VOLUME 1
STANDARD APPLICATIONS AND GUIDELINES

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VOLUME 1

STANDARD APPLICATIONS AND GUIDELINES

PART 1 GENERAL

1.00 FOREWARD

A. Placer County Water Agency (PCWA) completed a SCADA system upgrade in 2006. This upgrade established a wide area network with wireless and telephony communications, replaced the control systems at Bowman, Applegate, Colfax, Monte Vista, and Alta Water Treatment Plants, and upgraded the SCADA system and graphics at all Agency facilities. The replaced control systems generally included new PLC control panels, field instruments, new field (instrument) wiring through to the control panels and on-site local SCADA workstations. Additional elements of the upgrade included data logging, local and global reporting, system redundancy, back-up, and network failover systems.

B. The SCADA upgrade standardized elements of the Agency's many control systems, from materials, color conventions, manufacturing, and programming. The Agency intends to maintain these standards as it moves forward in its Capital Improvement Program. Substantial infrastructure will be built utilizing these standards, including the Auburn Tunnel Pump Station and Ophir Water Treatment Plant, and numerous other projects expected to be built in the future. This three volume document provides design guidelines, standard specifications, and SCADA/PLC programming guidelines to help ensure that these standards are maintained correctly.

C. In addition to the SCADA upgrade, PCWA's SCADA communications infrastructure was upgraded and expanded to include a High Speed Wireless and Fiber-Optic based SCADA Wide Area Network (WAN) which included the construction of two new radio communications towers. These towers located at the Sunset and Auburn Water Treatment plants provide for a secure wireless backbone that interlinks the Agency's larger treatment facilities and distribution system RTU's.

D. To assist in the design, development and implementation effort for Electrical, Instrumentation and Control Systems, PCWA has developed a set of standardized specification and application guidelines for use by designers, integrators and programmers. This document is intended to provide the user with technical information essential to the design, implementation and operation of the Agency's Electrical, Instrumentation and Control system, as they pertain to the SCADA system. It is the purpose of these standards and guidelines to provide the Agency's operations and maintenance divisions with a consistent and reliable SCADA monitoring and control system.

1.01 DOCUMENT ORGANIZATION

A. The documents are comprised of three volumes

1. Volume 1 – Standard Applications and Guidelines

a. Volume 1 provides a general overview of the PCWA SCADA standards documents and their usage for designing and implementing PCWA SCADA system applications. The document provides for an overview of PCWA operations, the existing SCADA topology and its configuration to meet the needs of PCWA.

b. This volume covers general SCADA system design and implementation procedures for SCADA system deployment. It also identifies basic equipment and materials requirements and application methods to be utilized when developing projects for PCWA's SCADA system.

c. An overall system diagram is provided for in this Volume as well as Volume 2 to represent the SCADA Wide Area Network and its general configuration.

2. Volume 2 – SCADA and PLC Applications Programming

a. This volume provides for comprehensive programming standards and guidelines for Programmable Logic Controllers (PLC), Supervisory Control and Data Acquisition (SCADA) systems and systems related programming methods for database and networked systems. This document is intended for designers and programmers.

b. Volume 2 provides designers with essential SCADA and PLC programming requirements for designing the system based on PCWA's programming methodology, PLC deployment, graphics development and implementation management requirements. This information shall be utilized by the design team to present a System Integrator with sufficient detail to program, configure and implement the SCADA system in accordance with PCWA requirements.

c. System integrators shall utilize this document along with existing applications disks for PLC and SCADA programming, configuration and development.

3. Volume 3 – General Specifications

a. This Volume establishes general specification requirements for Electrical, Instrumentation and Control systems. These documents are intended for the use of designers, integrators, contractors and developers.

b. The specifications provided in this Volume are a typical representation for small project applications and address the basic requirements and standards of implementation for PCWA's Electrical, Instrumentation and Control systems.

