



Water Wastewater Distribution and Collection System

Featuring advanced GE Fanuc Technology

Guide Form Specification

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1 Overview

1.1 Purpose

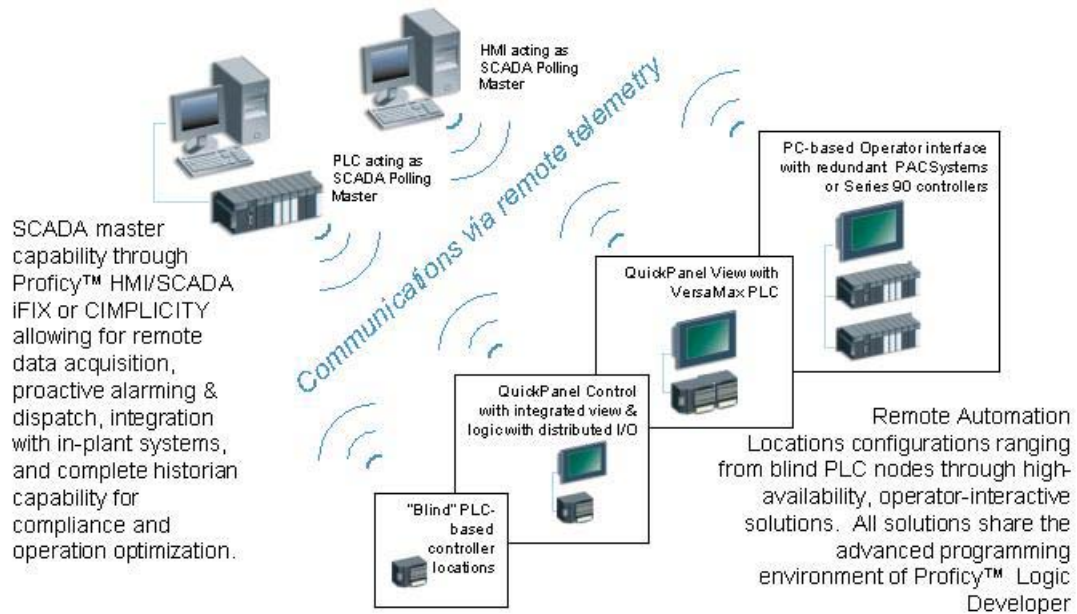
This document describes an overall automation and control architecture to support the functional aspects of a water collection or water distribution system. These descriptions are to be used in the design and implementation of a system that will support the day-to-day operations of the water processing. The system will also facilitate the collection of the necessary data to support continuous improvement of the operations and provide the proper level of data archiving to support all EPA or other compliance reporting requirements.

1.2 Architectural Overview

1.2.1 Architectural Drawing – the following diagram provides a functional overview of the desired system capability. This is a generalized architecture that might be applied to the delivery of potable water to the consumption points or the collection of wastewater and movement of that water to a water treatment facility. These two respective applications share the common requirement of extended geography that includes a number of remote pumping locations that may not be accessible through hard-wired or continuous connection.

1.2.2 The technology used to facilitate this capability is intended to be off-the-shelf automation products that could also be used in in-plant processing applications. This will minimize total cost of ownership and assure maximum interoperability.

Water Wastewater architecture for water collection / distribution



1.3 Central Site / SCADA Master

- 1.3.1 The SCADA Master site acts as the aggregation point for all system data and allows for a single view into the runtime operation of the system.
- 1.3.2 The SCADA Master will support a centralized network of visualization screens that allow for system operational overviews. It will also be possible to “drill in” to areas to obtain detailed information for specific remote locations.
- 1.3.3 The SCADA Master location will act as the single source for runtime alarming, the ability to respond to those alarms, and the impetus for dispatching solutions to these alarms.
- 1.3.4 The SCADA Master will act as the collector of process values and alarm conditions for historical reference.
- 1.3.5 There are a number of possible configurations for this function. Specific system characteristics of any actual application will drive the configuration selected for each installation. Even though it is typical for any particular installation to implement a singular orientation, there are very real benefits in terms of system growth and adaptability to technology that can be applied in various orientations.

1.4 Remote Automation Location (RAL)

- 1.4.1 A Remote Automation Location (RAL) is any critical point in the water collection or distribution system that requires local support of monitoring or control functions. RAL’s will be capable of running autonomously as stand-alone automation but may be networked into a larger system.
- 1.4.2 The RAL functionality will always include a monitoring function that captures real –time values from instrumentation.
- 1.4.3 RAL may also include the ability of the local controller to buffer values of process variables for local review and/or passage to the SCADA master.
- 1.4.4 RAL may include user interface capability to allow for local view of current values and if available buffered data.
- 1.4.5 RAL may include control capability that includes logic to perform setpoints based on changing input parameters.
- 1.4.6 RAL may include the capability to allow run-time access to current values and alarm conditions by the SCADA Master. The RAL may also be required to initiate communication to the SCADA Master to annunciate alarm conditions or deliver data uploads.
- 1.4.7 There are a number of possible configurations for this function. Specific system characteristics of any actual application will drive the configuration selected for each installation. Even though it is typical for any particular installation to implement a singular orientation, there are very real benefits in terms of system growth and adaptability to technology that can be applied in various orientations.

1.5 Remote Telemetry Communications

- 1.5.1 The connectivity between RAL and SCADA Master can be based on a wide variety of telemetry technologies. The technology selected for any particular application is based on a wide range of parameters unique to that application. This may range from physical topology of the geography through cost of connection.

2 Central Site / SCADA Master

These solutions can be customized to the particular needs of each individual implementation. Much of the following sections contain the definition of a number of scenarios for certain portions of the application. These scenarios are clearly labeled with a “SCENARIO XXX” designation. In most cases one scenario will be implemented exclusively at any particular location. However, these scenarios may not be mutually exclusive. There are very real benefits in terms of system growth and adaptability to technology that can be applied in various orientations.

2.1 SCADA Master Hardware Options

- 2.1.1 The hardware that makes up the SCADA Master system shall be categorized as Commercially Off The Shelf (COTS) hardware that is utilized across multiple industries. This will ensure that the hardware has longevity in terms of available spare parts and a clear migration plan as technology evolves.
- 2.1.2 The location of the SCADA Master site will be generally considered a light industrial environment. This environment will typically be air-conditioned and not subject to wide ranges of temperature or other environment variability. The environment is slightly harsher than office environment due in part to the systems need to support maintenance users. The hardware should be in a controlled area with access limited to a very limited set of authorized users and not in a location where power could be inadvertently interrupted or accidentally cycled. Any special needs of the designated hardware should be identified prior to purchase to allow for accommodation of these requirements.
- 2.1.3 The very nature of these solutions requires a very-high level of availability of the SCADA Master. It is expected that the system will be supplemented with UPS technology to allow for extended operating even upon temporary interruption of power. The overall system should have access to backup generation power for extended power outages.
- 2.1.4 All PC hardware shall be modern computing hardware utilizing standard Microsoft-based operating systems. The pace of recent technology advancements almost certainly assures any designation of computer specifications at the time of design will be outdated by the time of implementation. All computer specifications such as memory and storage space must be submitted and approved prior to purchase. Computers will be from a major supplier and include hardware maintenance and service agreements.
- 2.1.5 The SCADA Master Servers should be designed to provide for high availability and minimize the impact of any single point of failure. This may be accomplished by selecting servers specifically designed for with hardware resilience such as those from Stratus Technologies or similar vendors. Alternatively, standard PC’s from mainstream vendors such as Dell, HP and others can be used with a layer of application redundancy in the inherent SCADA Master software. It is required that all high-availability schemes be done through standard product offerings of the hardware or software vendors. Solutions based on application code written specifically for this application are unacceptable. All proposed implementations to meet the high availability requirements of the hardware must be submitted to the owner and approved prior to the purchase of any computing hardware.
- 2.1.6 SCENARIO ONE – Use of PC’s as Polling Hardware
 - 2.1.6.1 The SCADA Master polling hardware shall be a set of standard computers utilizing standard Microsoft operating systems.

