MINISTRY OF
ELECTRICITY & WATER

دولـة الكويت
STATE OF KUWAIT

وزارة الكهرباء والماء

POWER STATION AND
DISTILLATION PLANT
PROJECTS SECTOR

قطاع مشاريع محطات القوى
الكهربائية وتقطير المياه

SHUAIBA NORTH

DESALINATION PLANT

RECARBONATION PLANT OPERATION TRAINING

SYSTEM DESCRIPTION

Genny Della Penna

RECARBONATION PLANT

PURPOSE OF THE SHUAIBA NORTH RECARBONATION PLANT:

TO INCREASE THE ALKALINITY OF DISTILLED WATER FROM DISTILLERS

- **Distillate Alkalinity: ~ 0**
- **Recarbonated Water Alkalinity: up to 80 ppm as $CaCO_3$**

RECARBONATION PLANT

MAIN CHEMICAL REACTION INVOLVED IN RECARBONATION:

$$H_2O + CaCO_3 + CO_2 \leftrightarrow Ca^{++} + 2HCO_3^-$$

Calcium Carbonate

Carbon Dioxide

Calcium (ion)

Bicarbonate (ion)

By adding LIMESTONE (1÷5 mm)

Recovered from VENT GAS gathered from vacuum systems

Ca-ALKALINITY

RECARBONATION PLANT

pH CORRECTION:

$$CO_2 + NaOH \leftrightarrow Na^+ + HCO_3^-$$

Residual Carbon Dioxide

Caustic Soda

Sodium (ion)

Bicarbonate (ion)

From dosing system
(30% solution)

RECARBONATION PLANT

$$H_2O + CaCO_3 + CO_2 \leftrightarrow Ca^{++} + 2HCO_3^-$$

- Alkalinity increase

$$CO_2 + NaOH \leftrightarrow Na^{+} + HCO_3^-$$

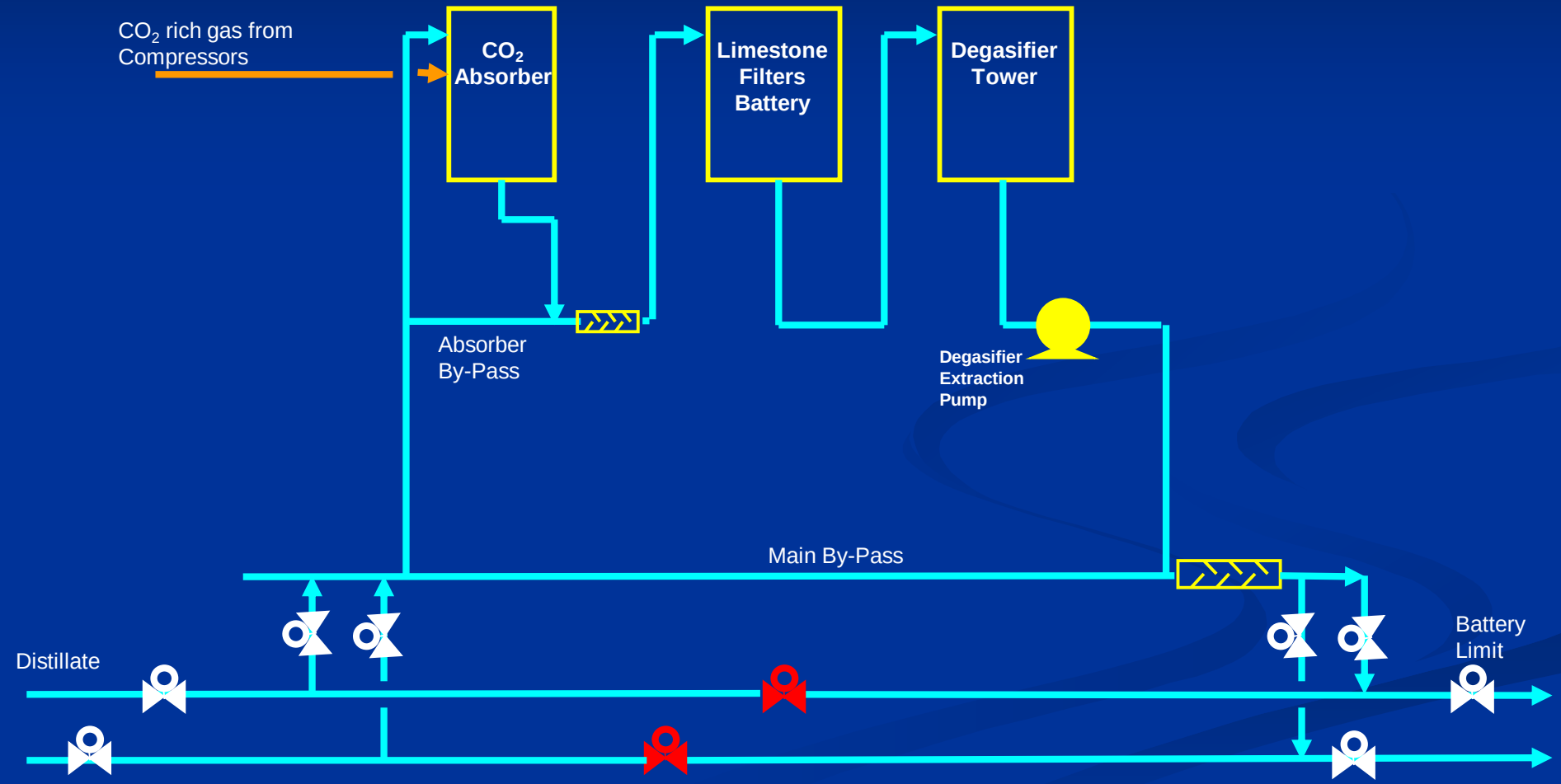
- pH increase

RECARBONATION PLANT

MAIN SYSTEMS

- VENT GAS (CARBON DIOXIDE) RECOVERY
- CARBON DIOXIDE COMPRESSION
- CARBON DIOXIDE ABSORPTION
- LIMESTONE DISSOLUTION
- DEGASSING
- CHEMICAL DOSING
- BACKWASH & WATER RECOVERY

RECARBONATION PLANT



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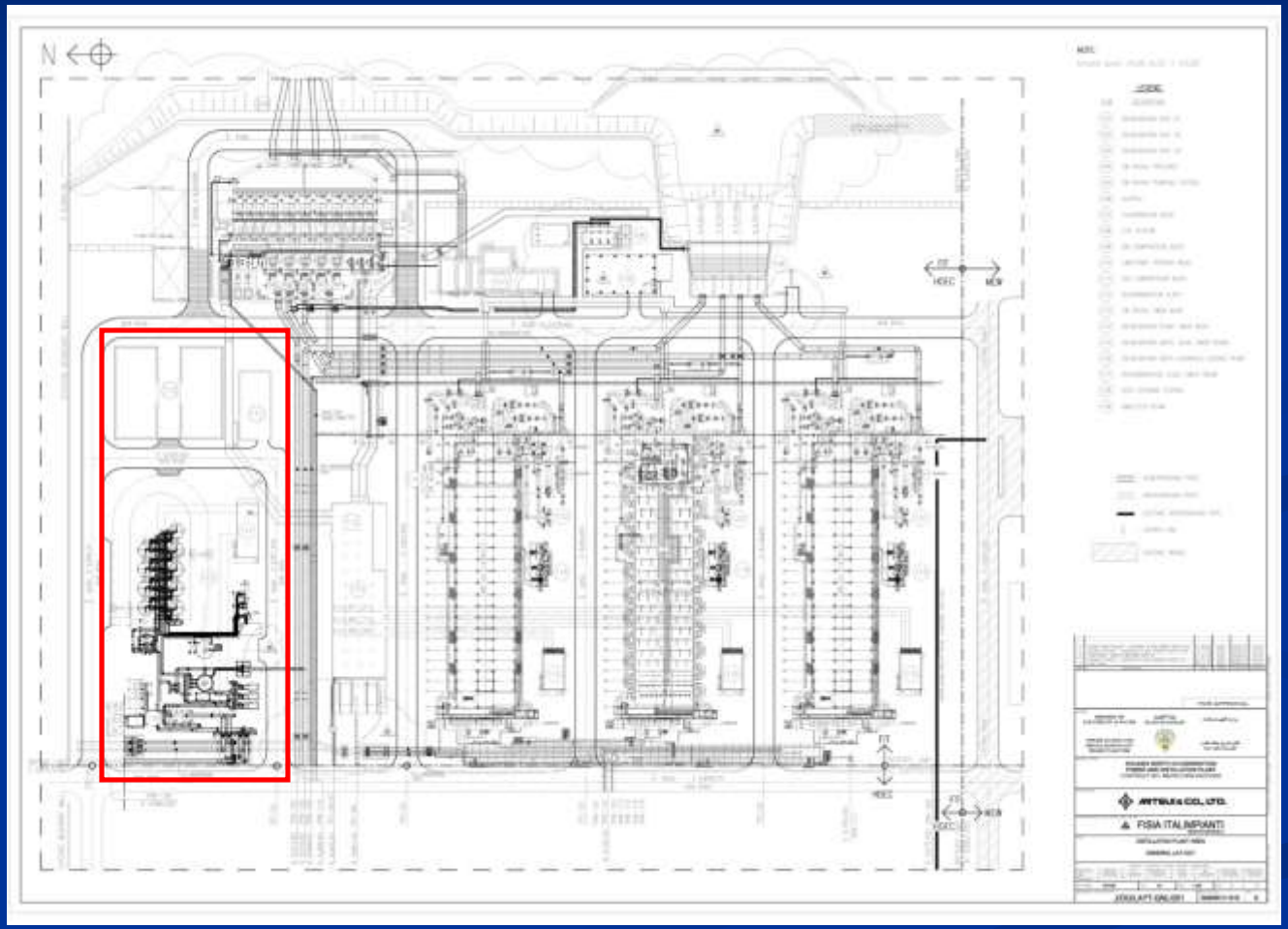

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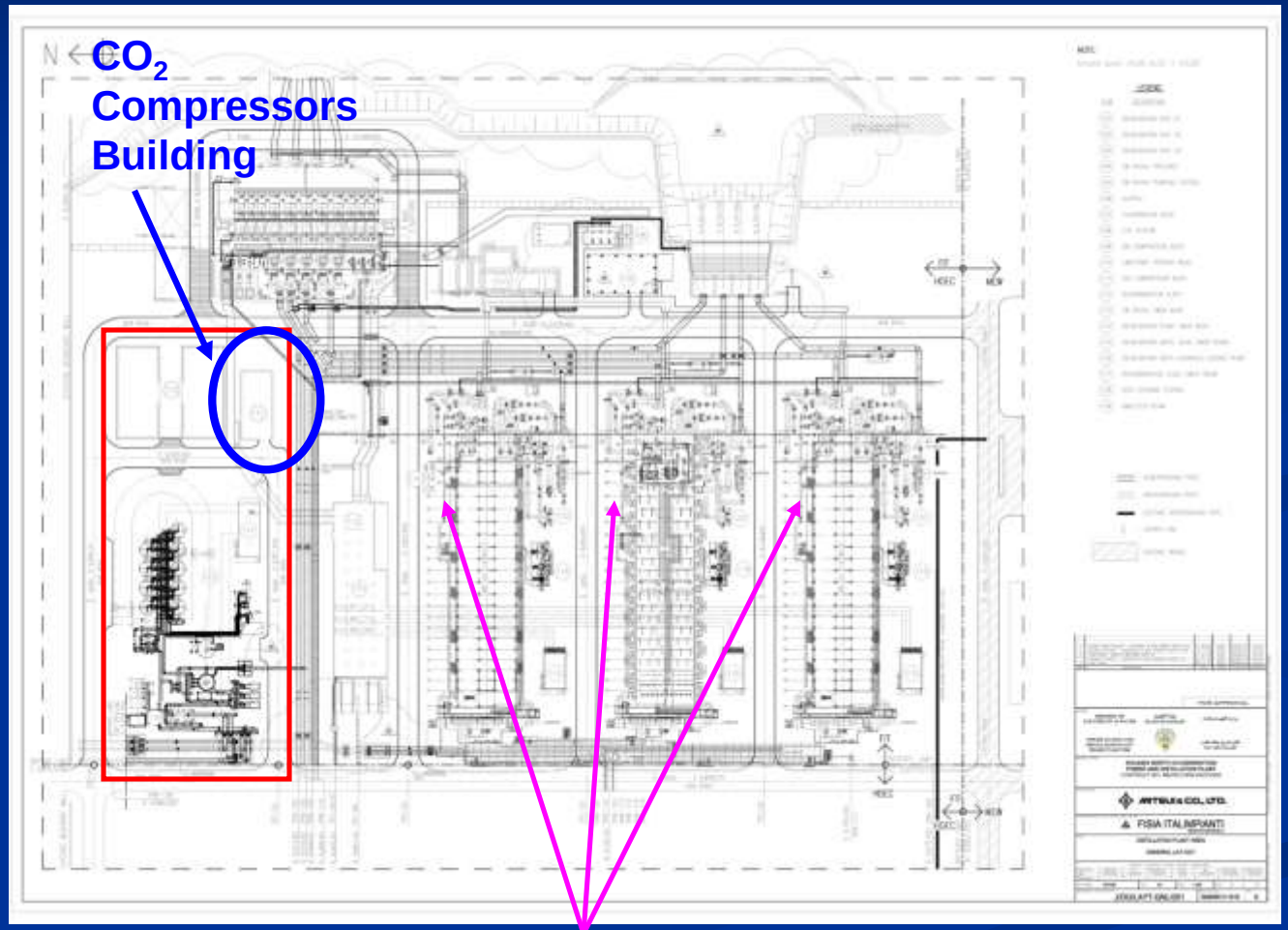

