

Emission control in urea plants in normal operation and upset cases – why so many different solutions?

Martina Schmitz – Athens, 20 – 23 February 2012



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Emission Control in Urea Plants

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Emissions during Normal Operation

International Requirements for Ammonia Emissions

IFC – International Finance Corporation (World Bank Group)

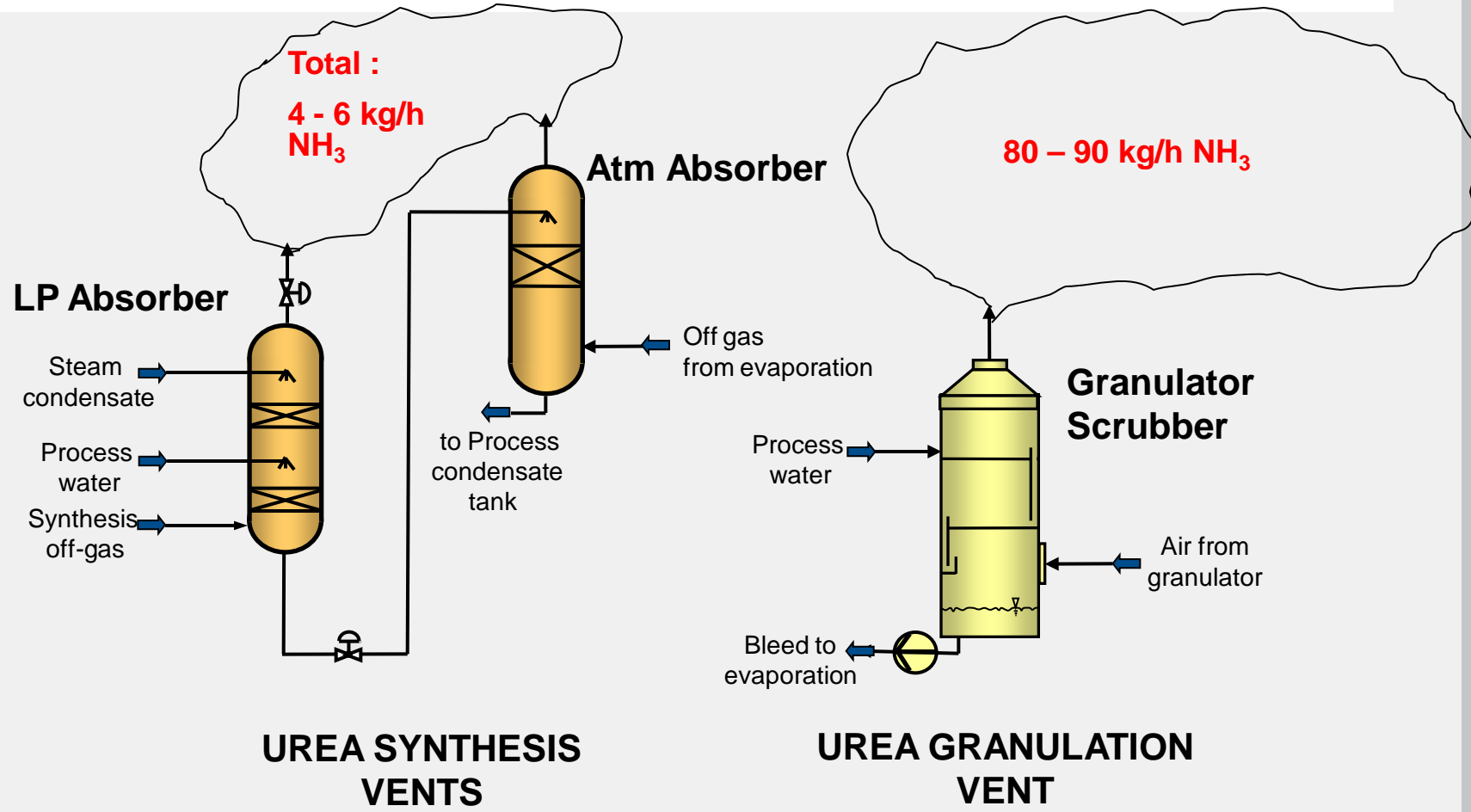
Granulation Unit	Prilling Unit
50 mg/Nm ³	50 mg/Nm ³

EFMA – European Fertilizer Manufacturer Association

Granulation Unit	Prilling Unit	Vents
50 mg/Nm ³	50 mg/Nm ³	4 kg/h
0.25 kg/t	0.5 kg/t	0.06 kg/t