- 2.1.6.2 These computers will interact directly with the telemetry system to accomplish all polling requirements and/or receive unsolicited messages from the RAL's. The PC's will be adequately configured with the appropriate hardware ports and software layers necessary to support the communications.
- 2.1.6.3 The PC's utilized in the RAL communication may be the same computers as the overall visualization and user support PC's or they may be dedicated data collection servers. A final functional architecture must be submitted and approved by owner prior to hardware purchase or application development.
- 2.1.7 SCENARIO TWO – User of PLC's/PAC's as Polling Hardware
 - 2.1.7.1 The SCADA Master polling hardware shall be a combination of both PC and PLC/PAC technology. (Programmable Logic Controller/Programmable Automation Controller)
 - 2.1.7.2 The polling of the remote sites shall be accomplished within the framework of the PLC/PAC CPU and additional communication cards/ports in the PLC/PAC rack.
 - 2.1.7.3 The PLC/PAC will handle the direct communication to the RAL's and interact with the selected telemetry system.
 - 2.1.7.4 It is required that all high-availability PLC/PAC schemes be done through standard product offerings of the hardware or software vendors. Solutions based on application code written specifically for this application are unacceptable.
 - 2.1.7.5 Aggregated process data and alarm conditions will be passed from the PAC's to the PC's through standard protocols and HMI/SCADA techniques.
 - 2.1.7.6 The PC's will then support the visualization needs and user support of the system. A final functional architecture must be submitted and approved by owner prior to hardware purchase or application development.

2.2 Polling Requirements

- 2.2.1 The SCADA Master will be sized appropriately to support XXX RAL's in the system. The SCADA Master should also include sufficient capacity for a 25% increase in the quantity of RAL's without the need for additional hardware or software purchases.
- 2.2.2 The SCADA Master system must be easily expandable to double the number of RAL's. This expansion should be possible within the context of the initial system with the simple addition of hardware and possible software licenses. This expansion should be possible without significant reconfiguration of the base system or interruption of operations of the existing system. The expandability plan must be submitted to and approved by the owner as part of the initial submission prior to the purchase of any hardware or software.
- 2.2.3 The SCADA Master should have a systemic method of identifying non-responsive RAL's. This method will include a configurable number of retries in terms of communication verification. The system will also include a configurable time period that is considered to be suspect in terms of non-communication. Any suspect communication loss will be annunciated through standard alarming.
- 2.2.4 Polling scenarios should utilize industry standard protocols to allow for inclusion of existing technology and the incorporation of other standard-compliant technology. It may be possible that multiple protocols could be utilized in the same overall system to include a number of different types of RAL hardware.

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- 2.2.5 The SCADA Master will have the responsibility of calibrating the internal clock of the RAL's. The SCADA Master will on regularly scheduled intervals set/reset the clock of the RAL over the telemetry connection. The RAL clock differentiation must never vary more than 1 minute per month from the clock at the Master SCADA computer. This will assure that time-stamped data from the RAL is with the time context of the overall system. The SCADA Master's clock will periodically be calibrated from standards sources.
- 2.2.6 The SCADA Master must be capable of simultaneously communication with XXX RAL's. The hardware and software architectures must be sized accordingly.
- 2.2.7 SCENARIO ONE: SCADA Master Round Robin Polling:
 - 2.2.7.1 The SCADA Master will have the responsibility of performing "round robin" polling of each individual RAL. The SCADA Master will connect to each RAL based on a predetermined polling schedule. The system will be sized to assure that each RAL is polled at least once every XXX minutes. This may require that the SCADA Master have a bank of ports and/or modems to meet this performance threshold.
 - 2.2.7.2 In addition to the polling sequence, it should be possible for a user to initiate a manual connection to any RAL. This will allow for the selection of a single RAL from a complete list for immediate connection. The connection will stay in place until the user chooses to disconnect from the RAL. This will allow for system investigation of potential problems and the quickest resolution of problems.
 - 2.2.7.3 Depending on the telemetry, the SCADA Master may have to first initiate a modem connection and then start polling the device. Under this scenario, the SCADA Master will poll the RAL for the current values of a preset number of process variables and discrete flags. The SCADA Master will compare these values to predetermine thresholds to determine if any of these values constitute an alarm condition. Certain values/parameters will have been pre-configured to be recorded in a historical log.
 - 2.2.7.4 The SCADA Master will stay connected to the polled RAL for a predetermined configurable period of time. Once this time has elapsed the SCADA Master will disconnect from the RAL and proceed to the next RAL in the polling sequence.
- 2.2.8 SCENARIO TWO: SCADA Master Round Robin Polling with RAL Report by Exception:
 - 2.2.8.1 The SCADA Master will have the responsibility of performing "round robin" polling of each individual RAL. The SCADA Master will connect to each RAL based on a predetermined polling schedule. The system will be sized to assure that each RAL is polled at least once every XXX minutes. This may require that the SCADA Master have a bank of ports and/or modems to meet this performance threshold.
 - 2.2.8.2 In addition to the polling sequence, it should be possible for a user to initiate a manual connection to any RAL. This will allow for the selection of a single RAL from a complete list for immediate connection. The connection will stay in place until the user chooses to disconnect from the RAL. This will allow for system investigation of potential problems and the quickest resolution of problems. This dynamic connection should also allow for user setpoints to initiate remote corrective actions.
 - 2.2.8.3 Depending on the telemetry, the SCADA Master may have to first initiate a modem connection and then start polling the device. Under this scenario, the SCADA Master will poll the RAL for the current values of a preset number of process variables and discrete flags. The SCADA Master will compare these values to predetermine

