

**6.EFRC Düsseldorf, Germany**

# Using reciprocating compressors to liquefy NG in a small scale LNG Plant

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Director**



# Contents

1. Introduction – RWE Energy and gas storage facilities
2. LNG Plant – Plant Data and Liquefaction Process
3. Type of compressors installed
4. Liquefaction compressor
5. Problems and considerations to optimize liquefaction
6. Solutions to be discussed
7. Conclusion

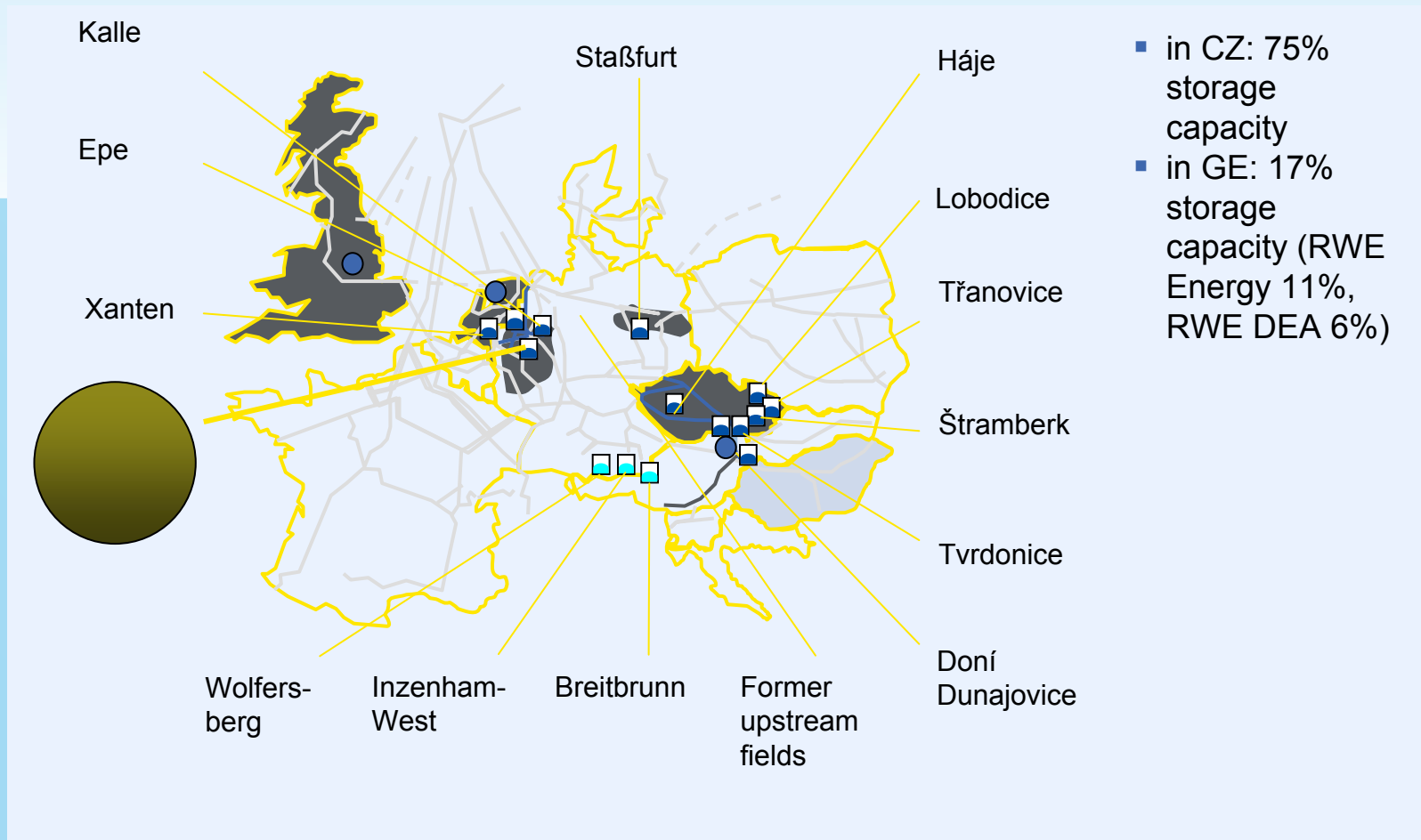
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# RWE Energy

