

New Processes for Second Generation Offshore Liquefaction Projects

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1. Introduction

2. Feedstock Preparation

3. Offshore Liquefaction Processes

4. End Flash and Nitrogen Removal

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1. Introduction

- FLNG technology development opens up new possibilities to monetize profitably stranded gas fields or flared or re-injected gas

- In order to be competitive an offshore unit shall require
 - Compactness for plot
 - Controlled weight for hull
 - Increased safety , therefore reduction of all LPG inventories
 - Operability , flexibility with respect to sea motions

- New processes covering main units ready to reply to this challenges :
 - Feedstock preparation for liquefaction
 - Liquefaction
 - Nitrogen removal

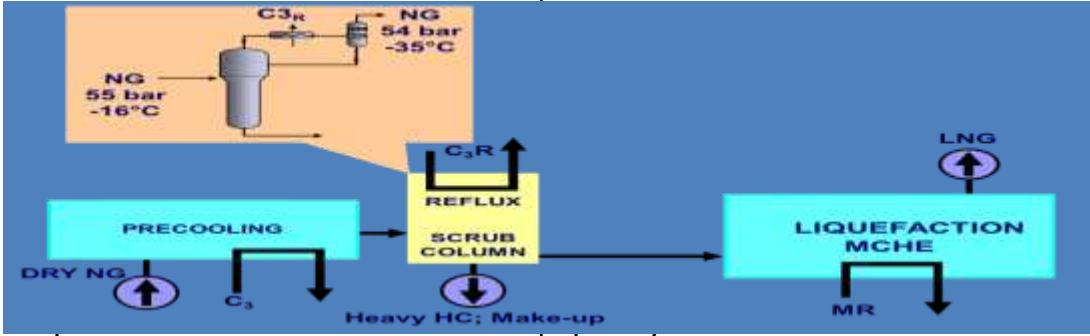
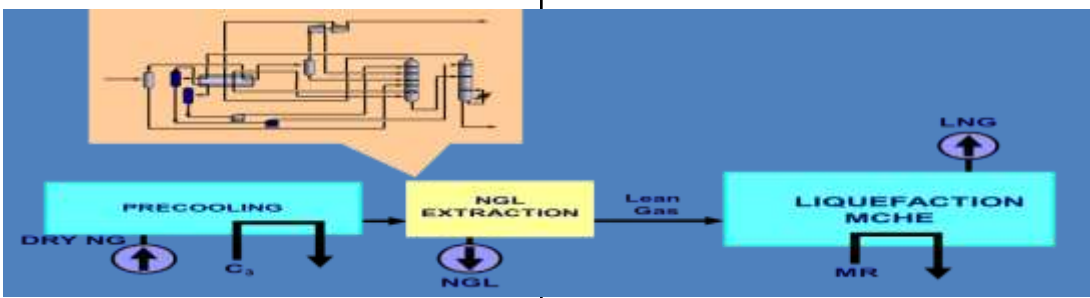
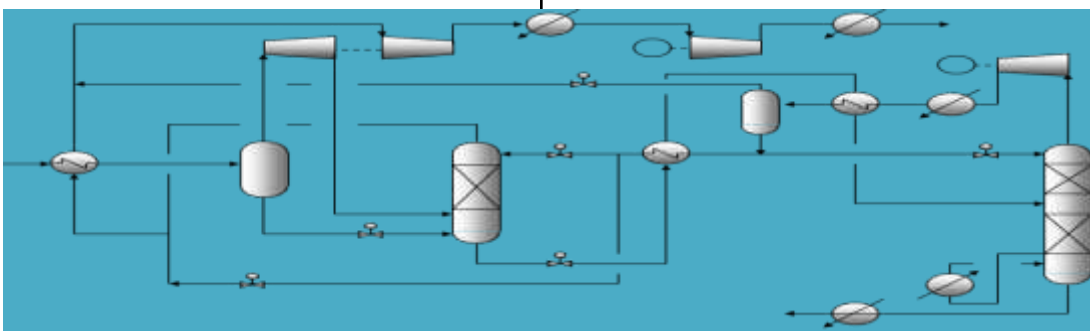
2. Feedstock Preparation Requirements

- Prior to liquefying, feedstocks requires treatment in order to remove corrosive compounds and impurities that could freeze
- Acid gas : CO₂ and H₂S content below 50 ppm and 10 ppm respectively
- Sulphur compounds : lower than 30 ppm
- Water to be as low as possible (below 1 ppm)
- Mercury to be removed not to damage cryogenic heat exchangers
- Heavy Hydrocarbons and aromatics to be reduced below 1 ppm

