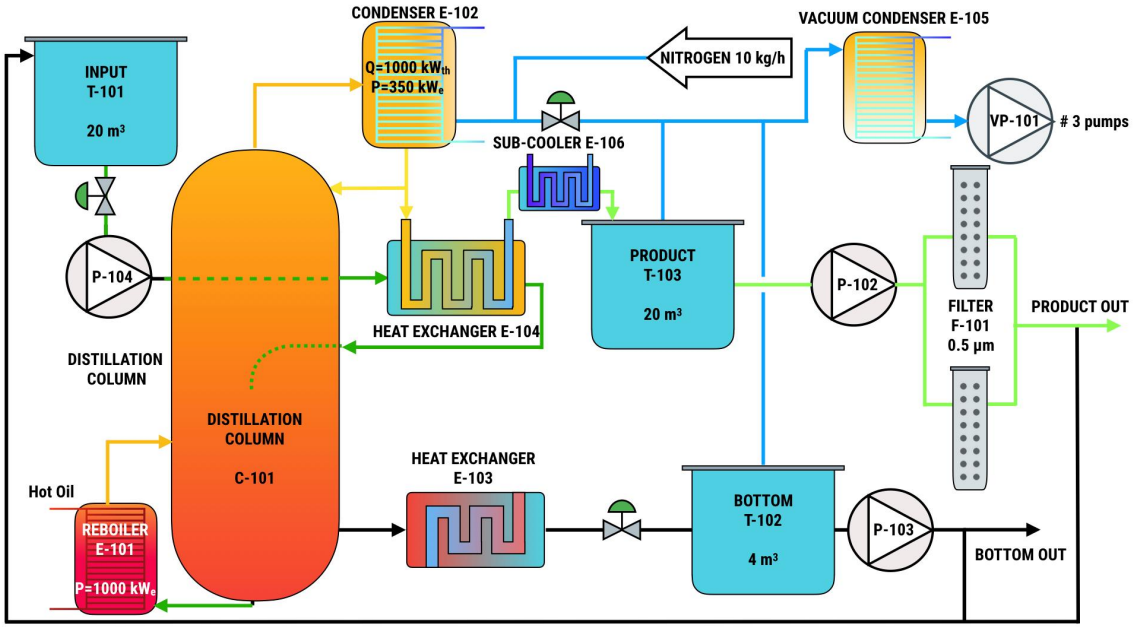
# *DISTILLATION AND STRIPPING PLANT*


on behalf of the Italian Liquid Scintillator group

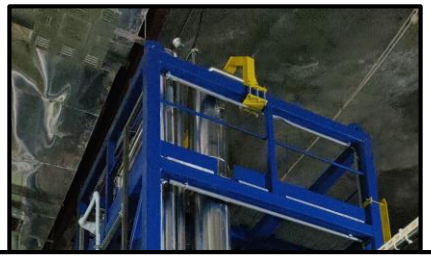
# Outline

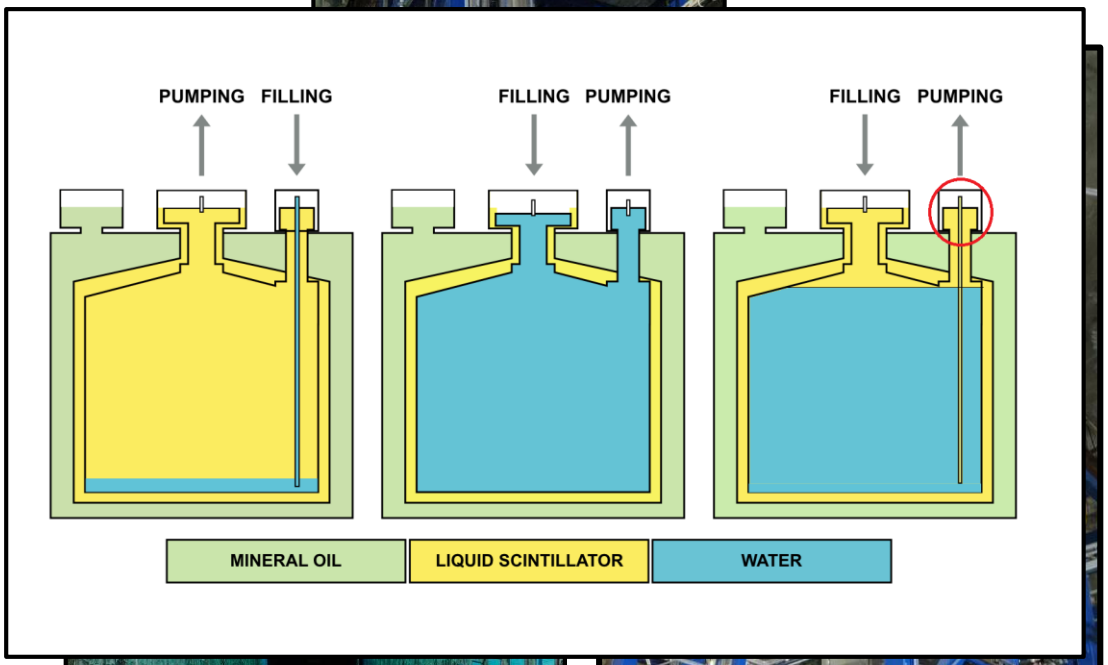
- Distillation Test @DayaBay
- Status of the design and construction
  - P&Id
  - Instrumentation
  - Equipment
- DCS
  - Hardware
  - Software
- OPC Server
  - Integration LabView with Siemens
- Procedure
  - Distillation
  - Stripping
- Conclusion



# Distillation Test @DayaBay

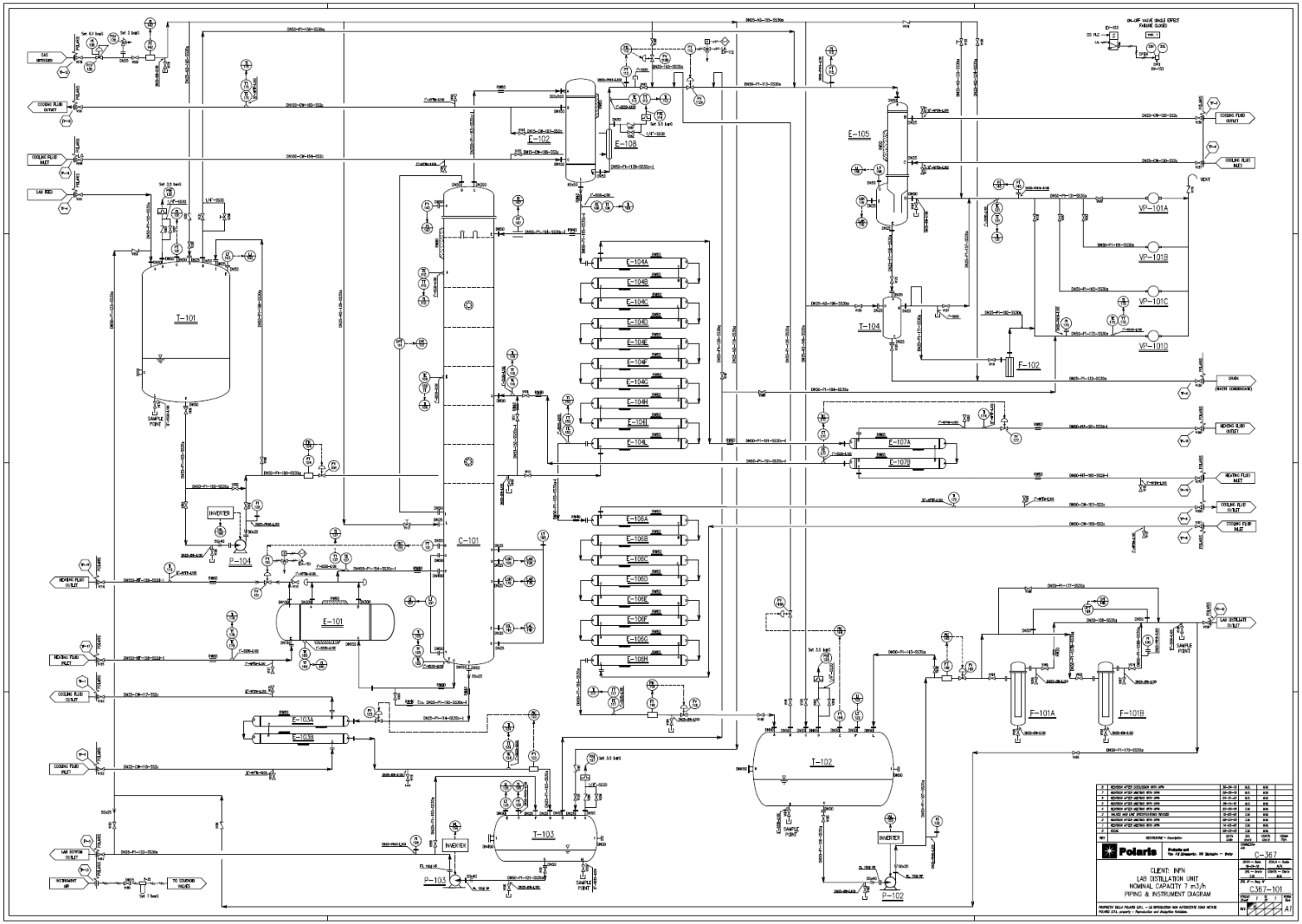
- Replaced LS in AD1 with water (before our arrival)
- Start distillation and stripping plant in loop mode
- Distillation and stripping pilot plant were very stable
- Start filling AD1 with purified LS
- Continuos check of the filling of the AD1 with DayaBay filling sistem and data analisys
- After 4 days found LS in the waste piping
- Immediate stop of the operations
- After opening AD1 found a crack on the acrylic pipe on the interface between acrylic and stainless steel





