HV-114	0.0
HV-124	0.0
HV-134	0.0
HV-144	0.0
HV-115	0.0
HV-125	0.0
HV-135	27.6
HV-145	0.0
HV-187A	40.0
HV-187B	40.0
HV-187C	0.0
HV-070	0.0
SDV-070	●
PV-196A	0.0
PV-196B	0.0
FV-101	0.0
PV-177A	0.0
PV-177B	100

## 2. PSA NUMBERING

### ■ REPRESSURIZATION VALVES

#### ■ 3 valves



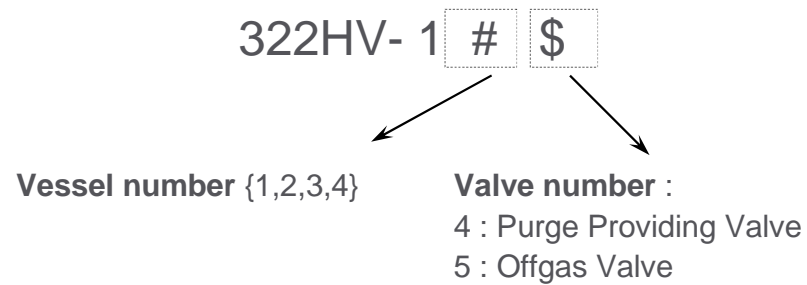
#### ■ 2 valves working in parallel

- Q<sub>valve</sub> = 50% Q repressurization

#### ■ 1 valve in stand-by (spare)

## 2. PSA NUMBERING

### ■ CONTROL VALVES

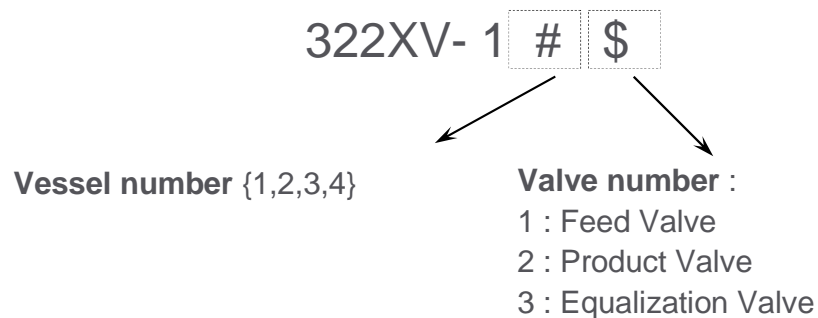


Example :

**322HV-134** : Purge  
Providing valve of vessel 3

**322HV-145** : Offgas Valve of  
vessel 4

### ■ ON/OFF VALVES

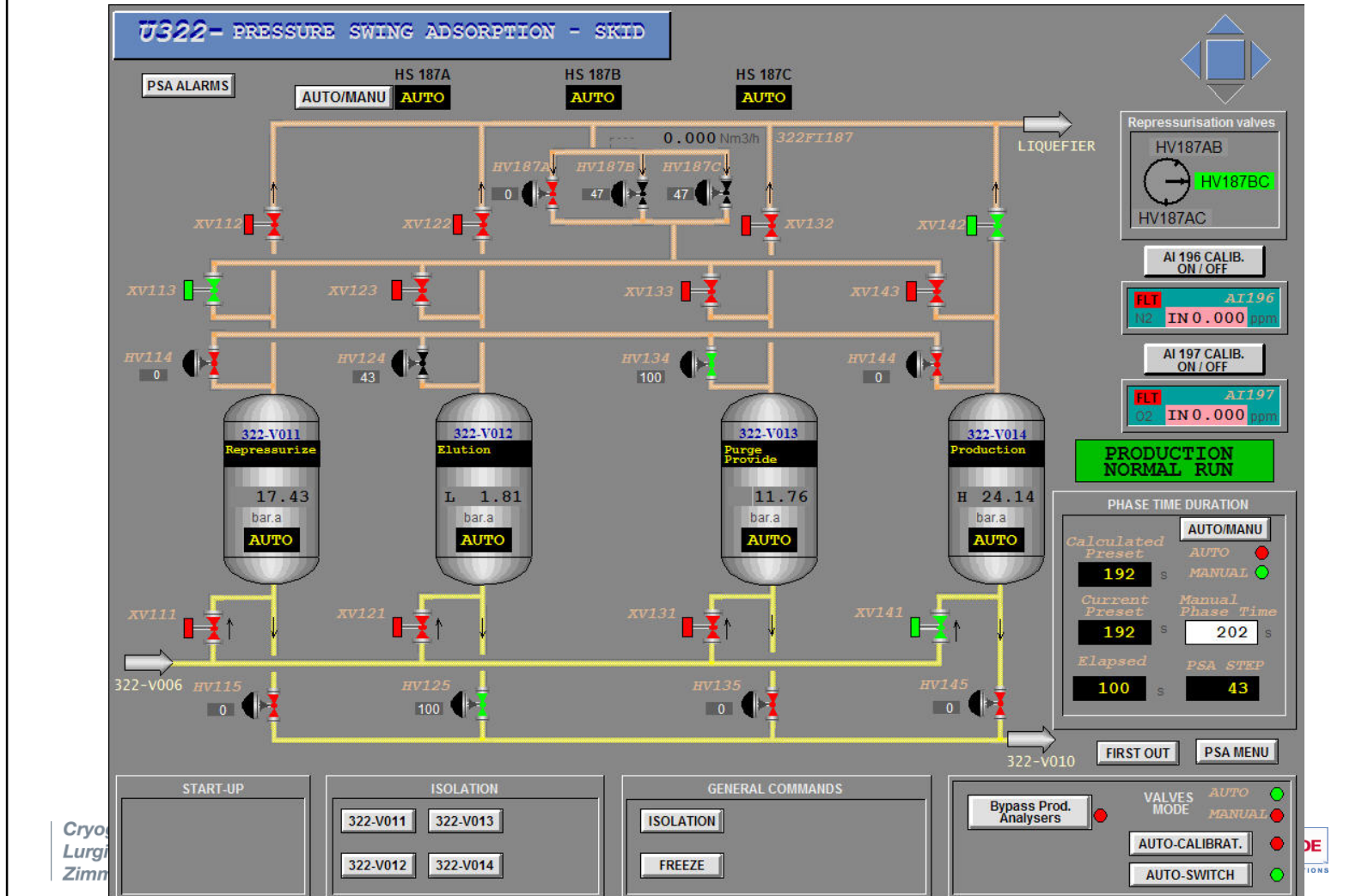


Example :

**322XV-123** : Equalization valve  
of vessel 2

**322XV-142** : Product Valve of  
vessel 4

## 2. PSA NUMBERING



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9. PSA Switch

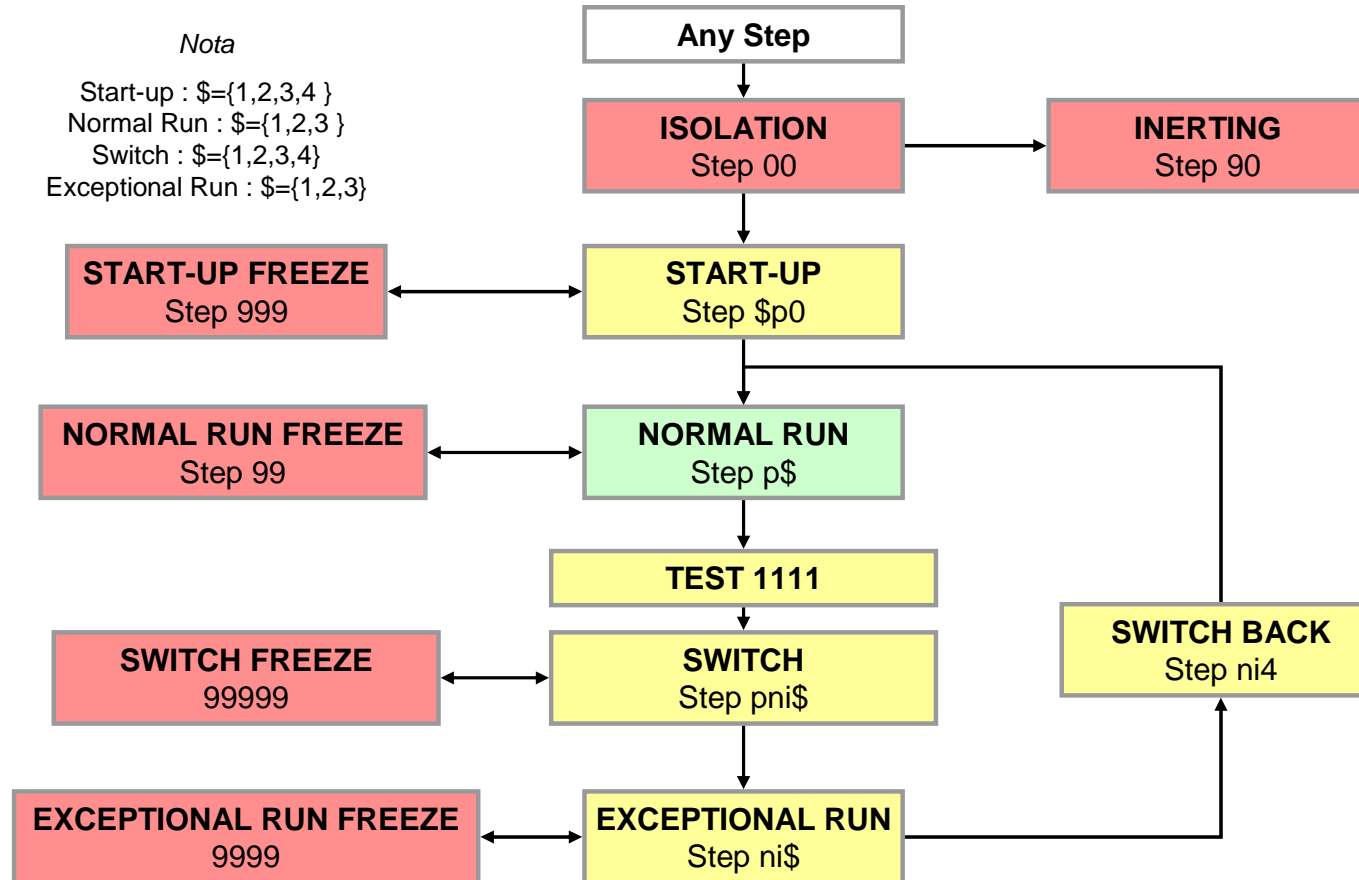
10. PSA Troubleshooting

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### 3. PSA STATES

*Nota*  
 Start-up :  $\$=\{1,2,3,4\}$   
 Normal Run :  $\$=\{1,2,3\}$   
 Switch :  $\$=\{1,2,3,4\}$   
 Exceptional Run :  $\$=\{1,2,3\}$



### 3. PSA STATES

- ISOLATION : *Operator's decision only*
  - ▣ All valves of the skid + 322SDV-070 & 322HV-070 closed
- START-UP
  - ▣ S.U sequence pressurizes adsorbers to fulfill pressure conditions to go to NR
- NORMAL RUN/EXCEPTIONAL RUN
  - ▣ 4 vessels and 3 vessels PSA running mode
- SWITCH
  - ▣ Intermediate sequence to fulfill pressure conditions to go from NR to ER
- SWITCH-BACK
  - ▣ Intermediate sequence in ER to reintroduce the isolated vessel and go back to NR
- FREEZE
  - ▣ All valves of the skid (*except offgas valve open before Freeze*)+ 322SDV-070 & 322HV-070 closed
  - ▣ Restart without vessel depressurization

