NEXTCHEM

UNFOLD
STAMICARBON
15TH SYMPOSIUM 2026

NEW DESIGN FOR ULE POOL REACTOR / CONDENSER

Mark Wagemans

AGENDA

01 INTRODUCTION

02 PROCESS DESCRIPTION

03 EQUIPMENT DESIGN

04 OPERATIONAL EXPERIENCES

05 CONCLUSIONS

01

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INTRODUCTION

INTRODUCTION

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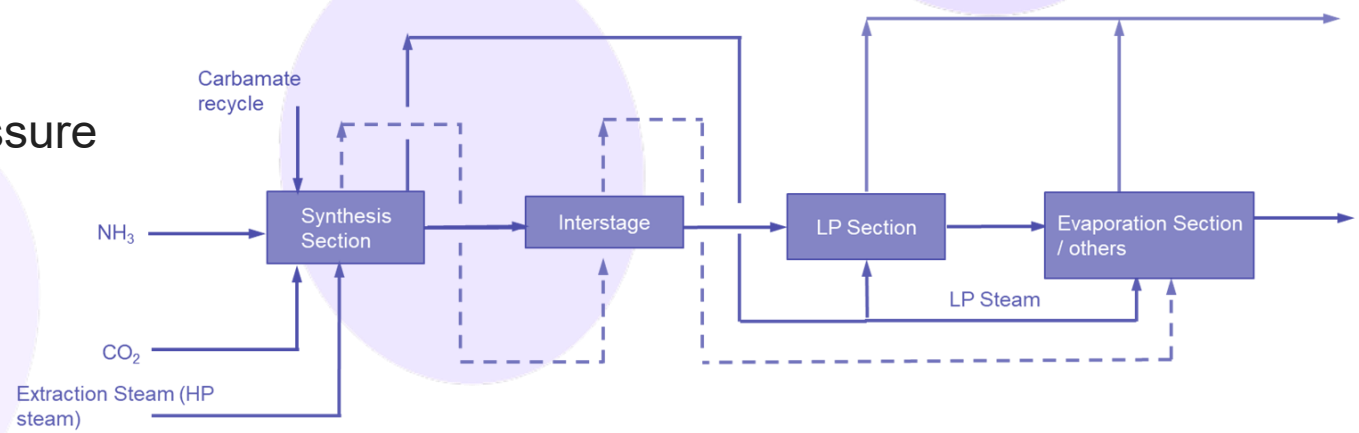
- The NX STAMI™ Urea Ultra-Low Energy Design was launched at the Stamicarbon Symposium in 2012
- Latest generation of pool condenser and pool reactor design
- Significant reduction of steam consumption
- Technological advancements:
  - Use of pool condensation in the synthesis section
  - Proprietary E-type steel as material of construction
  - Implementation of proven medium-pressure recirculation
- Heat integration concept:
  - Traditional urea processes: N=2
  - Ultra-Low Energy Design: N=3