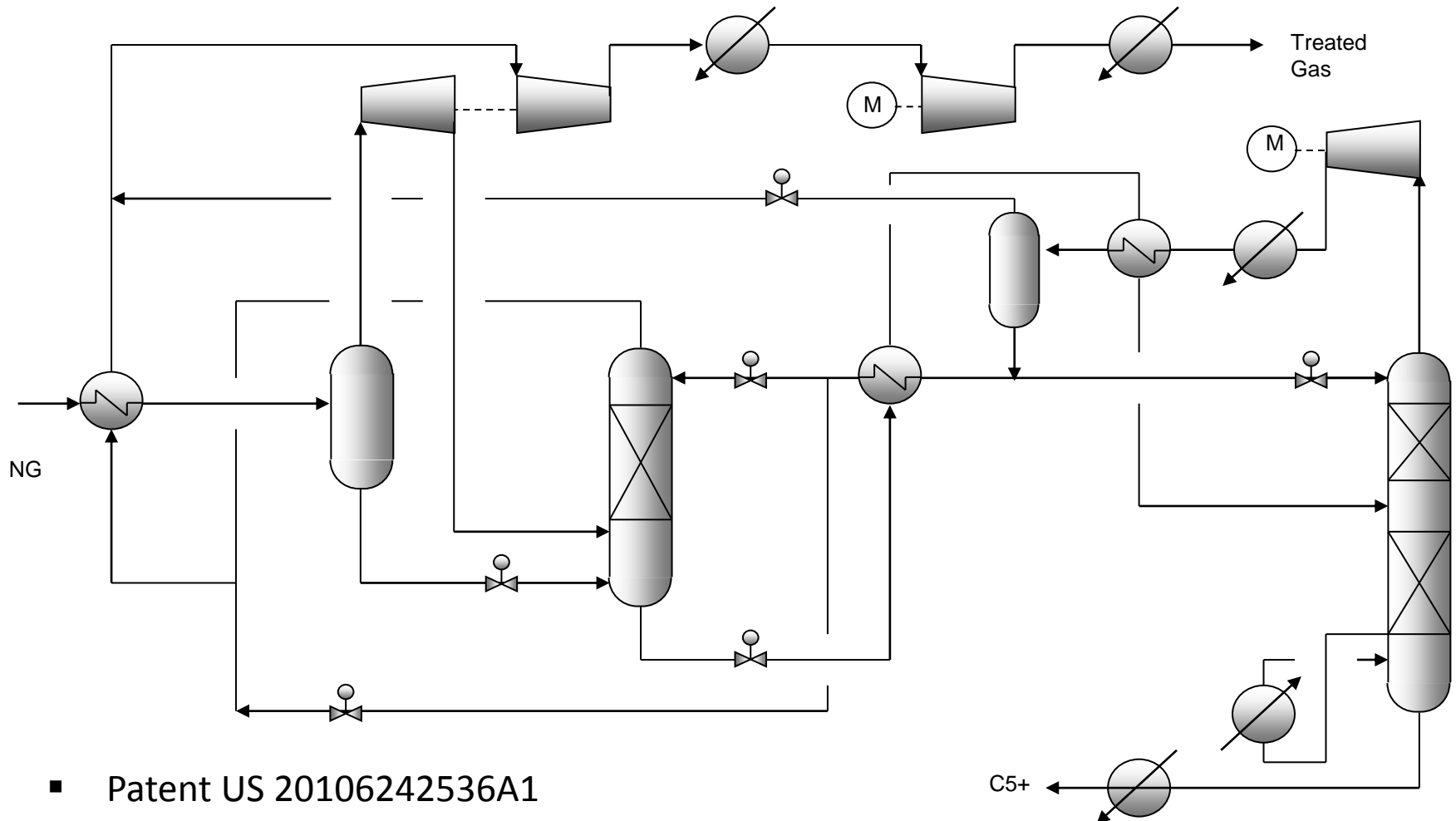
2. Feedstock Preparation Requirements

- Acid gas can be removed via regenerable solvent absorption
- Water can be removed via mole sieves adsorption
- Mercury can be removed via solid bed adsorption.
- Heavy Hydrocarbon removal process selection shall be adapted to the plant specificities and objectives
- A new process has been developed for HHC removal to respond to offshore liquefaction challenges