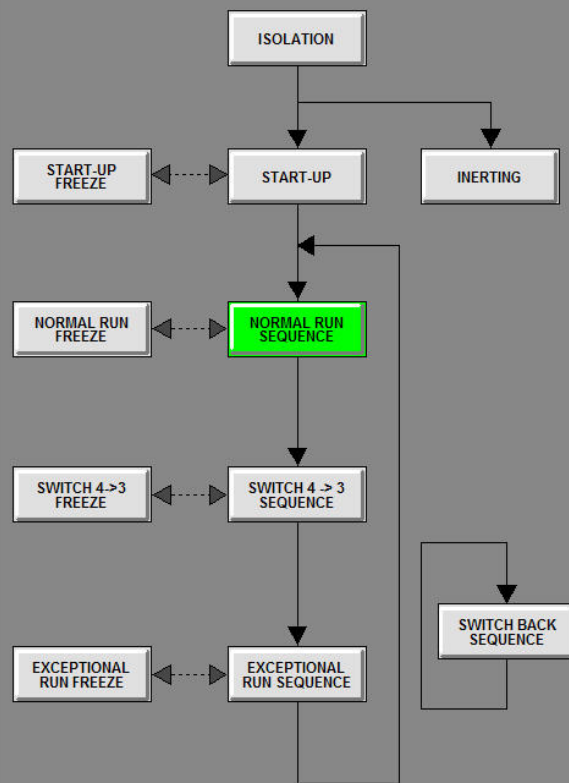


### 3. PSA STATES

#### U322- PSA SEQUENCE OVERVIEW

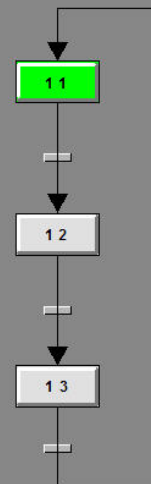
#### PSA ALARMS

##### SEQUENCES OVERVIEW



##### DETAILED SEQUENCE

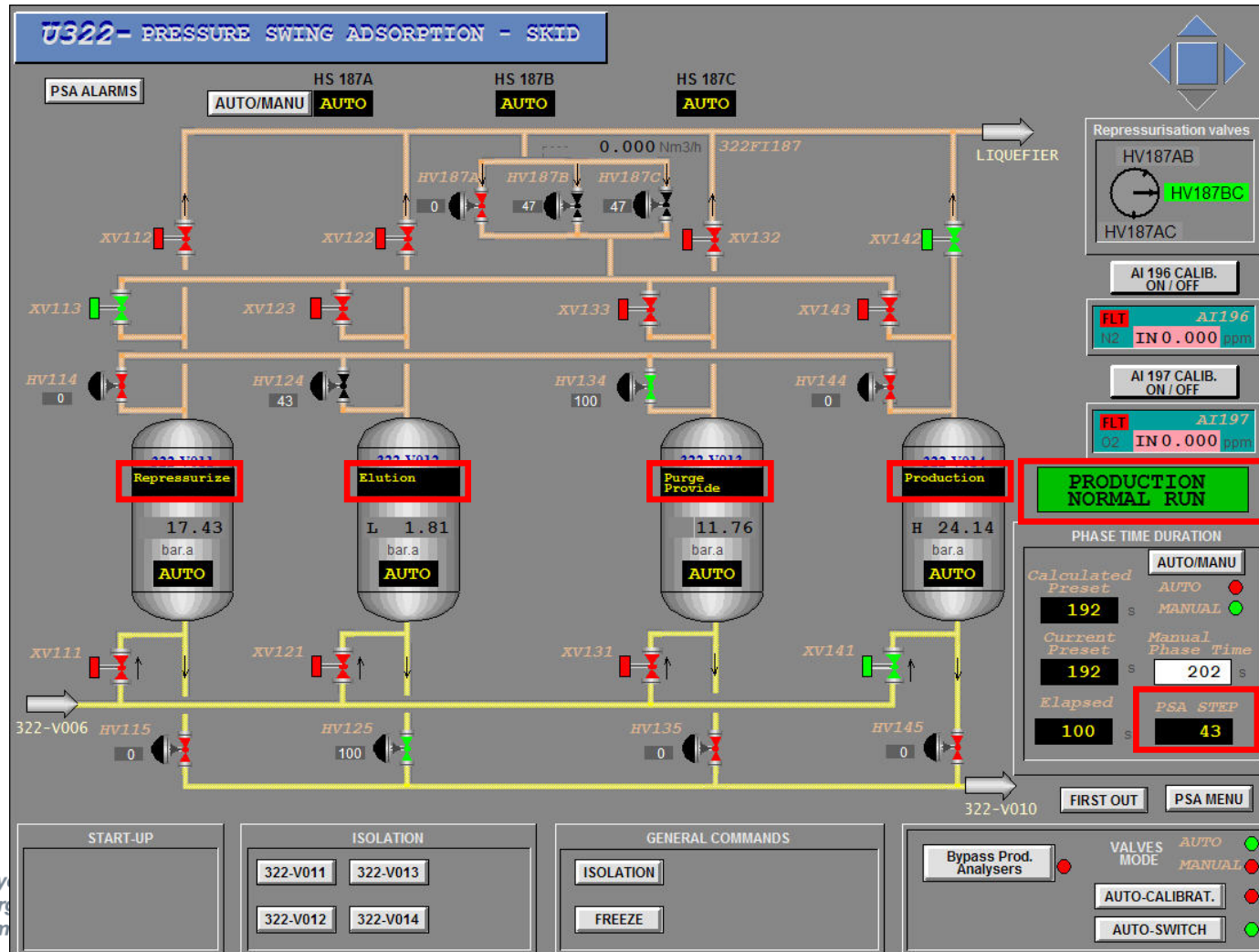
##### Normal Run Sequence



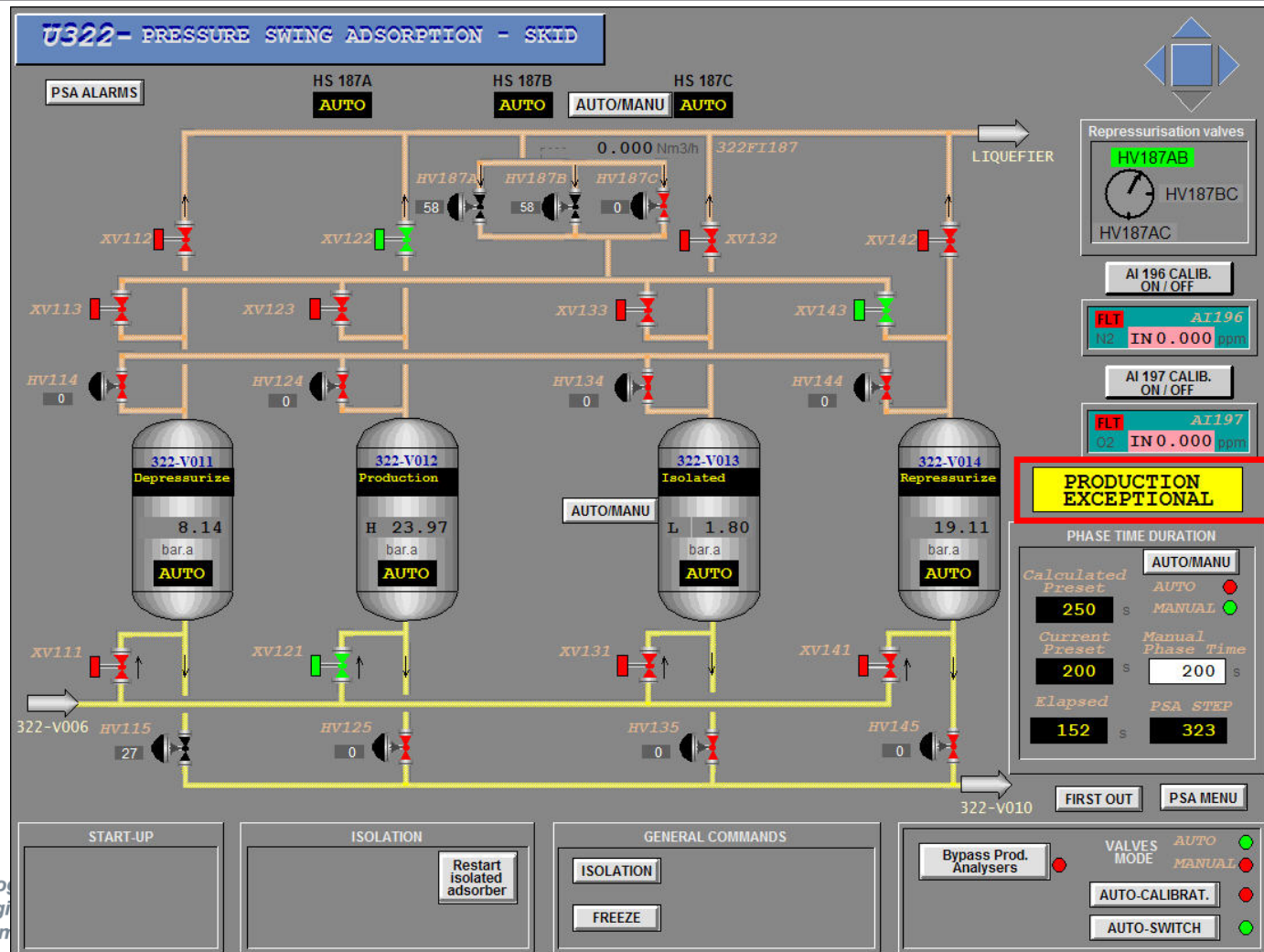
##### VALVES

XV-111	●
XV-121	●
XV-131	●
XV-141	●
XV-112	●
XV-122	●
XV-132	●
XV-142	●
XV-113	●
XV-123	●
XV-133	●
XV-143	●
HV-114	0.0
HV-124	0.0
HV-134	0.0
HV-144	0.0
HV-115	0.0
HV-125	0.0
HV-135	27.6
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HV-187A	40.0
HV-187B	40.0
HV-187C	0.0
HV-070	0.0
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PV-196A	0.0
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FV-101	0.0
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PV-177B	100

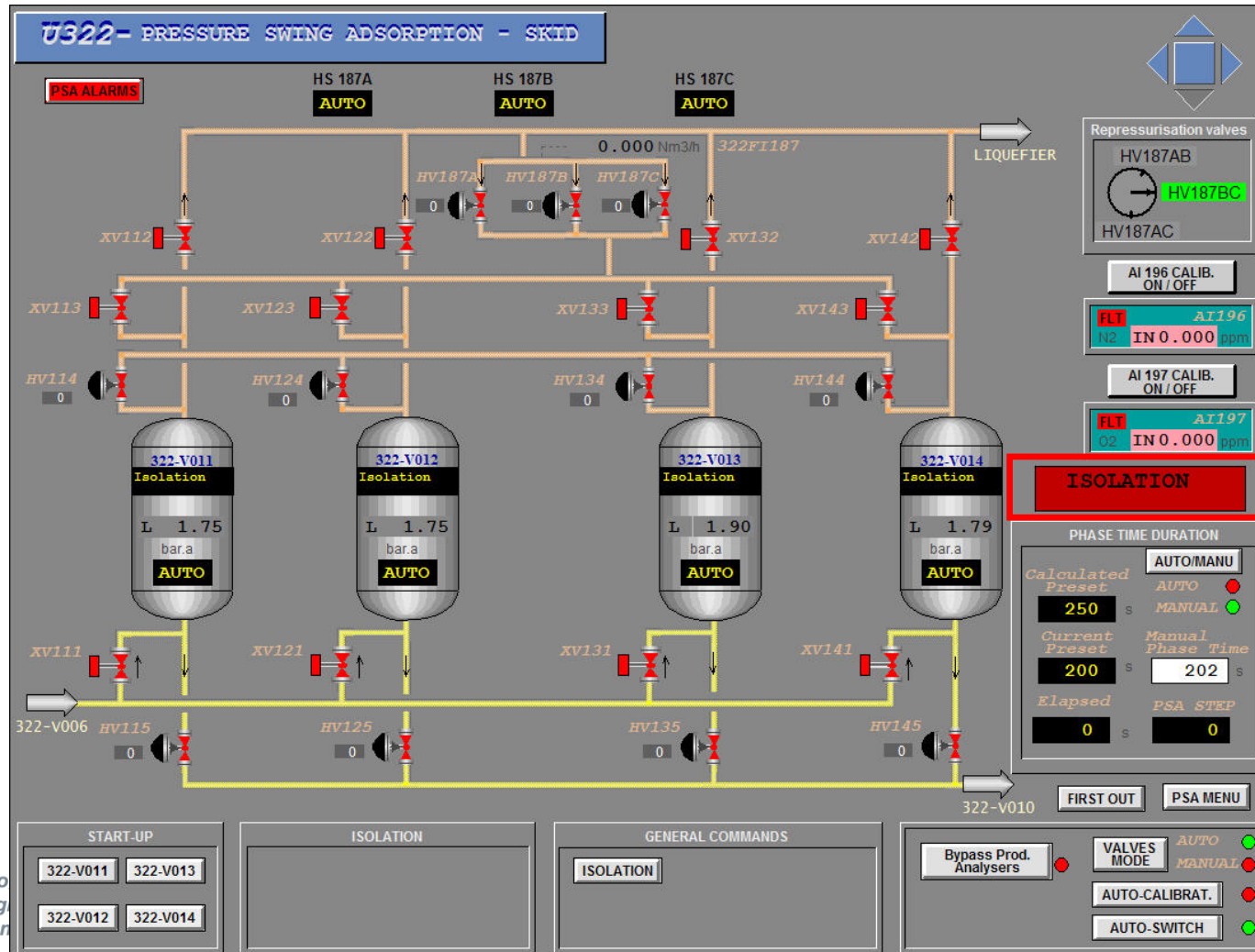
### 3. PSA STATES

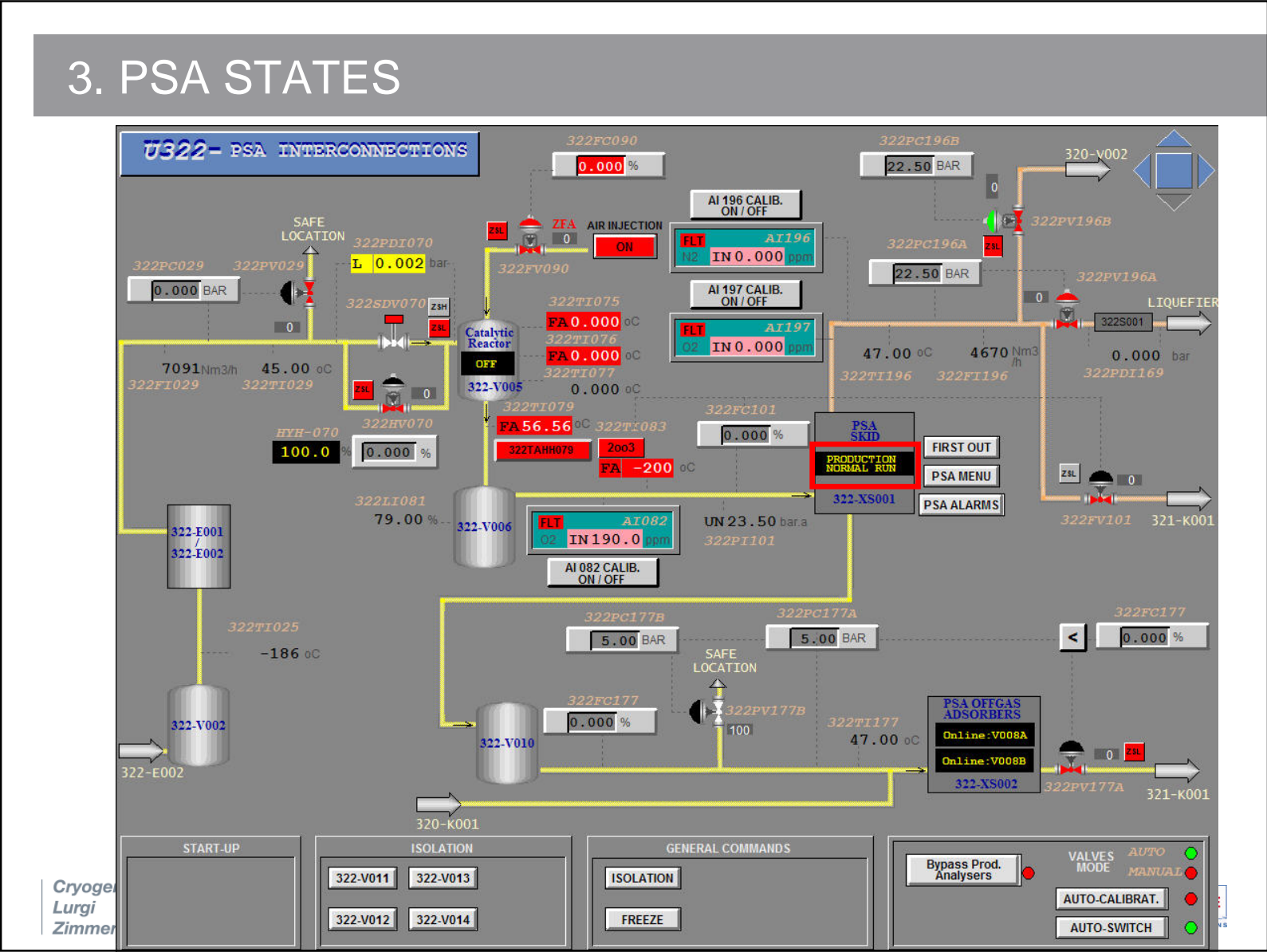


### 3. PSA STATES



### 3. PSA STATES







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## 4. PSA VALVE MODES

### ■ Repressurization Valves Mode

*322HV-187A/B/C*

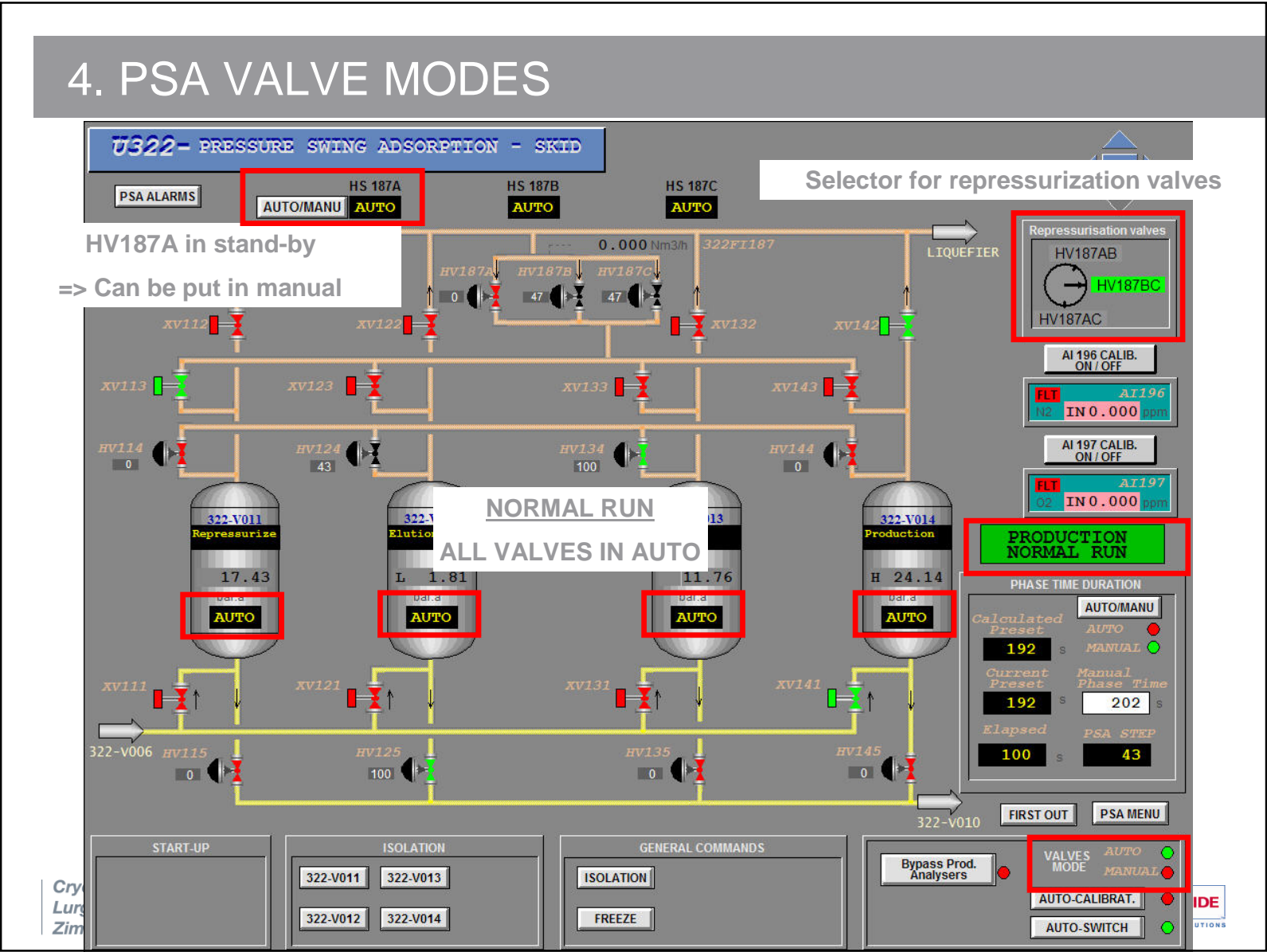
- ▣ Working Valves can be chosen with the selector
- ▣ In case of “a repressurization valve discrepancy” and “a repressurization bad ramp” the system will automatically switch to the other repressurization valve