- thresholds to determine if any of these values constitute an alarm condition. Certain values/parameters will have been pre-configured to be recorded in a historical log.
- 2.2.8.4 The SCADA Master will stay connected to the polled RAL for a predetermined configurable period of time. Once this time has elapsed the SCADA Master will disconnect from the RAL and proceed to the next RAL in the polling sequence.
- 2.2.8.5 The RAL will be capable of initiating a message to the SCADA Master. This messaging scenario is referred to as Report by Exception. The RAL will be sending the message across the telemetry to the SCADA Master. This message will at minimum be sufficient to identify the reporting RAL and a coded reason for initiating the request. The format of this message will be dependent on the telemetry in use. It may be an XML message, a Modbus RTU command, or even e-mail. The SCADA Master must be prepared to accept these messages and take the configurable action. This action could either result in a simple alarm that indicated the request or it may automatically initiate a polling connection similar to that described in the manual connection above.
- 2.2.8.6 The SCADA Master architecture must be sufficient to allow for XXX simultaneous unsolicited RAL requests. In addition to the connection sequence, it should be possible for a user to initiate a manual connection to any RAL. This will allow for the selection of a single RAL from a complete list for immediate connection. The connection will stay in place until the user chooses to disconnect from the RAL. This will allow for system investigation of potential problems and the quickest resolution of problems. This dynamic connection should also allow for user setpoints to initiate remote corrective actions.
- 2.2.9 SCENARIO THREE: SCADA MASTER Collection of Historical Data and As-needed On-line Web Connection
- 2.2.9.1 The SCADA Master will have the responsibility of performing “round robin” connection to each individual RAL. The SCADA Master will connect to each RAL based on a predetermined schedule. The system will be sized to assure that each RAL is connected to at least once every XXX minutes. This may require that the SCADA Master have a bank of ports and/or modems to meet this performance threshold.
- 2.2.9.2 Depending on the telemetry, the SCADA Master may have to first initiate a modem connection and then connect to the RAL. Under this scenario, the SCADA Master will then upload a file of historical data from the RAL.
- 2.2.9.3 The format of the file will include at least two basic sections. One section will be time-stamped values that have been recorded and buffered at the RAL. The second section will be time-stamped event/alarm records.
- 2.2.9.4 The SCADA Master will process the files and compare these values to predetermine thresholds to determine if any of these values constitute an alarm condition. Appropriate alarm conditions will be created and routed through the standard alarm interface of the SCADA Master.
- 2.2.9.5 All of the file data will be then batch loaded into a SCADA Master historical data with the time-stamps created by the RAL.
- 2.2.9.6 The SCADA Master will stay connected to the connected RAL long enough to upload the files available from the RAL. The files being transferred from the RAL will be encoded in such a way to insure that duplicate records are not created in the historical data. The SCADA Master should receive records once and only once. In some scenarios, the SCADA Master will initiate a deletion or move of the file at the RAL after the copy is complete.

- 2.2.9.7 In addition to the connection sequence, it should be possible for a user to initiate a manual connection to any RAL. This will allow for the selection of a single RAL from a complete list for immediate connection. The connection will stay in place until the user chooses to disconnect from the RAL. This will allow for system investigation of potential problems and the quickest resolution of problems. This dynamic connection should also allow for user setpoints to initiate remote corrective actions.
- 2.2.9.8 This “live” connection to the RAL should be through a standard web browser utilizing the web publishing capability of the RAL.
- 2.2.9.9 The RAL will be capable of initiating a message to the SCADA Master. This messaging scenario is referred to as Report by Exception. The RAL will be sending the message across the telemetry to the SCADA Master. This message will at minimum be sufficient to identify the reporting RAL and a coded reason for initiating the request. The format of this message will be dependent on the telemetry in use. It may be an XML message, a Modbus RTU command, or even e-mail. The SCADA Master must be prepared to accept these messages and take the configurable action. This action could either result in a simple alarm that indicated the request or it may automatically initiate a connection similar to that described in the manual connection above.
- 2.2.9.10 The SCADA Master architecture must be sufficient to allow for XXX simultaneous unsolicited RAL requests. This will allow for system investigation of potential problems and the quickest resolution of problems.

2.3 Monitoring / Visualization

- 2.3.1 The SCADA Master must provide a robust visualization and presentation environment for real time values of system data. This section covers some basic capability but the complete specification of HMI/SCADA capability is covered in a separate document.
- 2.3.2 Visualization will include the creation of graphic screens and the simple association of data points or tags with animation features such as fill, rotates, move and color changes. The animated objects should dynamically change to reflect the current value of the associated parameters.
- 2.3.3 Visualization should also include the representation of values in text of various sizes and fonts. The textual values should dynamically change to reflect the current value of the associated parameters.
- 2.3.4 By definition the SCADA Master will actually be connected to only a small percentage of the total RAL’s at any one time. The Master SCADA visualization capability will have built in tools to allow for the presentation of last known values for those RAL’s that are not actively connected. It will be also made obvious to the user that the values are not the current active values. This can be accomplished by either a designated color for “stale” data and/or through the posting of a collected time-stamp in a prominent place on the screen.
- 2.3.5 The visualization system will allow for re-usable objects that can be associated with different variable sets in different screens or even multiple times in the same screen. These objects or templates will allow for the rapid creation of nearly identical screens to represent RAL’s that are nearly identical. Changes to the template will automatically ripple through all screens where the object is used without the need to open the individual screens.
- 2.3.6 Visualization will also include the ability to view trends of values across a time period. Trends will allow for view of multiple parameters across the same time period and allow the user to page backward and forward through the historically retained data.

- 2.3.7 Visualization will include integrated user security to the system. This security will require user id and password, both of which will be integrated with the Microsoft Operating System security.

2.4 Alarming / Routing

- 2.4.1 The SCADA Master must provide a robust set of alarming functionality and alarm routing. This section covers some basic capability but the complete specification of HMI/SCADA alarming capability is covered in a separate document.
- 2.4.2 The SCADA Master will report alarms based on predefined, configurable thresholds for the individual scalar values.
- 2.4.3 The SCADA Master will report alarms based on discrete flags that indicate the presence of conditions of interest by equating to a high value.
- 2.4.4 The SCADA Master will report alarms based on the status of failed or questionable communication with sections of the system and/or individual RAL's.
- 2.4.5 All alarms will progress through a standard life cycle from generation through reset and user acknowledgement.
- 2.4.6 Alarms will be selectively routed to individual users and/or groups of users based on configurable parameters.
- 2.4.7 Alarm screens will be available through the standard user interface and integrated with the overall visualization screens.
- 2.4.8 If an RAL has local visualization capability and has the ability to locally alarm, the Master SCADA system will be capable of integration with this alarming schema. Alarms and their respective status can be shared between RAL and Master SCADA when the systems are connected.
- 2.4.9 Optionally the Master SCADA system can utilize standard HMI capability to automatically route alarms to pagers and/or thin clients for connection to remote users.

2.5 Historical Collection

- 2.5.1 The SCADA Master must provide a robust set of data logging and historical retention. This section covers some basic capability but the complete specification of HMI/SCADA and historian capability is covered in a separate document.
- 2.5.2 Time-stamped, streamed values of process variables will be captured and stored automatically into a data schema that is specifically designed and constructed for this type of data. This will assure the highest possible performance in recording the values and retrieving the values for analysis.
- 2.5.3 Time-stamped alarm and event data will be captured and automatically stored automatically into a data schema that is specifically designed for the relational aspects of the various data fields. This will assure the highest possible performance in recording the values and retrieving the values for analysis.
- 2.5.4 The historical collection database will include the capture and storage of data setpoints and system changes.
- 2.5.5 The system will be sized to allow for data storage for XXX years on-line to allow for data evaluation over that time. Data older than this period will be systematically archived or moved to another server for off-line evaluation.

