SCADA SYSTEM SPECIFICATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: This document covers work necessary for the design, documentation, assembly, installation, field testing, startup, training, and final documentation for a complete Supervisory Control and Data Acquisition (SCADA) system, as described herein. Major components of this system shall include the specified software, materials, equipment, and installation required to implement a complete and operational system. SCADA PC equipment shall be installed at the City of Statesville's Water Treatment Plant. The system shall communicate and integrate with existing communications from remote water system facilities.

1.2 GENERAL REQUIREMENTS

A. Electrical: All wiring shall be in complete conformance with the National Electric Code, state, local and NEMA electrical standards. All incoming and outgoing wires shall be connected to numbered terminal blocks and all wiring neatly tied and fastened to chassis as required. For ease of servicing and maintenance, all wiring shall be color coded and uniquely numbered. The wire color code and number shall be clearly shown on the drawings, with each wire's color and number indicated.

1.3 QUALITY ASSURANCE

A. General: The system provider (hereafter referred to as Contractor) shall be responsible for and shall provide for the design, supply, delivery, installation, certification, calibration and adjustment, software configuration, testing and startup, owner training, warranty and routine future field services, of a complete coordinated system which shall perform the specified functions.

B. Standard Products: In order to achieve standardization for appearance, operation, maintenance, spare parts and manufacturer's service, to the greatest extent practical, like items of equipment provided hereunder shall be the end products of the same manufacturer.

1.4 SUBMITTALS

A. Hardware Submittals: Before any components are fabricated, and/or integrated into assemblies or shipped to the job site, furnish to the Owner for their review copies of submittal documents. Submittals shall include full details, shop drawings, catalog cuts, and such other descriptive matter and documentation as may be required to fully describe the equipment and to demonstrate its conformity to these specifications. Specifically, the Contractor shall submit the following materials:

1. Operational Description shall include the principal functions/capabilities of each personal computer (PC) and PLC as provided and configured /programmed. Included shall be a description of system communications.
2. Provide a detailed Bill of Materials along with descriptive literature identifying component name, manufacturer, model number, and quantity supplied.

B. SCADA Software Configuration: Software programmer shall coordinate and attend meeting with Owner to develop conceptual layout of software screens and functionality.

C. Software Submittals: Provide data sheets for all supplier configured software and firmware.

1.5 OPERATION AND MAINTENANCE MANUALS AND SOFTWARE

A. General: The Contractor shall provide two complete hard-covered, ring bound, loose-leaf O&M manuals as well as one digital copy. In addition to "as-built" system drawings, the manuals shall include internal wiring diagrams and operating and maintenance literature for all components provided under this section. Wiring diagrams shall be provided for any provided equipment panels and shall include colors and unique numbers for all panel wires.

The submitted literature shall be in sufficient detail to facilitate the operation, removal, installation, programming and configuration, adjustment, calibration, testing, and maintenance of each component and/or instrument.

Operation and Maintenance manuals shall include copies of all PLC programs written to accomplish the monitoring and control functions specified. Programs shall be updated after startup is complete, with the fully commented program(s) licensed to and provided to the Owner on compact disk (CD).

All software and tools required for configuring and programming SCADA software shall be provided and licensed to the Owner. All custom programing shall be licensed to Owner for their use on existing facilities and as a base for future expansion of system.

The contents of the O&M manuals shall include the following sections:

1. System Hardware/Installation
2. System Software
3. Operation
4. Maintenance and Troubleshooting

PART 2 - PRODUCTS

2.1 GENERAL

A. General: The functions and features specified herewith are the minimum acceptable requirements for the SCADA system. The provided system shall equal or exceed each requirement. In some cases, the specifications may allow the accomplishing of certain functions by means of more than one hardware/firmware/software approach. Any approach that is proposed shall equal or exceed all functional, operational, convenience and maintenance aspects of the one described. Major equipment, component and software items are specified; however, the Contractor shall provide all appurtenant items necessary to achieve the required operation as hereinafter specified. This includes any network wiring for proper operation of system.

