

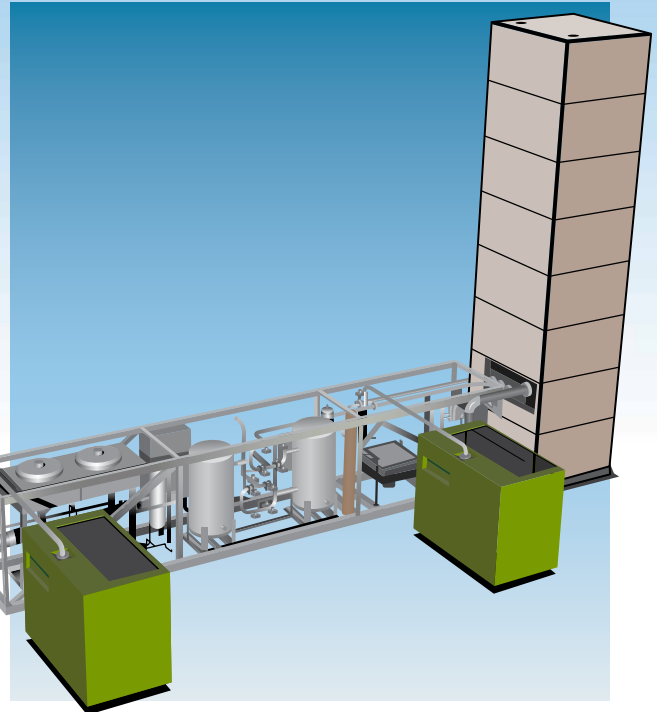
# Improved Efficiency Small Capacity ASU's

Traditionally, most customers value mobility and simplicity for small air separation plants (below 15 metric tons per day total liquid capacity). These small plants are usually installed as a "pilot plants" to develop new markets. Once the market develops, the small air separation plant is replaced with a larger more efficient plant and the small air separation plant is relocated to develop another market area. Others purchase the small plants for remote locations to supply the product to specific nearby customers, such as plants for the oil and gas drilling customers. Still others purchase multiple small plants in lieu of a single larger plant where the road infrastructure is poor and road transportation is difficult. In many of these remote locations, the power to the air separation plant is generated at site via diesel or gas generators and air cooled plant is required since there is no adequate cooling water available. Thus, many of the customers give priority to simple modularized plant design for easy relocation and a simple process design for robust reliability above other factors.

However, these traditional priorities are now shifting, as more and more customers are putting plant efficiency at the top of their plant design requirements. With ever increasing power and diesel costs around the world, many of our customers are discovering that they not only need a robust, highly modularized plant but also an efficient one. Power costs have become much more prevalent in the customers' economic analysis. Simply put, energy costs have now become the driving factor in many of the new applications for even small air separation plants.

To meet this new paradigm, Cosmodyne has improved the small air separation plant design to increase efficiency while maintaining the modularized design and reliability. Cosmodyne achieved efficiency gains by changing various aspects of the plant design. An ACD turbo-expander with booster compressor is now incorporated into the process. The expander booster compressor utilizes the available energy from the highly efficient, near-isentropic expansion occurring at the turbo-expander that produces the required low temperature. In previous designs, the energy from the turbo-expander had simply dissipated to atmospheric via an air brake. Another part of the plant that was improved was the heat exchanger design. Working closely with the heat exchanger manufacturer and using Cosmodyne's internal field operating database, the heat exchanger design was revised to incorporate a high efficient sub-cooler for liquid products as well as the latest technology high performance fins with close approaches to extract more energy from the process to reduce the power consumption. Also, the columns were redesigned with improved tray design and spacing for lower pressure drops and higher yield.

Engineering changes have resulted in a substantial improved specific power. For



example, the previous generation GFED 3 produced 7 metric tons per day of liquid oxygen at 2.4 kW-hr/Nm<sup>3</sup> specific power. The new plant (with single compressor design) produces 8 metric tons per day of liquid oxygen at 2.0 kW-hr /Nm<sup>3</sup>; an improvement of 17%. Moreover, all the new designs are field proven components to assure reliability. The expander-compressor unit and the higher efficient chiller compressor are from Cosmodyne's ASPEN plants. There are currently over 35 ASPEN plants operating around the world with tremendous reliability records.

Although many parts of the air separation plants have changed, the new plants still maintain the most efficient modularized design. The air treatment module is now skid mounted for better accessibility and lower fabrication time. The coldbox is now taller than the GFED. However, the air treatment module and the coldbox still fit into standard containers for simple and economical shipment.

Currently Cosmodyne is continuing to offer both GFED plants as well as the new improved small air separation plants to meet different customers' requirements.

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