

TURBOMACHINERY REVAMPING

RECONCILIATION OF HIGH EFFICIENCY
AND LOW COST

- Revamping and Upgrading
- Adapt existing compressor and steam turbine to new process condition

NEW JCM INTRODUCTION

NEW JCM, carrying the heritage industry brand of JCM, is one of the major Turbomachinery Manufacturers in China. With more than half a century of experience, from Maintenance, Repair, Revamp and Upgrading to Design, Manufacturing and Testing of Centrifugal Compressors and Steam Turbines, NEW JCM provides Total Solutions for the compression applications in the oil, gas, petrochemical and the refining industries.

Located in an industrial area of Jinzhou City, Liaoning Province of the P. R. China, NEW JCM has the unique capabilities for design, engineering, manufacture and testing of API 617 Centrifugal Compressors, API 612 Mechanical Drive Steam Turbines, API 613 Gearboxes, and API 614 Oil Units.

The Company's main focus is on Compressors and Turbines for SYNGAS based technologies including Ammonia and Urea Plants, Methanol Plants and Refrigeration Applications: Other applications like, injection, recycle gas and natural gas booster compressors are also among NEWJCM's common products. Years of studying and working with different plant licensors as well as continuous constructive feedbacks from different customers, users and operators, NEW JCM optimised the design and manufacturing methods and hence, its Compressors and Turbines have established an outstanding track record for performance, efficiency, reliability, and low maintenance in the most demanding and arduous upstream, midstream and downstream applications.



REVAMP REQUIREMENT

Nowadays, small size plants might not be economical to operate any longer or may result in less than expected added value to the owners. Also, high energy costs have raised operators' awareness and have directed their attention to the efficiencies of various equipment in the plant. This brings about increasing interest in revamping / upgrading of the existing equipment in the plants.

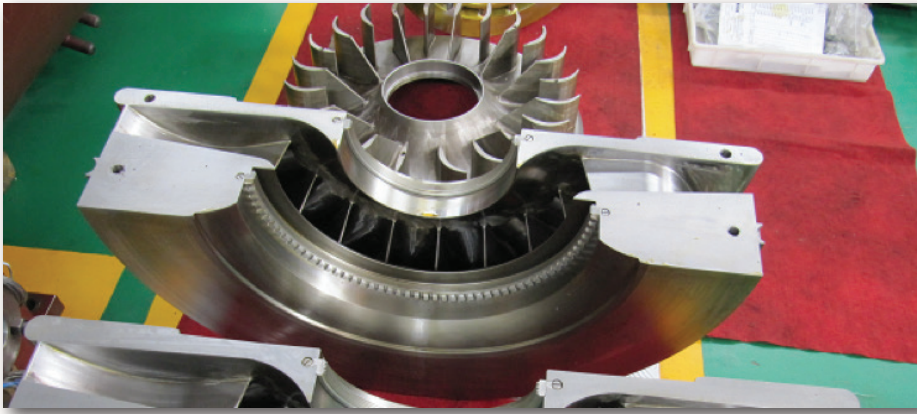
Turbo-machineries, as the heart of the oil/gas/petrochemical plants, could be the plant bottleneck requiring revamping. At the same time, machineries are the major energy consumers in a plant hence improving their efficiency could result in an appreciable energy saving which will have a tremendous effect on energy consumption rate per Kg of final product. However, replacement of compressors, and even the driving turbines can prove to be very costly, so, compressor/steam turbine re-rating and upgrading could be the more economical solution.

NEW JCM, with a long history in design, manufacturing and testing of centrifugal compressors and mechanical drive steam turbines, has a broad experience in upgrading used machines of different world renowned OEMs and helping the customers to upgrade their plants and boost their production with the lowest capital investment at the shortest possible time.

