Electrical Monitoring and Control System Solution

Guideform Specification

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1.1 Overview

The Power Management and Control System (PMCS) is a fully customizable/configurable, user friendly, integrated solution for reliable and accurate energy management.

The system solution centralizes monitoring data, control, disturbance recording and data collection providing a virtual window into the system for analysis and reporting through an integrated network of metering and protection devices across a single or multiple facility locations.

Furthermore, along with the capability to integrate with existing systems and devices, it supports a multitude of advanced system energy management functions such as load shedding, energy cost allocation, motor control and power quality monitoring.

1.2 System Solution – Functional

Provide all components, software, and systems integration for a complete operational Power Management and Control System (PMCS) designed for the following functions:

1.2.1 Monitoring

1. Provide a platform to support the automated monitoring and maintenance of the facility. This includes functions useful to the operation and maintenance of major electrical systems in the facilities such as: UPS systems, batteries, generators, ATS, paralleling switchgear, distribution boards, PDU systems, video cameras, fire systems, and security systems.

2. The Power Management and Control System offering shall provide reliable, up-to-date monitoring information (such as voltage, current power, and energy and demand data) on the status of devices, systems, and processes to the system operator(s).

3. Shall provide a defined hierarchy of user interface views for the monitoring information from a site plan of the facility down to individual devices and controls.

4. Provide a user interface view of alarms and events and the ability to acknowledge the events.

5. The system shall be equipped with a standardized Human Machine Interface (HMI) / Supervisory Control and Data Acquisition (SCADA) software for displaying data from monitored devices.

The software will be capable of configuring and displaying the following customized graphic screens:

a. Site plan
b. Animated one-line diagrams for each switchgear lineup including breaker status
c. Device Screens with tabular data for monitored devices
d. Waveform Capture for supported devices
e. Alarms
f. Trends with four points per monitored device
g. Event log
h. Generator Control Panel (GCP) overview screen - One per GCP.
i. PLC tabular screen
j. UPS tabular data screen
k. PDU tabular data screen
l. Battery Monitor status screen
m. Device communication overview screen
n. Total harmonic distortion (THD) analysis screen
o. System Status/Health screen

6. Provide the ability to perform off site and/or remote monitoring (Web access and viewing).
7. The system shall provide a backup log of monitoring and control information of the system status for diagnostic and forensic purposes.
8. The ability to produce summary graphs of CBEMA charts and time plots shall be provided with the ability to jump to specific events of interest. The specific charts required include CBEMA, ITIC, Sag Frequency Distribution, Harmonic Distribution, and time plots for each parameter measurement by the monitor to include energy, demand, PF, VARS, VA, THD, W, and unbalance.
9. The charting and graphing software shall not be device dependent. It shall be able to provide charting and graphing of all available power monitors available today as well as those that will be introduced in the future. It shall also be capable of plotting and charting non-power monitor kinds of data to include analog type data (temperature, flow, etc., as well as binary information (breaker open closed data).
10. For each cycle of waveform data displayed, the software will compute and display simultaneously power parameters to include W, VA, VARS, THD, any single harmonic, V or A unbalance, VRMS, ARMS, and Power Factor (PF).
11. Software shall be provided with graphical interface to view the archived data, both tabular and waveforms. Multiple waveform events representing a continuous waveform should be appended and displayed as a single multi-cycle waveform event.
12. The software required to enable the web capability will be provided by the supplier and have the following features:
   a. Graphics including Adobe Flash components as agreed by Customer.
   b. Database driven security levels allowing access to web reports and data.
   c. Ability to determine overall availability of reports and particular reports available reports to specific users.
   d. Links as determined by Customer
13. Report the status inputs and outputs, transformer temperature monitor relays (fan, alarm, and emergency shutdown relays), electronic trip unit status, status I/O associated with programmable logic controllers, etc.
14. Software shall contain interactive color-graphics as follows:
   a. One-Line electrical distribution drawing as shown on contract documents.
   b. Accurate graphical representation of each monitored device.
   c. Define and view trends for any of the parameters available via the metering devices on the network.
   d. Alarms sorted by date, time, device type or type of alarm.
   e. View captured and recorded waveforms.
   f. Provide capabilities for Annunciator panel creation.
   g. Custom screens and reports.
   h. Diagnostic system analysis reports.
1.2.2 Power Quality