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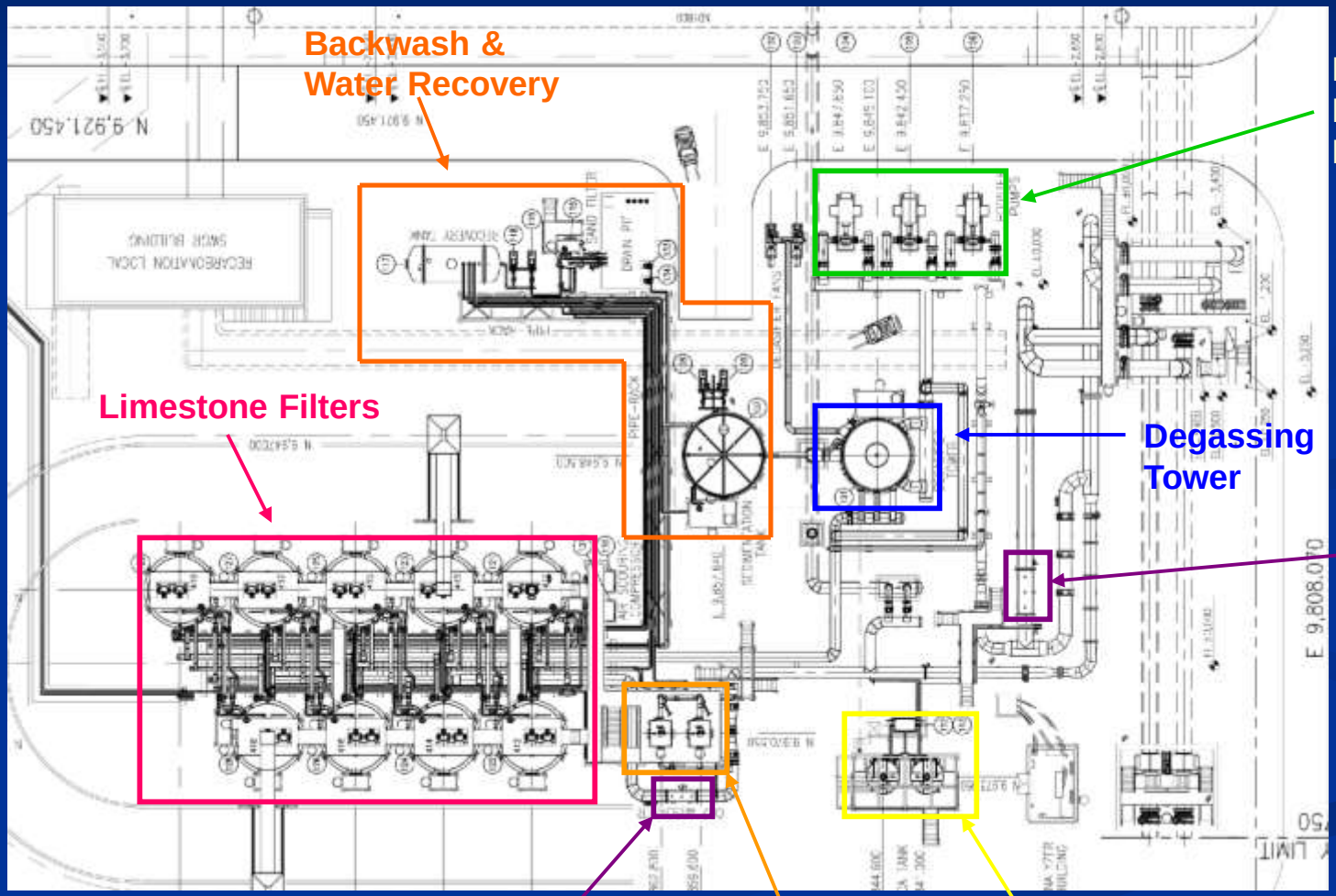

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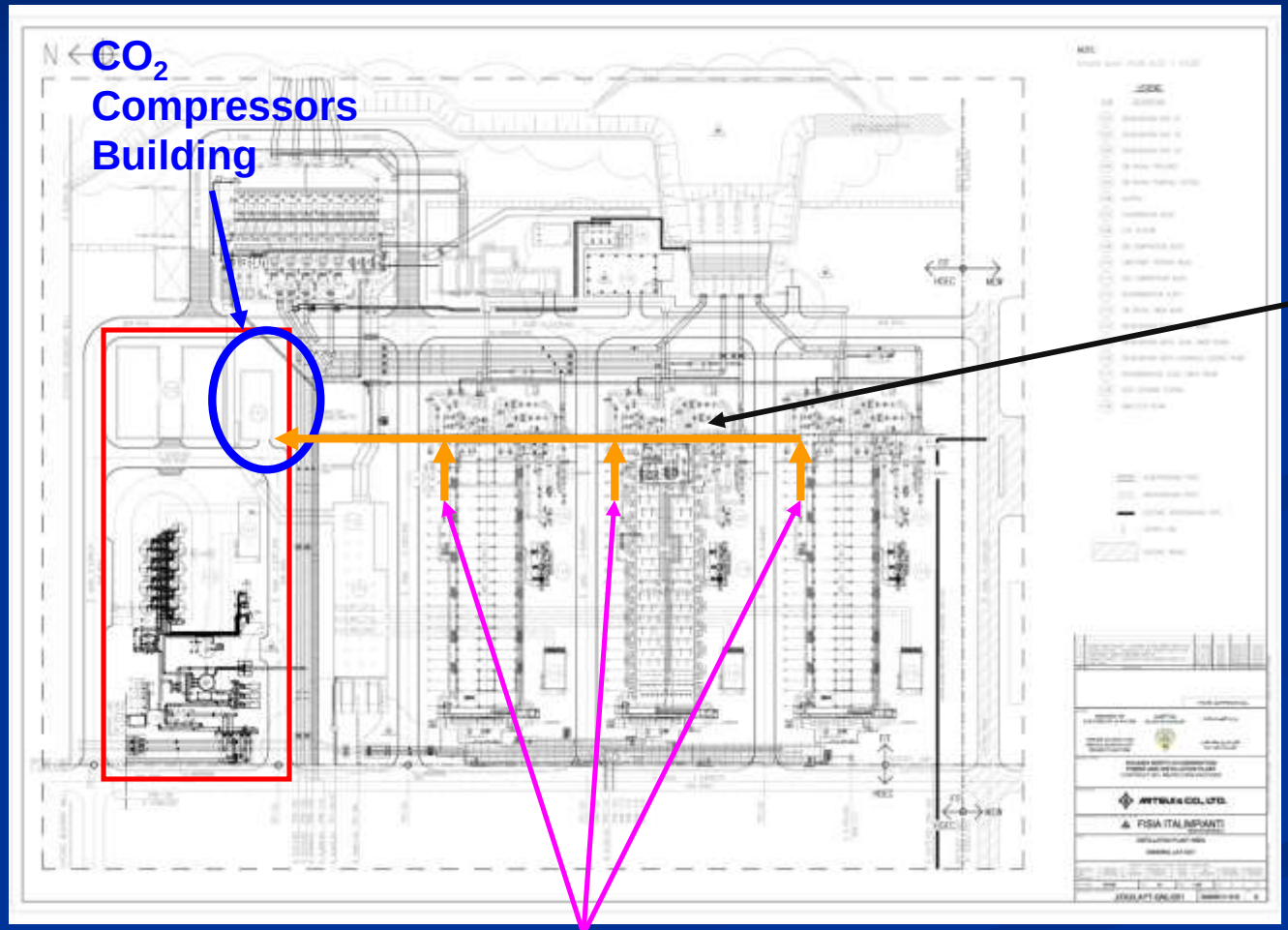

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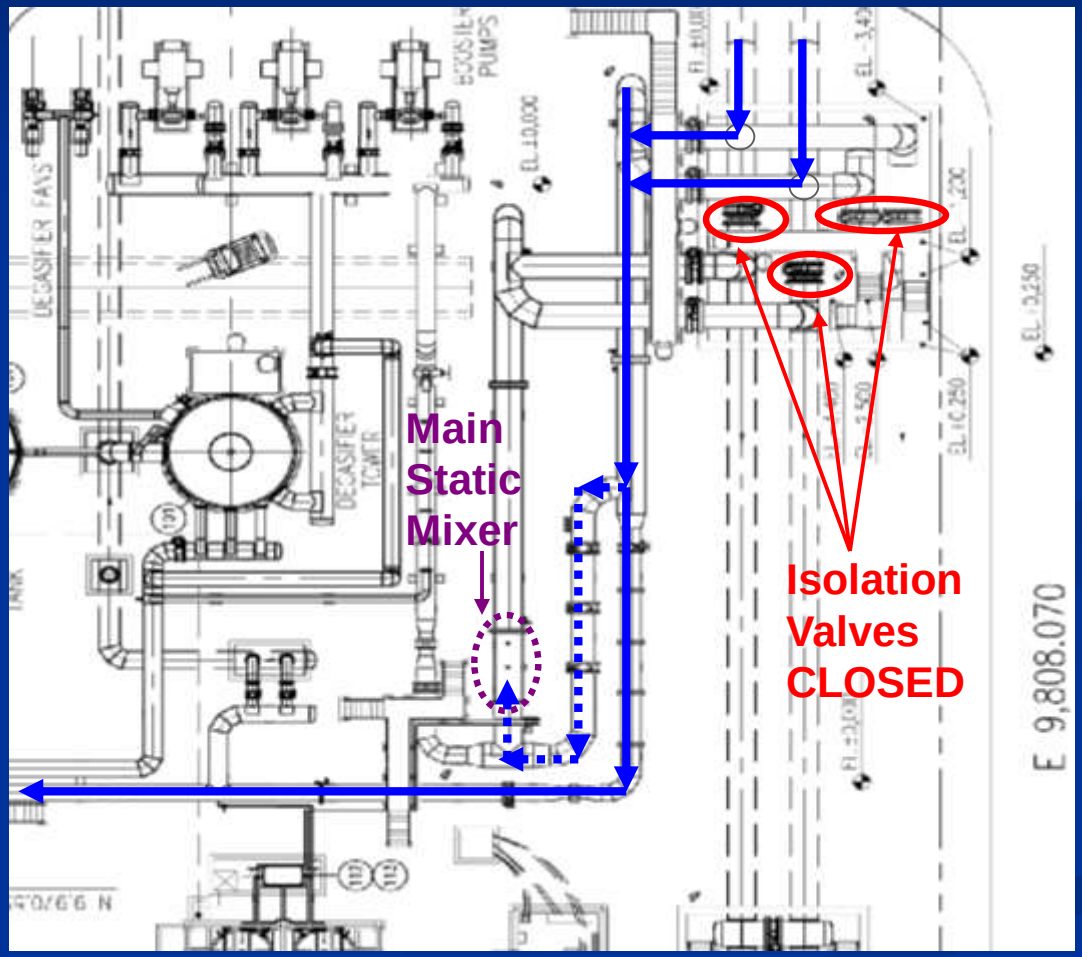
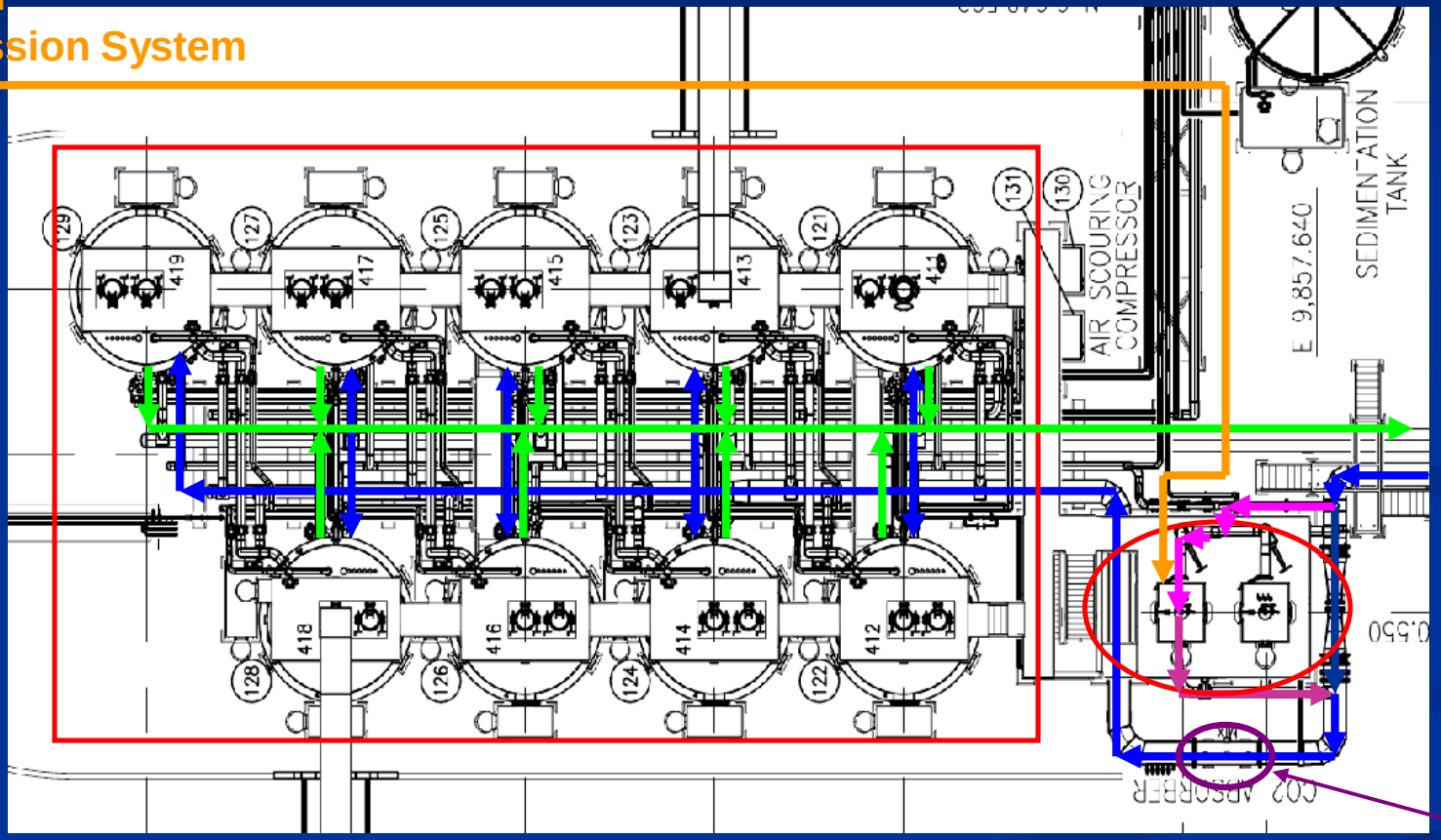