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PROCESS DESCRIPTION

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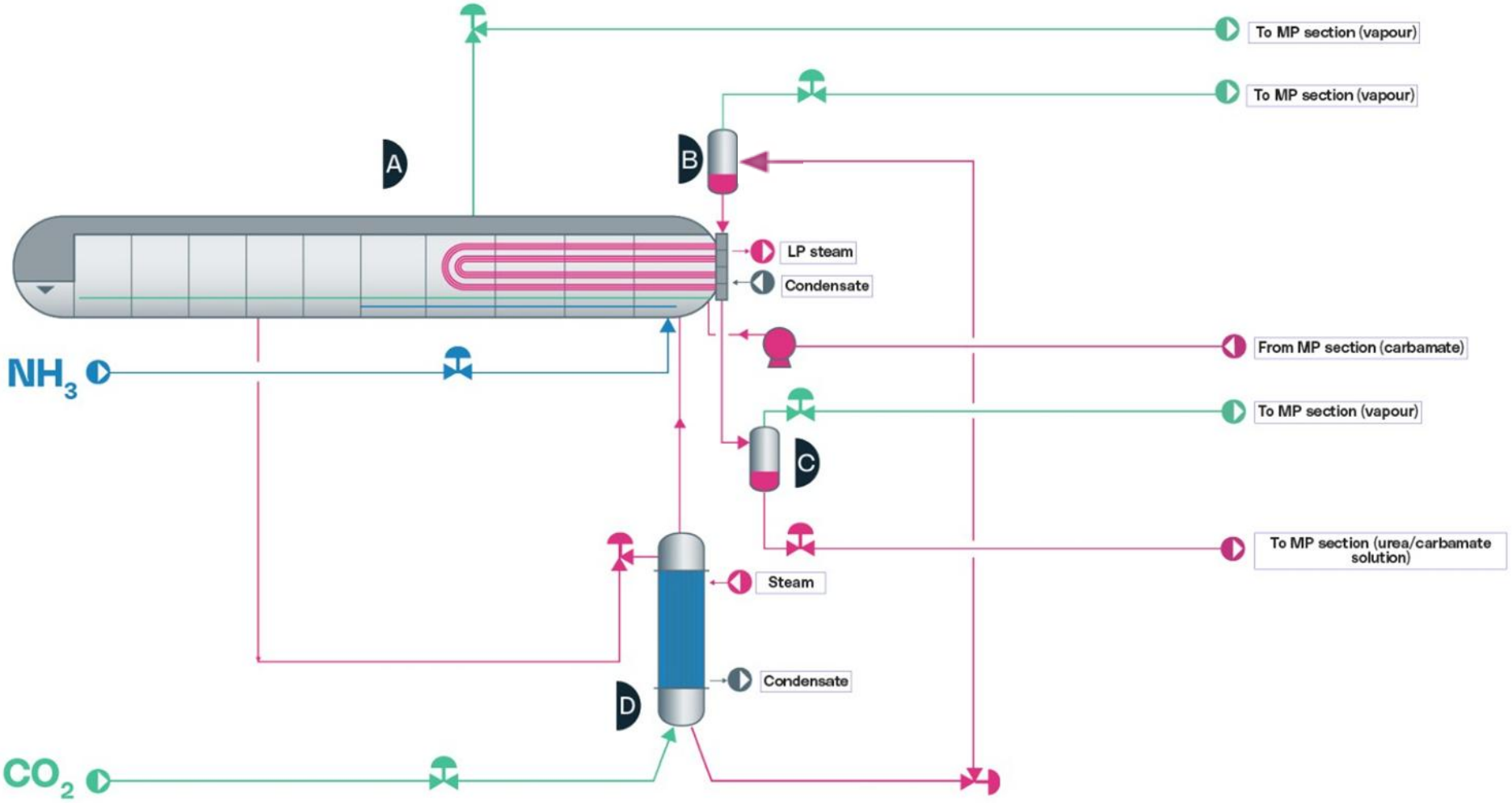

A | Pool reactor
B | First MP separator
C | Second MP separator
D | Stripper

EQUIPMENT DESIGN

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- Dual bundle is integrated in equipment
- Design allows corrosive media on shell side and tube side
- Superior resistant properties of E-type steel against corrosion fully utilized
- Two generations of equipment design

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EQUIPMENT DESIGN: FIRST GENERATION

