



Accident initiated by Power Failure

TWG 2- meeting 2018
The Hague

Ragnhild Larsen

2. oktober 2018

Herøya Industrial Park

1,5 km²

2500 employees

80 establishments

4 Seveso sites

Yara Porsgrunn

- Worlds largest producer of fertilizer.
- Volumes:
 - NPK, 2.250.000 ton
 - Calcium Nitrate, 1.260.000 ton
 - Nitric Acid, 1.700.000 ton
 - Ammonia, 525.000 ton
 - CO₂, 200 000 ton
- Employees 465 + 28 trainees



Yara Porsgrunn

Ammonia

Quays

Fertilizer(NPK)

Storage/quays

Nitric acid

Calcium nitrate

DSB

Direktoratet for
samfunnsikkerhet
og beredskap

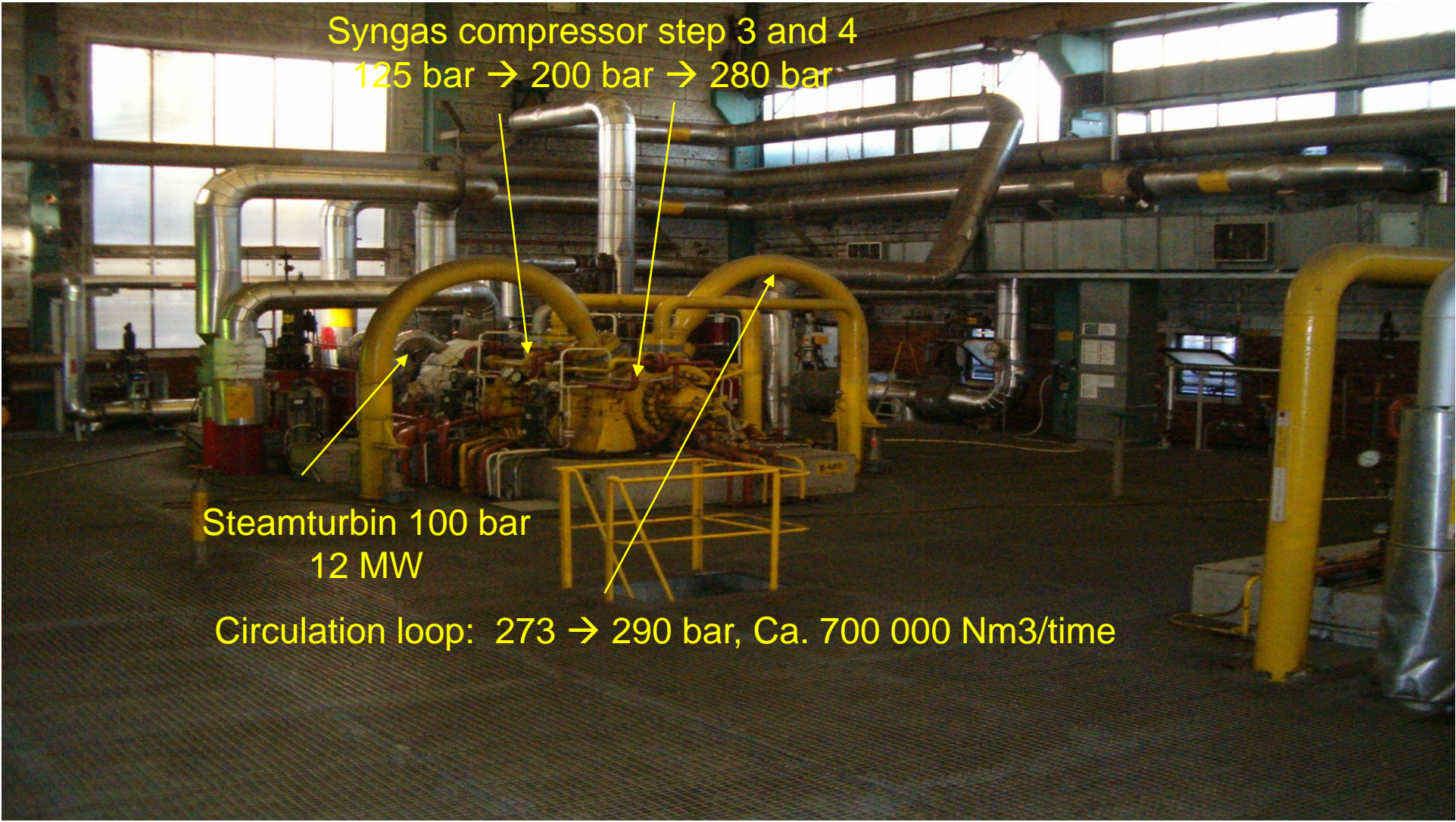
Ammonia Factory Layout



Syngas compressor step 1 & 2
21bar → 51 bar → 125 bar

Electroengine 17 MW





Syngas compressor step 3 and 4
125 bar \rightarrow 200 bar \rightarrow 280 bar

The image shows a large industrial room with a high ceiling and large windows. The floor is covered with a dark, textured material. Numerous large, yellow-painted pipes are visible, some running horizontally and others vertically. In the center, there is a complex piece of machinery, likely a steam turbine, with various pipes and valves connected to it. A yellow metal frame or platform is positioned in front of the machinery. The overall environment appears to be a power plant or a large-scale industrial facility.