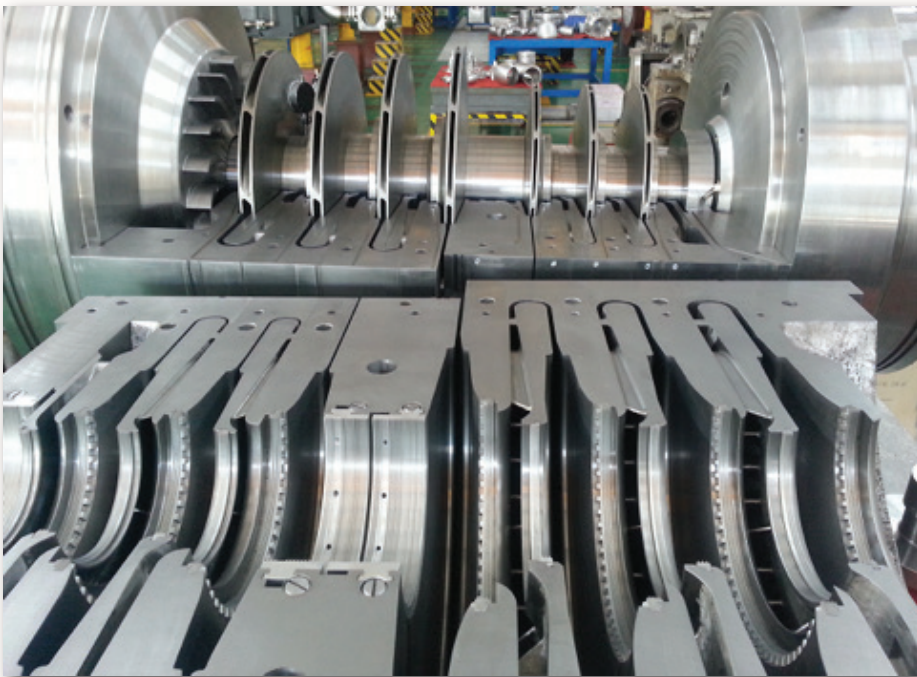


Why Revamp / Upgrade

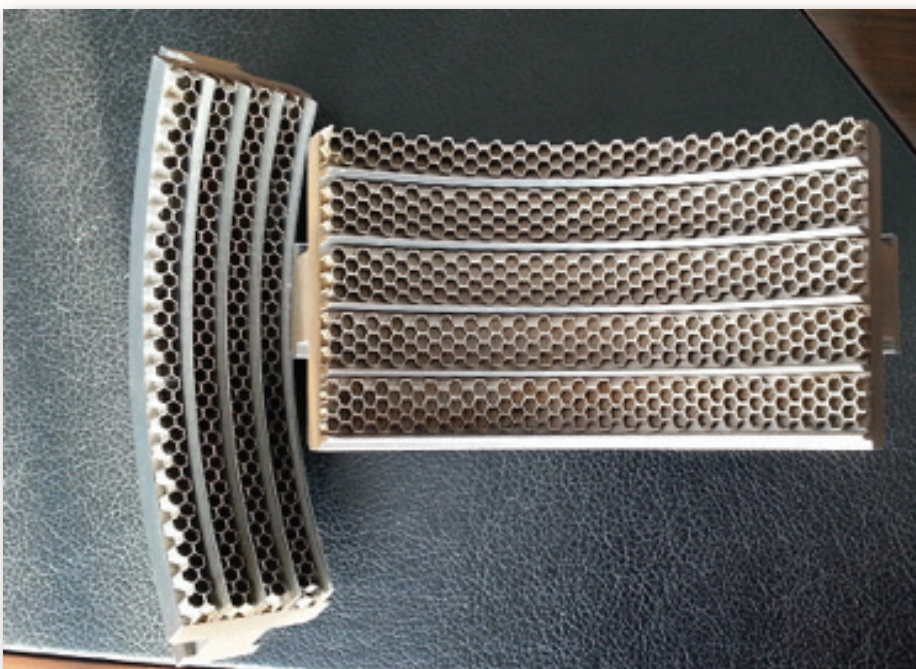
- More economical compared to new machines,
- Maintain the existing foundation and piping arrangements,
- Increase compressor capacity and hence boost plant throughput,
- Changing the inlet/outlet condition to meet new process requirements,
- Increase efficiency and hence reduce the power consumption,
- Reduction of power consumption is translated into lower energy/steam consumption,
- Decrease plant down time rate, hence operational costs, by increasing machine reliability,
- Short period of time required for Return on Investment.