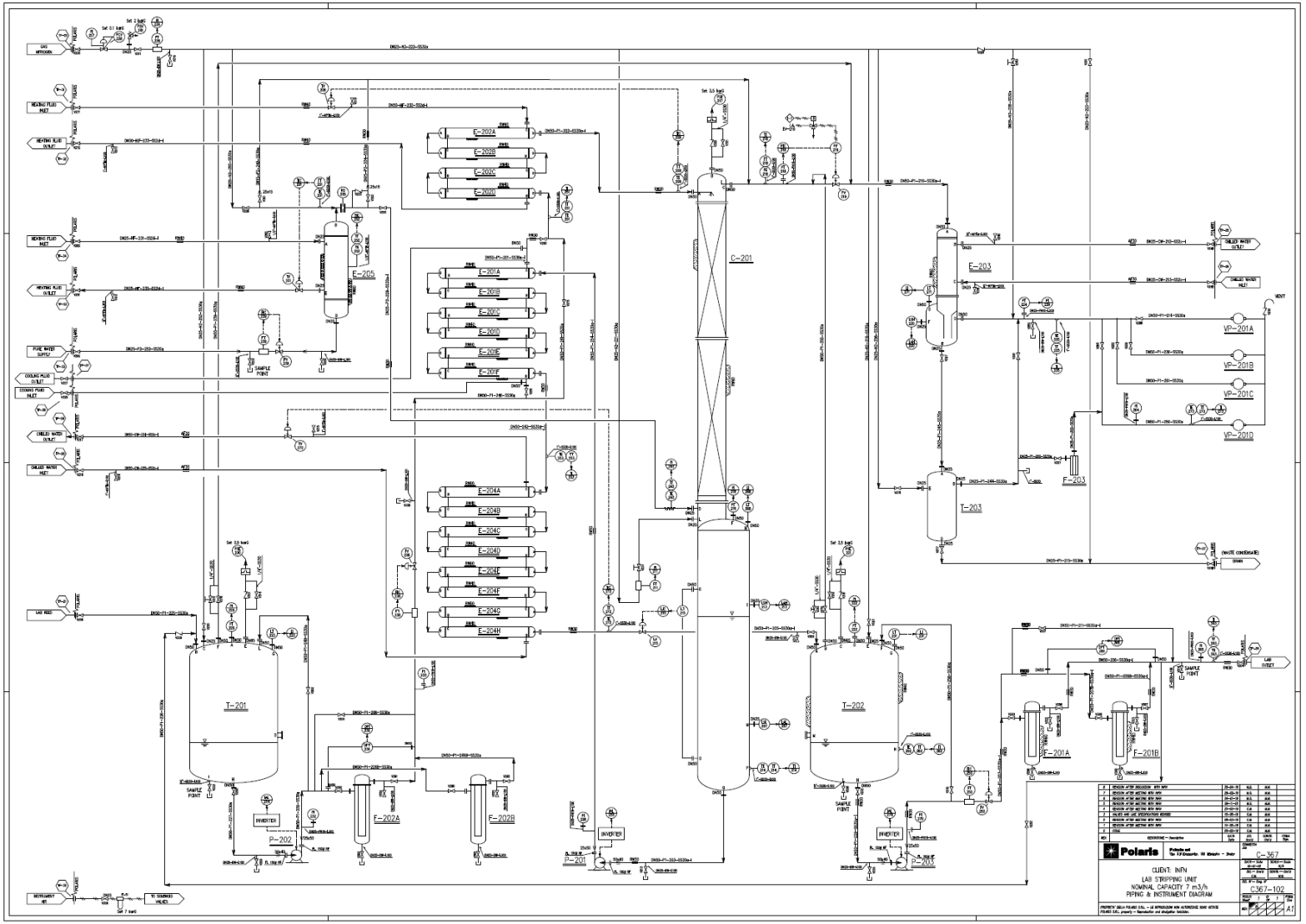

# Status of the Design and construction

## P&Id - Distillation



# Status of the Design and construction

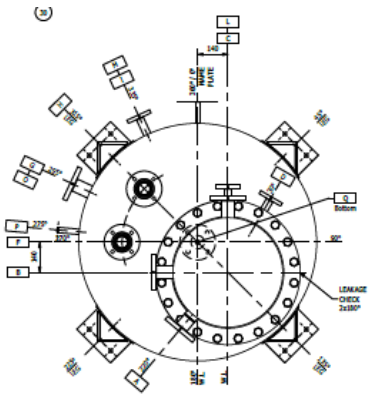
## P&Id - Stripping

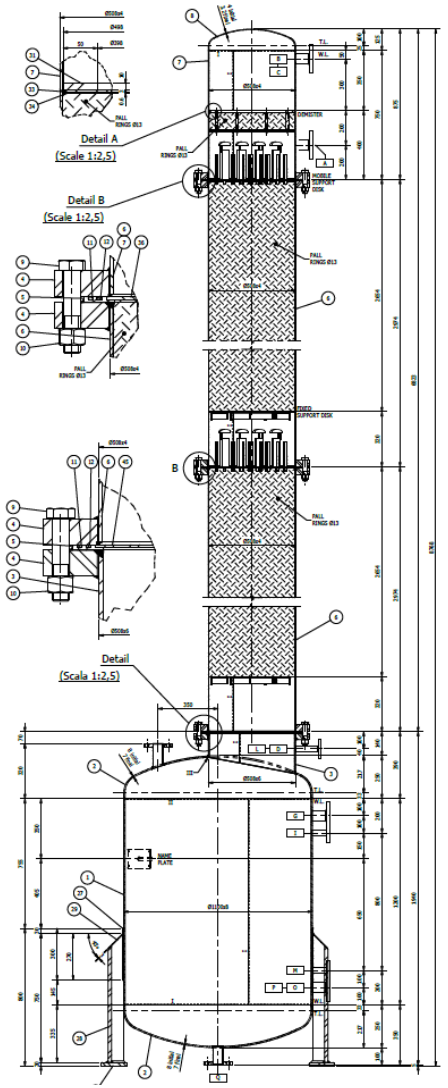


# Status of the Design and construction

## Equipment – Stripping Column

- Finalized the design of the Stripping Column
- Finalized the choose of the filling material of the stipping column
- Added multiple sensor to the stripping column in order to carfully control the level, the temperature and the pressure inside the column

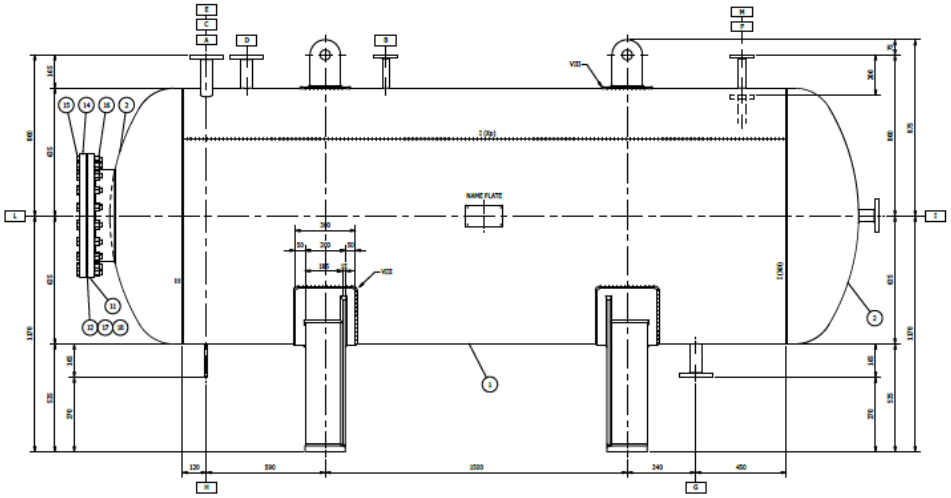


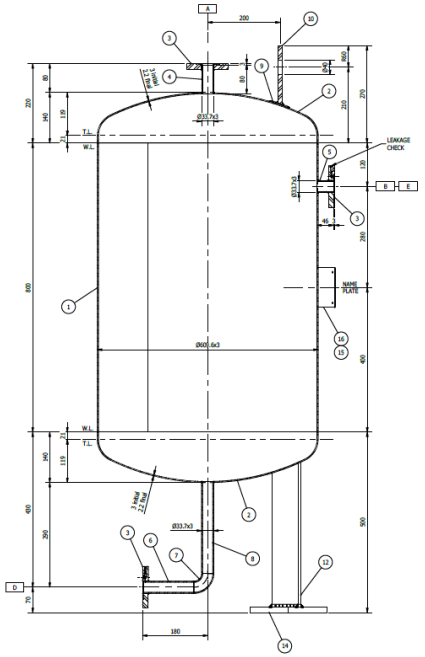


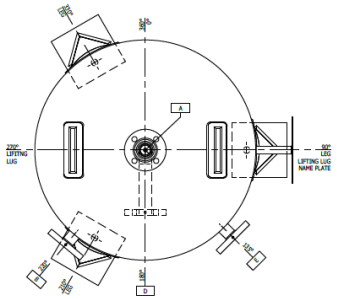
# Status of the Design and construction

## Equipment

- Finalized the design of the tanks in both distillation and stripping plant



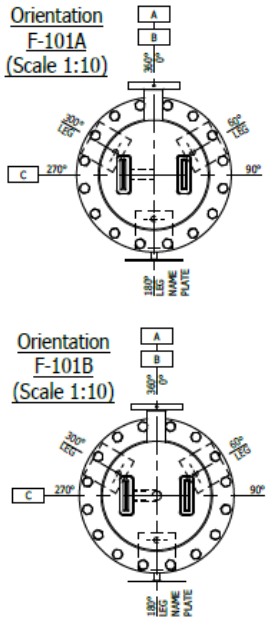


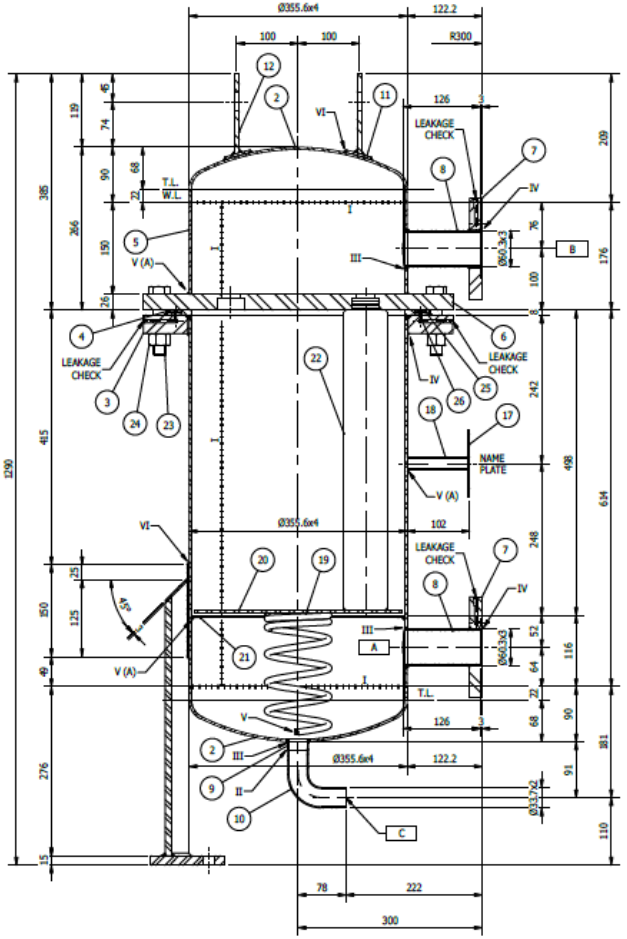


# Status of the Design and construction

## Equipment

- Design of the Filter holder used for both distillation and stripping
- Spring in order to keep the filter in place during the operations