B. Existing System Overview: The City operates a 15 MGD conventional water treatment plant (WTP). The existing SCADA system consists of networked Allen-Bradley SLC series programmable controllers (PLC) communicating either locally at the WTP or through a radio telemetry system. The existing SCADA system is not connected to the Internet, and it is desired that the upgraded SCADA Computer hardware remain unconnected to the Internet after installation and startup are completed.

C. Proposed System Overview: The new SCADA computer hardware and software will be the latest version of Microsoft Windows or Server software. The computers shall be installed in the operator control room, laboratory and Supervisor’s office. Instrumentation, tank levels, and all available equipment status indicators currently monitored by the existing SCADA system shall be monitored and recorded. The SCADA software shall provide data logging, trending, alarming, and server access from other local computers at the WTP. The SCADA software shall be

VTSCADA Version 12 or latest edition.

2.2 SCADA System Hardware and Software

A. General: Three (3) SCADA computers shall be installed at the City's Water Treatment Plant to serve as a central monitoring and control station. The SCADA computers will be networked in a dual server configuration to provide 'hot' standby operation in the event of a hardware or software failure on one of the computers. An additional computer will be provided for SCADA system use in the Laboratory. The provided computers shall be the central point of operator control and monitoring for the treatment plant and all remote sites. The operators shall have access to all current operation and historical data available. The system shall also be accessible via password protected local access from other computers at the WTP site. Computer stand required for computer in WTP Supervisor's office.

B. SCADA PC Functional Display Screens: The SCADA PC software shall include the following minimum display screens and indicated features. Screens for remote facilities shall have standardized general layout to provide uniformity and facilitate future addition of sites.

1. Overview Screen
    a. Schematic or Map Based overview of all City water facilities.
    b. Tank Levels depicted graphically and numerically as water level.
    c. Pump station and WTP status including Run, Fail, Idle condition
    d. Control valve status as Open or Closed Condition
    e. Selectable navigation to screen for any site providing full site details.
    f. Indication of signal failure to any site
2. Tank Sites
    a. Numerical display of current level
    b. Graphical indicator of current level
    c. Graphical display of 24 hour historical tank levels.
    d. High and low level alarm setpoints
3. WTP Process Overview
    a. Process schematic
    b. Plant flow rates
    c. Equipment status
    d. Process instrumentation readings
    e. Clearwell Tank Level
4. WTP Clearwell
    a. Numerical display of current level
    b. Graphical indicator of current level
    c. Graphical display of 24 hour historical tank levels.
    d. High and low level alarm setpoints
5. WTP Chemical Feed Pumps If Equipped
    a. Pump Status
    b. Flow rate if equipped
    c. Feed dosage
6. Filter Screens (Each Filter as equipped)

a. Influent Valve Status (Open/Close), Open/Close Operation Command, and Actuator Hand- Off-Auto Local Switch Position.

b. Effluent Valve Status (Open/Close and Position %), Flow Rate Setpoint, Manual Open/Close and Position Operation Command, and Actuator Hand-Off-Auto Local Switch Position.

c. Effluent Turbidity

d. Effluent Flow Rate

e. Loss of Head

f. Surface Wash Valve Open/Close Command and Status.

g. Backwash Pump Run/Stop command and Status.

h. Backwash Valve Status (Open/Close and Position %), Flow Rate Setpoint, Manual Open/Close and Position Operation Command, and Actuator Hand-Off-Auto Local Switch Position. Backwash Supply Flow Setpoint and Measured Flow Rate.

i. Run/Stop Filter Control (Operating Influent and Effluent Valves. Stop closes both valves. Run opens influent valve and returns effluent valve to last position resuming effluent rate of flow control).

j. Total Filtered Volume Since Last Backwash.

k. Effluent Flow Rate Value and Trend Line.

l. Effluent Turbidity Value and Trend Line.

m. Loss of Head Value and Trend Line.