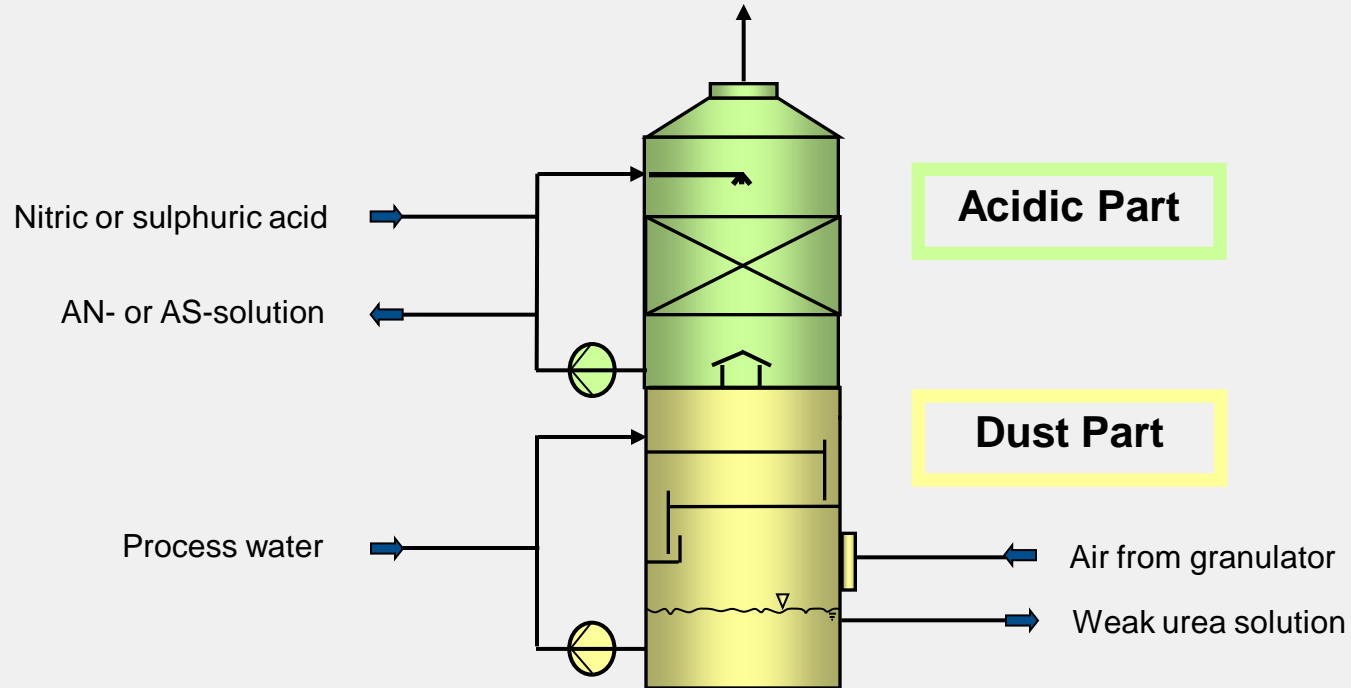
Emissions during Normal Operation

Emission Points



Emissions during Normal Operation

Acidic Scrubbing in Granulation Plant

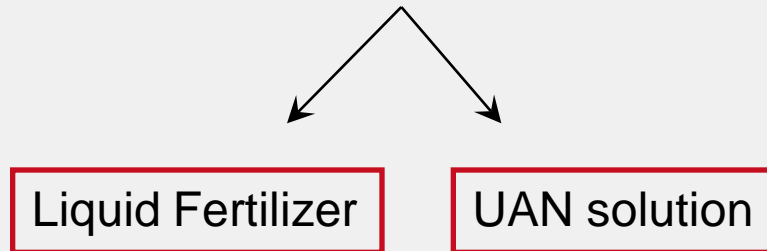


Granulator Scrubber

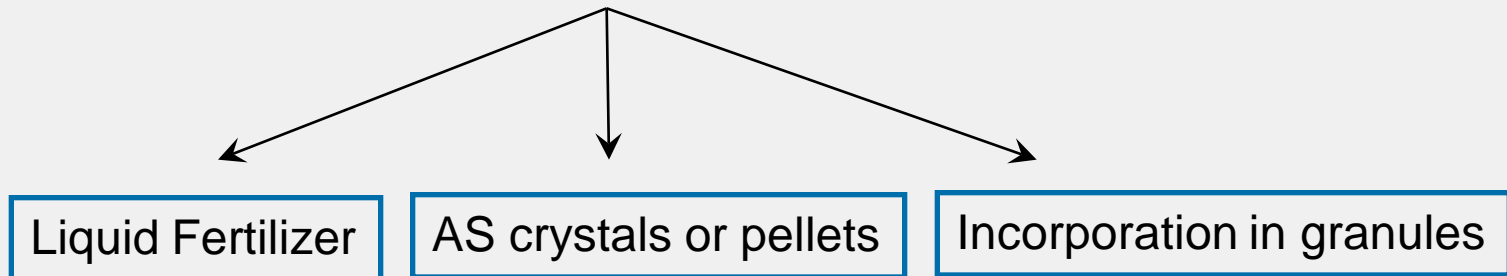
Emissions during Normal Operation

Acidic Scrubbing -> Purge Solution

Nitric acid + NH_3 -> **Ammonium nitrate (AN) solution**

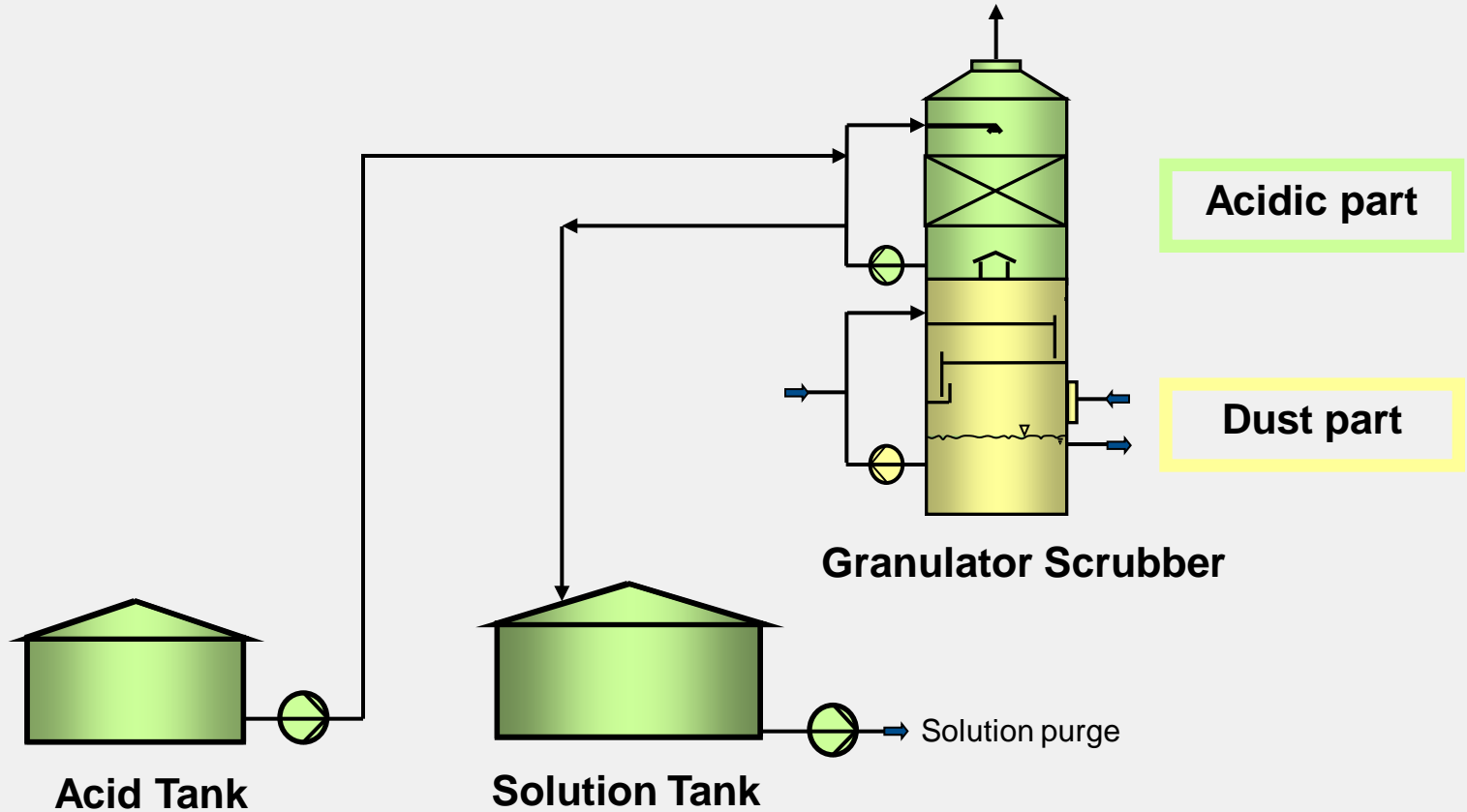


Sulphuric acid + NH_3 -> **Ammonium sulphate (AS) solution**



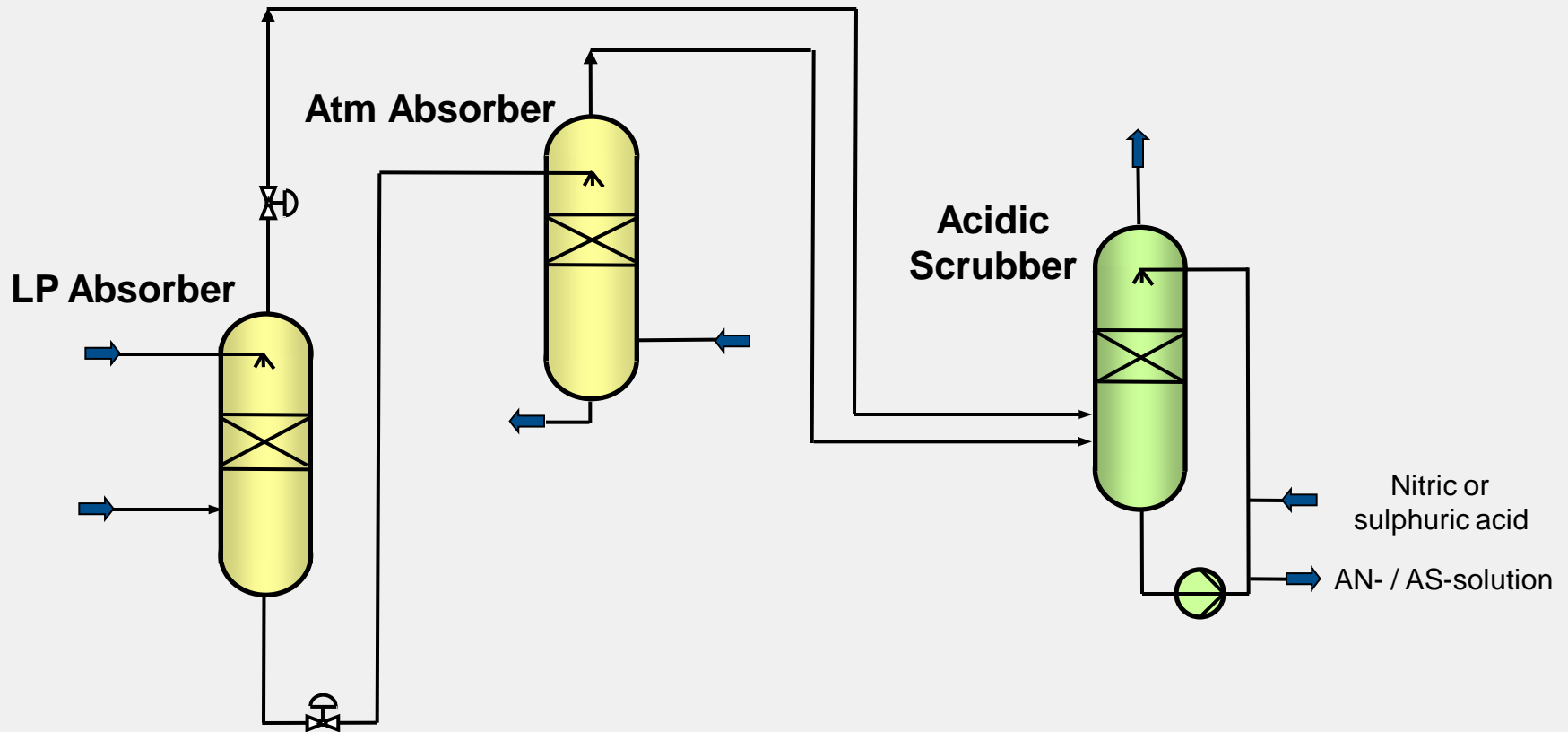
Emissions during Normal Operation