Combined labyrinth-swirl breaker: Advanced sealings for internal sealing of compressors



High Pressure CO2 compressor bundle for HP casing



Honeycomb type seal: Used for high pressure turbine's shaft end seal

UPGRADE POSSIBILITIES IN FERTILIZER PLANTS' COMPRESSORS AND STEAM TURBINES

The final goal of a revamp could be any of the below modifications or any combinations therein. During a revamp, the aim is to use the existing components of the machine as much as practically possible. For process changes, normally, the rotor and the diaphragms need to be exchanged with optimized design:

- Increase the inlet flow or side steams of the compressor,
- Change the process requirements (pressure/temperature) in Inlet/Side Stream/Discharge of compressors,
- Control system upgrade (including Antisurge control, Turbine speed control, logics, hardware, etc.),
- Upgrade from Oil Seal to Dry Gas Seal,
- Material upgrade of Compressors and Turbines,
- Change steam conditions in Steam Turbine, Inlet/Extraction/Admission/Exhaust to optimize the operating conditions,
- Reduce the steam consumption by using high technology blade profiles and steam path design,
- Increase machine reliability by upgrading individual components like bearings, sealing, TTV's etc.

The modifications like capacity increase on the compressor side, might lead to changes in power requirement, and hence, it may be required to upgrade the steam turbine too. NEW JCM can reduce the amount of such increase in power requirement by the compressor by using the most advanced high efficiency 3D impeller profiles. In some cases, like in the old fashioned compressor designs, the capacity increase can be done without a need for considerable changes in shaft power – all depending on the conditions. However, when the steam turbine driver needs to be upgraded as well, NEW JCM, again, can offer solutions.



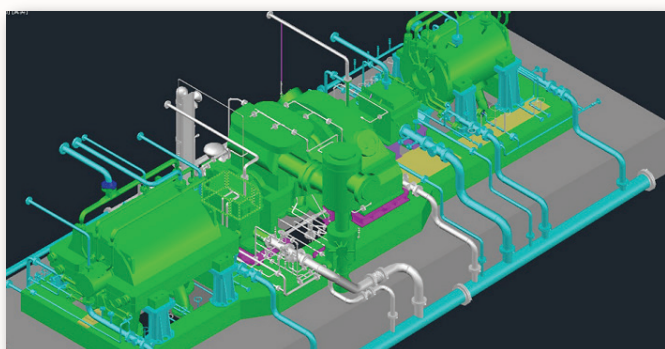
A Mega Petrochemical Plant (Ammonia and Urea) : NEWJCM manufactured all four compressor trains of phase 3



Single point of contact for Upgrading Compressor/Steam Turbine, Single Point Responsibility

Having the knowhow for both Centrifugal Compressor (API 617 design) and the Mechanical Drive Steam Turbine (API 612 Design), enables NEW JCM to design, modify and upgrade the existing Design, to Manufacturing and Test both the driver and driven machines. Furthermore, NEW JCM is well familiar with the process requirements of different petrochemical plant's Licensors specially SYNGAS based plants like Ammonia/Urea and Methanol units.

NEW JCM's broad experience lies in the field of fertilizer plants. In two cases, NEW JCM manufactured all four compressor trains of a MEGA Ammonia and Urea plants (Air, Ammonia, SYNGAS and CO2 Compressor Trains). These plant capacities reached up to 2,250 MTPD Ammonia and 3,250 MTPD Urea. NEW JCM also manufactured and tested the SYNGAS and the CO2 compressor trains of one of the largest fertilizers in the world which consists of a single line of 4,000 MTPD Urea plant.



Beside these new machines, NEW JCM has a broad experience of upgrading used equipment of different world renowned OEMs. With a wealth of hands-on experience in both driver and the driven equipment, NEW JCM can take the responsibility of the whole train by checking, upgrading, studying the effects of any modification or changes in one equipment on the other one and/or the whole train behaviour. This would include rotor dynamics study, train torsional analysis and study the required changes in auxiliary equipment (if any).

DRY GAS SEAL RETROFIT

Before 1990, or even from a later date, most of the compressors used contact type sealing like oil seals. Nowadays, Dry Gas Seal which is a proven technology, brings a lot of advantages to the plant owners.