2. Feedstock Preparation Processes Screening

Process type	Advantages	Drawbacks
Scrub column		
NGL recovery		
Offshore liquefaction HHC removal (new process)		

2. Feedstock Preparation The New Process



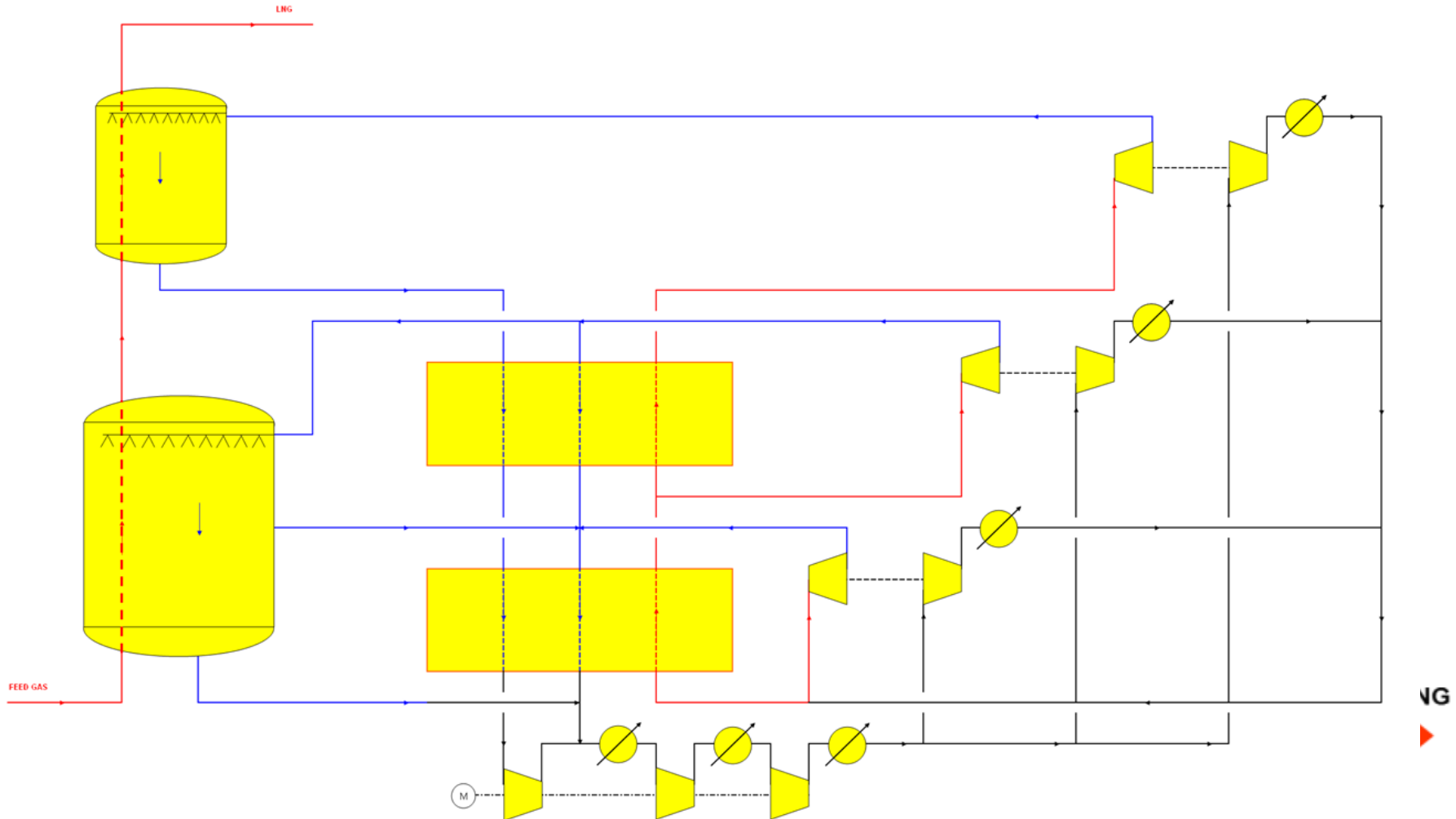
- Patent US 20106242536A1
- Offshore Dual Column Process