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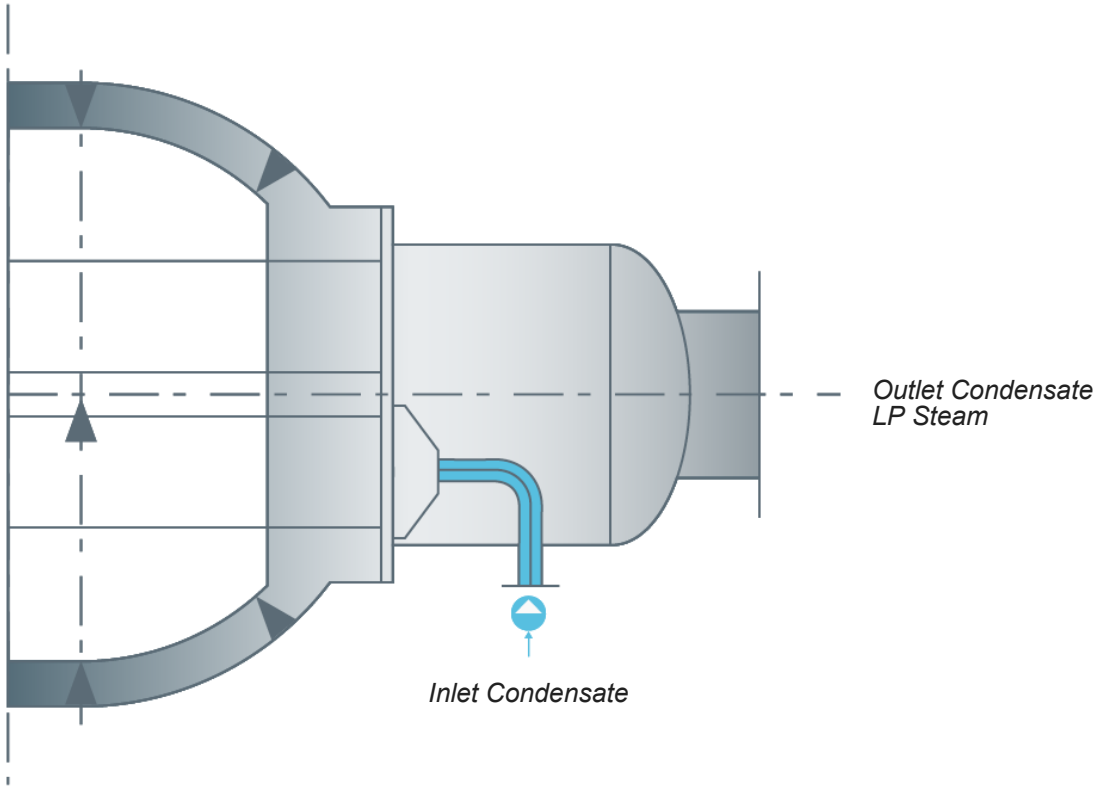
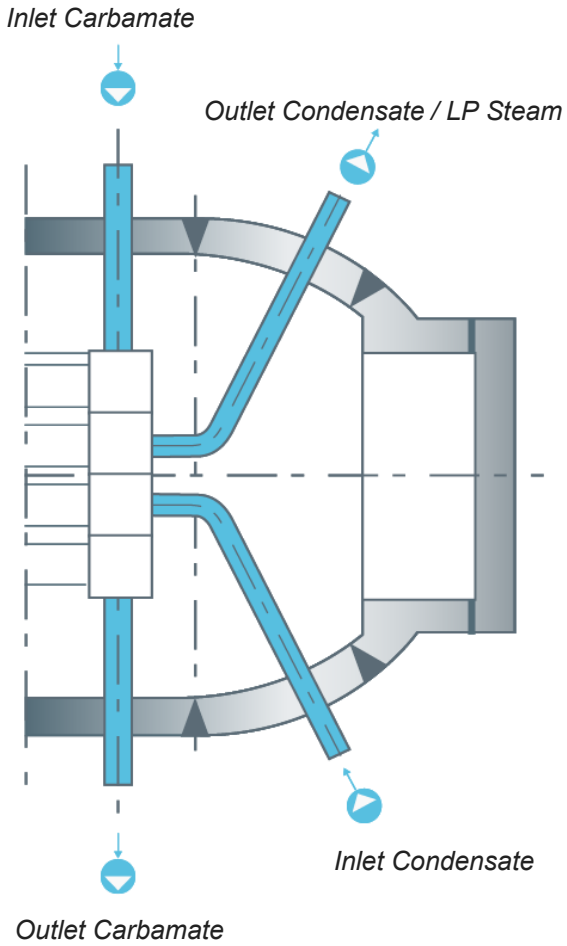
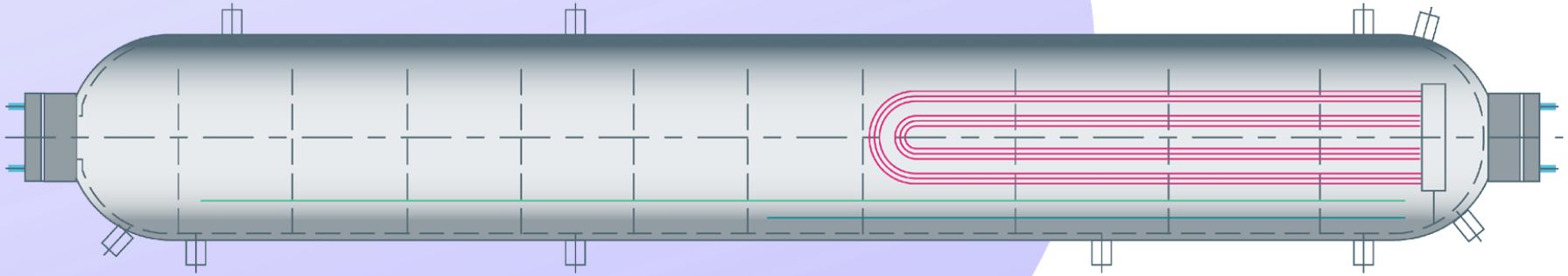


