



# European Process Safety Conference Antwerp

## Safe Start up of Capital Projects

Antwerp, 13.09.2022

Geert Vercruysse

# Safe Start up of Capital Projects

## Agenda

- Introduction
- Project Group Overview
- Construction Safety
- Construction – Good practices
- Project Operations – “Ready for Start Up”
- New trends in IT environment – Life Cycle documentation
- Conclusion

# Safe Start up of Capital Projects

## Introduction - essenscia chair / KU Leuven

- Curriculum / Learning Programme
  - ▶ Process Safety Academy (essenscia)
  - ▶ Master of Safety Engineering (KU Leuven)
- Process Safety expertise
  - ▶ Courses in Process Safety Engineering (module) & Process Safety of Unit Operations
  - ▶ Guidance of different thesis students on a variety of subjects:
    - Lessons Learned from Incidents
    - New developments in Project & Process Safety Engineering
    - Qualitative risk assessment – comparable units.
  - ▶ Follow-up of internships – Process Safety during the life cycle of a plant



Master of Safety Engineering (Leuven)

Master of Science

**KU LEUVEN**



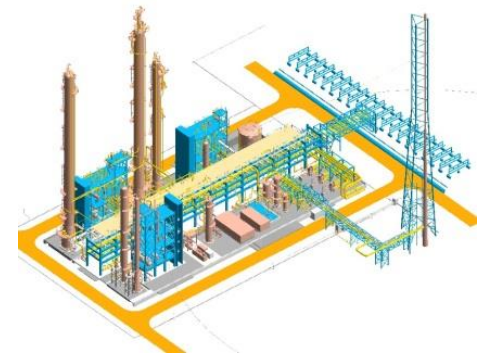
**BASF**  
We create chemistry

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## Introduction - Project Experience

- 2012 – 2014 Butadiene Extraction Plant – EPCm Project (Project Manager)
  - ▶ EPCm-Contract for Engineering, Procurement en Construction management.
  - ▶ First experience with EPCm-contract – difficult to align BASF & Contractor procedures.
- 2016 – 2019 FeedFlex Cracker – EPC Project (Program Manager)
  - ▶ Large Capital Brownfield Project in conjunction with TAR requires strong coordination.
  - ▶ EPC-project with strict milestone planning (cfr TAR).
  - ▶ Including construction of Light Feed (cold) storage tank by separate EPC-contractor.
- 2019 – 2022 EO2 Project – Engineering Partner (Project Execution Owner)
  - ▶ Engineering & Procurement services by Engineering Partner & Construction by OWNER.
  - ▶ Proprietary technology + integration in existing plant complex (EO1).

***“Integrating Process Safety into Engineering Projects” (CCPS Manual 2019)***



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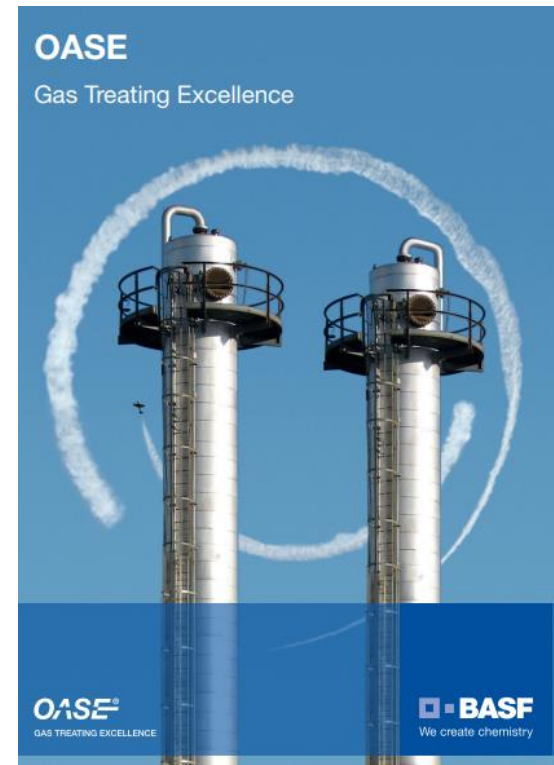
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## Project Group Scope

BASF expands its production capacity of ethylene and ethylene-oxide derivatives at the Antwerp site. This expansion consists of the erection of a second large ethylene-oxide installation and the construction of additional installations for ethylene-oxide derivatives.