<b>gas sales</b>	<b>258 bill</b>	<b>kWh</b>
electricity sales	168 bill	kWh
<b>gas-storage (underground)</b>	<b>3.3 bill</b>	<b>Nm<sup>3</sup></b>
<b>gas-storage (above-ground)</b>	<b>21,500</b>	<b>m<sup>3</sup> LNG</b>
	<b>14 mio.</b>	<b>Nm<sup>3</sup> gas</b>
	<b>140 mio.</b>	<b>kWh</b>

# RWE Energy storage facilities



- in CZ: 75% storage capacity
- in GE: 17% storage capacity (RWE Energy 11%, RWE DEA 6%)

- RWE Energy storage facility
- RWE Dea storage facility
- Supra-regional gas trading points (HUBs)

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# LNG Plant Nievenheim - basic data



**start of construction:** 1974  
**start of operation:** 1976  
**reinvestment:** 2003/07

## LNG-Tank:

**height:** ca. 32 m  
**diameter:** ca. 37 m  
**volume:** 21,500 m<sup>3</sup>



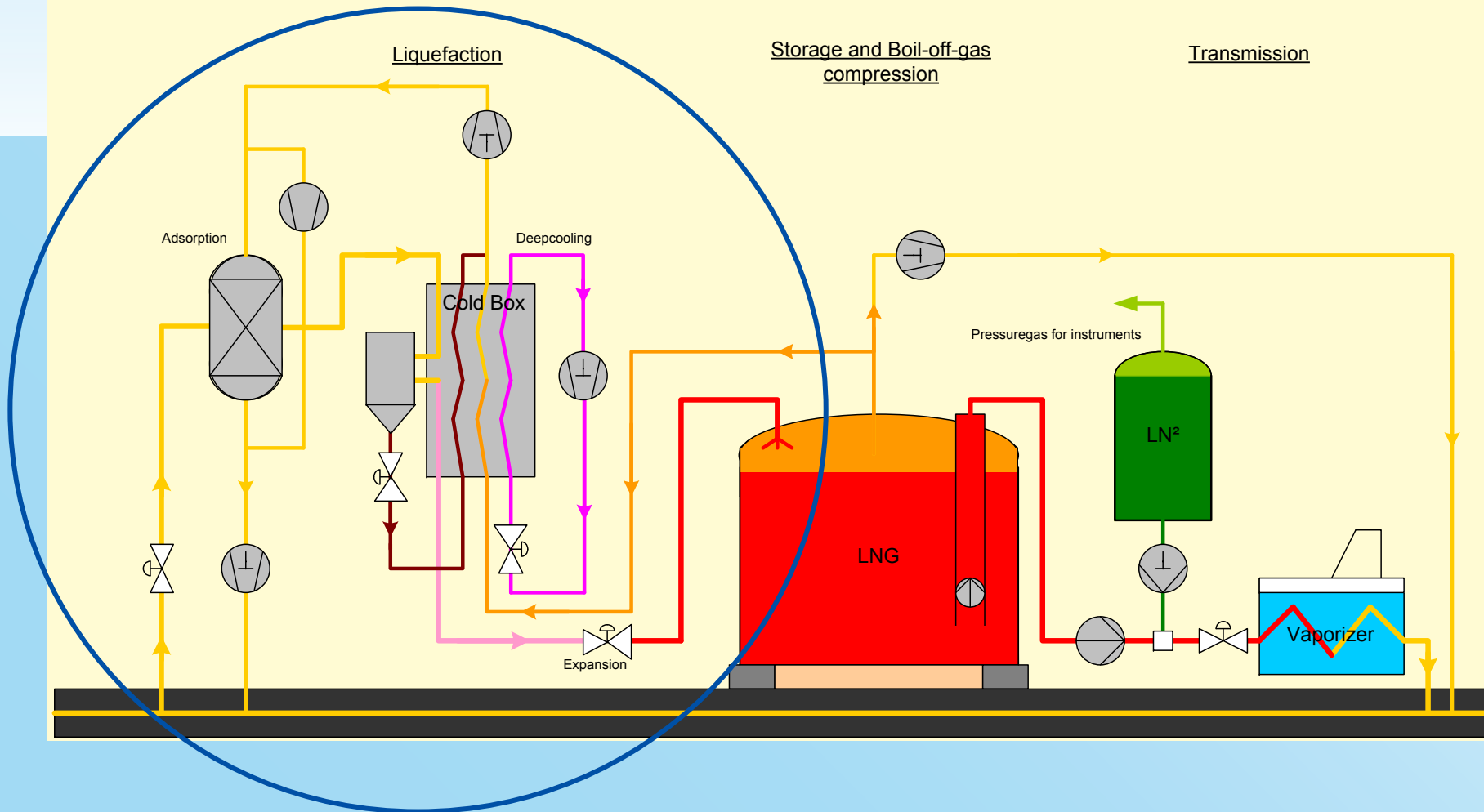
**capacity (L-gas form):** 14 Mio.Nm<sup>3</sup>  
**liquefaction** 2,400 Nm<sup>3</sup>/h  
**regasification** 100,000 Nm<sup>3</sup>/h

