



Hi-spec offshore instrument air and nitrogen plant with dual feed compressors.

The Art of On-site Nitrogen Generation

Generon IGS has advanced a technology to generate nitrogen on-site

Nitrogen is used extensively for the drilling, completion, de-watering and workover of oil and gas wells. It is also used for pressure maintenance. Even the gas gathering and pipeline systems benefit from the inert properties of nitrogen — both onshore and offshore. Nitrogen can be generated on-site at high pressures and low oxygen and moisture levels to safely prevent ignition of flammable gases or to protect oil field tubulars from downhole corrosion.

Generon IGS has developed a reputation as having one of the most efficient nitrogen membrane technologies in the world. Now in its third generation and more than 22 000 membranes sold, the Generon Nitrogen Membrane Module, at the heart of the process, is a nitrogen-generating hollow fiber membrane module.

“Generon’s patented membrane technology grew out of work initiated by Dow Chemical,” said Steven Todaro, compression product manager at Generon IGS’ Houston, Texas, U.S.A., facility. “The membrane is made from hollow fibers, each about the size of a human hair. Compressed air is put inside the fiber. The oxygen, carbon dioxide and water vapor tend to leak through the fiber wall much faster than the nitrogen. By controlling residence time, 95 to 99% pure nitrogen can be produced. More residence time yields a higher purity at a lower flow rate. We measure oxygen content on the product end and regulate residence time with a control valve.

“We have modules designed for 200 psi (13.78 bar) and a high-pressure product for 350 psig (24.13 bar) to take advantage of the large population of drilling compressors in the oil patch,” added Todaro. “The oxygen is exhausted out through an atmospheric vent. What comes out is about 37% oxygen versus 21% in the atmosphere. Beyond 3 ft. (.91 m) from the vent it is not hazardous and I’m told it will clear a hangover. The dewpoint of the membrane nitrogen product is very low — comparable to desiccant dried air.”

Generon IGS makes the fiber and puts it into the modules in its plant in California. The Houston facility builds complete systems including feed air treatment, PLC control systems, structure, vessels and piping. “We can incorporate feed air compression and booster compression to meet the customer’s requirements,” said Todaro. “Our pre-treatment ensures long service life of the fibers. We have modules in the field that are still providing good service after 10 years.

Generon IGS has a similar product that dehydrates compressed air. Compressed air that is essentially at the saturation point is put into a dehydration membrane module and -40°C pressure dewpoint air comes out. “This is much like a desiccant dryer except there are no moving parts. It’s a steady-state, steady-flow process instead of a cyclical operation,” said Todaro. “For an offshore platform where maintenance is costly, membrane dryers offer an advantage. On a desiccant dryer you’ve got to periodically rebuild the valving. With a membrane dryer system you don’t have to do that.”

Generon’s products are used in industries other than oil and gas. “We supply a lot of systems for marine tankers where they need to inert the space above the cargo,” said Todaro. “We also supply many smaller systems for the food industry where they use nitrogen inside the packaging. Less oxygen means better



A Generon Marine Nitrogen Unit designed for Marine applications.

shelf life. Bananas stay green longer in nitrogen and then ripen quickly to a desirable color when exposed to air. Flowers also transport better in nitrogen. Chances are a Generon product has touched your life in some way.”

“We introduced a new product at the Marine Expo show in Turkey earlier this year,” said Todaro. “It combines two seawater-cooled feed air compressors and the nitrogen system in a single integrated package. The space required is reduced by two-thirds and the installation is greatly simplified. It was well received by representatives of both shipyards and ship owners. We have already received a number of orders for the new design.”

Generon IGS offers product flow rates from 1.4 to 3000 Nm³/h at 95% purity and pressures to 689 barg with post compression. Systems are designed to economically supply nitrogen up to 99.9% with dewpoints to -64°C. According to Todaro, gas streams are free of hydrocarbon contaminants to <5 ppb.

“Generon IGS offers an economical alternative to the high-priced products that have traditionally been offered by the gas supply industry,” said Todaro. “The Generon IGS system offers reliable on-site generation to meet your nitrogen requirements, whether you are in an urban area, a remote industrial area, on an offshore platform or on a ship.”