RECARBONATION PLANT

CO_2 from Compression System



Abs. Static Mixer

LIMESTONE FILTERS

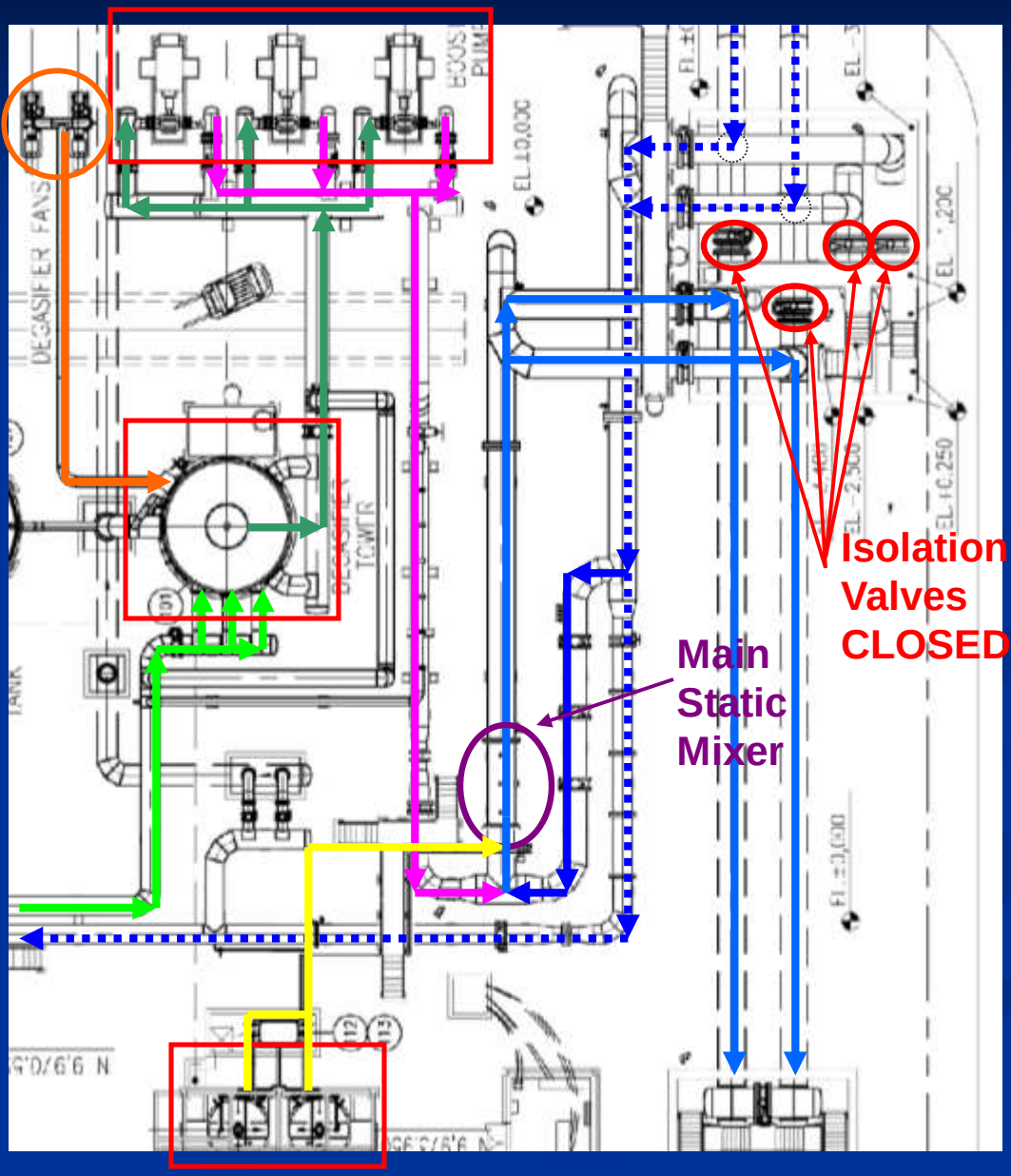
CO_2 ABSORBERS

RECARBONATION PLANT

DEGASIFIER FANS

DEGASSING TOWER

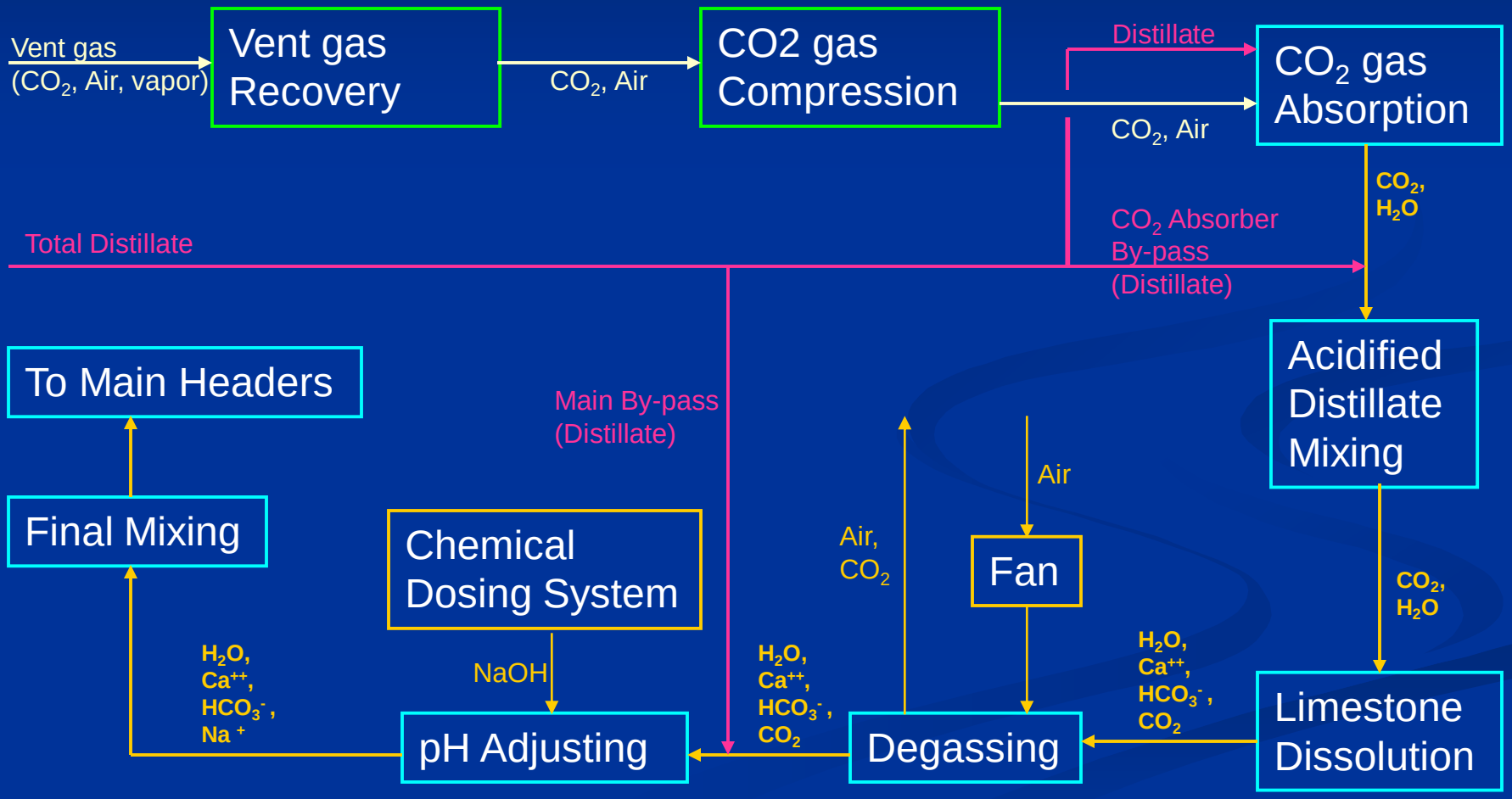
NaOH DOSING



DEGASIFIER EXTRACTION PUMPS

TO BATTERY LIMIT

RECARBONATION PLANT



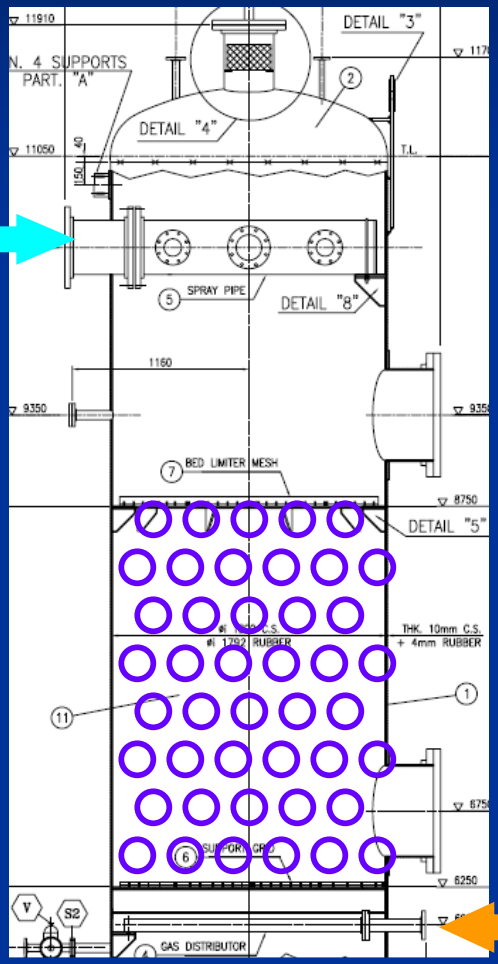
RECARBONATION PLANT

MAIN VESSELS AND TANKS

- CO_2 ABSORBERS
- LIMESTONE FILTERS
- DEGASSING TOWER

RECARBONATION PLANT

Distillate top-down



CO_2 bottom-up

CO2 ABSORBER

2 UNITS

1 IN OPERATION

1 IN STAND BY

OPERATING PRESSURE: 3.5 barG

MATERIAL: CS RUBBER LINED

HEIGHT: approx 12m

DIAMETER: approx 1.8m

PACKING: POLYPROPYLENE

RECARBONATION PLANT

CO_2 ABSORBERS

2 X 100%

RECARBONATION PLANT

CO_2 ABSORBERS

2 X 100%

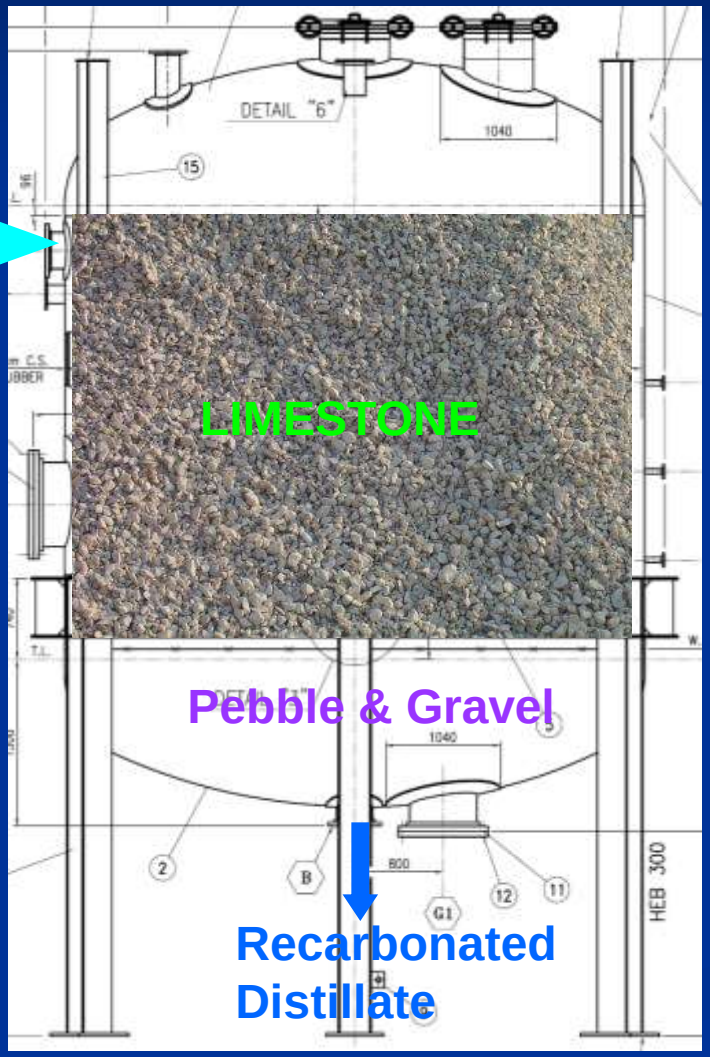
CO_2 Gas Line from
CO_2 Compressors

Acidified Distillate
to L.F.