**5 Compressors** (3 reciprocating, 2 turbo)

# Peak Shaving Plant Nievenheim

## Plant scheme

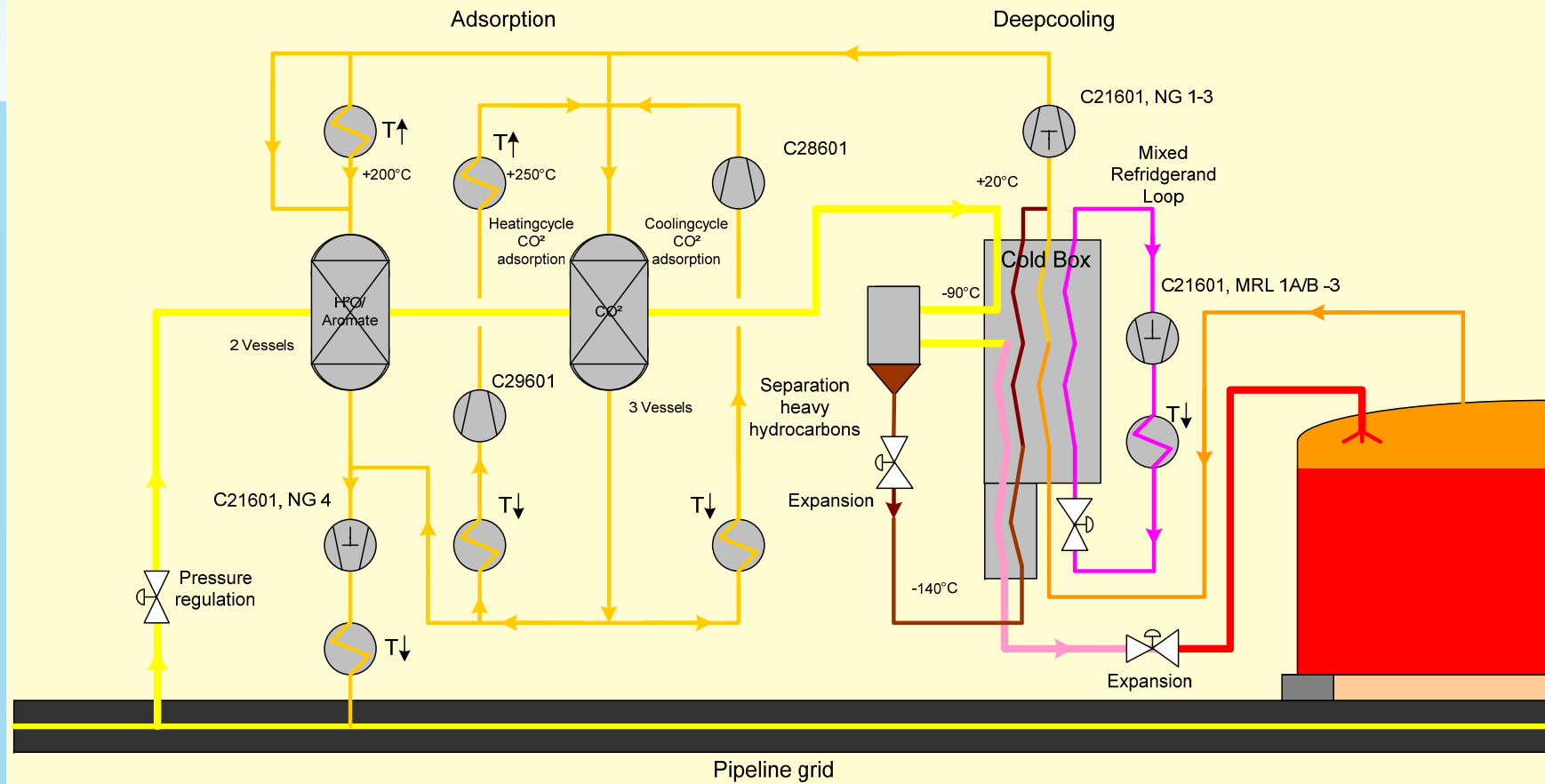
Stand 2008