7. Historical Data Screen

a. Configurable graphical display of any individual or multiple selected monitored or calculated values

b. Report Generation

2.3 SCADA COMPONENT SPECIFICATIONS

A. Battery Back Up System: Included with the SCADA computers shall be an intelligent battery backup system including battery health logic module, charger and sufficiently sized battery. Battery system shall provide full on-line protection, power conditioning, and a seamless switchover to battery upon detection of main power supply failure. Once main power is restored, the unit shall provide seamless switchback to normal power source and recharge the battery. Battery health logic module shall individually monitor main power supply, battery and converter voltages for low voltage conditions, and provide low voltage cutoff to protect battery from an unrecoverable depletion. An on board LED, or local Operator Interface (OI) if provided shall locally indicate detection of an alarm condition. The unit shall be capable of providing two hours of battery backed operation for the connected equipment.

B. PC Hardware and Operating System: Personal Computers shall be provided to be the central point of process control and monitoring. The Operator shall have access, through the PC, to all operating and historical process data available. The PC shall be capable of directing process control, telemetry and SCADA operations.

1. Personal Computer: Personal computer (PC) shall be provided for monitoring the local treatment plant and RTU's. Microsoft Windows 10 – 64 bit operating system software shall be provided. This shall permit "off the shelf" software applications to run concurrently with the provided SCADA system software/Human-Machine Interface (HMI). The HMI shall support Microsoft Windows Dynamic Data Exchange (DDE) and Net DDE. PC shall be Dell Precision Worksation, or approved equal.

   Each PC shall meet the following specifications as a minimum:

a. Intel Core i7 microprocessor or equal (minimum 6 Core, 9MB Cache,3.0 GHz)
b. User Memory (RAM) 32.0 GB (4x8GB) DDR4 2666 MHz Non-ECC
c. 2 TB SATA, 7200 RPM or Solid State Hard Drive
d. 8GB Graphics card with minimum 4 HDMI or display port outputs
e. 27 inch Widescreen Flat Panel Display
f. Wireless USB Keyboard
g. Wireless USB 3-button mouse
h. 1GB network interface card
i. Internal speakers on PC

2. Operating System Software Requirements:
   a. Microsoft Windows 10 Professional – 64 bit
   b. Microsoft Office Professional 2019
   c. Virus protection and anti-spyware protection shall be installed. Protection software shall be McAfee, Norton, or approved equal.

C. Supervisory Control and Data Acquisition (SCADA) Software

1. SCADA software shall be commercially available off-the shelf and shall be non-proprietary, such that independent systems integrators are able to provide configuration and maintenance services as required.
2. Software shall be a Client/Server architecture. No Microsoft Client Access Licenses (CAL) or Terminal Services shall be required for full installation (thick) or browser-based (thin) clients.
3. Software shall support running as a Microsoft Windows® service.
4. Software shall support development from a thin client.
5. Software shall support IPv6 addressing and be able to run on networks that support IPv4, IPv6 or both.
6. Software licenses shall be upgradable for an annual fee such that the client is able to download and install the current version of the product.
7. Software shall be tag-based and have an integrated development environment for creation of all aspects of the application.
8. Software shall be compatible with commercially available, off-the shelf PC hardware running Microsoft Windows client and server operating systems currently available at the time of installation.
9. Software shall not require dedicated server-level PC hardware for any individual system components.
10. Software shall support any computer running a thick copy of the software performing as both an application server and a user interface. Software shall support automatic server failover to an unlimited number of servers.
11. Software shall include the following integrated components available as standard components. These components shall not require 3rd party software. However, the system shall allow 3rd party components to be used if required.
    a. Online application development environment with version control.
    b. I/O drivers for a wide selection of communication protocols.
    c. Alarms management and alarms/events history.
    d. Fully-integrated historian.

e. Real-time and historical data trending and tabular views.

f. Report generation.

g. Security management.

h. Unlimited operator logbooks.

i. Support for networked applications.

j. Support for server redundancy.

k. Native High Performance / HMI widgets.

l. Support for master applications, which are able to monitor multiple independent subordinate applications.

m. An object oriented scripting language with debugging tools.

n. Browser-based thin clients for PCs and Mobile devices.