Acidic Scrubbing in Granulation Plant - Requirements



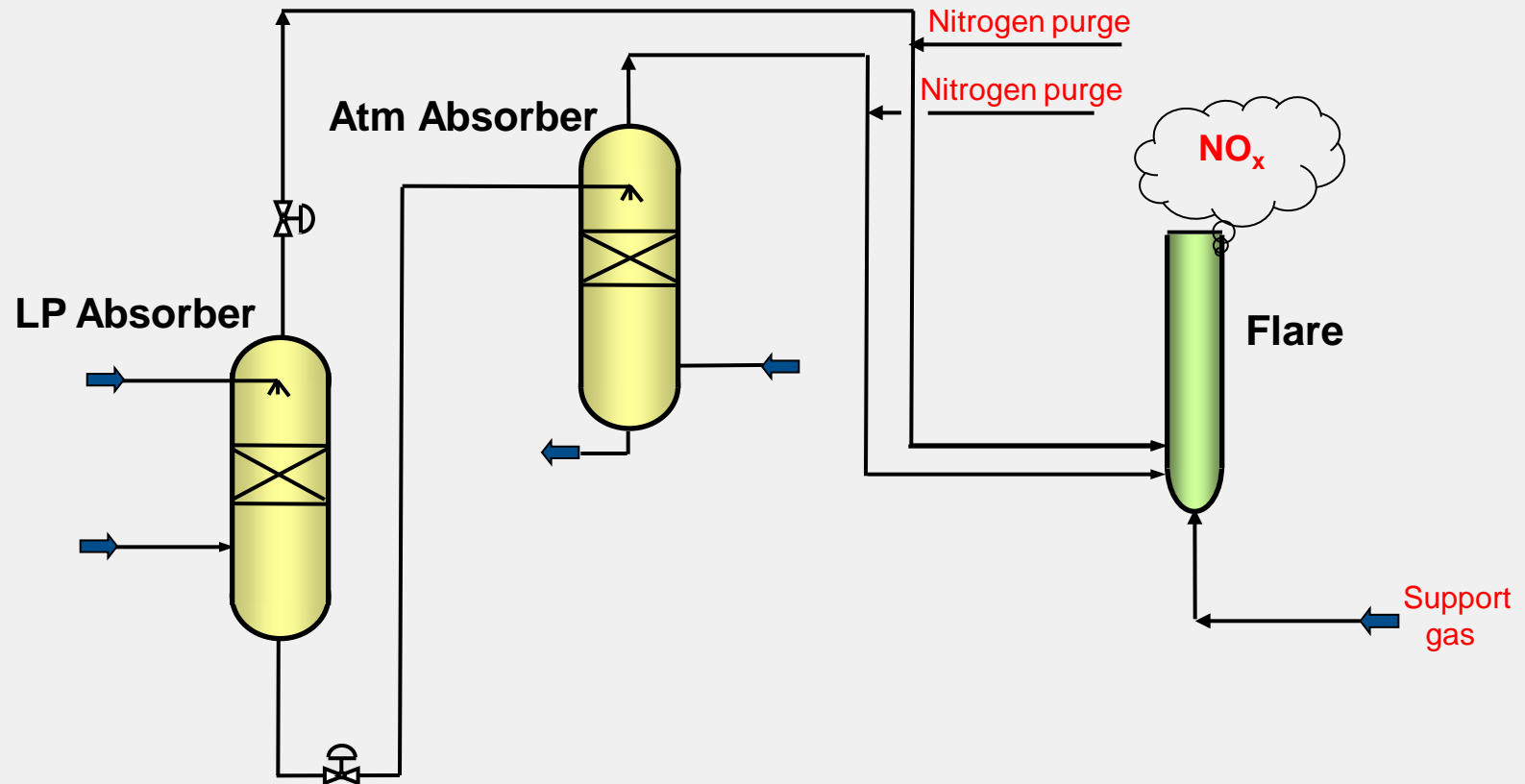
Emissions during Normal Operation

Acidic Scrubbing for Synthesis Vents



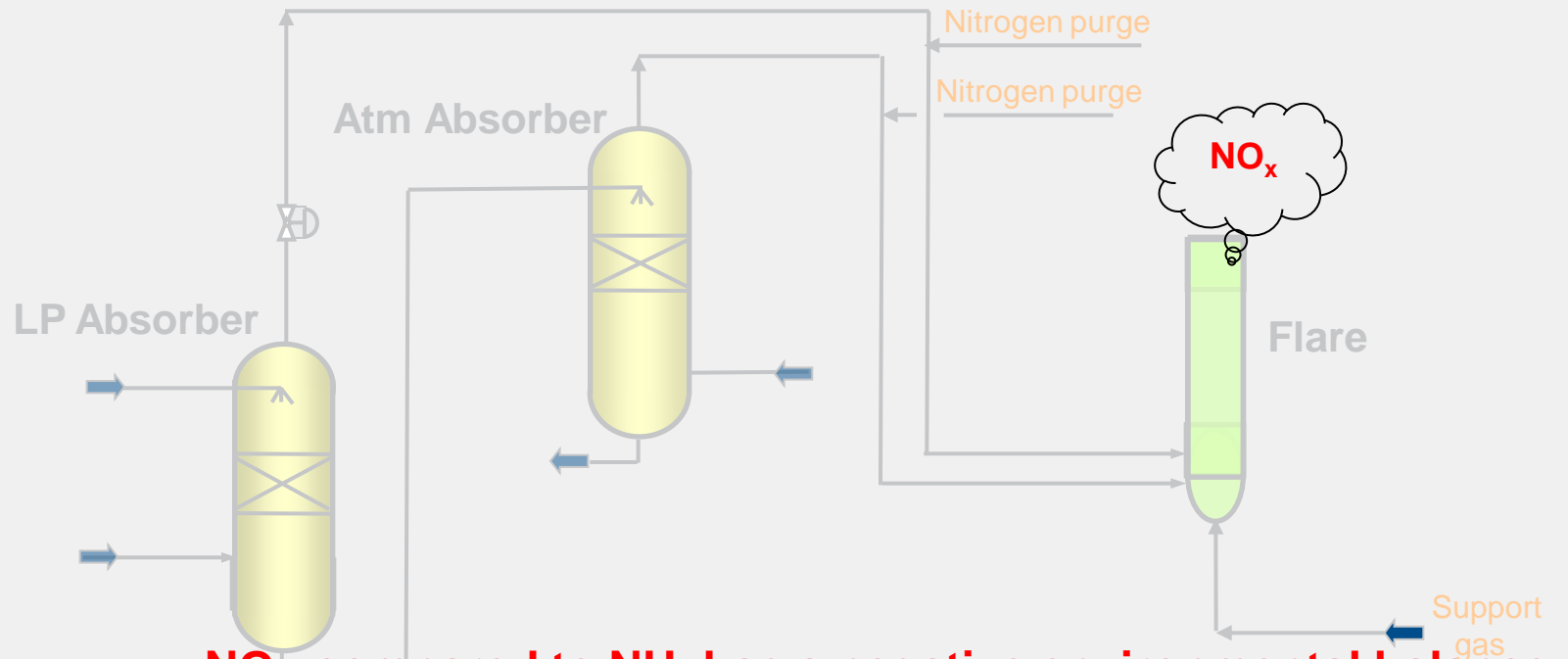
Emissions during Normal Operation

Flaring for Synthesis Vents



Emissions during Normal Operation

Flaring for Synthesis Vents - Consequences



NO_x compared to NH₃ has a negative environmental balance:

- **Global warming potential**
- **Tropospheric ozone-forming potential**
- **Ozone-depletion**

Emissions from Tank Vents and Safety Valves

International Requirements

IFC – International Finance Corporation (World Bank Group)