1.02 SYSTEM OVERVIEW

A. Placer County Water Agency operates a series of water systems at several locations within the county, generally located along the Interstate 80 corridor. The largest two systems are the Foothill/Sunset and Auburn/Bowman systems. The Foothill/Sunset system supplies water from Newcastle to west of Rocklin and wholesales treated water to Lincoln and California-American Water Co. The Auburn/Bowman system supplies water to the foothill communities in and around the Auburn/Bowman area. The remaining water systems are significantly smaller and located in the foothills from Colfax up to Truckee.

B. These are treated water systems that utilize filtration plants, storage, and distribution facilities. The complexity of these facilities and associated processes varies by site; however, the same higher level standards apply at each site for the processes that are monitored and controlled using SCADA. It is an ongoing goal of PCWA Operations that the control systems are similar between facilities and familiar to operators as they rotate between water systems.

C. The Agency also has raw water systems supplied by PG&E's Drum Spaulding hydro system and the Agency's Middle Fork Project. These water sources ultimately supply an interconnected canal system to provide water to Agency treatment plants and turnouts for canal water customers. The raw water system includes the American River Pump Station, Auburn Tunnel, Auburn Tunnel Pump Station, approximately 160 miles of canal, and appurtenant distribution and flow measurement facilities. SCADA systems are used at raw water pump stations and flow measurement structures.

D. The Agency operates these facilities out of its Water System headquarters in Auburn. In general the raw water facilities are operated by the Field Services Department and treated water facilities are operated by the Technical Services Department. However, several of the large raw water pump stations are also operated by the Technical Services Department as they supply water to treatment plants. The Agency SCADA services are conducted within the Administrative Services Department under Information Systems.

E. Agency operations, maintenance, SCADA, and engineering staff play an active role in the development of its SCADA systems to ensure consistency and functionality between complicated networks of water system facilities.

1.03 SCADA SYSTEM OVERVIEW

A. The SCADA system foundation is comprised of the Microsoft Windows 2000 operating system and the Intellution iFix SCADA software product line. Allen Bradley programmable logic controllers (PLC's) are utilized throughout the Agency for monitoring and control of water system facilities. Complex facilities use the ControlLogix PLC line of products and simpler facilities use a variety of Allen Bradley PLC products based on the number of I/O, communications method, and program complexity.

B. The overall SCADA system topology is designed and implemented as a large distributed SCADA wide are network (WAN) that incorporates distributed client server architecture for "view and control" anywhere operations. The system is configured with two main operations centers, Auburn and Foothill which are provided with redundant SCADA server applications allowing for complete monitoring and control capabilities of PCWA's SCADA system from either of these facilities.

C. Local SCADA workstations are provide for at PCWA's smaller treatment plants and more critical pump stations to provide for both local and global SCADA monitoring and control functions. Local SCADA workstations operate independent of the SCADA WAN, but are connected to the SCADA servers located at Auburn and Foothill as clients for "view and control" anywhere operations via the WAN. In general, any local SCADA workstation not only provides for local monitoring and control, it also provides for a portal into the overall SCADA system via the SCADA network.

D. The entire system resides on a Wide Area Network (WAN) comprised of radio, telephone and fiber optic systems configured to provide for high speed communications between SCADA servers and workstations. Although the WAN is a critical part of the system with redundant systems in place, each facility is designed to operate its system independent of the status of the WAN.

E. With respect to the remote site communications, Master Communications PLC's are located at Foothill WTP, Auburn WTP and the Schaefer Mills Pump Station to act as communications master hubs for the Agency's remote distribution and raw water RTU's and PLC's. The master PLC's communicate with their respective remote sites via several communications mediums that consist of licensed radio, spread spectrum, utility based dedicated lines from A,T&T and fiber optic sub-systems each of which are based on the sites geographical location and coverage capability.

F. Data logging and reporting functions are handled by a dedicated Historical Data Server (HDS) located at the Auburn WTP. The HDS is connected to the SCADA servers and workstations which provide data logging functions over the SCADA WAN for data analysis, archiving and reporting functionality.