- 2.5.6 The data historian target must allow for the optional aggregation of data from external systems into the system.
- 2.5.7 The data historian must allow for evaluation using industry-standard access techniques such as OLE DB. This will allow for the ad hoc and systematic query of data for generation or reports or correlation evaluation.

2.6 Support of Web-Portal

- 2.6.1 The SCADA Master must be able to deliver real and historical values to real-time information web portals. This data should be delivered via a standard interface to the runtime system and the historian values. This section covers some basic capability but the complete specification of Real-time Information Portal capability is covered in a separate document.
- 2.6.2 It is preferred that the web-portal enabling software be supplied from the same vendor as the HMI/SCADA software.
- 2.6.3 The web portal software should allow for integration of data from systems external to the SCADA Master system as well. This will allow for customized views of the complete data set that is required by users to make the best operational decisions in support of the water system.
- 2.6.4 All setpoint and parameter changes performed via the web portal must be logged into the same data historian as those performed through the standard HMI/SCADA screens. This will ensure a complete historical record of all user transactions in the system.

3 Remote Automation Location (RAL)

A Remote Automation Location (RAL) is a generalized designation that covers a wide range of applications in the water industry and other industries as well. The popular industry-used term Remote Terminal Unit (RTU) is coincident with RAL in many instances but cannot be universally substituted for RAL. In some applications the RAL will be as simple as a single analog input that is transmitted from the top of a water tower that reflects the current water level. An RAL can be an automatic meter reading station along a pipeline or canal. An RAL can be a controller doing pump-balancing logic at a wastewater lift station. An RAL can be a remote site of pumping and treatment systems that is made up of 1000's of inputs and outputs and several control and monitoring nodes. RAL in this context is thus any set of monitoring and/or control hardware and software that is remote and reports back to the central SCADA Master as a single logical entity.

These solutions can be customized to the particular needs of each individual implementation. Much of the following sections contain the definition of a number of scenarios for certain portions of the application. These scenarios are clearly labeled with a "SCENARIO XXX" designation. In most cases one scenario will be implemented exclusively at any particular location. However, these scenarios may not be mutually exclusive. There are very real benefits in terms of system growth and adaptability to technology that can be applied in various orientations.

Clearly the functional requirements at the Remote Automation Location sites are inter-related to the capability of the SCADA Master functionality described in the prior section. It is important to reconcile each function between these two sections and include the capability of the supporting telemetry system.

3.1 RAL Hardware Options

- 3.1.1 The hardware that makes up the Remote Automation Location (RAL) solution shall be categorized as Commercially Off The Shelf (COTS) hardware that is utilized across multiple industries. This will ensure that the hardware has longevity in terms of available spare parts and a clear migration plan as technology evolves.
- 3.1.2 The physical location of the RAL will be generally considered an industrial environment. Typical locations for the RAL will range from inside a cabinet in mortar block pump stations through standalone, dedicated meter cabinets that are out in the exterior elements that may be Nema 4 or better. The hardware selected for the specific applications must meet the environmental constraints of the application.
- 3.1.3 All supporting hardware should be in a controlled area with access limited to a very limited set of authorized users and not in a location where power could be inadvertently interrupted or accidentally cycled. Any special needs of the designated hardware should be identified prior to purchase to allow for accommodation of these requirements.
- 3.1.4 The very nature of these solutions requires a very-high level of availability. It is expected that the system will be supplemented with UPS technology to allow for extended operating even upon temporary interruption of power. The overall system should have access to backup generation power for extended power outages. As an alternative to backup power scenarios, the RAL must be configured to mechanically default to a safe/preferred state in the absence of the RAL control capability.

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- 3.1.5 All PC hardware shall be modern computing hardware utilizing standard Microsoft-based operating systems. The pace of recent technology advancements almost certainly assures any designation of computer specifications at the time of design will be outdated by the time of implementation. All computer specifications such as memory and storage space must be submitted and approved prior to purchase. Computers will be from a major supplier and include hardware maintenance and service agreements.
- 3.1.6 The RAL should be designed to provide for high availability and minimize the impact of any single point of failure. This typically means that the control portion of the RAL should be based on solid-state electronic solutions without mechanically moving parts. It is required that all high-availability schemes be done through standard product offerings of the hardware or software vendors. Solutions based on application code written specifically for this application are unacceptable. All proposed implementations to meet the high availability requirements of the hardware must be submitted to the owner and approved prior to the purchase of any computing hardware.
- 3.1.7 Depending on specific design characteristics of the RAL, it may be necessary to support the ability to “hot-swap” electrical components. This will allow for the absolute minimum interruption of normal operations even if repair or replacement parts are required.
- 3.1.8 Each RAL will be based on equipment with flexibility in terms of enhancements and/or expandability. It is typical that each RAL will be designed with the capability and capacity for the initial task. However the RAL will also include contingent capacity in terms of spare/unused I/O circuits, memory capacity, and processing performance to allow for future system growth. This technology can be in terms of physical capability available yet idle at installation or it can be in the form of potential expandability such as empty but available slots in a controller rack.
- 3.1.9 A control hardware device capable of accepting the required inputs from the local instrumentation will support the RAL.
- 3.1.10 The RAL will monitor the inputs and convert them from electronic signals to numeric or logical expressions available in designated memory locations.
- 3.1.11 The RAL will have the capability to have user-defined logic that can set outputs based on the input conditions. Some RAL will be monitoring only stations and will not require output generation capability.
- 3.1.12 It must be possible to communicate to the RAL through standard communication connections. This connection will be Serial RS232, RS485, or Ethernet. It is strongly preferred that this connection support industry standard protocols for data collection purposes.
- 3.1.13 SCENARIO ONE: RAL control / monitoring with no local user interface
 - 3.1.13.1 The RAL will be supported by a controller device/PLC.
 - 3.1.13.2 For smaller RAL applications the PLC may be of fixed I/O format such as a Micro PLC. Even in this form factor the PLC must be expandable in terms of adding hardware I/O. In addition, the PLC must be part of an extended family of controllers where the logic could be moved to a larger more capable controller using the same programming environment. This device must have at least two serial ports and support separate communication capability from the respective ports.