Generon IGS is part of the IGS family of companies, which consists of Generon IGS (U.S.A.), IGS Italia (Italy) and SMC Gas Systems (China). Located strategically around the globe, these companies provide integrated sales, service and manufacturing support to the growing on-site gas market. Equipment offerings include nitrogen membrane generators, nitrogen PSAs, oxygen PSAs/VPSAs, dehydration systems, instrument air systems and gas compressor packages.

IGS offers nitrogen generators and systems from small cabinet systems for laboratories and food packaging to portable nitrogen generator units for oilfield service to large tonnage nitrogen plants suitable for refining, chemical processing and other applications. “On the larger end, cryogenic plants are more economical,” said Todaro. “We have built liquid nitrogen plants but it is not currently a target market for us.”

IGS also manufactures nitrogen and oxygen PSA/VPSA generators that operate according to pressure swing adsorption (PSA) technology. These are similar to desiccant dryers commonly used in instrument air systems. The PSA process for nitrogen generation mirrors that of oxygen, but carbon molecular sieve (CMS) is used instead of Zeolite. Due to the adsorption properties of specially treated CMS, it’s pos-

sible to produce nitrogen by charging two alternatively used adsorber vessels with compressed air. While one vessel adsorbs, the other regenerates by pressure reduction. IGS has developed a proprietary mix of cycle timing and molecular sieve types to reach desired purity at maximum efficiency.

Generon Cabinet Systems are designed with the flexibility to meet nitrogen purities from 90 to 99.9%. Each of its cabinet series are expandable and are designed specifically to replace bulky cylinder and smaller cryogenic liquid nitrogen tanks. Generon offers three Cabinet Series Nitrogen Generators — Models Mini 4200, Standard 6500 and High Capacity 6500 with flows from 0.24 to 10 Nm³/m at 95% purity.

Skidded systems are also available. Skidded systems are offered with 4250, 6500 and 7200 Generon Modules. Portable Nitrogen Generators are offered with 7200 low-pressure and 7200 high-pressure Generon Modules. Systems are available with manual or PLC-based control, and come with digital oxygen purity.

According to Todaro, Generon has provided pre- and/or post-compression with its systems. Pre- or feed compression can be as straightforward as a standard packaged air compressor, to as complex as a custom package integrated with the nitrogen system to meet

complex project specifications and hazardous area requirements. Post or booster compression can be small-pressure amplifiers or high-horsepower balanced-opposed reciprocating compressors like those used in gas gathering. Compression prime movers can be diesel engines, gas engines or electric motors. Now the company offers stand-alone compression systems for natural gas, process gas and instrument air, as well as nitrogen process compression or containerized portable compression.

“We provide systems to service companies like Halliburton and Weatherford and Linde where we put all of the equipment into a marine shipping container,” said Todaro. “When it’s not in use, it is sitting in a back corner of their yard and it’s all buttoned up and secure. When they need to move it to a new site, these company’s have the equipment to handle it. They can be stacked. We’ve designed some of them to be run stacked up, such as in offshore applications where space is tight. We have built

systems to meet hazardous area classifications and marine specifications around the world.

“With this background of fabrication, process design, customer specifications and booster compression, it was just a matter of time before we got into natural gas compressor packaging,” added Todaro. “Right now we have two orders for pure gas compression units. The first order is for a dozen units for a rental fleet and a second order is for booster compression for a pilot process plant. Both utilize Gemini three-stage reciprocating compressors. The fleet units have Caterpillar gas engines while the plant unit is motor driven with shell and tube cooling.”

Generon moved into a new facility on a 8.9 ha site on the north side of Houston late last year. Utilities were sized with compression testing in mind. Natural gas for engines to 1491 kW and electric power for motors to 372 kW is available. After just eight months, the new facility is full. An

expansion is already being planned.

Looking ahead, Todaro sees continued growth for Generon IGS. “We have a product right now in R&D that utilizes a diesel engine, an oil-flooded screw feed air compressor and a 275.79 bar nitrogen booster compressor — both driven by the same engine. These are mounted on a trailer with a nitrogen unit. We can pull up to a wellhead and be rigged up to do 275.79 bar nitrogen in one truckload. Typically the way this is done now, there’s a feed compressor, there’s a nitrogen unit and then a booster compressor package. It’s usually two or three truckloads that have to be hooked up and connected, and it takes a while. We are trying to get this product to the point where it is one truckload with only a product nitrogen line to hook up. We will continue to pursue gas compressor packaging opportunities — particularly smaller horsepower, multiple-unit projects for fleet operators.”