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SPECIAL REQUIREMENTS

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Atlas Copco Rental Australia explores a variety of specialized rental solutions required throughout the lifecycle of a LNG plant.

The mix of equipment required is dependent upon the particular project phase, and does change significantly as the LNG plant progresses through site preparation to construction, then pre-commissioning and commissioning, and finally to operation and maintenance. Specialized portable equipment usually supplied includes air compressors, boosters and dryers, on-site nitrogen generators, electrical power generators, and steam boilers. The optimal procurement process is typically via a total solution concept, whereby a supplier can assist right from the commencement of the design phase, providing a complete suite of services including operators and remote monitoring, and has the appropriate safety, environment, and quality systems and certification in place.

When considering the type of specialized rental solutions required for a LNG project it is generally useful to first separate the project into four (4) major stages. Specific applications can then be identified for each of the stages, and similar equipment requirements grouped to simplify the procurement and management of the specialized rental solutions.

SITE PREPARATION STAGE

The first identifiable stage for specialized rental solutions is the site preparation phase. Applications normally include drilling and piling, and on-site electrical power generation for site facilities such as offices and workshops.

CONSTRUCTION STAGE

As the project moves into the construction phase the number of potential applications grows substantially, and it is helpful to split the consideration of applications into off-site and on-site construction as the geographic locations are normally far apart.

Off-site construction

During off-site construction the LNG train modules will be fabricated and assembled in a very large purpose built construction facility. Throughout this process specialized rental solutions will be necessary for:

- Line blowing to clear debris accumulated in the pipework of the LNG module during fabrication.
- Low and high pressure pneumatic testing to ensure no system leaks to atmosphere.
- Nitrogen purging to create a non-corrosive environment in the LNG module pipework during the transportation of the LNG train modules to the actual construction site.

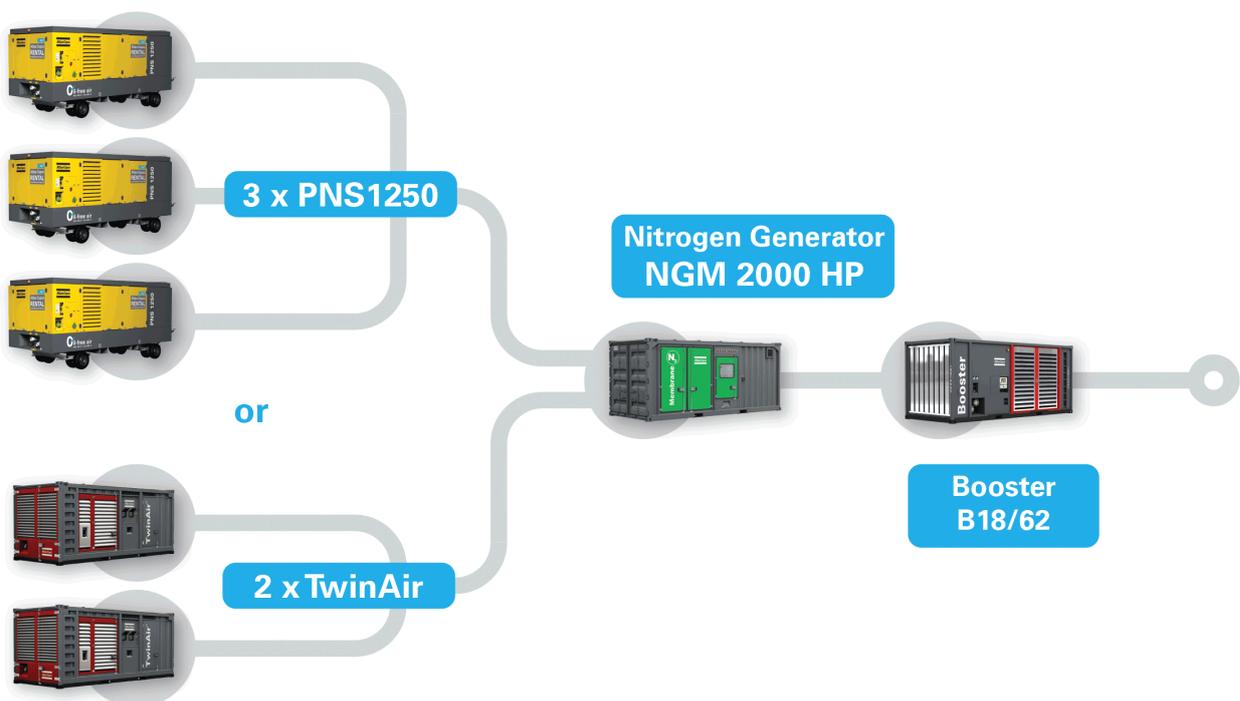
On-site construction

On-site construction broadly includes LNG product and heavy lift unloading wharfs, LNG storage tank construction, and LNG train module assembly installation. LNG product and heavy lift unloading wharfs may require specialized high pressure compressor rental

solutions for the drilling and piling processes related to installing wharf piles. Construction of the LNG tanks is a major project itself, and requires medium pressure compressed air to lift the tank roofs into place and for pneumatic testing of the tank pipework. Nitrogen is required for purging of the tanks once the construction is complete to create an inert environment. Large amounts of medium pressure air are used as an energy source for pneumatic tooling needed during the LNG train module assembly and installation. Also, temporary power will remain on-site during the construction phase, and additional electrical power may also be required for preservation of already installed critical process equipment.

PRE-COMMISSIONING AND COMMISSIONING STAGE

The next phase can be grouped as pre-commissioning and commissioning as the applications are similar in nature. Here the focus is typically upon preparing and testing the constructed LNG plant to receive first gas for processing, liquefaction and dispatch.



