

# Performance Improvement and Uprate

## Benefits

- ■ ■ Increased production
- ■ □ Higher efficiency
- □ □ Compliance with environmental regulations
- ■ ■ Availability and Reliability
- ■ □ Life extension

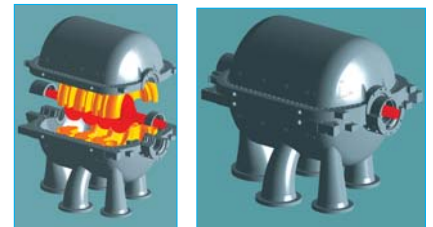
Customer benefits include:

- Improved economics
- Increased flow and efficiency
- Improved reliability
- Increased operating life
- Reduced maintenance costs
- Re-use and optimization of existing equipment
- Existing equipment upgraded using latest technology

## What it is

GE Oil & Gas has accumulated extensive experience in centrifugal compressor upgrading. Customer can benefit from implementing the latest technology and by leveraging our experience in new machines and numerous retrofit installations. GE Oil & Gas machines can be upgraded to meet new specifications for virtually any plant application. Upgrading a centrifugal compressor with new internals increases its performance, which typically increases efficiency, flow rate, and/or the polytropic head. Efficiency can usually be significantly increased (up to 8%, depending on the application) reducing the power required by the compressor and thereby saving energy.

The additional power can be used to increase the head and/or flow rate. New internals can be designed to increase the flow rate (up to 50%) at the nominal point, depending on the compressor size and application. Compressor upgrading based on a re-bundle cartridge approach permits the existing casing to be reused, thereby minimizing the impact on the plant layout foundations or piping.



Compressor assembly



Compressor rotor details



## How it works

### Internals Selection

Compressor internals are selected based on our broad experience. Impellers and stators are chosen from our standardized families of pre-designed and verified components, or may be customized for an individual application.

All components are designed in compliance with API codes and our rigorous internal standards. Components that are not already regulated by codes are designed to the highest engineering standards. Component designs are verified by application of FEA (Finite Element Analysis), CFD (Computational Fluid Dynamics) and model testing where necessary.

The following list shows the activities normally included in a revamping study:

#### Bundle Selection

- Identify axial and radial spacing available within casing
- Select impellers and stator parts to optimize performance
- Check mechanical layout

#### Gas Velocity Assessment

- Inlet nozzle and plenum
- Discharge nozzle, side streams and volute

#### Auxiliaries Assessment

- Lubricating oil system
- Sealing gas system
- Anti-surge system
- Drive train (turbine, motor, gear, couplings)

#### Aero/Rotordynamic Assessment

- Impeller selection within experience envelope
- Lateral/torsional analysis

#### Material Selection

- Materials optimized for new duty and process gas

### We have experience in highly successful rebundle projects:

#### Urea Synthesis Upgrade

##### Compressor Train:

ST+2MCL607+2BCL306/A

- Design flow: 27,000 NMC/H
- Upgraded flow: 34,000 NMC/H
- Flow increase: 25% with improved compressor efficiency and available driver power
- Scope of supply: new compressor bundles, no driver modification required

#### Ammonia Synthesis Upgrade

##### Compressor Train:

ST+2BCL508+BCL407/A+2BCL406/B

- Design flow (make up/recycle): 135,000/585,000 NMC/H
- Upgraded flow (make up/recycle): 185,000/730,000 NMC/H
- Flow increase (makeup/recycle): 35/25% with improved compressor efficiency
- Scope of supply: new compressor bundles, no driver modification required

