



**FUEL CELLS AND HYDROGEN**  
JOINT UNDERTAKING

# **REFHYNE Risk Assessment Approach**

**Workshop on Safety of Electrolysis**

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# REFHYNE - Clean Refinery Hydrogen for Eu

Workshop on Safety of Electrolysis



## Project Brief

- Consortium;
  - ITM Power
  - Shell Deutschland Oil GmbH
  - SINTEF
  - Sphera
  - Element Energy
- The **REFHYNE** project is at the forefront of the effort to supply Clean Refinery Hydrogen for Europe. and will install and operate the world's largest hydrogen PEM electrolyser the Shell Rhineland Refinery in Wesseling, Germany
- Design phase complete, execution phase underway and **will complete in 2021**
- **10MW electrolyser will produce 4000 kg/day**





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## Regulations, Codes and Standards (Electrolyser)

- CE marking Directives / Regulations:
  - The Pressure Equipment Directive, European Directive 2014/68/EU (PED);
  - The Machinery Directive, European Directive 2006/42/EC;
  - The Low Voltage Directive, European Directive 2014/35/EU;
  - The Electromagnetic Compatibility Directive, European Directive 2014/30/EU.
  - Elements of the „ATEX Equipment Directive“, European Directive 2014/34/EU
- ISO 22734 – however the electrolyser not assessed against this as part of the project







## Hazard Analysis

- Electrolyser: ITM Power
  - HazId, HazOp and LOPA
  - Additional risk assessments and method statements (RAMS) for individual activities that aren't covered by the design risk assessment:
    - Installation / commissioning
    - Maintenance
- Refinery: Shell Rheinland Refinery
  - ROGA

Safety Risk Matrix												
Consequence	Catastrophic	Negligible	ALARP	ALARP	Intolerable	Intolerable	Intolerable	Intolerable	Intolerable	Intolerable	Intolerable	Intolerable
	Extensive	Negligible	Negligible	ALARP	ALARP	Intolerable	Intolerable	Intolerable	Intolerable	Intolerable	Intolerable	Intolerable
	Major	Negligible	Negligible	Negligible	ALARP	ALARP	ALARP	Intolerable	Intolerable	Intolerable	Intolerable	Intolerable
	Significant	Negligible	Negligible	Negligible	Negligible	ALARP	ALARP	ALARP	ALARP	Intolerable	Intolerable	Intolerable
	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	ALARP	ALARP	ALARP	ALARP
	None	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
		Improbable	Unlikely	Rare	Possible	Centennial	Decennial	Occasional	Annual	Frequent	Monthly	Regular
		Likelihood										





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## Why does a refinery need Hydrogen?

- Hydrocracking to upgrade of lower value residue (VGO) to higher value fuels
- Hydrodesulfurization to remove sulfur components from fuels

## Hydrogen Compression Train

- Compress pure hydrogen from 16 barg to 300 barg
- Solid mechanical engineering from the 1930s
- Flywheel + Crankshaft weigh 70 tonnes
- We are connecting our newest unit to our oldest unit

