LNG CARRIER
LIFECYCLE
MAINTENANCE

Dynagas opts for condition-based turbine maintenance

An SPM Instrument online monitoring system has helped Dynagas win a turbine condition monitoring (TCM) notation for its three LNGCs

Dynagas Ltd has achieved the turbine condition monitoring (TCM) class notation for its three Lloyd's Register-classed 149,700m³ LNG carriers *Clean Energy*, *Clean Power* and *Clean Force*. The initiative has been enabled through the use of the Lloyd's Register (LR) ShipRight fatigue design assessment (FDA) software package and a condition monitoring system provided by SPM Instrument.

To enhance their operational flexibility two of the three Dynagas ships – *Clean Power* and *Clean Force* – were constructed to LR Ice Class 1A, enabling navigation in first-year ice with a thickness of up to 80cm. Apart from their strengthened side shells, the special design of the propeller, shafting, sea chest locations and compliance with relevant class requirements for 1A ships, the two vessels are equipped with various 'winterisation' features to enable them to successfully navigate in very low ambient temperature environments.

The TCM class notation that all three Dynagas LNG ships have recently been awarded indicates that the vessels have propulsion systems of improved reliability and enables the use of periodic condition monitoring as an alternative to the lifting of the turbine covers when the ships are drydocked. The condition monitoring process includes aspects such as vibration readings, lubricating oil analysis and plant performance verification, together with a sea trial at the time of the turbine survey.

Steam turbine-powered LNGCs without a TCM notation are required to have their steam turbine top casings lifted at their five-year inspections to enable an examination of the rotors and diaphragms by class society surveyors. Amongst other things, having to lift the turbine top casings creates a risk that such an inspection can introduce a new set of turbine problems.

Clean Power – one of the three Dynagas ships awarded the turbine condition monitoring class notation

"We want to be at the forefront of safety and reliability for our ships and to implement new technology when we see the advantages," says Mr D Doumouliakas in the technical department of Dynagas Ltd.

More specifically the requirements for TCM class notation encompass the following elements:

1. The rotor bearings, thrust bearings and couplings can be opened without lifting the top turbine casing.

2. Access to visually examine the final low-pressure and astern stage blading is provided.

3. Indicators for determining the axial position of rotors relative to their casings and for showing the longitudinal expansion of casings at the sliding feet are fitted.

4. The parameters specified below are measured and recorded at regular intervals not exceeding two months while the ship is in service.

The parameters which must be monitored periodically are as follows:

(a) shaft horsepower;

(b) shaft and turbine rotor rpm;

(c) plant performance data, e.g. steam conditions at the inlet and outlet of each turbine, boiler performance data, condenser vacuum, sea temperature and the steam conditions for other major steam-consuming auxiliaries;

(d) turbine bearing housing vibration;

(e) visual inspection at survey of rotor bearings, thrust bearings, couplings and casing axial expansion arrangements;

(f) inspection at survey of final low-pressure and astern stage blading;

(g) measurements of rotor axial position using permanent indicators;

(h) boiler water analysis; and

(i) sampling, laboratory testing, analysis and assessment of lubricants.

The condition monitoring system supplied by SPM Instrument enables the vibration monitoring requirements to be met. It provides for the continuous (24/7) monitoring of vibration at 14 points on the main turbine reduction gears and the periodic measurement of shock pulses and vibration on the turbine bearings by means of portable instruments.

The SPM online monitoring system, which has been essential to the award of the TCM class notation to the Dynagas ships, consists of vibration transducers and a measuring unit with up to 16 channels. This is connected to a PC, where readings from both the continuous monitoring system and the portable instruments are collected, organised and presented in simple graphs, in tandem with green-yellow-red condition information.

As part of its service package offering SPM Instrument has provided relevant training to crew members with responsibilities for the operation of the steam turbine propulsion systems on the three vessels. In addition, to ensure the satisfactory monitoring of plant performance, separate steam performance software has been installed.

For its part Lloyd's Register follows up with any necessary responses occasioned by its analyses of records and TCM routines carried out during the annual class surveys.

SPM Instrument points out that interest from the maritime sector for its condition-based maintenance (CBM) services is growing as a result of the trend towards larger vessels operated by fewer crew. The working environment brought about by this trend intensifies the focus on how to use manhours more effectively and shipping companies are increasingly keen to learn from the CBM strategies implemented by land-based industry.

There is also a growing awareness that a considerable part of the maintenance work based on shipboard inspections is in fact unnecessary and a product of tradition and previous demands for regularly scheduled surveys by class. In contrast the CBM approach is based on routine measurements and inspections carried out by selected crew trained to evaluate the results and determine possible corrective maintenance.

SPM Instrument explains that the use of the CBM approach increases reliability, enables maintenance work to be planned and results in a reduction in spare parts consumption. *LNG*
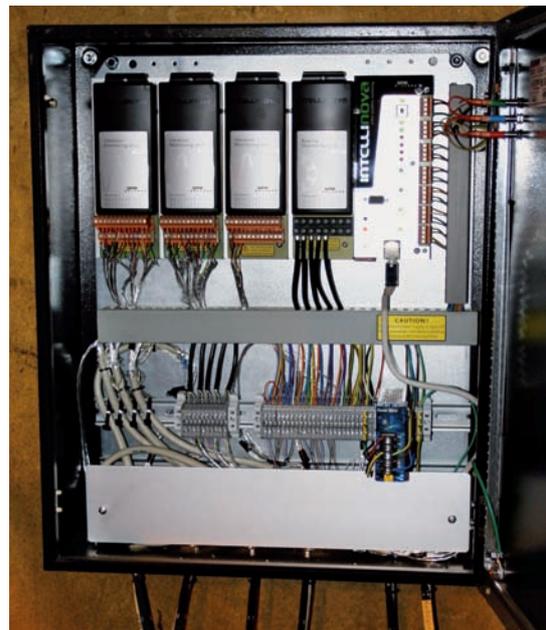
SPM's Intellinova continuous monitoring system delivers easily understood condition information straight to the control room