#### Mixed Refrigerant Compressor

##### Upgrade (LNG Application)

##### Compressor Train:

GT+DMCL1006+MCL1003+BCL804

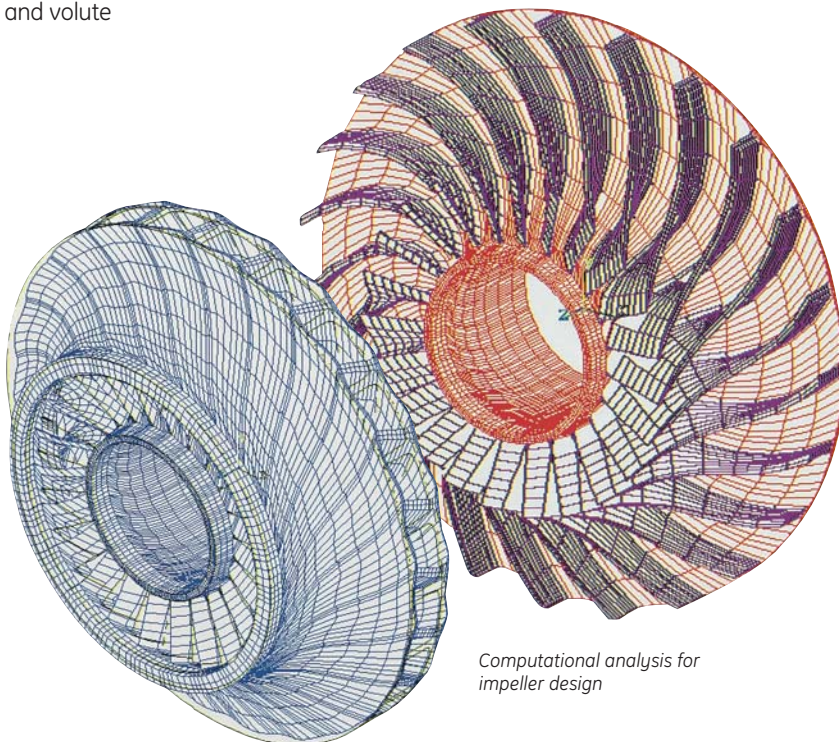
- Design flow: 600,000 NMC/H
- Upgraded flow: 720,000 NMC/H
- Flow increase: 20% with improved compressor efficiency
- Scope of supply: new compressor bundles – driver modified to increase output

#### Methanol Plant Reconfiguration

##### Compressor Train:

ST + Thermodyn RC9B + RC9B

- New plant operating conditions
- Scope of supply: new compressor bundle, no driver modification required



Computational analysis for impeller design

## How it works

Rebundled compressor designs incorporate the latest technology. Along with the new bundle, the following optional value packages can be implemented (where applicable) for improving performance and reliability:

**Honeycomb seals:** this is an alternative to conventional labyrinth seals in compressors with high discharge pressure or high molecular weight gases. Compressors handling heavy gases that reduce instabilities due to transverse aerodynamic forces caused by high density gas moving through rotating parts. This sealing type can be installed at the balancing piston and impellers in place of labyrinths. Honeycomb seals reduce lateral instability, and increase stiffness and damping characteristics. These seals also limit internal leakage, which reduces the absorbed power.

**Abradable seals:** this type of seal can be installed in place of the traditional labyrinth at the shaft end and balancing drum. The main

characteristic of these seals is the very small clearance between the static and rotating elements. The reduction in assembly clearance results from the use of different materials for the mating parts: the rotating component is made of a hard material (e.g., metals such as stainless steel) while the static part employs a softer material (e.g., composite polymers). The key benefits are reduced internal recycling, reduced absorbed power, and increased available process gas flow.

**Dry flexible couplings:** this type of coupling is normally installed as a replacement for gear type couplings. Its installation requires a feasibility assessment. Flexible couplings are a maintenance free alternative to lubricated gear couplings, yielding higher reliability/availability, lower axial load, and higher joint flexibility for potential misalignments. High performance options are available with reduced weight for possible rotordynamic improvements.

**Tilting-pad journal bearings:** this type of bearing improves the dynamic performance of the rotor and drastically reduces instability phenomena induced by lubricating oil. These bearings demonstrate lower spare parts cost, since only the tilting pads and not the bearing housing need to be changed. This system also allows better temperature monitoring, because the tilting pads can be easily equipped with thermocouples. Benefits include reduced lubrication, reduced parasitic power losses and lower bearing temperatures.

*Large horizontally split compressor*





GE imagination at work

**GE Oil & Gas**

Global Headquarters  
Via Felice Matteucci, 2  
50127 Florence, Italy  
T +39 055 423 211  
F +39 055 423 2800

Nuovo Pignone S.p.A.  
Nuovo Pignone S.r.l.

E [customer.service.center@ge.com](mailto:customer.service.center@ge.com)  
[www.ge.com/oilandgas](http://www.ge.com/oilandgas)

GE, the GE Monogram,  
and imagination at work  
are registered trademarks of  
the General Electric Company.

COMK/MARK 839/II - Designed by: Studio Tre Fasi  
Printed by: Sagraf - 12-2011  
©2011 General Electric Company  
All Rights Reserved