Distillate from
Absorber's By-pass

RECARBONATION PLANT

Acidified Distillate



LIMESTONE FILTERS

9 UNITS

7 IN NORMAL OPERATION

1 IN RECHARGING

1 IN STAND BY

OPERATING PRESSURE: 3.5barG

MATERIAL: CS RUBBER LINED

HEIGHT: approx 9 m

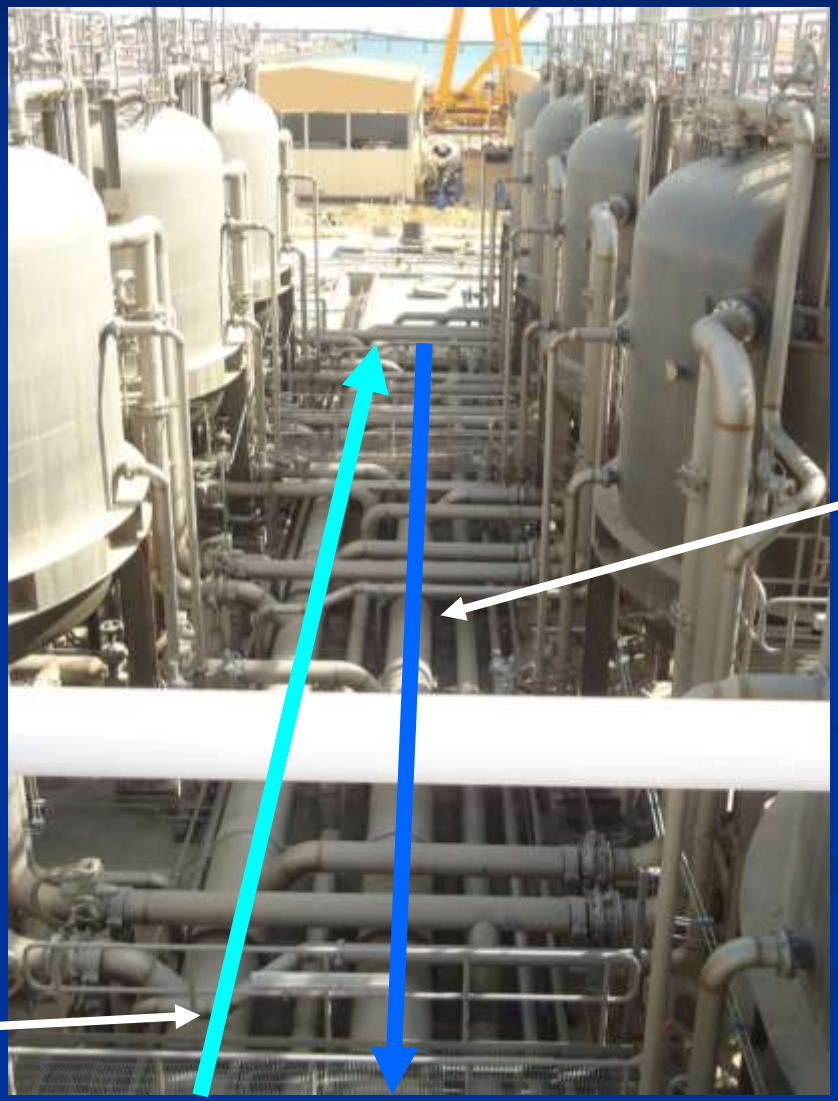
DIAMETER: approx 5.2 m

RECARBONATION PLANT

LIMESTONE FILTER

RECARBONATION PLANT

LIMESTONE FILTERS



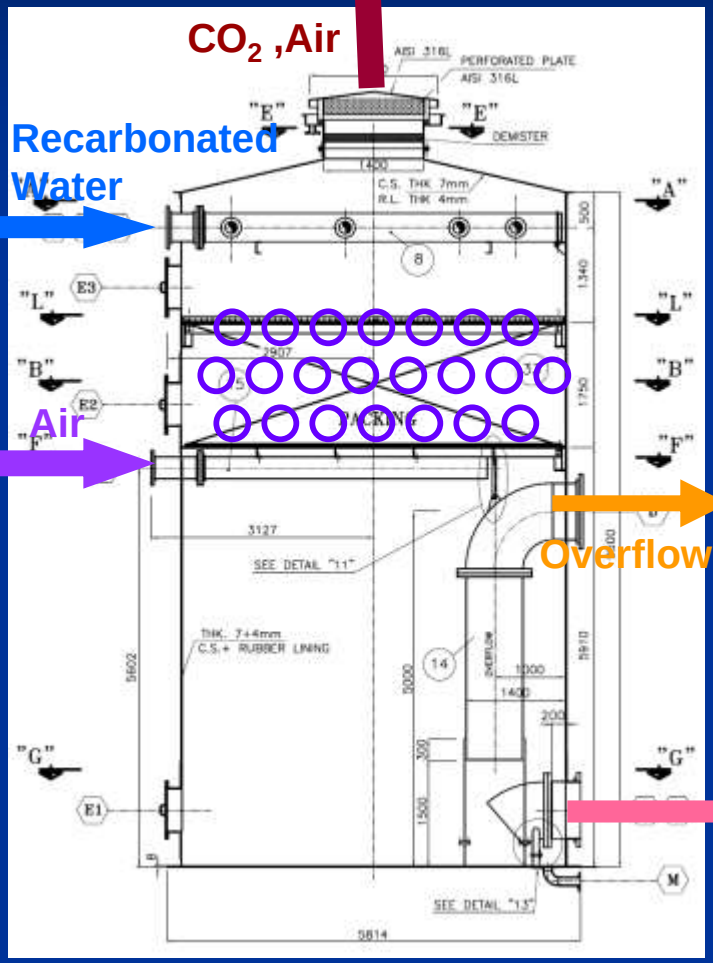
Sea

RECARBONATED WATER FROM L.F.

ACIDIFIED DISTILLATE TO L.F.

CO_2 Absorbers

RECARBONATION PLANT



DEGASIFIER TOWER

1 UNIT WITH BY-PASS

OPERATING PRESSURE: Atm

MATERIAL: CS rubber lined

HEIGHT: approx 9 m

DIAMETER: approx 5.4 m

PACKING: POLYPROPYLENE

RECARBONATION PLANT

DEGASSING TOWER

RECARBONATION PLANT

DEGASSING TOWER

RECARBONATION PLANT

MAIN PUMPS AND COMPRESSORS

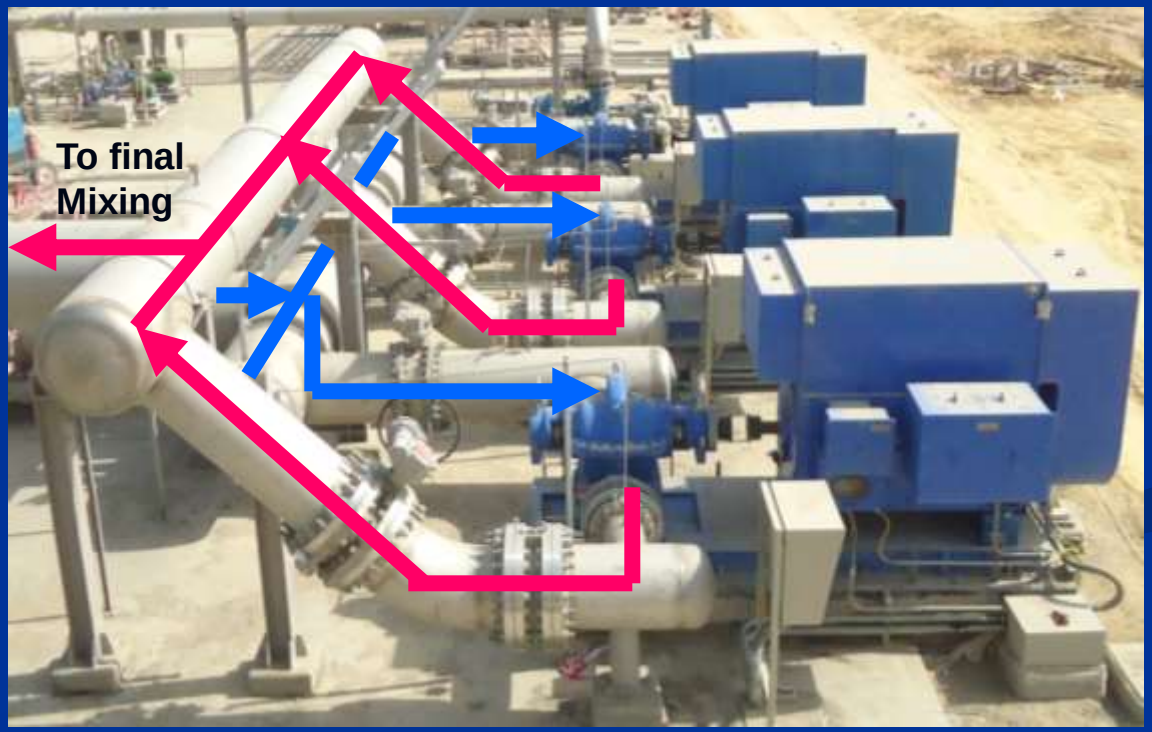
- DEGASIFIER EXTRACTION PUMPS
- CO2 BOOSTER PUMPS
- CO2 COMPRESSORS

RECARBONATION PLANT

DEGASIFIER EXTRACTION PUMPS (3 X 50%)

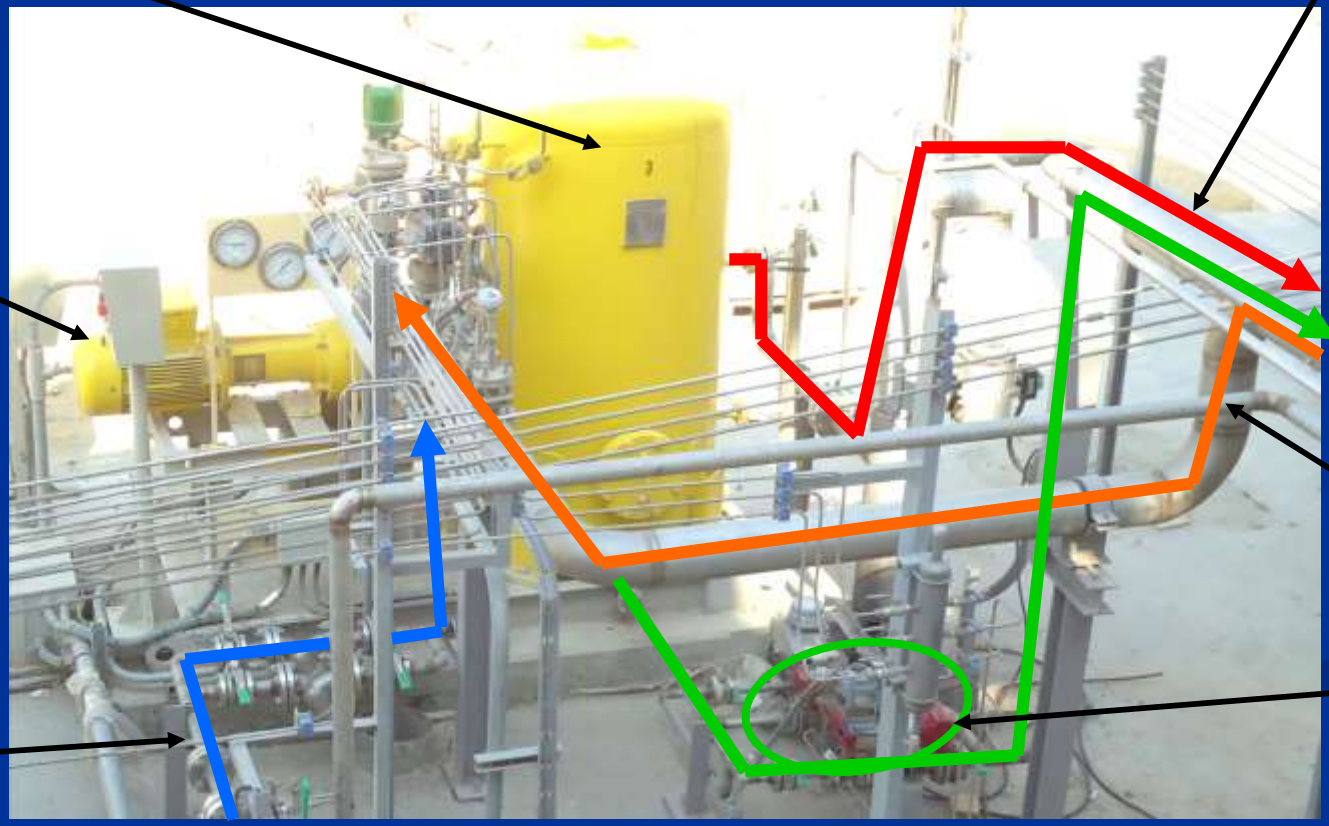
HORIZONTAL CENTRIFUGAL – DOUBLE SUCTION

FLOW	1540 m^3/h
HEAD	150 m
POW.	950 KW
MAT.	DUPLEX S.S.



