***Guide form Specifications***

***GE Multilin 889 Generator Protection Relay***

# Generator Protection Relay

Protection, monitoring and metering shall be supplied in one integrated digital relay package for application to generators suitable for incorporation into an integrated station control system.

The Digital Relay shall have a common Hardware and Firmware platform that shall support Feeder, Motor, Transformer and Generator applications. The relay shall be equipped with the following protection monitoring, control, automation, and reporting functions. If supporting functions are not available within the relay suitable external devices shall be provided to meet the specification requirements.

## Protection and Control

### The relay shall provide the following protection functions.

#### Stator differential (87S) with enhanced security checks for CT saturation and current directionality

#### Overall (Generator + Generator step-up) Differential (87O) with enhanced security checks for CT saturation and current directionality

#### Stator and Overall differential shall operate concurrently.

#### 100% Stator Ground protection functions (59X/27TN and 64TN – 3rd harmonic voltage difference)

#### Directional Power (32)

#### Loss of Excitation (40)

#### Loss of Excitation using Reactive Power (40Q)

#### Over Excitation – Volts per Herz (24)

#### Inadvertent Generator Energization (50/27)

#### Generator Unbalance (46)

#### Stator Thermal Overload and RTD (49)

#### Synchrocheck (25)

#### Voltage Restrained Phase Overcurrent (51V) with adjustable voltage lower limit

#### Neutral Time Overcurrent (51N)

#### Ground or Sensitive Ground Time Overcurrent for ground (51G/51SG)

#### Phase Instantaneous Overcurrent (50P)

#### Neutral Instantaneous Overcurrent (50N)

#### Negative Sequence Instantaneous Overcurrent (50\_2)

#### Offline Overcurrent (50OFL)

#### Ground or Sensitive Ground Instantaneous Overcurrent (50G/50SG)

#### Neutral Directional Overcurrent (67N)

#### Ground or Sensitive Ground Directional Overcurrent (67G/67SG)

#### Phase Overvoltage and Phase Undervoltage (59P, 27P)

#### Neutral Overvoltage (59N)

#### Negative Sequence Overvoltage (59\_2)

#### Bearing Over Temperature (using dcmA Analog Input) (38)

#### Bearing Vibration (using dcmA Analog Input) (39)

#### Voltage Phase Reversal (47)

#### VT Fuse Failure Detection (60FL)

#### Breaker Failure Detection (50BF)

#### Trip Coil Supervision

#### Sequential Shutdown

#### Overfrequency and Underfrequency (81O/81U)

#### Frequency accumulation for turbine maintenance alarm (81A)

#### Restricted Ground Fault (RGF)

#### Generator Running Hours

#### Generator Status (Online/Offline/Tripped) Monitoring

#### Field Breaker Discrepancy

### The relay shall have 4 Programmable Flexcurves with graphical manipulation of the individual points.

### The Phase Time Overcurrent can be selected to operate either on RMS or Fundamental value.

### The relay shall have an ability to build trip and alarm matrices and directly assign a corresponding output relay without using programmable logic.

### The relay shall have a configurable option to select any protection elements to be used as a trip, alarm or latched alarm function without using programmable logic.

### The relay shall have 6 switchable setting groups for dynamic reconfiguration of the protection elements due to changed conditions.

### The relay shall support 8 Flex elements that can use any available/calculated analog parameters within the relay (e.g. comparator, inverter, over/under, etc.)

### The relay shall support up to 16 Digital Counters.

### It should be possible to test the Binary Inputs, Outputs and protection functions without the need for an external test kit.

### The relay shall be capable of measuring the generator speed

### The relay shall provide temperature or other parameter monitoring (using dcmA Analog Input).

## Programmable Logic

### The relays shall support 1024 lines of user defined logic to build control schemes supporting logic gates, timers, and nonvolatile latches.

### The programmable logic in the relay shall be executed 8 times per power system cycle.

### The relay configuration tool shall have an embedded graphical user interface to build programmable logic.

### The relay shall provide up to 96 Virtual Outputs + 64 Virtual Inputs.

### The relays shall support Logic designer and Logic Monitor – i.e. graphical logic editing tool and online monitoring of logic states in a graphical way.

## Communications/Integration

### The relay shall support the following communication protocols: Modbus RTU, Modbus TCP/IP, IEC 61850 GOOSE, IEC 61850 edition 2 MMS, HSR, DNP 3.0, IEC 60870-5-104, IEC 60870-5-103, and OPC-UA.

### The relay shall have the ability to configure both protection and IEC 61850 related settings directly from a single setting (IEC 61850-6 based XML format) file. There shall be direct uploading of single IEC 61850-6 based XML file into the relay. There shall be no further proprietary file format conversion required. All setting managements through a single IEC 61850-6 based file shall be supported.

### The relay shall support up to eight IEC61850 concurrent client connections.

### The relay shall support GOOSE Analog reception and transmission.

### The relay shall support up to 128 Virtual Outputs and Virtual Inputs over GOOSE

### The relay shall support file transfer protocol (TFTP) and file transfer through 61850.

### The relay shall support multiple time synchronization sources such as IRIG-B, IEEE 1588 and SNTP(2) with the ability to configure priority for the time sources and dynamically switch based on availability of each source.

### The relay shall provide two fiber optic Ethernet ports with two modes of operation – Fail over mode or Independent mode.

### The relay shall support networks for IEC62439/PRP (Parallel Redundancy Protocol).

### The relay shall have an option for Wi-Fi (IEEE 802.11 b/g/n) connectivity to configure settings and retrieve operational records.