These advantages are:

- Less process gas emissions,
- Avoiding contamination of the process gas by the seal oil,
- More simplified lubrication unit by removing high pressure components, degassing etc.,
- Less maintenance/operational costs,
- Less shaft power losses,
- Improving Product Quality by avoiding Process gas contamination by the seal oil.

As compressor designers, NEW JCM can retrofit Dry Gas Seals to your application. Also, NEW JCM can apply DGS to HP casing of CO₂ compressor to reduce the leakages which would result into more Urea products. Such retrofits require re-checking of the rotor dynamics and stability for which NEW JCM have the full knowledge and softwares.



CONTROL SYSTEM UPGRADE

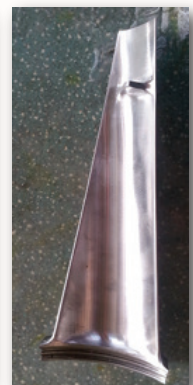
- Upgrading the Mechanical Governor to Electronic Governor,
- Antisurge system re-design based on the new conditions and upgrading the control (if required),
- Optimize or modify the logics, design and hardware of control systems
- Dry Gas seal control and logics implementation.
- Upgrade turbine trip block to increase safety and operability

MATERIAL UPGRADE

Material Upgrade is applicable to major components of the compressor and the turbine. In case of the compressor, Corrosion could be a possible motive for the requirement of such an upgrade. As an example, Air and specially CO₂ compressor parts are susceptible to corrosion in case of process malfunction (wet CO₂ or Air). Parts in contact with process gas need to be upgraded to a better and more resistant material, while keeping the same or superior mechanical strength requirements. Example of such parts could be impellers of the first few stages, compressor inlet volute or compressor diaphragms.



In case of turbines, the blades of the last few stages face wet steam and condensate droplets. This severe condition will cause corrosion and erosion in the blades of the last stages and considering the long blade design of the last stages, they experience high moments and bending forces. Applying high-strength and low-weight Titanium alloy blades for this application can tremendously reduce the risk of erosion/corrosion and possible resulting failures.

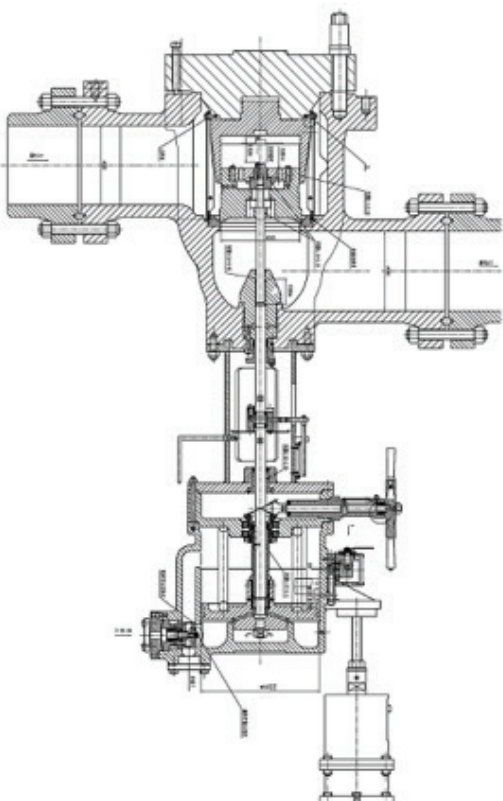


Left: Weld overlaying of compressor end cover to increase corrosion resistance Right: Titanium Blade for Steam turbine last stages

OIL OPERATED TRIP AND THROTTLE VALVE (TTV)

Traditionally, the turbine Trip and Throttle Valves were manually operated. They required intensive labour work to open the valves on high differential pressure steam and compressing the springs. Also, remote operation of these valves were not possible.

NEW JCM can upgrade the traditional manual TTVs to Oil Operated TTVs which let the plant operators start the turbine remotely from the control room. Also, using oil allows us use high stiffness springs which leads to shorter TTV closure time during shutdowns.