RECARBONATION PLANT

CO2 BOOSTER PUMPS

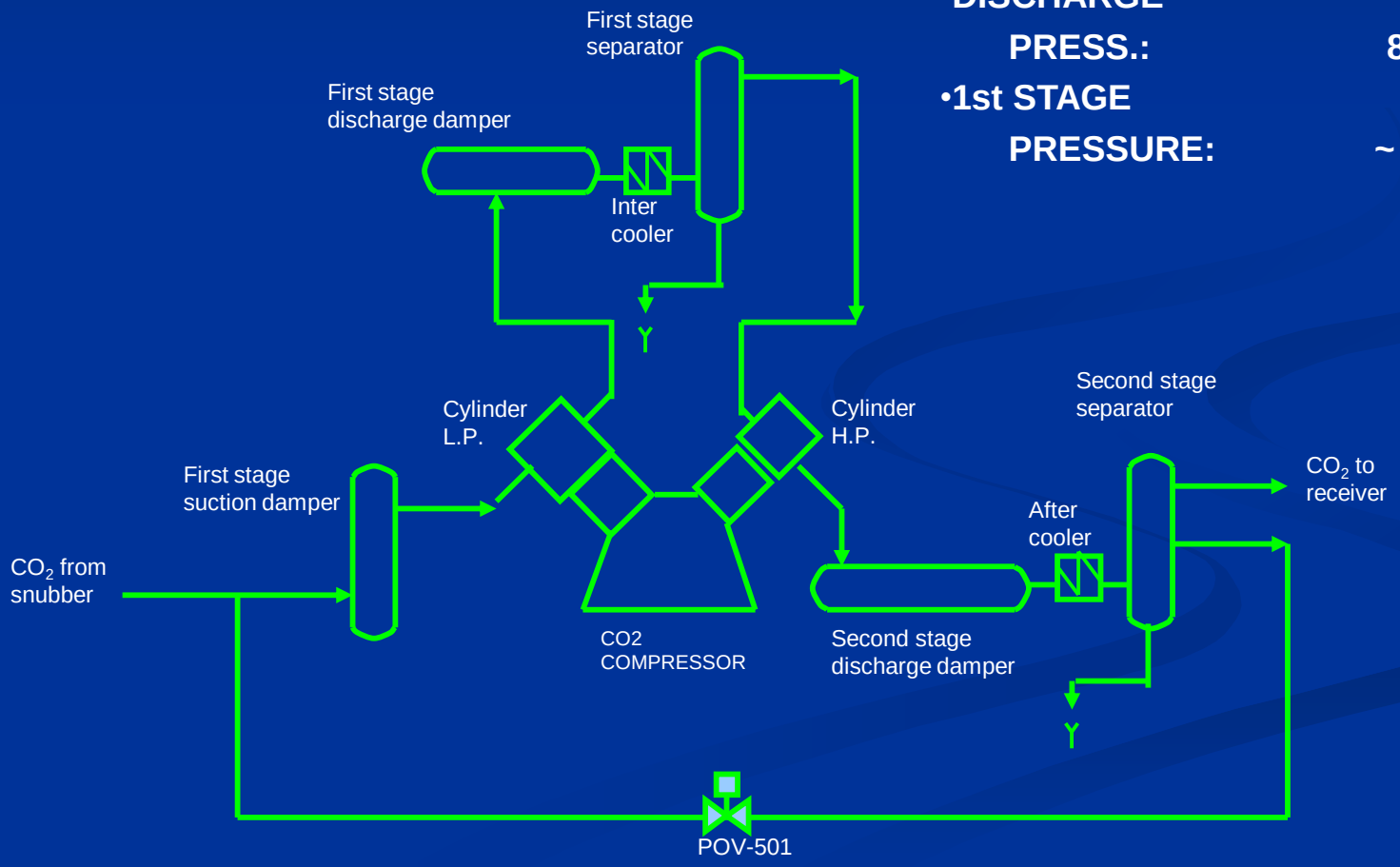


RECARBONATION PLANT

CO_2 COMPRESSORS

RECIPROCATING TYPE
2 STAGES

- **CAPACITY:** 650 Nm3/h
- **DISCHARGE PRESS.:** 8 bar (a)
- **1st STAGE PRESSURE:** ~ 3 bar (a)