1. Remotely capture and present data (such as individual/total harmonic distortion, sub-cycle transients) to benchmark power quality levels at each facility and/or for the total organization.
2. Inclusion of harmonic information in the graphic waveform displays for power quality meters including total harmonic distortion (THD), RMS magnitudes, peak values, crest factors (CF), magnitudes of the individual harmonics, telephone interference factor (TIF), etc.
3. Capability to plot and apply fast Fourier analysis to AC voltage and current waveforms, captured by network devices, for accurate viewing of harmonic content up to the 128th order;
4. Provide continuous performance information to Account Managers for evaluation of customer power quality concerns.
5. Perform automatic power analysis and report generation for power quality events.
6. Provide immediate trending analysis when a power quality event occurs that can be used to correct equipment failures in-house or correlate an internal failure with a utility event.
7. Shall have the ability to perform event triggered waveform recording
8. Provide a single database for storing all disturbance monitoring and recording data that is needed for power quality, reliability, and fault analysis.
9. Provide power quality data to evaluate performance of power conditioning equipment. Show compliance with specification to include transfer times, voltage regulation, and harmonic output.
10. Provide reports of power quality performance that can be used to prioritize system maintenance and capital expenditure plans.
11. Perform automated power quality audits and produce reports to pinpoint fault causes and possible preventive measures.
12. Identifies internal power quality problems before catastrophic failure. An example is predicting the failure of a UPS based upon its output harmonics and unbalance.

1.2.3 Cost Allocation and Reporting

1. Capability to aggregate inputs from 1 or more devices or aggregations.
2. Allow for aggregation of numerous sites at common location.
3. Provide the ability to scale the inputs or aggregations.
4. Allocation of utility costs per building, floor, shift, production line, process step or department.
5. Capability to determine when and by whom peak demands are set.
6. Capability to determine to determine energy use by individual tenants or departments.
7. Ability to record energy use by individual tenants or departments and determine energy savings.
8. Support creation of virtual meters to aggregate one or more physical meters and the definition of cost centers.
9. Generation of reports and bills in a customizable format with support for summary charts/graphs to present collected data in a visual format.
10. Provide support to configure, implement and execute rate structures such as Time of Use, Seasonal, etc.
11. Provide information/reporting service that can be offered to customers for evaluation of the system performance and the impact of power quality variations on their equipment.
12. Allow for the import or generation of real-time pricing structures.
13. Management of up to 50 different rate structures at the same time.
14. Standardized reports to simplify routine printouts of various data formats. Reports shall contain information as described within this specification.
15. Use of an SQL database to store data.
16. Use Comma Separated Value (.CSV) format to store data in the database.
17. Web-based solution capable of standalone operation from the Power Management and Control System (PMCS).

1.2.4 Control and Automation
1. Provide access to individual field devices within the facility or at a remote location, using specific device protocols to retrieve device information or perform control.
2. Provide control of system elements such as generators, utility feeds and power distribution network.
3. Provide ability to configure, implement and execute automatic schemes such as load shed, power feed transfer and staged equipment/process startup.

1.2.5 Analysis
1. Provide the ability to perform analysis of retrieved data from devices such as UPS, motors/turbines for predictive maintenance, energy analysis and cost analysis.

1.2.6 Integration of Devices
1. Shall have the ability to integrate, communicate and present information retrieved from both GE and Third-party devices.
2. The PMCS system shall communicate power system values and data via Modbus RTU connectivity, dry contacts, analog 4-20 ma signals, or a combination of each of the following devices:
   a. Automatic Transfer Switches (ATS)
   b. Automatic Static Transfer Switches (ASTS)
   c. Batteries
   d. Generators
   e. Generator Paralleling Switchgear
   f. Distribution Boards
   g. Load Bank
   h. Main Switchboards
   i. Panel Boards
   j. Power Distribution Units
   k. Primary Service Switchboards
   l. Uninterruptible Power Supplies (UPS)
   m. Trip Units
n. Meters/Relays

(Note: See product sections for specifications of these devices. See drawings for quantities and locations)

3. The system will collect all data recorded by the system field devices. This will involve retrieving data from the various stored logs to include historical or trend logs, power quality logs and waveform logs. Each meter location shall have its own data collection frequency. The power quality meter and data collection configuration information shall be stored in a relational database. Error checking will be used to verify data integrity. All data will be stored in a comma separated value (.csv) file format on the device.

4. The communications network shall consist of a combination of RS-485 Modbus RTU and Ethernet TCP/IP technology as indicated on the contract drawings. If another protocol is required, the vendor shall indicate the proprietary protocol and provide the equipment with gateway devices and/or drivers necessary to convert to Modbus RTU. Under no circumstances shall a proprietary protocol be accepted.

5. If LAN based communications are not available, the equipment vendor will make the appropriate data available via dry contact discrete signals and 4-20 ma analog signals. The PMCS supplier will provide the necessary Input/Output devices to integrate those signals into the PMCS.

6. The communications layer shall be designed to collect data over many networking technologies including modem, Ethernet, etc. The communications software shall support both solicited and unsolicited data input from field devices. Software for identifying and adding new monitors to the system shall be included.