### ■ Automatic Valves **MANUAL** Mode

*322XV-1\$1, 322XV-1\$2, 322XV-1\$3, 322HV-1\$4, 322HV-1\$5, 322HV-187A/B/C*

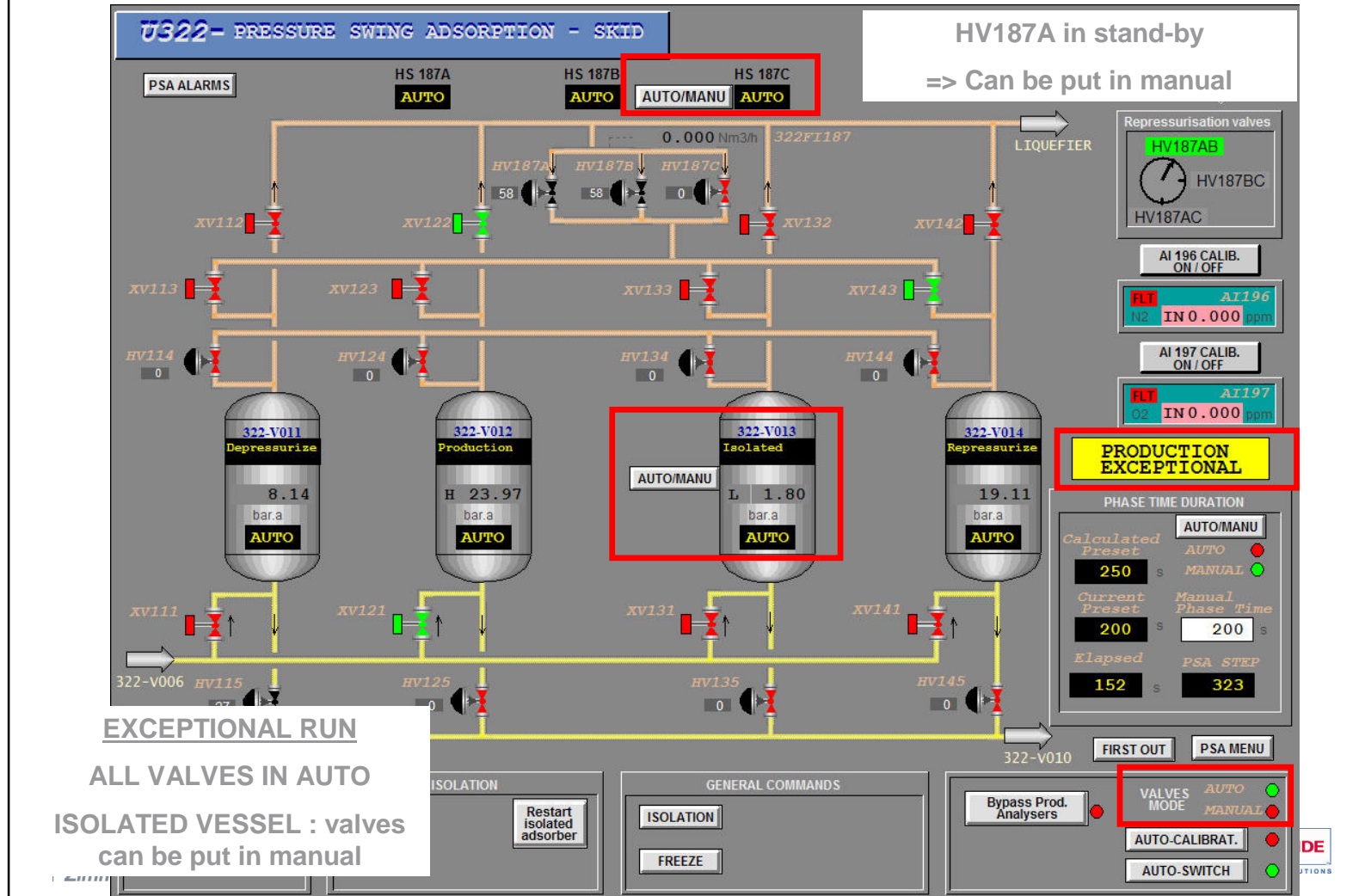
- ▣ ISOLATION / FREEZE : All valves of the skid
- ▣ EXCEPTIONAL RUN (311 Cycle) : Only valves of the isolated vessel
- ▣ ANY STATE : Stand-by Repressurization Valve

## 4. PSA VALVE MODES

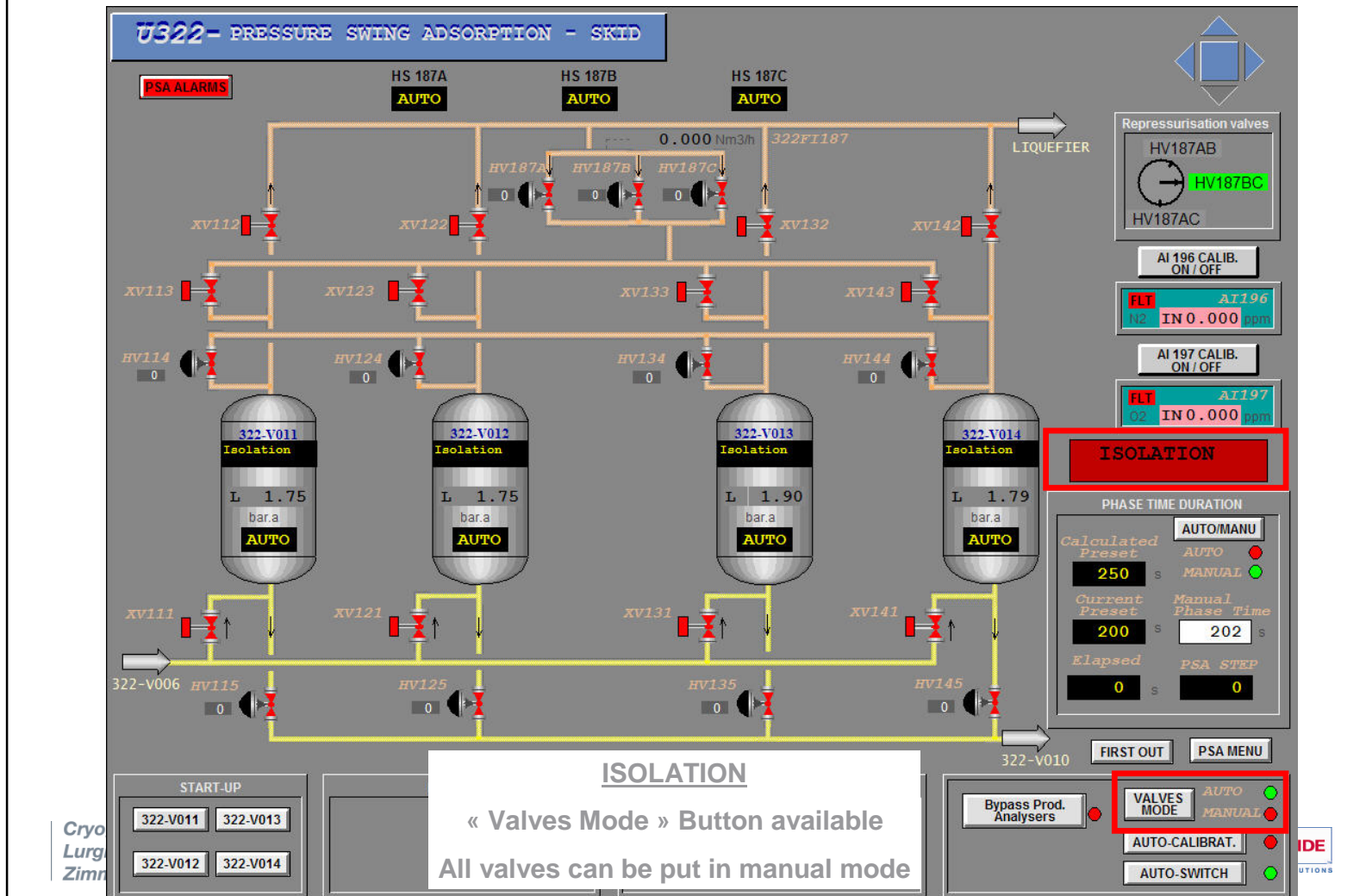




## 4. PSA VALVE MODES



## 4. PSA VALVE MODES

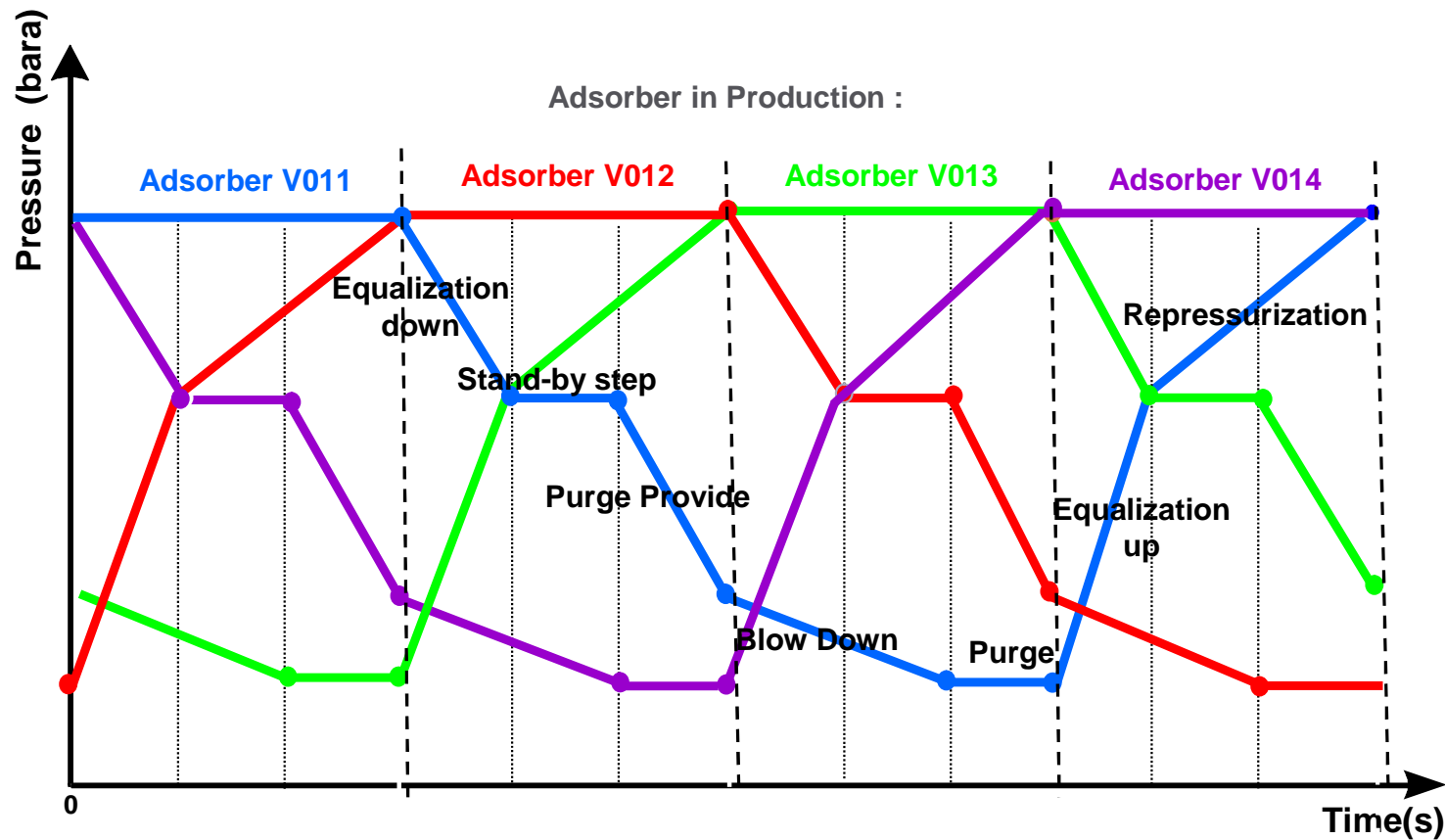


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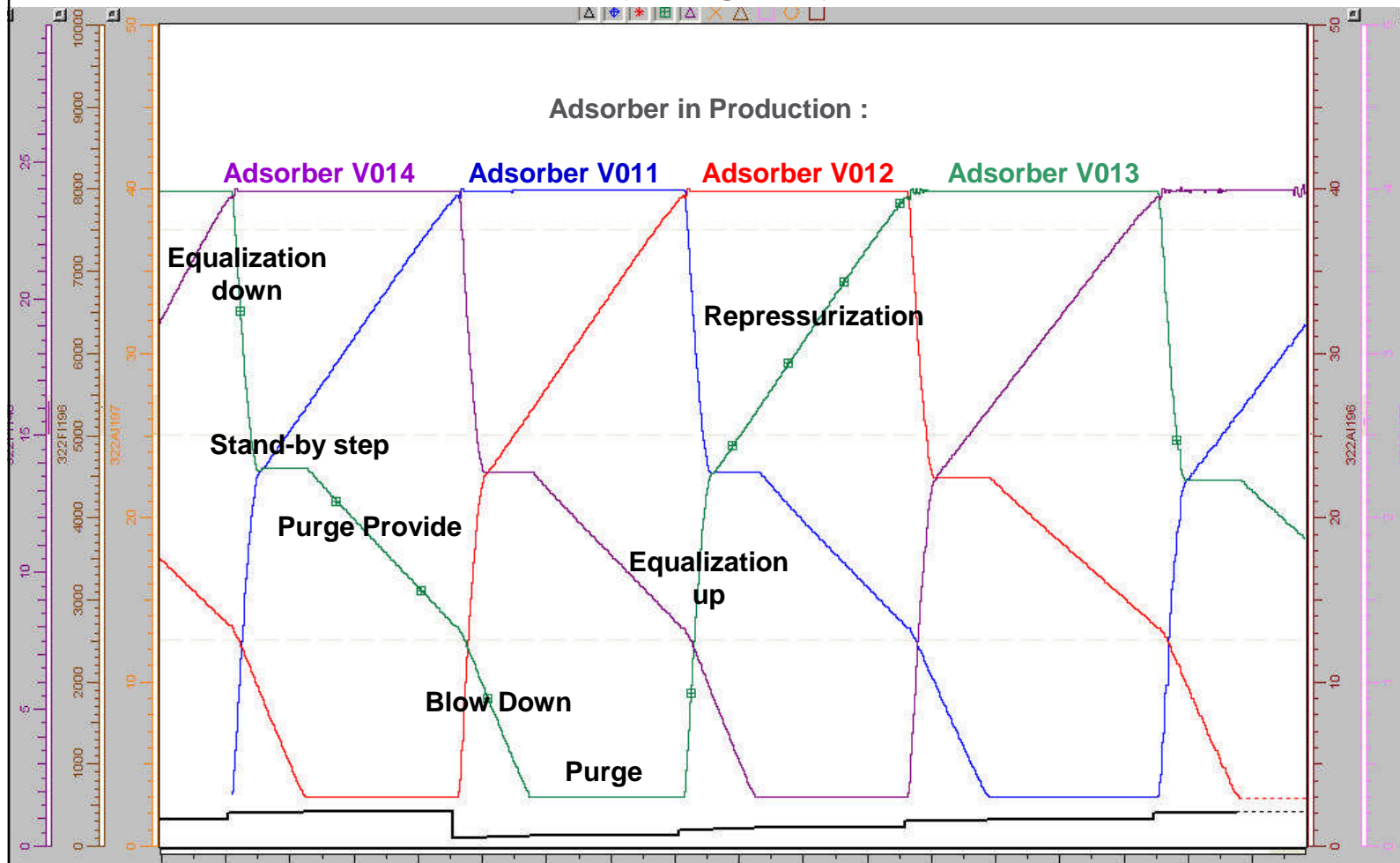
## 5. PSA TRENDS

### ■ Theoretical Pressure Trends



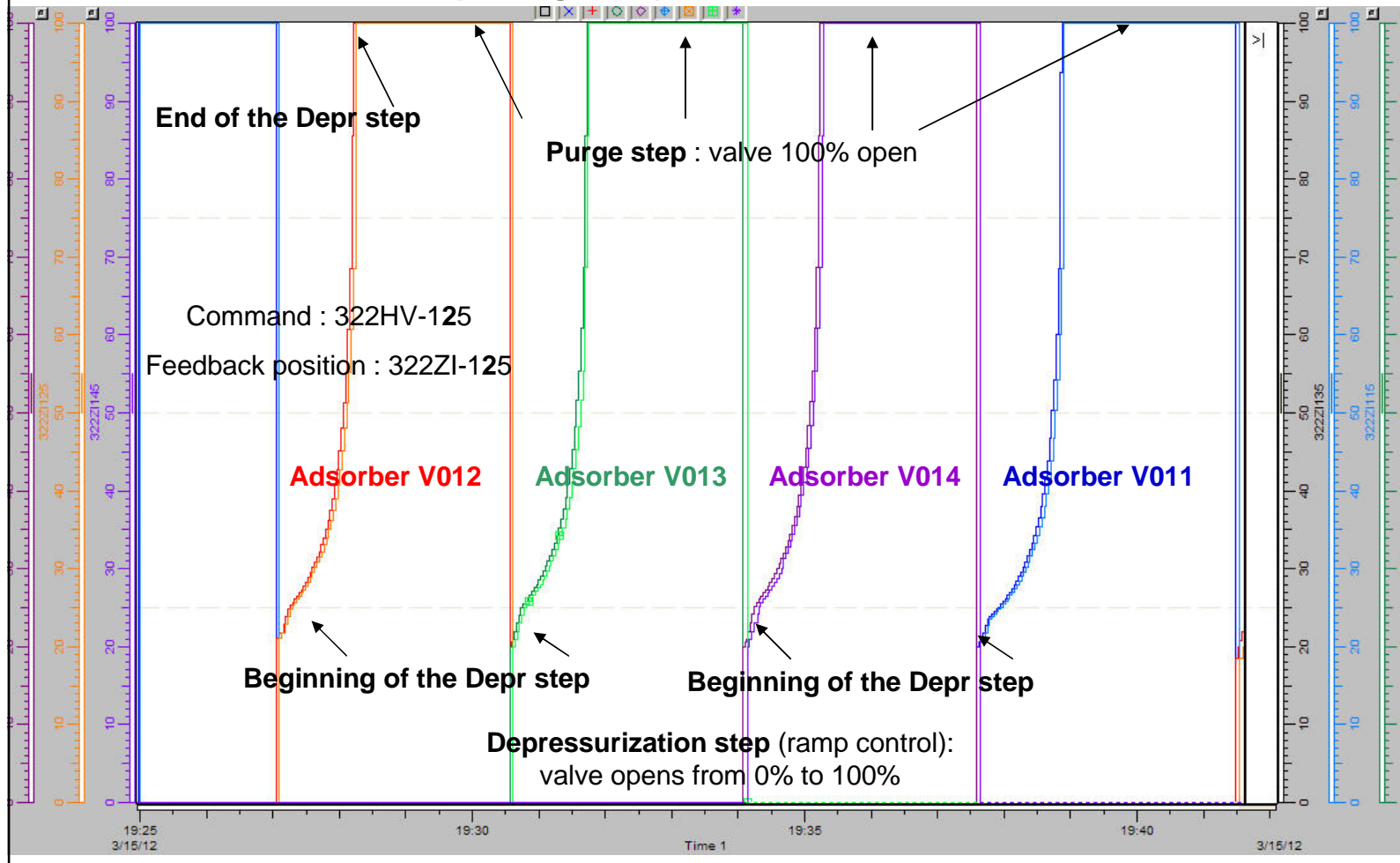
## 5. PSA TRENDS

### ■ TrendView Pressure Trends (during FAT)



## 5. PSA TRENDS

### ■ TrendView Trends (during FAT) – 322HV-1x5 vs 322ZI-1x5



## 5. PSA TRENDS

- To check the operation of the PSA
    - Use Pressure Trends
  - In case of abnormal pressure trend
    - Check valve command vs feedback position trends
      - One Graph configured in TrendView for each type of valve
- |                        |                                  |
|------------------------|----------------------------------|
| Feed valve             | 322XV-1x1 vs 322ZSL-1x1          |
| Product valve          | 322XV-1x2 vs 322ZSL-1x2          |
| Equalization valve     | 322XV-1x3 vs 322ZSL-1x3          |
| Purge Provide valve    | 322HV-1x4 vs 322ZI-1x4           |
| Depressurization valve | 322HV-1x5 vs 322ZI-1x5           |
| Repressurization valve | 322HV-187A/B/C vs 322ZI-187A/B/C |
- Helpful to identify which valve is failing