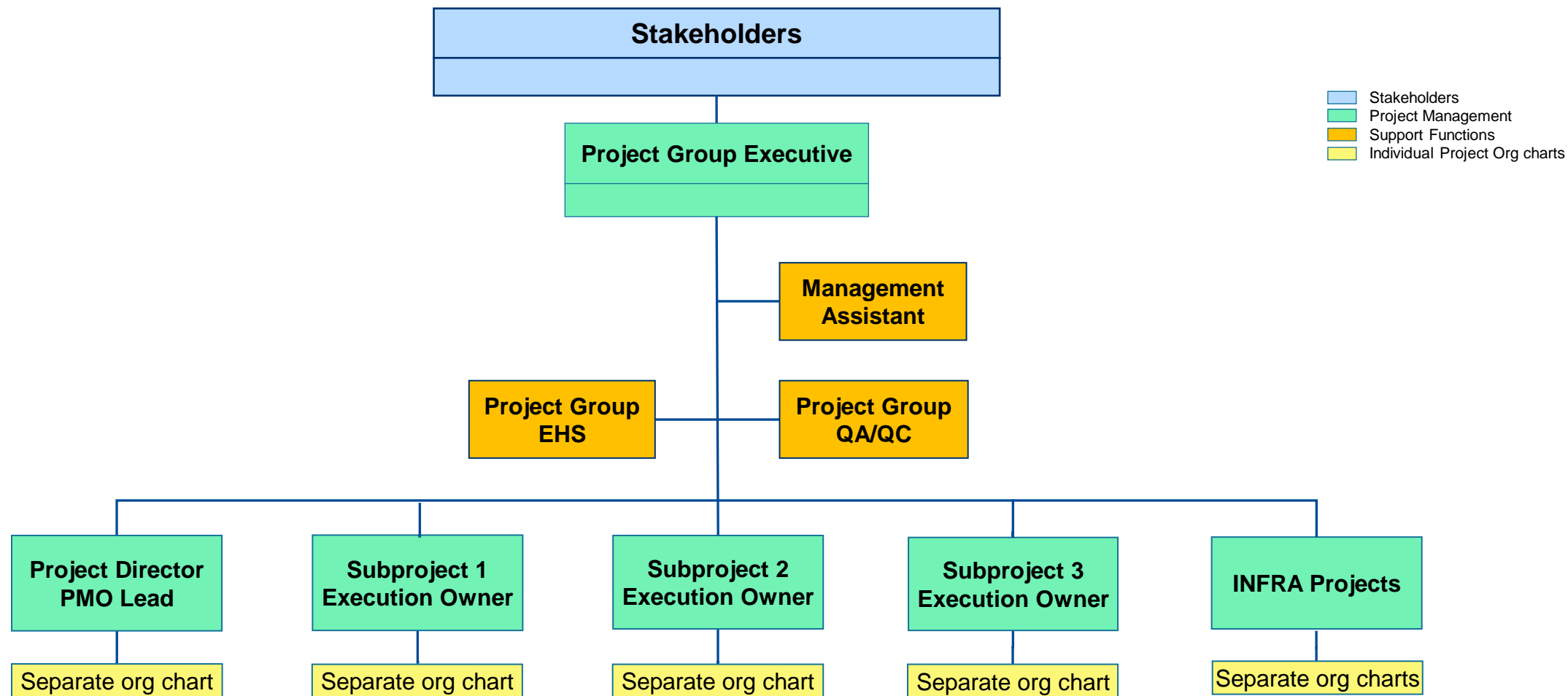
This investment of more than € 500 million supports the growing market need for alkoxylates among customers active in “home and personal care” as well as for use in industrial applications. The alkoxylates are used for eg. Detergents, cleaning products, dishwasher detergents, han gels, etc... They are also the basis for plastics and crop protection.

With the construction of these new installations BASF increases the production capacity with 400.000 ton a year.



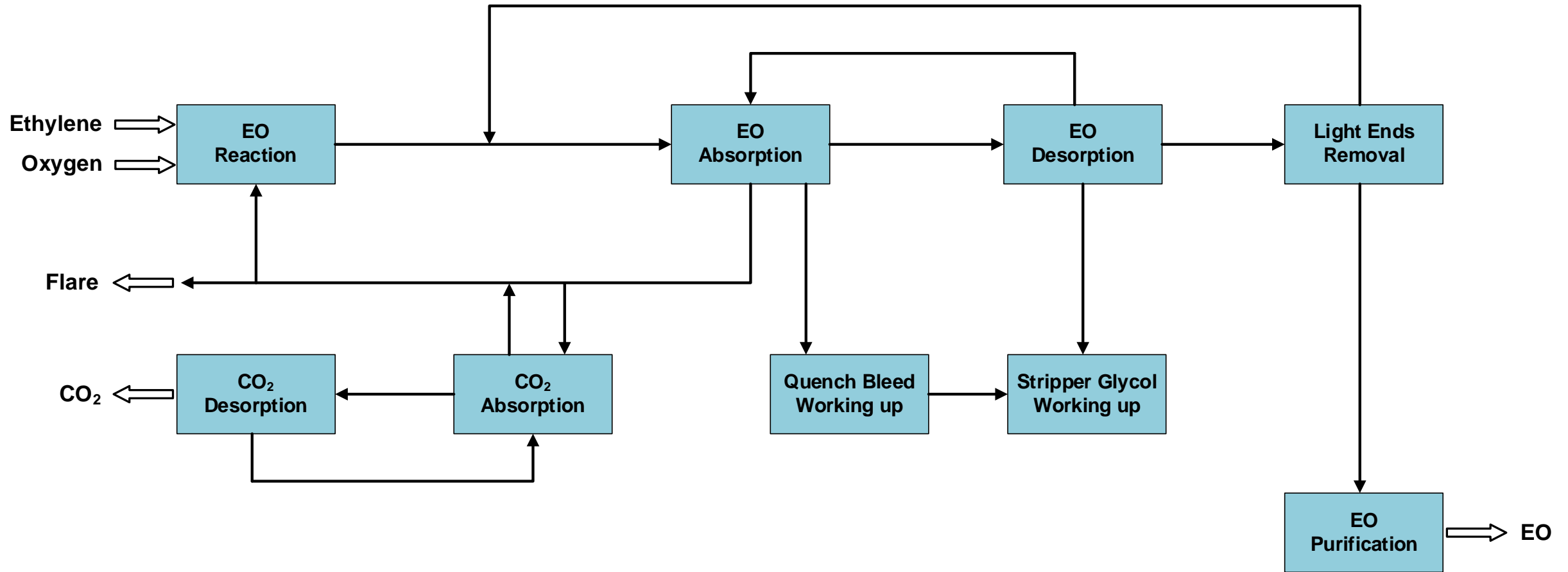
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## Project Group Organization



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## Ethylene-Oxide Production Process