Manually Operated TTV



Oil Operated TTV (without Hand-wheel)

RENOVATION OF OLD MACHINES

There are cases where the Compressor OEM does not exist any longer to provide services for the produced compressors. Plant owners might need renovation of such equipment as their plant is still operationally economical and they are willing to continue production with minimum costs. Having extensive experience with different compressors and turbines of most OEMs, NEW JCM is capable of offering the customers a cost effective solution to renew the internal components by reverse engineering. This could be a drop-and-fit barrel, for barrel type compressors. Such designs can save a lot of project time compared to buying new equipment as well as increasing reliability of the old machine.



SYNGAS compressor internal reconditioned. New steam turbine made by NEWJCM is used because of the change of inlet steam condition from MP to HP steam.

CASE STUDY 1

CAPACITY INCREASE OF SYNGAS COMPRESSOR TRAIN: ERDOS CHEMICALS

Because of excess available steam at ERDOS plant (300,000 t/y Ammonia Plant), the owner decided to use this steam to increase the production capacity by revamping the key equipment of their 300,000 T/y Ammonia plant. NEW JCM was requested to upgrade the SYNGAS compressor train to meet the new process requirement. This syngas compressor, like other SYNGAS trains had two vertically split (barrel type) LP and HP casing compressors. The below table shows the OEM design parameters of the compressors as well as the revamped conditions (Upgraded by NEWJCM):

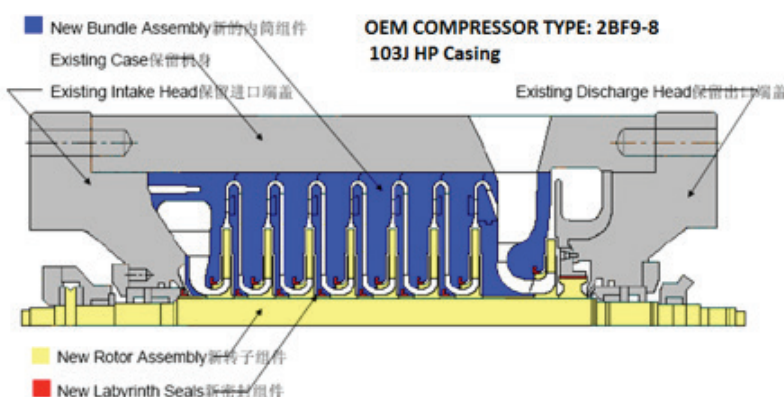
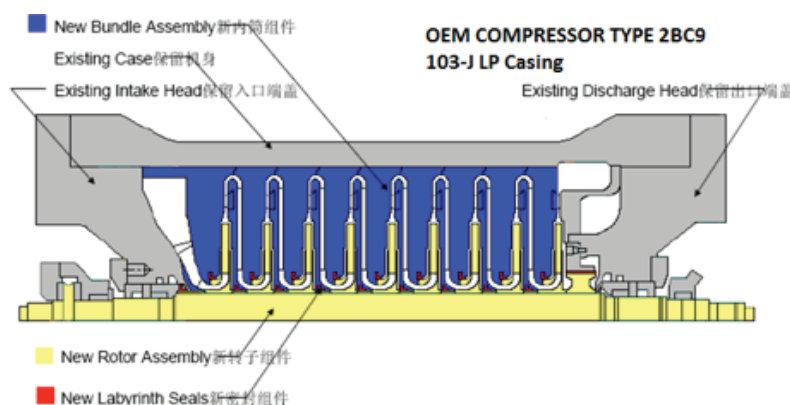
PARAMETER	ORIGINAL DESIGN (BEFORE MODIFICATION)	REVAMPED CONDITIONS (AFTER MODIFICATION)	REMARKS
Inlet flow (Nm ³ /h)	100,900	125,000	~24% Increase in Capacity
Inlet Pressure (BarA)	26.5	26.5	
Discharge Pressure (BarA)	150	150	
RPM	10,300	10,300	
Shaft Power (KW)	9,370	10,500	12% Increase in Power

The Internal Bundles of both LP and HP casings and the rotors were redesigned and replaced the old ones.

The existing casings and the end-covers were reused as there was no necessity to change them.

The modified compressor train was put in service and successfully met the new requirements.