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## 6. PSA PHASE TIME

### ■ PHASE TIME

#### ■ Calculation

$$T1SP = \frac{CT1NOM(*) * CFEEENOM(*)}{FY101M} \times CT1Coeff(*) \times Kpurity \times KO2 \times KPH \times Koffgas$$

- CT1NOM(\*) : nominal phase time corresponding to the nominal flow
- CFEEENOM(\*) : nominal feed flow
- FY101M : average feed flow measured over the previous phase time
- CT1COEFF(\*) : operator parameter for manual adjustment of the phase time
- K... : parameters for automatic adjustment of the phase time

#### ■ PSA Adsorber bed has a fixed capacity to remove impurities based on nominal PSA feed flow

- At lower feed flowrate, adsorption time (=phase time) is increased
- At higher feed flowrate, adsorption time is decreased

## 6. PSA PHASE TIME

### ■ PHASE TIME

#### ■ Modes

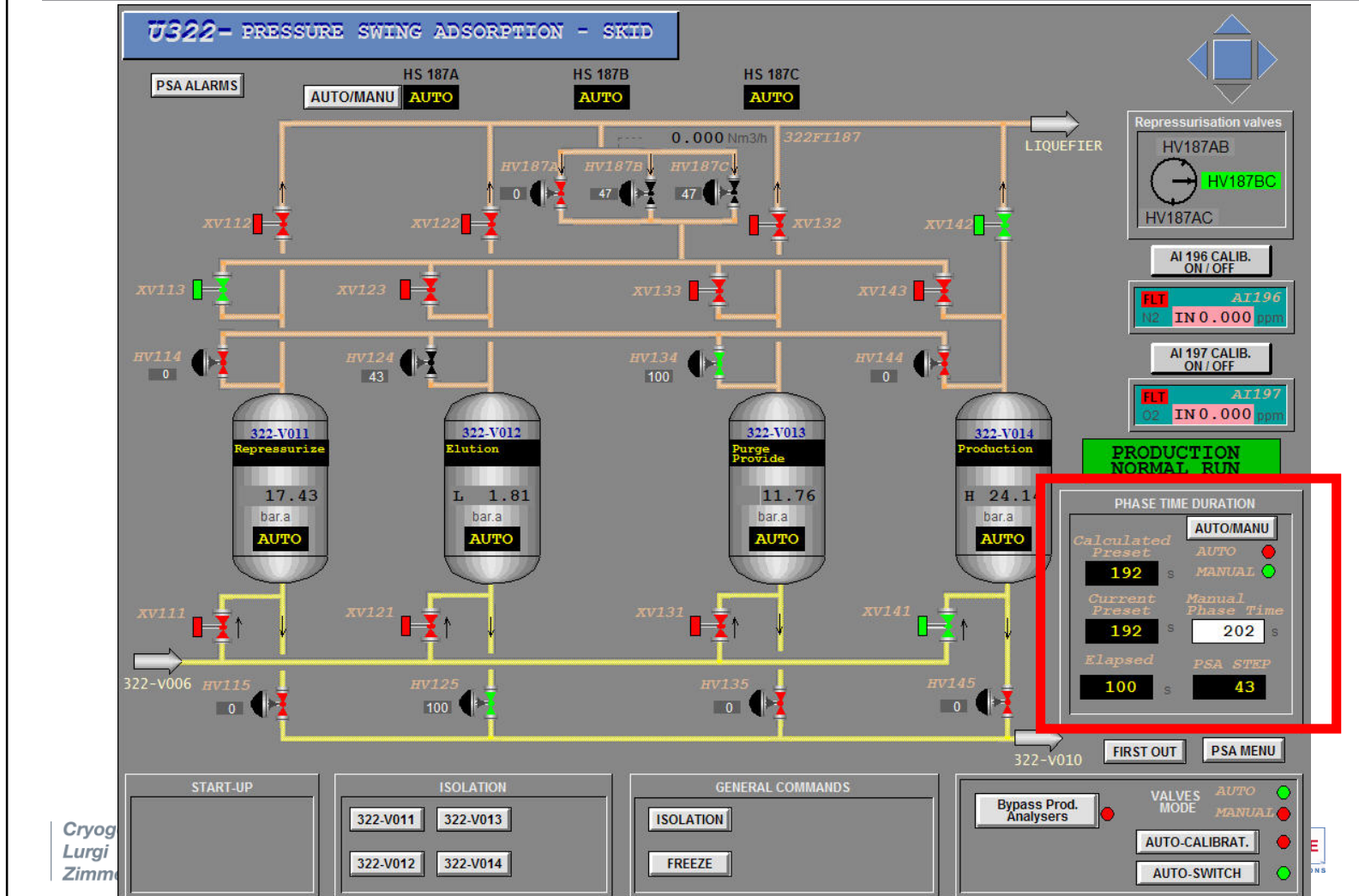
##### ■ Automatic

- Phase time is calculated

##### ■ Manual

- Phase time entered manually by the operator
- Manual phase time < Calculated phase time

## 6. PSA PHASE TIME



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### 7. PSA Start-Up

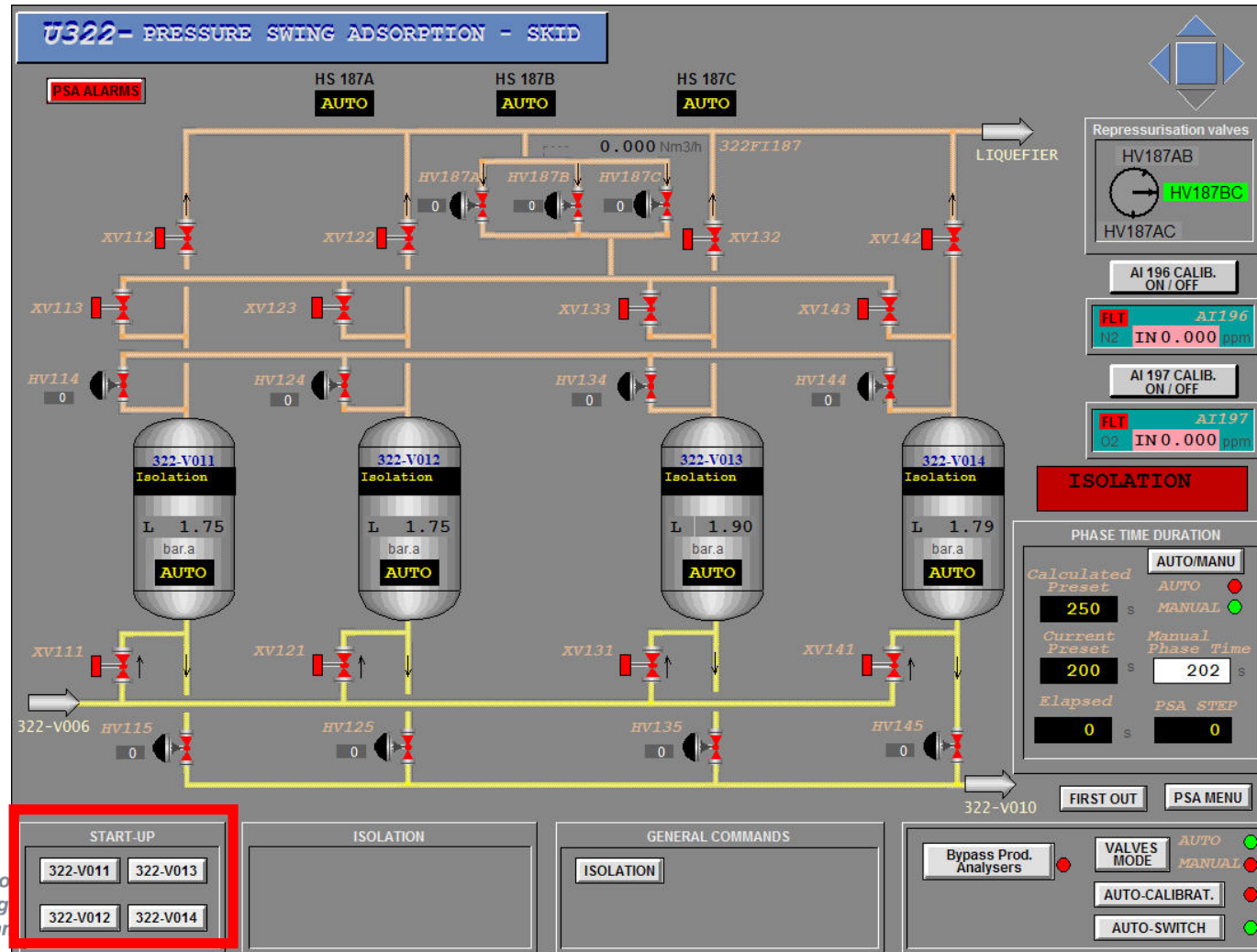
8. PSA Freeze
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## 7. PSA START-UP

### ■ START-UP STEPS

- PSA Inerting (if needed)
- All vessels to be depressurized below 2 bar.abs.
- PSA Skid : All manual valves to be checked
- Check Start-Up Permissive
- Push “Start up” button
- Open manually PSA inlet pressurization valve HV070
- PSA inlet valve SDV070 will open automatically
  - Conditions : PDSL070, PSH1-s8, Not PSL-196
- When PSA Start-up Sequence is complete
  - Push “Start Normal Run” button

## 7. PSA START-UP



## 7. PSA START-UP

### U322- PSA START-UP PERMISSIVE

#### PSA ALARMS

SET POINT	PROCESS VALUE		DESIRED CONDITIONS
-185	-186	oC	PSA Status : ISOLATION
22.00	24.00	bar.a	Not 322TSH-025 : Not High temperature at V002 outlet
2.00	1.80	bar.a	Not 322PSL-029 : Not Low battery limit feed gas pressure
2.00	1.75	bar.a	322PSLL-101 :Very Low feed gas pressure
	1.75	bar.a	
	1.90	bar.a	322PSL1#8 : Low pressure in all adsorbers
	1.79	bar.a	
2.00	1.80	bar.a	322-PSLLL-196 : Very very low He product pressure
2.00	1.35	bar.a	322-PSL-177 : Low offgas drum pressure
			322-ZSL-070 : BL feed valve SDV-070 is closed
80.00	79.00	%	NOT 322-LSH-081 : Not High level in V006
			Catalytic Reactor : ON
			Valves are in Automatic Mode

## Course Agenda

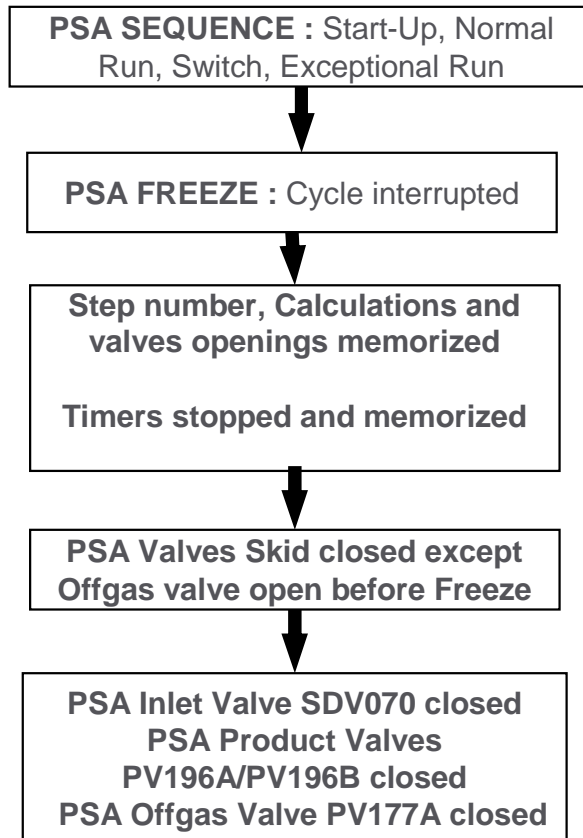
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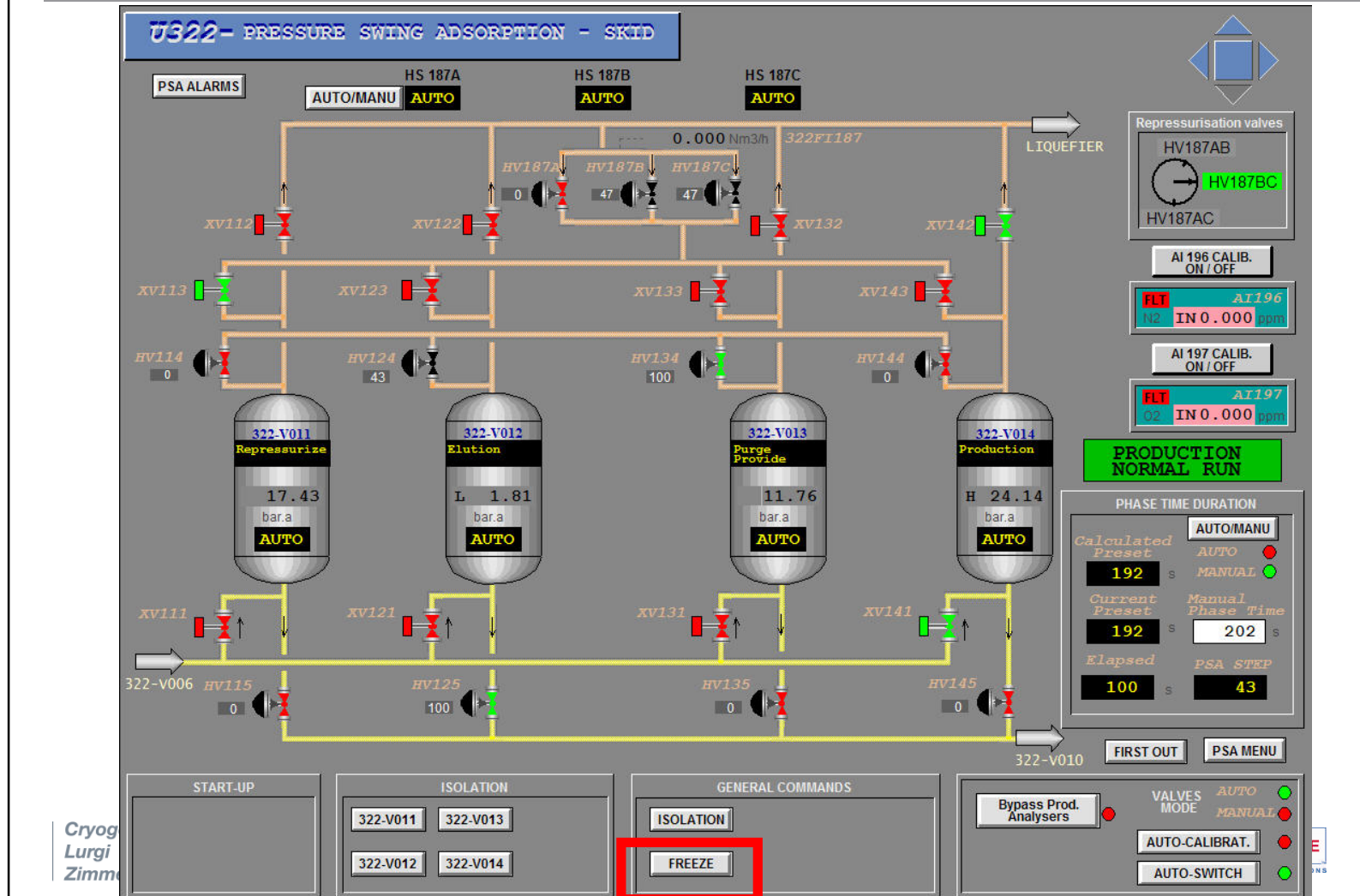
## 8. PSA FREEZE