1.04 WIDE AREA NETWORK (INFORMATION NETWORK)

A. The PCWA SCADA system consists of two major operations centers located at the Auburn and Foothill Water Treatment Plants (WTP) with additional SCADA nodes operating at satellite water treatment plants and larger more complex facilities located throughout PCWA's area of operation. The operations center SCADA servers and workstation nodes at all locations are interconnected via a SCADA Wide Area Network (WAN) configured for view and control anywhere operations.

B. The WAN consists of fractured and full T1 frame relay networks, a wireless point-to-point network, and a fiber-optic infrastructure that interconnects the Agency's SCADA system servers and workstations. SCADA information is transmitted via the WAN to allow for graphical system displays, system wide alarm notification, remote system access, and historical data logging. Telephony communications employ a Cisco based hardware network topology utilizing T1 routers and intelligent switches for advanced network routing of SCADA information. The wireless communications employ Microwave Data Systems (MDS) wireless Ethernet bridges.

C. The SCADA WAN is often referenced as the "information network" and is configured and programmed to support client/server architecture with securities to restrict and limit client access based on authorized levels of control for individual operators. Local SCADA workstations provided at water treatment plants and facility control rooms are configured and programmed to monitor and control local plant functions independent of the status of the SCADA WAN and remote site SCADA servers. The local workstations are configured to access, control, monitor, and perform alarm acknowledgement functions over any SCADA node within the WAN infrastructure. This functionality is generally described as "view and control anywhere."

D. To accommodate high speed data transmissions between the Auburn and Foothill WTP SCADA servers a multiple point to point wireless network is established with the Sunset communications tower acting as a repeater. As a back-up to the wireless system a T1 network links the Auburn and Foothill WTP servers as a secondary/back-up to the wireless system. The system is configured to provide primary communications via the wireless system with customized router algorithms configured to redirect data via the T1 in the event of wireless data traffic congestion or a loss of the wireless system.

E. As a part of future construction, the Ophir Water treatment plant the raw water pipeline system between Foothill and Ophir is provided with a medium haul fiber optic communications system that will extend the WAN to the Ophir plant for future WAN communications.

F. An additional SCADA communications Master PLC is located in the Truckee-Donner area and is dedicated to acting as the Master PLC for the Martis, Timilick and Lahonton developments. This system utilizes a dedicated fiber optic network routed with PCWA's pipeline for both SCADA Information and PLC Control Networks.

1.05 REMOTE SITE COMMUNICATIONS

A. Remote stations PLC's are interfaced with the SCADA WAN via master Communications PLC's located at the Auburn WTP communications tower and Foothill WTP. The master PLC's communicate with remote sites via dedicated phone lines (ADN), spread spectrum radio, licensed radio, and Agency owned fiber-optic systems. Each of these communications masters are designed to operate independent of the SCADA system servers allowing for critical data to be passed on for monitoring and control of the remote systems in the event of a SCADA server failure.

B. Radio communications is achieved via two primary 100 plus foot communications towers; one located at the Auburn WTP and the other located at the Sunset WTP. The Auburn WTP tower provides for 900 MHz, Spread Spectrum communications to remote PLC's; and the Sunset WTP communications tower acts as a repeater site for a Licensed 900 MHz MAS system. Communications is based on a Microwave Data System (MDS) point to multipoint, multiple address system (MAS) polled communications topology. The master and repeater radio systems are configured as "Hot Standby" systems providing the Agency with communications system redundancy.

C. Radio communications is the primary mode of communications providing the Agency with critical monitoring and control data from remote facilities, including reservoirs, pump stations, pressure reducing stations, and canal turnout locations. Radio communications (data reads/writes) are initiated in each of the radio systems by their respective master communications PLC via a serial radio connection. The communications protocol utilized by each of the communications master PLC's is based on Allen Bradley DF-1 serial communications.

D. For those PLC stations not capable of radio based communications, AT&T digital subscriber lines are employed to communicate data to their respective master PLC's via a serial connection operating on a 56K, Advanced Digital Network (ADN). The ADN circuits are divided into various control groups to maintain increased reliability and data throughput in the event of a single circuit failure.