# Status of the Design and construction

## Instrumentation – Flow Meter

- Coriolis mass flow meter will be used for Nitrogen (t-mass 65F) , LS (Promass 40E) (Same used in the pilot plant)
- Produced by Endress+Hauser

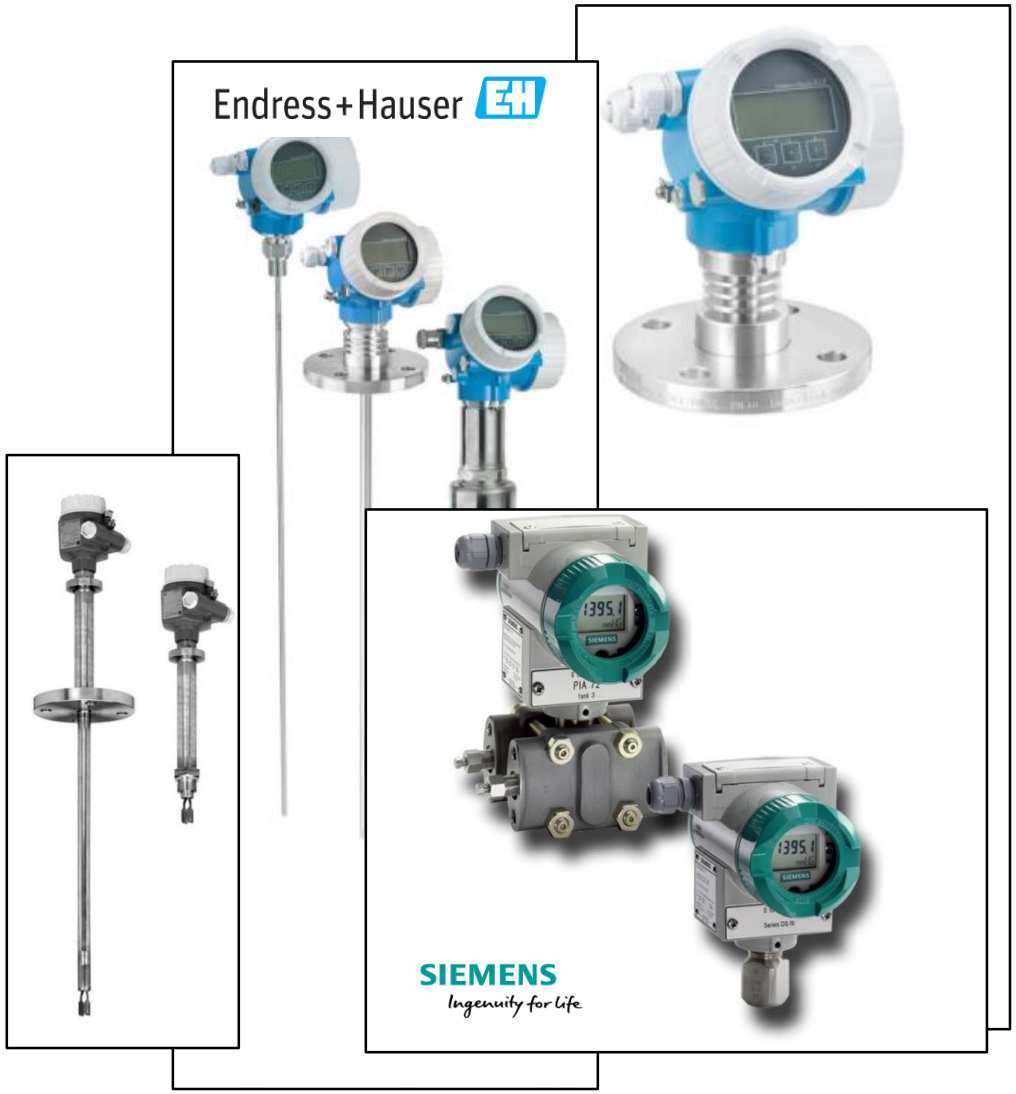
- miniCoriolis mass Flow meter will be used for Water
- Produced by Bornkhorst

- Clamp-on flowmeter produced by SIEMENS will be used for the measurement efo the reflux flow of the distillation column

# Status of the Design and construction

## Instrumentation – Level Meter

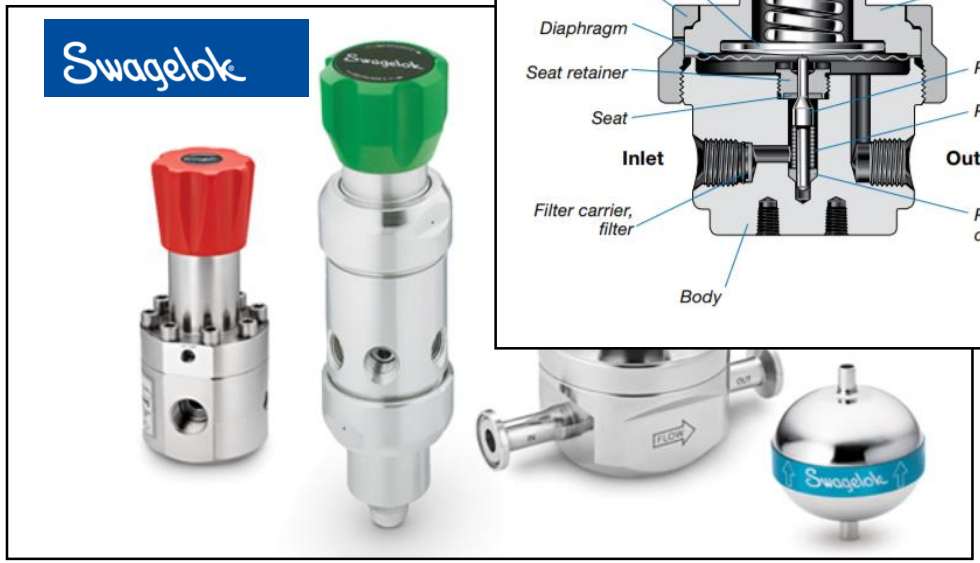
- Free space radar (FMR51) produced by Endress+Hauser installed where is the installation is difficult
- Guided wave radar (FMP54. FMP51) and Level switches (FTL51 and FTL51H) installed in the Distillation Column and in vacuum line condensers of both plants.
- Differential pressure transmitter produced by SIEMENS (Model 7MF4*33) will be used for the measurement of the level in the distillation and stripping columns.
  - Will be used proper oil for high temperature

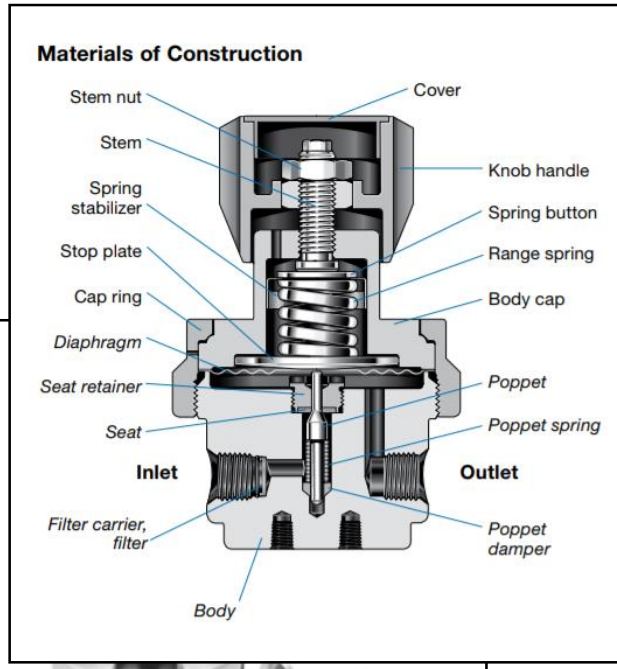


# Status of the Design and construction

## Instrumentation – Pressure reducer

- Pressure reducer from Swagelock has been chosen for the Nitrogen line



# Status of the Design and construction

## Instrumentation - Magnetic Driven Pump

- Magnetic driven pump produced by CDR (Milano)
- Cleaned and assembled by us
- Hydraulic test

Inner and Outer magnets are equipped with NdFeB (neodymium iron boron) and SmCo (samarium cobalt) permanent magnets.
Patented cage magnet attachment guarantee stability during the operation of the pump.

All PFA components are made through Transfer Moulding process.
The Transfer Moulding process is also employed for PVDF \ PP lined casing.