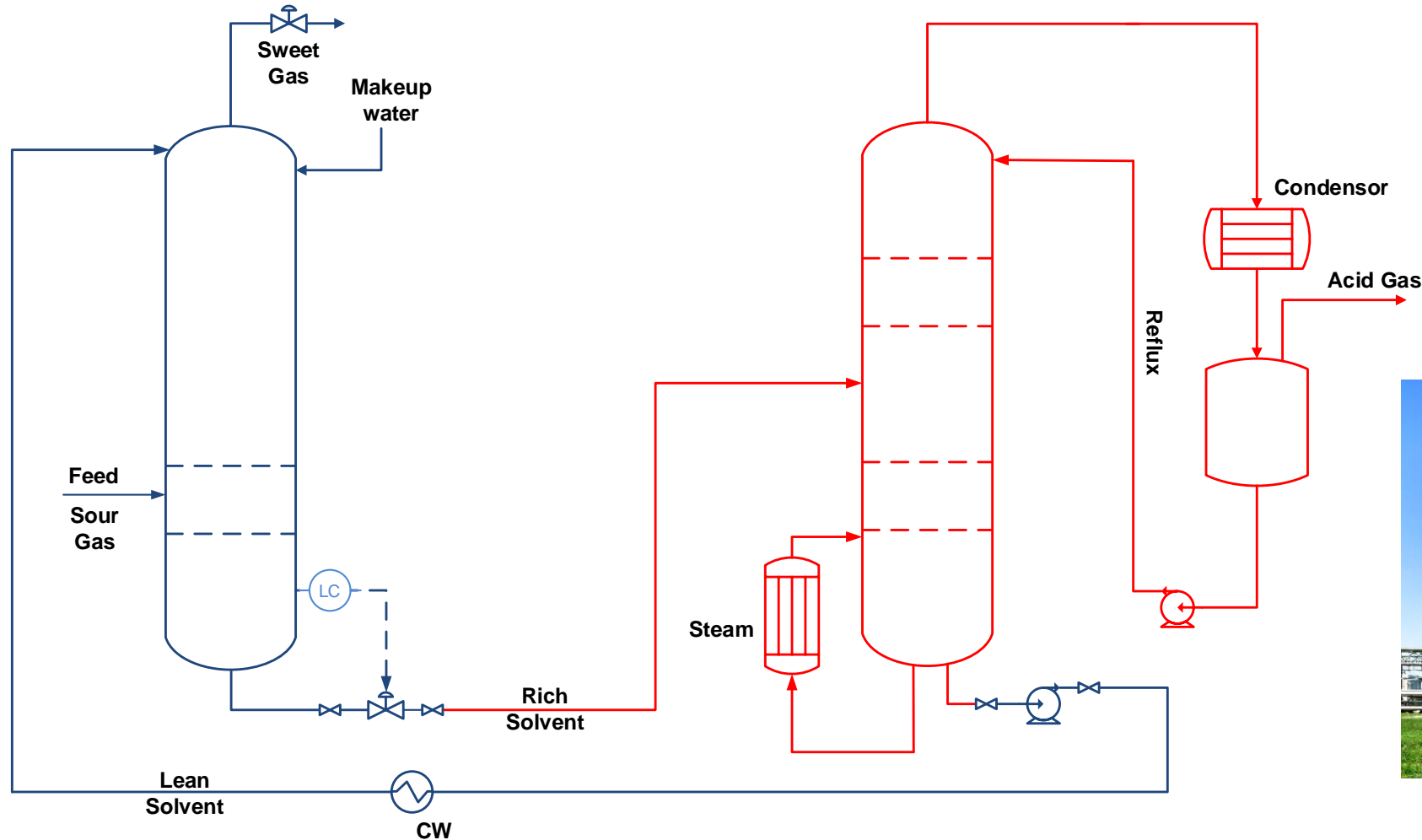




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## Definition of a process unit

An example of a process flow diagram : A combination of an absorption / desorption column system