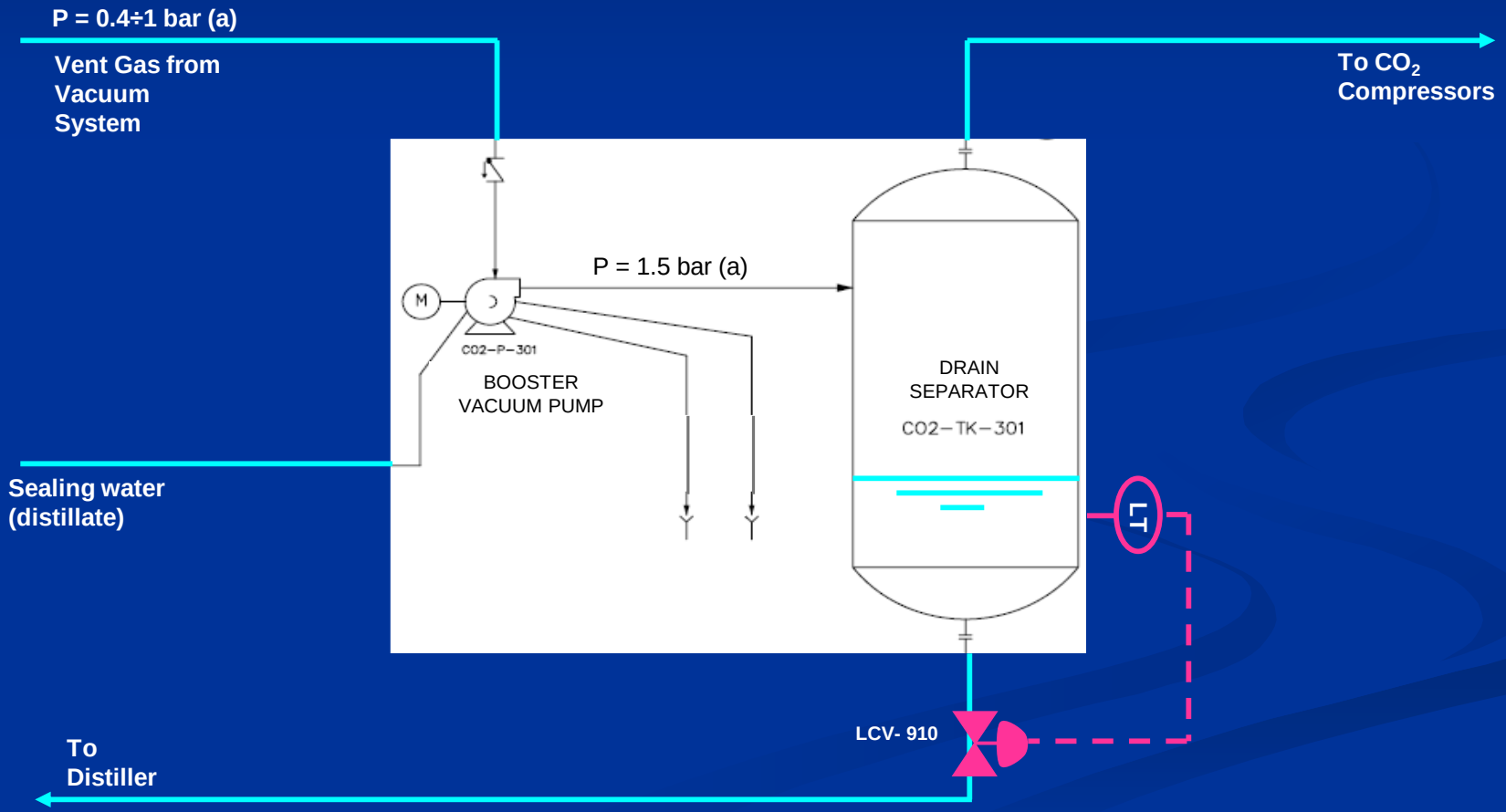


RECARBONATION PLANT

CO_2 COMPRESSORS

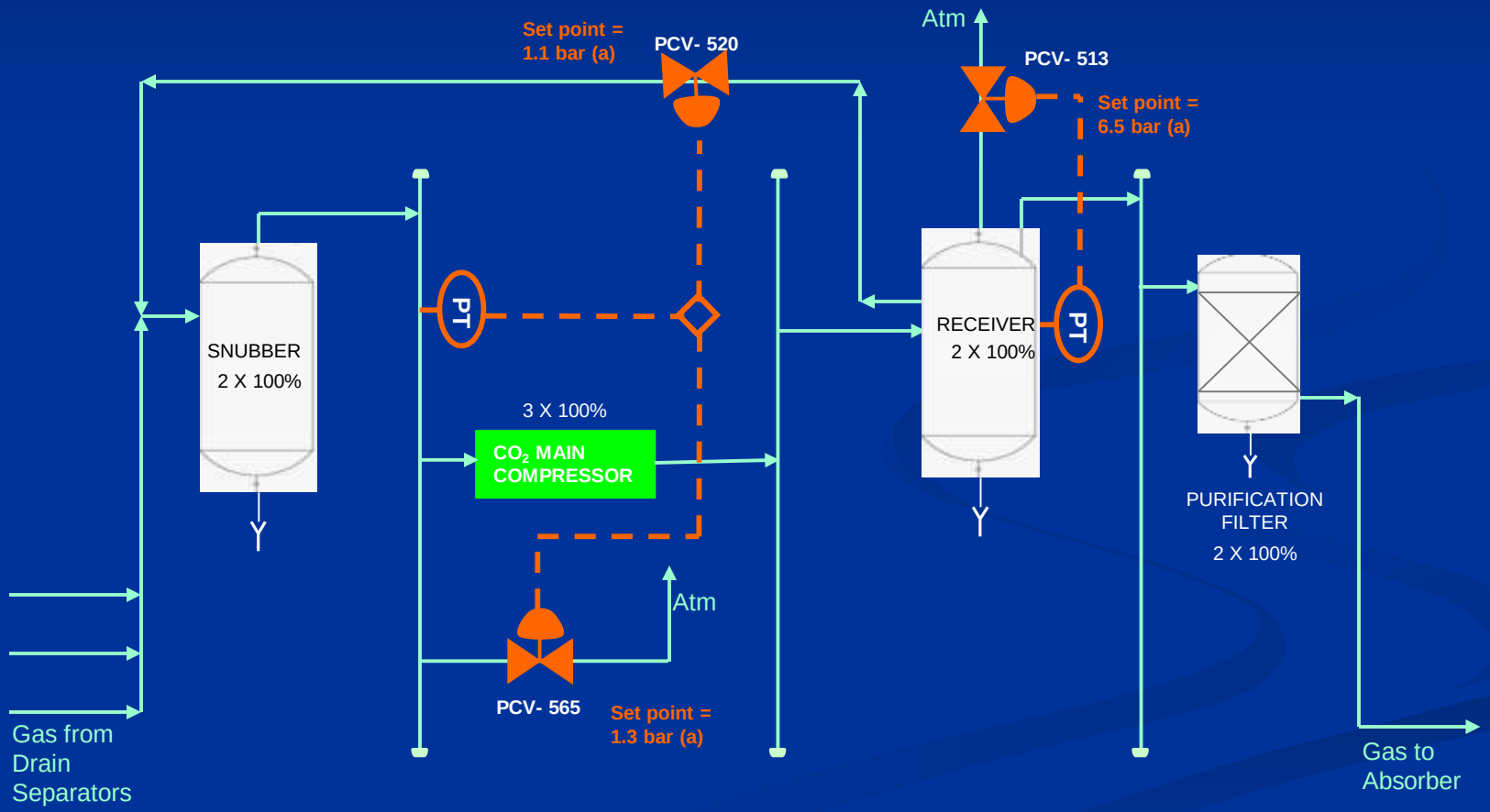
RECARBONATION PLANT

GAS RECOVERY SYSTEM



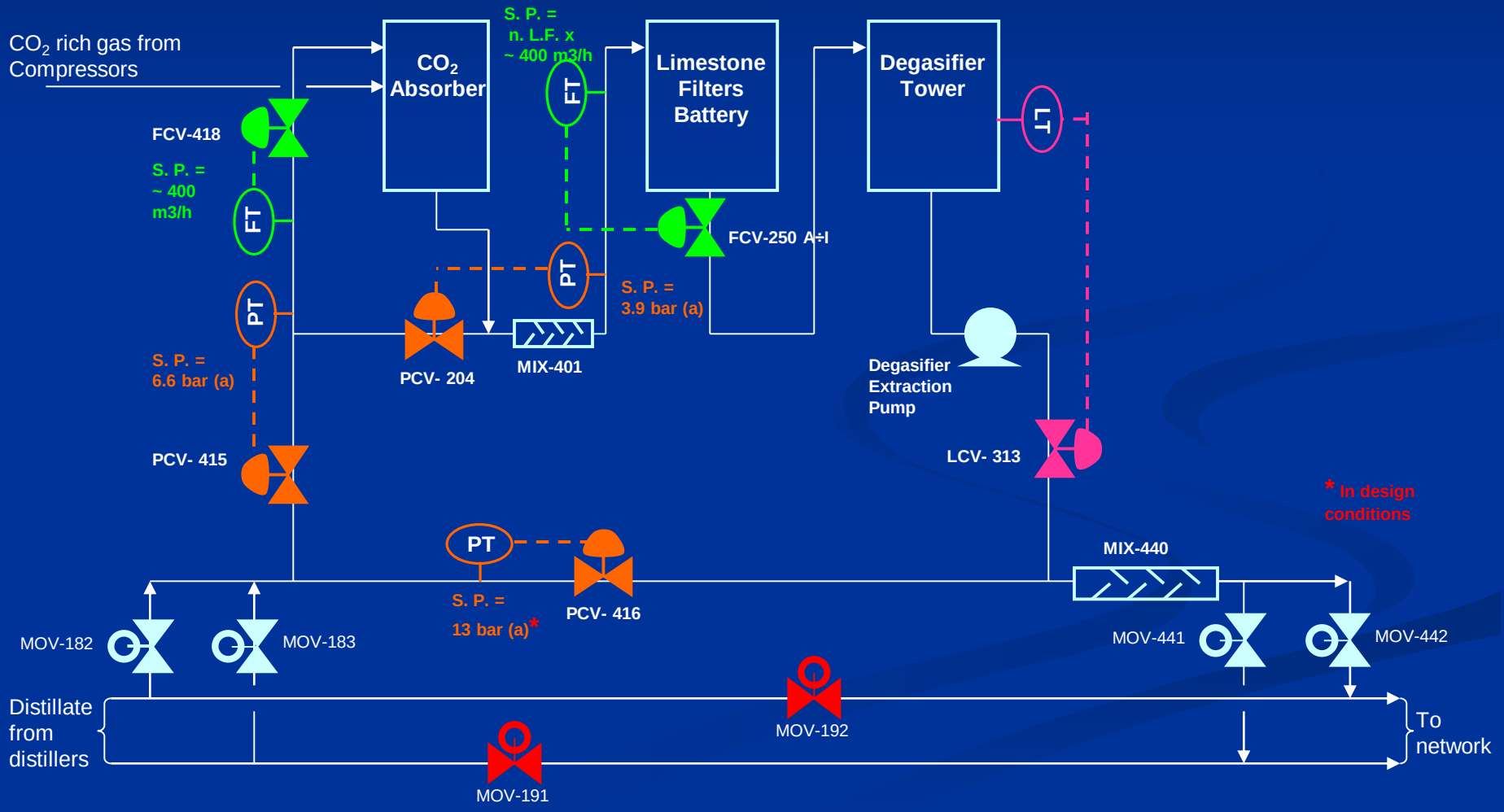
RECARBONATION PLANT

GAS COMPRESSION SYSTEM



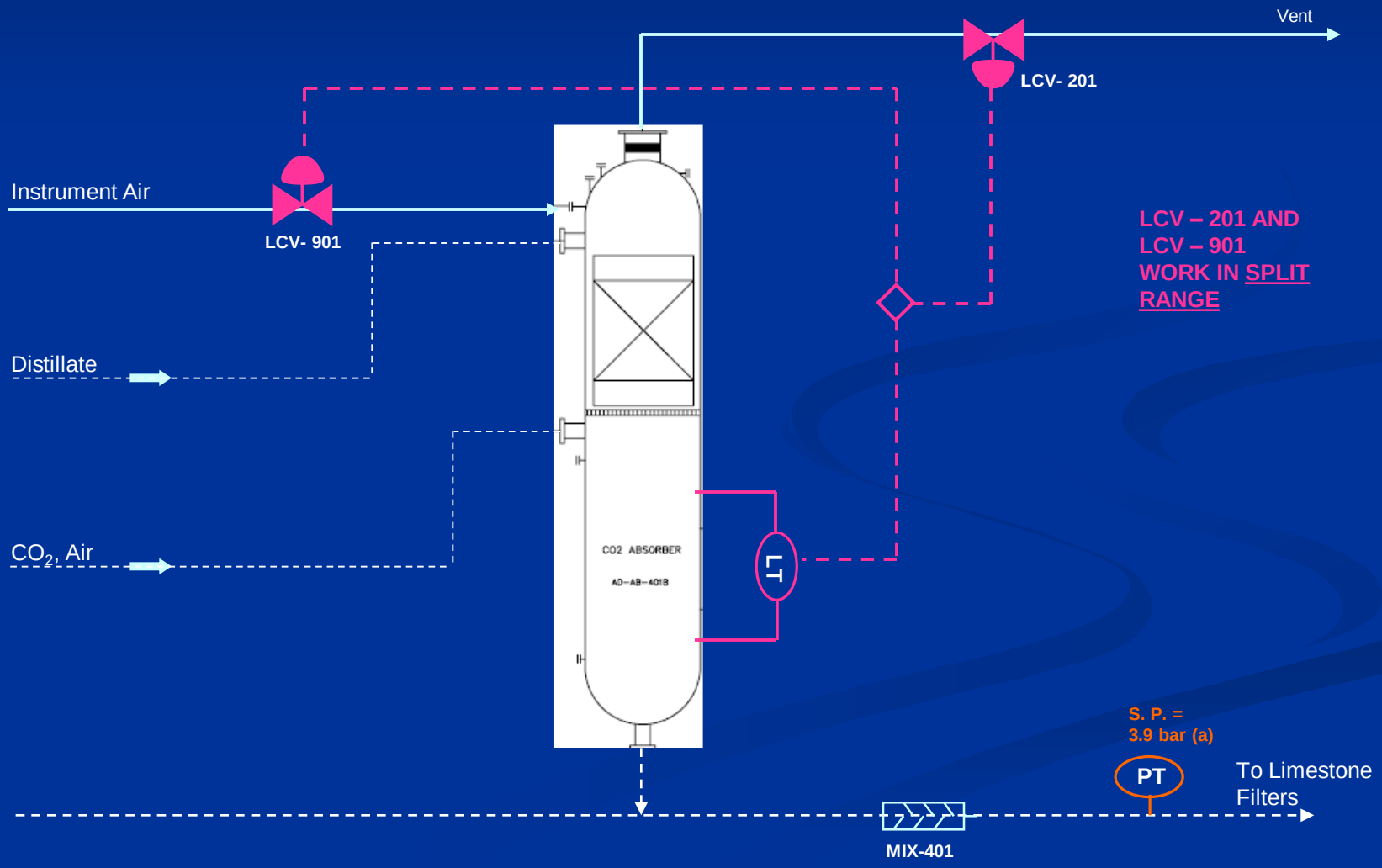
RECARBONATION PLANT

PLANT CONTROL SYSTEM



RECARBONATION PLANT

CO_2 ABSORBER CONTROL SYSTEM



RECARBONATION PLANT

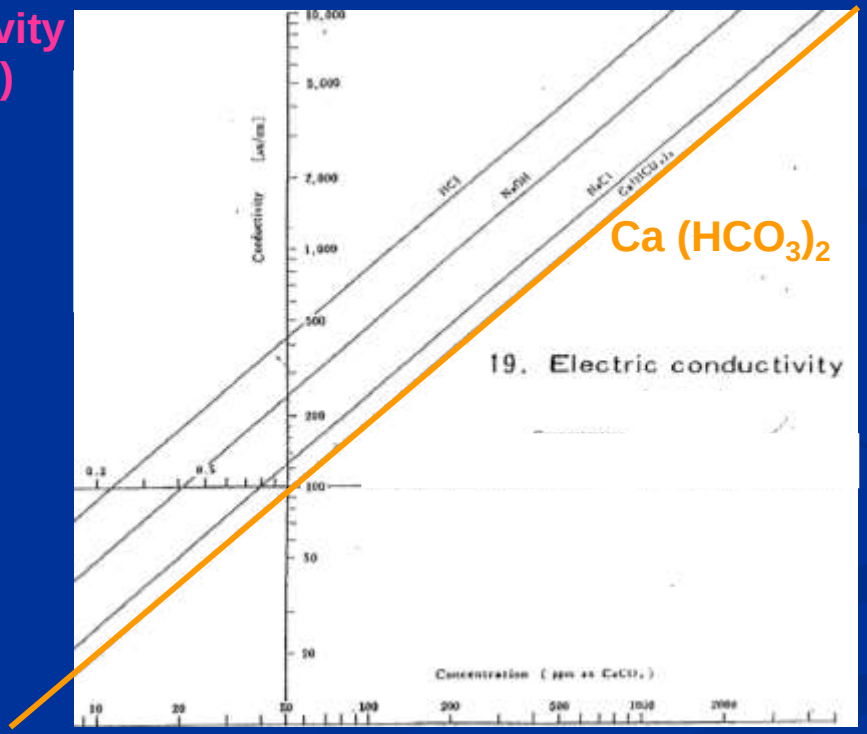
WATER ALKALINITY CONTROL SYSTEM

ALKALINITY ⟷ CONDUCTIVITY

CONDUCTIVITY

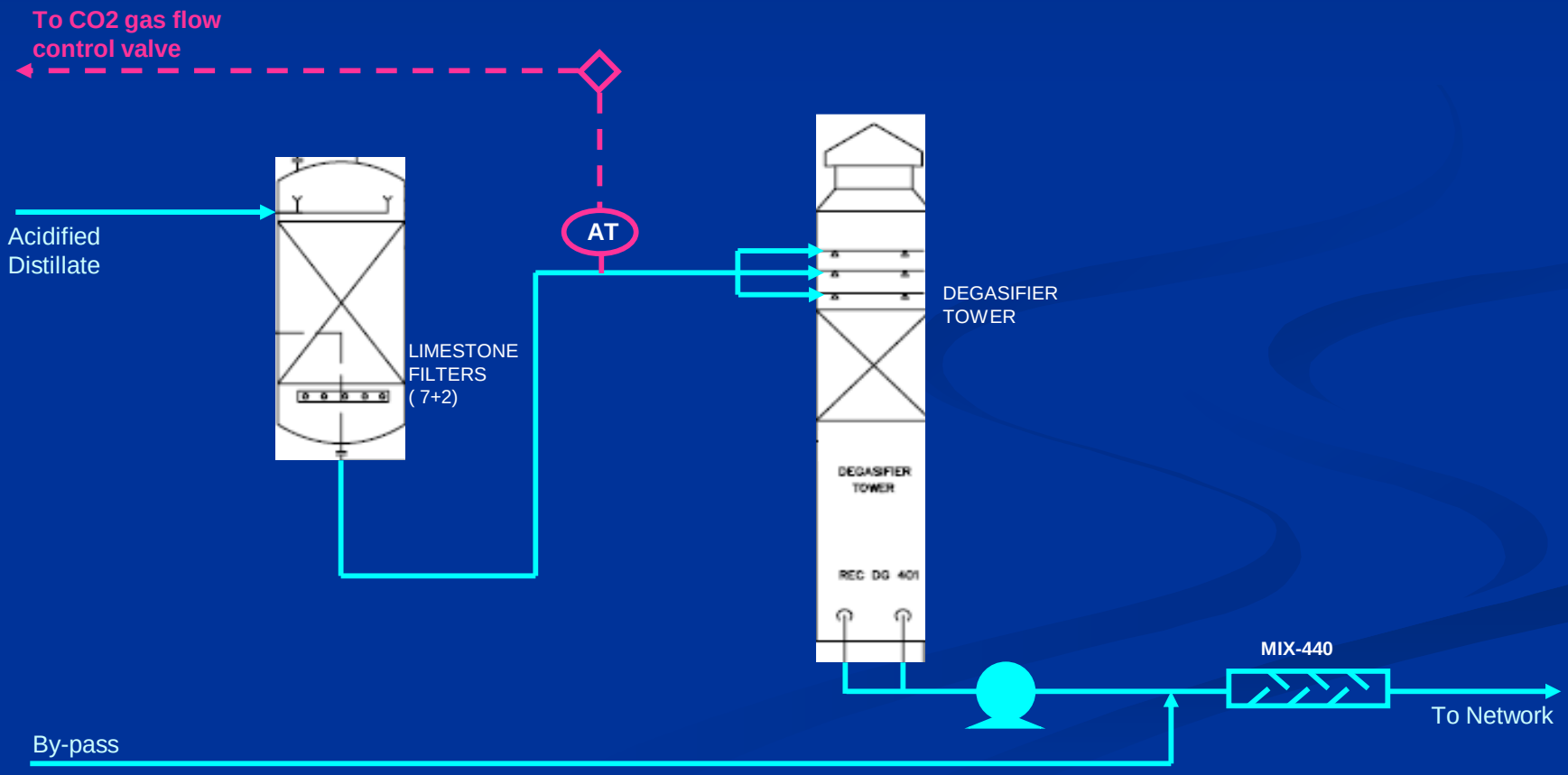
=

F(ALKALINITY)



RECARBONATION PLANT

WATER CONDUCTIVITY CONTROL SYSTEM



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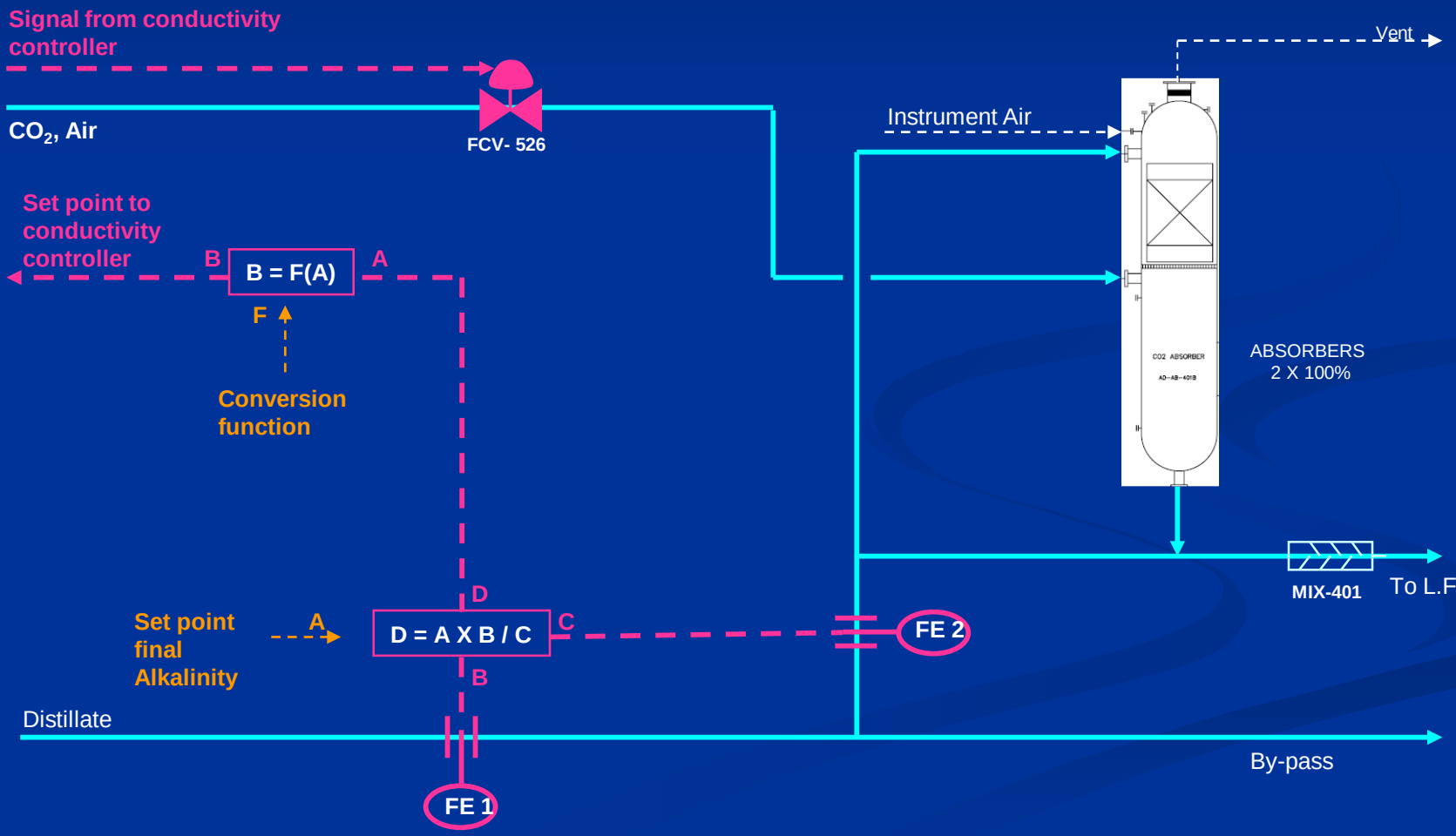