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- 3.1.13.3 For applications requiring more flexibility, the controller / PLC must be of a modular / rack construction. This allows for the flexible selection of modules for individual RAL's. In addition, the PLC must be part of an extended family of controllers where the logic could be moved to a larger more capable controller using the same programming environment.
- 3.1.13.4 The RAL device must have at least two serial ports and support separate communication capability from the respective ports. This PLC must provide an Ethernet connection as an option. The PLC must also support optional local connections to industry standard LAN's including Profibus and Devicenet.
- 3.1.13.5 The PLC must accept a programming connection via one of the serial ports or via the Ethernet port. It is strongly preferred that a port be left available to allow for connection by a portable programmer. This can be accomplished via Ethernet by the inclusion of an industrial hub or switch inside the RAL cabinet.
- 3.1.13.6 The RAL will provide for polling of live data from the Master SCADA system. The current value of individual memory locations or blocks of data will be provided based on standard polling requests.
- 3.1.13.7 The PLC controller may be programmed to store very small amounts of buffered data that can then be collected through the same polling requests. This data will typically be stored in a FIFO circular buffer on the limited device memory. The SCADA Master must make accommodations to collect and interpret this buffered data.
- 3.1.14 SCENARIO TWO: RAL control / monitoring with separate local user interface
 - 3.1.14.1 The RAL will be supported by a controller device/PLC and a simple yet separate operator interface
 - 3.1.14.2 For smaller RAL applications the PLC may be of fixed I/O format such as a Micro PLC. Even in this form factor the PLC must be expandable in terms of adding hardware I/O. In addition, the PLC must be part of an extended family of controllers where the logic could be moved to a larger more capable controller using the same programming environment. This device must have at least two serial ports and support separate communication capability from the respective ports.
 - 3.1.14.3 For applications requiring more flexibility, the controller / PLC must be of a modular / rack construction. This allows for the flexible selection of modules for individual RAL's. In addition, the PLC must be part of an extended family of controllers where the logic could be moved to a larger more capable controller using the same programming environment.
 - 3.1.14.4 This device must have at least two serial ports and support separate communication capability from the respective ports. This PLC must provide an Ethernet connection as an option. The PLC must also support optional local connections to industry standard LAN's including Profibus and Devicenet.
 - 3.1.14.5 The PLC must accept a programming connection via one of the serial ports or via the Ethernet port. It is strongly preferred that a port be left available to allow for connection by a portable programmer. This can be accomplished via Ethernet by the inclusion of an industrial hub or switch inside the RAL cabinet.
 - 3.1.14.6 The RAL will provide for polling of live data from the Master SCADA system. The current value of individual memory locations or blocks of data will be provided based on standard polling requests.
 - 3.1.14.7 The PLC controller may be programmed to store very small amounts of buffered data that can then be collected through the same polling requests. This data will typically be stored in a FIFO circular buffer on the limited device memory. The SCADA Master must make accommodations to collect and interpret this buffered data.

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- 3.1.14.8 The simple operator interface will at a minimum provide 4 lines of textual display. This operator interface will typically be connected to one of the serial ports via a short cable. Alternatively it can utilize an Ethernet connection. The user interface will be configurable to display data from the PLC and to optionally accept inputs from the operator. Data input will require a membrane numeric keypad.
- 3.1.14.9 Alternatively the operator interface may have full graphical capability. The graphical display will allow for the elimination of the keypad and operator input will be accomplished via touchscreen capability of the screen itself. The development of the graphical screens and the configuration of the operator interaction must all be done in the same development environment and using the same software as the logic development in the PLC.
- 3.1.14.10 Operator interface hardware must have at a minimum two serial ports and in the case of graphical interfaces must also have an Ethernet connection.
- 3.1.14.11 Under certain circumstances the SCADA Master may communicate directly to the operator interface hardware rather than the PLC. Certain graphical operator interfaces based on the Microsoft CE operating system will have increased capability in terms of memory capacity and the ability to buffer data as compared to the PLC.
- 3.1.15 SCENARIO THREE: RAL control / monitoring with integrated local user interface
 - 3.1.15.1 A single, composite unit that is both the controller and the operator interface will support the RAL. This unit will run the Microsoft Windows CE operating system.
 - 3.1.15.2 The controller will utilize standard PLC I/O of modular / rack construction. The controller must be part of an extended family of controllers that include PLC's. The composite controller and the related PLC's must be programmed using the same programming environment and development software.
 - 3.1.15.3 The connection to the I/O from the controller may be through a standard serial connection, via Ethernet, or optionally through a standard I/O LAN including Devicenet or Profibus.
 - 3.1.15.4 The controller device must have at least two serial ports and support separate communication capability from the respective ports.
 - 3.1.15.5 The controller must provide an Ethernet connection.
 - 3.1.15.6 The controller must also support optional local connections to industry standard LAN's including Profibus and Devicenet.
 - 3.1.15.7 The controller must accept a programming connection via the Ethernet port. It is strongly preferred that a port be left available to allow for connection by a portable programmer. This can be accomplished via Ethernet by the inclusion of an industrial hub or switch inside the RAL cabinet.
 - 3.1.15.8 The RAL will allow for polling of live data from the Master SCADA system. The current value of individual memory locations or blocks of data will be provided based on standard polling requests. This connection from the Master SCADA may be through either the serial ports or the Ethernet port.
 - 3.1.15.9 The controller may be programmed to store very small amounts of buffered data that can then be collected through the same polling requests. This data will typically be stored in a FIFO circular buffer on the limited device memory. The SCADA Master must make accommodations to collect and interpret this buffered data.

- 3.1.15.10 The operator interface will have full graphical capability. The controller will provide options for different size displays. The controller will also be available in color or grayscale models.
- 3.1.15.11 The development of the graphical screens and the configuration of the operator interaction must all be done in the same development environment and using the same software as the logic development in the PLC.
- 3.1.15.12 The controller will have removable flash memory capability to allow for data storage. This standard removable media will allow for the collection and transfer of data via
- 3.1.16 SCENARIO FOUR: RAL control / monitoring with PC based local user interface
 - 3.1.16.1 The RAL will be of sufficient size and scope to require a PC local to the control location.
 - 3.1.16.2 All PC hardware shall be modern computing hardware utilizing standard Microsoft-based operating systems. The pace of recent technology advancements almost certainly assures any designation of computer specifications at the time of design will be outdated by the time of implementation. All computer specifications such as memory and storage space must be submitted and approved prior to purchase. Computers will be from a major supplier and include hardware maintenance and service agreements.
 - 3.1.16.3 The nature of the installation location may be such that office grade “white” PC’s may not be sufficient in terms of environmental conditions. If appropriate industrialized computers will be utilized at the RAL. These may be panel mounted or rack mounted computers.
 - 3.1.16.4 The PC will have sufficient communication capability to communicate to local control devices. This capability will include at a minimum two Ethernet ports, two serial ports, and standard slots for the potential use of the LAN cards.
 - 3.1.16.5 The deterministic control logic that facilitates the functional will run in a separate PLC unit or if necessary distributed across multiple PLC’s.
 - 3.1.16.6 The PLC must be part of an extended family of controllers where the logic could be moved to a larger more capable controller using the same programming environment. This device must have at least two serial ports and support separate communication capability from the respective ports. The PLC’s must be of a modular / rack construction. This allows for the flexible selection of modules for individual RAL’s. In addition, the PLC must be part of an extended family of controllers where the logic could be moved to a larger more capable controller using the same programming environment.
 - 3.1.16.7 The PC will typically act as the connection point from the SCADA Master communication and will support the associated communication ports and/or modems.