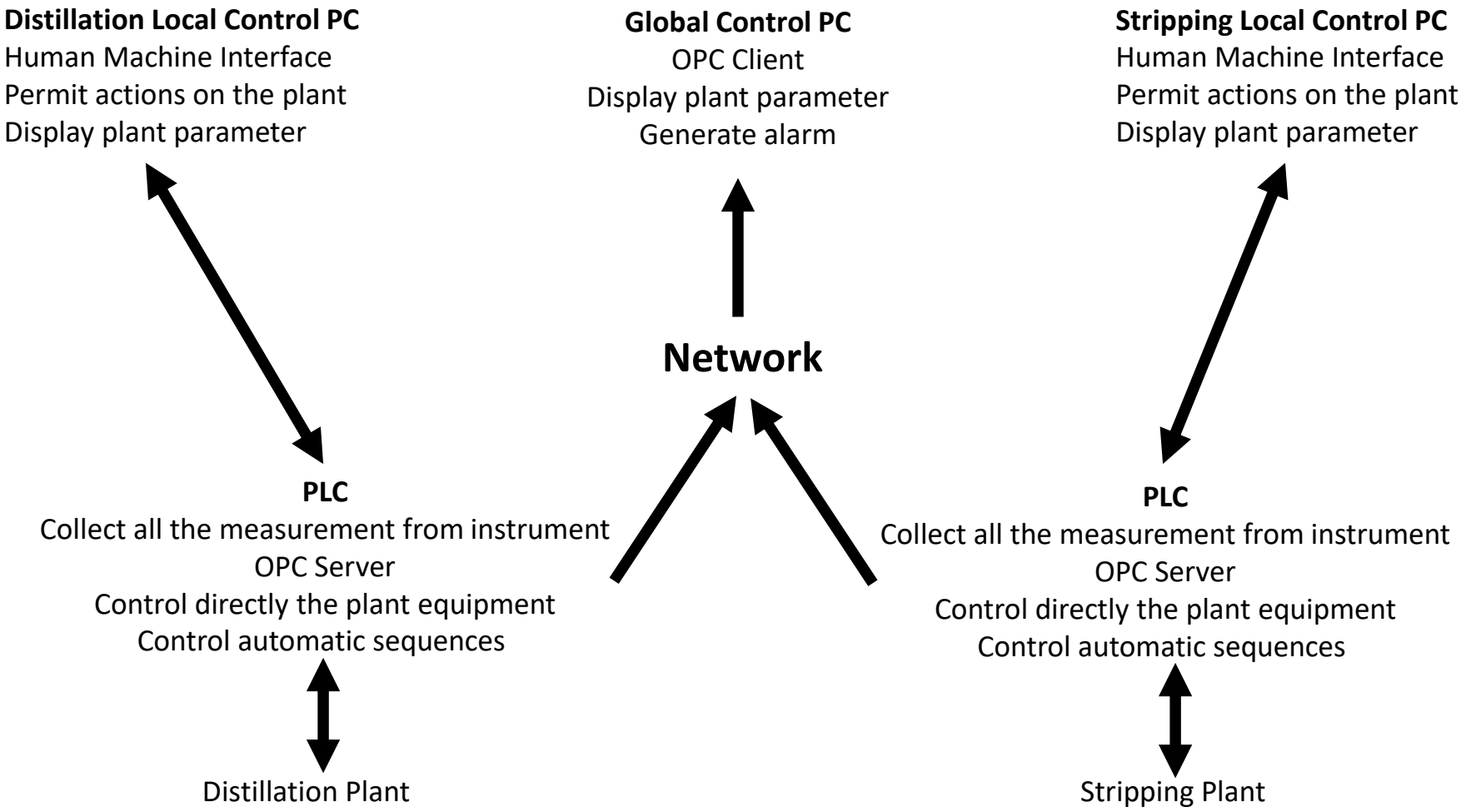
Sealless design
Total containment, essential for hazardous, aggressive or valuable product.

All wetted parts have a high chemical resistance employing a performing material as Virgin unfilled PFA, granting also a wall thickness of at least 4mm to 5mm Virgin PFA.
Alternative available materials for the Wetted parts: PP and PVDF.

Vacuum resistant housing lining. Moreover, all PFA components are made through transfer moulding process.

CDR Pompe s.r.l.

## General Structure



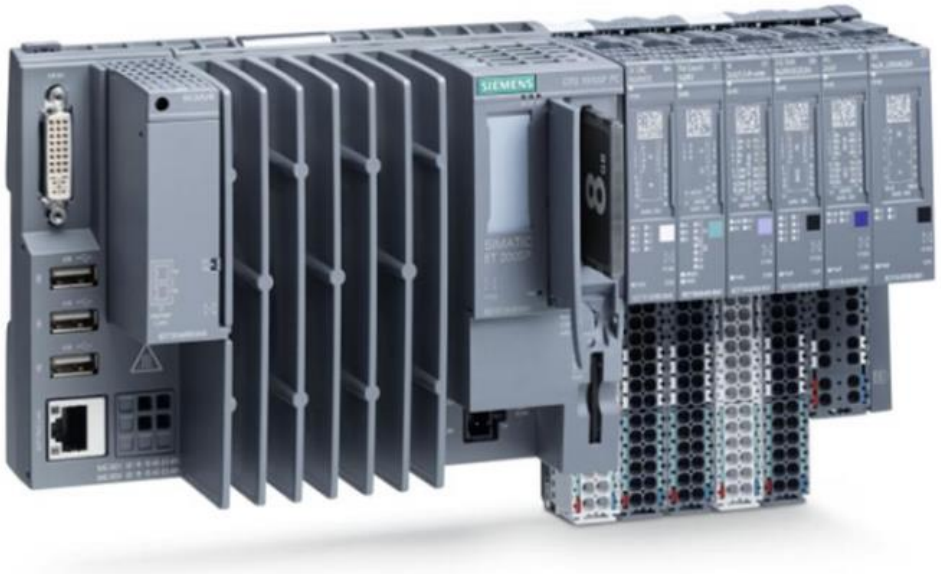
## Hardware

**ET200SP**

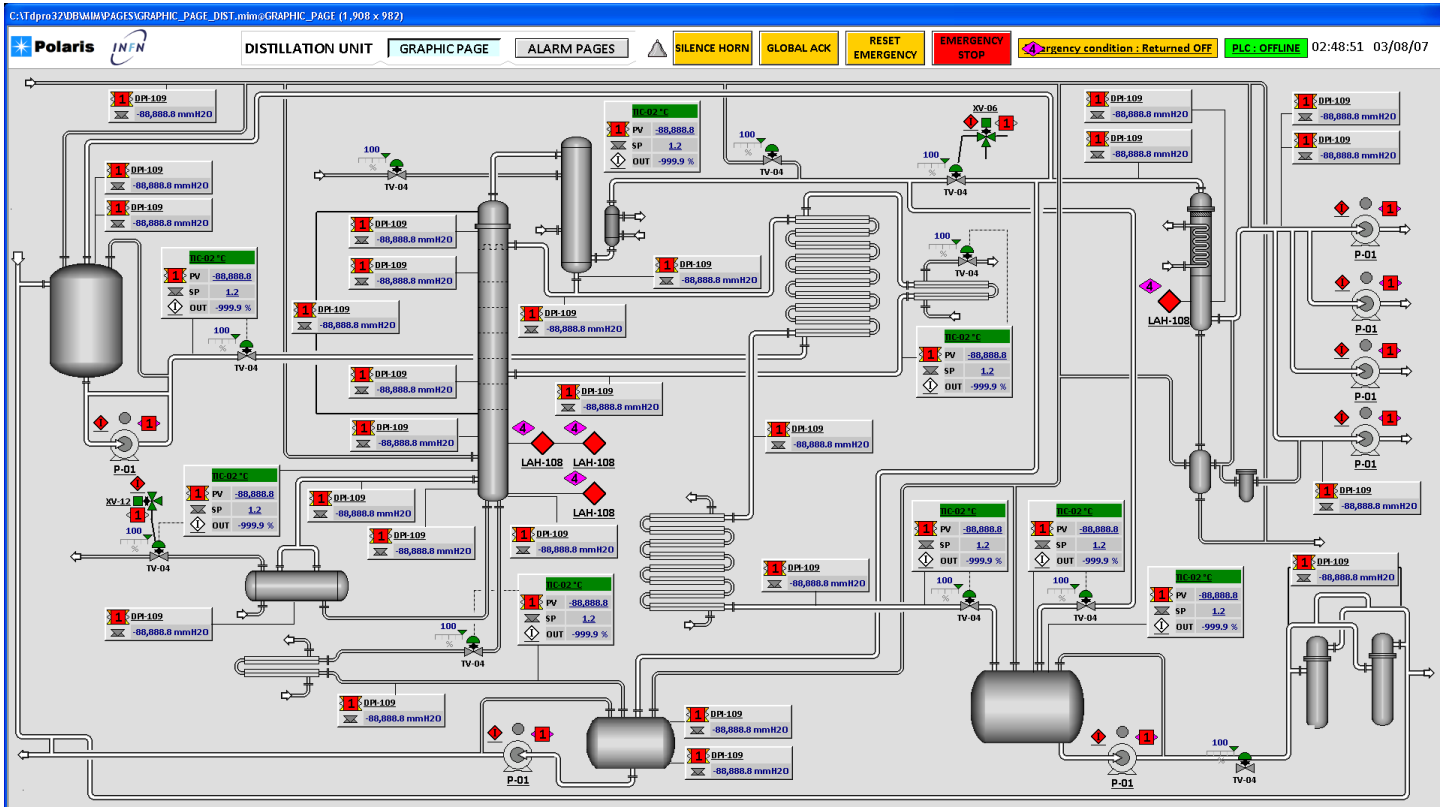
- Bit-modular design
- Exchange of modules during operation (Hot Swapping)
- Wide range of modules
- Integrated safety oriented design
- Integrated channel-specific diagnostics
- Easy to configure by joining modules
- Automatic diagnosis for each channel
- Use in hazardous areas (Zone 2)

**CPU (IM 1512SP-1PN) Bit-modular design**

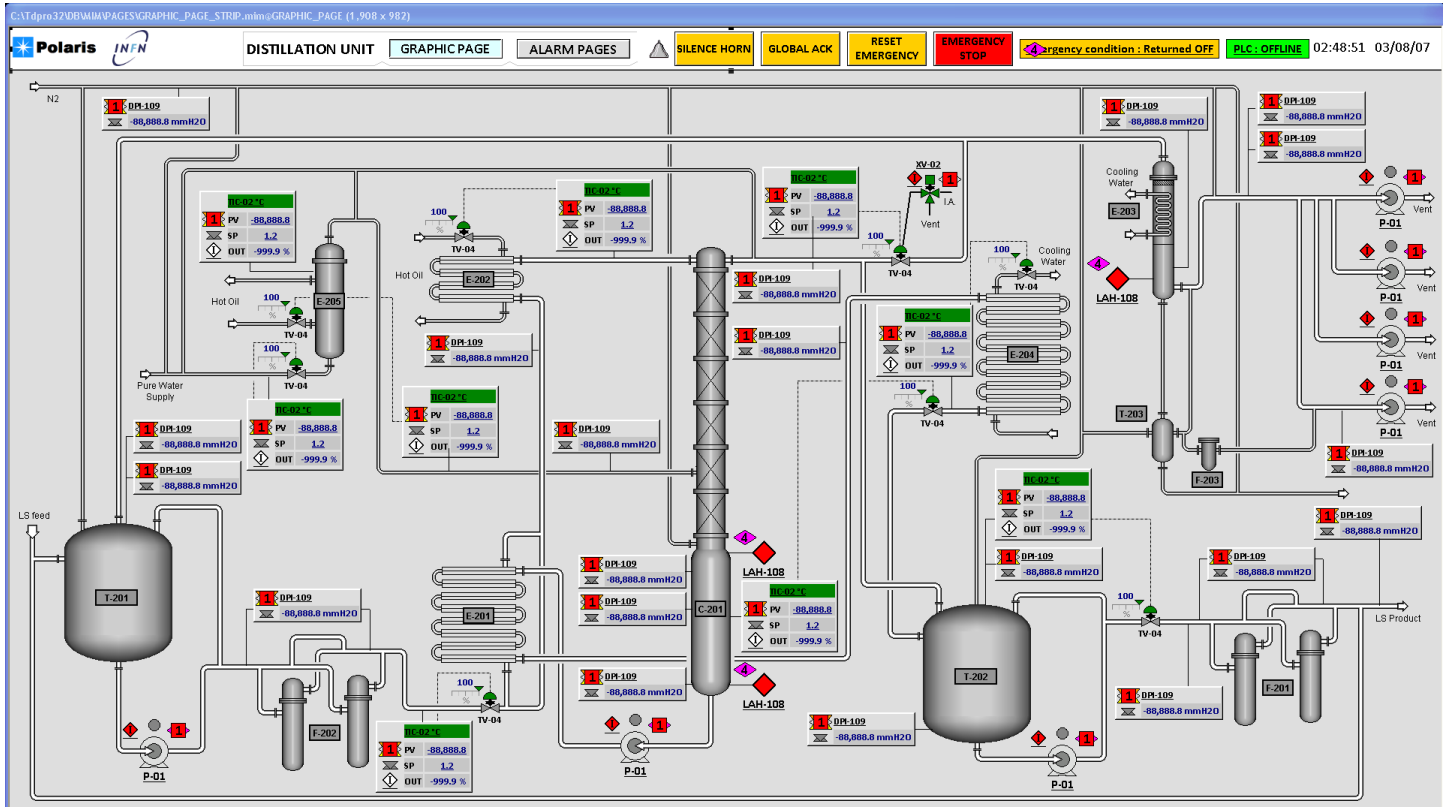
- AMD Dual Core 1.0 Ghz (fanless)
- 2 GB RAM / 4 GB ROM
- Many communication options: PG/OP communication, PROFINET IO, TCP, web server
- SD/MMC memory slot



