

★ *Competitive, clean energy...today*

Spiralling power costs?

Cryostar technology may hold the key

★ *Production investment*

Giant cranes spell big business

★ *Pumps under pressure*

New modular concept
developed for liquid nitrogen



Clean energy, lower power costs and greater plant efficiency, return on investment in two to three years... the answers we all want to hear in the face of today's spiralling cost of oil and natural gas.

The outlook for affordable energy from traditional sources is not bright. Already many industries in the developed world are feeling the pain of too-high factory gate prices, in shrinking markets, against stiff competition from low cost, low taxation emerging economies.

In many countries the ordinary citizen is also being hit by fast rising electricity bills, power cuts and rising knock-on retail prices. It is an issue that affects all of us today and one which has worrying implications for the future.

No, CRYOSTAR is not waving the proverbial 'The End is Nigh' placard. But we are in the business of raising awareness about technology that can help our customers.

Let's take clean energy - CRYOSTAR has the turbine technology to generate low to carbon-free electricity. Lower power costs and greater efficiency? Our turbines can help cut costs or increase output - it's up to you, the customer.

And we have more answers to the problems of power generation. For many years, our engineers have been studying the issue in relation to our business, our technology and how CRYOSTAR can provide solutions.

Since 1986, our expertise has provided customers with more than 1,000GWh of recovered electricity. And we can do more. Be it exploiting kinetic energy, geothermal or geo-pressure. It could be installing technology that exploits waste heat at an existing plant - typically producing one to 12MW of clean electricity.

So, if power, the production of power and cost containment is of interest, then I urge you to read our feature *Competitive, clean energy...today* on page 3. CRYOSTAR has the technology to provide solutions to issues confronting your business right now.

Daniel MEYER
President



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Competitive, clean energy...today

The price of oil, natural gas and electricity is spiraling and this means companies face crippling running cost rises – many have been driven out of business. Cryostar technology holds the key to exploiting competitive, clean energy, today...

As energy prices continue to rise rapidly, so does the need to optimize energy usage and recovery. This trend is being accelerated by government pressure on industry to reduce carbon emissions to the bare minimum.

Since 1986, Cryostar's energy recovery expertise has provided customers with more than 1,000GWh of recovered electricity.

The principle of energy recovery is turning untapped energy into electricity. The expansion of a working fluid, such as gas, transfers kinetic energy into mechanical energy. Cryostar turbo-expanders generate electricity by utilising the expansion process to rotate a wheel and generate electricity.

Cryostar has also been perfecting the radial in-flow turbine to harvest wasted energy from a working fluid into electricity. This is achieved by the direct conversion (primary cycle) of kinetic or mechanical energy into electricity, utilising Cryostar Geo-pressure units, the same principle by which wind power operates. Geo-pressure units work in parallel with pressure reduction valves on gas networks.

The second method (binary cycle) is by converting low grade heat (100°C) into a working fluid, then expanding it through the radial in-flow turbine which converts the kinetic energy into electricity, the principle used for geothermal and waste heat electricity plants.

Cryostar's radial inflow turbine is particularly suitable for harvesting geo-pressure as it is up to 92 per cent efficient.

In the geo-pressure energy recovery unit in Arlesheim (GVM), commissioned by Cryostar in 2003, a pressure drop is needed to reduce the natural gas pipeline pressure of 55 bar to meet the low pressure of the local gas distribution networks.

In other words, the gas flow from 35,000 Nm³/h is allowed to expand and during this process drives the Cryostar turbine within the geo-pressure energy recovery unit.

The turbine wheel drives a gearbox coupled to a synchronous generator. The resulting 1.9MW of electricity recovered in this way is then supplied to local electricity suppliers. The electrical efficiency of the whole installation is about 85 per cent*, vastly superior value when compared to CHPs, to gas and steam turbine and even fuel cells. Mr Kreyenbühl, of GVM, said: "With all the thought and effort that has gone into the conception of this first unique power station in Switzerland, we believe that all Cryostar's objectives for reliability and service have been met. Especially to reach a 10 per cent higher power efficiency than guaranteed in the contract."



As a travelling companion of natural gas, geo-pressure energy follows electrical base load demand, meaning the supply of electricity generated from geo-pressure is as secure as the gas supply itself.

Natural gas comes out of the ground at very high pressure, called geo-pressure. It is this pressure that moves the gas through the distribution pipelines. However, the pressure is too high to be used safely by end-users of gas (power stations, industrial, commercial and domestic users).

The pressure at the production platform is between 100-800 bar. In order for the gas to be suitable for domestic use it has to be available at 1 bar, the pressure of the gas used by a cooker for example.