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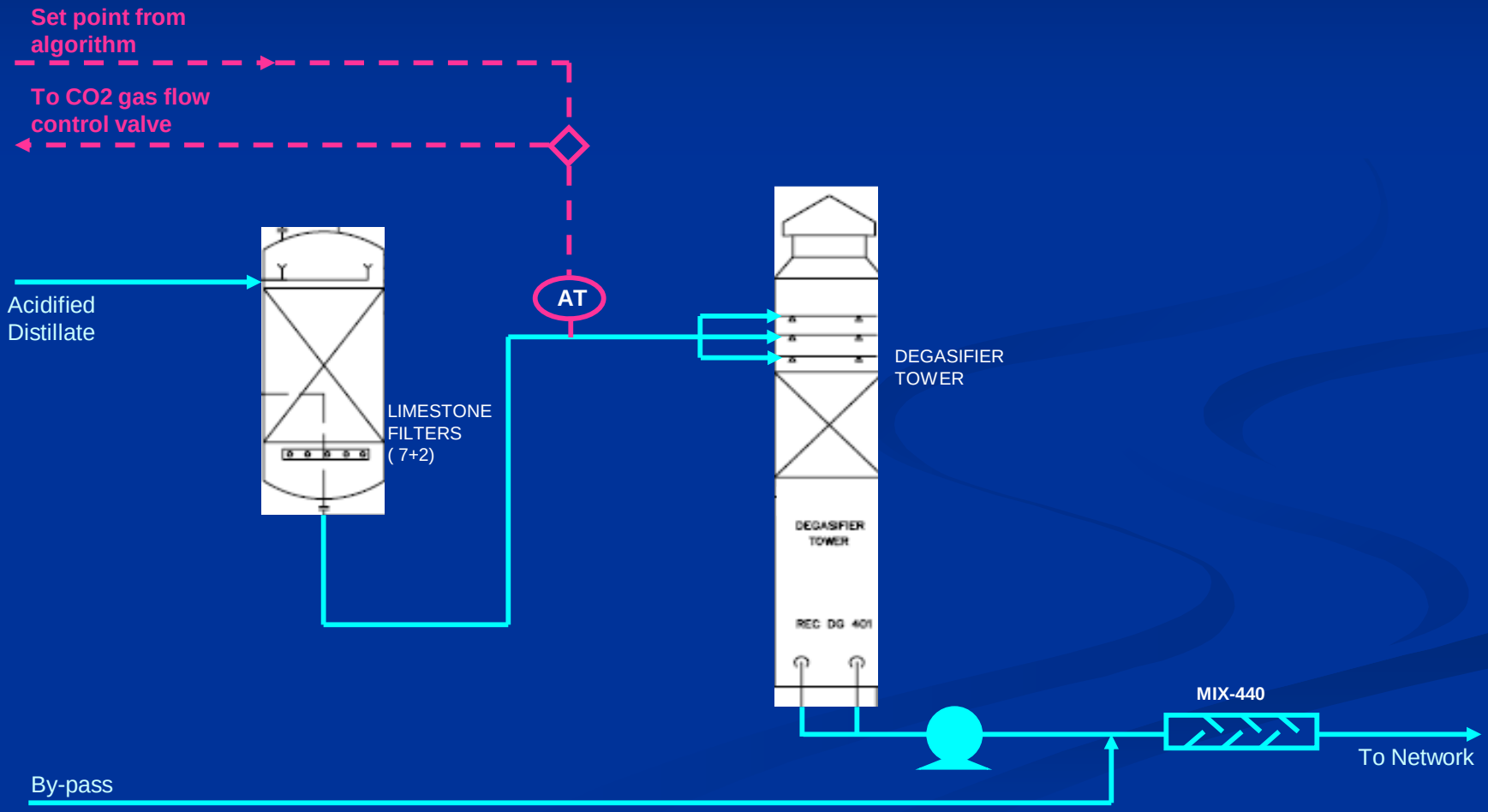
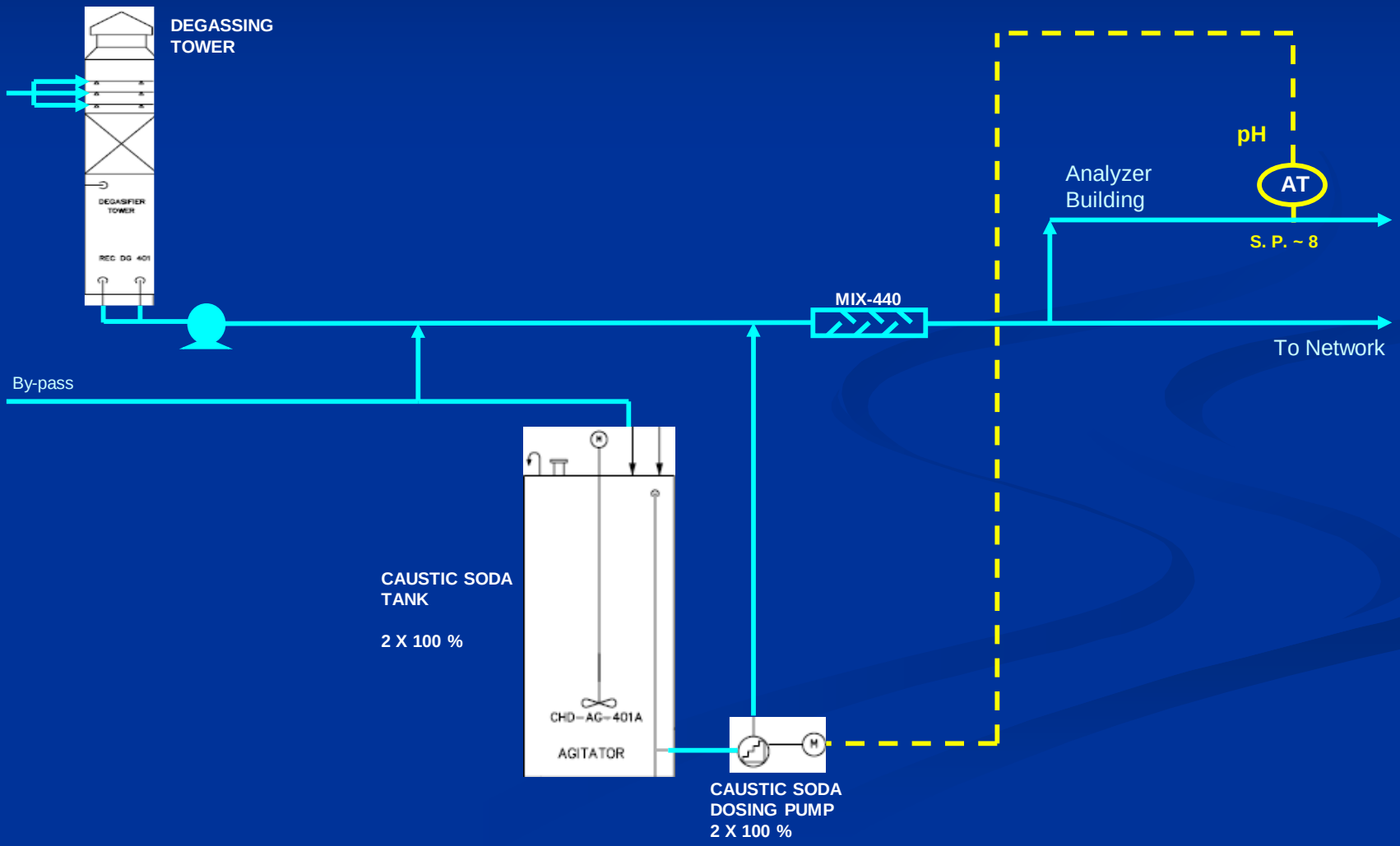
WATER CONDUCTIVITY CONTROL SYSTEM