12. Software shall automatically compensate for deploying the same application simultaneously on a variety of monitor resolutions, while maintaining the aspect ratios of all displays.

13. Software shall protect against file corruption in the event of an unexpected loss of power or hardware failure. Software shall support an automatic, orderly shutdown when power levels drop to a user defined setpoint.

14. Software shall support automatic startup upon computer restart, to full operation without user intervention.

15. Software shall provide a mechanism to backup and restore the entire application configuration.

16. Software shall include an integrated security system supporting an unlimited number of user accounts, roles and privileges. System users with appropriate account privileges shall be capable of changing the application configuration without requiring the software supplier's assistance. No lockout mechanisms or passwords shall be withheld from the final customer.

17. Integrated software help manuals shall be provided to assist operators and maintenance personnel with operational and configuration tasks.

B. Server Redundancy and Load Balancing

1. Redundancy

a. A minimum of two levels of redundancy for all application services shall be supported. Software shall support automatic failover from primary server to backup server(s). No manual intervention shall be required. This functionality shall be supported in both standard and virtual server environments.

b. Software must not require each redundant server to use a second network card to monitor the availability status of the primary server.

c. All servers shall be aware of which server is in control of each software process. No two servers shall perform the same function at the same time (e.g. I/O communications to a specific device, incrementing a totalizer.)

2. Load balancing

a. Software shall support the assignment of specific services (e.g. driver connections, alarms management, alarm notification) to specific computers.

b. Software shall support the use of named server lists, to which drivers can be assigned rather than requiring that a separate list be created for each driver.

c. Software shall support distribution of historical data storage to an unlimited number of computers.

d. Software shall support management of alarm and event history separately from I/O process history.

e. Software shall allow each workstation to hold a complete and automatically synchronized copy of alarm and event history so that alarms can be managed locally on any workstation if the workstation's connection to the rest of the network is lost.

f. Software shall automatically redirect incoming thin client connections to the server with the lowest number of active thin client connections.

g. Software shall support redundant networks and shall be able to use these for load distribution when both are available.

C. Thick (full-installation) Client User Interface

1. Software licensing shall not limit the number of application display pages allowed.

2. Software shall support the following navigation methods:

a. A menu for navigating from one display to another. Menu shall be configurable to allow logical grouping of displays.

b. Tiled view of any number of displays concurrently, all tiles showing real-time data or pictures of displays (user-selectable). Selecting one of the tiles will switch to the full-screen view of that display.

c. Mouse-over selectable hot box for navigating to a specific display.

d. Button for navigating to a specific display.

e. Browser-like forward and reverse buttons to scroll through previously viewed displays.

f. A list of previously viewed displays with the option to navigate to a selection from the list.

g. A mapped view of assets with the option to navigate to an application display by selecting any asset from the map.

3. Application displays shall be event-driven, in that data will be delivered to client computers by the server immediately upon receipt. Client computers will not poll the server for new data.

4. Means shall be provided to allow the operator to print graphical displays.

5. Software shall support flagging tags as ‘questionable data’ (i.e. not commissioned or value is in question.) These values will continue to display the incoming values. These flags shall be removable by users with sufficient privileges.

D. Thin (browser-based) Clients

1. Software shall offer an optional zero-footprint thin client for use with HTML5-compatible browsers running on operating system variants, including

a. Windows

b. Linux

c. Apple

d. Android

2. Server for thin clients shall be an integral feature of the SCADA software. Use of the thin client shall not require a 3rd party Internet server software (e.g. Microsoft IIS, Apache).

3. System shall support two levels of server redundancy for thin client connectivity, with automatic failover and client load sharing.