At several points in the system, therefore, gas goes through 'stations', where the pressure of the gas is reduced by squeezing it through a valve. Reducing the pressure in this way releases energy. In most instances today, this energy is not used though it is possible to generate carbon-free electricity, merely by installing Cryostar turbine generation systems.

The gas passes through the turbine as the geo-pressure is reduced, and the turbine generates electricity. No gas is burned or used up in this process. And as it is not the gas but the actual pressure reduction which produces energy, installation of an expander turbine driving a generator in parallel of throttle valve in natural gas pressure reducing stations is a way to produce almost CO₂-free electricity.

Temperature drop through the expander is around 1.5-2°C per bar. It means that the gas must be preheated before the expander to avoid negative temperatures after expansion which may lead to problems due to hydrocarbons condensation, hydrate formation and pipe material damages.

If preheating is by using waste heat from gas-driven engines, which also produce electricity, the CO₂ emissions are at a remarkably low level of 200-250g

CO₂/kW.h elec. for the gas engine, the turbine itself consumes no gas nor emits CO₂. If waste heat is recovered from an existing industrial process or even solid oxide fuel cell, it can drop to zero CO₂ emissions.

Geo-pressure also applies to other applications where pressure is reduced such as for example with steam.

Imagine the huge energy potential which stays unexploited under our feet: only 0.1% of our globe is colder than 100°C. One km³ of 200°C hot granite cooled by 20°C delivers about 10 MW of electric power for a period of 20 years. One km³ of 180°C hot geothermal water-cooled to 100°C delivers about 7 MW of electric power for a period of 250 years.

Put another way: installed 1 MW is enough to supply 2,500 homes every year.

Geothermal water has been used since the Roman times, principally for bathing, but today it is also a way to produce electricity, even for a low temperature source of about 100°C.

Hot water from an aquifer source is pumped to the surface. This natural source of heat is used to vaporise an appropriate working fluid mixture with a boiling point below 100°C. The vapour is then expanded through a radial inflow turbine which drives a generator and delivers electricity to the grid. The low pressure vapour is then condensed with an existing cold source (fresh water or ambient air) and the liquid is pumped back to the evaporator to begin the cycle again.

The hot geothermal water, which was cooled by the cycle, can be used for district heating and then re-injected at depth.

The Cryostar technology of high efficient radial inflow turbine perfectly matches the needs of this application. Unlike axial turbines, the efficiency of Cryostar's expander can reach 92 per cent.

Thanks to in-house developed tools, Cryostar engineers have the ability to optimise the process and the expander design to offer to the customer the best compromise between recovered power and cost.

Cryostar is currently working with a German customer in order to provide a tailored turbine solution for a geothermal application. The objective is to produce electricity from geothermal heat, with 100 l/s of geothermal fluid at 180°C.

Operating a closed loop binary cycle, the appropriate fluid mixture is expanded inside the Cryostar turbine to produce six to 7MW of clean electricity without any CO2 emission. The remaining low grade temperature is able to supply a local district heating network.

Waste heat recovery

A waste heat binary plant is quite similar to a geothermal binary plant, hence the thermal energy is coming from an unexploited heat source (100°C-200°C typically), for example a thermal oil loop in an industrial plant, steel factory, cement factory, glass manufacturer etc. Thanks to a closed loop binary cycle, the selected fluid mixture is expanded inside the Cryostar turbine to produce one to 12MW of clean electricity

Potential sources include: biomass boilers; biogas engines; residual heat from industries; solar heat; and fuel exhaust heat.

Cryostar has been a world leader in radial inflow turbine technology for more than 30 years and its superior product quality is recognised across the globe.



The company continuously builds on its world-class engineering skills and innovative drive, to keep at the forefront of technological development in the industry.