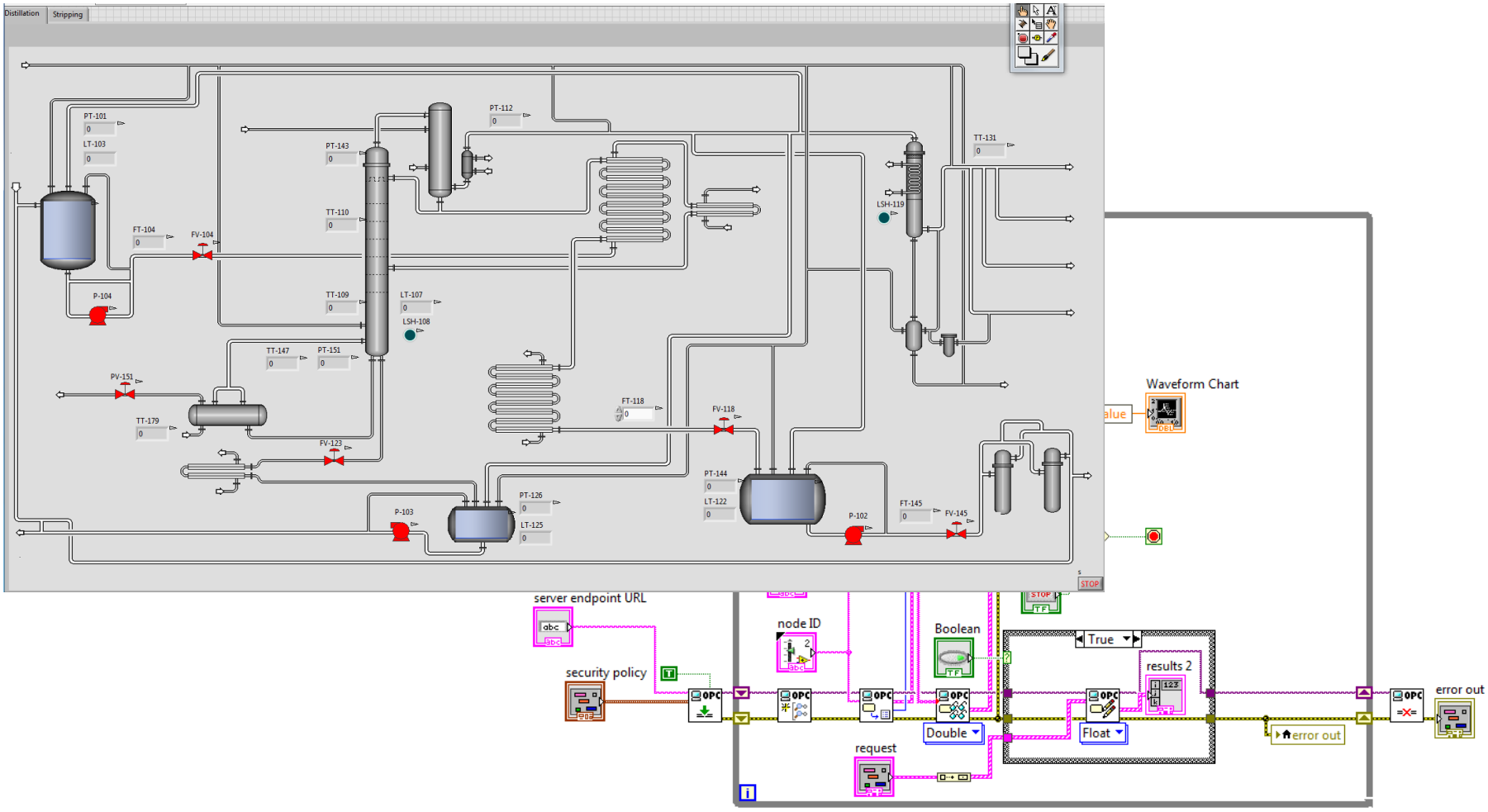
# Software – HMI Distillation



# Software – HMI Stripping



# Software – HMI OPC

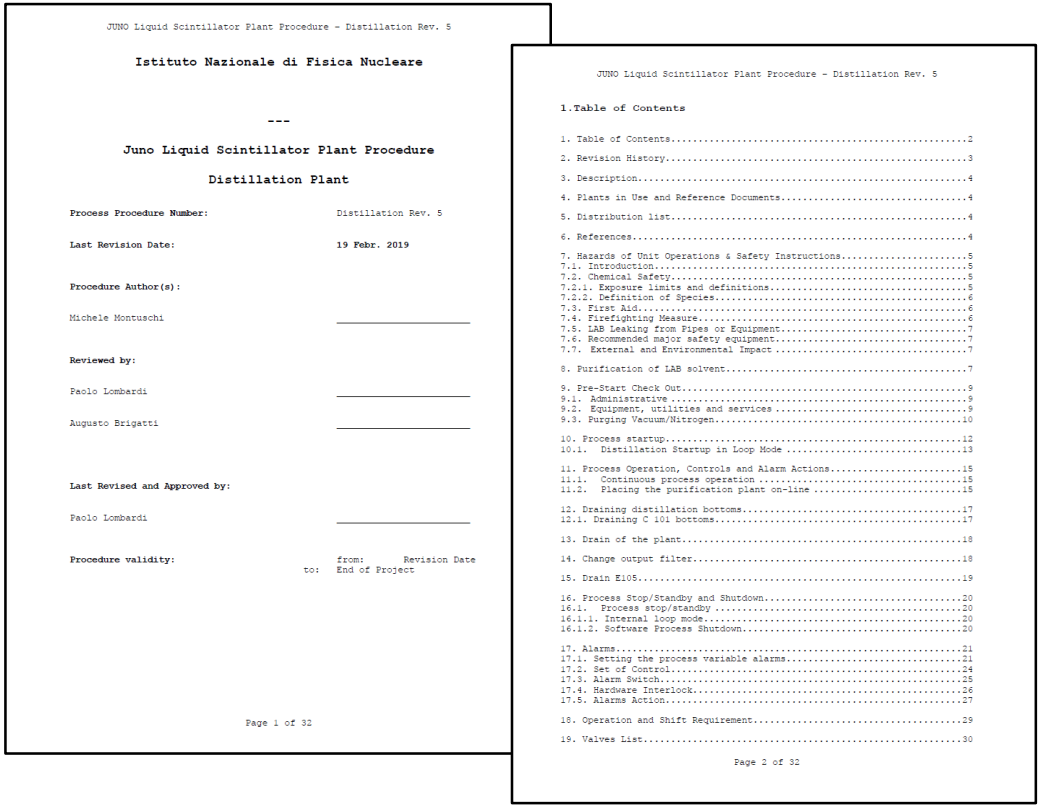


## Distillation and Stripping

- **Introduction**
  - Description
  - Plants Reference (P&Id, Sketch, Drawings, etc)
  - References (Norms, Law, other procedures, etc)
- **Sequences**
  - Pre-Start Check out (Administrative, Equipment)
  - Pump and purging
  - Process Start-up (Internal loop mode)
  - Continuous process operation (Placing plant on-line, Drain of bottom, Replacement of the Filter)
  - Shutdown operation (Drain of plant)
  - Emergency Shutdown (Internal loop mode, complete shutdown)
- **Alarms**
  - Threshold
  - Control (PID)
  - Alarm actions
- **Valve List**

# Procedure

## Distillation and Stripping



JUNO Liquid Scintillator Plant Procedure - Distillation Rev. 5

**Istituto Nazionale di Fisica Nucleare**

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**Juno Liquid Scintillator Plant Procedure**