7. The PMCS Ethernet network should allow the owner the capability to program and troubleshoot PLC’s and other IED devices over the network.

8. Ethernet switches shall be managed, industrial hardened switches using the appropriate cable to handle bandwidth and speed in the case of copper and for fiber optics.

9. The data collection software will be a multi-threaded application to allow for the simultaneous collection of data from multiple monitors.

10. Ability to interface with an enterprise level network for communications to other systems/devices.

1.2.7 Time Synchronization

1. The system shall be IRIG-B time synchronization capable.

2. The system data collection layer shall use a GMT standard to account for time zones and time changes.

3. The collected data will use the time stamp of the monitor itself and will not be adjusted by the System.

4. The system will support the ability to incorporate devices that can be time synchronized by the PC clock or an IRIG-B signal.

5. The System shall be capable of synchronizing the monitor clocks with a degree of accuracy dependent upon the communications topography using Internet based time synchronization services.
1.2.8 Alarm and Event Management

1. The system shall gather and locally store historical operation/fault, events with original IED time stamping preserved. Options can be configured to logically combine events, to eliminate duplicate events, or to display the events grouped by either time/day/month/year or by device.

2. The system shall retrieve and locally store facility fault records and waveforms generated during the abnormal operation of facility devices.

3. The system shall provide a high-level of flexibility for alarm configuration and notification configuration when a user-defined event has occurred. For each monitor site, the ability shall be provided to select an “event parameter” a high and low limit, and an “action”. The Bidder shall provide details of the proposed system’s capabilities or make recommendations of the options available to provide this capability.

4. The system shall accommodate a customizable text message defined by the user to describe the alarm condition and the monitor.

5. Upon alarm, one or more designated people will be paged and/or emailed with the text message. The system should accommodate numeric and alphanumeric pagers.

6. All alarms and associated alarm information will be recorded in an alarm log. All software required to perform notification functions must be included.

7. The system shall also provide for automatic report generation triggered by an alarm condition. All reports generated by the system shall be available to be triggered by an alarm condition.

8. The system shall provide a separate event viewer and log, allowing the user to sort the events by time stamps, event type, etc.

9. The event log file shall be capable of holding at least 1,000 events capturing the date/time of the event, and a descriptive event text.

1.2.9 Configuration

1. The PMCS software will have separate distinct modules for Development software package (for configuration such that the owner is licensed to modify the software in the event of future expansion or equipment modifications) and a Runtime only package (for use by the end user during operation).

1.2.10 Access

1. The PMCS system shall be web enabled with the ability to specify and administer security/user access roles and permissions. For example, roles can be setup so that Business Users and Engineers can view reports generated by the system and only Engineers can have full access to the monitor data.

2. Capability for remote diagnostics and troubleshooting using the Internet, and appropriate communications software.

3. The System shall be capable of restricting access using roles and password protection.
1.2.11 System Health Monitor

1. The system shall have an integrated System Health Monitor to continuously monitor the functionality of the server and the software associated with the PMCS.

2. The computer health monitoring component shall continuously monitor the functioning of the computer as well as the related system software. In case of a problem, the software shall automatically generate alarm for predictive as well as diagnostic maintenance.

1.3 System Solution – Non-Functional

The system shall be designed for the following non-functional specifications:

1.3.1 Operating System Compatibility


1.3.2 Database


2. The database shall be an open architecture, ODBC compliant database for the storage of all measurement data.


4. Self-documenting, tagged structures shall not be acceptable.

5. The system software will include an API for the database.

6. The system will log PMCS data to a hard disk at user-specified intervals and provide exporting functions to allow usage of the logged data by other software products/applications.

7. The system will have the capability to export data to other Microsoft ® Windows applications via the OPC server, comma separated variable (.CSV) file format or COMTRADE file format.

1.3.3 Architecture

1. The PMCS shall be supplied with user-friendly application software running on a centralized application server. The PMCS application server shall serve as central control station by monitoring and displaying the configured devices in the PMCS system; recording events; indicating alarm conditions, and logging device data.

2. The PMCS shall be a true Client/Server architecture. The system shall be capable of viewing (monitoring) critical system parameters from a workstation other than the server PC. The system shall support two types of remote viewing. The first type shall be with an individual viewer software license located on a client PC. The second type shall be with a server based web viewer software license and a commercially available web browser on the client PC.

3. The Power Management and Control System (PMCS) offering must have open system architecture.

4. The architecture of the system is modular with separate components for configuration tools, HMI Engine, database, communications, and devices.
1.3.4 Redundancy
1. The system configuration shall be capable of offering redundancy at all HMI, Networking and Device levels.
2. The system shall be capable of providing a multitude of redundancy implementations without the loss of data. Examples include hot-hot, hot standby redundancy.