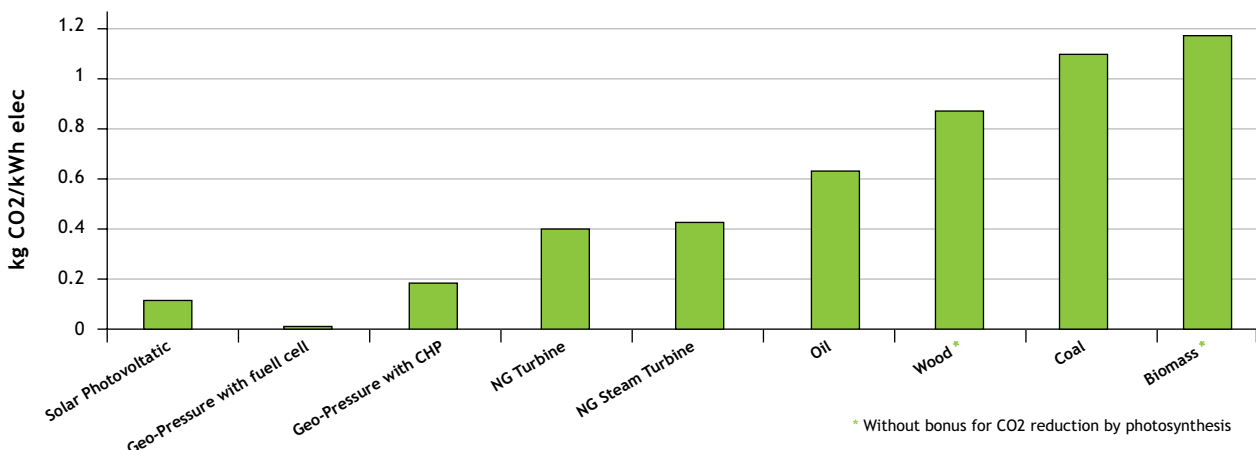


Cryostar Lo-C Energy has been established as a result of the rapidly increasing need for low carbon energy recovery and covers a variety of applications such as pressure let down, geothermal plants, waste heat and natural gas liquefaction.

The newly established Lo-C business unit within Cryostar focuses solely on low carbon technologies for energy recovery, emphasising the company’s long-term strategic commitment to customers in this area.

* “Stromerzeugung mit Erdgas-Enstpannungsanlage” issued from German Magazin GWA 6/2004

CO₂ emissions from different energy sources





Giant cranes spell big business

Strong growth in all business segments ensures continued expansion for Cryostar. This increase in activity hasn't happened overnight. Cryostar's turnover has risen from €33 million in 2000 to more than €100 million in 2005.

In February, the first phase of a major extension programme was completed at Cryostar's manufacturing facility in France. It's a €2.5 million project that is adding 25 per cent in production capacity. The extension project, initially projected to begin in the 2006 financial year, was moved ahead given the increase in activity already experienced in 2005 and the projected trend into 2006.

It is the booming LNG shipping sector that is a key contributory factor in the need for extending facilities. Changes in ship-board technology are also playing into Cryostar's hands as some of the LNG ships are now being built with natural gas reliquefaction units on board. By equipping the Hesingue site now with all the necessary technology and capability to manufacture these units, Cryostar will be in a strong position to respond to market needs.

The new workshop which is extending production space by 1,200sqm constitutes the first phase of the extension project. It will be totally dedicated to LNG machines and LNG reliquefaction units.

It is, of course, not just on the LNG side of its business that Cryostar has seen considerable expansion. Sales of pumps and turbines for industrial applications have doubled in the last three to four years and one of the biggest regions for growth has been China. Also the machinery being manufactured is getting bigger and heavier. The turbines for hydrocarbon applications which used to be three or 4MW are now ranging from six-8MW and even more. That means the need for bigger and stronger lifting equipment.

The installation of two 50-tonne cranes gives the ability to lift machines up to 100 tonnes.

The second phase of the project is due to begin and be completed in 2006 and comprises a 500sqm test facility which will mainly be testing large machines, such as turbines, compressors and the future LNG on-board reliquefaction units.

Until the current site expansion, however, Cryostar's growth has been largely one of personnel. Employee numbers are expected to increase from the current figure of just over 300 to between 320 and 330 in 2006. Cryostar needs mechanical or process engineers and sales people with a technical or mechanical background. Good project managers who can be the link between customers and Cryostar staff are also vital.

The company's strength lies not just in its technology, but in the people who are out there designing, manufacturing, selling and maintaining it and building strong relationships with customers.