SYNGAS train as received in NEWJCM shop



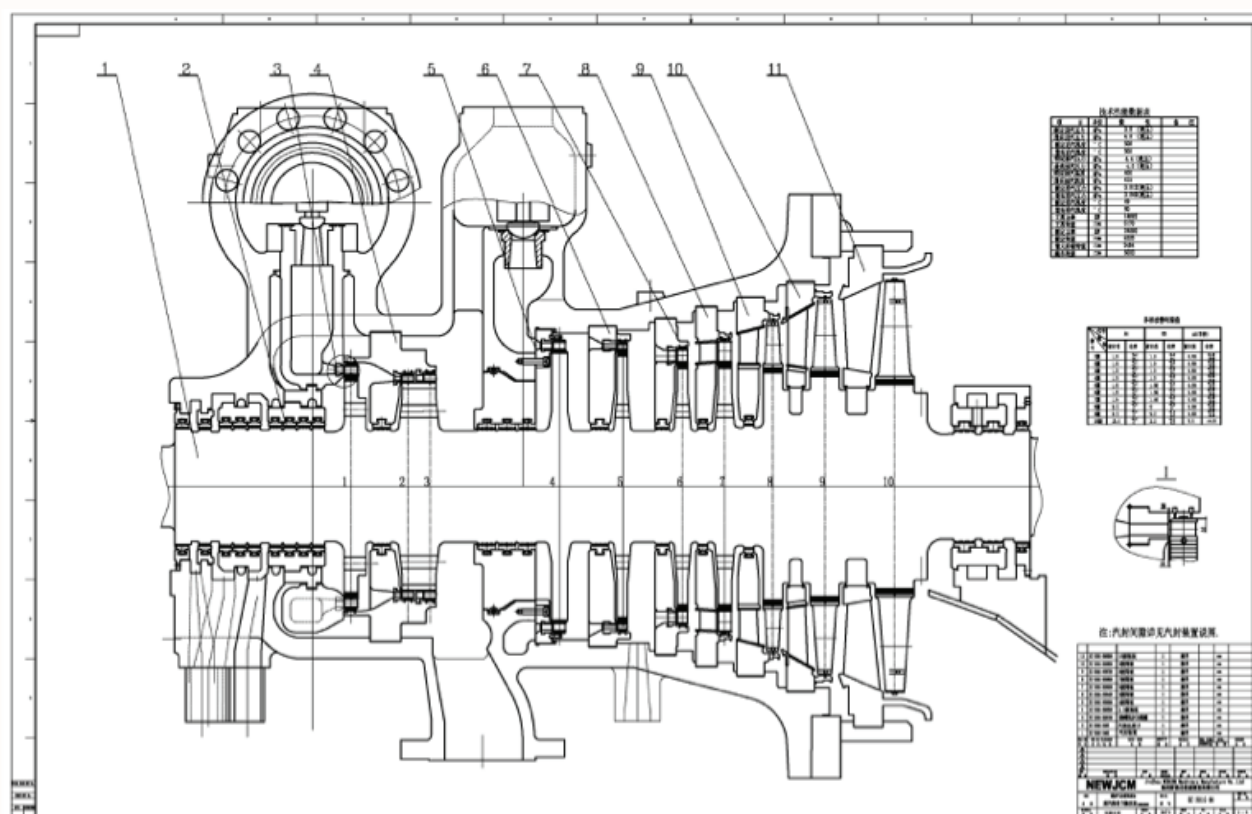
CASE STUDY 2

INCREASING STEAM TURBINE EFFICIENCY: PETROCHINA DAQING CRACKING PLANT

Originally manufactured in 1979, the steam turbine (EC-301) was an extraction condensing type turbine. This turbine was upgraded in 1994 by replacing the nozzles and diaphragms by others.

Considering the old technology, long time of operation and high shaft end leakage, the efficiency of the machine had dropped considerably. NEW JCM was requested to increase the turbine efficiency, reduce costs and boost production by removing the existing bottlenecks.