Granulation Unit	Prilling Unit
50 mg/Nm ³	50 mg/Nm ³

- This requirement only applies to 95 % of the time that the plant is operating

EFMA – European Fertilizer Manufacturer Association

- Connection of tank vents to the plant main stack or other safe location
- Connection of ammonia pump safety relief valves to a flare

Emissions from Tank Vents and Safety Valves

Mitigating the Consequences

Vents from tanks

- ⇒ Vent stack
- ⇒ Acidic scrubbing
- ⇒ Flaring

Safety valves ammonia pump

- ⇒ Flaring

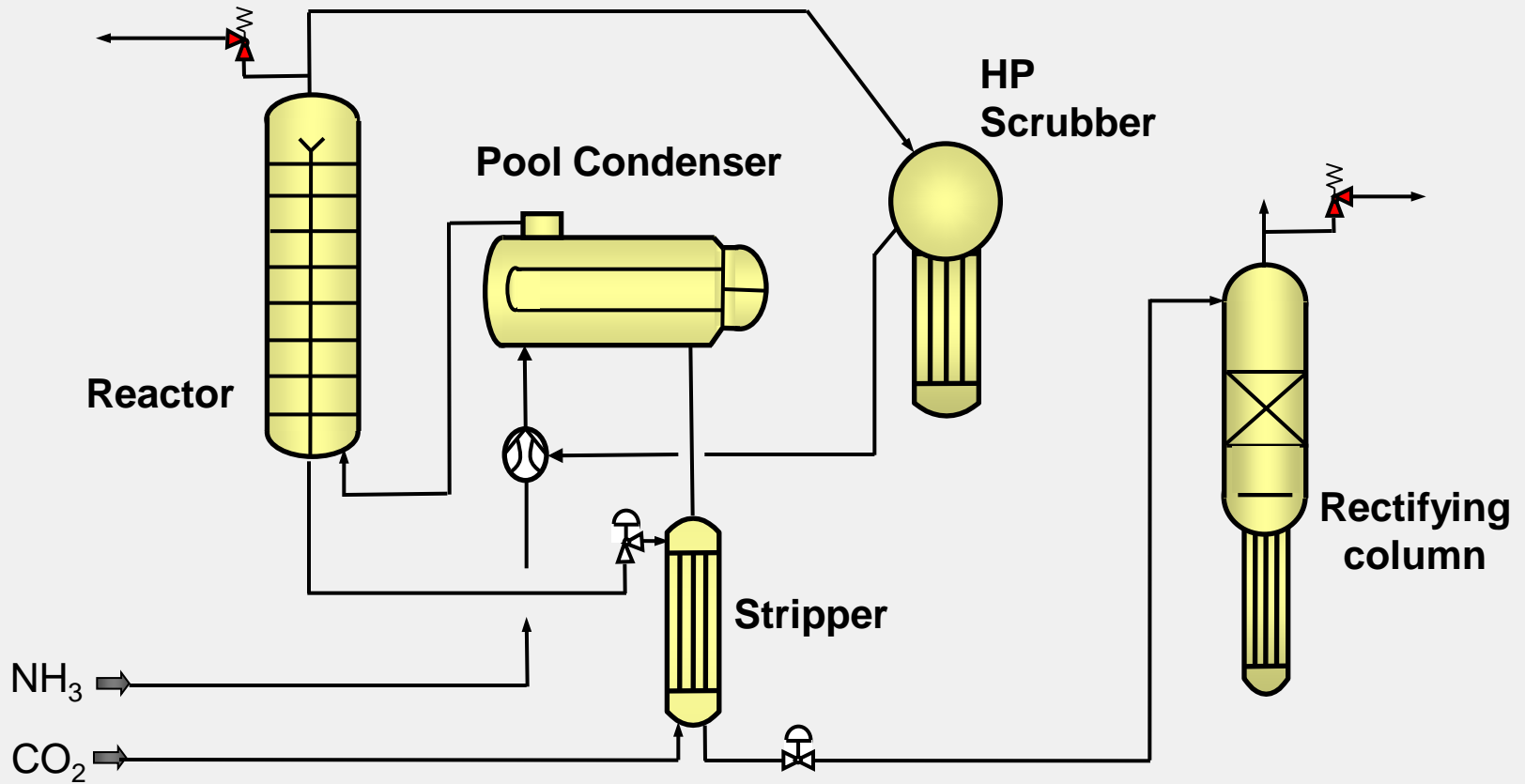
Safety valves carbamate

- ⇒ Avoidance of PSV (design)