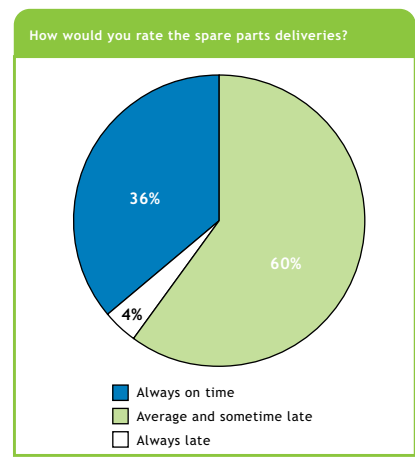
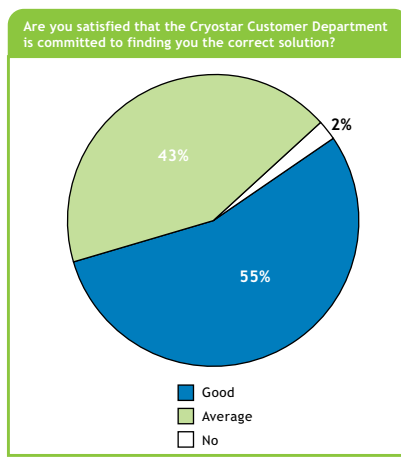
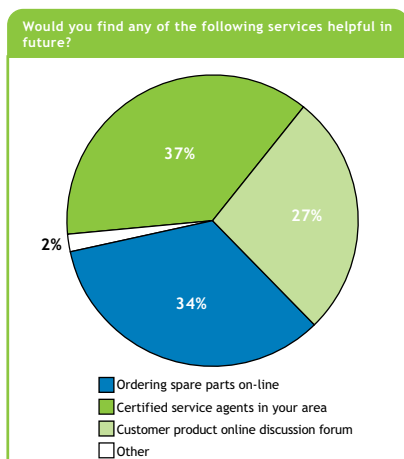
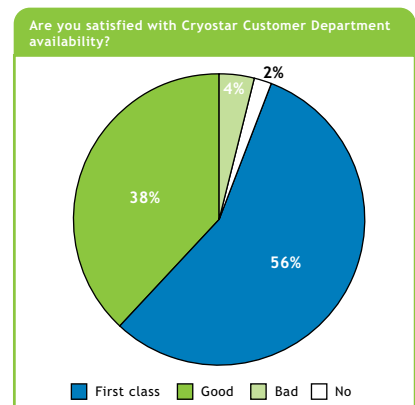
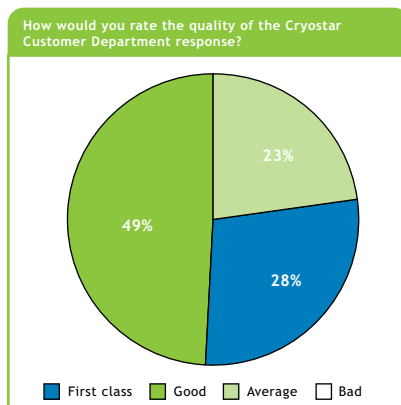
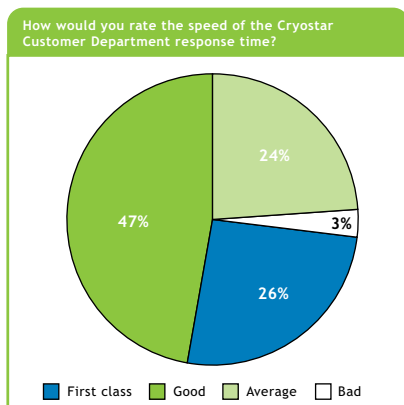
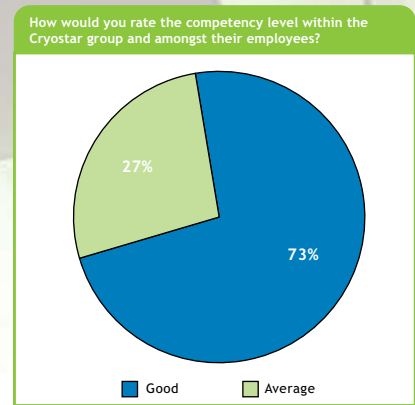
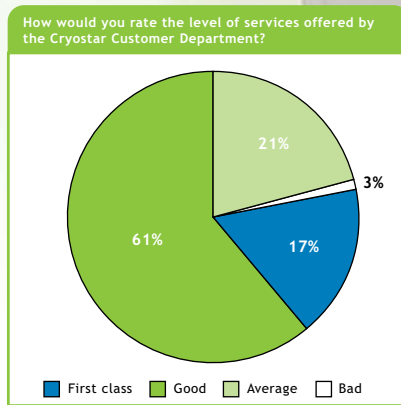
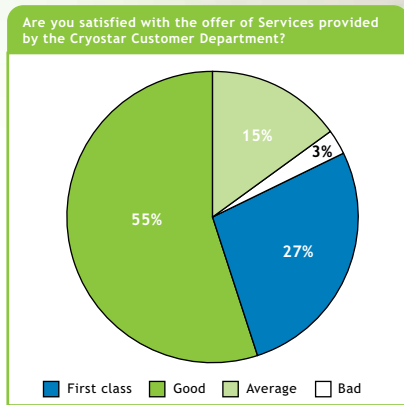
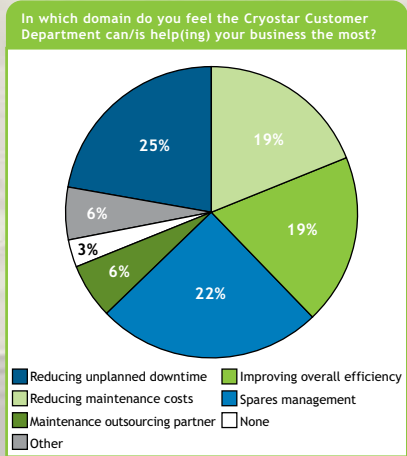


Customer survey results

Cryostar’s Customer Service Department recently conducted an e-survey of 500 customers to determine how the company can better meet their needs. As a result, Cryostar is to boost its efforts in the areas of customer relationship management, with the possible launch of new CRM tools and portals, spares deliveries and the opening of its training centre.