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## Project Execution Format

**Engineering** executed by Engineering Partner (EP)

**Procurement** services delivered by EP / BASF

**Construction** in OWNER's responsibility:

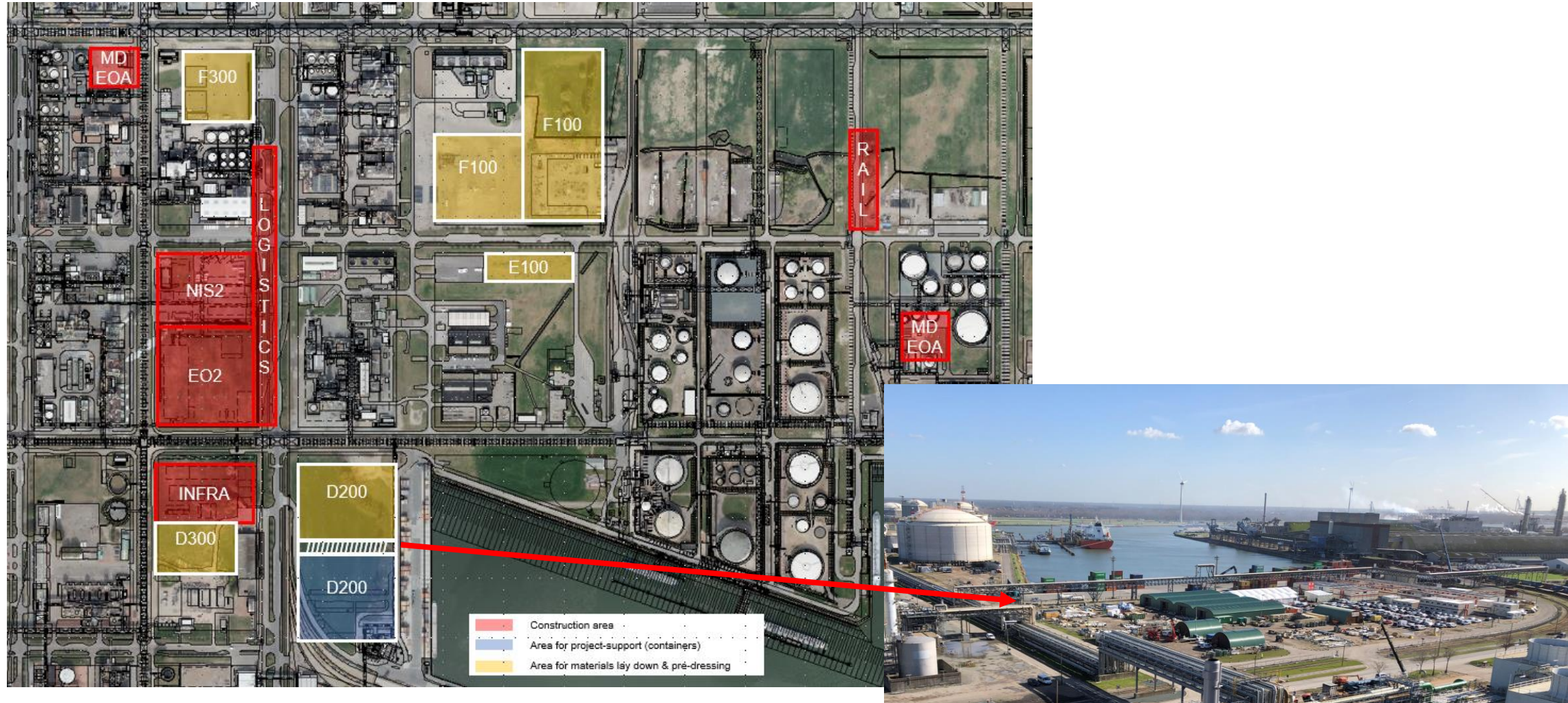
- Team composed by BASF Ludwigshafen delegates, BASF Antwerp colleagues, Third Parties and EP colleagues
- SCCS (Standard Contract Construction Services) applied

	Civil	Structural Steel	Heavy Haul & Heavy Lift	Piping & Mechanical	Electrical & Instrumentation	Scaffolding	Insulation
Subproject 1	Company 11 Netherlands	Company 12 Netherlands	Company 13 Belgium	Company 14 Italy	Company 15 Portugal	Company 16 Germany	Company 17 Belgium
Subproject 2	Company 21 Belgium	Company 12 Netherlands	Company 13 Belgium	Company 24 Germany	Company 25 Ireland	Company 26 Netherlands	Company 27 Belgium



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## Overview Construction & Lay Down areas – Temporary Facilities



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## Safety – Key Performance Indicators

### 1. Occupational safety

- ▶ KPI = LTI (Lost Time Injury)
- ▶ Goal: No LTI's for the total project
- ▶ LTI according to OSHA definition

### 2. Process safety

- ▶ KPI = PSI (Process Safety Incident)
- ▶ Goal: No PSI's during start up phase
- ▶ PSI definition according to corporate guidelines

*Definitions taken up in the Construction EHS plan*



Construction Management Europe  
Construction EHS Plan (CEHSP)  
Job: 18442 & 20742 ; Projects: EO2 & NIS2