Conventional pool reactor or pool condenser



ULE pool reactor

EQUIPMENT DESIGN: FIRST GENERATION



Conceptual layout of ULE pool reactor

Standard design for tube-to-tube sheet weld like stripper

All internal components of ULE pool reactor are made from E-type steel

Tube sheet and distribution box are built inside the vessel

EQUIPMENT DESIGN: FIRST GENERATION

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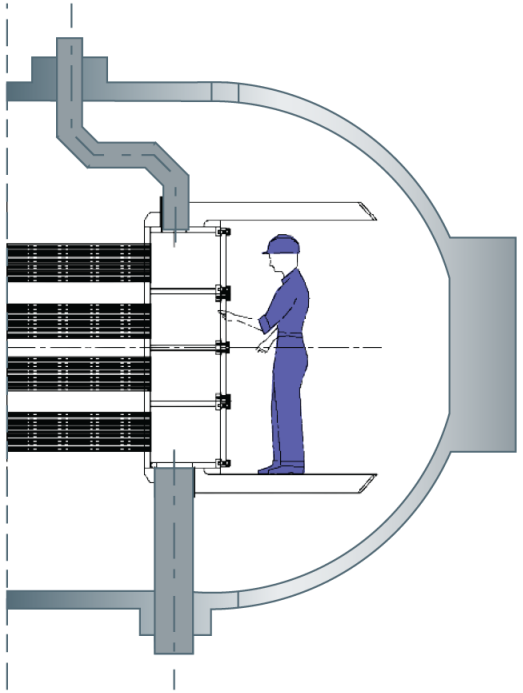
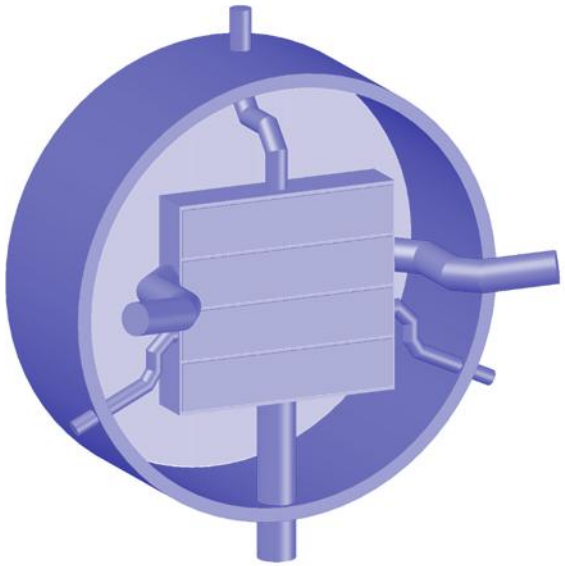
- Tube bundles are accessible through manhole
- Tube sheet and distribution box components fully accessible by opening internal covers
- Special sealing system on internal covers
- Piping elbows:
  - Bended pipes
  - Segments
- Finite Element Analysis for internal components
- Computational Fluid Dynamics for medium-pressure outlet flow