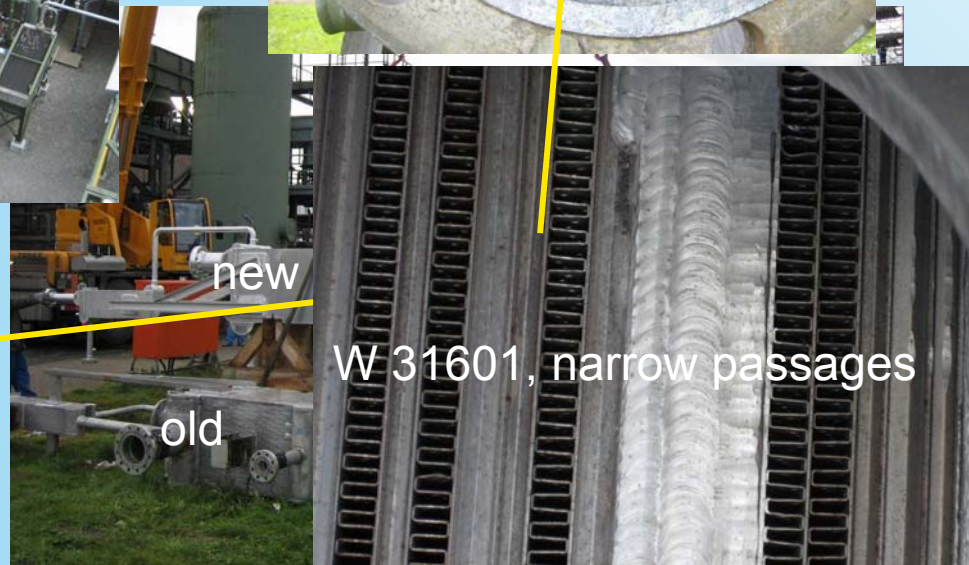
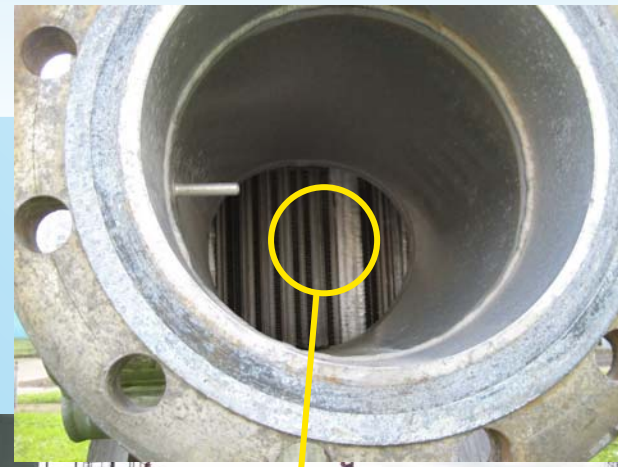
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## Liquefaction - Natural gas flow