Rev.04 07-06-2021

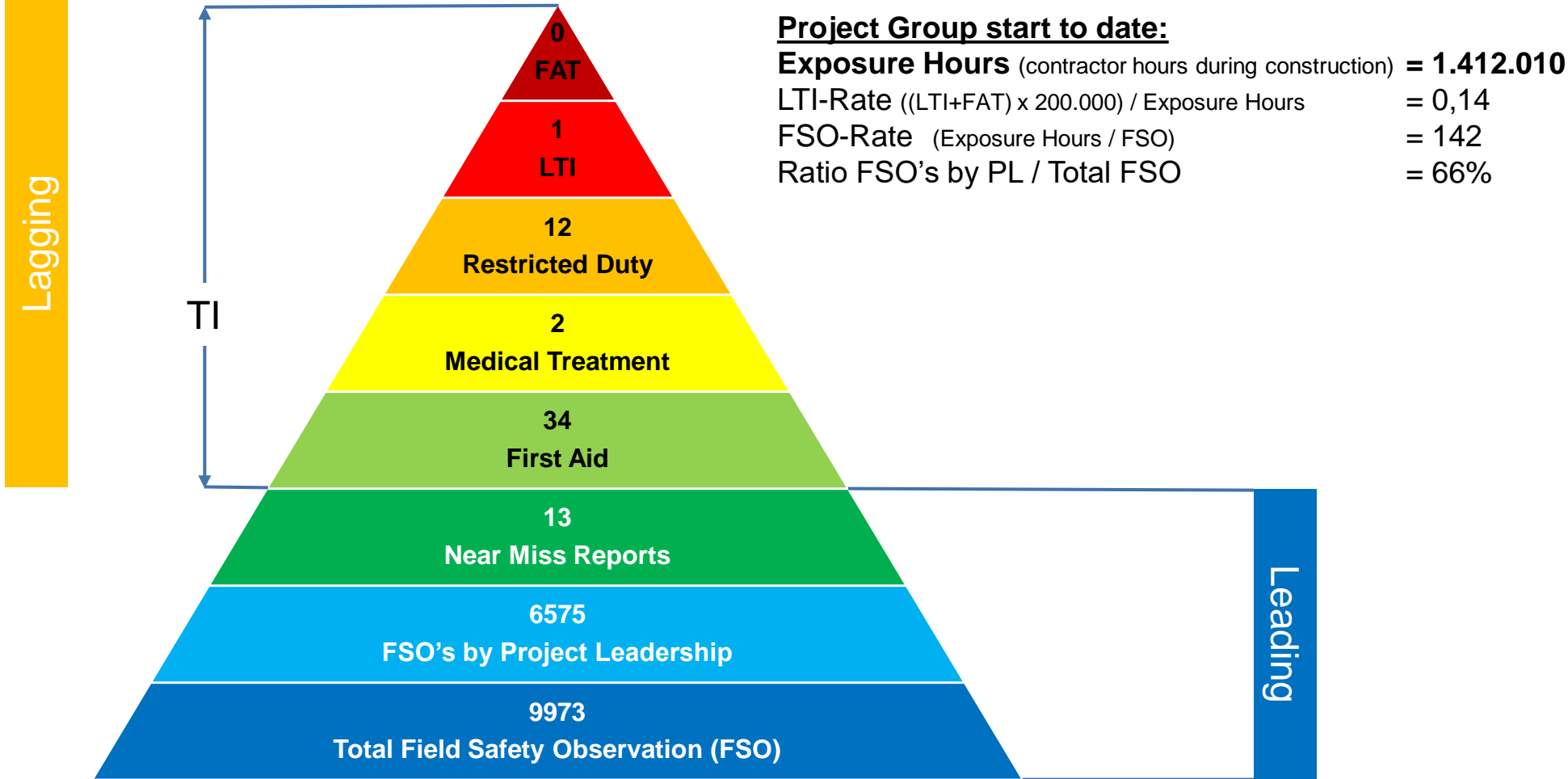


**EO2 & NIS2 Expansion Project**

**Construction EHS Plan**

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## EHS Performance



Total Injury Rate (TIR), Fatality (FAT), Lost Time Injury (LTI), Field Safety Observation (FSO), Project Leadership (PL)

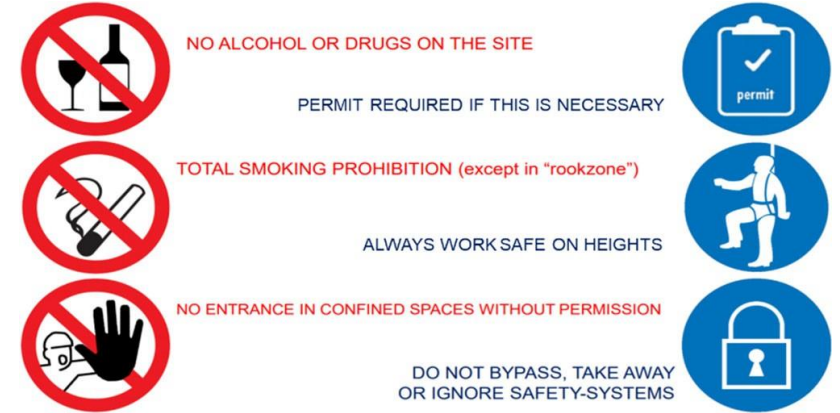


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## Occupational Safety – Challenges

- BASF Antwerp Site regulations vs EP guidelines
  - ▶ Different company cultures
  - ▶ Working at height ( 6ft vs 2m)
  - ▶ Use of cage ladders for access, with harness and 100% tie off

### Life saving rules



- Follow up of live saving rules and a strict “Balance of Consequences” policy.
- How to implement “phased” mechanical completion without compromising occupational safety guidelines.

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## EO Overall Construction





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## Good practices: Pre-dress columns – Prefab steel – Reactor lifting



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## Good practices: Heavy Lift activities



Installation PEO column and casing



Lifting CO2 Absorber



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## Good practices: Pre-assembled Pipe Racks





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## Good practices: Engineered scaffolding



Engineered/Planned



Erection of scaffold



Final scaffold

- During engineering the construction interaction with all disciplines is taken into account.
- Collisions detected due to check with 3D model.
- More efficient material planning for erection of scaffolds.
- Minor modifications required during construction = cost & time saving
- Positive feedback from all contractors



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## Good practices: Above ground Cable Trays + Sarcophagus PEO Tank