**Distillation Plant**

**Process Procedure Number:** Distillation Rev. 5

**Last Revision Date:** 19 Febr. 2019

**Procedure Author(s):**

Michele Montuschi _____

**Reviewed by:**

Paolo Lombardi _____

Augusto Brigatti _____

**Last Revised and Approved by:**

Paolo Lombardi _____

**Procedure validity:** from: Revision Date
to: End of Project

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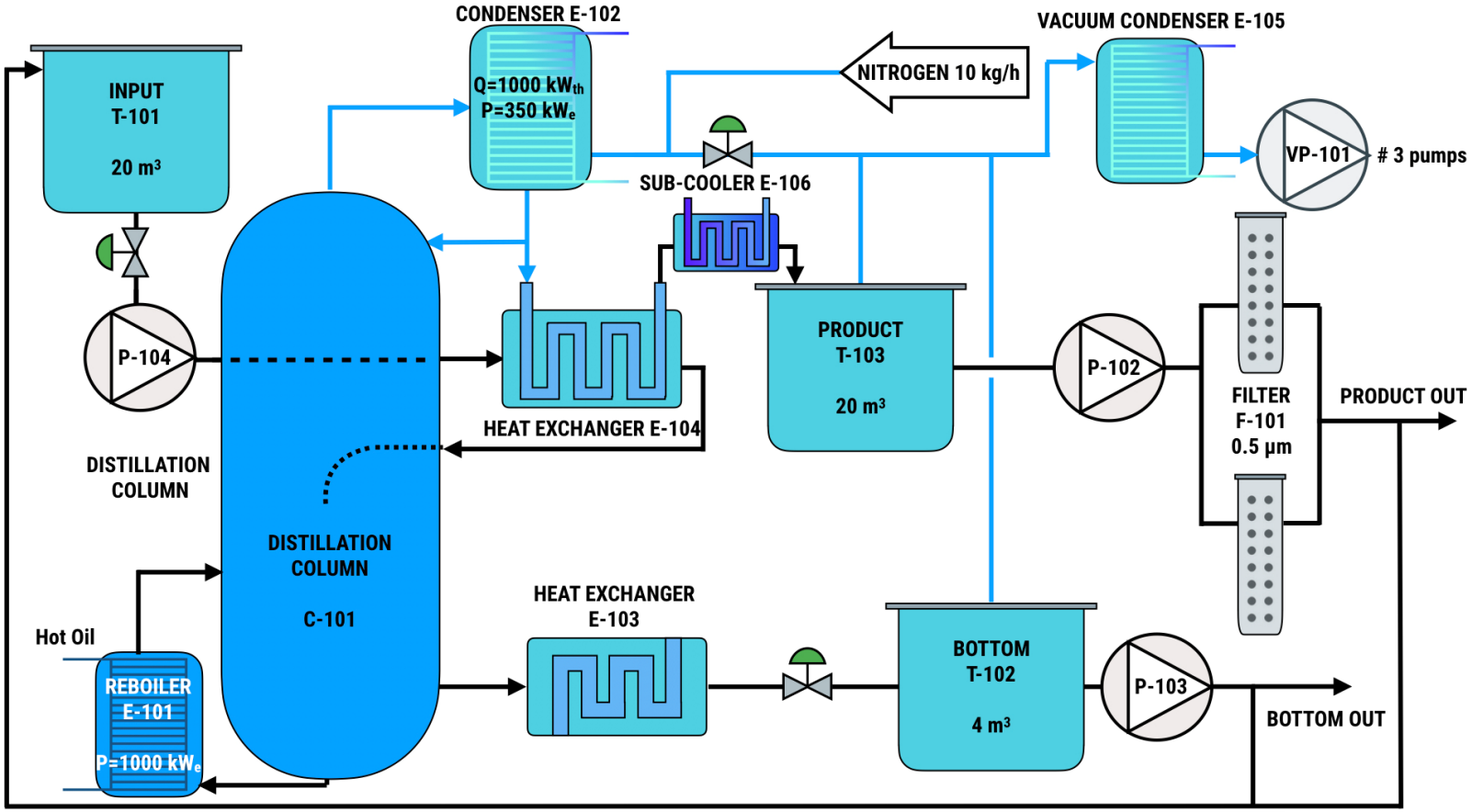
**Stripping:** http://juno.ihep.ac.cn/cgi-bin/Eng_DocDB/ShowDocument?docid=13

## Distillation – Start Up



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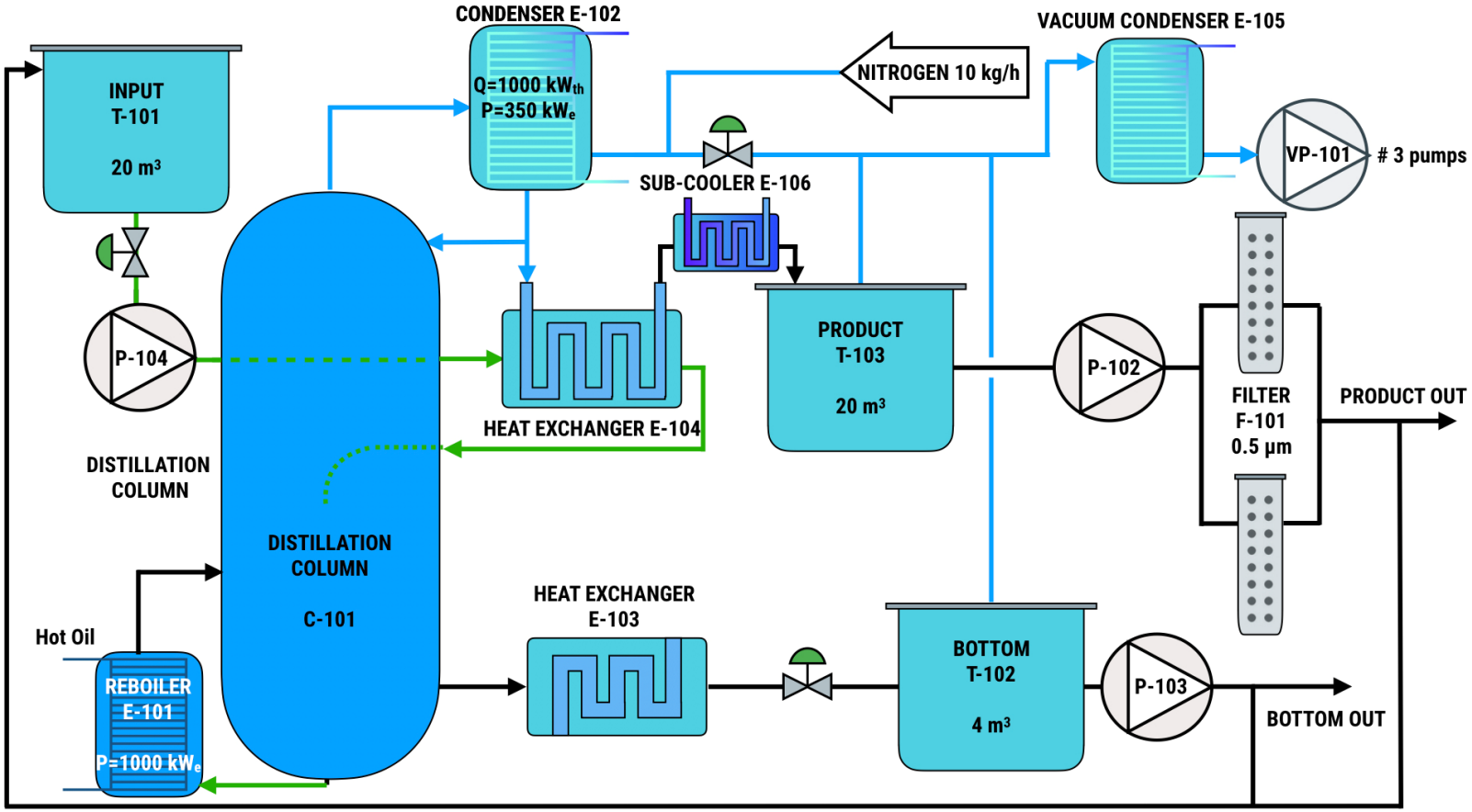

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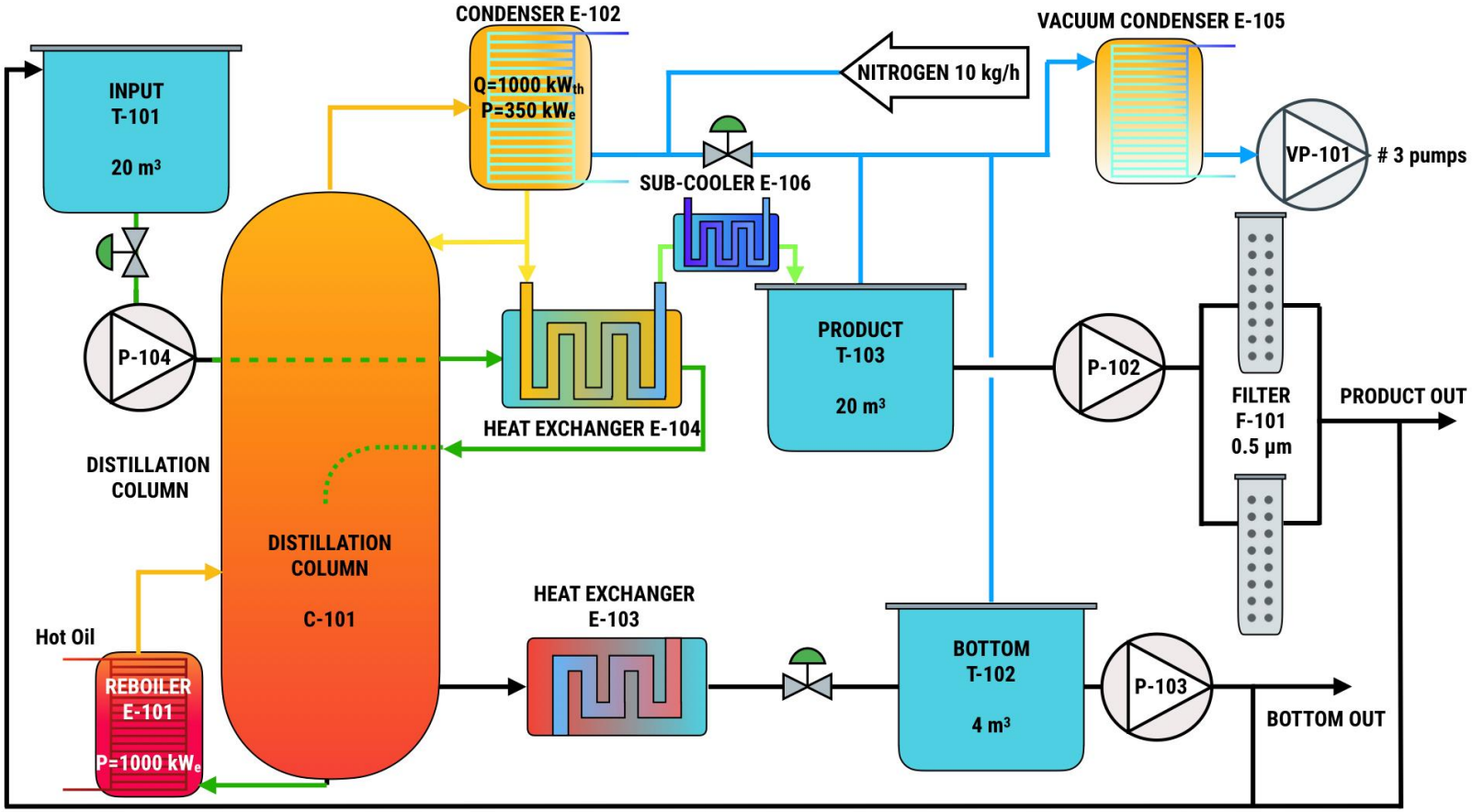