Didier Walch, Customer Service Director, said: “We have analysed the results of this survey very carefully and will in the coming months work on the highlighted improvement areas.

“A return rate of 13 per cent was achieved, quite high compared to the usual 10 per cent return for electronic surveys. This shows our customers have a real interest in helping us to serve them better. We will of course keep customers informed on our progress.”



High pressure flows for new pump

Cryostar engineers have developed a new reciprocating pump specifically for liquid nitrogen at very high pressures and high flows. The HPP75/110 rates up to 690barg and up to 1100l/min respectively.

The new modular concept pump is available with one cylinder (simplex version), three cylinders (triplex execution) or five cylinders (quintuplex execution), which allows a large range of flow at high pressures (See attached table).

Samuel Zouaghi, Cryostar's Director Distribution Line, said: "Cryostar has served the industrial gas market with cryogenic equipment for more than 30 years and the launch of the HPP emphasises the company's technological edge and continued devotion to meet customer needs.

"The applications of the HPP and the nature of the cryogenic liquids which can be used are varied. The pump can be utilised as process or back up pump where high pressures and high flows are required, for example, pipe line supplying, but there are also many applications in oil and natural gas well service, like trailer mounted nitrogen units."

Cutting-edge technology

Explaining the technology behind the new offer, Pierre Papirer, Pumps Design Manager, said: "The HPP pump been developed in order to ensure its use for transfer applications as well as for process applications. The lubrication of the crank drive is made by oil splashing and the bearings assembled on eccentric shaft are rotating in a closed oil volume.

"Two special roller bearings absorb the high axial loads due to the pressure acting on the piston (about 30tonnes) with low friction coefficient. The new cross-head guiding design, which is also lubricated by injected oil produces also very low friction."

The low heat generated by the friction is dissipated by adequate thins in order to reach an acceptable balance temperature in continuous duty. The oil lubrication system is an integrated part of

the drive and is activated by the connecting rod displacement, eliminating any need for external oil pump and oil tank, said Pierre Papirer.

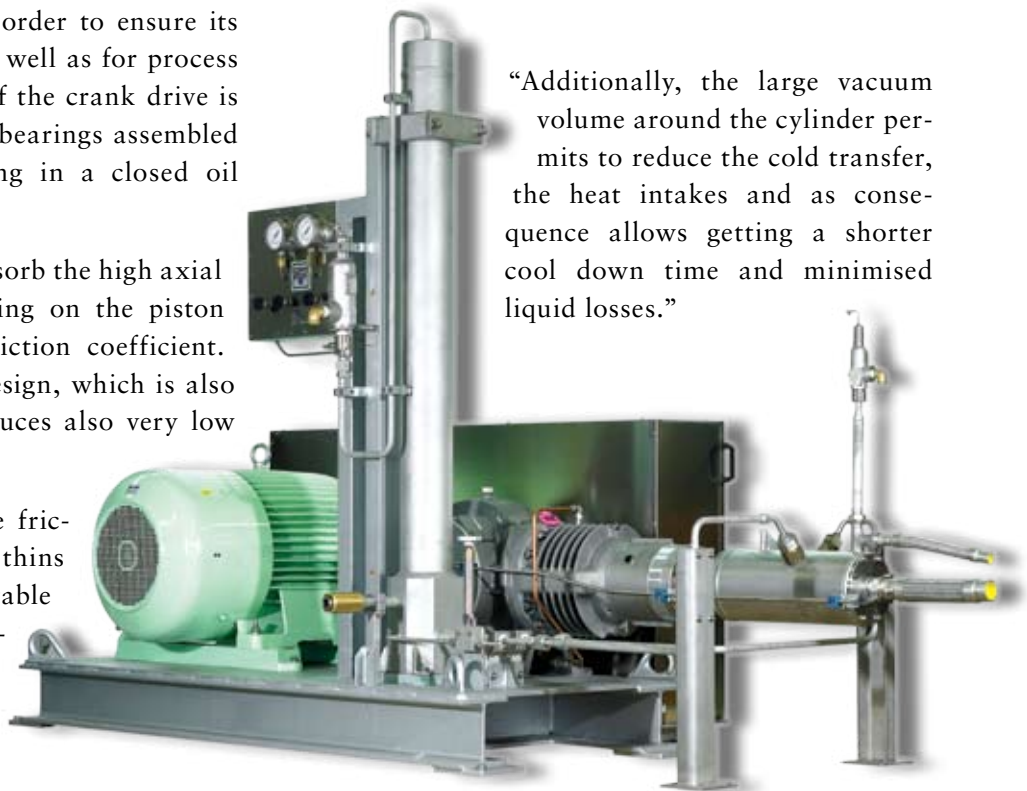
He added: "The power needed by the drive can be supplied by an electrical motor through a pulley and belts system or by a thermal motor through an adequate gear for speed reduction.