3.2 Inputs, Outputs, and Signal Conditioning

- 3.2.1 The inputs and outputs of the hardware will be of typical PLC orientation.
- 3.2.2 The PLC will offer a sufficient variety of signal types to accommodate typical RAL requirements. These inputs will include ranges in Voltage, mAmps, and Relay amps.
- 3.2.3 Some instrumentation may be engineered to require signal condition prior to wiring to the PLC. Whether this is electrical conversion or interposing relays, the design will make the best use of technology inside and outside of the PLC framework.

3.3 Monitoring / Visualization

3.3.1 SCENARIO ONE: RAL control / monitoring with no local user interface

3.3.1.1 There is no local visualization in this scenario. It is possible that simple hardware lights and /or pushbuttons may be incorporated into the design to allow for very basic operator interface.

3.3.2 SCENARIO TWO: RAL control / monitoring with separate local user interface

3.3.2.1 The operator interface will provide for basic display of key process variables and operating status.

3.3.2.2 A network of screens will be developed to allow for navigation through multiple views and different information.

3.3.2.3 At a minimum the operator interface will have a separate screen to display and allow operator interaction with local alarms. This capability should be inherit in the capability of the operator interface and associated configuration software.

3.3.2.4 It should be possible to configure setpoint screens that will allow an operator to change process variables or start and stop equipment manually. There must be options to password protect these actions to protect the process from inadvertent or unauthorized changes. The setpoints commands will be transferred to the PLC / Controller portion of the RAL for execution.

3.3.2.5 Whether textual or graphical, the user interface must allow for flexible creation of displays and user interaction. The user interface must provide either a membrane keypad or touch screen capability to allow for operator interaction.

3.3.2.6 Graphical units must provide for the ability to do simple animation including at a minimum color changes, simple fills, and bar chart objects.

3.3.2.7 The operator interface units should provide the capability to display simple trends of process variables.

3.3.3 SCENARIO THREE: RAL control / monitoring with integrated local user interface

3.3.3.1 The operator interface will provide for basic display of key process variables and operating status.

3.3.3.2 A network of screens will be developed to allow for navigation through multiple views and different information.

3.3.3.3 At a minimum the operator interface will have a separate screen to display and allow operator interaction with local alarms. This capability should be inherit in the capability of the operator interface and associated configuration software.

3.3.3.4 It should be possible to configure setpoint screens that will allow an operator to change process variables or start and stop equipment manually. There must be options to password protect these actions to protect the process from inadvertent or unauthorized changes. The setpoints commands will be transferred to the PLC / Controller portion of the RAL for execution.

3.3.3.5 Whether textual or graphical, the user interface must allow for flexible creation of displays and user interaction. The user interface must have touch screen capability to allow for operator interaction.

- 3.3.3.6 Graphical units must provide for the ability to do simple animation including at a minimum color changes, simple fills, and bar chart objects. Visualization should also include the representation of values in text of various sizes and fonts. The textual values should dynamically change to reflect the current value of the associated parameters.
- 3.3.3.7 The operator interface units should provide the capability to display simple trends of process variables.
- 3.3.3.8 The creation and configuration of the basic graphic screens should be accomplished without scripting. This screen creation, configuration and maintenance should be performed in the same programming environment as logic development.
- 3.3.4 SCENARIO FOUR: RAL control / monitoring with PC based local user interface
 - 3.3.4.1 Visualization in this scenario will utilize the same software environment as that used for visualization at the SCADA Master level. This will allow for re-use of screen imagery and the complete integration of visualization capability.
 - 3.3.4.2 Visualization will include the creation of graphic screens and the simple association of data points or tags with animation features such as fill, rotates, move and color changes. The animated objects should dynamically change to reflect the current value of the associated parameters.
 - 3.3.4.3 The visualization system will allow for re-usable objects that can be associated with different variable sets in different screens or even multiple times in the same screen. These objects or templates will allow for the rapid creation of nearly identical screens to represent RAL's that are nearly identical. Changes to the template will automatically ripple through all screens where the object is used without the need to open the individual screens.
 - 3.3.4.4 Visualization will also include the ability to view trends of values across a time period. Trends will allow for view of multiple parameters across the same time period and allow the user to page backward and forward through the historically retained data.
 - 3.3.4.5 Visualization will include integrated user security to the system. This security will require user id and password, both of which will be integrated with the Microsoft Operating System security.

3.4 Control Logic Programming / Development Environment

- 3.4.1 All RAL scenarios will be programmed with the same single robust software environment. The programming software will run on standard PC's under contemporary Microsoft operating systems. This section covers some basic capability but the complete specification of the programming capability is covered in a separate document.
- 3.4.2 The programming environment will allow for the configuration of the RAL hardware using pick and select capability from available options. The hardware profile will include the specification of modules, the assignment of physical inputs to memory locations, calculate module power consumption, and if necessary provide for scaling at the I/O module.
- 3.4.3 The programming of the logic for RAL monitoring and control will be done using industry standard programming languages. Depending on the need of the application and the hardware technology selected, it may be possible to create programs using Ladder Logic, Structured Text, Instruction List, Function Block Diagram, Sequential Function Chart, and even "C" programming.

- 3.4.4 The programming software will provide a modern engineering work environment with the ability to perform things like cut, paste, search, and other more advanced editing functions.
- 3.4.5 Programs will be created and developed in the programming environment and then downloaded for execution into the RAL target. Depending on the profile of the RAL, the program can be downloaded via a hardware serial port or across the Ethernet port.
- 3.4.6 In many cases the program will be downloaded from a laptop that has been temporarily positioned near the RAL. If the telemetry supports it, the connection can be made remotely and program changes, monitoring, and verification can be done remotely.
- 3.4.7 The programming software will not only provide the ability to create and maintain logic, but will also support the online monitoring of programs as they run in the designated RAL target. The programming environment will allow for on-line view of parameters during logic execution and have access to RAL hardware fault tables.
- 3.4.8 The programming environment will facilitate the reuse of code between similar RAL targets without major re-programming. The user should be able to flexibly use the same program code on multiple targets that best match the needs of a specific RAL installation.
- 3.4.9 The vendor supplying the program environment must also offer as an option change management / audit software. This software will automatically capture changes to programs and maintain current versions in a systemic way. This will allow for a controlled programming environment and assure that back-up programs are readily available in case of a need for back up or recovery.