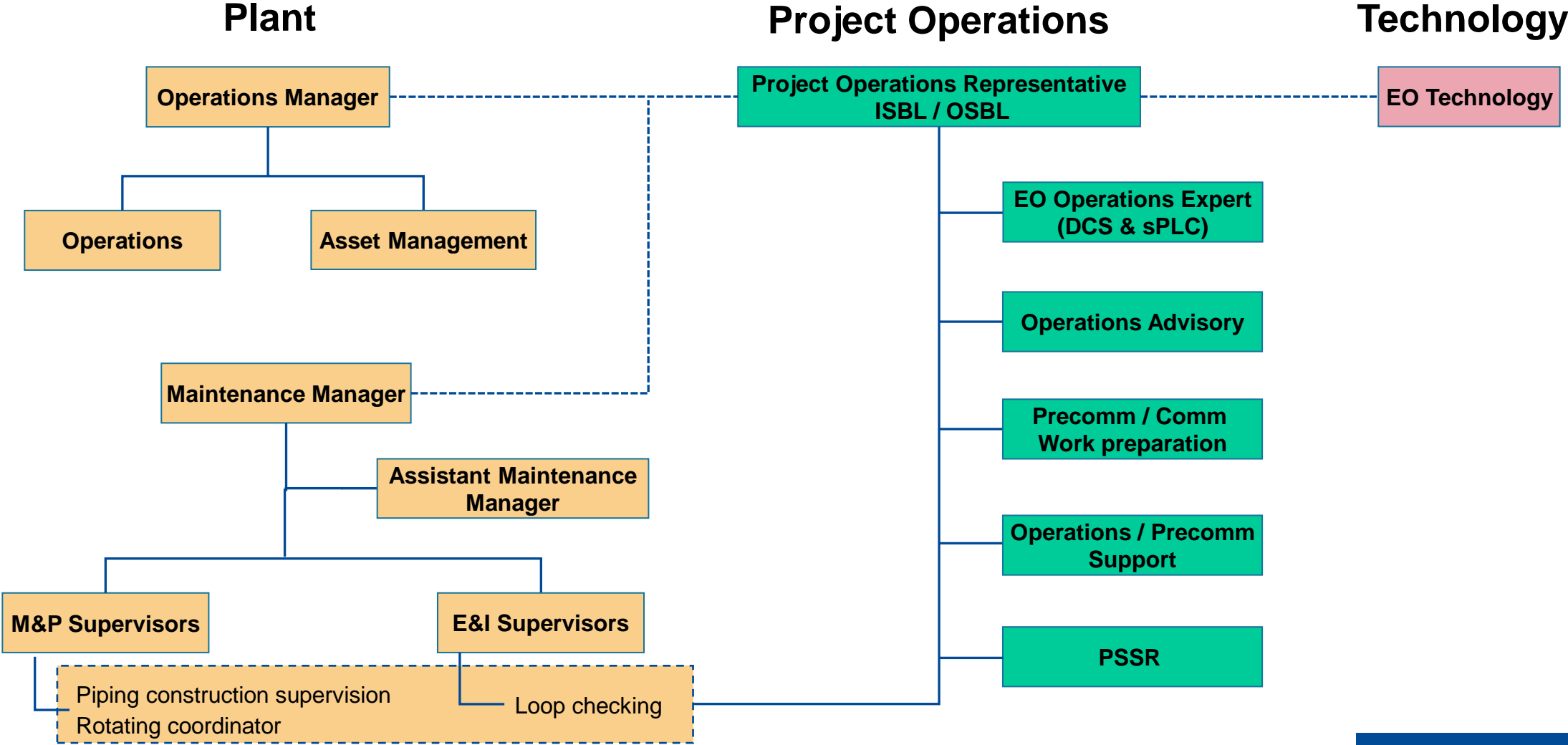
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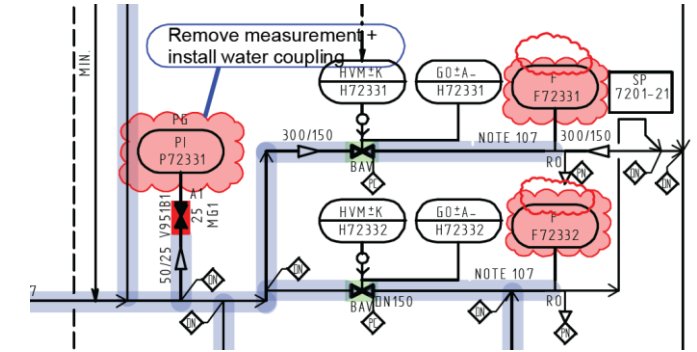
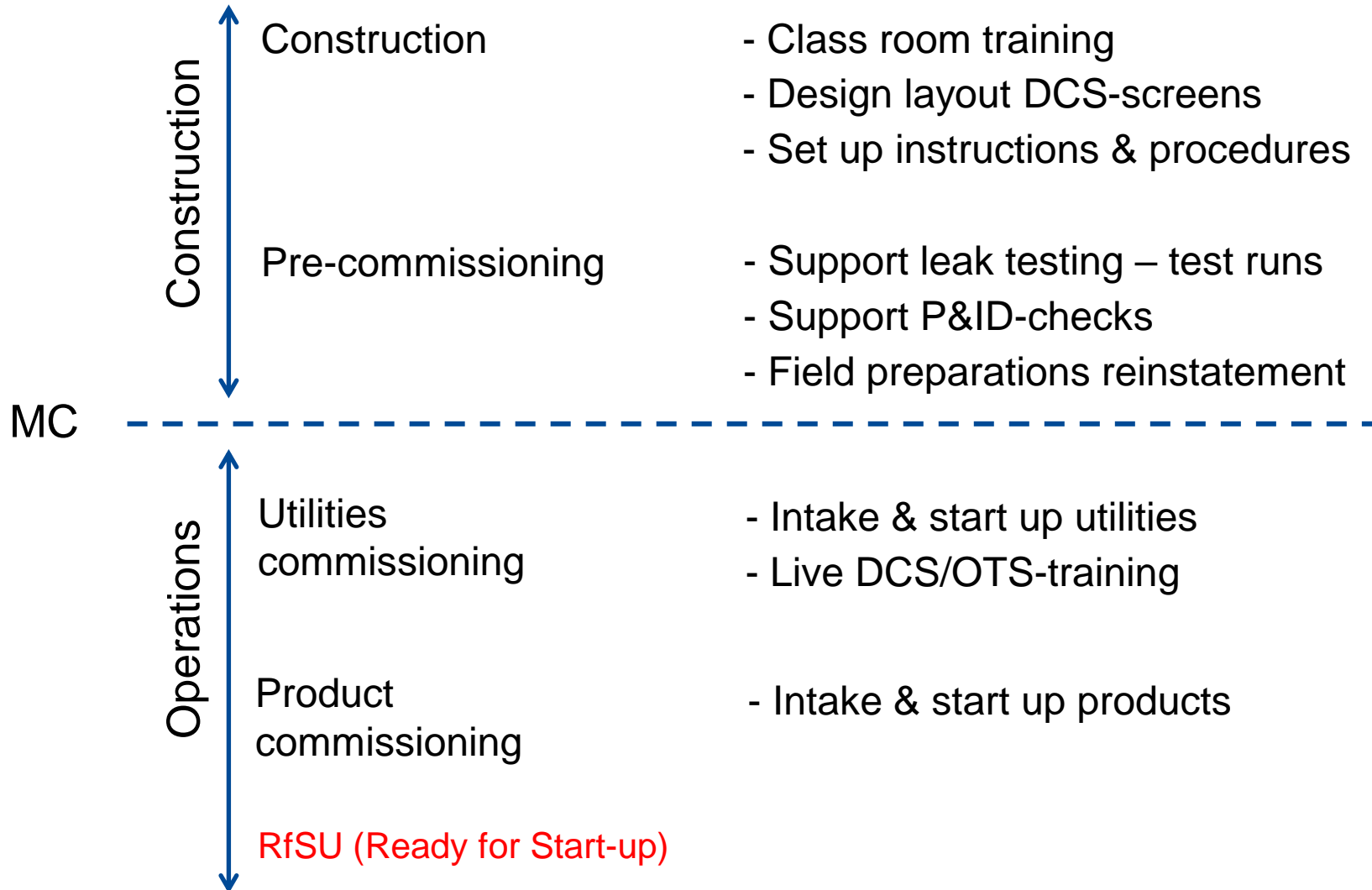
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## Plant & Project Operations Organization