1.3.5 On-line help
1. Systems shall be capable of providing context sensitive on-line help.

1.4 System Operating Requirements
1. The PMCS system shall have a minimum of one Microsoft Windows based Host Computer / Server Computer / Mission Critical Computer. All computers supplied shall be complete with required Operating System, Application Software and license(s) as specified. The computers shall be pre-configured with all software and configuration files by the vendor and ready to connect and operate when delivered to the job site.
2. The Host Computer / Server Computer / Mission Critical Computer shall serve as central control station by monitoring the devices in the system, recording events, indicating alarm conditions, and displaying and logging device data.
3. The Host Computer / Server Computer / Mission Critical Computer shall have the following system requirements:

<table>
<thead>
<tr>
<th>Component</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported Operating systems</td>
<td>• Windows 7 -32 bit</td>
</tr>
<tr>
<td></td>
<td>• Windows Server 2008 SP2 – 32 bit</td>
</tr>
<tr>
<td>Computer and processor</td>
<td>Minimum:</td>
</tr>
<tr>
<td></td>
<td>• Pentium® IV 3 GHz processor or higher</td>
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<tr>
<td></td>
<td>• CD-ROM drive</td>
</tr>
<tr>
<td></td>
<td>• Mouse (minimum two buttons)</td>
</tr>
<tr>
<td></td>
<td>• Keyboard</td>
</tr>
<tr>
<td></td>
<td>• Speakers (to support audible alarms)</td>
</tr>
<tr>
<td></td>
<td><strong>Recommended (Server):</strong></td>
</tr>
<tr>
<td></td>
<td>• Single processor: AMD Opteron™ 4122, 4C 2.2GHz, 3M L2/6M L3,</td>
</tr>
<tr>
<td></td>
<td>1333Mhz Max Memory</td>
</tr>
<tr>
<td></td>
<td>• Additional processor: AMD Opteron™ 4122, 4C 2.2GHz, 3M L2/6M L3, 1333Mhz</td>
</tr>
<tr>
<td></td>
<td>Max Memory</td>
</tr>
<tr>
<td></td>
<td>• 8GB Memory (8x1GB),1333MHz Single Ranked UDIMM for 2 Procs, Sparing</td>
</tr>
<tr>
<td></td>
<td>• 500GB 7.2K RPM SATA 3.5&quot; Hot Plug Hard Drive</td>
</tr>
<tr>
<td></td>
<td>• RAID 1 for PERC H200 and H700 Controllers, x8 Chassis</td>
</tr>
<tr>
<td></td>
<td>• PERC H200 Integrated RAID Controller, 8HD</td>
</tr>
<tr>
<td></td>
<td>• 750 Watt Redundant Power Supply</td>
</tr>
<tr>
<td></td>
<td>• 2x NEMA 5-15P to C13 Wall Plug, 12S Volt, 15 AMP, 10 Feet (3m),</td>
</tr>
<tr>
<td></td>
<td>Power Cord</td>
</tr>
</tbody>
</table>
4. The Viewer Computer (optional) shall have the following system requirements:

<table>
<thead>
<tr>
<th>Component</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported Operating systems</td>
<td>• Windows 7 - 32 bit</td>
</tr>
<tr>
<td></td>
<td>• Windows Server 2008 SP2 – 32 bit</td>
</tr>
<tr>
<td></td>
<td>• Windows XP Professional</td>
</tr>
<tr>
<td></td>
<td>• Windows Server 2003</td>
</tr>
<tr>
<td>Computer and processor</td>
<td>Minimum:</td>
</tr>
<tr>
<td></td>
<td>• Pentium® IV 1 GHz processor or higher</td>
</tr>
<tr>
<td></td>
<td>• 24X CD-ROM drive</td>
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<tr>
<td></td>
<td>• Mouse (minimum two buttons)</td>
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<td></td>
<td>• Keyboard</td>
</tr>
<tr>
<td></td>
<td>• Speakers (to support audible alarms)</td>
</tr>
<tr>
<td>Memory</td>
<td>512MB of RAM (minimum), 2GB (recommended)</td>
</tr>
<tr>
<td>Hard disk</td>
<td>Minimum 1GB of free hard disk space for installation (additional space required for project configuration).</td>
</tr>
<tr>
<td>Display</td>
<td>Minimum 17” monitor, minimum resolution 1280 x 1024, minimum 16-bit color</td>
</tr>
<tr>
<td>Connectivity</td>
<td>Ethernet - Intel PRO 1000PT dual port server adapter</td>
</tr>
</tbody>
</table>
D. Printer:
   1. Network capable laser printer
   2. USB port line printer for alarms

2  DEVICES
<< Include guideform specs for system devices here>>