"The sealing of the drive is obtained by two adequate seals incorporated in a cartridge, which can be dismantled without opening the crank drive. The frame material of the crank is a strong aluminium alloy in order to reduce its weight, which is especially interesting in case of trailer installation."

Pierre Papirer points out that the coupling between the cold end and the drive is easy to adjust to get the adequate clearance between the piston and the suction valve. It also integrates a plate in order to vaporise the process liquid in case of leakage.

"The design of the cold end is an extrapolation of the MRP concept developed three years ago, which now has more than 100 machines in operation. The large suction chamber integrating an appropriate filter and the suction valve design are made in such a way to reduce the pressure drops at the inlet," said Pierre Papirer.

"Additionally, the large vacuum volume around the cylinder permits to reduce the cold transfer, the heat intakes and as consequence allows getting a shorter cool down time and minimised liquid losses."



The six high-pressure segments have a special design in order to get a high volumetric efficiency. As a consequence of reduced pressure drops, minor heat entrances, large vacuum volume and high volumetric efficiency, the required NPSH will be low and less than 1.5m at maximum running speed.

The new low pressure seals, which are developed from a proven design, combined with the relative low maximum pump speed (500rpm), mean a longer life-span. The new cylinder design, adapted in line with international standards to take the high pressures, enables compensate contractions on welds during cool down periods where the internal envelop is cold and the external one still warm.

Pierre Papirer added: "There are two discharge pipe connections for each cylinder in order to reduce the pressure losses between the real pressure needed by the customer and the existing one at the discharge valve level.

The pump is equipped in standard with a temperature probe in the intermediate piece between the cold end and the drive in order to detect any liquid leakage and an another one in the anti-pulsation block (when supplied) for cool down and cavitation controls.

	HPP 75/110	HPP3-75/110	HPP5-75/110
Number of piston	1	3	5
Piston diameter(mm)	75	75	75
Stroke (mm)	110	110	110
Speed range (rpm)	80--500	80--500	80--500
Max flow l/min--GPM	210 / 55	660 / 175	1100 / 290
Max delivery Pressure barg /Psig	690 / 10000	690 / 10000	690 / 10000
Maw power (kW/HP)	400 / 500	900 / 1200	1500 / 2000

The machine can also be equipped with a probe in the degassing line to check the correct liquid arrival and a probe at the cross-head level to detect any abnormal increase of temperature in the drive. A nitrogen purge inside the crank drive and inside the intermediate piece can be provided on demand."

News

Cryostar's China guarantee

Cryostar has set up a new workshop in China to provide a better service to customers. With more than 260 square meters, state-of-the-art tools and a team of technical experts, Cryostar China has put in place a strong repair service for cryogenic equipment such as pumps, turbines and related items. This includes Cryostar's high quality repair, labor and work, all of which will be guaranteed.

Cryostar China has also installed a full set of special machines for the mechanical seal repair. This will enable customers to send damaged mechanical seals directly to Cryostar China for repair and thereby reduce the downtime of pumps. The mechanical seal is one of the most important parts of the pump.

Cryostar Service Department's objective is to enable customers to get a repair service on this essential part at a reduced cost in comparison to purchasing a new seal.

For repair on mechanical seals, contact: Michael-Yaogu Liu, Service Supervisor, by tel: 86-571-85368331 or 86-13819170318, or fax: 86-571-85368409

Brazil

In March, Cryostar has opened its first office in South America. The South American region has continued to show significant growth rates and this initiative is an important element in Cryostar's global growth strategy.

The new office in Sao Paulo, Brazil will consist of both a sales office and a local workshop. Cryostar is the first of the major cryogenic pump and turbine manufacturers to open an office in this region, which means that in terms of responsiveness, local expertise and spare parts availability we will be able to offer our customers a unique and high level service.

eBusiness, the one-stop-shop



Cryostar has launched an eBusiness portal to enable customers to order spare parts, check prices and track deliveries online.

It is easy to use and includes the ability to view previous orders while offering delivery options tailored to the customer's specific requirements.

