



Application Note

Nigeria LNG

Location	Bonny Island, Rivers State, Nigeria
Monitoring system	COMPASS (on-line and off-line)
Monitoring strategy	Integrated, plant-wide safety, condition and performance monitoring
Machines monitored	On-line: 125 critical machines Multiplexed: 500 fin-fans Off-line: 800 auxiliary machines
Interfacing	Process parameters imported and COMPASS values and alarms exported to DCS. DCS also used for time synchronization
Commissioning	1998 (trains 1, 2), 2000 (train 3), 2004-5 (trains 4, 5)
Services	3-year service agreement

Nigeria LNG (www.nlng.com) first started production in 1999 with two production trains, but has since been expanded several times. By 2005, Nigeria LNG will become the third largest LNG plant in the world with a total production capacity of 17 million tons/yr of LNG, 2.3 million tons of LPG and 1 million tons of condensate. In order to protect the environment and minimize unnecessary flaring, Nigeria LNG was specially designed to run 100% on associated gas.

Formal studies are already underway to add a sixth train.



COMPASS selected for all trains

The COMPASS monitoring system was selected by Shell in 1996 and commissioned in 1998 for safety and condition monitoring of all critical machines and many auxiliary machines in the gas treatment, refrigeration and liquefaction cycles of both trains 1 and 2. This includes portable monitoring instruments for some of the auxiliary machines. As there are many machines that are being automatically monitored that could potentially interrupt production, the life cycle costs of the system are low.

The monitoring system was also used for pre-delivery string testing of the LNG machines at the vendor's factory prior to shipment to Nigeria. This reduces the risk of detecting potential machine faults on site, which could cause delays. COMPASS also provided completely independent machine verification since it was not aligned to the machine manufacturer.

An interface was also implemented to export measurement values and alarm information from COMPASS to the distributed control system (DCS) to keep plant operators informed on the condition of the machines. The DCS was also used for time synchronization for the monitoring system. This is important for root cause analysis when comparing

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data from different machines for a specific event (e.g. machine trip).

When it was decided to add a third train, COMPASS was again selected. COMPASS was delivered with the same scope as for the first two trains.

COMPASS was again selected for the new trains 4 and 5 in 2003. The monitoring strategy for these trains was the same as for the first three trains, but with performance monitoring capability added for the MR and PR gas compressors, end flash gas compressors and LPG storage and loading propane compressor. (All of these machines were already being vibration monitored on trains 1,2 and 3). Many process parameters are imported into COMPASS so they can be used in the thermodynamic calculations for performance monitoring.

Trains 4 and 5 were also special since these are cooled by fin-fans and not by water as is done for trains 1,2 and 3. This required 1000 extra multiplexed on-line monitoring channels.

Integrated monitoring solution

There is generally one central server for each train, where vibration, process and performance data trends can be correlated in the same plots. This is important for diagnostic purposes. COMPASS also allows relevant information to be displayed for all five trains in a single screen. As there are so many machines being monitored at the LNG plant, it is important to have a quick overview and assessment over all relevant parameters.

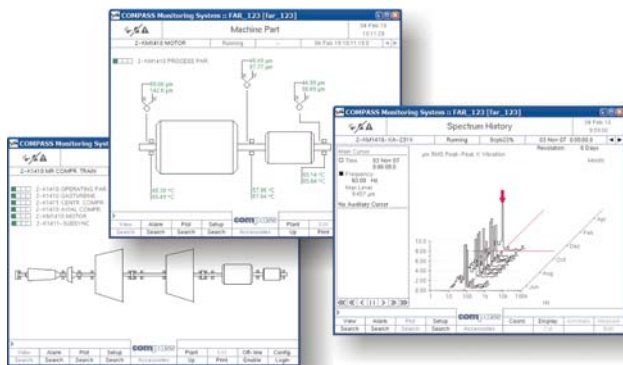


Fig. 1 Screen view of the mixed refrigerant compressor train 2, showing a spectrum history plot (right) from the helping motor outboard bearing.

The monitoring system is also 100% web-enabled, where operators can securely access the COMPASS database and system setup on any computer without specialist software or licenses. This also allows the Brüel & Kjær Vibro Diagnostic Center in Denmark to provide many remote services without a site visit.

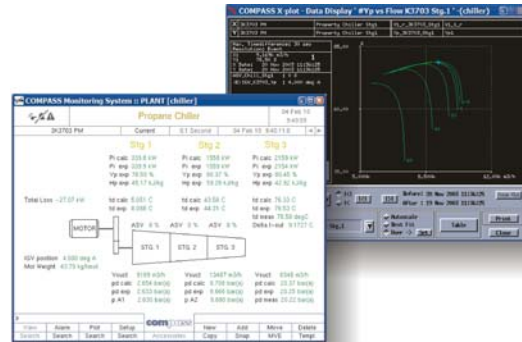


Fig. 2 Screen view of the train 2 propane chiller compressor (left) and an efficiency vs. flow/speed compressor map plot for the first stage (right).

Long-term service agreement

COMPASS is an inherently stable platform that requires upgrading and maintenance, but Brüel & Kjær Vibro specialists are on-site several visits each year anyway to take care of contingencies. Training is often done on-site, for example, as there is often new personnel arriving. Services provided include:

- Help desk
- Software update
- System optimization
- Preventive monitoring system maintenance
- Training (system operator, diagnosis and vibration analysis)

The 3-year service agreement with NLNG has recently been extended.

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