Steamturbin 100 bar
12 MW

Circulation loop: 273 \rightarrow 290 bar, Ca. 700 000 Nm³/time

24th April 2017 02:43

- Trip in ammonia plant due to an external power supply fluctuation
 - The dip lasted 0,4 seconds.
- This fluctuation caused automatic shutdown of the plant.
- Normal shut-down operation was performed, and flammable content flared off



Restart followed by explosion and fire

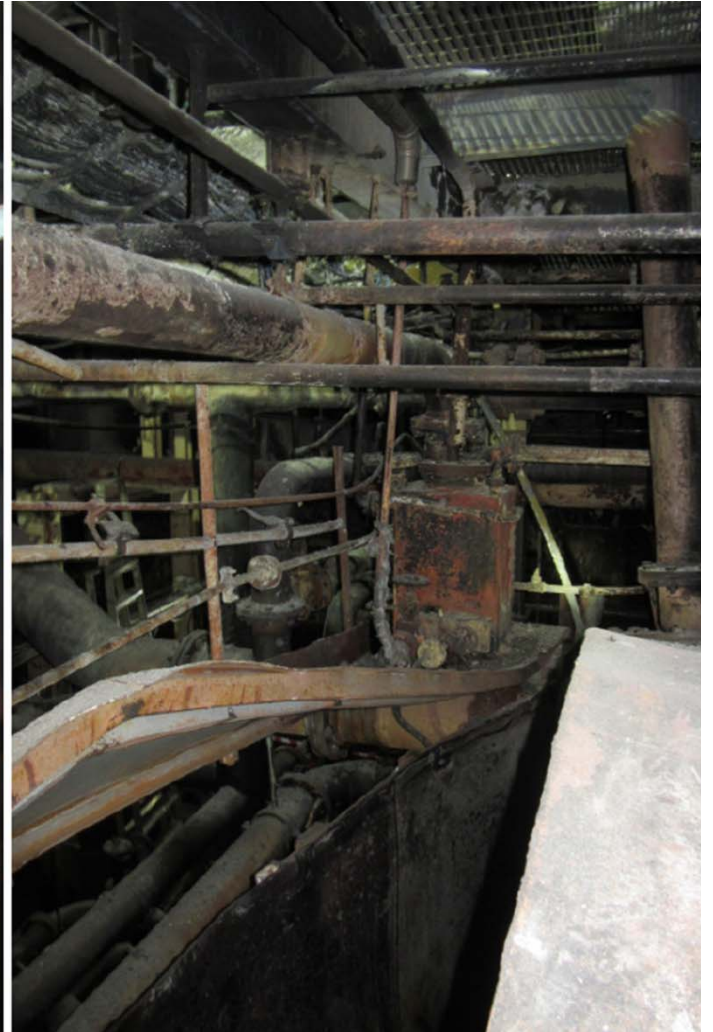
- Preparations are made for restart of the factory
- Operators follow restart procedures, all seems to be normal
- 03:15 an explosion occurs, followed by an intense oil fire in the compressor hall.
- Two operators that are present, evacuate without physical injuries
- Internal and external fireservices are on site shortly after, and 45 minutes later the fire is extinguished.
- Soon after they can see that the main syngas oiltank (lubricant oil) has «torn» and the fire is localized to this tank.



Compressor hall after the fire



Oil
tank
after
the
fire



Investigation of accident

- An «external» Yara investigation committee is formed, with representatives from Yara International. Mandate and composition of commission is decided by the top management.
- Police performs a normal fire investigation, DSB gives technical advice when requested
- DSB performs an inspection , have meetings with Yara and follow up findings in the Yara investigation report.

Initial and direct causes

- The initial power fluctuation did not cause the accident, but initiated the shut down.
- The direct cause is the generation of an explosive and highly sensitive atmosphere in the vapour phase of the oil tank.
- Oxygen enriched air came into the nitrogen purging system from the Air Separation Unit.

Main root cause and contributing factors

- The main root cause is an uncontrolled Management Of Change on the air separation unit trip system that allows enriched air to be sent in the nitrogen grid used as a safety barrier in the syngas compressor oil tank explosion scenario.
 - a low suction pressure trip mentioned in both P&ID and standard operating procedure was removed from the field some years back (2011).
- Contributing factors:
 - Lack of Process Hazard Analysis that generated inadequate standard operating procedure and inadequate training.
 - Lack of proper alarm management program and poor human machine interface

Damages

- No physical injuries
 - Immediate consequence on people are limited to psychological impact (one employee in a long sick leave).
- In terms of environment there has been a limited oil release to the fjord that has been rapidly and effectively cleaned.
- Large fire damages on building, no damages caused by overpressure
 - Damages under roof, windows, and on traverse crane
- Extensive damages in the electrical/instrumentation systems.
- Vast amount of cleaning
- Cost: 165MNOK
- Restarted and ordinary operation from October 4.

Compressorhall after rebuilding