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EQUIPMENT DESIGN: SECOND GENERATION

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- Second-generation design to implement ULE process for higher plant capacities
- Concept is based on proven design
- Carbon steel tube sheet:
  - Stainless steel weld overlay at the high-pressure shell side
  - Stainless steel weld overlay at the medium-pressure tube side
- Medium-pressure carbamate tube side:
  - Stainless steel sleeves at the tube sheet holes
  - Monitored by a leak detection system

EQUIPMENT DESIGN: SECOND GENERATION

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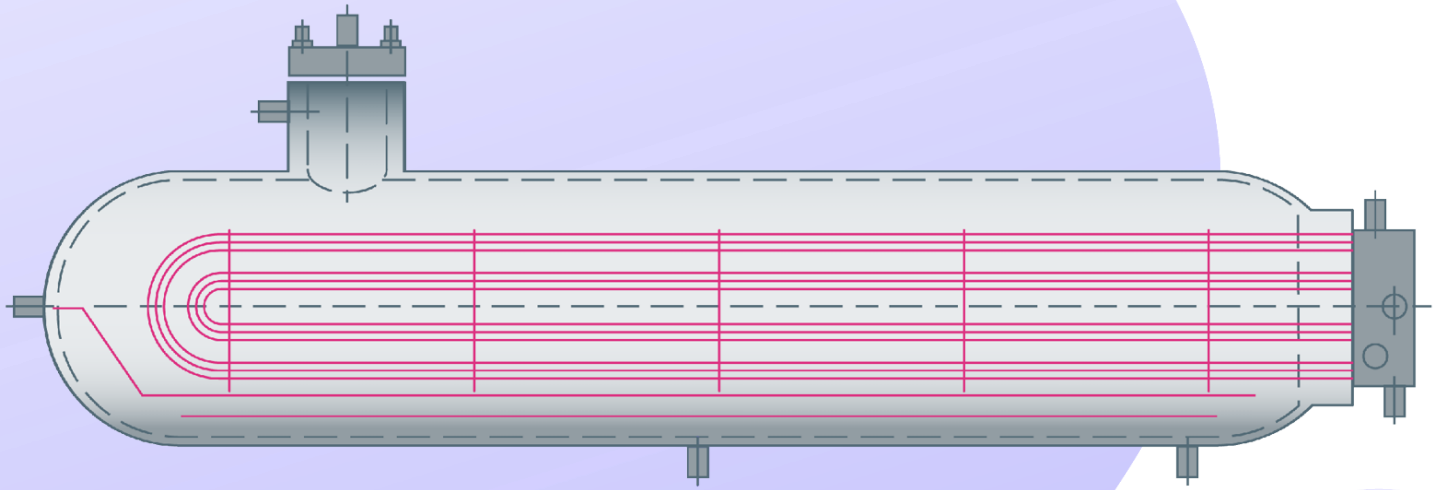

Conceptual layout of ULE pool condenser

Distribution box is located outside the vessel

U-tube bundle is connected to tube sheet by internal bore welds

Tube sheet and distribution box components fully accessible for maintenance and inspections