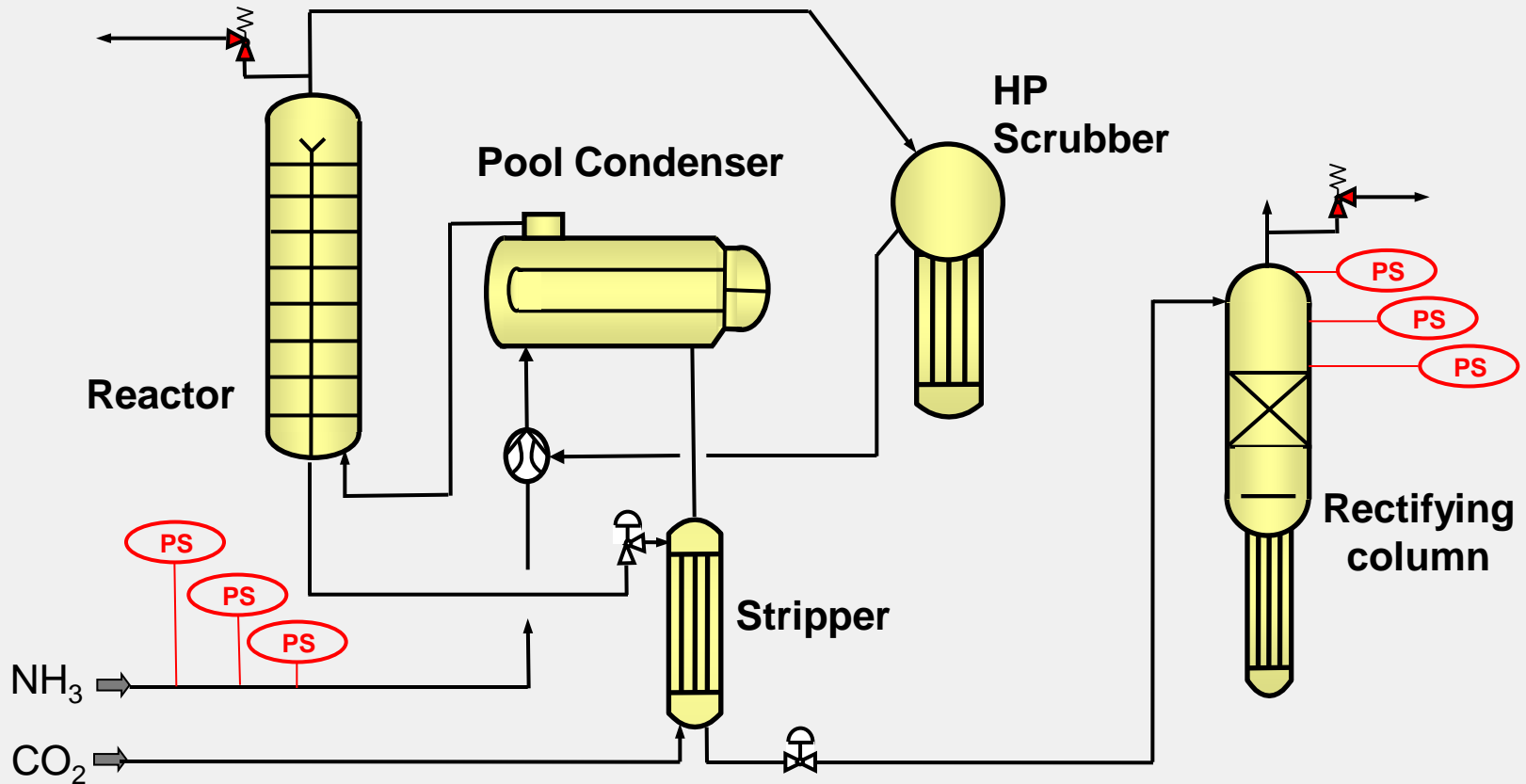
Emissions from Tank Vents and Safety Valves

Main Safety Valves in Urea Plant



Emissions from Tank Vents and Safety Valves

Main Safety Valves in Urea Plant



Emissions from Tank Vents and Safety Valves

Overview Mitigating the Consequences

Vents from tanks

- ⇒ Vent stack
- ⇒ Acidic scrubbing
- ⇒ Flaring ☹️

Safety valves ammonia pump

- ⇒ Flaring

Safety valves carbamate

- ⇒ Avoidance of PSV (design)
- ⇒ Avoidance of blowing (pressure switches)
- ⇒ Vent stack
- ⇒ Flaring

Emergency Release

No international standards available, but

- neighbouring inhabitants?
- areas with frequent emissions?

⇒ local authority requirements or company policy limits

Event rare, but impact serious -> Risk evaluation



Emergency Release

Risk – Definition and Ranking

Risk = Frequency x Consequence

Risk Ranking by

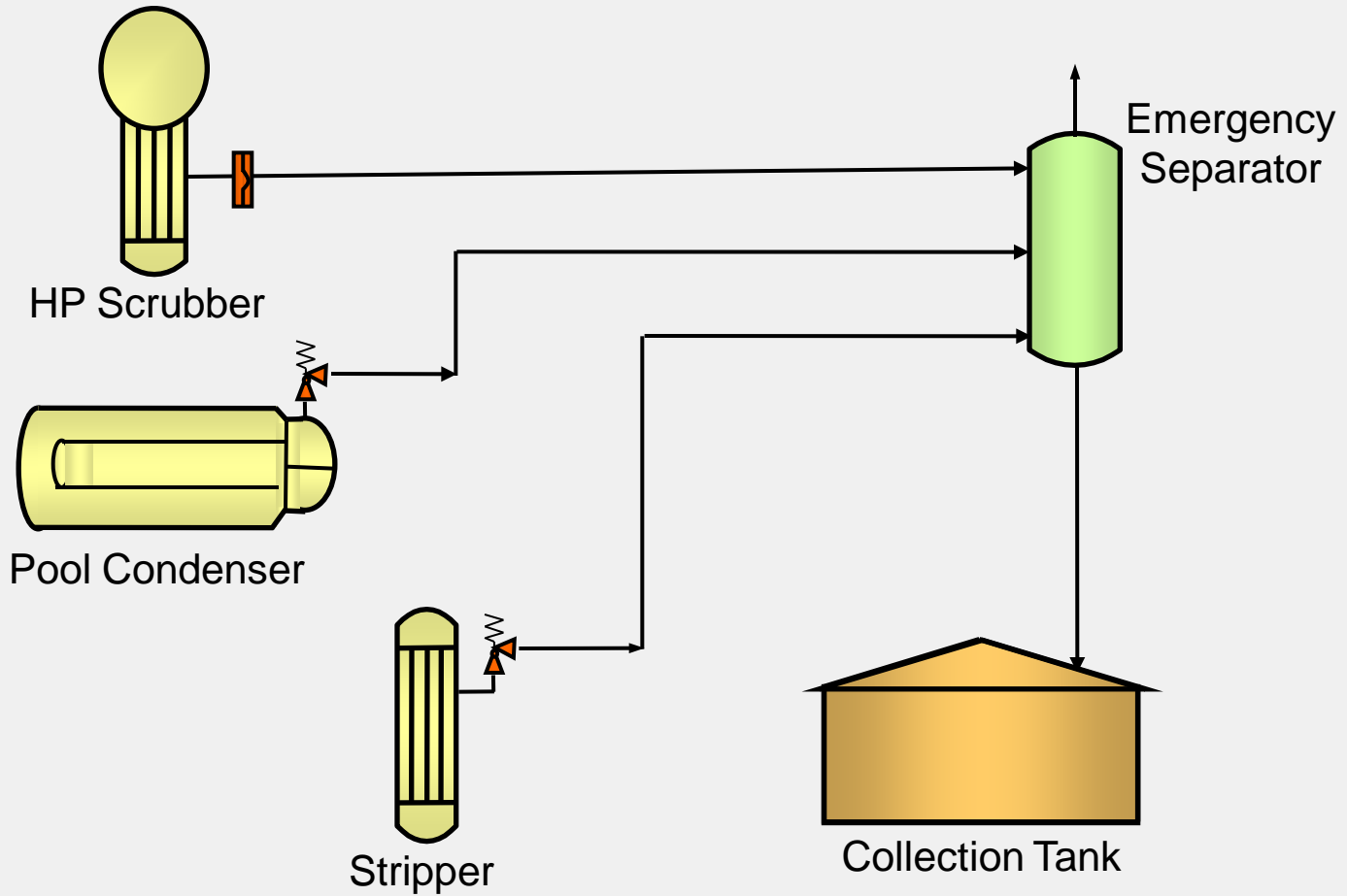
⇒ Risk Matrix

⇒ LOPA (**L**ayer **O**f **P**rotection **A**nalysis)