4. System shall support cyber security measures including Firewalls, Virtual Private Networks (VPN) and Secure Socket Layer (SSL.)
5. OpenID Connect shall be supported for secure thin client logons.
6. Thin client connections shall be concurrent. Tools shall be provided to monitor client connectivity and to disconnect users or switch them to alternate servers on demand.
7. The thin client shall share the same security accounts as the rest of the SCADA Software. A separate privilege shall be required for browser client access. Revocation of this privilege will immediately terminate the user's client connection.
8. Thin Client displays shall be generated automatically, requiring no additional configuration.
9. On-line configuration changes shall be deployed immediately to all thin client interfaces without requiring the client interface to be restarted or refreshed.
10. An authorized user on a thin client connection shall be able to perform configuration changes.
11. The Thin Client user interface shall be offered in two variants, the choice of which to use being user-selectable.
    a. Graphical (preferred for large user interfaces) – A user experience mirroring (graphically and operationally) that of the Thick Client.
    b. Text-based (preferred for mobile phone interfaces) – Simplified lists of monitored values, with support for control actions, alarms management, trending and mapped asset view.

E. Historian

1. Historian shall support logging of all the SCADA system data, including real-time, historical, transactions, alarms and events, regardless of the number of tags in the system. For example, a 25,000 tag system shall support historical data storage for 25,000 tags, plus alarms and events.
2. Software shall include an integrated Historian and historical data storage at no additional cost, but may optionally use Microsoft SQL Server as the database.
3. The Historian and its historical data storage shall not require dedicated server computers, however, dedicated servers may be used if preferred by the customer.
4. Historian shall be capable of logging up to 4,000 values per second.
5. A synchronization scheme shall be included such that a copy of all historical data storage resides on all designated computers. Data shall be synchronized in real-time.
6. Any historical database that has been offline must be automatically resynchronized with the historian holding the most recent data. Software shall be capable of synchronizing 100,000+ values per second between databases. This process shall occur in parallel with runtime SCADA processes and shall be designed to minimize interference.
7. Distributed Historian architecture shall be supported. For example, two plants (A and B) may be responsible for historical storage for locally collected data, while a central facility (C) may be responsible for redundant historical storage for both A's and B's data. This architecture shall be scalable to support the addition of future plants.
8. Historian shall support SQL queries of logged historical data. Queries of historical data may be for raw data or summary (value at beginning, average, max, min, delta) over a period.
9. Historian shall be able to import collected data that was not available to be logged in real-time.

F. Historical Data Display (trend plots and tabular)

1. Software shall display historical and real-time data in both plot and tabular format.

2. Software shall allow users to generate ad-hoc plots of historical data by clicking on each of the values to be trended. Selected groups shall be recordable for future recall.

3. Software shall support ad-hoc and preconfigured trend plots of real-time and historical data as integrated elements of graphical process displays. Historical and real-time plotted values shall be shown in a continuous, uninterrupted, scrolling fashion. The display shall support:

    a. An unlimited number of pens (i.e. tag values), including both analog and digital values. Name and description of each tag shall be provided.

    b. Analog pens as either layered or as stacked individual plots.

    c. Time frame selectable from one second to five years.

    d. Scaling for each pen as high/low values or graduated divisions.

    e. Value of each tag at the date/time of the mouse location.

    f. Statistical data, including average, minimum and maximum values, for each plot.

    g. Annotating trends

    h. Stop/pause scrolling.

    i. Zoom in/out on the time (x) and value (y) axis'.

    j. Pan/Scroll along the time axis or select a date to display.

    k. Move analog tag plots vertically (in the value (y) axis), either individually or as a group.

    l. Print displayed plot data.

    m. Annotate a moment in time on the plot.

    n. Display alarm setpoints that are associated with the tag(s) as continuous marker lines across the plot.

    o. Export plotted data to comma separated value (.csv) file or directly to a database, for use by 3rd party data analysis software.

    p. Display plot data on a dedicated page, or as a component of a process display page.

    q. Allow configuration of the plot display characteristics.

4. For tabular data, means shall be provided for the following;

    a. An unlimited number of pens (i.e. tag values), including both analog and digital values. Name and description of each tag shall be provided.

    b. Time frame selectable from one second to five years.

    c. Stop/pause scrolling.

    d. Show raw data.

    e. Show summary data for a duration sampled at consistent periods (e.g. average, minimum or maximum value every 15 min for past 8 hrs).

    f. Export plotted data to comma separated value (.csv) file or directly to a database, for use by 3rd party data analysis software.