2. Feedstock Preparation

Main Advantages

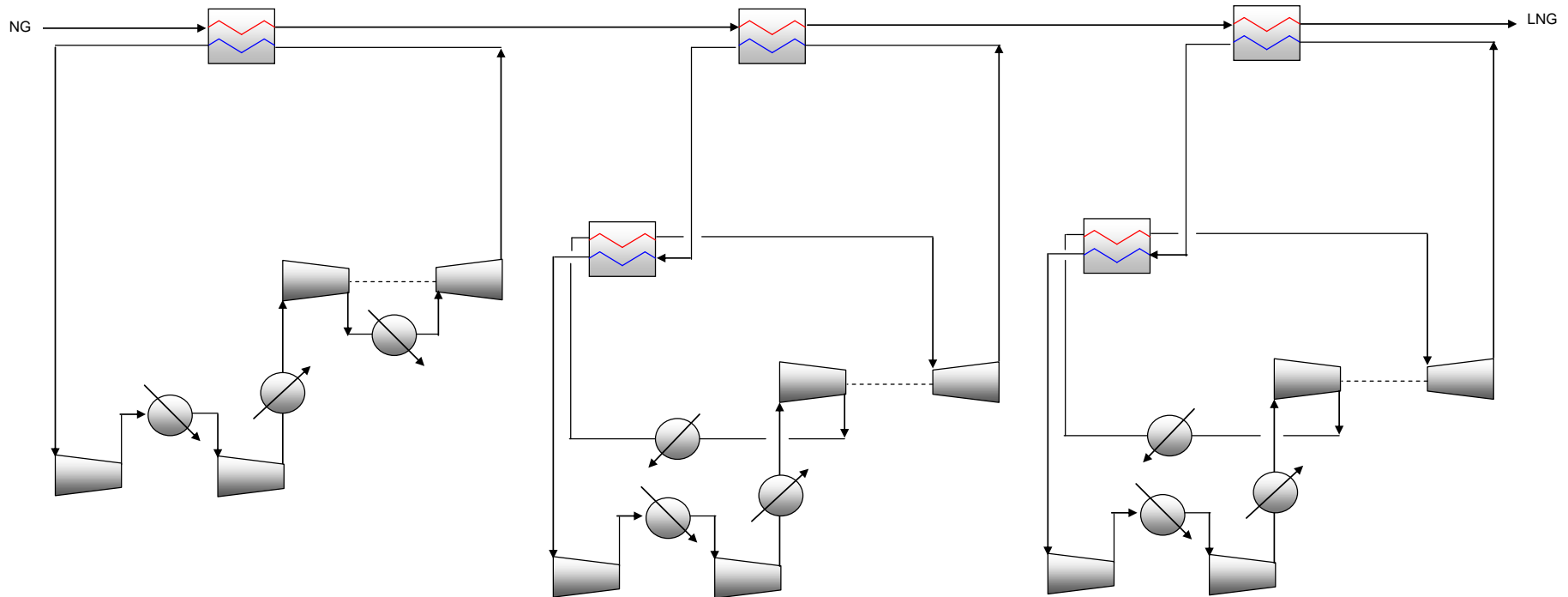
- Increased safety due to low liquid inventory
- Enhanced robustness by selecting S&T heat exchangers
- Turbo-expander provides all required refrigeration: smooth and fast start-up
- Recycled treated gas during start-up to minimise flaring : optimise investment return and limit environmental impact
- Optimised footprint: no fractionation unit required
- Liquefaction can be operated at high pressure to improve liquefaction efficiency
- This process is best adapted to offshore liquefaction processes not using mixed refrigerant