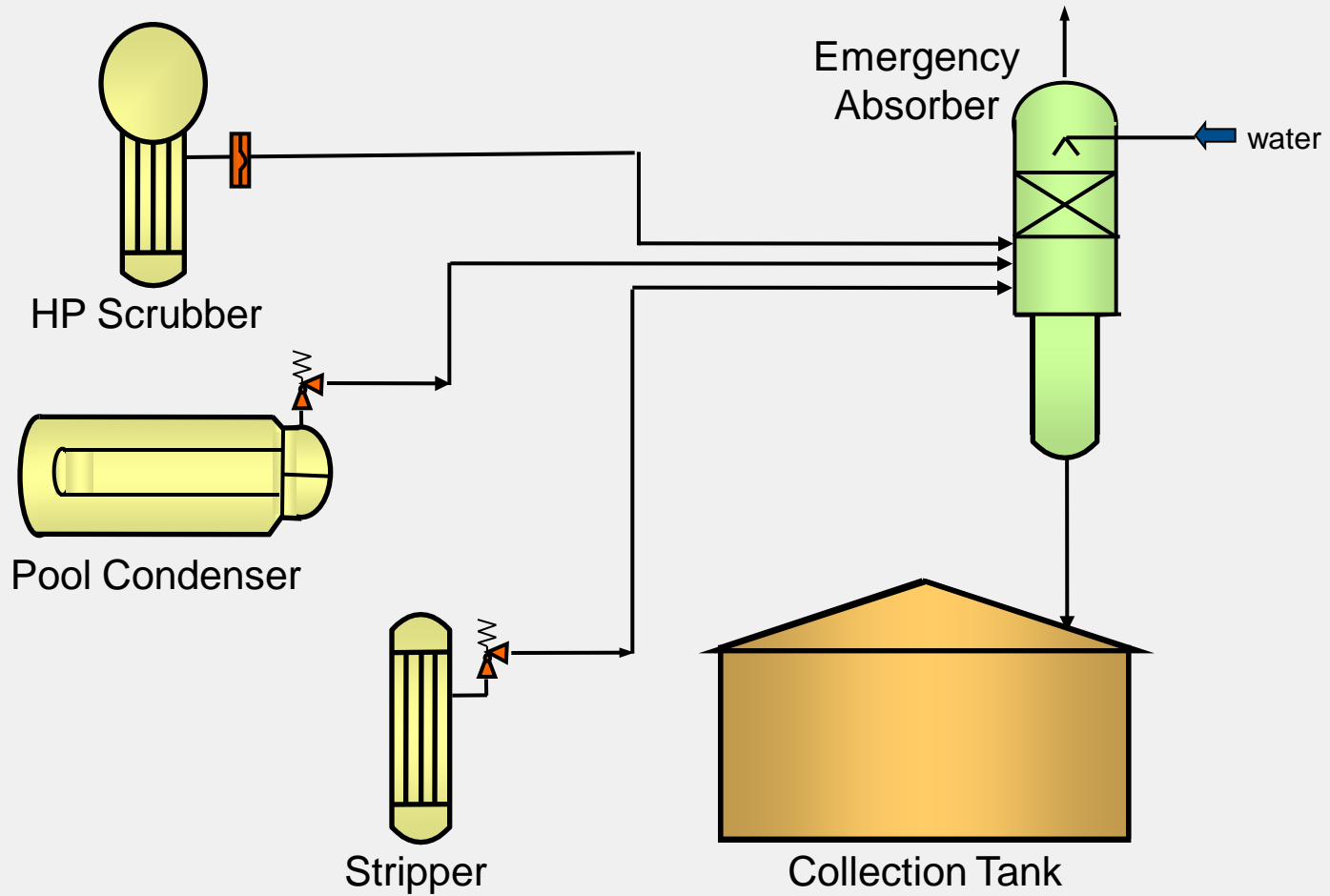
Emergency Release

Tube Rupture - Separator System



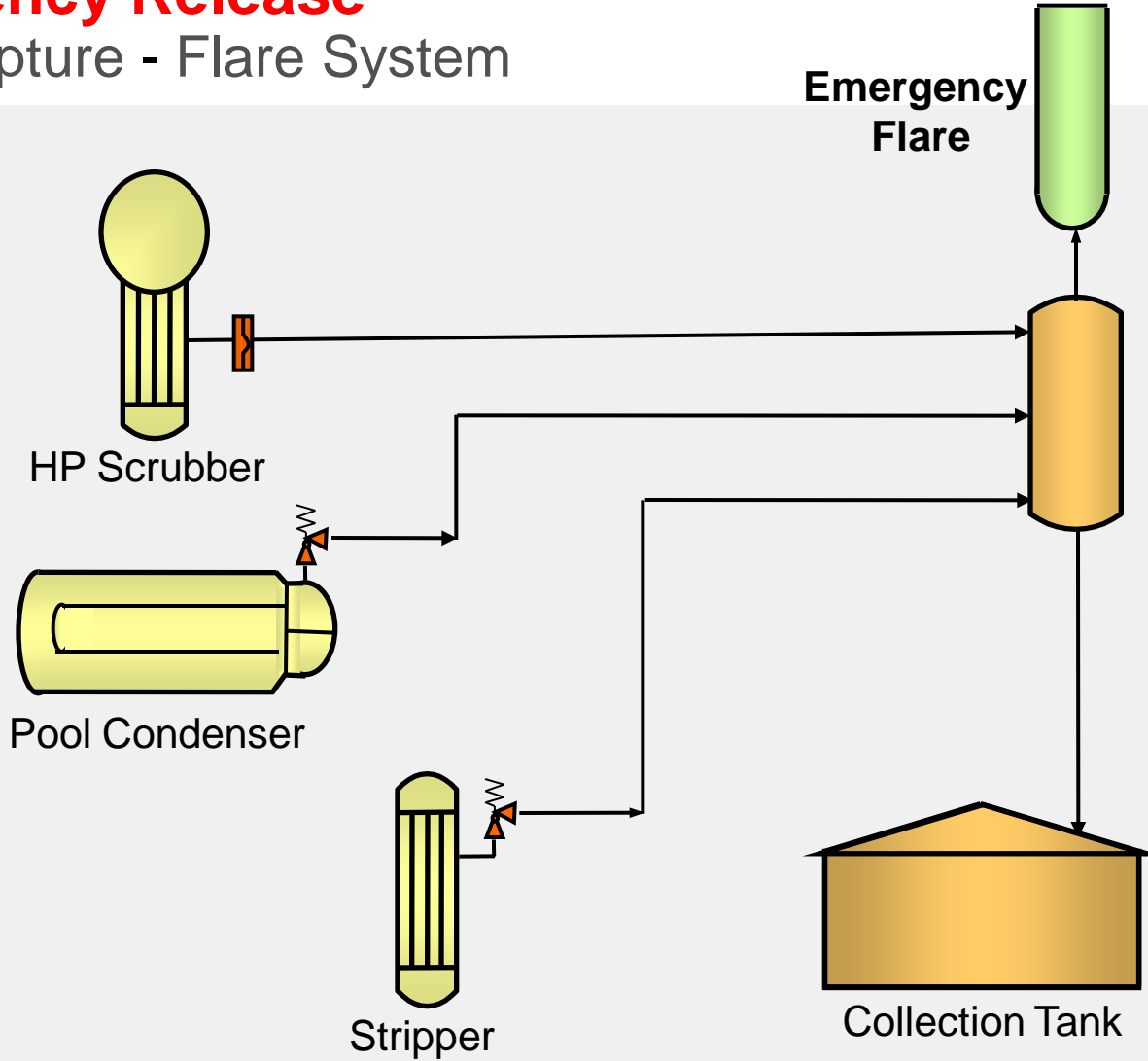
Emergency Release

Tube Rupture - Absorber System



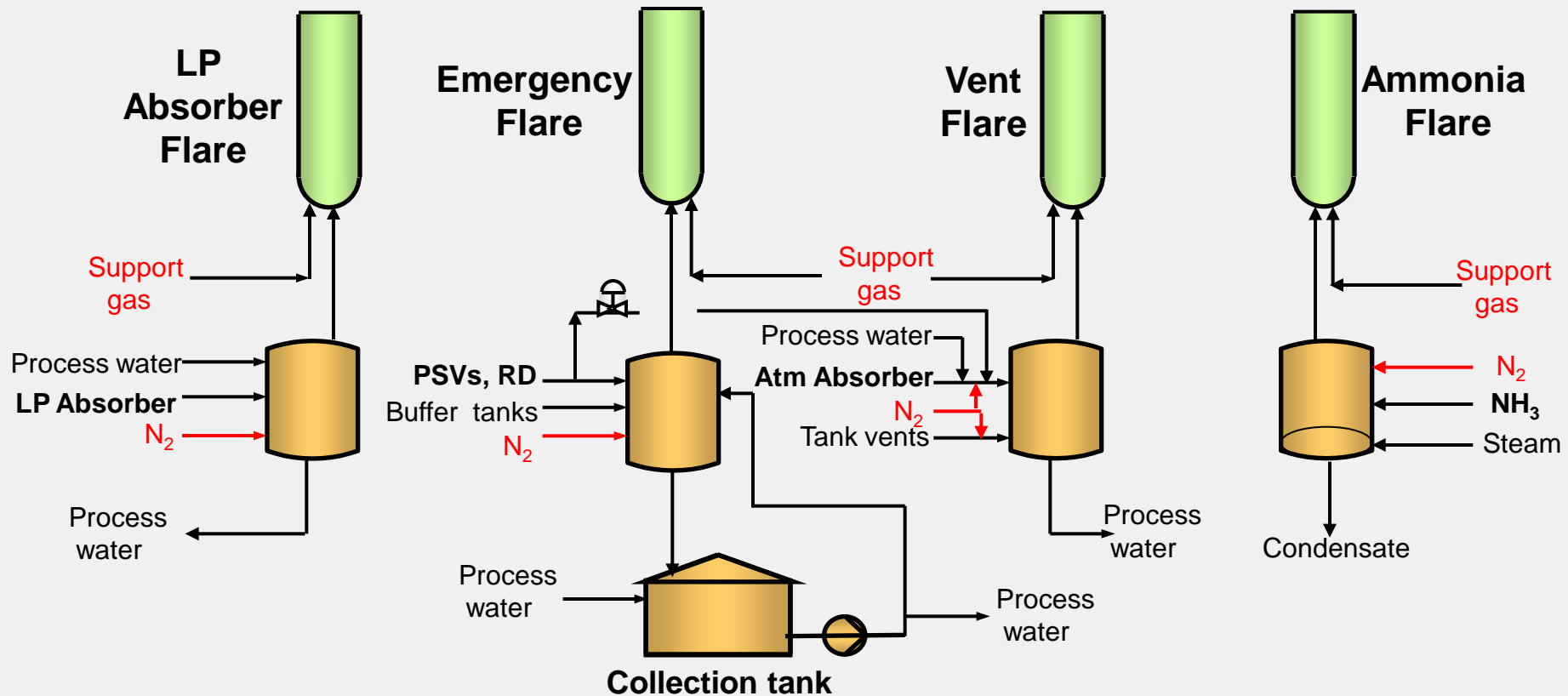
Emergency Release

