TYPE APPROVAL CERTIFICATE

Certificate no.:
TAA000001E
Revision No:
1

This is to certify:

that the Programmable Electronic System

with type designation(s)
GE Mk VIe and GE Mk VIeS Turbine Controllers for Electric Motor / Compressor Set and for Turboexpander / Generator Set

issued to
Nexus Controls LLC
Longmont, CO, USA

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

Application:

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

Temperature	**(Refer to Table 3)**
Humidity	**B**
Vibration	**A**
EMC	**A**
Enclosure	**Required protection according to DNV rules shall be provided upon installation on board.**

Issued at **Houston** on **2024-04-19**

This Certificate is valid until **2029-04-19**.

for **DNV**

DNV local unit: **Houston, Approval CMC**

Approval Engineer: **Pasquale Macri**

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.

Product description

The Mark VIe and VIeS product is used for controlling steam/gas/hydro turbines using a GE Computer/Controller. The I/O are digital inputs, digital outputs, analog inputs, and analog outputs to control speed and monitor the health of the turbine (prime mover) and the mechanical load. The I/O parameters include temperatures, pressures, speeds, valve positions, and other various parameters. Controlled outputs include gas fuel valve and steam valve control, load sharing and alarm and fault monitoring. If unsafe operation is detected, then the control system will perform the necessary alarms and/or trips and provide notification through communication networks. The Mark VIe and VIeS product is contained in a cabinet provided with hinged door(s) that is secured closed by a key-lock.

The product comes in four (4) configurations, being;
1. Gas Turbine/Generator set
2. Steam Turbine/Generator set
3. Hydro-electric Turbine/Generator set
4. Gas Turbine/Compressor set.

The only difference between the four configurations is the software and the low voltage I/O configuration, being;
1. Simplex version; one CPU and one I/O Processing Network.
2. Dual version; two CPU for redundancy and a Primary/Backup I/O Processing Network
3. TMR version; three (3) CPU for redundancy and three (3) I/O Processing Network

Controller UCSx Controller Processors

Controller (P/N)	Processor
IS220UCSAH1A	667MHz PowerQUICC II Pro Freescale
IS420UCSBH1A	600MHz EP80579 Intel
IS420UCSBS1A	600MHz EP80579 Intel
IS420UCSBH3A	1200MHz EP80579 Intel
IS420UCSBH4A	1066MHz EP80579 Intel
IS420UCSEH2A	2800MHz Quad Core 11th Gen Intel Core i7
IS420UCSEH2B	1200MHz Dual Core 11th Gen Intel Core i7
IS420UCSEH2C	1200MHz Dual Core 11th Gen Intel Core i7
IS420UCSCH2A	1600MHz Dual Core AMD G Series

Table 1

Control System Input/Output (I/O) Module Types

I/O Pack/Quantity per Board	Board
General Purpose, Discrete I/O types	
PDIAH1A/1,2,3, PDIAH1B/1,2,3	TBCIH2C
PDIAH1A/1,2,3, PDIAH1B/1,2,3	TBCIH2C
PDIAH1A/1,2,3, PDIAH1B/1,2,3	TBCIH3C
PDIAH1A/1,2,3, PDIAH1B/1,2,3	TBCIH4C
PDIAH1A/1,2,3, PDIAH1B/1,2,3	TICIH1A
PDIAH1A/1,2,3, PDIAH1B/1,2,3	TICIH2A
PDIAH1A/1, PDIAH1B/1	STCIH1A
PDIAH1A/1, PDIAH1B/1	STCIH2A
PDIAH1A/1, PDIAH1B/1	STCIH4A
PDIAH1A/1, PDIAH1B/1	STCIH6A
PDIAH1A/1, PDIAH1B/1	STCIH8A
PDIIH1A/1, PDIIH1B/1	SDIIH1A, WDIIH1A, WDIIH2A, WDIIH3A, SDIIH2A
PDIOH1A/1, PDIOH1B/1	TDBSH2A
PDIOH1A/1, PDIOH1B/1	TDBSH4A
PDIOH1A/1, PDIOH1B/1	TDBSH6A