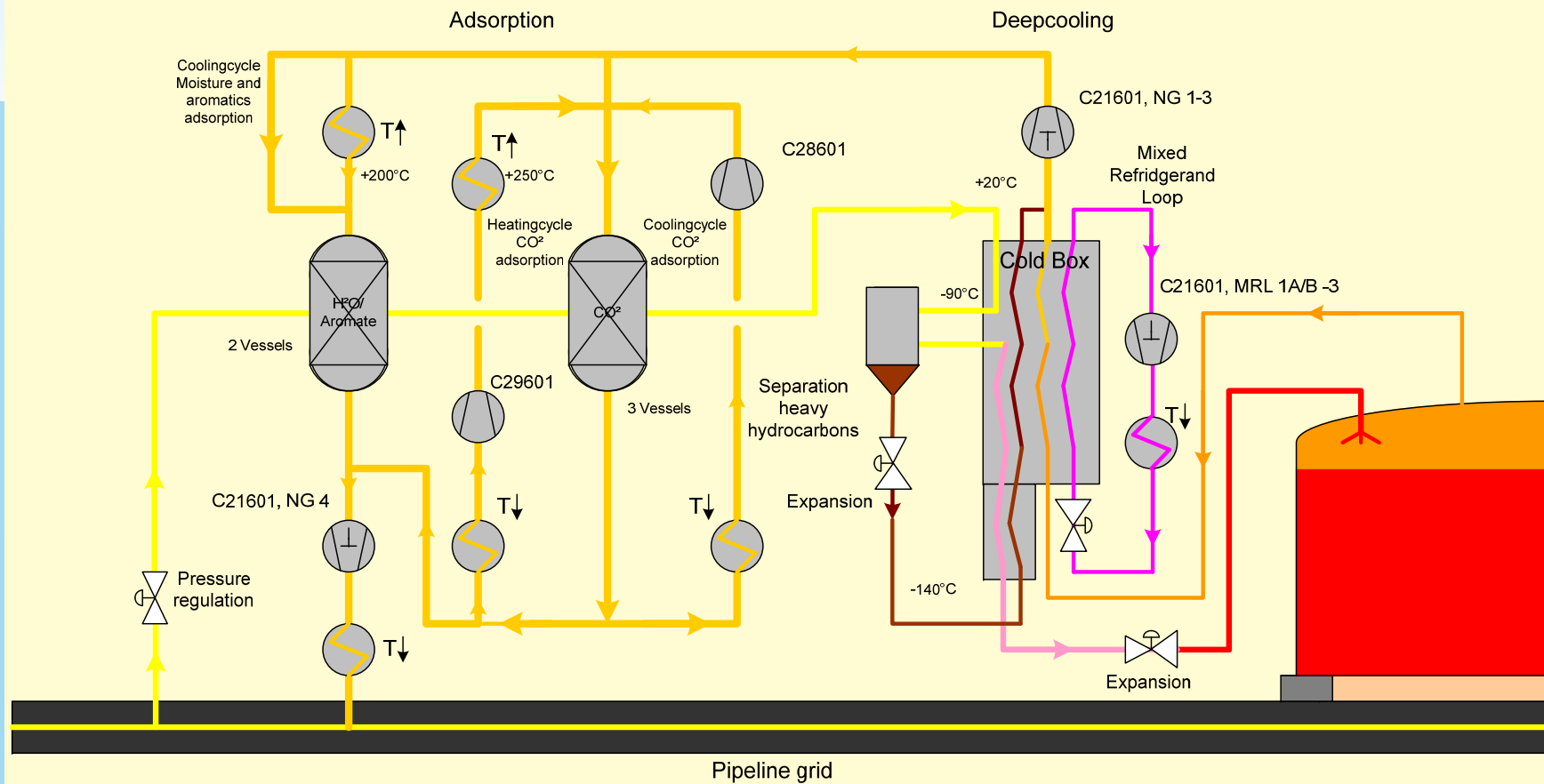
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# Peak Shaving Plant Nievenheim

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## Liquefaction - Regeneration



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Central-heating boiler

Heat exchanger  
(carbon dioxide  
adsorber)