### A front panel USB port shall provide connectivity to configure settings and retrieve operational records.

### The relay shall provide a User Definable Memory Map.

### The relay shall support Modbus connectivity to slave devices to gather data.

## Relay Configuration/Setting File Management

### Setting the entire relay from only a single setting file shall be supported.

### The entire relay settings (not only communication related but also protection & control functional settings) shall be part of the same single setting file.

### The relay shall be configured through the IEC 61850-6 standard based Configured IED Description (CID in XML) format file only.

### There shall be only a single relay setting (i.e. CID based XML format) file which can be directly uploaded into the device. This means there is no intermediate conversion of any proprietary setting file formats which requires managing multiple settings files for just one relay.

### The relay shall be able to receive single configuration/setting files from any third party tool (not only vendor specific proprietary relay configuration tool).

## Front-Panel Visualization

### User interfaces shall provide a large color LCD front panel display and navigation keys.

### The front panel shall have color LCDs to display up to 6 configurable Single Line Diagrams (SLD), 12 control objects, 15 status & 15 metering objects with a provision to control the breaker, online metering and status information.

### The front panel shall be capable of displaying measured values, calculated values, I/O status, device status, target messages, events, generator learned data and configured relay settings.

### The front panel shall have support for breaker and switch control through the single line diagram and pushbuttons with Select-Before-Operate mechanism.

### The front panel shall have user-programmable LEDs and pushbuttons.

### The relay shall provide up to 36 configurable annunciation indicators like an annunciator panel to monitor and reset alarms through the front panel.

### The relay shall provide configurable 20 soft pushbuttons that are controlled from the front panel of the relay.

### The relay shall provide 10 programmable home pages.

## Monitoring & Diagnostics

### The relay shall provide a Generator Health Report retrievable via the communication ports that provides a snapshot of the generator operating and diagnostic information. The Report shall include information pertaining to Device and Generator Status.

### The relay shall record its exposure to temperature, humidity and surge. In addition, a report shall be retrievable via the communication ports on the minimum/maximum average of those recorded values. The relay shall provide Environmental awareness statistics that trends temperature, humidity and surge pulses.

### The relay shall provide Breaker Health Monitoring features including Breaker close and breaker open times, Trip/Close circuit monitoring, Spring charging time, Per-phase arcing current, and Trip counters.

### The relay shall provide information on the power factor of the protected device.

###  The relay shall provide up to 64 digital channels and up to 16 analog channels of oscillography at a sampling rate of 128 samples per cycle.

### The relay shall provide Event Records - with a record of the last 1024 events, time tagged with a resolution of 1 ms.

### The relay shall store all its recorded data in non-volatile memory.

### The relay shall provide a separate data logger function which shall record a maximum of 16 Analog channels with a settable sampling rate of 1 cycle, 1 second, 30 seconds, 1 minute, 15 minutes, 30 minutes or 1 hour including a trigger source of sample, min, max, mean.

### The current metering accuracy shall be at +/- 0.25% of the reading for up to 2 times the rated secondary current and +/- 1% for above that.

### The voltage metering accuracy shall be at +/- 0.5% of the reading from 15 to 208V.

### The power metering accuracy shall be at +/- 1% of the reading.

### The frequency metering accuracy shall be typically at 1 millihertz accuracy level.

## Hardware

### The protection relay shall provide analog input systems that can reproduce up to 46 times CT rating RMS symmetrical. The relay shall execute protection related main algorithms at 8 times per power system cycle.

### The relay shall have conformal coated electronic board assemblies for harsh environment deployment.

### Microprocessor based protective relays shall employ IPC (Institute for Interconnecting and Packaging Electronic Circuits) Class 3 printed circuit boards (PCB) i.e. IPC Class 610-3.

### The relay shall have a draw-out construction to facilitate testing, maintenance and interchange flexibility.

### The relay shall provide a field swappable (i.e. removable) power supply module.

### The relay shall have a scan rate of 128 samples per power system cycle for digital inputs and provide less than 1 millisecond time stamp resolution for state changes.

### The relay shall provide a continuous operating temperature range of -40° to +60°C and be tested per IEC 60068 for 16-hour operation between -40° and +85°C.

### The relay shall support at a minimum 15 Digital Outputs and 21 Digital Inputs.

### The relay shall provide built-in Trip Coil and Close Coil supervision.

### The Digital Inputs should capable of accepting wet or dry input signals. In cases where an external wetting voltage is used, the Voltage Threshold shall be software selectable for 24V, 48V, 125V and 250V DC sources.

### The relay contacts should be rated for a minimum of 10A continuous.

### The relay shall support 7 dcmA outputs, 4 dcmA inputs.

### The relay shall support a total of 12 RTDs.

### The relay shall have integrated arc flash protection with support for up to 4 Arc flash sensors.

## Security

### The relay shall provide an option for RBAC (Role based access control) with three roles such as Observer for accessing operational data, Operator for start-stop of the generator, and Administrator for configuring the relay.

### The relay shall provide an option for password complexity.

### The relay shall provide option for local device level authentication and for remote server authentication using RADIUS.

### The relay shall provide optional support for SYSLOG to publish security related events.

### The relay shall support secure file transfer protocol (SFTP).

### Security Setting Reports must include the following events with time stamp.

#### Failed Authentication

#### User lock out

#### Setting changes

#### Login

#### Logout

#### RADIUS server unreachable

#### Clear Event/Transient/Fault records

### The relay shall provide SSH tunneling connection.

## Service And Support

### Warranty: The relay shall include a ten-year warranty for all material and workmanship defects.