I/O Pack/Quantity per Board	Board
PDIOH1A/3, PDIOH1B/3	TDBTH2A
PDIOH1A/3, PDIOH1B/3	TDBTH4A
PDIOH1A/1, PDIOH1B/1	TDBSH6A
PDIOH1A/3, PDIOH1B/3	TDBTH2A
PDIOH1A/3, PDIOH1B/3	TDBTH4A
PDIOH1A/3, PDIOH1B/3	TDBTH6A
PDIOH1B	TDBTH8A, TDBSH8A
PDOAH1A/1,3, PDOAH1B/1,3	TRLYH1B
PDOAH1A/1,3, PDOAH1B/1,3	TRLYH1C
PDOAH1A/1,3, PDOAH1B/1,3	TRLYH2C
PDOAH1A/1,3, PDOAH1B/1,3	TRLYH1D
PDOAH1A/1, PDOAH1B/1	SRLYH1A
PDOAH1A/1, PDOAH1B/1	SRLYH2A
PDOAH1A/1,3, PDOAH1B/1,3	TRLYH1E
PDOAH1A/1,3, PDOAH1B/1,3	TRLYH2E
PDOAH1A/1,3, PDOAH1B/1,3	TRLYH3E
PDOAH1A/3, PDOAH1B/3	TRLYH1F
PDOAH1A/3, PDOAH1B/3	TRLYH2F
IS420ESWAH1A, IS420ESWAH2A, IS420ESWAH3A, IS420ESWAH4A, IS420ESWAH5A	n/a
IS420ESWBH1A, IS420ESWBH2A, IS420ESWBH3A, IS420ESWBH4A, IS420ESWBH5A	n/a
Option Boards	
	WROBH1A, WROFH1A, WROGH1A, WPDFH1A, WPDFH2A
General Purpose, Analogue I/O types	
PAICH1A/1,3, PAICH1B/1,3	TBAIH1C
PAICH2A/1,3, PAICH2B/1,3	TBAIH1C
PAICH1A/1, PAICH1B/1	STAIH1A
PAICH2A/1, PAICH2B/1	STAIH1A
PAICH1A/1, PAICH1B/1	STAIH2A
PAICH2A/1, PAICH2B/1	STAIH2A
PAICH1A/1, PAICH1B/1	SAIIH1A
PAICH2A/1, PAICH2B/1	SAIIH1A
PAICH1A/1, PAICH1B/1	SAIIH2A
PAICH2A/1, PAICH2B/1	SAIIH2A
PAOCH1A/1,2, PAOCH1B/1,2	TBAOH1C
PAOCH1A/1, PAOCH1B/1	STAOH1A
PAOCH1A/1, PAOCH1B/1	STAOH2A
PHRAH1A/1, PHRAH1B/1	SHRAH1A
PHRAH1A/1, PHRAH1B/1	SHRAH2A
PPDAH1A/1, PPDAH1B/1	JPDS, JPDM, JPDG, JPDC, JPDL, JPDHG1A, JPDDG3A
PTCCH1A/1,2,3, PTCCH1B/1,2,3	TBTCH1B
PTCCH2A/1,2,3, PTCCH2B/1,2,3	TBTCH1B
PTCCH1A/1,2, PTCCH1B/1,2	TBTCH1C
PTCCH2A/1,2, PTCCH2B/1,2	TBTCH1C
PTCCH1A/1, PTCCH1B/1	STTCH1A