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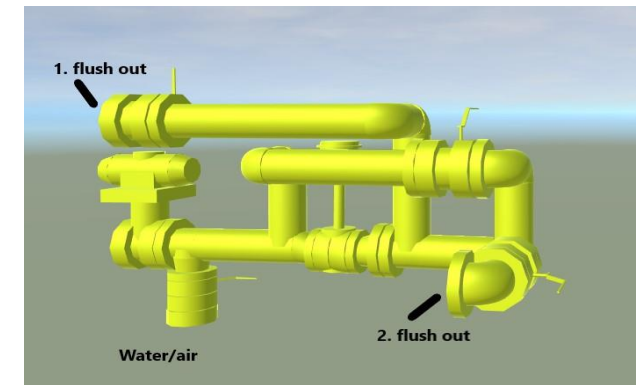
## From Construction to RfSU



Helpful IT tool: Universal Plant Viewer (**UPV**)

Direct link between P&ID and 3D model

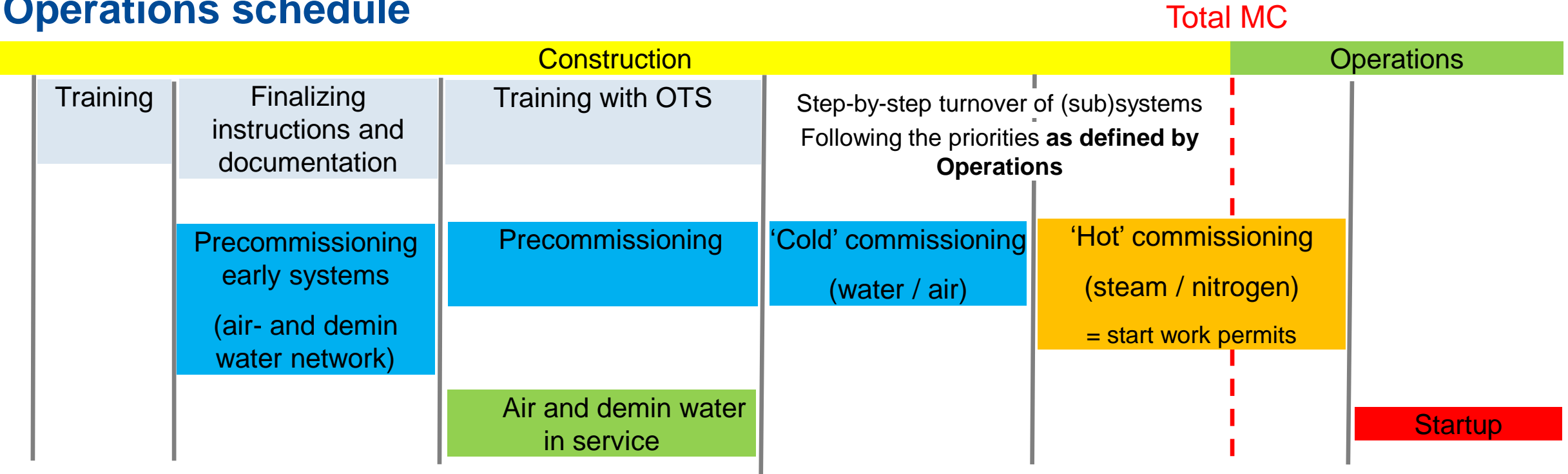
Very positive feedback from  
Operations and Maintenance





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## Operations schedule

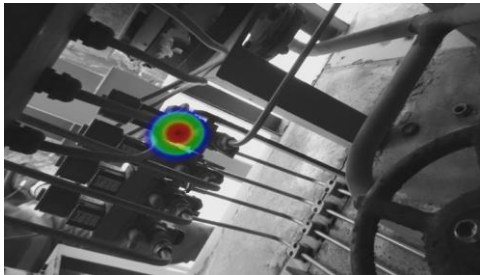


**Core team Operations:**

See org chart

Additional and temporary support for pre-commissioning:  
Shift supervisor EO Ludwigshafen / Experienced operator Steamcracker Antwerp

+ support mechanical preparation required (assistance by maintance)





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## Operator Training Simulator

- Operator Training Simulator fully operational 6 months prior to effective start up of the plant
- Simulation of start-up of EO2 plant by production supervisors of EO1

- **Already proven benefits:**

- ▶ Optimization of start-up sequence of different systems
- ▶ Improvement of the start-up procedures with these new insights
- ▶ Adjusting of E&I ranges, trip points, start-up overrides, DCS logic, HMI...
- ▶ Defining tuning parameters of controllers

- **Until start-up:**

Intensive training of the EO2 operators, with focus on critical steps during the start-up.



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## IT-tools – Project Documentation towards Life Cycle Documentation

### Set-up of IT environment

- Long term vision required – Starts already in the early project phase.
- Take into account the final IT environment (at least the documentation requirements (format, structure,...)).
- Flexibility required to work with third parties.
- Open minded towards new IT developments.