### ■ FREEZE ACTIVATION

- Interconnection conditions
  - Catalytic Reactor Trip
  - 322TSHH-083
  - 322PSLL-029
  - 322LSHH-081
  - 322PSLL-196
- Operator's action
- PSA internal conditions (valve discrepancy and pressure failure) in case of Manual Switch Mode or in Exceptional Run

## 8. PSA FREEZE



## 8. PSA FREEZE

U322- PSA INTERLOCK NORMAL RUN FREEZE/UNFREEZE 1

PSA ALARMS

RESET\_INTERLOCK

SET POINT	PROCESS VALUE	
21.00	24.00	bar.a
54.00	47.00	oC
85.00	79.00	%

20.50	1.80	bar.a
-------	------	-------

22.00	24.00	bar.a
-185	-186	oC
25.00	1.80	bar.a
80.00	79.00	%
21.50	1.80	bar.a
0.500	0.002	bar

### FREEZE CONDITIONS

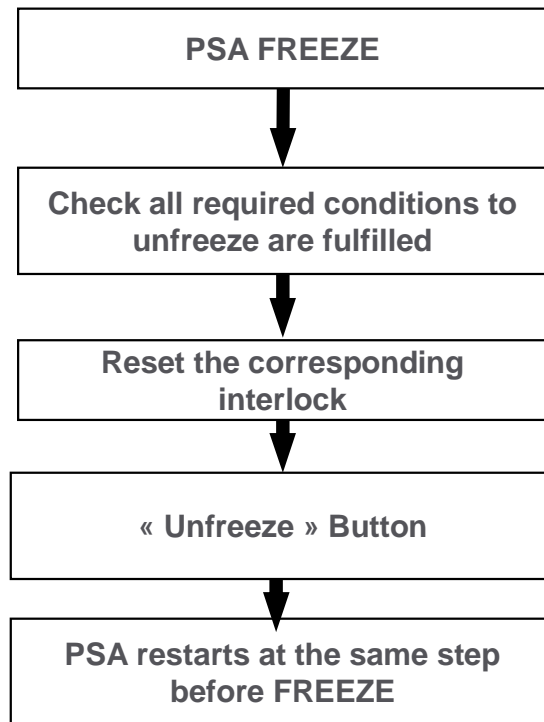
#### FO

- ☐ ☐ 322PSLL-029 : Very Low Battery Limit Feed Gas Pressure
- ☐ ☐ 322TSHH-083 : Very High Feed Gas Temperature
- ☐ ☐ 322-LSHH-081 : Very High level in V006
- ☐ ☐ 322UY200 : Catalytic Reactor OFF
- ☐ ☐ 322HS99 : PSA Freeze Button
- ☒ ☒ 322PSLL-196 : Very Low He product pressure
- ☐ ☐ Freeze from Test 999

### UNFREEZE DESIRED CONDITIONS

- ☒ Not 322PSL-029 : Not Low battery limit feed gas pressure
- ☒ Not 322TSH-025 : Not High temperature at V002 outlet
- ☒ Not 322PSH-101 : Not high feed gas pressure
- ☒ Not 322LSH-081 : Not High level in V006
- ☐ Not 322PSL-196 : Not Low He product pressure
- ☒ 322PDSL-070 : Low Differential pressure on SDV-070
- ☒ Interlock Reset
- ☐ NR Freeze Sequence
- ☒ Not 322HS99 : PSA Freeze button
- ☒ Valves are in Automatic Mode
- ☒ Catalytic Reactor : ON
- ☒ NO Pressure Transmitter Fault

## 8. PSA FREEZE



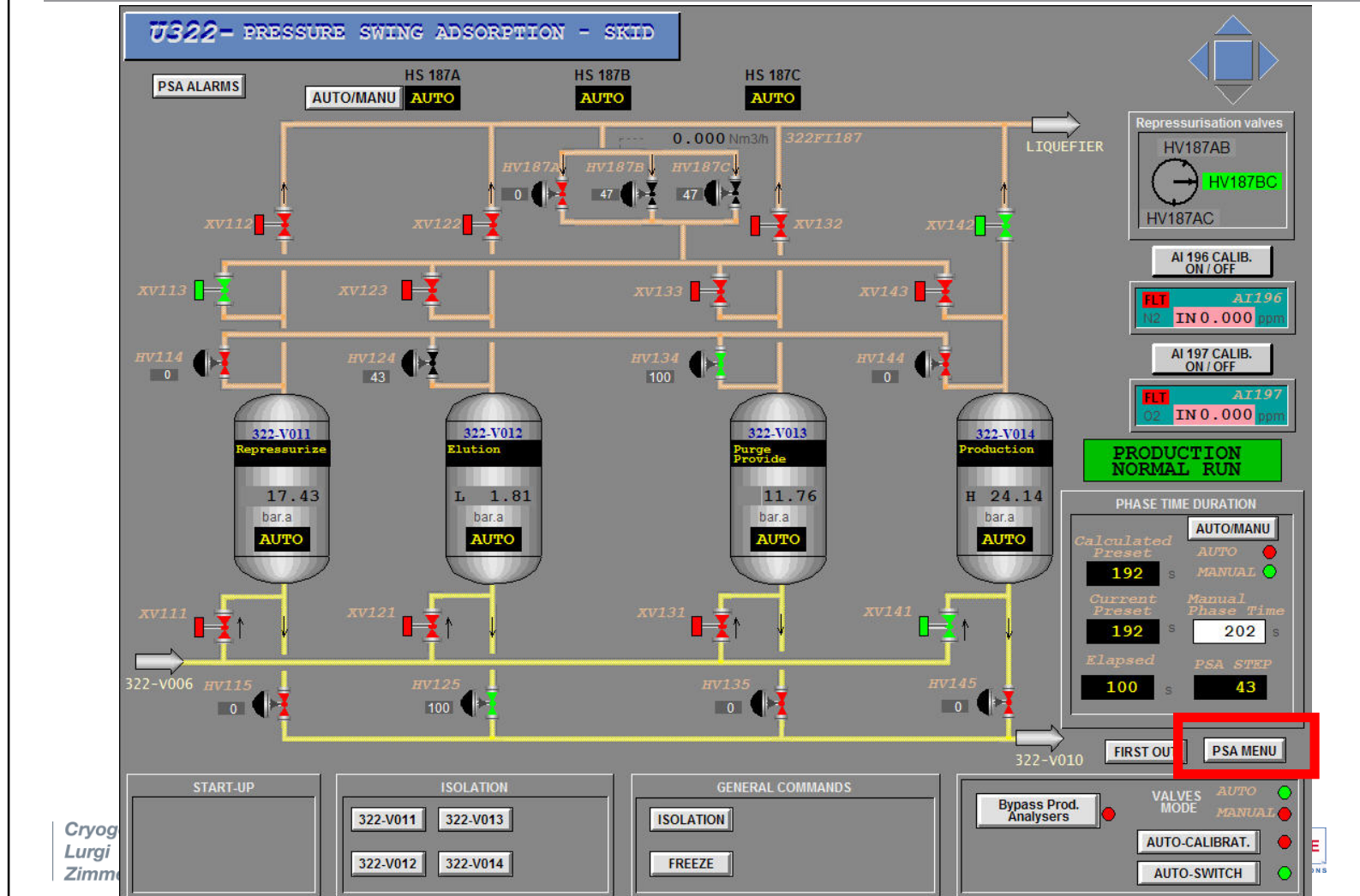
### ■ UNFREEZE ACTIVATION

- Operator's action

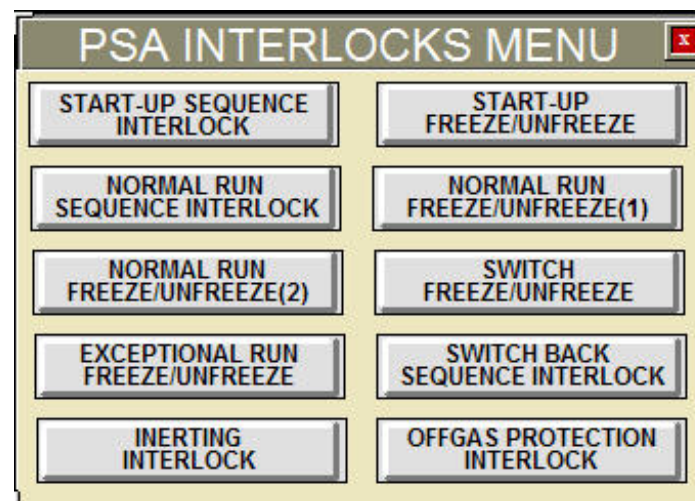
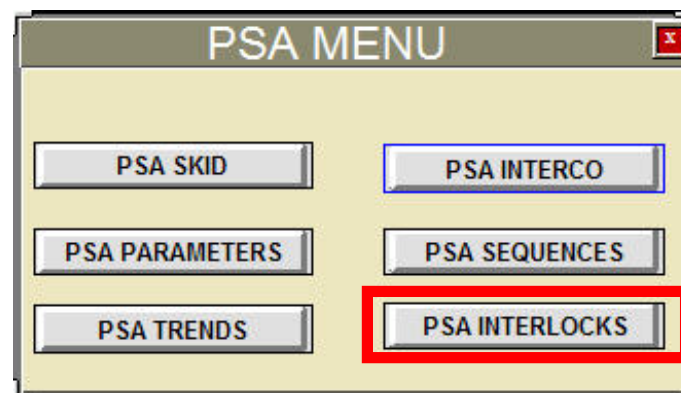
### ■ One Freeze/Unfreeze interlock specific to each PSA Sate

- START-UP
- NORMAL RUN (1)
- NORMAL RUN (2)
- SWITCH
- EXCEPTIONAL RUN

## 8. PSA FREEZE



## 8. PSA FREEZE



## 8. PSA FREEZE

U322- PSA INTERLOCK NORMAL RUN FREEZE/UNFREEZE 1

PSA ALARMS

RESET\_INTERLOCK

SET POINT	PROCESS VALUE	
21.00	24.00	bar.a
54.00	47.00	oC
85.00	79.00	%

20.50	1.80	bar.a
-------	------	-------

22.00	24.00	bar.a
-185	-186	oC
25.00	1.80	bar.a
80.00	79.00	%
21.50	1.80	bar.a
0.500	0.002	bar

### FREEZE CONDITIONS

#### FO

- ☐ ☐ 322PSLL-029 : Very Low Battery Limit Feed Gas Pressure
- ☐ ☐ 322TSHH-083 : Very High Feed Gas Temperature
- ☐ ☐ 322-LSHH-081 : Very High level in V006
- ☐ ☐ 322UY200 : Catalytic Reactor OFF
- ☐ ☐ 322HS99 : PSA Freeze Button
- ☒ ☒ 322PSLL-196 : Very Low He product pressure
- ☐ ☐ Freeze from Test 999

### UNFREEZE DESIRED CONDITIONS

- ☒ Not 322PSL-029 : Not Low battery limit feed gas pressure
- ☒ Not 322TSH-025 : Not High temperature at V002 outlet
- ☒ Not 322PSH-101 : Not high feed gas pressure
- ☒ Not 322LSH-081 : Not High level in V006
- ☐ Not 322PSL-196 : Not Low He product pressure
- ☒ 322PDSL-070 : Low Differential pressure on SDV-070
- ☒ Interlock Reset
- ☐ NR Freeze Sequence
- ☒ Not 322HS99 : PSA Freeze button
- ☒ Valves are in Automatic Mode
- ☒ Catalytic Reactor : ON
- ☒ NO Pressure Transmitter Fault



## Course Agenda

1. PSA Process Description
2. PSA Numbering
3. PSA States
4. PSA Valve Modes
5. PSA Trends
6. PSA Phase Time
7. PSA Start-Up
8. PSA Freeze
9. PSA Switch
10. PSA Troubleshooting
11. PSA Special Features
12. PSA Displays



## 9. PSA SWITCH

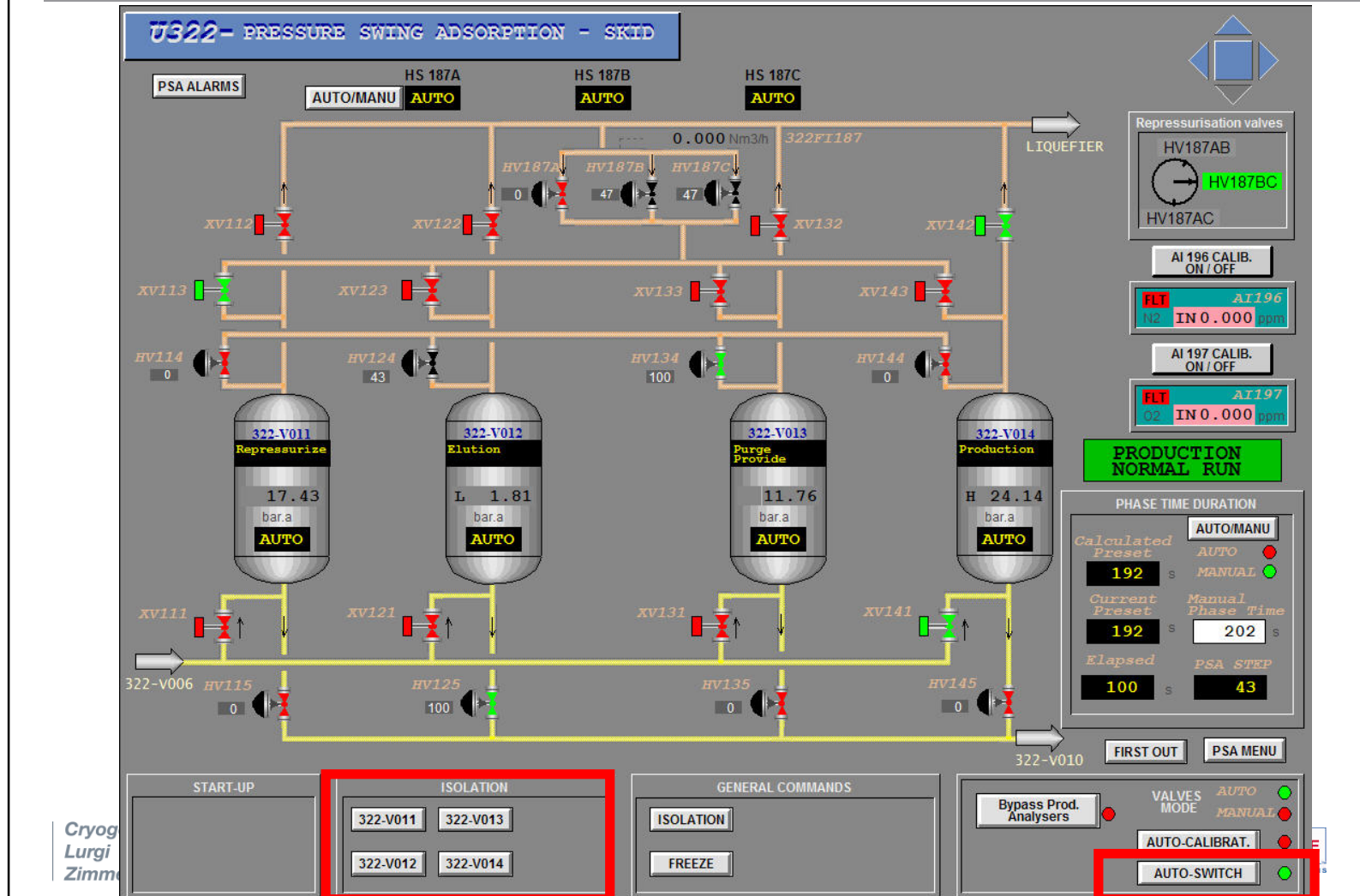
### ■ SWITCH

- Switch from 4 vessels to 3 vessels operation
  - Allows to operate PSA with 1 adsorber out of service while maintaining product specification with full feed flow
  - Valve maintenance can be performed on the isolated adsorber
  - Once maintenance is completed, isolated adsorber can be reintegrated into cycle with SWITCH BACK
- Automatic or Manual Mode
  - Button "AUTO-SWITCH"
- Activation
  - Troubleshooting
    - Valve discrepancy AND pressure failure (in case of Automatic Switch Mode)
  - Operator's decision to isolate one vessel (*at any time*)
    - Button "ISOLATION" linked to the corresponding vessel

### ■ SEQUENCE

- 4 Switch sequences fully automatic depending on the current state of the vessel to be isolated (p, q, r or s)
- Purpose
  - Prepare pressure inside vessels before starting Exceptional Run
  - Minimize disturbance to feed, product or offgas

## 9. PSA SWITCH



## 9. PSA SWITCH

### ■ SWITCH BACK

- Switch from 3 vessels to 4 vessels operation
- Activation
  - At any time during Exceptional Run
  - Only by operator with the button “Restart Isolated Adsorber”
  - “Restart Isolated Adsorber” button display see Switch Back Permissive
- Sequence
  - Switch back sequence fully automatic
  - Elution of the isolated vessel is done with PSA product gas
  - Waiting for the good vessels configuration
  - Switch-back to Normal Run sequence
- Switch Back sequence Cancelling
  - Operator’s request
  - Exceptional Run Freeze
  - Not PSL-1n8 in isolated vessel