E. Where radio communications is unavailable and new construction permits, fiber optic communications is deployed with new pipelines to provide for future expansion of both the information and control networks. Due to the terrain factors involved, the Martis Camp development located within the Tahoe Donner/Truckee area was constructed with a fiber optic communications system that interconnects the remote sites a local Master Communications PLC and SCADA workstation. The SCADA workstation is connected to the WAN via an AT&T fractured T1, Frame Relay circuit.

1.06 SYSTEM RELIABILITY AND REDUNDANCY

A. SCADA servers located at the Auburn Water Treatment Plant (AUB) and Foothill Water Treatment Plant (FTH) are configured as redundant servers to the treatment plant control systems and WAN. Although process monitoring and control is achieved continuously by each of the servers, certain communication drivers and data loggers are defined as secondary systems to the primary data server. In the event of a primary server failure the secondary system establishes itself as the primary, a function which is transparent to the user, and initiates communications to WAN, Master PLC and local PLC systems. In essence, servers at FTH and AUB are redundant to the overall system and their defined Master communications PLC's.

B. Treatment plants and critical pumping facilities are configured utilizing two distinct operational networks; a control network and an information network.

C. The information network is configured as the stations local SCADA network configured for historical data logging, reporting and Wide Area Network access for remote client monitoring and control. In, general the Information Network is the SCADA information system that utilizes an Ethernet TCP/IP Local and Wide Area Network configuration.

D. The Control Network is configured as the process control or more specifically referred to as the PLC network for critical monitoring and control applications. The control network is structured such that PLC control system continues to operate regardless of the status of the SCADA WAN or local SCADA workstation. The control network is configured utilizing a variety of data networks depending on the design and type of PLC network put in place. For major plant facilities such as AUB and FTH the control network is configured as an industrial Ethernet system while other pumping facilities utilize Allen Bradley based DH+ or ControlNet applications.

E. Each WTP and critical facility employs a primary and secondary communications and control hierarchy that provides the Agency with increased communications system reliability and redundancy. For the most part each critical facility is connected to the WAN for primary monitoring and control with a secondary low bandwidth radio or modem (DSU) connection that allows for automatic transfer of data.

F. In the event of an Information Network or WAN access failure to a critical facility the following control actions are initiated:

   1. A WAN communications failure is established notifying operations of a communications problem.

   2. Local SCADA workstations log data to the local hard drive. Data is locally stored until the Historical Data Server returns on line at which time the locally stored data is automatically transferred to the HDS.

   3. SCADA Servers at FTH and AUB transfer communications to the back-up mode for critical data monitoring and control information accessed from the sites respective master communications PLC

1.07 HISTORICAL DATA SERVER

A. A Historical Database Server (HDS) operating with Intellution iHistorian is used for system wide historical data logging and reporting functions. The SCADA servers and local site workstations update the HDS via the WAN system. Local SCADA servers and workstations provide for redundant local database logging and reporting for a period of up to 90 days in the event of an HDS system failure.

B. With respect to the Historical Data Server configuration, system is configured as a traditional Microsoft Client/Server based database that is linked to the various SCADA servers and workstations connected to the WAN. Each of the SCADA servers and workstations logs data at specified intervals to the HDS for historical data archiving and report generation.

C. Data access for trending and reporting functions utilize both local and global data access to data presentation at local SCADA workstations. To minimize data communications via the WAN 24 hour trend data and archive data are accessed from the local workstation. Archive data that exceeds the 24 hour and local archive data interval is accessed from the HDS to provide for additional data at a local workstation.

D. For reporting functionality a third party report generation tool, ReportBuilder by Worksmart Automation, is deployed on the SCADA servers, workstations and selected SCADA clients to provide for data retrieval. The report generator is a Microsoft Excel based reporting tool that allows for preconfigured and custom report tools via a standardized spreadsheet interface.

E. The reporting functionality is comprised of Historical Data Server programs, report tool scripting and configuration, and PLC trigger and timer values to present the data with near real time stamps and totals for on demand type reporting functionality.