Tube Rupture - Flare System



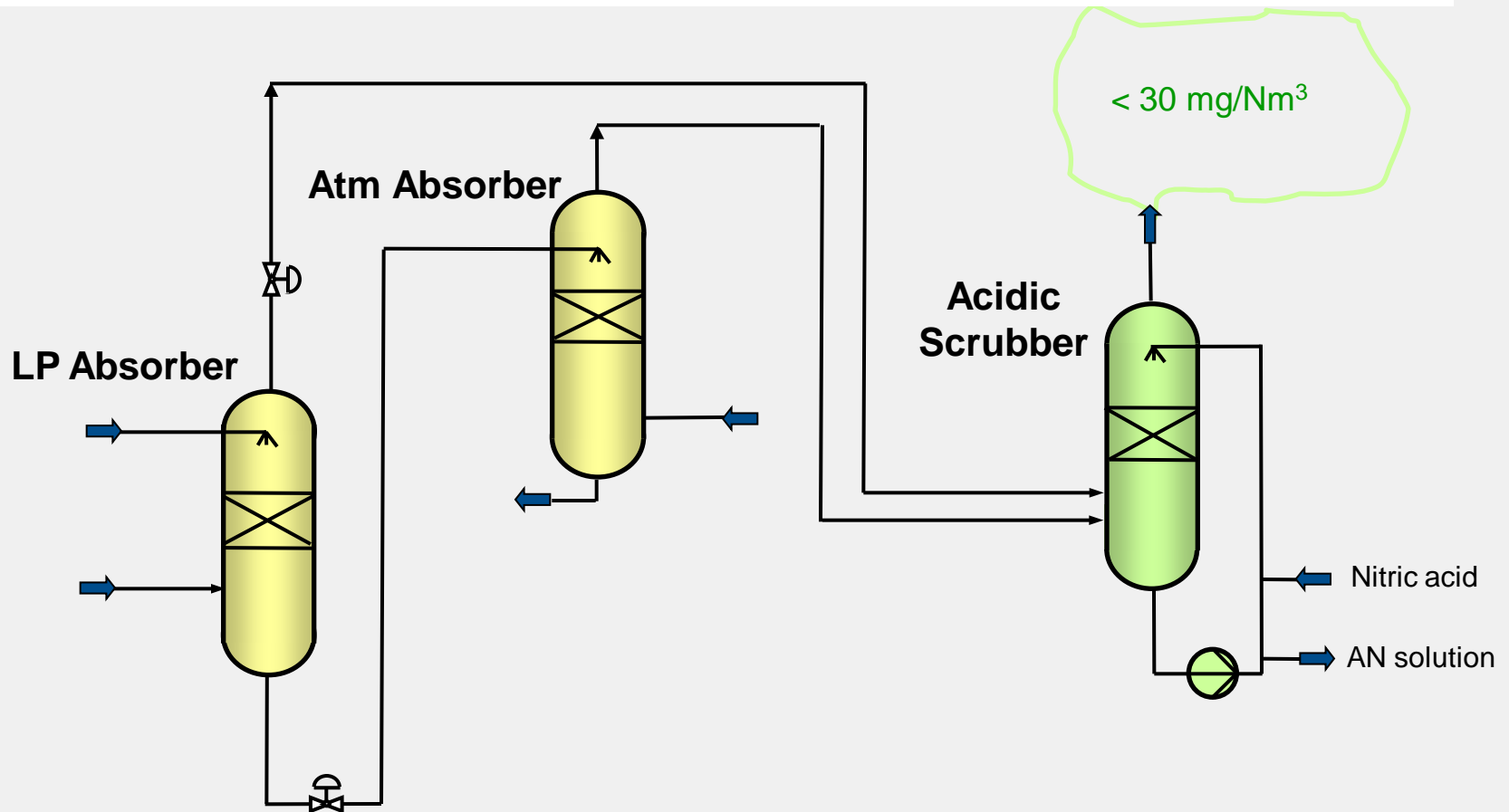
Case Studies

„Zero Emission“ Flaring System installed in Fertil Plant, Abu Dhabi



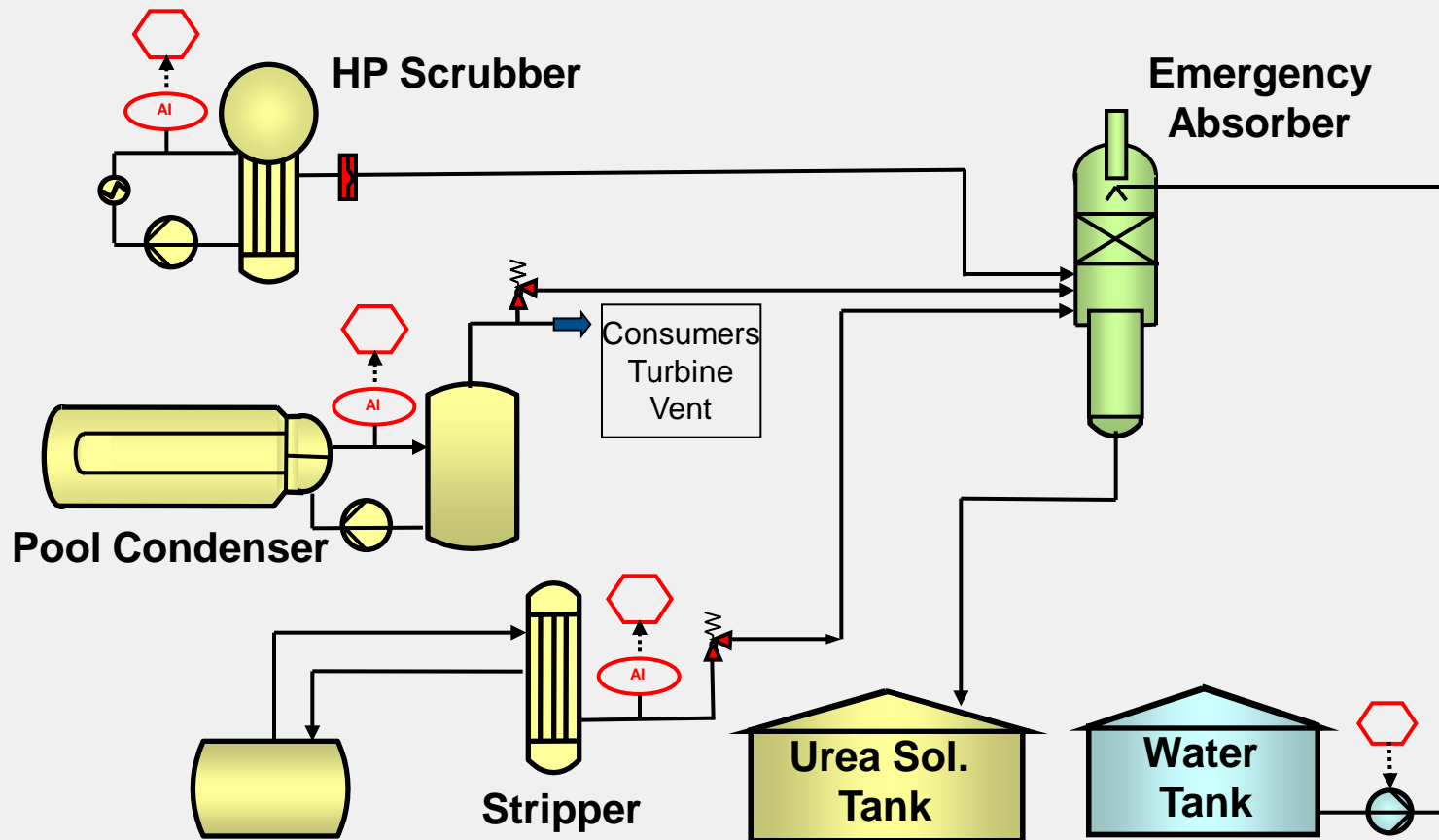
Case Studies

Acidic Scrubbing installed in Yara Plant, The Netherlands