## 9. PSA SWITCH

U322- PSA INTERLOCK SWITCH BACK

PSA ALARMS

SET POINT

PROCESS  
VALUE

2.00

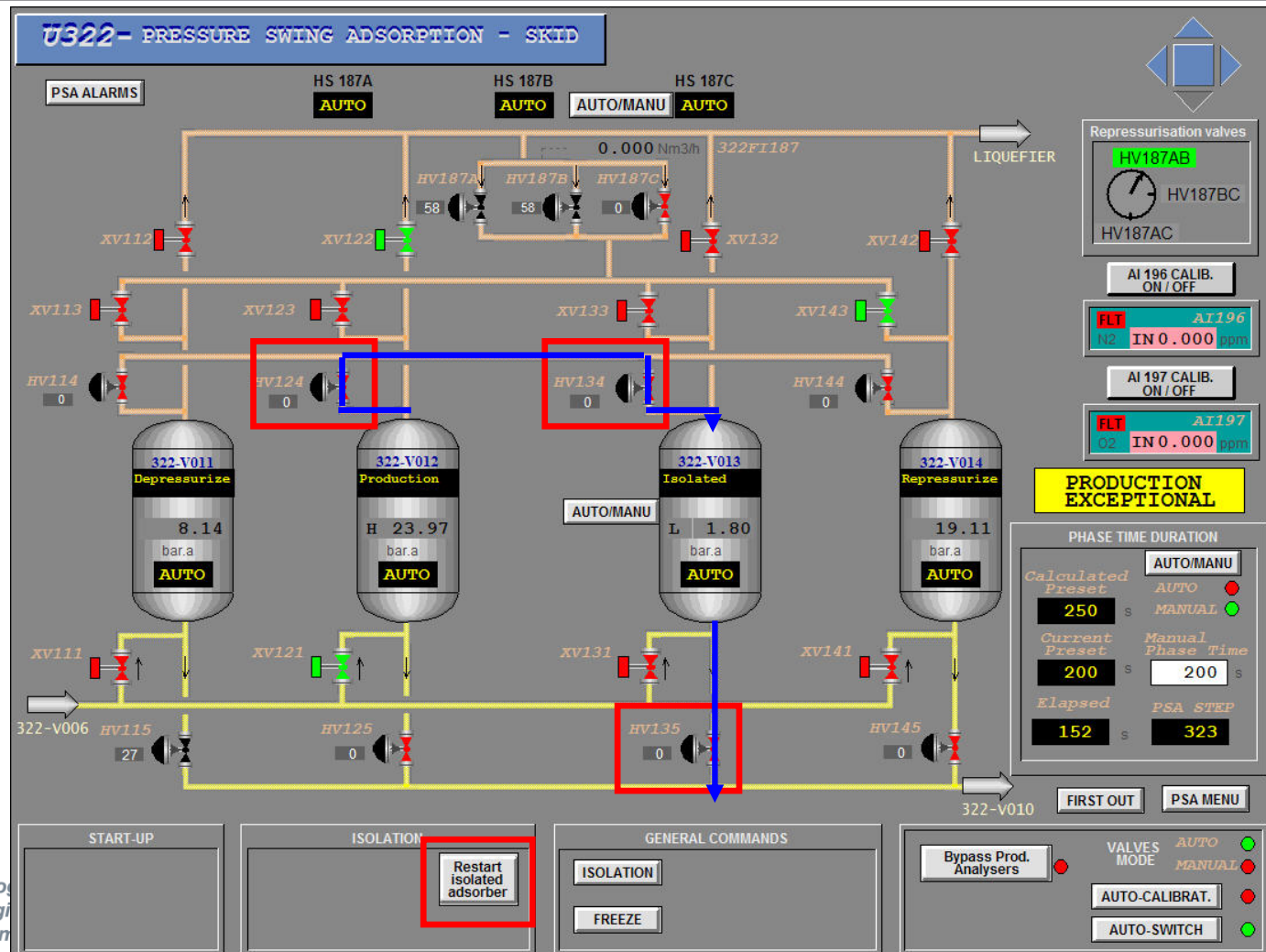
1.90

bar.a

DESIRED CONDITIONS

- ☐ HS1000 Restart isolated absorber button
- ☒ 322PSL-138 : Low pressure in V013
- ☒ Valves of isolated Adsorber are in Automatic Mode
- ☒ NO Pressure Transmitter fault

## 9. PSA SWITCH

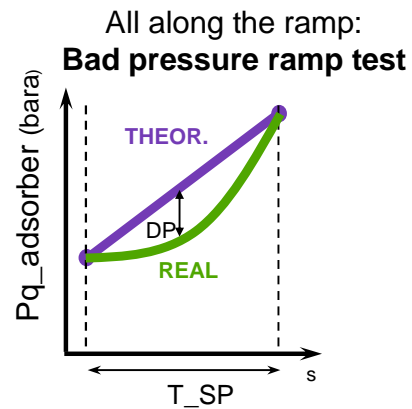


## Course Agenda

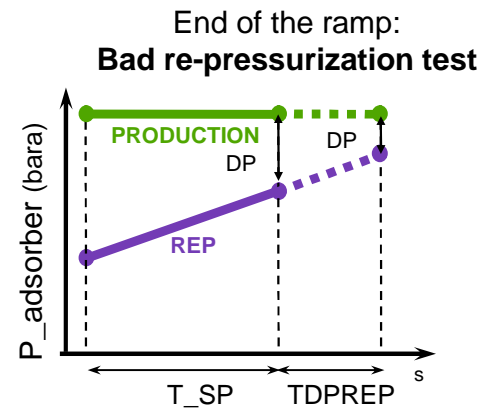
1. PSA Process Description
2. PSA Numbering
3. PSA States
4. PSA Valve Modes
5. PSA Trends
6. PSA Phase Time
7. PSA Start-Up
8. PSA Freeze
9. PSA Switch
10. PSA Troubleshooting
11. PSA Special Features
12. PSA Displays

## 10. PSA TROUBLESHOOTING

- Troubleshooting test (Test 999)
  - ▣ Pressure ramp and valve discrepancies check
- Pressure Ramp Monitoring
  - ▣ Repressurization



+ valve discrepancy  
**ACTION : Switch or Freeze**



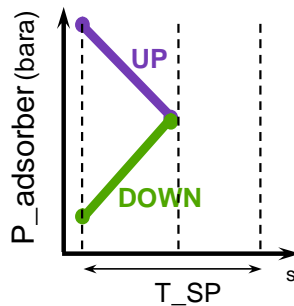
**ACTION : Freeze**

## 10. PSA TROUBLESHOOTING

### ■ Pressure Ramp Monitoring

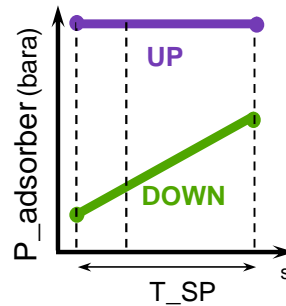
#### ▣ Equalization

$T_T < 0.5 * T_{SP}$   
**Completed too quickly**



**ACTION : Freeze**

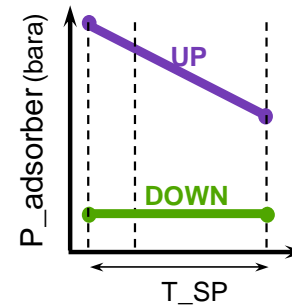
$T_T = 0.6 * T_{SP}$   
**Not start in Upstream**



+ valve discrepancy

**ACTION : Switch or Freeze**

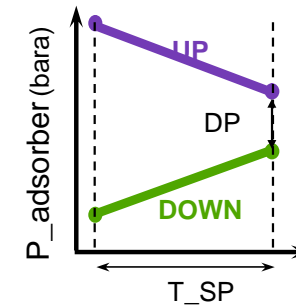
$T_T = 0.6 * T_{SP}$   
**Not start in Downstream**



+ valve discrepancy

**ACTION : Switch or Freeze**

**End of the Ramp Not Completed**



+ valve discrepancy

**ACTION : Switch or Freeze**

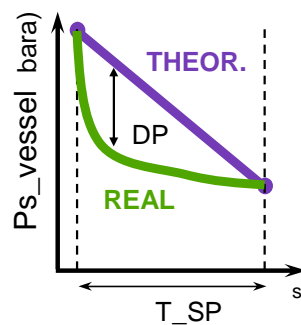


## 10. PSA TROUBLESHOOTING

### ■ Pressure Ramp Monitoring

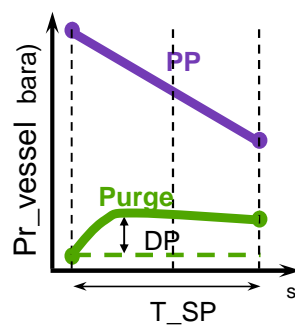
#### ■ Purge Provide

All along the ramp  
**Bad pressure Ramp**



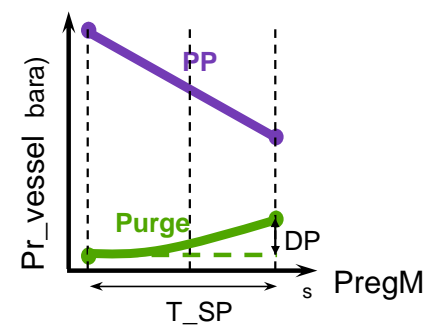
+ valve discrepancy  
**ACTION : Switch or Freeze**

All along the ramp  
**Elution did not start**



+ valve discrepancy  
**ACTION : Switch or Freeze**

All along the ramp  
**Elution not completed**

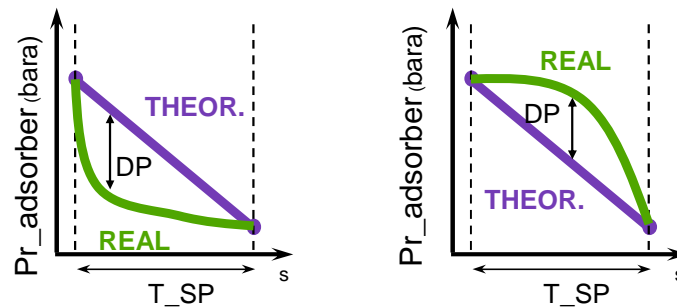


+ valve discrepancy  
**ACTION : Switch or Freeze**

## 10. PSA TROUBLESHOOTING

- Pressure Ramp Monitoring
  - ▣ Depressurization

All along the ramp  
**Bad pressure Ramp**



**+ valve discrepancy**

**ACTION : Switch or  
Freeze**

## Course Agenda

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10. PSA Troubleshooting

## 11. PSA Special Features

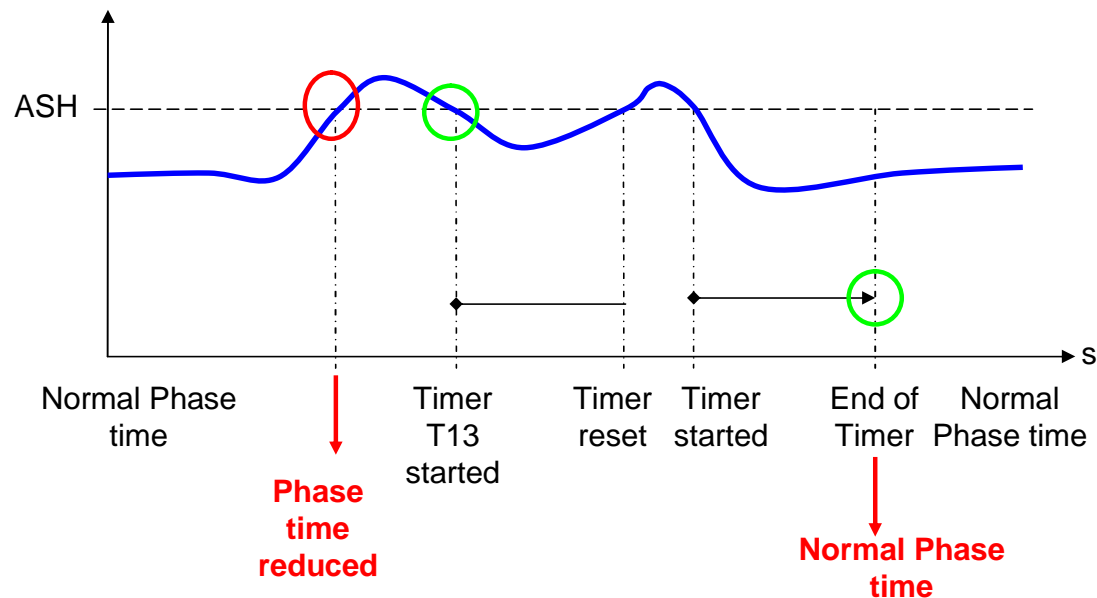
## 12. PSA Displays

# 11. PSA SPECIAL FEATURES

## ■ IMPURITIES LOGIC

- Specific logic in case of PSA product bad purity
  - PSA phase time is automatically reduced (Kpurity factor) in case of 322ASH-196 or 322ASH-197

N2 ppm (322AI-196)  
or O2 ppm (322AI-197)



# 11. PSA SPECIAL FEATURES

## ■ PRODUCTION VALVE 322PV-196A

### ■ Specific logic depending on PSA state

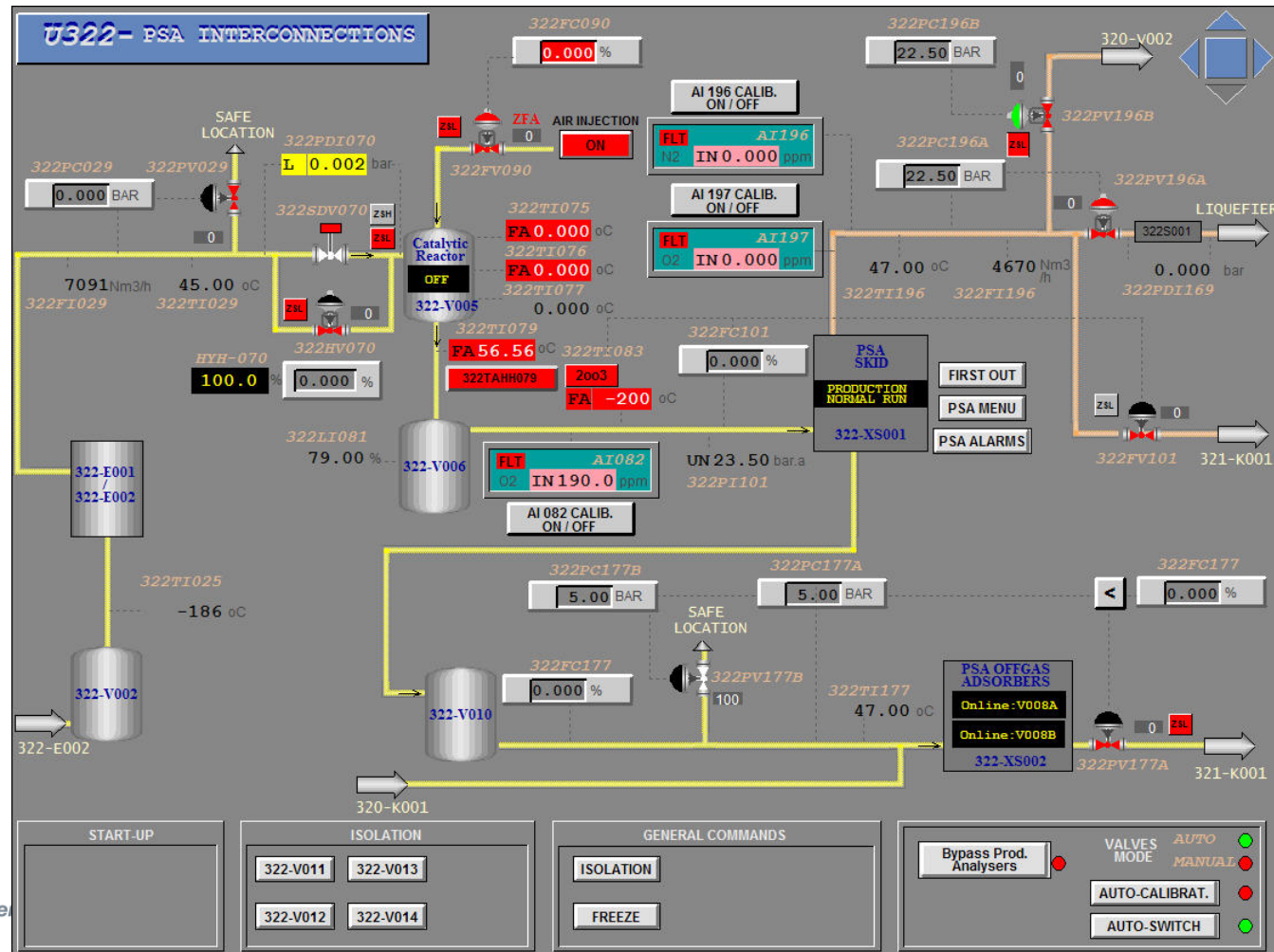
#### ■ 322PV-196A solenoid deactivation in case of:

- Signals coming from PSA
  - PSA ISOLATION
  - PSA INERTING
  - PSA FREEZE
  - PSA START-UP
  - PSA SWITCH P (vessel in production isolated)
  - High High impurity level in PSA product (322ASHH-197 or 322ASHH-196)