I/O Pack/Quantity per Board	Board
PTCCH2A/1 PTCCH2B/1	STTCH1A
PTCCH1A/1, PTCCH1B/1	STTCH2A
PTCCH2A/1 PTCCH2B/1	STTCH2A
PRTDH1A/1,2, PRTDH1B/1,2	TRTDH1D
PRTDH1A/1,2, PRTDH1B/1,2	TRTDH2D
PUAAH1A/1	SUAAH1A
Fieldbus, Fieldbus I/O	
PSCHHIA/1,2	SSCAH1A, SSCAH2A
PRTDH1A/1, PRTDH1B/1	SRTDH1A
PRTDH1A/1, PRTDH1B/1	SRTDH2A
PSCAH1A/1, PSCAH1B/1	SSCAH1A
PSCAH1A/1, PSCAH1B/1	SSCAH2A
PCNOH1A/1, PCNOH1B/1	SPIDG1A
PPRFH1A/1, PPRFH1B/1	SPIDG1A
PPNGH1A	n/a
PFFAH1A/1	n/a
PHRAH1A/1, PHRAH1B/1	SHRAH1A
PHRAH1A/1, PHRAH1B/1	SHRAH2A
Turbine Application, Turbine Specific I/O	
PAMCH1A/1,2	SAMBH1A
PAMCH1B	SAMBH2A
PCLAH1A/1, /3, PCLAH1B/1, /3	SCLSH2A, SCLTH2A, SCLTH2A
PCAAH1A/1, /3, PCAAH1B/1, /3	TCASH2A, TCATH2A
PEFVH1A/1,2,3	TEFVH1A
PGENH1A/1,3	TGNAH1A
PVIBH1A/1,3	TVBAH1A, TVBAH2A
PVIBH1B/1,3	TVBAH1A, TVBAH2A
PSVOH1A/1,3	TSVCH1A, TSVCH2A
PSOVH1B/1,3	TSVCH1A, TSVCH2A
PSVPH1A/1	SSVPH1A, SSVPH2A
PTURH1B/1,3, /1, /3	TTURH#C, STURH#A, TRPAH#A
PTURH1A/1,3, /1, /3	TTURH#C, STURH#A, TRPAH#A
PPRAS1B/3, PPRAS1A/3	TREAS#A + WREAS1A, TREAS1B
PPRAH1A/3	TREAH#A + WREAH1A
PPROS1B/3	TPROS#C
PPROS1B/3, /1, /3,	TPROH#C, SPROH#A, TREAH#A, TREGS2B
PPROH1A/3, /1, /3	TPROH#C, SPROH#A, TREAH#A
Migration, Mark V & V LM and Mark VI, Migration to Mark VIe Control I/O	
PIOAH1A/1	n/a
PMVE/1,3	QTBA, TBQA, TBQB, TBQC, TBQF, TBQD, TBQG, CTBA, TBCA, TBCB
PMVD/1,3	DTBA, DTBB, DTBC, DTBD
PMVP/3	PTBAG1A, PTBAG2A
PIOAH1A/1	n/a
PCMI	VRID
Mark VIeS Functional Safety I/O Types	