3. Offshore Liquefaction Processes State of the Art Technologies



3. Offshore Liquefaction Processes

Technip Tricycle Liquefaction Process



- Patent US 20100126214A1
- Tricycle Process

3. Offshore Liquefaction Processes

The Tricycle Process : Advantages

- No liquid inventories increasing safety
 - Use of gas expansion cycles

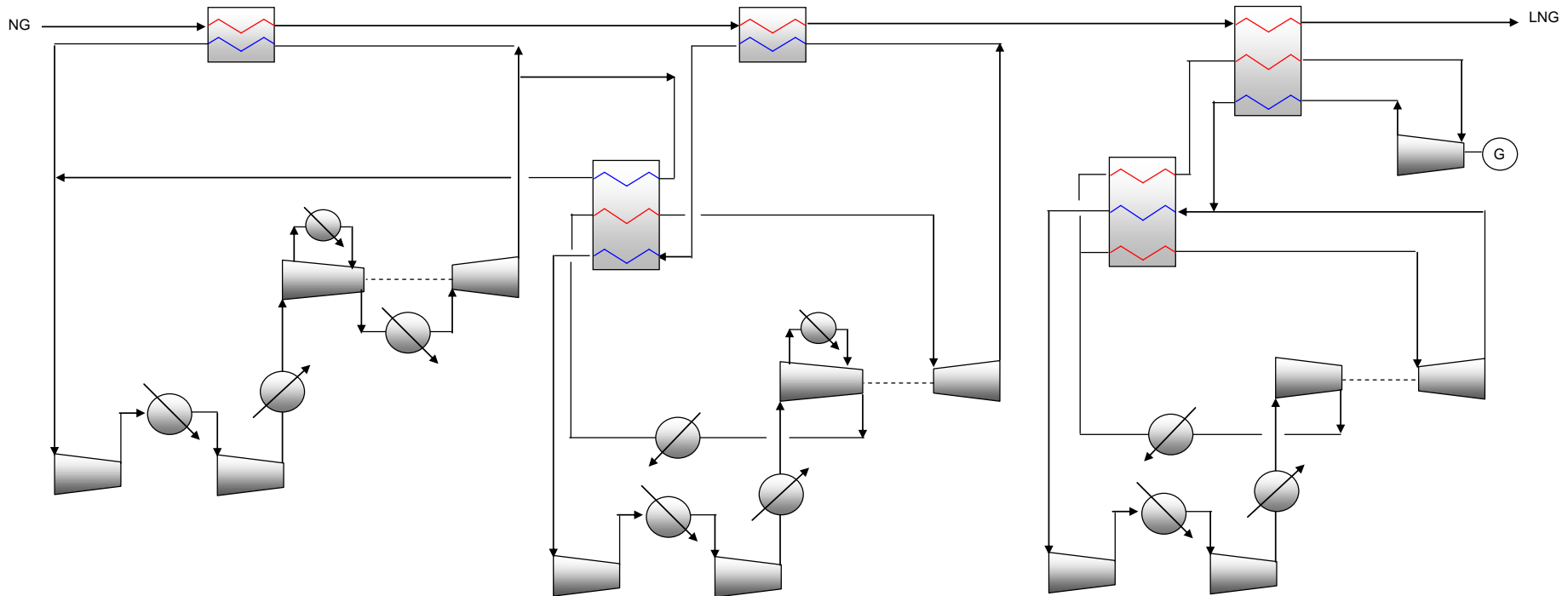
- Efficiency approaches that of a liquid refrigerant cycle
 - Better efficiency than conventional Nitrogen Expansion Processes

- Three cycles totally independent
 - Easy operation and start-up

- Flexible
 - In term of layout and arrangement between equipment
 - In term of refrigerant composition

3. Offshore Liquefaction Processes

The Tricycle Process : Flexibility



4. End Flash and Nitrogen Removal

Why use an End Flash process ?

- Nitrogen removal
 - Commercial Nitrogen content in the LNG is 1% mol

- Produce End Flash Gas
 - Use of lean and clean gas for gas turbine instead of gas with heavy's