1.08 ALARM HANDLING AND MANAGEMENT

A. To facilitate alarm handling and management the SCADA system is configured to support both local and global alarming functionality. All sites are configured to provide for local alarm management and handling on a facility by facility basis. Alarms are processed and handled in a normal fashion standard to the industry.

B. In addition to the local alarm management function, each SCADA server within the system has global alarm monitoring capability. In essence alarms for the entire system are monitored and can be acknowledged from any location in the system.

C. In addition to the alarm handling functions, maintenance and operations type triggers are utilized to notify operations when equipment is disabled or Out of Service.

D. Critical alarm handing and management is achieved by an alarm annunciation package SCADALARM configured to provide for remote notification of alarms via conventional dial-out utilities.

1.09 DOCUMENT USAGE

A. General

1. The standards documents have been prepared to address the needs of various entities that require information related to PCWA's requirements for Electrical, Instrumentation and Control (EIC) systems. The document is provided to designers, integrators, contractors, developers and programmers to assist in the design and implementation of the Agency's EIC. These documents contain information for standardized methods, procedures and materials as they relate to EIC.

B. Developers, Designers and Planners

1. Designer's developers and planners shall utilize all volumes of these standards for the design and development of project plans and specifications.

2. Information provided in these documents shall be referenced and incorporated as part of the project specifications and drawings. A considerable amount of time and effort has been expended to generate a specific programming standard and methodology as it pertains to SCADA and PLC applications programming. The designer shall reference Volume 2 PLC and SCADA applications programming standards as a part of the project requirements. The system designer shall review these requirements and implement project specific programming requirements such as process control strategies, programming descriptions and system architecture to supplement the standard programming requirements.

3. Section 16340 of the standard specifications, address specific requirements for assembly, layout, wiring and manufacture of control panels to maintain consistency between plants and facilities. This specification shall be utilized by the designer to address the needs of PCWA for control panel fabrication. The section shall be modified by the designer to reference appropriate sections for equipment and components such as panel devices, PLC's and communications equipment.

4. Designers and developers shall utilize the standard specifications as a foundation of design for project specific requirements.

C. System Integrators and Programmers

1. System integrators and programmers shall utilize volume 2 for the development and implementation of SCADA and PLC systems. Information contained in this volume establishes the base foundation for all PLC and SCADA development efforts in the form of standardized methods, procedures and system configurations.

D. Contractors

1. The standards documents are provided to contractors to establish the minimum requirements for providing electrical, instrumentation and control systems installations. These documents are utilized by contractors for the installation of smaller facilities associated with raw water monitoring, pressure reducing stations and other smaller systems or pump stations on a case by case basis.

PART 2 GENERAL APPLICATIONS

2.00 OVERVIEW

A. It is the intent of the Contract specifications and drawings to secure the highest quality in all materials and equipment in order to facilitate operation and maintenance of the facility. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items.

B. For uniformity and operational and maintenance consistency, the Agency has standardized on a variety manufacturers products for implementation as a part of the electrical, instrumentation and control systems. These products are based on system compatibility and standardization of product components to improve serviceability, maintainability and spare parts availability.

2.01 COMMUNICATIONS SYSTEMS

A. General

1. System designers shall evaluate and assess the communications needs for each remote site based on its ability to communicate via radio, telephone or PCWA owned fiber to the SCADA system. The station type, location, process and critical nature of operation will determine the best method for communications.
2. For those sites with potential radio paths, the designer shall include a radio path survey to determine if a viable communication path is available. The path study shall evaluate line of site capability and signal strength to either the Auburn or Sunset communications towers.
3. Sites deemed to be critical systems shall be provided with primary and secondary communications systems. The primary connection shall be established with the WAN utilizing the preferred wireless network path available, or a T1 connection. The designer shall coordinate the circuit capacity and the T1 requirements with PCWA. The secondary communications network shall utilize radio or Telco (ADN) as a back-up to provide for critical data monitoring, with the preferred method being direct radio communications to either the Sunset or Auburn WTP communications towers.
4. Plant and facility communications networks shall utilize an industrial Ethernet communications network employing switches and fiber optic communications for the transmission of control information via dedicated plant control networks. SCADA information and WAN access shall utilize Ethernet as an Information Network dedicated to SCADA client/server applications and historical data services. In all cases SCADA workstation shall be configured to provide view and control functionality.
5. Facility's employing remote I/O shall utilize Controlnet communications. Critical applications shall utilize redundant ControlNet systems.