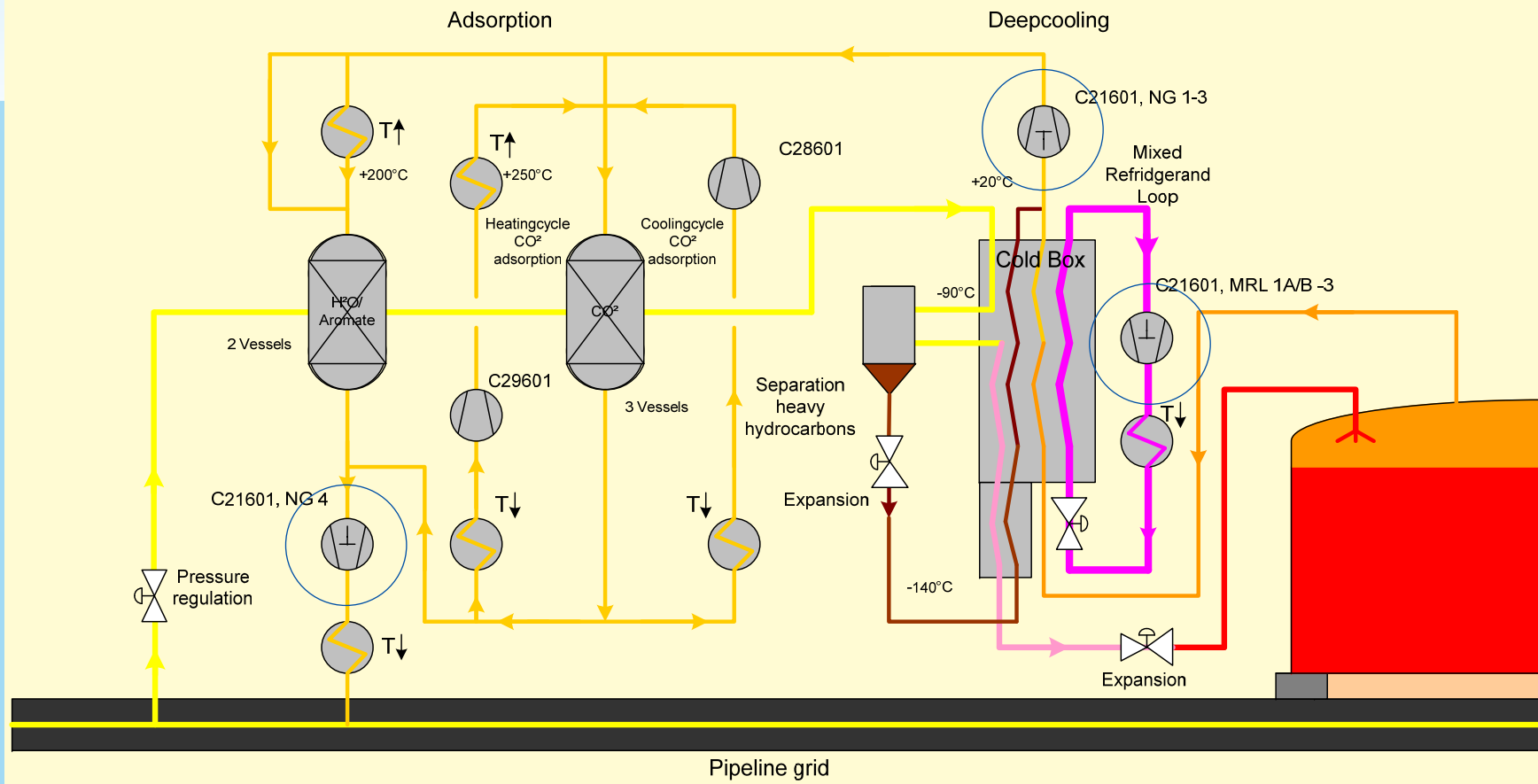


Heat  
exchanger  
(Moisture and  
araomatics  
adsorber)

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## Liquefaction – Coolant circuit



# Contents

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REG Gas handling >>> compressor C 28/29 – 601



Turbo compressors for Heating up /cooling within the REG Gas cycle



# Peak Shaving Plant Nievenheim

BOG handling >>> compressor C 22601

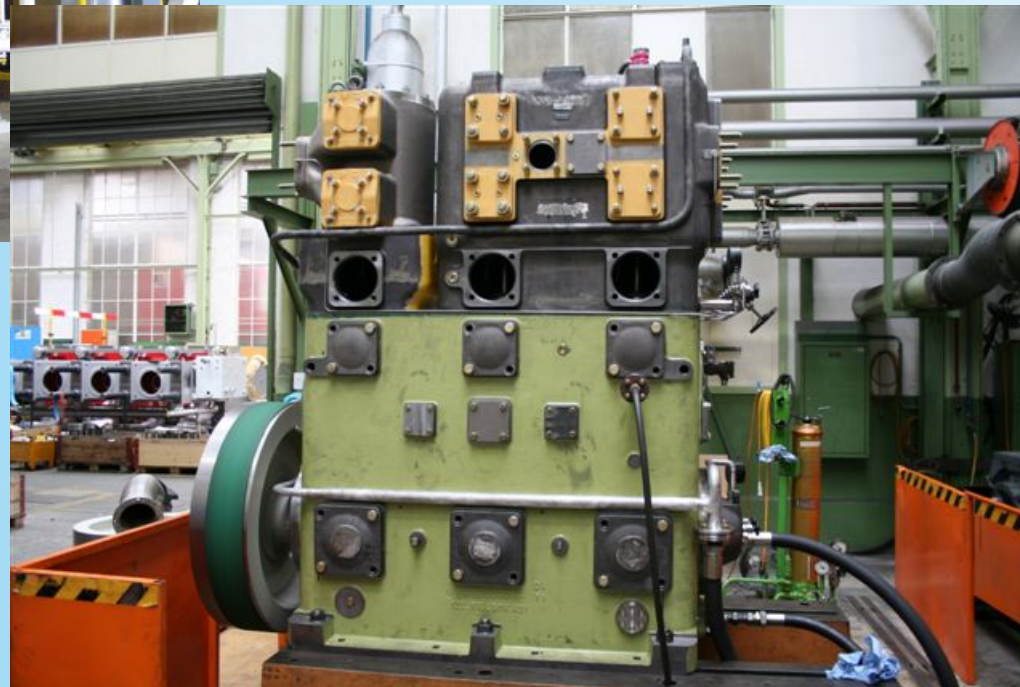


# Peak Shaving Plant Nievenheim

BOG handling >>> compressor C 22601



Mechanical Test run



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# Peak Shaving Plant Nievenheim