3.5 Alarming / Routing

- 3.5.1 SCENARIO ONE: RAL control / monitoring with no local user interface
 - 3.5.1.1 There is no operator interface and thus no local alarm annunciation in this scenario. It is possible that simple hardware lights or audible signals may be incorporated into the design to allow for very basic operator alerts.
 - 3.5.1.2 Local RAL logic conditions will be created that reflect alarms and events of interest, but these will be passed to the Master/SCADA system in the form of current values. The Master/SCADA system will then manage the life of the alarm condition.
- 3.5.2 SCENARIO TWO: RAL control / monitoring with separate local user interface
 - 3.5.2.1 The local operator interface will have the ability to display alarm conditions to the local users. This ability will be a standard function of the RAL operator interface and supporting software and not based on custom application scripting.
 - 3.5.2.2 Local users will have the ability to scroll through currently active alarms. Based on configuration, local users will be able to acknowledge, reset, and/or delete alarms in the local system.
 - 3.5.2.3 Alarm thresholds can be configured inside the operator interface or in the controller as status flags indicating that a condition of interest exists.
 - 3.5.2.4 If the Master SCADA system is connected to the controller and not the operator interface, then local alarms and events of interest will be passed to the Master/SCADA system in the form of current values. The Master/SCADA system will then manage the life of the alarm condition.

- 3.5.2.5 If the Master SCADA system is connected to the operator interface and not the controller, then alarms can be selectively integrated within the overall alarming scheme of the greater system. Alarms will have identities as alarms in both places with the local RAL being responsible for creation, initial time stamping, and local display. Users at the Master SCADA site can selectively acknowledge, reset, and/or delete alarms and these actions will automatically be transferred to the RAL.
- 3.5.3 SCENARIO THREE: RAL control / monitoring with integrated local user interface
 - 3.5.3.1 The local operator interface will have the ability to display alarm conditions to the local users. This ability will be a standard function of the RAL operator interface and supporting software and not based on custom application scripting.
 - 3.5.3.2 Local users will have the ability to scroll through currently active alarms. Based on configuration, local users will be able to acknowledge, reset, and/or delete alarms in the local system.
 - 3.5.3.3 Alarm thresholds can be configured inside the operator interface or in the controller as status flags indicating that a condition of interest exists.
 - 3.5.3.4 Alarms can be selectively integrated within the overall alarming scheme of the greater system. Alarms will have identities as alarms in both places with the local RAL being responsible for creation, initial time stamping, and local display. Users at the Master SCADA site can selectively acknowledge, reset, and/or delete alarms and these actions will automatically be transferred to the RAL.
- 3.5.4 SCENARIO FOUR: RAL control / monitoring with PC based local user interface
 - 3.5.4.1 The local operator interface will have the ability to display alarm conditions to the local users. This ability will be a standard function of the RAL operator interface and supporting software and not based on custom application scripting.
 - 3.5.4.2 Local users will have the ability to scroll through currently active alarms. Based on configuration, local users will be able to acknowledge, reset, and/or delete alarms in the local system.
 - 3.5.4.3 Alarm thresholds can be configured inside the operator interface or in the controller as status flags indicating that a condition of interest exists.
 - 3.5.4.4 Alarms can be selectively integrated within the overall alarming scheme of the greater system. Alarms will have identities as alarms in both places with the local RAL being responsible for creation, initial time stamping, and local display. Users at the Master SCADA site can selectively acknowledge, reset, and/or delete alarms and these actions will automatically be transferred to the RAL.
 - 3.5.4.5 Because a full PC supports the RAL, it may be possible to create a local alarm history log. This log would be created using standard functions of the HMI software used and allow for more complete local evaluation.

3.6 Historical Record Collection

- 3.6.1 For scenarios where the connection between RAL is between Master SCADA is to the controller and not to an operator interface, the collection of historical records will be based on the Master SCADA collection of current values from the RAL and the Master SCADA selectively recording values at the centralized level.

- 3.6.2 For scenarios where the connection between RAL is between the Master SCADA and an operator interface, there should be the capability to tightly integrate historical record collection. RAL operator interfaces that are using Microsoft operating systems, CE or full PC, will have the ability to run a local historian collector.
- 3.6.3 The historian collector will act as a client to the RAL application and will be configured to capture data from the local application. If there is an open Ethernet connection to the Master SCADA, these records are automatically passed to the centralized historian function.
- 3.6.4 If the Ethernet connection is temporarily unavailable, the local historian collector will store the records. Upon re-establishment of the connection the local historian collector will forward all the records captured during the disconnected interval.

3.7 Support of Web Publishing

- 3.7.1 RAL operator interfaces that support the Microsoft CE operating systems will have the ability to web-publish all local graphic screens. This will include operator interaction screens and alarm pages.
- 3.7.2 PC's running standard web browsers will be able to connect to the RAL by simply entering the IP address of the RAL into the URL field of their browser.
- 3.7.3 This connectivity will be supported by using a laptop connected to a local switch or router to allow for non-invasive evaluation of the RAL system.
- 3.7.4 This connectivity will be supported by remote connections over Ethernet. Scenarios can be developed that allow centralized users to connect to an RAL and have the complete capability that a local user would have. The centralized user does not have to have any prior knowledge of the particular RAL configuration or layout. The centralized user also does not need to utilize any licensed software or application other than the standard browser.

4 Communications / Telemetry

The communications network for these solutions tends to involve telemetry hardware and application layers that are highly engineered to the custom needs of each application. The following section outlines some high level considerations for supporting various aspects of these architectures.

4.1 Serial Communications

- 4.1.1 The Master SCADA system will be capable of performing a master / slave communication scheme using Modbus RTU across the telemetry. The Master SCADA system will be the Modbus Master and the RAL will respond as a Modbus Slave.
- 4.1.2 Serial communication will be for data collection and monitoring only. Programming of the remote station will be done with local laptops at the RAL.

4.2 Ethernet Communications

- 4.2.1 Utilizing Ethernet communications as the basis of the telemetry network can greatly reduce the engineering associated with the application. The Master SCADA system will act as the “logical” master but protocols can include peer-to-peer communications schemes.
- 4.2.2 The Ethernet backbone may be used for remote programming if the telemetry has sufficient bandwidth. Major programming of the remote station will be done with local laptops at the RAL.
- 4.2.3 Ethernet telemetry will support the web publishing capability of certain classes of RAL and allow for very efficient, on-line ad hoc connections to these sites.

5 Scope of Services

5.1 Services Overview

The level of services required for the design, installation, commissioning, and maintenance of these systems will vary by individual sites and applications. The following sections are intended to provide a base level of sample categories of the required services. It is expected that that the specification for any actual implementation will consist of the services required for that particular application.

5.2 Installation

- 5.2.1 Installation of the SCADA master system will be performed within the designated area at a central location. The characteristics of the existing designated location will be shared with the service contractor. It will be the responsibility of the service contractor to design and submit any additional requirements needed beyond the existing capability. After owner review, the contractor will implement any special environmental or electrical capability.
- 5.2.2 Where possible, it is expected that SCADA Master and RAL equipment will be installed in existing cabinetry at the respective locations. The extent of changes will be limited to the required mounting holes for the new automation and/or communication equipment. The characteristics of the existing designated location will be shared with the service contractor. It will be the responsibility of the service contractor to design and submit any additional requirements needed beyond the existing capability. After owner review, the contractor will implement any special environmental or electrical capability.
- 5.2.3 It is expected that the service contractor will submit a complete test plan that includes a representative factory acceptance test (FAT) as well as an on-location test. The FAT shall include an agreed upon representative number of RAL sets of hardware to reflect the station variety and communication volume. FAT must be completed satisfactorily prior to any on-site installation.
- 5.2.4 On-site installation is to be done with an absolute minimum interruption of current operations. The owner as part of an overall installation plan must approve any and all potential temporary shutdowns.