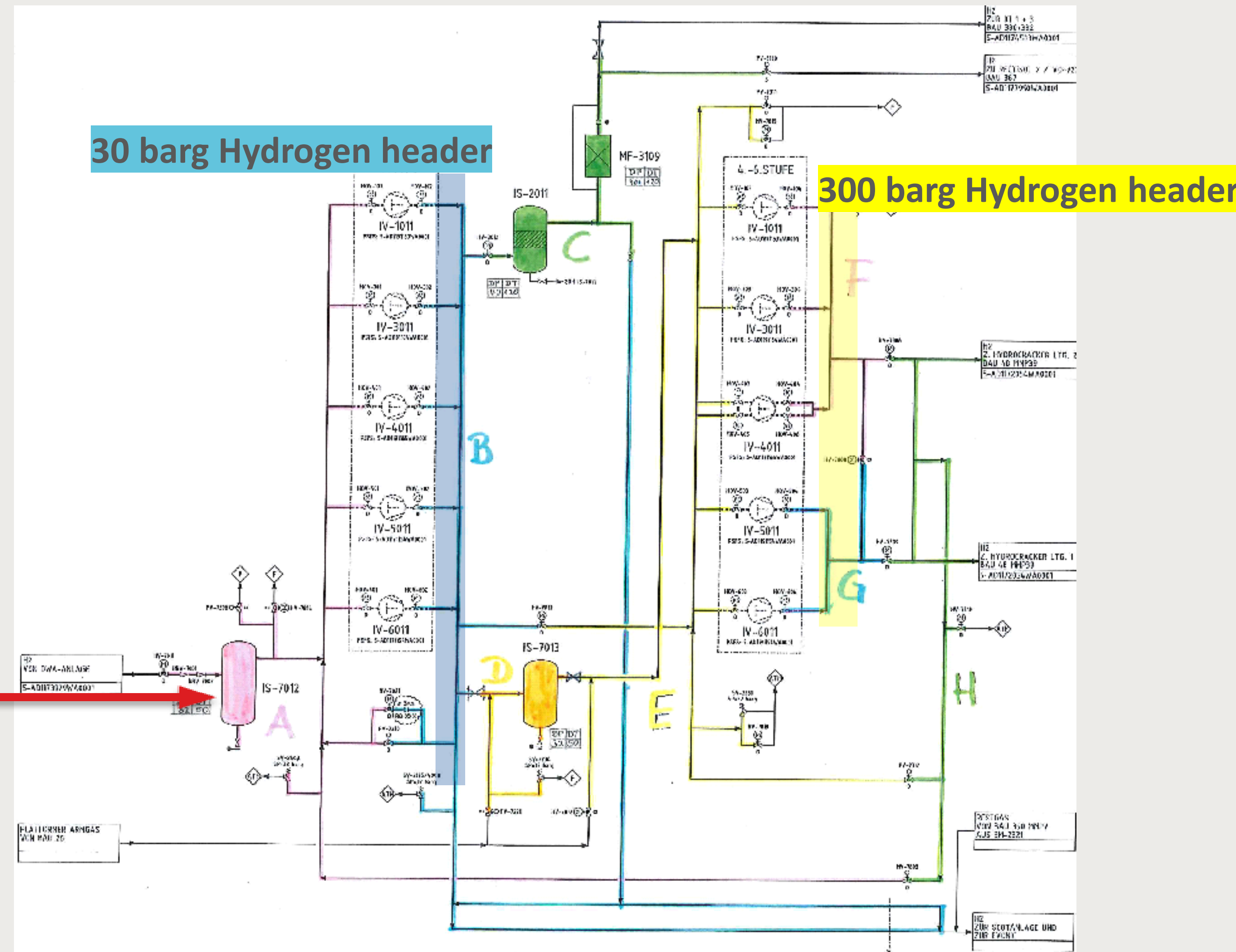




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## Flow Scheme with Tie-In



Tie-in  
REFHYNE





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## Safety Topics at the Interface between the Electrolyser and the Hydrogen Compression Train

### Prevention and mitigation

- Water carryover from the Electrolyzer to the Hydrogen Compressor
- Oxygen ingress to the Hydrogen from the Electrolyser and thereby Oxygen ingress into the Hydrogen compressor
- Backflow from the Hydrogen compression train to the Electrolyser





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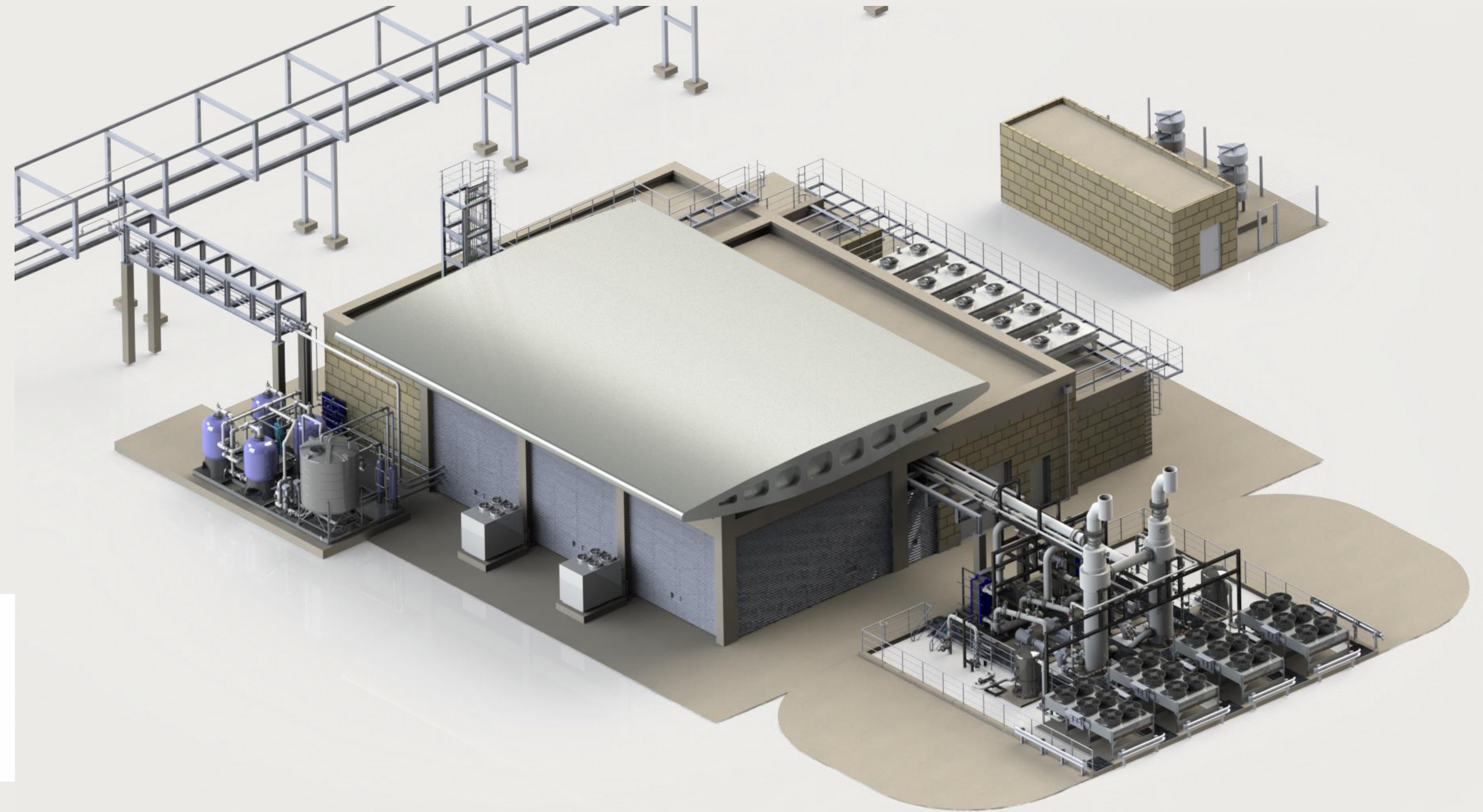
## Safety issues observed so far

- **REFYNE is under construction** and there is no operational data yet.
- So far in the construction **more than 25,000 hours** were spent with **more than 2,500 tons of concrete** and **more than 110 tons of steel reinforcements**.
- **We are on target for Shell's Goal Zero target, with no HSE incidents.**





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