G. Alarms and Events Management

1. Software shall include alarms and events management tools consist with implementation of the ANSI/ISA 18.2-2009 Management of Alarm Systems for the Process Industries standard.

2. Software shall include a predefined alarms and events management interface. The interface shall provide the following operational tools.

a. Lists of Current, Unacknowledged, Disabled, Active, Configured Historical and Shelved alarms and events.

b. Tools for searching and filtering lists.

c. Add a blog-style note to any alarm.

d. Notes may not be edited after saving, but comments may be added.

e. Day and night view toggle.

f. Acknowledgement of individual alarms or all visible alarms.

g. Option to require confirmation before acknowledging all alarms in the list.

h. Option to require that a note be created when alarms are acknowledged.

i. Font size adjustment for visually impaired users.

j. Representation of alarm priorities using shape, colour and numeric priority level for enhanced operational awareness.

k. Option to plot data associated with an alarm.

l. Option to open a process display where the alarm is currently shown.

m. Option to have a relevant process display open automatically if there is no operator action for a defined period of time following the triggering of that alarm.

n. Alarm mute and silence.

o. Alarm shelving options for a defined period or indefinitely. Shelved alarms shall still be recorded to the alarms history but shall not annunciate or require acknowledgement.

p. Option to include or exclude shelved alarms in the list of Current, Unacknowledged, and Active alarms. Shelved alarms to be visible at all times in lists of Historical alarms and events, Configured alarms and Shelved alarms.

3. Alarm acknowledgement shall immediately be propagated to all networked stations.

4. A full redundant copy of alarm and event history shall be stored on every workstation, allowing that workstation to continue to process local alarms if it becomes isolated from the network. History to be automatically synchronized when the workstation is reconnected to other servers.

5. Software shall allow alarms to be associated with functional areas, such that a user only has to deal with alarms in his/her functional area(s).

6. Alarm occurrence, acknowledgement, clear, disable and shelve actions shall be recorded.

7. Alarm disabling to be provided only as a configuration option, not as an operational action.

8. Software shall provide user-configurable settings for deadband on analog alarms and delay on analog and digital alarms.

9. Alarms and events records shall include;

a. Time/Date stamp.

b. The name and description of the alarm tag.

c. Priority.

d. Status of Alarm (i.e. Active, Acknowledged, Cleared). Alarm Acknowledgement records shall include the name of the user who acknowledged the alarm.

e. The value of the associated tag at the time of alarm occurrence.

f. The value of the alarm setpoint at the time of alarm occurrence.

10. Software shall support an unlimited number of alarm priorities and shall allow unique annunciation sounds, shapes, and colors for each.

11. Alarm annunciation shall be configurable to use alarm tones, text to speech descriptions, sound files or popup displays.

12. Users must be notified, both visibly and audibly, of the occurrence of an alarm, regardless which display is presently being viewed.

H. Alarm System Auditing and Reporting

1. Software shall support printing of alarms/events created over a range of dates/times.

2. Software shall provide a means to identify frequently occurring alarms (e.g. nuisance alarms.

3. Software shall provide a means to identify and analyze alarm flood conditions.

4. Software shall provide a summary of alarm percentages by priority, for comparison with generally accepted percentages as defined in the ANSI/ISA 18.2-2009 Management of Alarm Systems for the Process Industries standard.

I. Security Management

1. Software shall include a security system with privilege and role based user accounts. Level-based access shall not be acceptable.

2. All output controls shall be locked automatically when no user is signed in.

3. Security system shall support an unlimited number of user accounts and roles. System shall allow creation of an unlimited number of additional security privileges where necessary.

4. User passwords must be configurable to require a minimum length, contain a combination of letters, numbers and special characters, and expire after a pre-set period. User passwords shall be stored in an encrypted format.

5. System shall allow changes to user accounts, roles and privileges while the application is running. Changes shall become effective immediately.

6. User sign-in and sign-out activity shall be recorded in the application event log. Disabling accounts after X failed attempts within Y seconds shall be supported where X and Y are configurable options.