### IT tools during Project Execution

- Doc database (Engineering & Procurement)
- Doc database (Construction)
- Sharepoint (Construction)
- Sharepoint (Operations)
- Coreworkx (Engineering Partner)
- PIRS (Correspondence)
- SITS (Material Certificates)
- Lucy (Turnover)
- MatMan (Warehouse management)
- S3D (3D Model)



### IT environment Life Cycle documentation

- Smart Plant Foundation
- SAP
- Documentum D2
- Sharepoint
- E3D (3D Model)

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## Conclusion

- Large Capital Projects require comprehensive (EHS) guidelines for all EPC-phases independent of the contract format.
- Predefined life saving rules established for Construction Safety and strict adherence required.
- Recent developments within Construction Execution improve occupational safety records.
- Project Operations Roles require a good integration/cooperation with Construction and is beneficial for the overall project execution and life cycle of the plant.
- New trends in IT environment clearly facilitate the path forward to a safe start up.

***“Process Safety during the Transient Operating Mode” (CCPS Manual 2021)***

***Managing risks during Process Start-Ups***

## Safe Start up of Capital Projects

# Team Work!







We create chemistry

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## Safety – Reporting Criteria KPI - PSI

### PSI

Release of a chemical in a facility with:

- a) FAT or LTI
- b) Fire, explosion, implosion > 2,500 EUR
- c) Off-site impact
- d) Release of content in 1 hour > threshold

Substance Classification	GHS Classification H...	Release threshold <sup>5)</sup> in kg; PSI	Release threshold <sup>5)</sup> in kg; sPSI
Highly toxic	300, 310, 330	≥ 1	≥ 0,1
Toxic	301, 302, 311, 312, 331, 332	≥ 10	≥ 1
Any other hazard (except toxic)	any other GHS H... statement not listed above	≥ 100	≥ 10
No GHS classification	-	Not reportable	≥ 2000

### sPSI

Release of a chemical in a facility with:

- a) First aid
- b) Fire, explosion, implosion < 2,500 EUR
- c) N/A
- d) Release of content in 1 hour > 10% of threshold

### AFPD

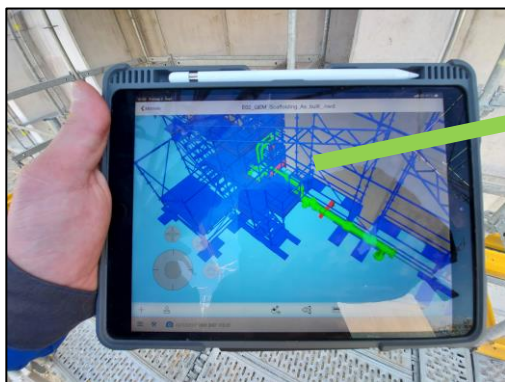
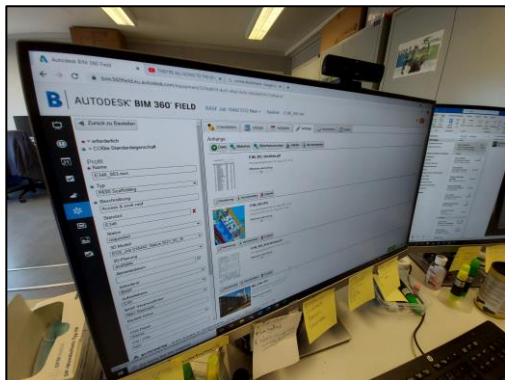
Activation/Failure of Protective Devices & measures covering B and C risks

- a) PSV – rupture disks
- b) SIL2 / SIL3
- c) O(B-C)

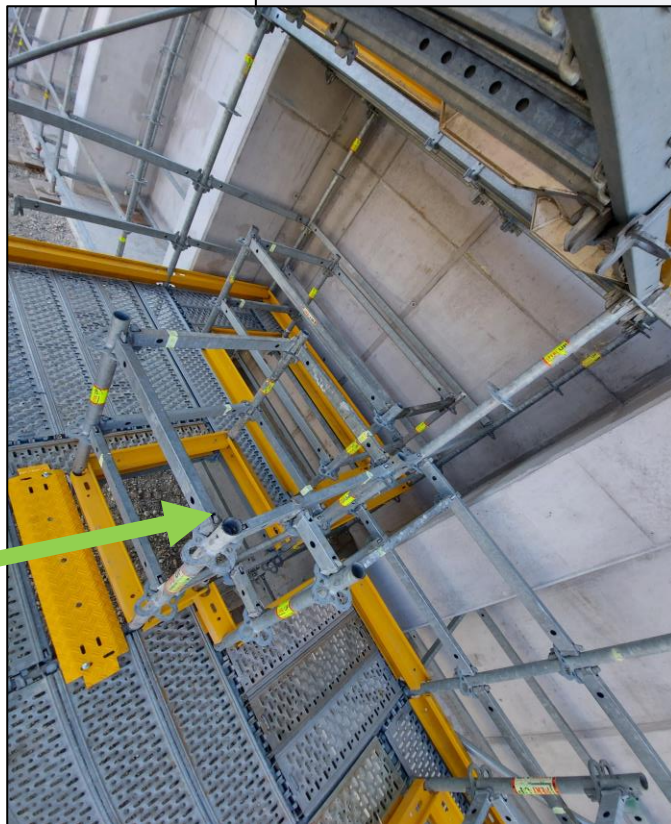
### Near Miss

Any undesired process event that under “slightly” different circumstances could have escalated in significant harm to people, damage to property, equipment or environment

All data in **BIM**



Upload for  
scaffolders



Detailed execution