EQUIPMENT DESIGN: SECOND GENERATION

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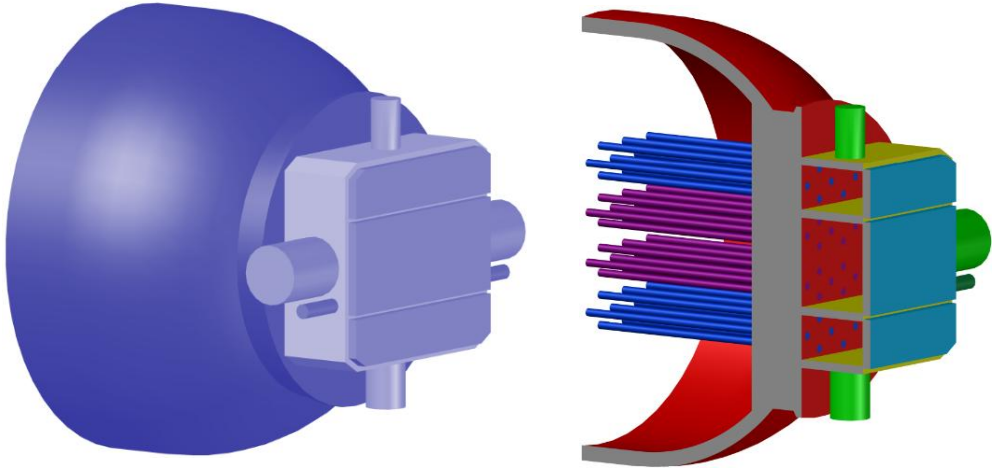
- Special sealing system on distribution box covers
- Design of gasket configuration verified by:
  - Using Finite Element Analysis considering all load cases
  - Additional hydro test simulating deformation of components
- Finite Element Analysis performed for tube sheet and distribution box based on load cases predefined by Stamicarbon



EQUIPMENT DESIGN: SECOND GENERATION

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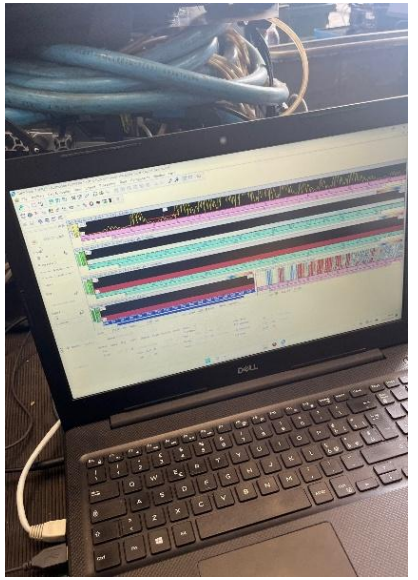
- Inspection requirements defined for critical parts
- Special efficient NDT techniques developed for critical components and welds
- Repair and plugging options designed and tested in case required
- Alignment with equipment manufacturer on:
  - Welding technologies
  - Fabrication sequence
  - Inspection and testing plan
- Quantitative Risk Assessment:
  - All potentional risks for design and fabrication identified
  - Mitigation actions defined and implemented



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OPERATIONAL EXPERIENCES

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- Six grassroot plants in operation since the beginning of 2021
- Three other grassroot plants are currently in the manufacturing phase
- Nameplate capacities vary between 1640 and 3850 MTPD
- Plant operational staff trained during the pre-commissioning period of the plant
- Risk-based inspection program developed for regular planned turnarounds
- All ULE plants are running stable
- Targeted energy savings are within the expectations

First manufactured second-generation ULE pool condenser ready for transport

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05

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CONCLUSIONS

CONCLUSIONS

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- Ultra-Low Energy concept is licensed 10 times:
  - Six grassroot plants successfully in operation since the beginning of 2021
  - Three other grassroot plants are in the construction phase
  - One grassroot plant recently contracted
- The first-generation mechanical design is validated by stable operation of five running plants
- Stable operation of Chinese urea plant since September 2025 proves the process and mechanical concept of the second-generation design
- The design fully employs the superior corrosion resistant properties of E-type steel
- Internal parts of the distribution box are easily accessible for maintenance and inspections

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THANK YOU