Typical compressor in Cavern storage plants



# Peak Shaving Plant Nievenheim

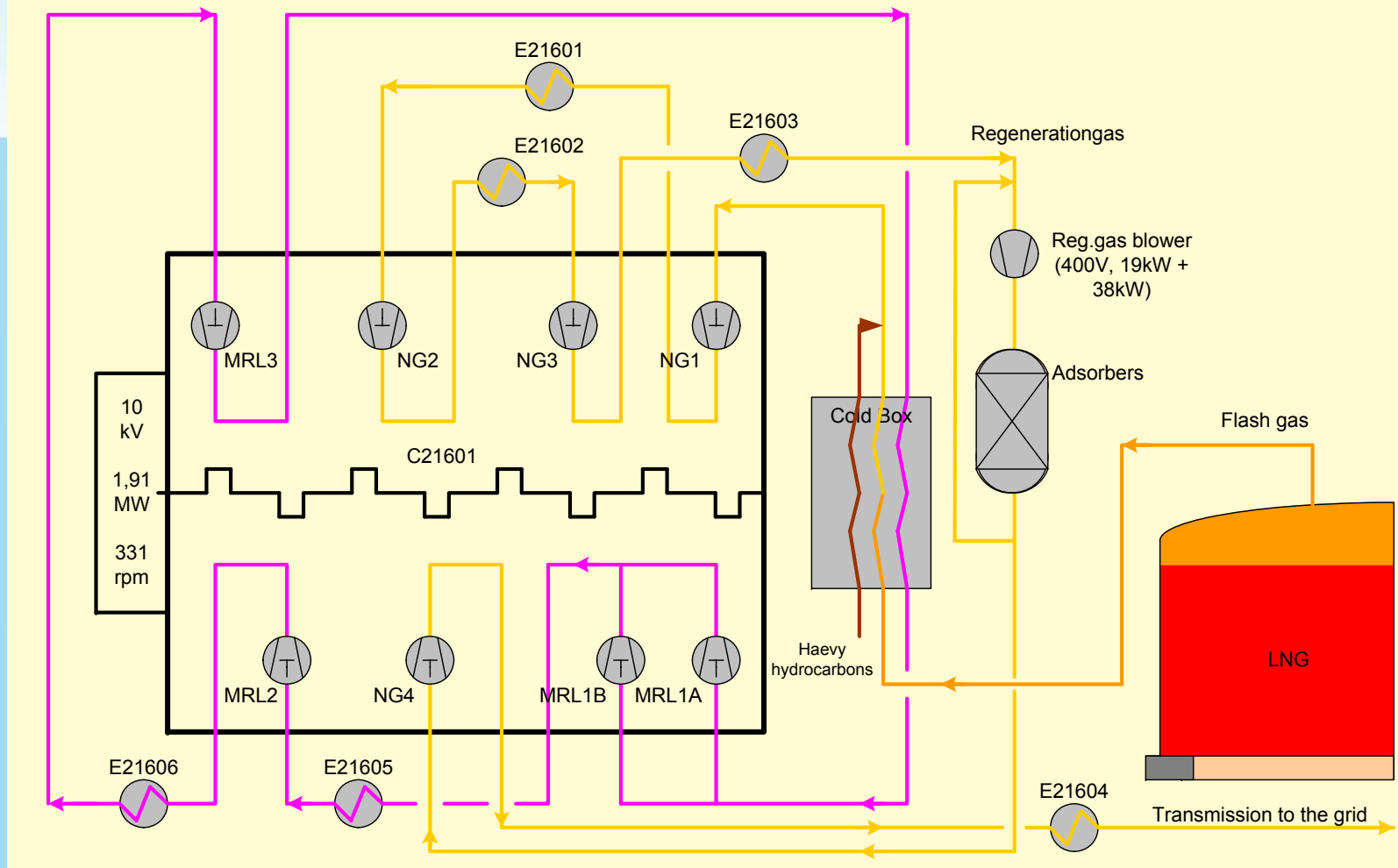
## Compressor C21601



# Peak Shaving Plant Nievenheim

## Compressor C21601

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# Peak Shaving Plant Nievenheim

## Compressor C 21601



# Contents

1. Introduction – RWE Energy and gas storage facilities
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## Compressor C 21601

### Some operation problems and limitations

- ▶ Control of process
- ▶ Startup conditions
- ▶ Trip function/ control of compressor safety features
- ▶ Control of process at partial load conditions
- ▶ High risk to damage the compressor

