***Guide form Specifications:***

***GE GRIDNODE: Network Interconnection Protection***

# **Network Interconnection solution**

Integral to the main controller shall be the powerful hardware and software along with the user-friendly HMI that allows for complex configurations of topology, parameters and logics. The controller shall have the ability to communicate with various IEDs over a wide area in the network that includes PMU’s, meters, switches, and protocol converters to realise the network interconnection solution that ranges from simple to complex systems.

It shall be possible to implement (**a**) Contingency action solution and (**b**) Oscillation detection solution within the same hardware.

It shall be possible to achieve following actions within the **Contingency solution** as a minimum requirement:

* Detect major changes in any of the connected networks (faults)
* Measure overload in Interconnect and potential voltage and frequency changes in connected network
* Shed Load to reduce load, voltage, and frequency balances on interconnect
* Drop Generation to reduce load, voltage and frequency balance on interconnect
* Trip the interconnect
* Balancing the two networks

**Additionally, Contingency solution shall have the following key Characteristics:**

* Ability to supports existing protection and metering devices and protocols
* Response time to act in less than 250ms (typical) with operating time as low as 50ms
* To support complex network topologies (i.e. mesh grids)
* Provide advanced notice of interconnection trip to operators
* The system shall have an HMI allowing for operator interactions

Similarly, within **Oscillation detection solution** following actions shall be achievable:

* Detect prolonged/growing interconnect oscillations
* Trigger network damping circuits such as Power System Stabilizers (PSS) to dampen oscillations
* Temporary Shed Load to dampen large oscillations
* Temporary Drop Generation to dampen large oscillations
* Trip the interconnect

Additionally, **Oscillation detection solution** shall have the following key Characteristics:

* Requires Phasor Measurement Units at key network locations
  + High resolution time aligned Synchrophasor data
* shall support complex network topologies (i.e. mesh grids)
* Provide advanced notice of interconnection trip to operators
* The system shall have an HMI allowing for operator interactions

**Hardware platform:**

1. The hardware platform shall be a single platform containing a Real Time operating system and a non-real time Operating System.
2. The following functions shall run on the non-real-time Operating System: configuration, Human Machine Interface.
3. The following shall run on the real time Operating System: device data concentrator and interconnection protection applications.
4. The platform shall have an embedded logic engine in the real time operating system to allow custom application development.
5. The platform shall have an embedded HMI running on non-real time operating system.
6. The Logic engine shall be configurable in a graphical user interface embedded on the hardware platform.
7. The platform shall natively support IEC-61850-Ed-2
8. The configuration must support IEC 61131-3

**The Viewer (Human Machine Interface)**

The Viewer shall provide a GUI for controlling and monitoring substation systems from a station-level computer. The Viewer shall include a series of screens where all substation components can be displayed.

**Viewer** features shall include the following capabilities:

* Multi-language support: All worldwide languages supported
* Navigation between screens with a single click
* Vectoral drawings allowing zoom and pan functionality
* Sequence of events (SOE) shall be available through a web server interface.
* Multiple screens displayed simultaneously, with an optional overview of all opening screens
* The ability to disable/enable communications to IEDs from the HMI client (useful during maintenance or testing operations).
* Scalability: Real Applications for 1 IED up to > 1000 (simultaneously connected to 1000 IED)
* Embedded HMI Solution: HMI can run connected with the gateway h/w or external computer
* Resolution: UHD compatibility
* Multi HMI: Shall have the capability to connect to 50 Workstations connecting to the H/w
* Multiwindow Popups
* Operating System supported: Win 7, Win 10, Windows Server.
* Zooming, Panning, Decluttering Number of Screens.
* Interlocking: (menu to define both the equation and the graphic interlocks without using the equations)
* User Management levels per functionality: up to 10 different user levels
* Unlimited number of user Configurable Rights per user
* Up to 5 Rights individually configured per user (Navigation, Operation, User admin, Program Exit, settings)
* Alarm Management includes: Unlimited Alarm Groups, 10 Alarm (Sound) Priority Groups, Alarms Filter, Remote Alarm Notification (SMS)
* Events Filter
* Template screens (For Multiple IEDs)
* Dual-Language configuration
* Analog Trending objects (visualization)
* Historian (events, measures)
* Historian data export tools. CSV and database files
* Remote Access (to access the HMI)
* Refresh time < 1sec
* Simulation tool to validate the database (can force any point in the database - to be viewed in HMI)
* Right-Click Menu

**Device data Concentrator:**

The device shall able to communicate with devices using multiple simultaneous protocols and distributes to different Interconnection applications.

**Concentrator** features shall include:

* IEC 61850 Ed.2 compliance
* IEC-61850 KEMA certification
* C37.118-1 synchrophasor data
* Must be able to communicate up to 1000 devices
* Data concentrator shall be able to send data to cloud applications
* KEMA Certified IEC 61850 GOOSE and R-Goose
* C37.118 Synchrophasor Protocol.
* PDC Application and Logics.
* 50 PMUs downstream / 1 PMU upstream.
* IEC 60870-5-101/104 Server/Client, KEMA Certified
* DNP3 Master/Slave RTU and TCP
* SNMP Client
* NTP client. With Redundancy
* Modbus RTU/TCP Master/Slave.
* IEC 6070-5-103 Master.
* SPA-Bus Master.
* OPC DA & AE Server/Client.
* OPC UA
* EGD Producer
* Avalanche performance. Tested with up to 700 events/sec for 48 hours.
* 7,000 events in less than 2 secs
* Redundancy. Hot-Hot; Hot-standby (Zero lost)
* Historic Data Retrieval. Events, Metering, oscillography.

**Logic development engine:**

The device shall have a logic development engine, with a set of programing tools to develop complex substation level logic function.

* Logic development engine shall be able to utilize communication information retrieved by the data concentrator function.

**Hardware shall have the following physical port capabilities:**

* PRP
* HSR
* IEEEE 1588 (PTP)
* IRIG-B Ethernet
* SFP ports.
* Up to 8 Ethernet RJ45 Ports.

**CYBERSECURITY features shall include:**

* Encryption. Between gateway and HMI (TLS 1.2)
* Authentication. Between gateway and HMI
* User Management. Radius and LDAP / Pwd encrypted (hash HMACSHA256)
* Hardening
* Whitelisting
* FTPS service
* Database protected with encrypted pwd
* Database Signed and encrypted
* Achilles level 1 pass
* Operating System write protected

**Functional capability** of the Gateway controller shall include the following functions:

* Power threshold
* Thermal threshold
* Frequency, angular & voltage threshold
* Rate of change of frequency threshold