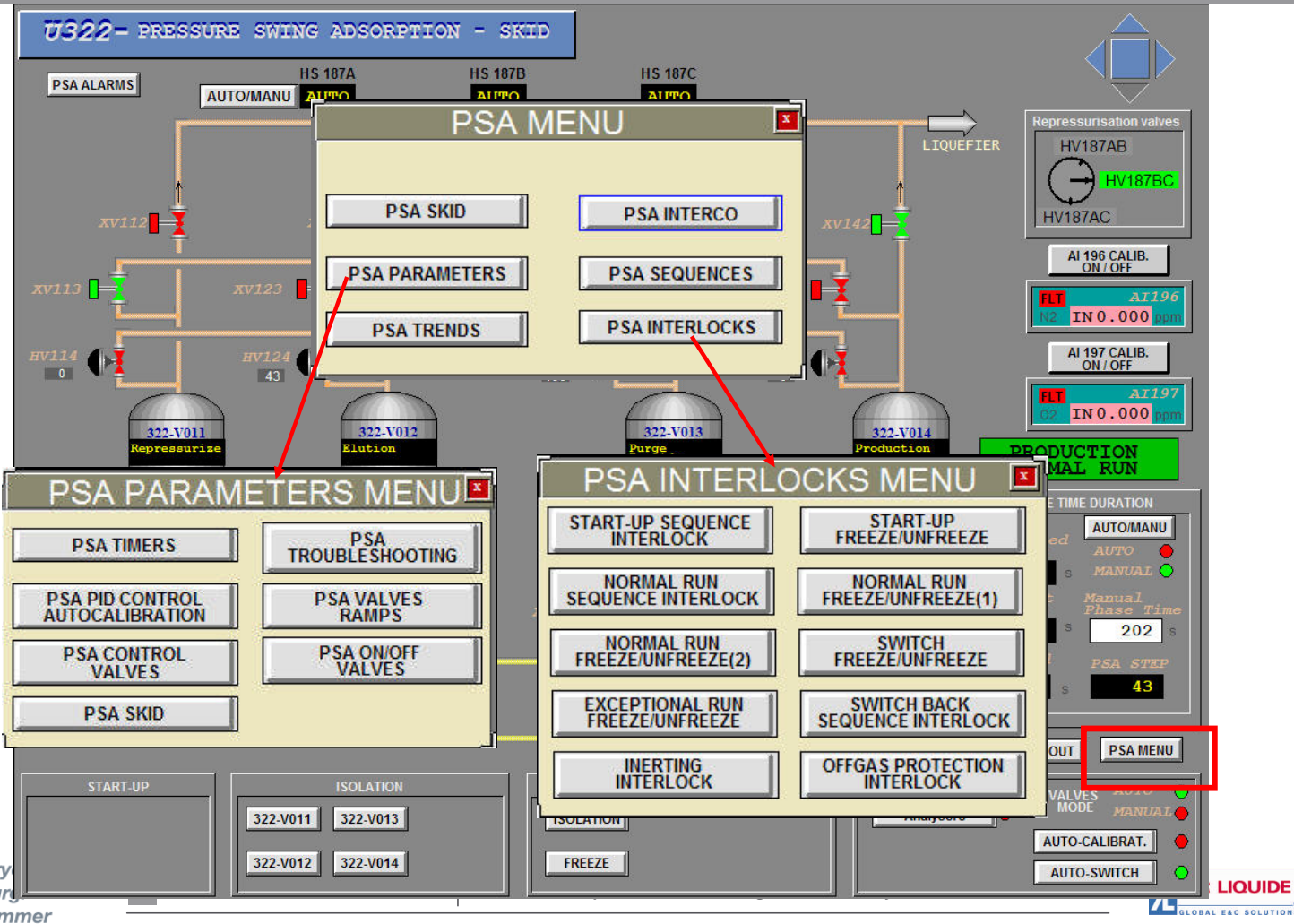
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12. PSA Displays

## 12. PSA DISPLAYS



## 12. PSA DISPLAYS





## 12. PSA DISPLAYS

U322- PSA PARAMETERS - TIMERS

PSA ALARMS

### 4 BED CYCLE

CT1COEFF(4)	1.00
CT1NOM(4)	213.0 s
T1T	23 s
T1SP	191.7 s
CT3NOM(4)	30.00 s
T3T	23 s
T3SP	30.00 s
CT4NOM(4)	143.0 s
T4T	0 s
T4SP	128.7 s
CT5NOM(4)	70.00 s
T5T	23 s
T5SP	63.00 s
CT6NOM(4)	183.0 s
T6T	0 s
T6SP	161.7 s
CT7SWITCH	130.0 s
T7T	0 s
T7SP	114.2 s
CT1Switch	243.0 s
CT4Switch	70.00 s
CT6Switch	160.0 s
CTDPswitchNOM	30.00 s

### Delay Opening / Closing

T1C SP	0 s
T2C SP	0 s
T5O SP	0 s
T3O SP	0 s
T3C SP	0 s

### PHASE TIME

CT1 Min	160.0 s
CT1 Max	555.0 s
T1T	23 s
T1CALC	191.7 s
CFEEDNOM	7027 Nm3/h
T1SP_Z1	200.0 s
FY-101M	7027 Nm3/h
Kpurity coeff	0.900
Kpurity	1.00
KPH coeff	0.900
KPH	0.900
KO2 coeff	0.900
KO2	1.00
Koffgas	1.000
Koffgas O	1.36
Koffgas T	0.200
Koffgas Min	0.900
Koffgas Max	1.10
PregM	1.80 bara

### 3 BED CYCLE

CT1COEFF(3)	1.00
CT1NOM(3)	250.0 s
T1T	23 s
T1SP	191.7 s
CT3NOM(3)	30.00 s
T3T	23 s
T3SP	30.00 s
CT4NOM(3)	87.00 s
T4T	0 s
T4SP	128.7 s
CT5NOM(3)	133.0 s
T5T	23 s
T5SP	63.00 s
CT6NOM(3)	133.0 s
T6T	0 s
T6SP	161.7 s

### 4 & 3 BED CYCLE

CT13NOM	240.0 s
T13T	0 s
T13SP	216.0 s
CT15NOM	500.0 s
T15T	0 s
T15SP	500.0 s
CTDPREPNO	20.00 s
TDPREPT	0 s
TDPREPS	18.00 s
CTTAHH083	60.00 s
TTAHHF083T	0 s
TTAHH083SP	60.00 s

## 12. PSA DISPLAYS

U322- PSA PARAMETERS - SKID

PSA ALARMS

322PI118	322PI128	322PI138	322PI148
<i>Measure</i> <b>1.75</b> bar.a	<i>Measure</i> <b>1.75</b> bar.a	<i>Measure</i> <b>1.90</b> bar.a	<i>Measure</i> <b>1.79</b> bar.a
<i>PSH</i> <b>21.50</b>	<i>PSH</i> <b>21.50</b>	<i>PSH</i> <b>21.50</b>	<i>PSH</i> <b>21.50</b>
<i>Max</i> <b>30.00</b>	<i>Max</i> <b>30.00</b>	<i>Max</i> <b>30.00</b>	<i>Max</i> <b>30.00</b>
<i>PSL</i> <b>2.00</b>	<i>PSL</i> <b>2.00</b>	<i>PSL</i> <b>2.00</b>	<i>PSL</i> <b>2.00</b>
<i>Min</i> <b>0.000</b>	<i>Min</i> <b>0.000</b>	<i>Min</i> <b>0.000</b>	<i>Min</i> <b>0.000</b>

	TOTAL CYCLES NUMBER	INTERMEDIATE CYCLES NUMBER	RECOVERY
322-V011	<b>6176</b> cycles	<b>0</b> cycles <input type="button" value="RESET"/>	<b>0.00</b> %
322-V012	<b>6498</b> cycles	<b>0</b> cycles <input type="button" value="RESET"/>	<b>0.00</b> %
322-V013	<b>6143</b> cycles	<b>0</b> cycles <input type="button" value="RESET"/>	<b>0.00</b> %
322-V014	<b>6160</b> cycles	<b>0</b> cycles <input type="button" value="RESET"/>	<b>0.00</b> %

AVERAGE PSA **0.00** %

## 12. PSA DISPLAYS

U322- PSA PARAMETERS - CONTROL VALVES

PSA ALARMS

	V011	V012	V013	V014
PURGE	<div>322HV114</div> <div>COUNTER RESET</div> <div>0.0</div> <div>Interm.: 0</div> <div>Total: 10071</div> <div>Opening Delay Disc. 6.0</div> <div>Closing Delay Disc. 6.0</div>	<div>322HV124</div> <div>COUNTER RESET</div> <div>0.0</div> <div>Interm.: 0</div> <div>Total: 10180</div> <div>Opening Delay Disc. 6.0</div> <div>Closing Delay Disc. 6.0</div>	<div>322HV134</div> <div>COUNTER RESET</div> <div>0.0</div> <div>Interm.: 0</div> <div>Total: 10549</div> <div>Opening Delay Disc. 6.0</div> <div>Closing Delay Disc. 6.0</div>	<div>322HV144</div> <div>COUNTER RESET</div> <div>0.0</div> <div>Interm.: 0</div> <div>Total: 10579</div> <div>Opening Delay Disc. 6.0</div> <div>Closing Delay Disc. 6.0</div>
	<div>322HV115</div> <div>COUNTER RESET</div> <div>0.0</div> <div>Interm.: 1</div> <div>Total: 7042</div> <div>Opening Delay Disc. 6.0</div> <div>Closing Delay Disc. 6.0</div>	<div>322HV125</div> <div>COUNTER RESET</div> <div>0.0</div> <div>Interm.: 1</div> <div>Total: 7997</div> <div>Opening Delay Disc. 6.0</div> <div>Closing Delay Disc. 6.0</div>	<div>322HV135</div> <div>COUNTER RESET</div> <div>0.0</div> <div>Interm.: 0</div> <div>Total: 7844</div> <div>Opening Delay Disc. 6.0</div> <div>Closing Delay Disc. 6.0</div>	<div>322HV145</div> <div>COUNTER RESET</div> <div>0.0</div> <div>Interm.: 0</div> <div>Total: 8185</div> <div>Opening Delay Disc. 6.0</div> <div>Closing Delay Disc. 6.0</div>
	REPR.	<div>322HV187A</div> <div>COUNTER RESET</div> <div>0.0</div> <div>Interm.: 0</div> <div>Total: 14930</div> <div>Opening Delay Disc. 6.0</div> <div>Closing Delay Disc. 6.0</div>	<div>322HV187B</div> <div>COUNTER RESET</div> <div>0.0</div> <div>Interm.: 0</div> <div>Total: 24174</div> <div>Opening Delay Disc. 6.0</div> <div>Closing Delay Disc. 6.0</div>	<div>322HV187C</div> <div>COUNTER RESET</div> <div>0.0</div> <div>Interm.: 0</div> <div>Total: 9485</div> <div>Opening Delay Disc. 6.0</div> <div>Closing Delay Disc. 6.0</div>

DZAH 4	DZAH 5	DZAH 187
8.0 %	8.0 %	8.0 %
DZAL 4	DZAL 5	DZAL 187
8.0 %	8.0 %	8.0 %

## 12. PSA DISPLAYS

U322- PSA PARAMETERS - ON/OFF VALVES
PSA ALARMS

	V011	V012	V013	V014
FEED	322XV111 COUNTER RESET CLOSE Interm.: 0 Total: 6591 Opening Delay Disc. 6.0 Closing Delay Disc. 6.0	322XV121 COUNTER RESET CLOSE Interm.: 0 Total: 6885 Opening Delay Disc. 6.0 Closing Delay Disc. 6.0	322XV131 COUNTER RESET CLOSE Interm.: 2 Total: 6454 Opening Delay Disc. 6.0 Closing Delay Disc. 6.0	322XV141 COUNTER RESET CLOSE Interm.: 1 Total: 6784 Opening Delay Disc. 6.0 Closing Delay Disc. 6.0
PROD	322XV112 COUNTER RESET CLOSE Interm.: 0 Total: 6566 Opening Delay Disc. 6.0 Closing Delay Disc. 6.0	322XV122 COUNTER RESET CLOSE Interm.: 0 Total: 6850 Opening Delay Disc. 6.0 Closing Delay Disc. 6.0	322XV132 COUNTER RESET CLOSE Interm.: 2 Total: 6433 Opening Delay Disc. 6.0 Closing Delay Disc. 6.0	322XV142 COUNTER RESET CLOSE Interm.: 1 Total: 6766 Opening Delay Disc. 6.0 Closing Delay Disc. 6.0
EQU	322XV113 COUNTER RESET CLOSE Interm.: 0 Total: 12231 Opening Delay Disc. 6.0 Closing Delay Disc. 6.0	322XV123 COUNTER RESET CLOSE Interm.: 0 Total: 13543 Opening Delay Disc. 6.0 Closing Delay Disc. 6.0	322XV133 COUNTER RESET CLOSE Interm.: 0 Total: 12583 Opening Delay Disc. 6.0 Closing Delay Disc. 6.0	322XV143 COUNTER RESET CLOSE Interm.: 1 Total: 12962 Opening Delay Disc. 6.0 Closing Delay Disc. 6.0

Cr  
Lu  
Zimmer

R LIQUIDE  
GLOBAL E&C SOLUTIONS

## 12. PSA DISPLAYS

U322- PSA PARAMETERS - PRODUCT/OFFGAS INTERCONNECTIONS

PSA ALARMS

### PRODUCTION

<b>N2 ANALYSER - 322AI196</b> Measure <span>Max</span> 50.00 5.00 ppm <span>Min</span> 0.000 AAHH 10.00 AAH 8.00	<b>O2 ANALYSER - 322AI197</b> Measure <span>Max</span> 50.00 5.00 ppm <span>Min</span> 0.000 AAHH 20.00 AAH 15.00	<b>322TI196</b> Measure <span>Max</span> 100.0 52.00 °C <span>Min</span> -200	<b>322FI196</b> Measure <span>Max</span> 6800 307.0 Nm3/h Average <span>Min</span> 0.000 4670 Nm3/h FAH 6700 FAL 300.0	<b>322PI196</b> Measure <span>Max</span> 30.00 23.00 bar.a <span>Min</span> 0.000 PAL 21.50 PSLL 2.00 PALL 20.50
------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------

<b>322PV196A</b> Measure <span>Max</span> 100.0 0.000 % <span>Min</span> 0.000 Set point 23.00 bar.a	<b>322PV196B</b> Measure <span>Max</span> 100.0 0.000 % <span>Min</span> 0.000 Set point 23.00 bar.a	<b>322FV101</b> Measure <span>Max</span> 100.0 51.00 % <span>Min</span> 0.000 Set point 0.000 bar.a
---------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------

### OFF GAS

<b>322PV177A</b> Measure <span>Max</span> 100.0 0.000 % <span>Min</span> 0.000 Set point 4.10 bar.a	<b>322PV177B</b> Measure <span>Max</span> 100.0 50.00 % <span>Min</span> 0.000 Set point 4.10 bar.a	<b>322TI177</b> Measure <span>Max</span> 100.0 47.00 °C <span>Min</span> -200	<b>322FI177</b> Measure <span>Max</span> 5500 1.00 Nm3/h <span>Min</span> 0.000	<b>322PI177</b> Measure <span>Max</span> 5.00 4.10 bar.a <span>Min</span> 0.000 PSL 2.00 PSHH 4.00 PAH 3.00
--------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------

## 12. PSA DISPLAYS

U322- PSA PARAMETERS - FEED INTERCONNECTIONS

PSA ALARMS

322TI025

Max 100.0

Measure -186 °C

Min -200

TAH -185

322FI029

Max 10000

Measure 0.000 Nm3/h

Min 0.000

322PI029

Max 30.00

Measure 22.30 bar.a

Min 0.000

PALL 21.00

PAL 22.00

322PD1070

Max 30.00

Measure 30.00 bar

Min 0.000

PSL 0.500

322LI081

Max 100.0

Measure 66.00 %

Min 0.000

LAL 20.00

LAH 80.00

322LAHH081

322AI082

Max 3000

Measure 4.90 ppm

Min 0.000

AAL 100.0

AAH 900.0

AALL 5.00

AAH 500.0

322TI083

Max 100.0

Measure 54.10 °C

Min -200

TAH 54.00

322TAHH083

322FI101

Max 10000

Measure 0.000 Nm3/h

Min 0.000

FAL 1450

FALL 300.0

FAH 9700

322PI101

Max 30.00

Measure 2.30 bar.a

Min 0.000

PSL 22.00

PSLL 2.00

PAH 25.00

He content in feed

yHe 89.00 %

## 12. PSA DISPLAYS

### U322- PSA PARAMETERS - VALVES RAMP

#### PSA ALARMS

NORMAL RUN		
CV187 REPR	CV4 PURGE	CV5 DEPR
CV187Ball(4)	CV4(4)	CV5(4)
0.165	7.66	0.000
CV187Repr(4)		CV5(switch_pqr)
2.22		280.0
CV187Repr(switch_pqr)		CV5(switch_pqr)
12.90		325.8
CV187Repr(switch_ppr)		CV5(switch_ppr)
12.90		0.000

REPRESSURIZATION VALVES		
CV187_C	COEFF BALL(4)	COEFF BALL(3)
0.330	1.00	1.00
	OFFSET BALL(4)	OFFSET BALL(3)
	0.000	0.000