PARAMETER	BEFORE MODIFICATION	AFTER MODIFICATION
Inlet steam condition	98 Bar@500°C	Same as “before”
Inlet steam flow	165 T/h	150.3
Extraction steam rate	93 T/h @ 40Bar	95 T/h@40 Bar
Power/RPM	18,000 KW/5170	Same as “before”



CASE STUDY 2 cont'

NEW JCM studied the operating condition and design of OEM and offered modification on external and internal shaft sealing which would result in significant reduction of steam consumption. Advanced Honeycomb type sealing was employed instead of the age-old labyrinth type seals to reduce the leakage rate and increase rotor stability. Interstage seals were also improved and other modifications on the Blade shroud and tip seals were applied.

The TTV was changed from manual operation to fully oil operated TTV to add remote controllability specially during start up.

Governor valves, also, reconditioned to increase stability and improving sealing characteristics. All modifications changed the machine to as good as a New and appreciably reduced the inlet steam rate by 15 T/h (~10%) while increasing the extraction flow by 2.0 T/h.



Used machine in customer plant



CASE STUDY 3

OGDCL Qadirpur Gas Field's Compressors Revamping

OGDCL is the National Oil & Gas Company of Pakistan and the flagship of the country's E&P sector. The Company is the local market leader in terms of reserves and production.

In 2010, OGDCL went through a major expansion project for their Qadirpur Gas Processing Plant. This field required compression of large volumes of gas. Not willing to invest on new compressor trains, OGDCL intended to relocate and install Pirkoh Turbo-Compressor for the Qadirpur site. Three trains of gas turbine driven Natural Gas Compressors with two casings of LP and HP per train were relocated to Qadirpur plant. However, there were differences in gas composition and process conditions of these two fields and hence, the compressors were required to be rerated. The major differences of Qadirpur plant compared to Pirkoh were higher gas MW, existence of condensate and considerable H₂S gas in Qadirpur plant. Over and above meeting the changes in the process conditions, OGDCL required NEW JCM to increase the capacity of the compressors as well.

NEW JCM started the feasibility and engineering study to meet the new site operating conditions and offered an upgrade solution using new bundles for the existing compressors with NACE compliant materials. The offer, also included reconditioning of the existing DGS as well as upgrading the DGS panel considering H₂S gas traces and condensation possibilities. The Compressor design flow rate was increased from 88t/h to 100 t/h and the other parameters were designed based on the new plant conditions.



Existing Compressor's Bundle Removal
at Customer's Plant



NEW JCM Made New Bundle



Oil & Gas Development Company Limited

17th July, 2013

Testimonial

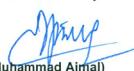
REF : OGDCL CONTRACT NO. PROC-FD/CB/P&P(1452)-766856/2011

: Jinzhou NEWJCM Manufacturing Company Ltd Bid Ref N. 799-60202

We are pleased to certify that company M/s Jinzhou NEWJCM Manufacturing Company Ltd, of P.R. China is awarded above referred OGDCL Contract No. PROC-FD/CB/P&P(1452)-766856/2011 for the overhaul / refurbishment of 03 Trains (06 Centrifugal Compressors) – Gas Turbine Driven Centrifugal Compressors to be installed at Qadirpur Gas Field "Front End compression Project".

We are pleased to certify that company M/s Jinzhou NEWJCM Manufacturing Company Ltd, and their Pakistan agent M/s Hard castle Waud Pvt. Ltd have performed the scope of work of Contract with diligence, which includes engineering study to qualify the compressors for desired output and operating conditions, inspection, replacement of parts including Rotor and Diaphragm, Mechanical Shop Test and Performance Test in accordance with API 617 and ASME PTC 10 standards, installation and successful commissioning at Qadirpur Site.

During the execution of the contract we have found M/s Jinzhou NEWJCM Manufacturing Company Ltd and M/s Hard castle Waud Pvt. Ltd committed and diligent towards their responsibilities and commend the same. We wish them prosperity and growth and look forward to a healthy mutual cooperation in the future as well.


(Muhammad Ajmal)
Manager (Mechanical)
Ext: 3588

CASE STUDY 3 cont'

Considering the gas production requirement in Pakistan, the revamping of all three trains were completed and delivered within less than a year. NEW JCM conducted the API 617 Mechanical Running and ASME PTC-10 Performance Test on the compressor trains and all trains were commissioned successfully and to the full satisfaction of the client.



PTC-10 Performance test of re-rated compressors

NEW JCM

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