Via the portal on www.cryostarparts.com, all orders are confirmed within 48 hours, complete with an acknowledgement of prices, delivery date, shipping options and payment terms.

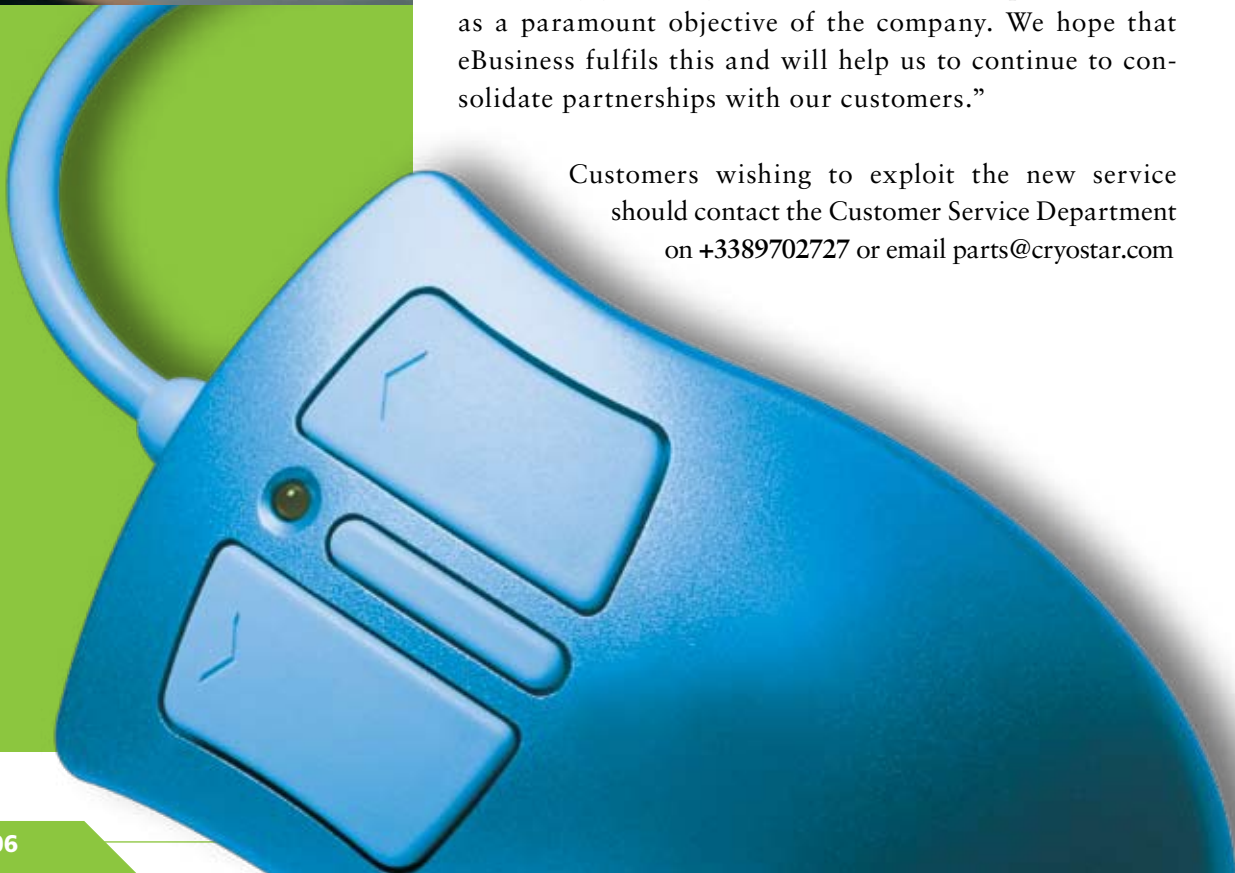
The eBusiness one-stop-shop is available to customers through a log-in password supplied by Cryostar. Once log-in has been completed, the customer can order spare parts on-line, select special product options and fill all required fields to complete the order.

To date more than 1,200 customers have been informed of the new service, which went live at the start of 2006.

Neil Chraibi, Cryostar's eBusiness coordinator, said: "This new online tool enables Cryostar to offer more solutions to customers and is in line with our determination to offer nothing less than a top-of-the-range service. Demand for such service is growing constantly and gaining more importance in the decision-making process when customers must select suppliers.

"For many years Cryostar has considered superior service as a paramount objective of the company. We hope that eBusiness fulfils this and will help us to continue to consolidate partnerships with our customers."

Customers wishing to exploit the new service should contact the Customer Service Department on +3389702727 or email parts@cryostar.com



Events

★ April 26-28, 2006

EXPO-GAS 2006, Kielce Fairground, Zakladowa 1, 25-672 Kielce, Pologne.