EXCEPTIONAL RUN	
CV187 REPR	CV5 DEPR
CV187Ball(3)	CV5(3)
3.07	63.76
CV187Repr(3)	
4.41	
CV187Elu(3)	
3.07	

PREDETERMINED VALVE OPENING		
CX4	CX5	CX187
14.00 %	25.00 %	15.00 %

CV MAX CALCULATIONS			
REPR	PURGE	DEPR	HV-070
XT 187	XT 4	XT 5	XT 070
0.700	0.750	0.680	0.640
Xdir down	Xdir up	Xdir down	Xdir up
1.60	0.600	1.60	0.600
MM He	MM He	MM depr	MM feed
0.179 kg/Nm3	0.179 kg/Nm3	0.540 kg/Nm3	0.300 kg/Nm3
Eps H15	Eps H15	Eps H2-10	Eps H2-10
0.350	0.350	0.350	0.350
DE H15	DE H15	DE H2-10	DE H2-10
0.975 1E-3.m	0.975 1E-3.m	1.981 1E-3.m	1.98 1E-3.m
RHO H15	RHO H15	RHO H2-10	RHO H2-10
736.0 kg/m3	736.0 kg/m3	585.0 kg/m3	585.0 kg/m3
mu He	mu He	mu depr	mu feed
1.60 1E-5.Pa.s	1.60 1E-5.Pa.s	1.51 1E-5.Pa.s	1.37 1E-5.Pa.s
Fk repr	Fk purge	Fk depr	Fk feed
1.19	1.19	1.10	1.16
CVmax 187	CVmax 4	CVmax 5	CVmax 070
12.90	30.00	400.0	15.15



## 12. PSA DISPLAYS

**U322- PSA PARAMETERS - PID CONTROL AUTOCALIBRATION**
PSA ALARMS

PID

	REPRESSURIZATION		PURGE PROVIDING			DEPRESSURIZATION		
	TAU	RATIO	TAU	RATIO	OS PP	TAU	RATIO	OS DEPR
V011			60.00	30.00	0.000	60.00	30.00	0.000
V012	60.00	30.00	60.00	30.00	0.000	60.00	30.00	0.000
V013			60.00	30.00	0.000	60.00	30.00	0.000
V014			60.00	30.00	0.000	60.00	30.00	0.000

*Pow187 (4) Pow187 (3)*  
Ramp Power: 1.00 1.00

*VEQ He*  
Equivalent Volume: 12.00 Nm3/bar

*SG He*  
Specific gravity: 0.160

*DP end repr*  
Dpend Repr: 0.200 bar.a

*Pow4 (4)*  
1.00

*VEQ PP*  
12.00 Nm3/bar

*SG PP*  
0.200

*Pow5 (4) Pow5 (3)*  
1.00 1.00

*VEQ depr*  
16.00 Nm3/bar

*SG depr*  
0.410

*SG depr 0 SG depr offgas*  
0.220 0.410

*Filter T*  
0.200 s

*Filter TAU*  
1.00 s

*TK*  
320.1 K

**OVERSHOOT TIMER**  
*T OS*  
2.00 s

PID RAMP TIMERS

<i>T4 ramp SP</i>	126.5 s	<i>T4 ramp T</i>	0.000 s	<i>Delay ramp PP</i>	0.000 s	<i>DTpp</i>	2.00 s
<i>T5 ramp SP</i>	60.80 s	<i>T5 ramp T</i>	36.20 s	<i>Delay ramp Depr</i>	0.000 s	<i>DTdepr</i>	2.00 s
<i>T6 ramp SP</i>	159.5 s	<i>T6 ramp T</i>	5.60 s	<i>Delay ramp Repr</i>	0.000 s	<i>DTrepr</i>	2.00 s
<i>T7 ramp SP</i>	107.0 s	<i>T7 ramp T</i>	0.000 s				
<i>T5 init SP</i>	10.00 s	<i>T5 init T</i>	10.00 s				

AUTOCALIBRATION

	PURGE PROVIDING		DEPRESSURIZATION			REPRESSURIZATION		
	CVmin	CFvan4_4	CVmin	CFvan5_4	CFvan5_3	CVmin	CFvan187_4	CFvan187_3
V011	1.07	1.00	4.00	1.00	1.00	0.270	1.00	1.00
V012	1.07	1.00	4.00	1.00	1.00			
V013	1.07	1.00	4.00	1.00	1.00			
V014	1.07	1.00	4.00	1.00	1.00			

**AUTOCALIBRATION**  

 ACTIVATED  
 DEACTIVATED

*CFvan min*  
0.200  
*CFvan max*  
3.50  
*K CF*  
0.500  
*Coeff min*  
0.500  
*Coeff max*  
1.50



## 12. PSA DISPLAYS

U322- PSA PARAMETERS - TROUBLESHOOTING

PSA ALARMS

TROUBLESHOOTING



ACTIVATED

BY PASSED

### REPRESSURIZATION RAMP

DP<sub>prep</sub> 1.00 bar

DP<sub>prepH</sub> 2.50 bar

### DEPRESSURIZATION RAMP

DP<sub>dep</sub> 0.80 bar

DP<sub>depH</sub> 1.00 bar

### PURGE PROVIDING RAMP

DP<sub>pp</sub> 1.00 bar a

P<sub>elu</sub> 1.80 bar a

DP<sub>elu</sub> 1.00 bar

DP<sub>eluH</sub> 2.50 bar

DP<sub>intH</sub> 1.00 bar

C<sub>4</sub> 0.300 s

P<sub>int(4)</sub> 8.14 bar a

### EQUALIZATION

P<sub>prod</sub> 23.61 bar a

P<sub>reg down</sub> 1.78 bar a

P<sub>ball up</sub> 13.16 bar a

DP<sub>bal</sub> 1.00 bar

DP<sub>balH</sub> 2.50 bar

DP<sub>I start</sub> 0.200 bar

DP<sub>I end</sub> 0.200 bar

C<sub>30</sub> 0.600 s

C<sub>3</sub> 0.300 s

### PRESSURE MONITORING

DP<sub>ball mon</sub> 0.200 bar

P<sub>ball mon</sub> 13.16 bar

DP<sub>prod mon</sub> 0.200 bar

P<sub>prod mon</sub> 23.96 bar

### BALANCING PRESSURES

P<sub>ball(4)</sub> 13.66 bar a

P<sub>ball(3)</sub> 13.91 bar a

### OVERRIDE DIAGNOSTIC

N<sub>Cycle</sub> 4.00

N<sub>start</sub> 4.00

N<sub>freeze</sub> 2.00

N<sub>switch</sub> 3.00

N<sub>switchback</sub> 2.00

### PHASE TIME DURATION

Calculated  
Preset  
192 s

AUTO/MANU  
AUTO  
MANUAL

Current  
Preset  
192 s

Manual  
Phase Time  
202 s

Elapsed  
70 s

PSA STEP  
43

## 12. PSA DISPLAYS

U322- PSA START-UP PERMISSIVE

PSA ALARMS

SET POINT	PROCESS VALUE		DESIRED CONDITIONS
-185	-186	oC	● PSA Status : ISOLATION
22.00	24.00	bar.a	● Not 322TSH-025 : Not High temperature at V002 outlet
2.00	1.80	bar.a	● Not 322PSL-029 : Not Low battery limit feed gas pressure
2.00	1.75	bar.a	● 322PSLL-101 :Very Low feed gas pressure
	1.75	bar.a	● 322PSL1#8 : Low pressure in all adsorbers
	1.90	bar.a	
	1.79	bar.a	
2.00	1.80	bar.a	● 322-PSLLL-196 : Very very low He product pressure
2.00	1.35	bar.a	● 322-PSL-177 : Low offgas drum pressure
			● 322-ZSL-070 : BL feed valve SDV-070 is closed
80.00	79.00	%	● NOT 322-LSH-081 : Not High level in V006
			● Catalytic Reactor : ON
			● Valves are in Automatic Mode

## 12. PSA DISPLAYS

U322- PSA INTERLOCK START UP FREEZE/UNFREEZE

PSA ALARMS

RESET\_INTERLOCK

SET POINT	PROCESS VALUE	
21.00	24.00	bar.a
54.00	47.00	oC
85.00	79.00	%

22.00	24.00	bar.a
-185	-186	oC
25.00	1.80	bar.a
80.00	79.00	%
0.500	0.002	bar

### FREEZE CONDITIONS

FO

- ☐ 322PSLL-029 : Very Low Battery Limit Feed Gas Pressure
- ☐ 322TSHH-083 : Very High Feed Gas Temperature
- ☐ 322LSHH-081 : Very High level in V006
- ☐ 322UY200 : Catalytic Reactor OFF
- ☐ 322HS99 : PSA Freeze Button

### UNFREEZE DESIRED CONDITIONS

- ☒ Not 322PSL-029 : Not Low battery limit feed gas pressure
- ☒ Not 322TSH-025 : Not High temperature at V002 outlet
- ☒ Not 322PSH-101 : Not High feed gas pressure
- ☒ Not 322LSH-081 : Not High level in V006
- ☒ Catalytic Reactor : ON
- ☒ 322PDSL-070 : Low Differential pressure on SDV-070
- ☒ Interlock Reset
- ☐ Start-up Freeze Sequence
- ☒ Not 322HS99 : PSA Freeze button
- ☒ Valves are in Automatic Mode

## 12. PSA DISPLAYS

U322- PSA NORMAL RUN PERMISSIVE

PSA ALARMS

SET POINT	PROCESS VALUE		DESIRED CONDITIONS
54.00	47.00	oC	● NOT 322TSHH-083 : Not Very High Feed Gas Temperature
22.00	24.00	bar.a	● NOT 322PSL-029 : Not Low battery limit feed gas pressure
21.50	1.75	bar.a	○ 322PSH-118 High pressure in V011
21.50	1.79	bar.a	○ 322PSH-148 High pressure in V014
21.50	1.80	bar.a	○ NOT 322PSL-196 : Not Low He product pressure
80.00	79.00	%	● NOT 322LSH-081 : Not High level in V006
			○ Start-up sequence on V011 is running

## 12. PSA DISPLAYS

U322- PSA INTERLOCK NORMAL RUN FREEZE/UNFREEZE 1

PSA ALARMS

RESET\_INTERLOCK

SET POINT	PROCESS VALUE	
21.00	24.00	bar.a
54.00	47.00	oC
85.00	79.00	%

20.50	1.80	bar.a
-------	------	-------

22.00	24.00	bar.a
-185	-186	oC
25.00	1.80	bar.a
80.00	79.00	%
21.50	1.80	bar.a
0.500	0.002	bar

### FREEZE CONDITIONS

#### FO

- ☐ 322PSLL-029 : Very Low Battery Limit Feed Gas Pressure
- ☐ 322TSHH-083 : Very High Feed Gas Temperature
- ☐ 322-LSHH-081 : Very High level in V006
- ☐ 322UY200 : Catalytic Reactor OFF
- ☐ 322HS99 : PSA Freeze Button
- ☒ 322PSLL-196 : Very Low He product pressure
- ☐ Freeze from Test 999

### UNFREEZE DESIRED CONDITIONS

- ☒ Not 322PSL-029 : Not Low battery limit feed gas pressure
- ☒ Not 322TSH-025 : Not High temperature at V002 outlet
- ☒ Not 322PSH-101 : Not high feed gas pressure
- ☒ Not 322LSH-081 : Not High level in V006
- ☐ Not 322PSL-196 : Not Low He product pressure
- ☒ 322PDSL-070 : Low Differential pressure on SDV-070
- ☒ Interlock Reset
- ☐ NR Freeze Sequence
- ☒ Not 322HS99 : PSA Freeze button
- ☒ Valves are in Automatic Mode
- ☒ Catalytic Reactor : ON
- ☒ NO Pressure Transmitter Fault

## 12. PSA DISPLAYS

U322- PSA INTERLOCK NORMAL RUN FREEZE/UNFREEZE 2

PSA ALARMS

RESET\_INTERLOCK

SET POINT	PROCESS VALUE	
21.00	24.00	bar.a
54.00	47.00	oC
85.00	79.00	%

21.50	1.80	bar.a
-------	------	-------

22.00	24.00	bar.a
-------	-------	-------

-185	-186	oC
------	------	----

25.00	1.80	bar.a
-------	------	-------

80.00	79.00	%
-------	-------	---

21.50	1.80	bar.a
-------	------	-------

0.500	0.002	bar
-------	-------	-----

### FREEZE CONDITIONS

#### FO

- ☐ ☐ 322PSLL-029 : Very Low Battery Limit Feed Gas Pressure
- ☐ ☐ 322TSHH-083 : Very High Feed Gas Temperature
- ☐ ☐ 322.LSHH-081 : Very High level in V006
- ☐ ☐ 322UY200 : Catalytic Reactor OFF
- ☐ ☐ 322HS99 : PSA Freeze Button
- ☒ ☒ 322PSLL-196 : Very Low He product pressure
- ☐ ☐ Freeze from Test 999

### UNFREEZE DESIRED CONDITIONS

- ☒ Not 322PSL-029 : Not Low battery limit feed gas pressure
- ☒ Not 322TSH-025 : Not High temperature at V002 outlet
- ☒ Not 322PSH-101 : Not High feed gas pressure
- ☒ Not 322LSH-081 : Not High level in V006
- ☐ Not 322PSL-196 : Not Low He product pressure
- ☒ 322PDSL-070 : Low Differential pressure on SDV-070
- ☐ Interlock Reset
- ☐ NR Freeze Sequence
- ☒ Not 322HS99 : PSA Freeze button
- ☒ Valves are in Automatic Mode
- ☒ Catalytic Reactor : ON

## 12. PSA DISPLAYS

U322- PSA INTERLOCK SWITCH FREEZE/UNFREEZE

PSA ALARMS

RESET\_INTERLOCK

SET POINT	PROCESS VALUE	
21.00	24.00	bar.a
54.00	47.00	oC
85.00	79.00	%

### FREEZE CONDITIONS

#### FO

- ☐ 322PSLL-029 : Very Low Battery Limit
- ☐ 322TSHH-083 : Very High Feed Gas Temperature
- ☐ 322LSHH-081 : Very High level in V006
- ☐ 322UY200 : Catalytic Reactor OFF
- ☐ 322HS99 : PSA Freeze Button
- ☐ Freeze from Test 999

### UNFREEZE DESIRED CONDITIONS

22.00	24.00	bar.a
-185	-186	oC
25.00	1.80	bar.a
80.00	79.00	%
0.500	0.002	bar

- ☒ Not 322PSL-029 : Not Low battery limit feed gas pressure
- ☒ Not 322TSH-025 : Not High temperature at V002 outlet
- ☒ Not 322PSH-101 : Not High feed gas pressure
- ☒ Not 322LSH-081 : Not High level in V006
- ☒ 322PDSL-070 : Low Differential pressure on SDV-070
- ☒ Interlock Reset
- ☐ Switch Freeze Sequence
- ☒ Not 322HS99 : PSA Freeze button not activated
- ☒ Valves are in Automatic Mode
- ☒ Catalytic Reactor : ON
- ☒ NO Pressure Transmitter Fault

## 12. PSA DISPLAYS

U322- PSA INTERLOCK EXCEPTIONAL RUN FREEZE/UNFREEZE

PSA ALARMS

RESET\_INTERLOCK

SET POINT

PROCESS  
VALUE

bar.a

21.00

24.00

oC

54.00

47.00

%

85.00

79.00

bar.a

20.50

1.80

FREEZE CONDITIONS

FO

- ☐ ☐ 322PSLL-029 : Very Low Battery Limit Feed Gas Pressure
- ☐ ☐ 322TSHH-083 : Very High Feed Gas Temperature
- ☐ ☐ 322-LSHH-081 : Very High level in V006
- ☒ ☒ 322PSLL-196 : Very Low He product pressure
- ☐ ☐ 322UY200 : Catalytic Reactor OFF
- ☐ ☐ 322HS99 : PSA Freeze Button
- ☐ ☐ Freeze from Test 999

UNFREEZE DESIRED CONDITIONS

22.00

24.00

bar.a

-185

-186

oC

25.00

1.80

bar.a

80.00

79.00

%

0.500

0.002

bar

21.50

1.80

bar.a

- ☒ Not 322PSL-029 : Not Low battery limit feed gas pressure
- ☒ Not 322TSH-025 : Not High temperature at V002 outlet
- ☒ NOT 322PSH-101 : Not High feed gas pressure
- ☒ NOT 322LSH-081 : Not High level in V006
- ☒ 322PDSL-070 : Low Differential pressure on SDV-070
- ☐ Not 322PSL-196 : Not Low He product pressure
- ☒ Interlock Reset
- ☐ ER Freeze Sequence
- ☒ Not 322HS99 : PSA Freeze button
- ☒ Valves are in Automatic Mode
- ☒ Catalytic Reactor : ON
- ☒ NO Pressure Transmitter Fault



## 12. PSA DISPLAYS

U322- PSA INTERLOCK SWITCH BACK

PSA ALARMS

SET POINT

PROCESS  
VALUE

2.00

1.90

bar.a

DESIRED CONDITIONS

- ☐ HS1000 Restart isolated absorber button
- ☒ 322PSL-138 : Low pressure in V013
- ☒ Valves of isolated Adsorber are in Automatic Mode
- ☒ NO Pressure Transmitter fault

## 12. PSA DISPLAYS

U322- PSA INERTING PERMISSIVE

PSA ALARMS

SET POINT	PROCESS VALUE	
300.0	7027	Nm3/h
2.00	1.75	bar.a
	1.75	bar.a
	1.90	bar.a
	1.79	bar.a
2.00	1.80	bar.a
2.00	1.35	bar.a
2.00	1.80	bar.a

### DESIRED CONDITIONS

- 322ZSL070 : SDV 70 is closed
- 322FSL1101 : Very low feed gas flowrate
- 322PSL1#8 : Low pressure in All adsorbers
- 322PSLL-196 : Very very low He product pressure
- 322PSL-177 : Low offgas drum pressure
- 322PSLL-101 : Very Low feed gas pressure
- Valves are in Automatic Mode
- PSA Status : ISOLATION

Thank you for your attention  
Questions?