RECARBONATION PLANT

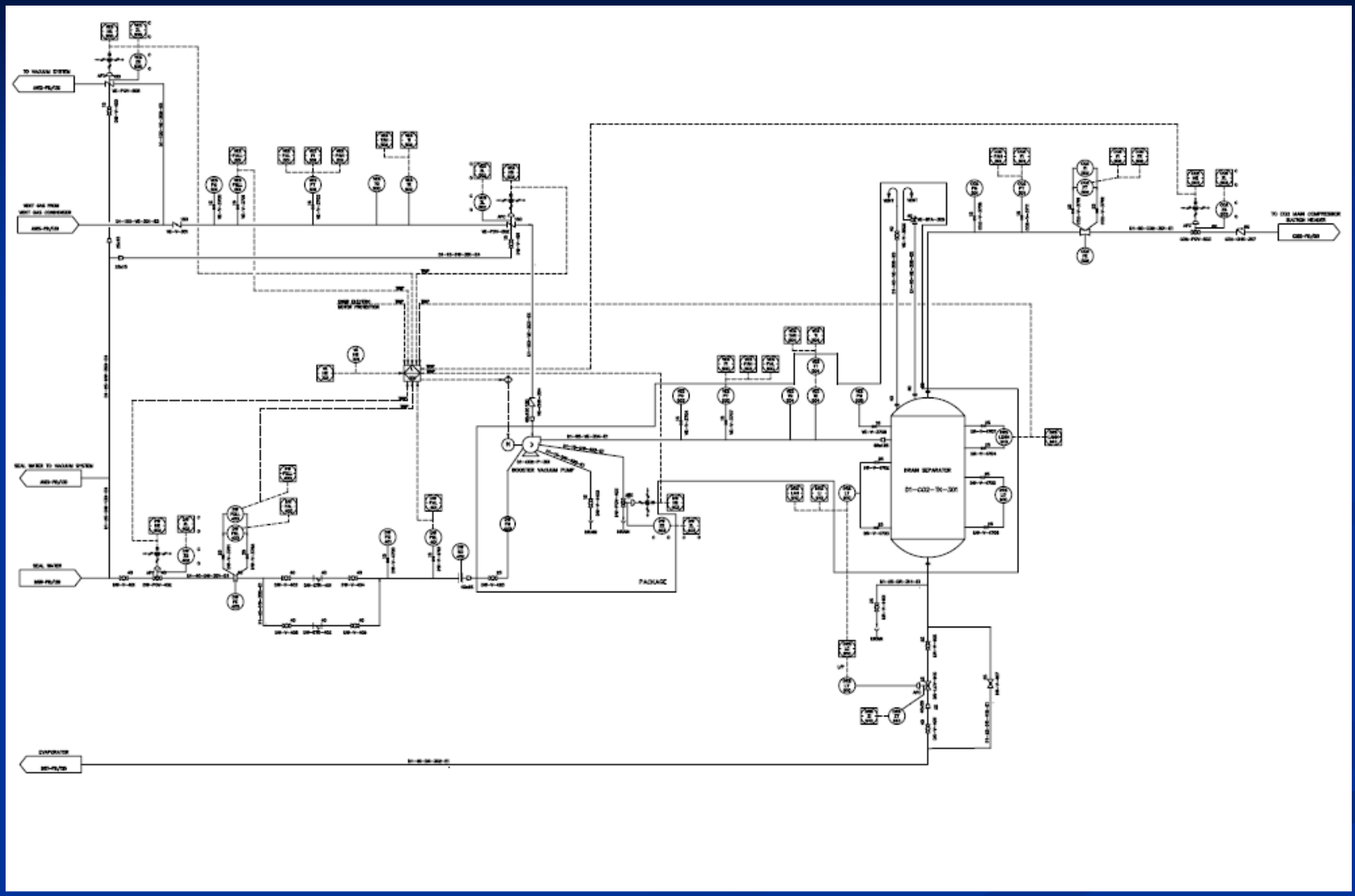
pH CONTROL SYSTEM

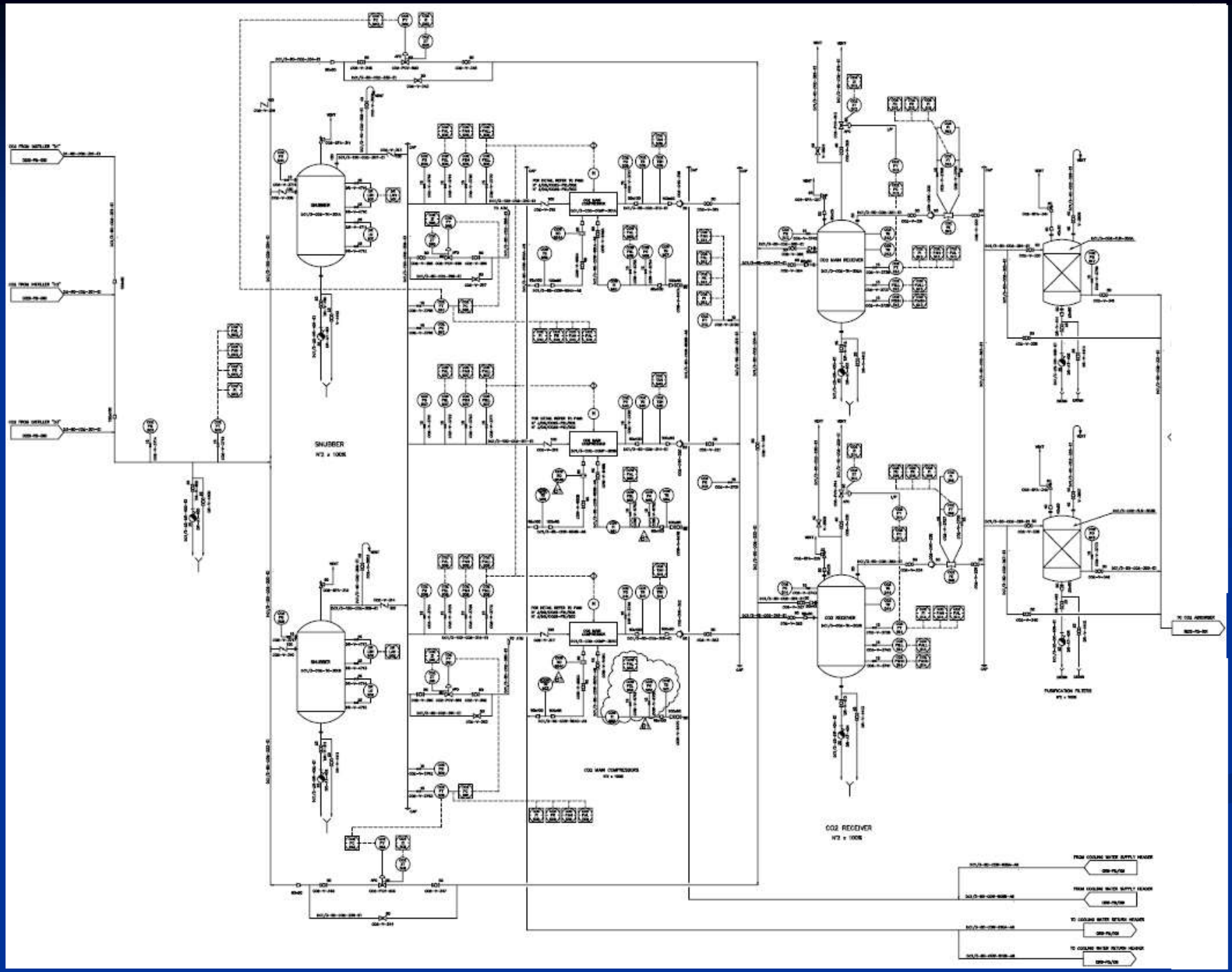


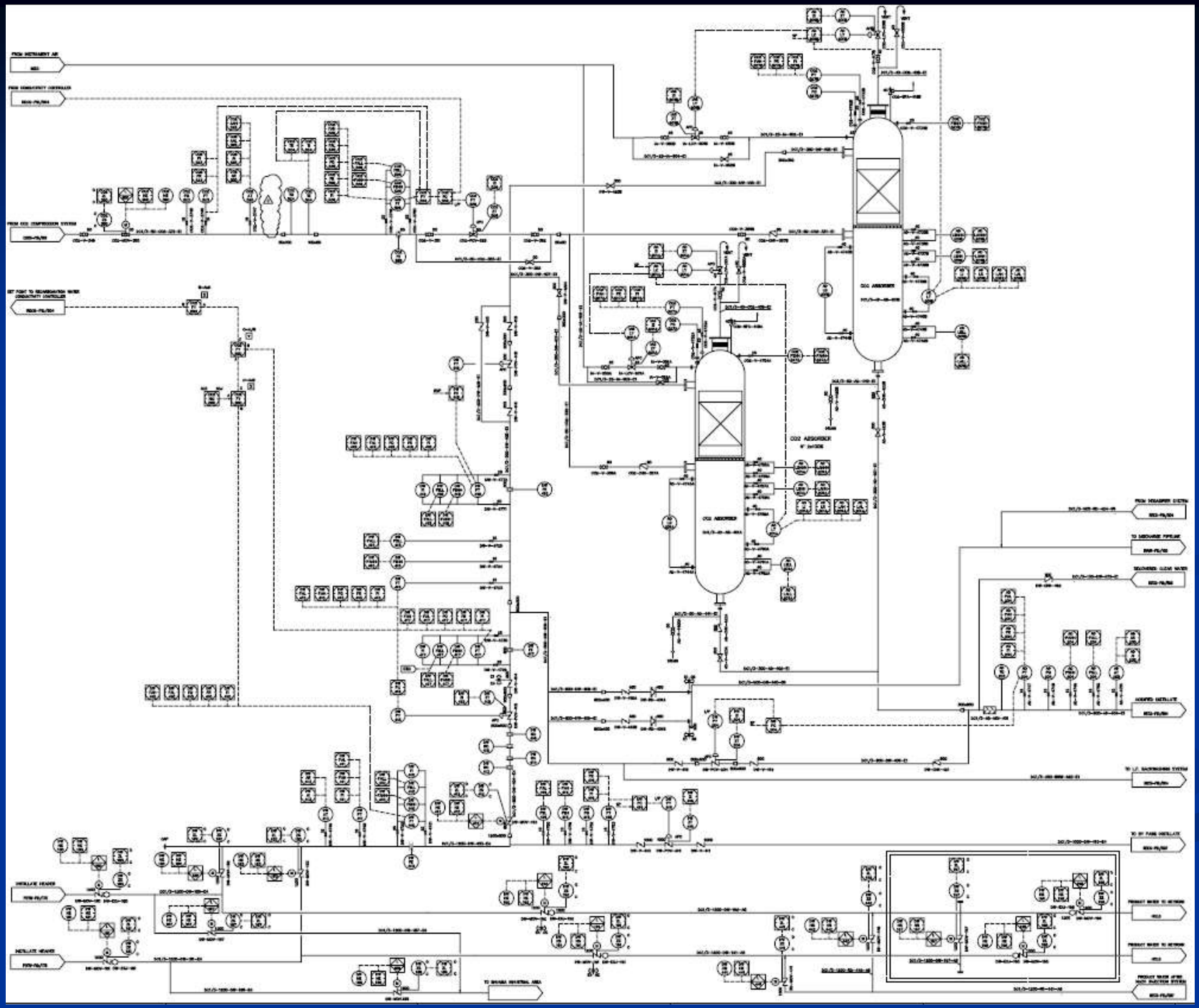
RECARBONATION PLANT

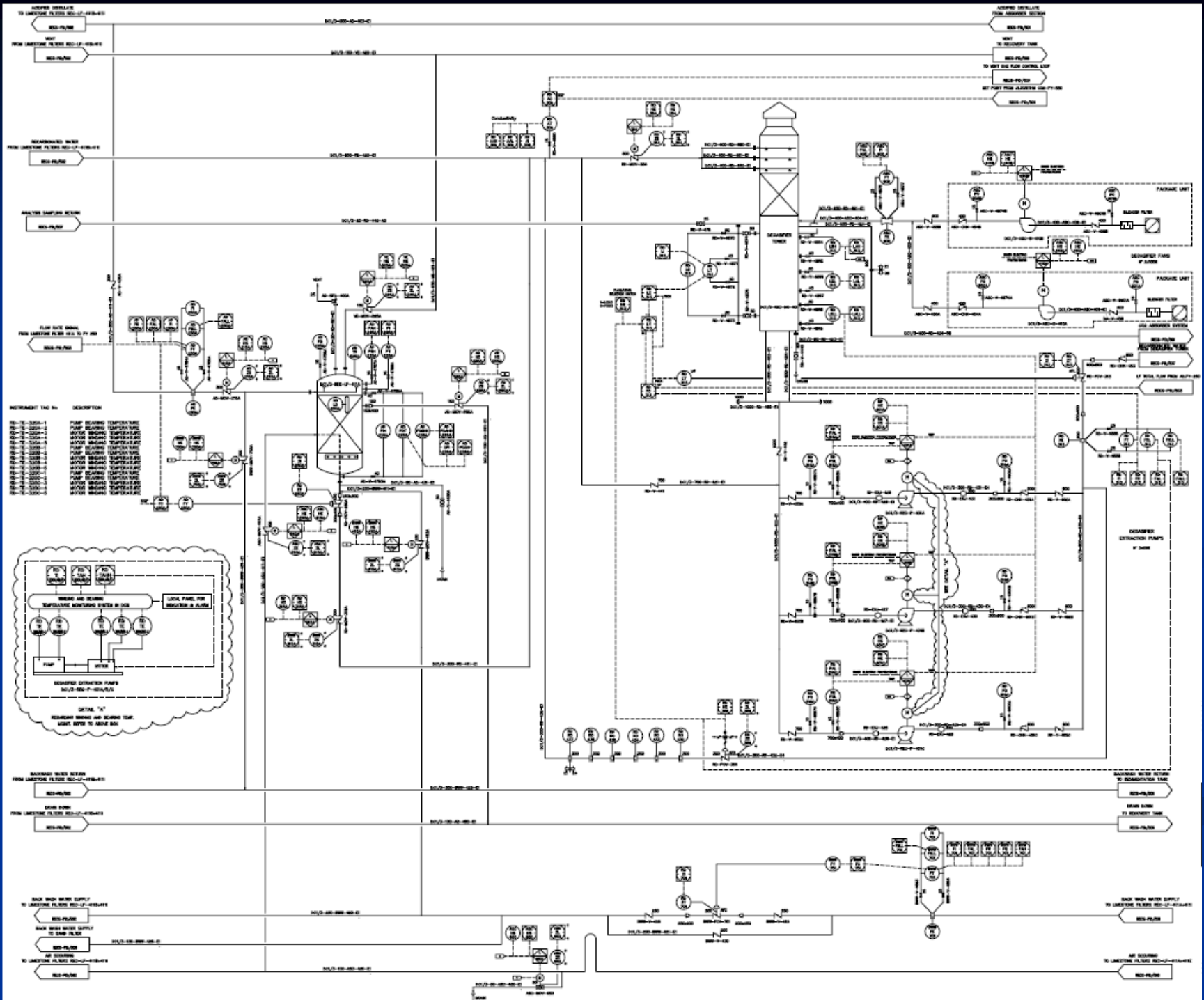
P. I . D.

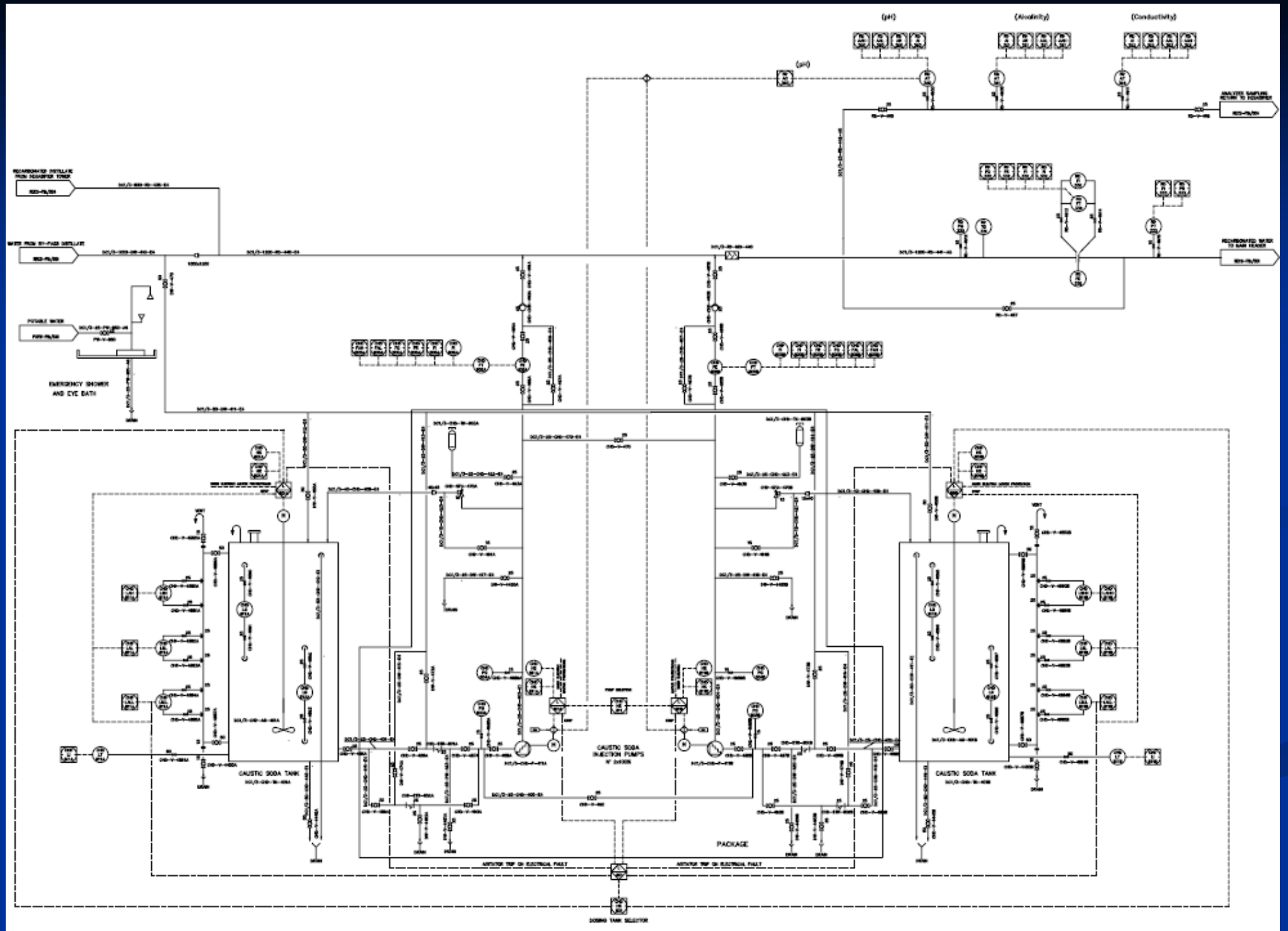
PROCESS &
INSTRUMENTATION
DIAGRAM




SNUBBER
CO2 RECEIVER






(pH)
(Alcalinity)
(Conductivity)
(pH)
EMERGENCY SHOWER AND EYE BATH
CAUSTIC SODA TANK
CAUSTIC SODA INJECTION PUMPS
CAUSTIC SODA TANK
PACKAGE

RECARBONATION PLANT