6 Generalized Technical Requirements

6.1 System Architecture

6.1.1 Operating System -- for software applications

The operating system shall be Microsoft-based and intended for support of robust continuous computing. The specific Microsoft operating system installed on individual nodes may vary according to current technological practices. That is the operating system for a multi-user server may be a different offering from Microsoft than that of PC clients or thin client users.

6.1.2 Computer Hardware Requirements -- for software applications

Hardware systems shall be designed and implemented on modern class of servers and clients that are appropriate at the time of implementation. The pace of recent technology advancements almost certainly assures any designation of computer specifications at the time of design will be outdated by the time of implementation. All computer specifications must be submitted and approved prior to purchase. Computers will be from a major supplier and include hardware maintenance and service agreements.

Each class of computing machine will be designated with a minimum for the following computer characteristics:

- 512 MB RAM
- 1 GB hard disk space
- TCP/IP Network protocol-based workstation

Optionally, the system shall also be capable of supporting:

- Additional RAM memory
- Larger hard drive
- Support of multiple port serial add-on boards
- High-speed PLC communication cards
- Touch-screen monitor

6.2 Applicable Standards

6.2.1 Where appropriate the offering must be compliant with OPC, OLE DB, SQL or other stated industry standards.

6.2.2 Where appropriate the offering must be compliant with Microsoft standards.

6.2.3 Where appropriate the offering must be capable of communicating via DNP 3.0, Modbus Serial, Profibus, and/or other industry-prevalent communication protocols.

6.3 Documentation

6.3.1 The system shall provide complete user documentation, including examples of how to operate the various modules within the system. The documentation must be in electronic format, HTML based with the ability to search for topics by keyword or search for specific text.

- 6.3.2 The online help system in the product needs to be context sensitive such that immediate help is available for the selected functionality.
- 6.3.3 An on-line "help" facility, based upon Windows standard Hypertext, shall provide useful, context-sensitive information on the operation of the package. This help facility shall be capable of being invoked on-line through a point-and-click operation. The "help" facility must also support the ability to perform full text word search, copy and pasting into another applications, print, and use of system fonts and colors.
- 6.3.4 Product Documentation must be available on the vendor's web site for users to download.

6.4 Sample System

- 6.4.1 The vendor shall provide a set of samples to assist a user in using the software for the first time. Samples shall be available for OI/MMI, Control, and Historian and shall demonstrate most of the features available in the software.

7 System Acquisition & Management

7.1 Licensing

7.1.1 The licensing mechanism shall support single user licenses as well as site licenses. The site licenses must not require any web or telephone authorization process. Both hardware and software licenses may be applicable.

7.2 Security

7.2.1 The security system shall control access to an automation application and control the operations that are permitted within that application.

7.2.2 Access to administrative functions needs to be limited to those with Administrative privileges.

7.2.3 The system should have an option for enforcing operations based on the highest level of permission for the specific user.

7.2.4 The system shall provide option for a unique combination of two distinct identification components (username and encrypted password).

7.3 Administration

7.3.1 Administration functions shall be available only to those users belonging to the administrator groups, or to those granted permission for the specific administrative function.

7.3.2 Administration of the system needs to be possible from any client. The user must have appropriate permissions to access these functions.

8 Service and Support

8.1 Training

8.1.1 Both on-site and off-site training may be required for x number of personnel. The manufacturer of the equipment/software or an authorized training partner of the supplier must provide trainers and training material.

8.2 Installation Services

8.2.1 The vendor shall have the ability to provide qualified consulting and installation services. These services need to be provided either by the vendor or via certified partners. Services include:

- Site Assessment
- Consultation
- Implementation
- Assistance and turnkey
- Validation services

8.2.2 Vendor needs to be able to provide service and support the installations locally worldwide.

8.3 On-line Support Contact

8.3.1 The manufacturer or its authorized representative shall provide complete technical support for all of the products. This shall include headquarters or local training, regional application centers, and local or headquarters technical assistance. A toll-free (800) number shall be available for technical support.

8.4 Warranty

8.4.1 Vendor shall provide the option to purchase support contract. This contract is to include:

- Telephone and Email support Mon-Fri 8:00AM to 8:00PM EST
- 24x7 Emergency Support
- Software Upgrades
- 24x7 Access to web based technical and support information

8.4.2 The vendor shall have a location on their web site where users can download software improvements, bug fixes, add-ons, components and so forth.

8.4.3 The vendor shall provide an easy mechanism for upgrading and installing software improvements and for allowing a user to quickly ascertain what improvements have been installed.

9 Vendor Requirements

9.1 Development Life Cycle

- 9.1.1 The vendor must have an established documented development procedure. This procedure must track customer requirements, development risk, and corrective action. The procedure must include a product validation cycle.
- 9.1.2 The vendor must have a formal and documented set of quality assurance procedures that are applied to the engineering design, development, and documentation of the software. The presence of a formal quality assurance department shall be required.
- 9.1.3 The vendor must also demonstrate that it's source code for the product is regularly archived with suitable backup.
- 9.1.4 The vendor must follow a documented configuration management system.

9.2 Product Life Cycle / Obsolescence

- 9.2.1 The vendor must have an established product life cycle policy. Documentation of the product life cycle shall be available.
- 9.2.2 The vendor of the supplied product must have a formal obsolescence policy that describes the expected life cycle of product life cycle. This needs to include a declaration of time period between product maturity and ultimately last buy opportunities.

9.3 Manufacturer Qualifications

- 9.3.1 The manufacturer shall have shown a high commitment to product, manufacturing and design process quality. The manufacture shall be ISO9000 registered.
- 9.3.2 The manufacture shall have fully operational quality assurance and quality control programs in place. Complete documentation describing the quality assurance and quality plan shall be available.
- 9.3.3 The software must be generally available (that is, non-custom).
- 9.3.4 Vendor needs to be certified under the ISO 9001-2000 guidelines.

9.4 Approved Vendor / Manufacturer

- 9.4.1 Pre-evaluation has identified that a preferences for products from GE Fanuc Automation and their associated subsidiaries. Specifically PACSystems, Series 90 PLC's, VersaMax I/O, Proficy Logic Developer - Machine Edition, Proficy Change Management, Proficy HMI/SCADA CIMPLICITY, Proficy HMI/SCADA iFIX, Proficy Historian, and Proficy Real-time Information Portal are pre-approved. Any proposed solution must include at a minimum the functionality contained in the current commercially available versions of these products.
- 9.4.2 Additional or alternative products can be provided assuming that they meet the equivalent functional and commercial criteria described in this document.
- 9.4.3 Licensing for GE Fanuc software products will be provided to support XX simultaneous users and will include an annualized contract for Proficy™ GlobalCare Support.