Temporary medium pressure compressed air is required for instrumentation and instrument system testing. Medium and high pressure air is necessary for final line blowing, tightness and pneumatic testing of the LNG train pipework. Then high pressure leak testing is usually undertaken with nitrogen and a small trace of detectable helium, prior to final medium pressure nitrogen inerting of the completed LNG train. Some temporary power may remain as mentioned just above.

OPERATION AND MAINTENANCE STAGE

As the plant moves into operation and maintenance, the applications again change for specialized rental solutions. Standby medium pressure air compressors can be necessary to support the plant instrument air supply. Whereas during shutdowns or turn-arounds nitrogen is typically necessary to inert the LNG trains at the commencement and completion of the operation to create a safe environment for people and the process. Medium pressure air may be also required for blasting, painting and to power pneumatic air tools.

DIFFERENT TYPES OF SPECIALIZED RENTAL SOLUTIONS

Broadly, this includes diesel powered air compressors, boosters and desiccant air dryers, portable on-site nitrogen gas generating systems, diesel powered electrical generators, and portable diesel steam boilers.

Air compressors can be initially categorized into Class 0 oil free or oil flooded, and the type used for the application is very important as the air quality differs substantially. The TUV in Germany has certified Class 0 oil free air compressors as having no detectable traces of oil in the compressor outlet, and this type of compressor is mandatory where even the smallest amount of oil cannot be tolerated. Oil flooded compressors can be a slightly more economical solution, acceptable only when oil carry over to the application can be tolerated. Single, two or three stage compressors are available to provide medium to high pressure Class 0 or oil flooded air. Pneumatically purged and controlled desiccant air dryers can be supplied with any compressor type to bring the pressure dew point of the compressed air to -40°C , or lower if necessary. Whereas diesel powered boosters will take high pressure air from two or three stage feed air compressor and boost it too much higher pressures, in excess of 150 bar if required.

Very large volumes of nitrogen gas, with purities up to 99%, can be generated from on-site nitrogen generators. A typical spread may include three high pressure feed air compressors, a nitrogen generator, and a booster if necessary. Such a system provides on demand nitrogen at highly variable purities, flows and pressures. It also eliminates the sometimes substantial boil off losses during transportation and gasification of liquid nitrogen.

Specialized rental generators should be capable of operating as a prime power source, able to manage the starting current peaks of large

rotating equipment, and be capable of synchronization to load share and reduce fuel consumption with varying electrical loads wherever possible. Diesel fired steam boilers packaged into containers provide a portable and simple system for steam generation in any location of a LNG plant.

CASE STUDIES

Australia and Papua New Guinea have many recent examples of the use of specialized rental solutions throughout the lifecycle of a LNG plant. With the Gorgon project in particular having some very specialized requirements.

To illustrate the unique needs of LNG plant applications, and the specialized rental solutions available, some selected cases are noted below.

During site preparation of the Gorgon project drilling of the construction site was necessary, however being an "A Class" nature reserve the process was extremely environmentally sensitive with only minimal environmental impact allowed. In this instance six (6) medium pressure compressors were packaged into helicopter lifting frames to allow the units to be lifted directly to the drill site, and substantially reduce the environmental risk.

Throughout the off-site module fabrication process for the QCLNG and APLNG projects Class 0 oil free compressors, desiccant dryers and boosters, were used for line blowing, pressure testing, and chemical cleaning. The specialized system provided Class 0 dry oil free air for the medium, high and very high pressure applications.

On-site construction for the Gorgon project included a large heavy lift wharf. High pressure compressed air was needed for drilling and piling, however the barge deck space was very limited. To support the application seven (7) TwinAir compressors, each in 20 foot sea container, giving an installed 14000 CFM of high pressure air in a small

135m² footprint were supplied. The Gorgon tank construction was a major undertaking and required a variety of specialized rental solutions. Including, portable medium compressor packages with undercarriages for site mobilization during the roof lifting, a portable high volume nitrogen generation system providing up to 99% purity nitrogen gas on demand for inerting the 180,000 m³ storage tanks, and a unique Class 0 43 bar high pressure compressed air and booster package for testing of the tank pipework.

Pre-commissioning and commissioning line blowing and pneumatic testing of the PNG LNG project was undertaken with Class 0 oil free air compressors and desiccant dryers to ensure no oil would be present after the process was undertaken. In this instance two and three stage Class 0 oil free compressors ensured no risk of oil contamination, with the added advantage of clean condensate being discharged from the compressors inter and after coolers in the hot and humid Papua New

Guinea operating environment. Both the PNG LNG and Gorgon projects used portable high pressure nitrogen gas generating spreads with boosters to facilitate the helium leak testing, and inert of the LNG trains prior to first gas.

During operation and maintenance at the Darwin LNG and Karratha Gas Plants Class 0 oil free air compressors provide medium pressure air for standby instrument air supply, and during routine maintenance of the LNG plant instrumentation oil free air compressors. For shutdowns and turn-arounds high pressure compressors supply air for portable nitrogen gas generation, and portable medium pressure compressors on undercarriages with integral air treatment equipment supply air for pneumatic tooling, blasting and painting.

CONCLUSION

When considering procurement of a specialized rental solution it is important to look at the total solution, not simply equipment

supply, as potential suppliers can add significant value through a number of ways.

It is advantageous to have engagement throughout the design of the temporary system so the solution can be optimized for the application to provide the desired output in any operating conditions and the lowest fuel consumption for instance. The logistics can often be managed from project commencement to completion, and installation, commissioning and operator services may also be useful where site labor is constrained. Energy management, such as re-fuelling services, also reduces the project management workload. Final considerations should be level of remote monitoring, where a satellite based system can often alert the supplier and the LNG plant personnel of any potential problems, and appropriate safety, environment and quality systems and accreditations held.

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