DNV·GL

Certificate No:
TAA00000RR

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Gas Turbine System

with type designation(s)
Core software for GE gas turbines LM2500 + SAC commercial Marine

Issued to
Woodward Inc.
Fort Collins, CO, United States

is found to comply with
DNV GL rules for classification – High speed and light craft
DNV GL rules for classification – Ships

Application :

Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV GL.

This Certificate is valid until **2018-10-19**.

Issued at **Høvik** on **2016-10-20**

for **DNV GL**

DNV GL local station: **Approval CMC – Houston**

Approval Engineer: **Thorbjørn Hansen**

Odd Magne Nesvåg
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

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Job Id:
Certificate No: **TAA00000RR**

Product description

Woodward core software for installation in either Woodward Micronet™ / Micronet™ Plus hardware to serve monitoring control and safety of GE gas turbines LM2500 + SAC commercial Marine.

The following software is included in this Type Approval:

Gap version :	6.00
Coder version :	3.10-1
Code part number and revision :	5418-7225 Rev. A, 18-FEB-2016

The following functions are covered in the Type Approved software:

Scheduling Functions:

1. Gas generator speed governing
2. Fuel metering valve
3. Acceleration fuel scheduling
4. Deacceleration fuel scheduling
5. Variable stator vane

Limiting functions:

1. Gas generator corrected speed
2. Power turbine acceleration
3. Power turbine speed
4. Maximum speed limit
5. Power turbine output torque

Safety Functions:

1. Gas generator overspeed
2. Power turbine overspeed
3. Fuel shutoff
4. Stall detection
5. Fuel manifold pressure
6. Vibration
7. Lube supply pressure
8. Overtemperature (T5.4)
9. Power supplies (redundant)
10. Hardware watchdog timer

Monitoring Functions:

1. Various interfacing analog and logic signals for safe starting, operation and shut down
2. Status and alarm signals
3. Fuel metering valve (actuator position)
4. Variable stator vane (actuator position)

Application/Limitation

This Type Approval covers core software for LM2500+ gas turbine as described under product description, installed on DNV GL Type Approved hardware type MicroNet™ / MicroNet™+.

With each new version of the core software a **Core Software Technical Service Bulletin** for engine model **LM2500 + SAC Commercial Marine** is issued identifying the core product number **5414-586** and the new revision letter (**A** at time of type tests, **C** at the date of issuance of previous certificate), giving a summary of all changes that has been included in the new version.

When the type approved software is revised (affecting all future deliveries) DNV GL is to be informed by forwarding updated software version documentation. If the changes are judged to affect functionality for which rule requirements apply a new functional type test may be required and the certificate may have to be renewed to identify the new software version.

Product certificate
Each delivery of the application system is to be certified according to Pt.4 Ch.9 Sec.1. The certification test is to be performed at the manufacturer of the application system before the system is shipped to the yard. After the certification the clause for application software control will be put into force.

Clause for application software control
All changes in software are to be recorded as long as the system is in use on board. The records of all changes are to be forwarded to DNV GL for evaluation and approval.
Major changes in the software are to be approved before being installed in the computer.
A Certification of Application Functions may be required for the particular vessel.

The following documentation of the actual application is to be submitted for approval in each case:
- Copy of this Type Approval Certificate including reference to type approved hardware
- Functional description of the Application Software
- System block diagram
- Power supply arrangement (may be part of the System block diagram)
- Instrument list
- Alarm and shut-down list
- Test program for Approval Test of the Application Software

Type Approval documentation

Tests carried out
Type Test of Software was performed 8-February 2016 through 12-February 2016.

Periodical assessment
The scope of the periodical assessment is to verify that the conditions stipulated for the type are complied with, and that no alterations are made to the product design or choice of systems, software versions, components and/or materials.

The main elements of the assessment are:
- Ensure that type approved documentation is available
- Inspection of factory samples, selected at random from the production line (where practicable)
- Review of production and inspection routines, including test records from product sample tests and control routines
- Ensuring that systems, software versions, components and/or materials used comply with type approved documents and/or referenced system, software, component and material specifications
- Review of possible changes in design of systems, software versions, components, materials and/or performance, and make sure that such changes do not affect the type approval given
- Ensuring traceability between manufacturer's product type marking and the type approval certificate

Periodical assessment is to be performed at least every second year and at renewal of this certificate.

END OF CERTIFICATE