- Recover Helium
 - Recovery will increase the economics of the project

4. End Flash and Nitrogen Removal

Open art N2 removal process

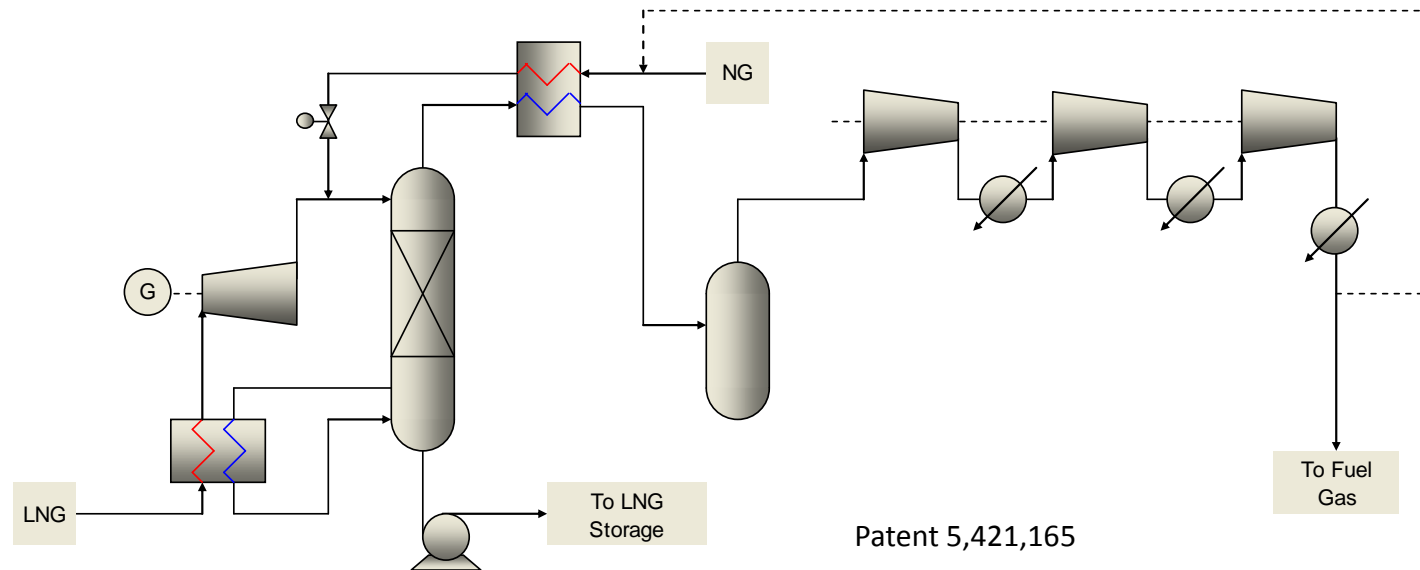
- Simple Flash Drum:
 - Efficient for Nitrogen levels up to 2% mol only

- Double Column Process:
 - Low energy consumption,
 - But efficient from 20% mol N2 content only

- Two Column Process:
 - More efficient than Double Column Process,
 - But more equipment

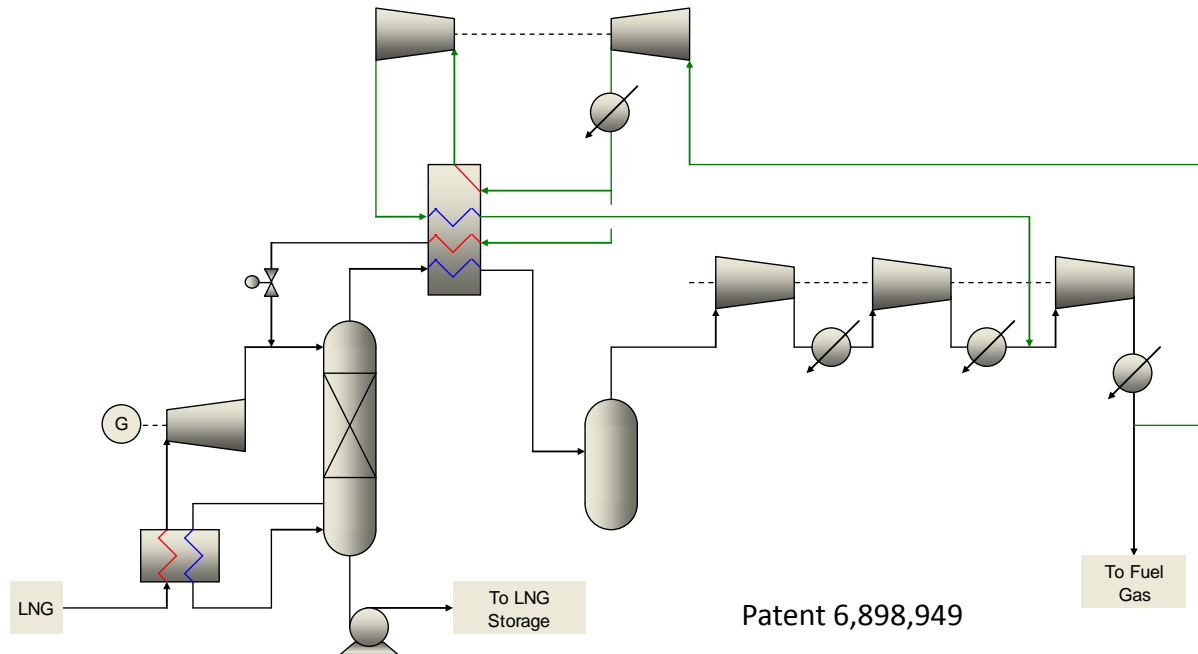
- Single Column Process:
 - Very low Methane content in the vent,
 - But power consuming

