



Nigeria LNG - Monitoring Strategy and Solution



Oil & Gas

Nigeria LNG is one of the world's largest producers of liquefied natural gas (LNG) with a total current capacity of 22 million tons/year of LNG, plus 5 million tons of liquefied petroleum gas (LPG) and condensate. LNG production will be increased to 30 MTPA when train 7 is put into operation. Overall production capacity will account for more than 8% of the world-wide LNG consumption.

Monitoring strategy – Nigeria LNG

Location	Bonny Island, Rivers State, Nigeria
Monitoring system	VC-8000/SETPOINT® CMS and B&K Vibro legacy systems (online and offline)
Monitoring strategy	Integrated, plant-wide machine protection, condition and performance monitoring
Machines monitored	Critical and balance-of-plant machinery in liquefaction, gas treatment, power/ utilities and loading & storage
Interfacing	Data import/export to DCS, native connection to AVEVA™ PI System™
Monitoring commissioned	1999-2000 - Trains 1 and 2, 2002 - Train 3, 2005 - Train 4, 2006 - Train 5, 2007 - Train 6, 2022 - Train 7 (monitoring system ordered but equipment not yet installed)
Services	Long-term service agreement

B&K Vibro selected for all trains

Due to a need for a comprehensive and reliable, plant-wide monitoring solution for expected the harsh operating conditions at the proposed LNG plant, the monitoring solution from Brüel & Kjær Vibro (B&K Vibro) was selected in 1996 by tender. The machine protection and condition monitoring system was commissioned in 1999 for all critical machines and many auxiliary machines in the gas treatment, refrigeration and liquefaction cycles of both trains 1 and 2. Machines in the Power & Utilities and Loading & Storage were also included to be monitored.

The monitoring system was subsequently extended to trains 3, 4, 5 and 6 when these units were built.

Even before the trains were operational, the monitoring system was used for pre-delivery string testing of the LNG machines at the vendor's factory prior to shipment to Nigeria.



Figure 1. Nigeria LNG plant



This reduces the risk of detecting potential machine faults on-site, which could cause delays.

The monitoring strategy for all trains is similar. For the critical machines, condition monitoring is done with a rack-based plant-wide system that includes protection. Some of the machines are also performance monitored, such as the gas turbines and the compressors for mixed refrigerant, propane refrigerant, end flash, LPG storage and loading compressors.

The plant-wide system also monitors a lot of semi-critical auxiliary machines (balance-of-plant). This applies for example to the fin-fans. While trains 1, 2 and 3 are cooled by water, trains 4-6 are cooled by almost 750 fin-fans. These are not critical machines but require online condition monitoring.

Many balance-of-plant machines are also monitored by B&K Vibro portable vibration monitoring devices.

Upgrade of legacy systems

The legacy COMPASS Classic systems have been successfully and reliably running since 1999, but in 2023 they have been upgraded to VC-6000 and Compass 6000. The upgrade includes adding advanced extra cyber security.

The upgrade also includes monitoring the boil-off compressor in the loading/storage part of the plant, but in this case the

protection, condition monitoring and performance monitoring will be done by the VC-8000/SETPOINT® CMS system. When train 7 is completed, these machines will also be monitored by the same system.

Services

A wide range of services are available to ensure Nigeria LNG gets maximum benefit from their monitoring solution. Remote monitoring and diagnostic support can be provided as the need arises without a site visit. There is also a long-term service agreement where B&K Vibro specialists are onsite twice a year for 3 weeks to take care of contingencies. Training is often done onsite, as for example when new personnel arrive. Services include:

- Help desk
- Software update
- System optimization
- Protection and condition monitoring system maintenance and upgrading
- Remote and onsite diagnostic support
- Training (system operator, system administrator, diagnosis, and vibration analysis)

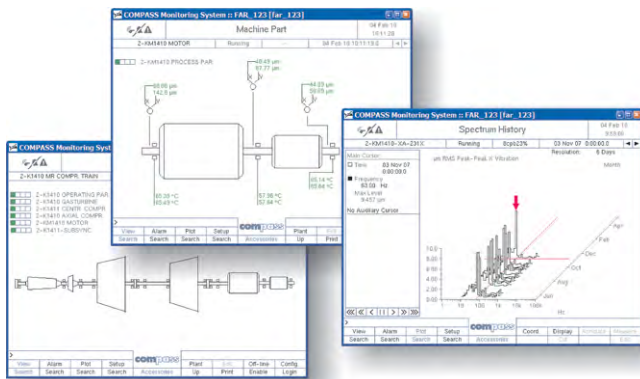


Figure 2. Screen view of the mixed refrigerant compressor train 2, showing a spectrum history plot (right) from the helping motor outboard bearing.

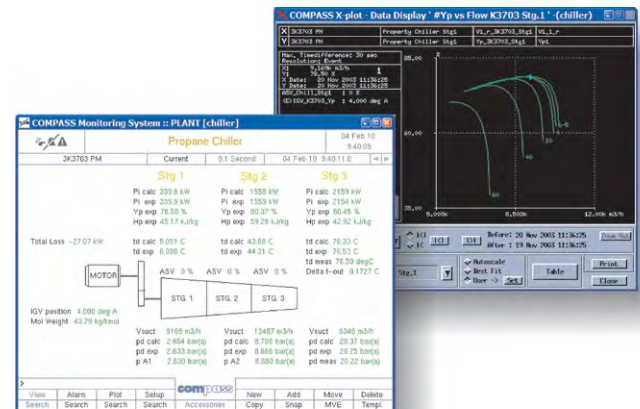


Figure 3. Screen view of the train 2 propane chiller compressor (left) and an efficiency vs. flow/speed compressor map plot for the first stage (right).



Brüel & Kjær Vibro

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