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# Peak Shaving Plant Nievenheim

## Solutions/next steps

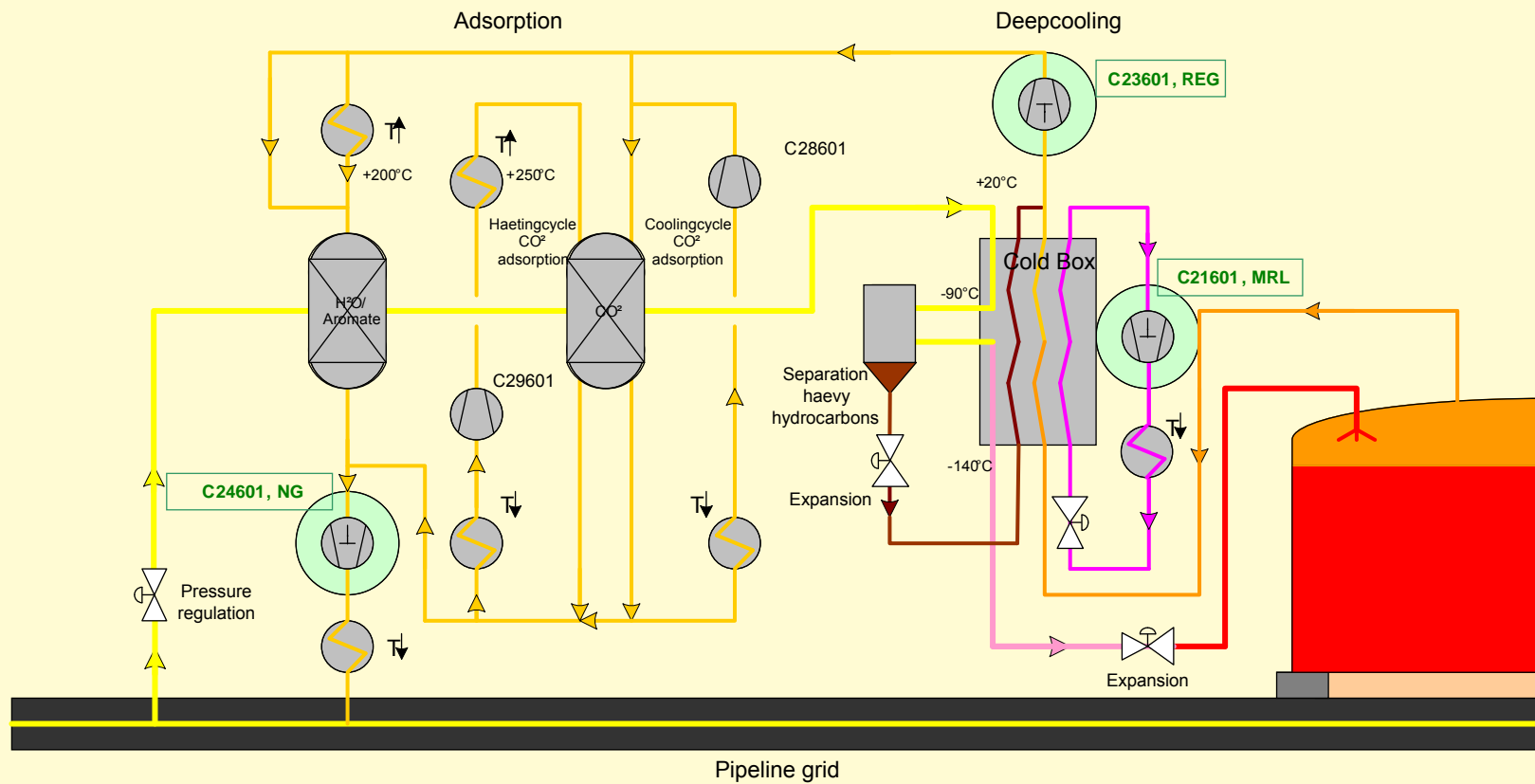
### Solutions to be discussed

- ▶ New liquefaction process
- ▶ Optimized existing plant arrangement ( modify MRL)
- ▶ New compressor arrangement

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## Liquefaction process-new-

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# Peak Shaving Plant Nievenheim

## Conclusions

- ▶ Existing compressor arrangement is complex but it works
- ▶ Still possibilities to optimized the existing process
- ▶ Discuss new compressor arrangements
- ▶ **Next Step:** Conduct feasibility study to compare CAPEX/OPEX of the alternatives

# Peak Shaving Plant Nievenheim

**Thank you  
for your attention !**

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