I/O Pack/Quantity per Board	Board
YAICS1A/1,3,/1,/1/1 YAICS1B/1,3,/1,/1/1	TBAIS1C, STAIS1A, STAIS2A, STAIS4A
YDIAS1A/1, 2, 3, /1, 2, 3, /1, 2, 3/1, /1, /1, /1 YDIAS1B/1, 2, 3, /1, 2, 3, /1, 2, 3/1, /1, /1, /1	TBCIS1, TBCIS2, TBCIS3, STCIS1A, STCIS2A, STCIS4A, STCIS6A
YDOAS1A/1, 3	TRLYS1D,
YDOAS1A/1, 3, / 3, / 3, / 1, / 1	TRLYS1B, TRLYS1F, TRLYS2F, SRLYS1A, SRLYS2A
YHRAS1A/1	SHRAS1A SHRAS2A
YTCCS1A/1 , 2, /1 , 2, /1, /1	TBTCS1B, TBTCS1C, STTCS1A, STTCS2A
YVIBS1A/1,3 YVIBS1B/1,3	TVBAS1A TVBAS2A TVBAS2B
YPROS1A/ 3, /3, /3, /3, /3, /3, /1	TREAS1A, TREAS2A, TREAS3A, TREAS4A, TREGS1B, TREGS2B, SPROS1A
YTURS1A/3	TTURS1C, TRPAS1A, TRPAS2A, TRPGS1B, TRPGS2B
YDOAS1A/1,3 YDOAS1B/1,3	TRLYS1B
YDOAS1A/1,3 YDOAS1B/1,3	TRLYS1D
YDOAS1A/1,3 YDOAS1B/1,3	SRLYS1A
YDOAS1A/1 YDOAS1B/1	SRLYS2A
YDOAS1A/1 YDOAS1B/1	SRAS1A, SRSA3A
YDOAS1A/3 YDOAS1B/3	TRLYS1F
YDOAS1A/3 YDOAS1B/3	TRLYS2F
YSILS1B	SCSAS1B, TCSAS1B
YUAAS1B	SSUAS1A
Renewables, Renewables Energy I/O	
AEPAH1A	AEPAH1A, BPPB
AEPAH1C	AEPAH1A, BPPC
AEPCH1A	AEPCH1A, BPPB
AEPCH1B	AEPCH1B, BPPB
AEPCH1C	AEPCH1C, BPPB
AEPCH1D	AEPCH1A, BPPC, WEMDH4
AEPCH1E	AEPCH1B, BPPC, WEMDH5
AEPCH1F	AEPCH1C, BPPC
WEPAH1A	AEPAH1B, BPPB, WPCI
WEPAH1B	AEPAH1B, BPPC, WPCI
WEPAH2A	AEPAH1B, BPPB
WEPAH2B	AEPAH1B, BPPC
WETAH1A	WETAH1A, BPPB
WETAH1B	WETAH1A, BPPC
WCBMH1A	WCBMH1A
WEMAH1A	WEMA, BPPB

I/O Pack/Quantity per Board	Board
WEMAH1B	WEMA, BPPC
WEMAH2A	WEMA, BPPB
WEMAH2B	WEMA, BPPC
WECAH1A	MACC, BPPx, BPPB
SECAH1A	MACC, BPPx, BPPB

Table 2

Limitations

Item	Temperature
Controller IS220UCSAH1A	B
Controller IS420UCSBH1A	D
Controller IS420UCSBH3A	B
Controller IS420UCSBH4A	D
Controller IS420UCSEH2A	D
Controller IS420UCSEH2B	D
Controller IS420UCSEH2C	D
Controller IS420UCSCH2A	D
General Purpose, Discrete I/O types	D
General Purpose, Analogue I/O types	D
Fieldbus, Fieldbus I/O	D
Turbine Application, Turbine Specific I/O	D
Safety, Safety Controller I/O	D
Renewables, Renewables Energy I/O	D

Table 3

Note: Other part numbers or updated revisions may be acceptable under this Certificate provided that critical aspects of the design remain the same. Changes shall be documented and approved (via Engineering Change Notice or similar) by the Manufacturer's Engineering and/or Quality department as appropriate. The DNV local surveyor shall verify the change before issuance of Product Certificate.

Application/Limitation

The Type Approval covers hardware listed under Product description. When the hardware is used in applications to be classed by DNV, documentation for the actual application is to be submitted for approval by the manufacturer of the application system in each case.

Reference is made to,
DNV Rules for Classification of Ships Pt.4 Ch.9 Control and monitoring systems,
DNV Offshore Standard OS-D202 Control and monitoring systems.

Product certificate
If specified in the Rules, ref. Pt.4 Ch.9 Sec.1, the control and monitoring system and ref. OS-D202 Sec.1, the control and monitoring system, in which the above listed hardware is used shall be delivered with a product certificate. For each such delivery the certification test is to be performed at the manufacturer of the application system before the system is shipped to the yard. The test shall be done according to an approved test program. 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 for evaluation and approval.
Major changes in the software are to be approved before being installed in the computer.

Type Approval documentation

Tests carried out

Applicable tests according to Class Guideline DNV-CG-0339

Marking of product

The products to be marked with:

- manufacturer name
- model name
- serial number

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