7. System shall provide a mechanism to limit client access to specific IP addresses.

8. System shall support authentication of user accounts via a Windows domain and authorizing SCADA user roles from domain security groups.

9. System shall support the use of proximity cards/readers.

10. The integrated version control system shall allow the option of including or excluding security-related changes if returning the application to an earlier configuration state.

J. Report Generation

1. Authenticated operators shall, in the runtime environment, be able to produce reports including any analog, digital or calculated tag data from the historical database.

2. Data format options shall be as follows:

   i. To screen.

   ii. To a comma separated value (.csv) file.

   iii. To a text file.

   iv. To an ODBC-compliant database.

   v. To any direct-connected or networked printer.

vi. To a 3rd party software (e.g. Microsoft Excel) template for advanced data analysis and formatting.

vii. To e-mail, if an external email server is provided.

b. Reports may be created for one-time use or saved for reuse.

3. The following reports should be included:

a. Analog Summary Report

b. Daily Snapshot Report

c. Daily Total Report

d. Derived Flow Report

e. Detail Report

f. Driver Communication Error Detail Report

g. Driver Communication Summary Report

h. Hourly Snapshot Report

i. Hourly Total Report

j. Rainfall Report

k. Pump Activity Report

l. Pump Discrepancy Report

m. Standard (raw data) Report

4. Report generation shall be invoked either on demand, by a monitored event, or on a scheduled basis.

5. For reports that are created on a scheduled basis, a mechanism shall be provided to allow operators to re-create the last scheduled report.

6. A data-query add-in tool be available for addition to Microsoft Excel®, thereby allowing reports to be generated in that program.

K. Configuration Management

1. Software shall be capable of on-line configuration. That is, changes to most aspects of the application (e.g. tags, displays, calculations, reports, trends, server lists) can be deployed in real-time without recompiling or restarting the application or restarting computers.

2. Software shall be capable of offline configuration, such that changes to most aspects of the application can be imported and deployed without recompiling or restarting the application or restarting computers.

3. Software shall be capable of testing configuration changes to tags and displays in the runtime environment before changes are deployed.

4. Users shall be able to deploy a set of changes either automatically or manually, with the option to select and deploy specific changes.

5. Software shall allow multiple users to configure an application simultaneously.

6. Any shut down client shall automatically download newly deployed changes from the server when the client is restarted.

7. All application servers and clients shall automatically synchronize with the primary application server. No manual file duplication shall be required.

L. Application Version Control

1. The software shall have an integrated version control system that automatically logs application configuration changes to an encrypted repository. Versions shall be auto-numbered. No manual changes to the repository shall be permitted.
2. A chronologically ordered summary of versions shall display the time and date when the version was created, the user who created the version and any comments entered by the user when deploying the version.
3. It shall be possible to determine which version is currently deployed on each client and server station.
4. The version history shall allow review of all changes applied within each version.
5. The version control system shall allow the following version management methods.
    a. Switch (aka rollback) to a previous version of the application.
    b. Reverse changes applied during a specific version.
    c. Merge changes made local to a specific workstation.
    d. Option to include or exclude security changes made between the current revision and the target revision when switching.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Equipment specified in this section shall be installed in accordance with the manufacturer's recommendations and all applicable codes.

B. Field Service: The Contractor shall provide experienced personnel to for installation, adjustment, testing, and startup of the system. All elements of the system shall be tested to demonstrate that the total system satisfies all of the requirements of the Contract Documents. The Contractor shall provide all special testing materials and equipment required. The Contractor shall coordinate and schedule all of his testing and startup work with the Owner.

C. Training: The training program shall educate operators, maintenance, engineering, and management personnel with the required levels of system familiarity to provide a common working knowledge concerning all significant aspects of the system being supplied. The training program shall include a minimum of two trips with a minimum of 8 hours on-site instruction per trip (minimum 16 hour total on- site) after all final programming modifications and testing have been performed. At least two weeks prior to the requested start of the program, the proposed dates of training shall be submitted to the Owner for approval. The supplier shall provide all instructional course material, equipment, and manuals to conduct the training program.

END OF SECTION