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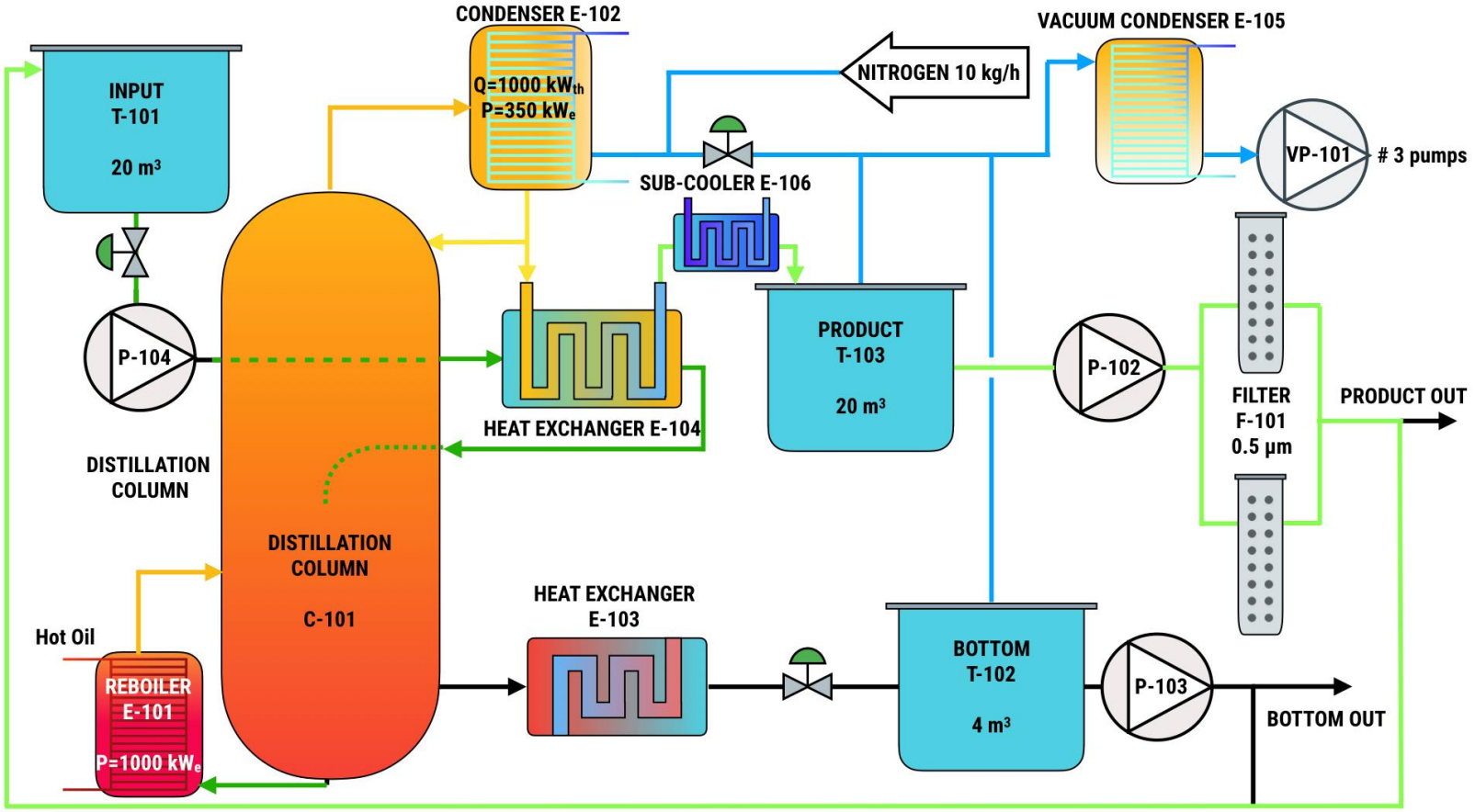
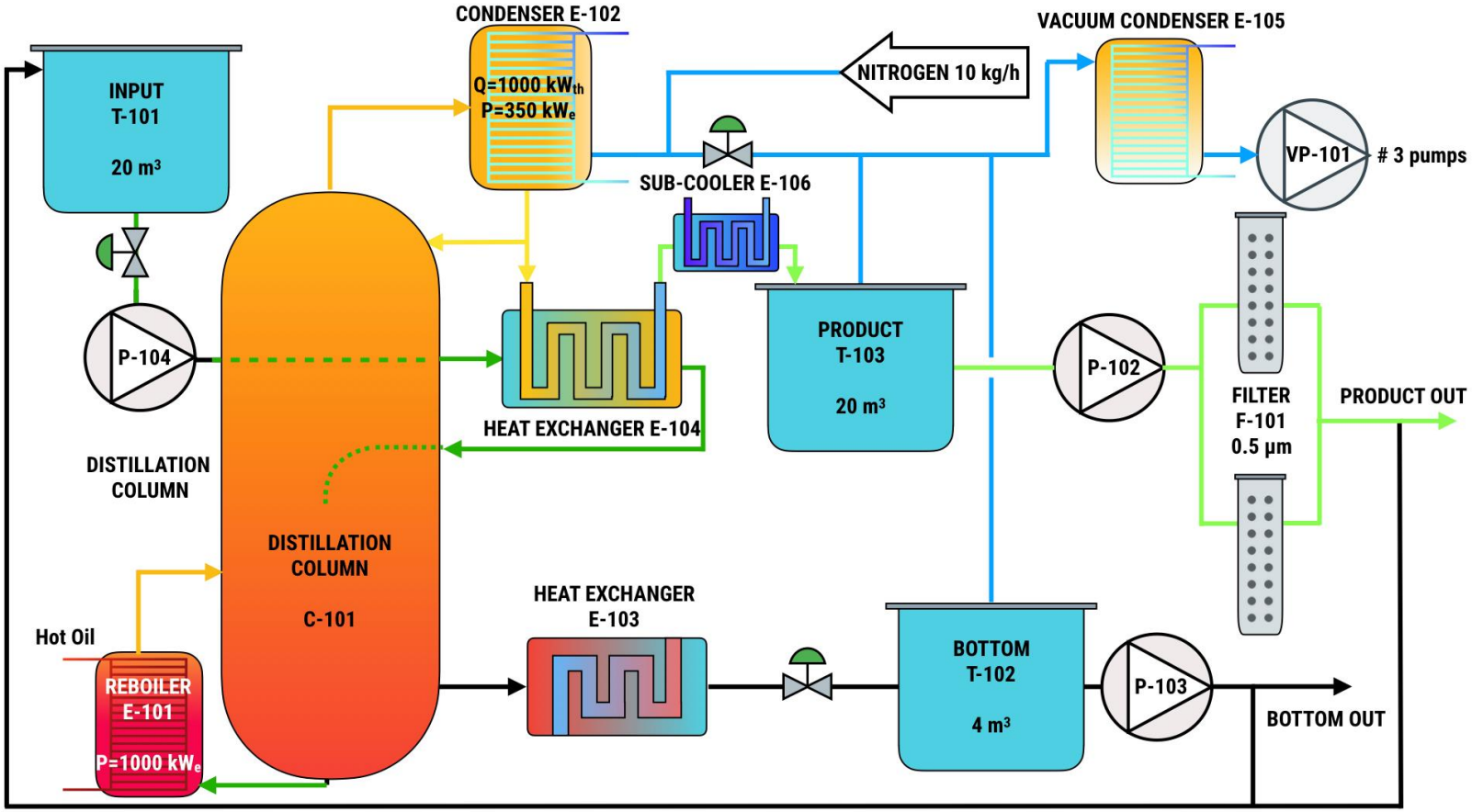
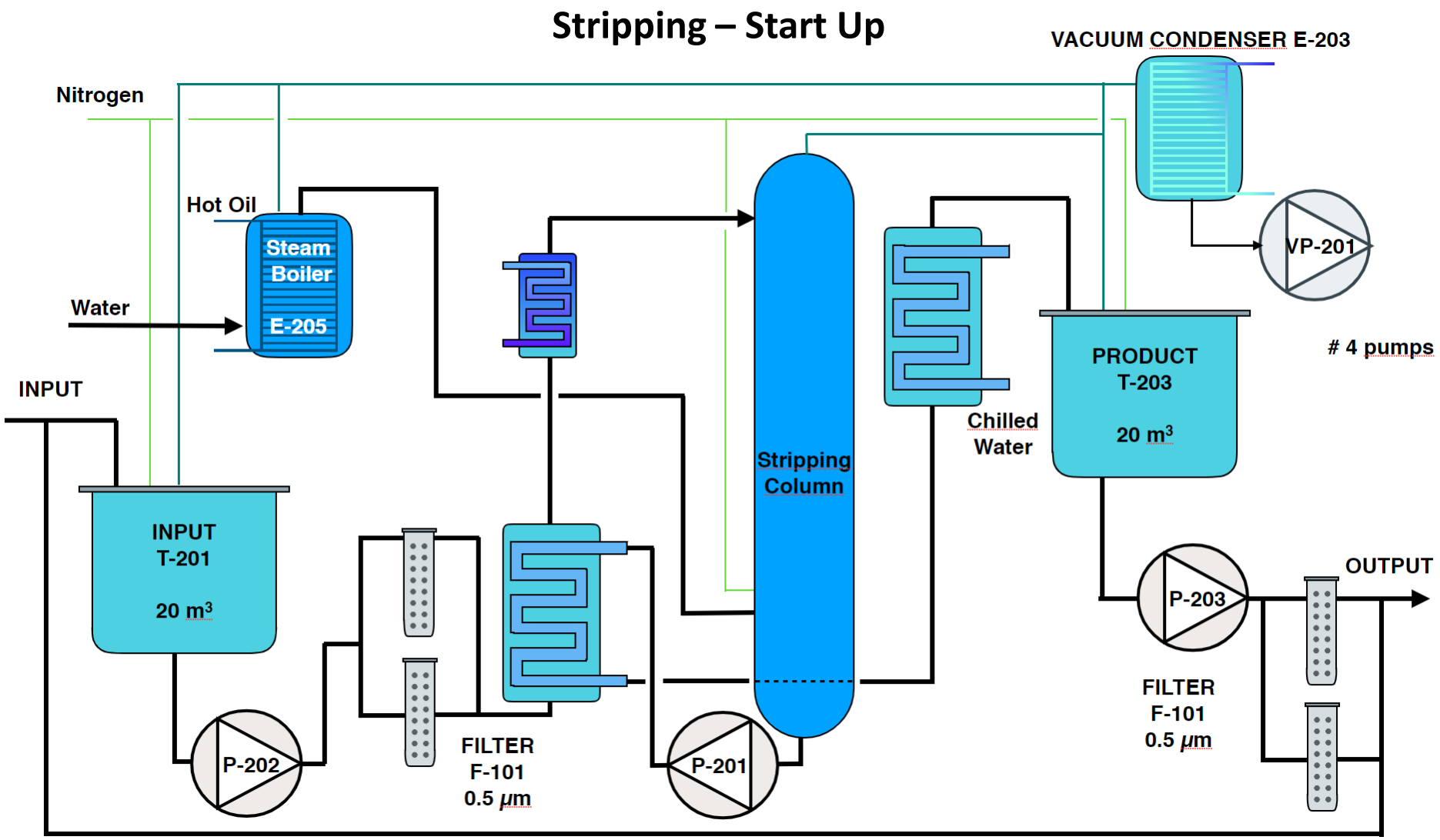