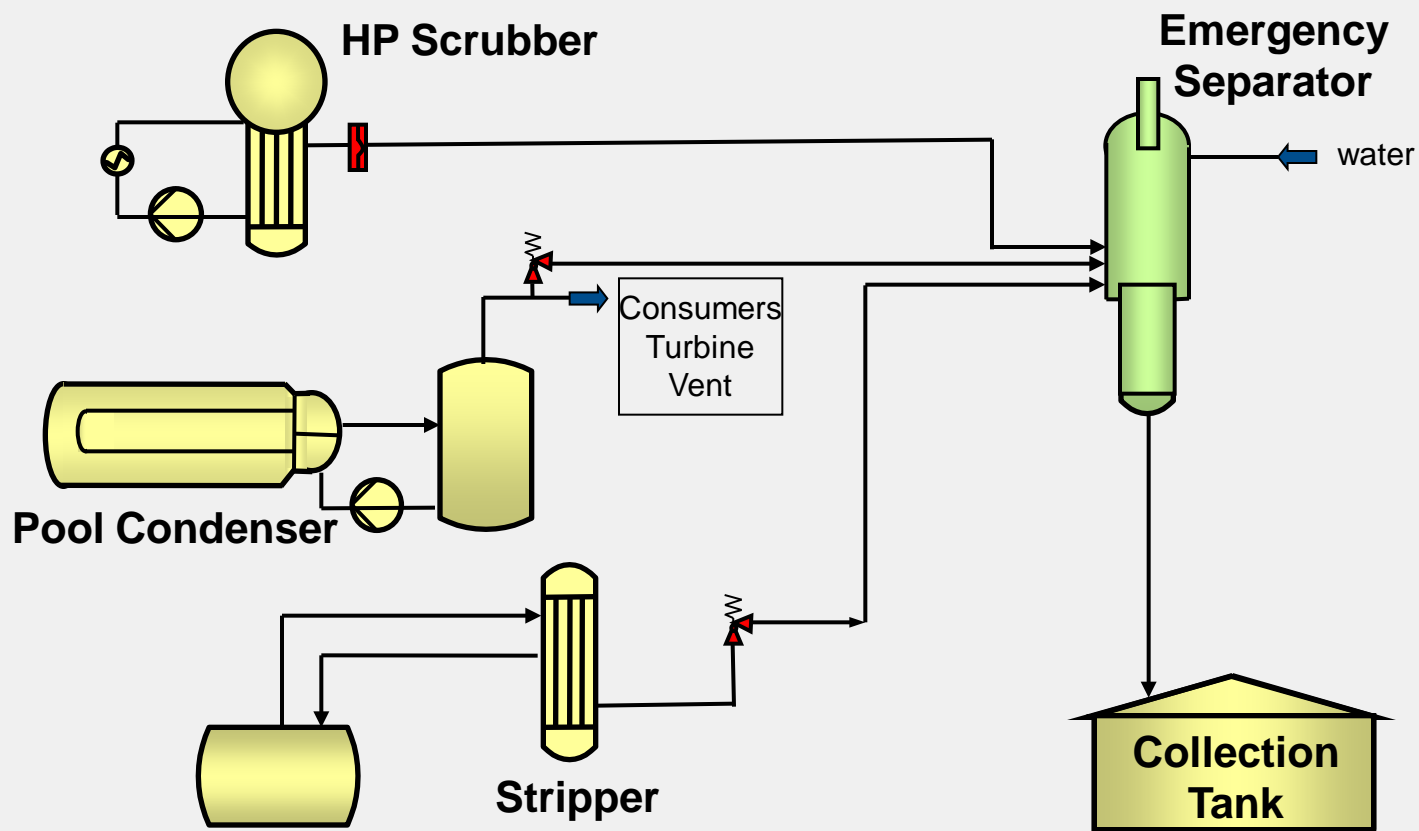
Case Studies

Emergency System installed in Yara Plant, The Netherlands



Case Studies

Emergency System installed in Safco 4 Plant, Saudi Arabia



Any questions?



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