★ May 30 – June 1, 2006

POWERGEN EUROPE 2006, Cologne, Germany

★ June 6-9, 2006

WORLD GAS CONFERENCE 2006, Amsterdam, Nederland

★ June 13-16, 2006

16th World Hydrogen Energy Conference, Lyon, France

★ July 17-21, 2006

Cryoprague 2006, Prague, Czech Republic

★ August 24-26, 2006

FIGAS 2006, Lima, Peru

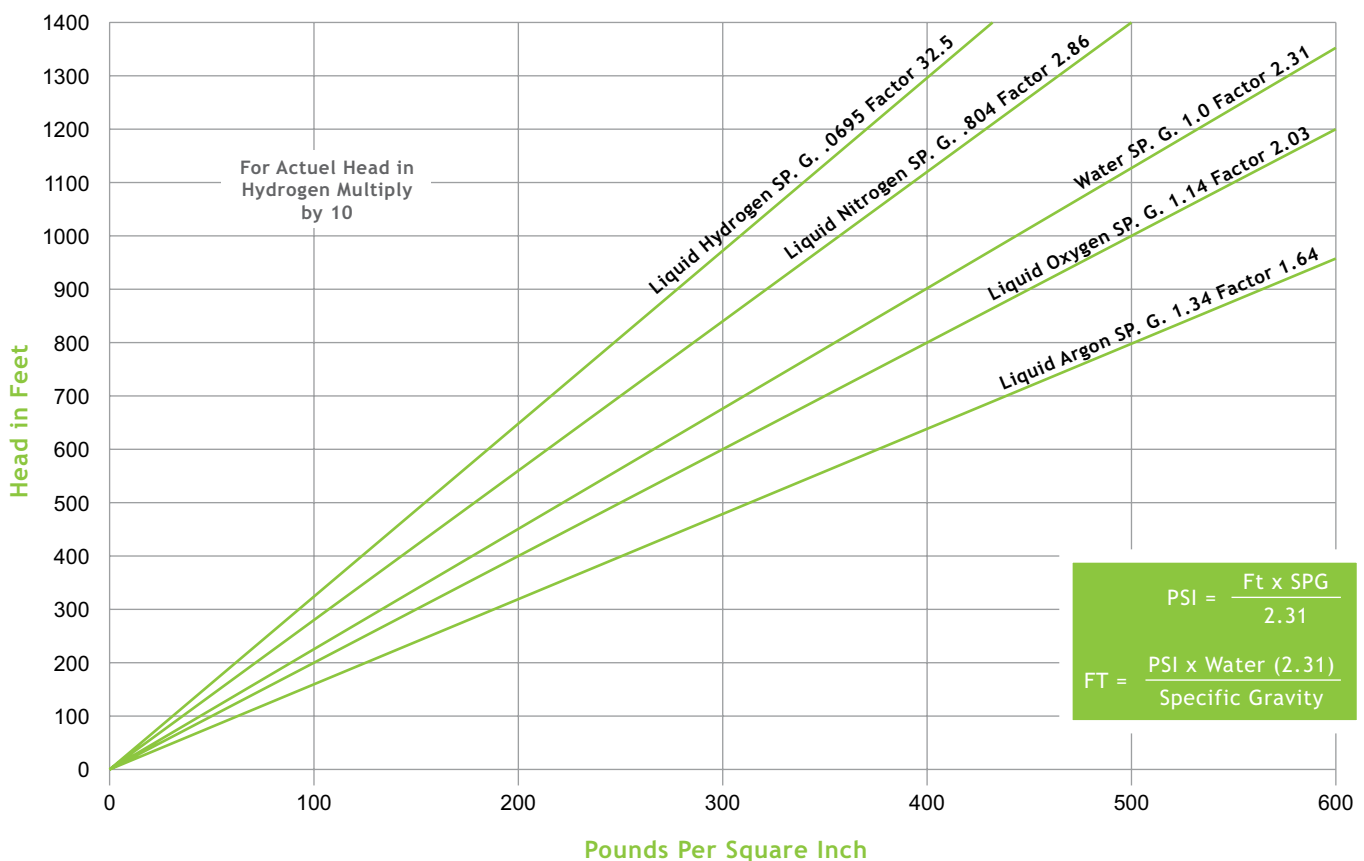
★ September 19-22, 2006

SVARKA - WELDING 2006, GASSUF 2006, Sokolniki Culture & Exhibition Centre, 1 Sokolnicheskiy Val, Pav.4, Moscow 107113, Russia

★ October 17-18, 2006

EAGC 2006, Noga Hilton, 50, boulevard de la Croisette, 06414 Cannes Cedex, France

Tools and datas: Head to PSI conversion





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