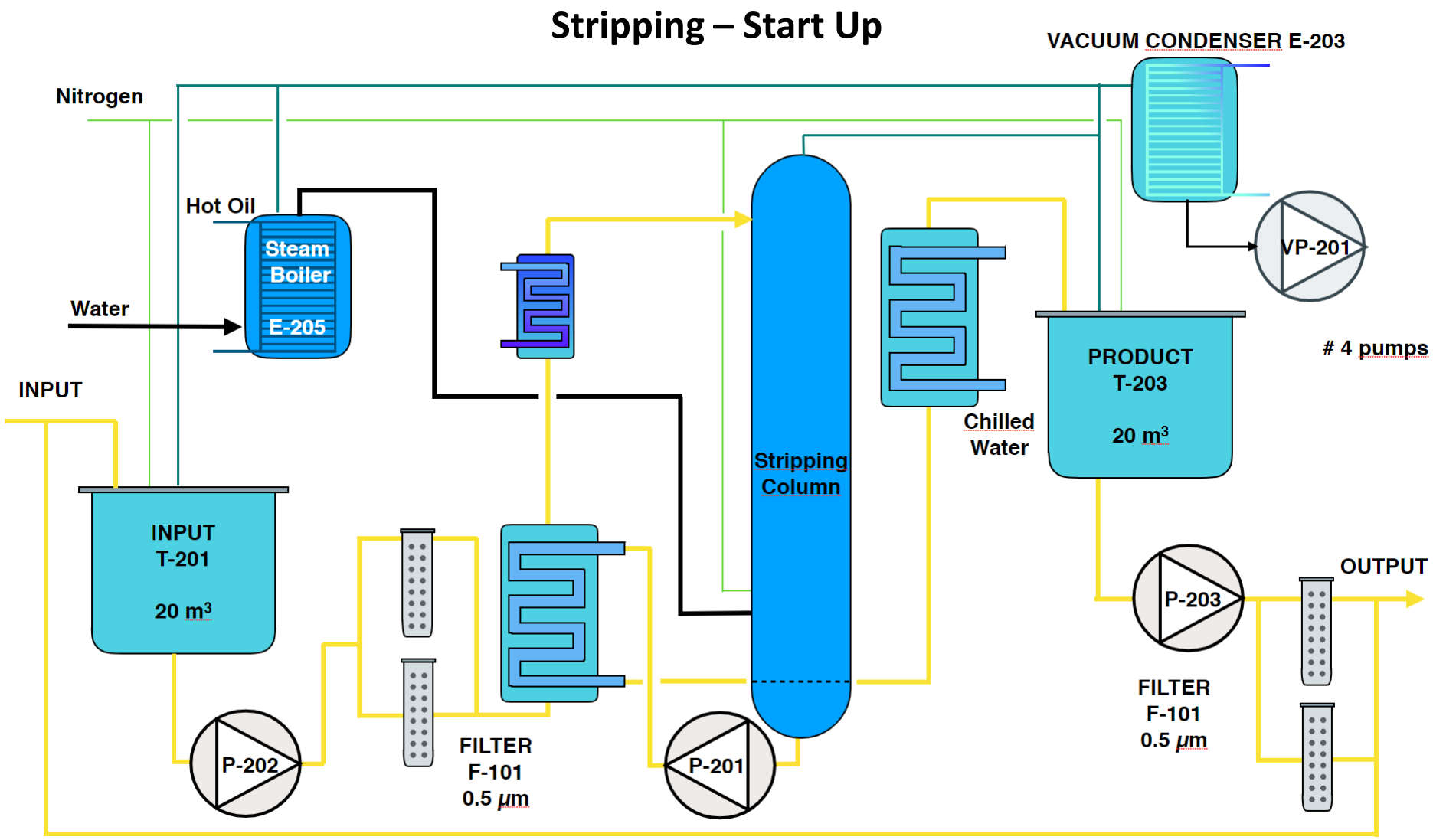
## Distillation – Start Up



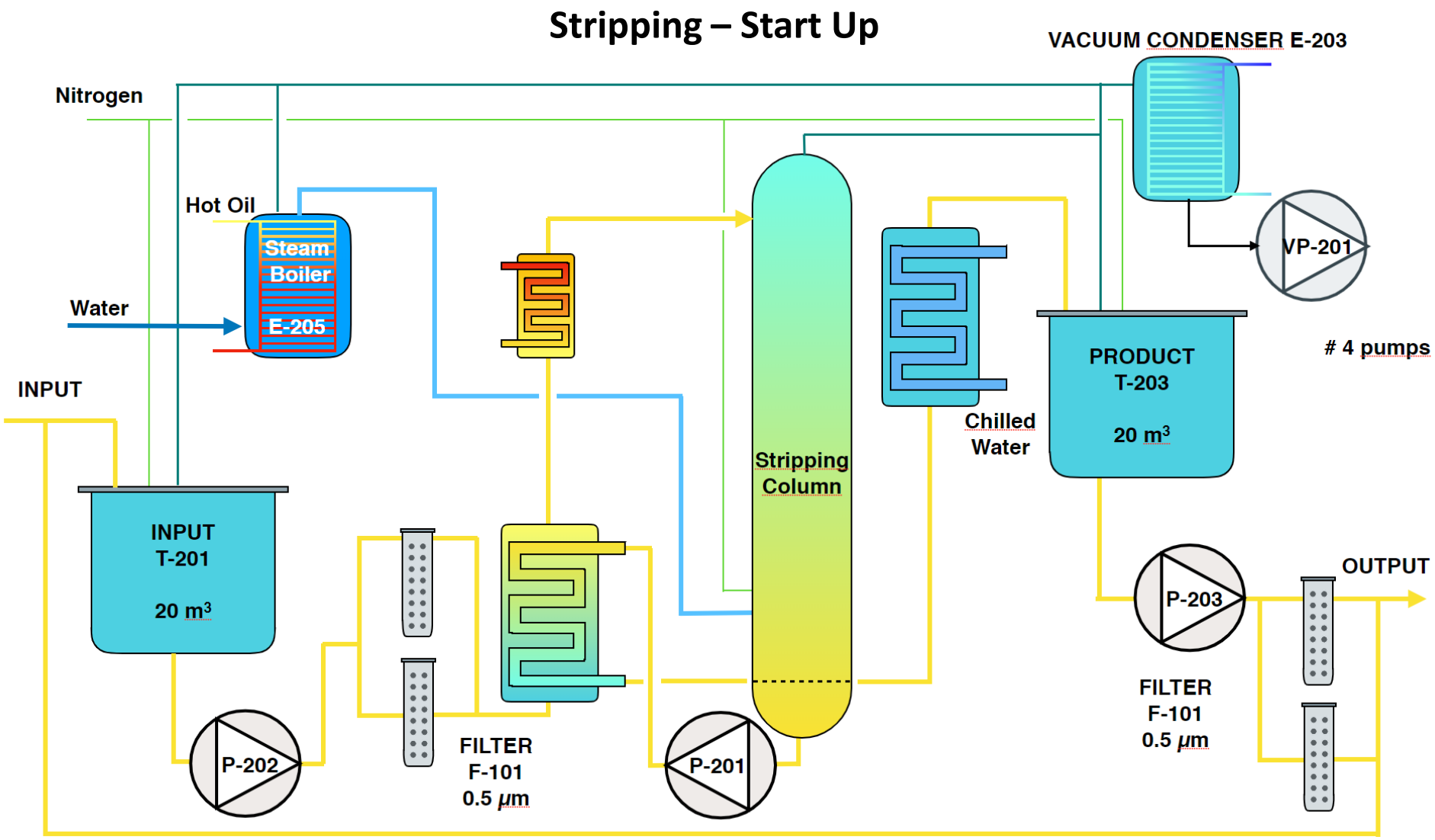
# Procedure


Stripping – Start Up
VACUUM CONDENSER E-203
Nitrogen
Hot Oil
Steam Boiler
E-205
Water
INPUT
VP-201
# 4 pumps
PRODUCT
T-203
20 m3
Chilled Water
Stripping Column
INPUT
T-201
20 m3
OUTPUT
P-203
FILTER
F-101
0.5 μm
P-202
FILTER
F-101
0.5 μm
P-201

# Procedure


Stripping – Start Up
VACUUM CONDENSER E-203
Nitrogen
Hot Oil
Steam Boiler
E-205
Water
INPUT
VP-201
# 4 pumps
PRODUCT
T-203
20 m3
Chilled Water
Stripping Column
INPUT
T-201
20 m3
P-202
FILTER
F-101
0.5 μm
P-201
P-203
FILTER
F-101
0.5 μm
OUTPUT

# Procedure


Stripping – Start Up
VACUUM CONDENSER E-203
Nitrogen
Hot Oil
Steam Boiler E-205
Water
INPUT
INPUT T-201 20 m3
P-202
FILTER F-101 0.5 μm
Stripping Column
P-201
Chilled Water
PRODUCT T-203 20 m3
VP-201
# 4 pumps
P-203
FILTER F-101 0.5 μm
OUTPUT

# Conclusion

- The Distillation test @DayaBay shows very stable performances of the Distillation and stripping plants, but it was not successful due to a failure of the insertion pipe
- The Design of the final plants is almost finalized
- The Executive drawings of the equipments are almost complete
- The instruments that will be installed in the plants are chosen
- The hardware for the distillation and stripping column DCS has been decided and tested with good result in the pilot plant
- The HMI of the DCS has been developed
- The software will be developed starting from the experience gained during the pilot plant test
- The OPC UA server is implemented on the ET200SP and it will be available for the Global Monitoring system
- The procedures (sequences, alarm response) for the Distillation plant and Stripping plant are almost completed