4. End Flash and Nitrogen Removal Technip Reboiled Scheme



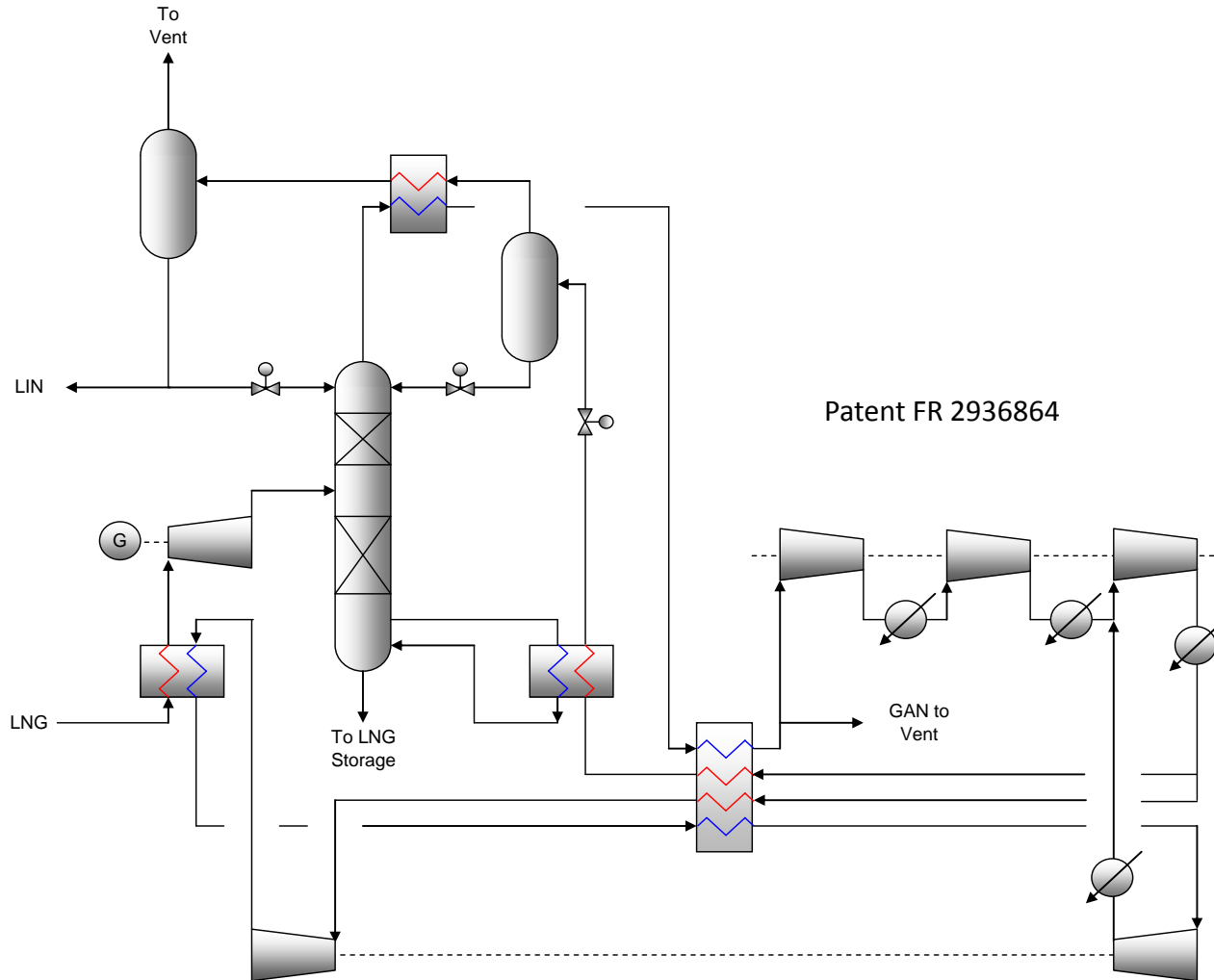
- **Main Advantages**
- Reduces the N₂ content in LNG to very low value
- Takes benefit of the reboiler to sub-cool the LNG from the MCHE

4. End Flash and Nitrogen Removal Technip MLP Process



- **Main Advantages**
- Takes advantage of the full installed power of the EFG Compressor with a small additional cost
- Allows the control of the Fuel Gas production

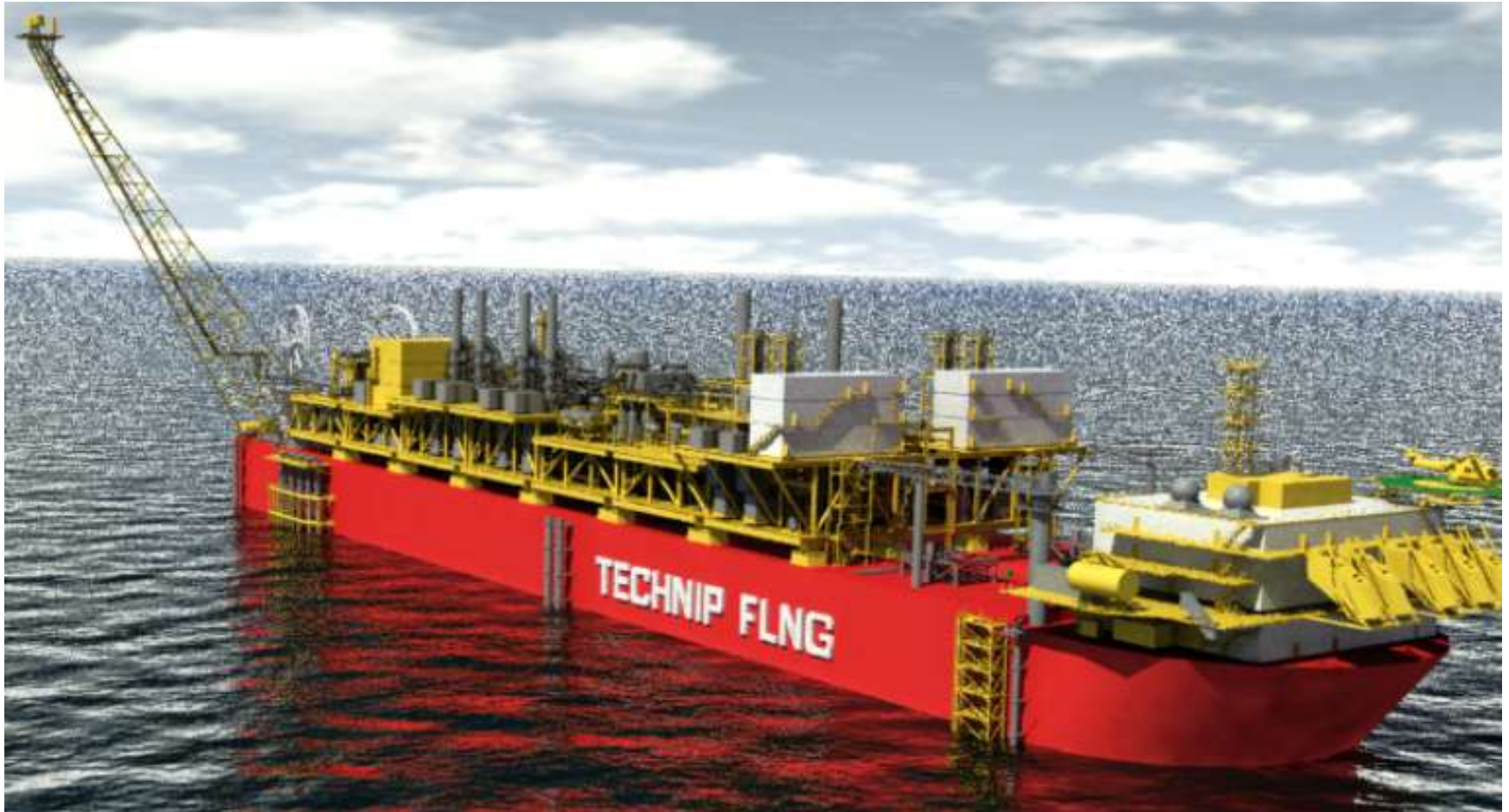
4. End Flash and Nitrogen Removal Technip Hi-Pur Process



4. End Flash and Nitrogen Removal Technip Hi-Pur Process : Main Advantages

- Maximize LNG production
- Methane content in the Nitrogen Vent is less than 0.1%mol
 - Impact on environment reduced
- Nitrogen (Liquid and Gas) production
 - Reduce size of utilities plant
- Helium production possible at low additional cost
 - More valuable process
- This process is particularly interesting for Floating LNG

5. Conclusions



25th world gas conference
"Gas: Sustaining Future Global Growth"

Thank You

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