6. Instrument communications networks are utilized on a case by case basis and shall adhere to standard protocols for device networks. Device networks shall incorporate Modbus, Profibus of Devicenet. PCWA currently utilizes device network communications within the plant infrastructure for the communications of water quality data which includes turbidity, streaming current, chlorine residual and other critical water quality parameters for both data monitoring and system diagnostics.
7. In general, all remote site serial based communications to remote facilities, other than WTP and critical pumping stations, will be routed to one of the master communications PLC's located at Auburn or Foothill for processing and SCADA access. Communications to these remote site PLC's will be either MAS radio or ADN Telephone.

B. Communications Products

1. PCWA has standardized communications products based on their use and method of communications within the SCADA system. These products are to be utilized for existing systems as follows:
   a. Sunset WTP - Licensed Radio (900 MHz)
      1) Microwave Data Systems – MDS 9710
   b. Auburn WTP - Unlicensed Radio Spread Spectrum (900 MHz)
      1) Microwave Data Systems – MDS 9810
   c. Telephone
      1) Adtran DSU/CSU 54/64
   d. Fiber Optic PLC Communications
      1) N-Tron Series 500 and 900
   e. Fiber Optic WAN Communications (Information Network)
      1) Allied Telesyn (Modular Components)
   f. Industrial Ethernet Switches (Control Network)
      1) N-Tron Series 500 and 900
   g. Information System Switches and Routes
      1) Cisco Catalyst
      2) HP Procurve
2. Communications product configuration
   a. Radio's shall be provided with the remote diagnostics and configured to communicate with the associated master radio.
   b. Routers shall be custom programmed to route data based on throughput, data congestion and path availability. Routers shall be programmed to optimize communications and be allowed to provide for self discovery outside of the SCADA WAN environment.

c. Routers and switches shall be provided with the maximum amount of memory available and provided with SNMP management tools and diagnostics compatible with the PCWA WAN.

d. N-Tron fiber optic modules shall be provided with the OPC option and the Allen Bradley firmware configurations to support optimized Allen Bradley TCP/IP communications with the Control Network environment.

e. Telco communications configurations and their implementation shall be coordinated with PCWA IS and the ATT to insure that the products integrate seamlessly into the existing infrastructure.

2.02 INSTRUMENTATION AND CONTROL SYSTEMS

A. To maintain consistency and minimize the maintenance efforts, PCWA has established generalized list of acceptable manufacturers for variety of instrumentation applications.

1. Level Transmitter (Submersible)
   a. Instrument Northwest
2. Level Transmitter (Ultrasonic)
   a. Milltronics
3. Pressure Transmitter
   a. Rosemount
   b. Siemens
   c. Endress-Hauser
   d. Instrumentation Northwest
4. Turbidity
   a. Hach
5. PH
   a. Hach
6. Chlorine Residual
   a. Hach
7. ORP
   a. Hach
8. Streaming Current
   a. Chemtrac
9. Flowmeters (Magmeter)
   a. Siemens (Danfoss)
   b. ABB
   c. Sparling

10. Flowmeters (Calculated)

    a. The Agency utilizes a variety of calculated flow methods to establish flow requirements at raw water monitoring sites and pressure reducing stations. The calculated flow algorithms generally reside in the PLC for raw water applications and are part of the flow instrument at pressure reducing stations.

    b. Raw water flow calculations are based on level and flume/weir formulas to establish the flow.

    c. Pressure reducing station valves are outfitted with a flow calculation instrument supplied with the valve which is typically a ClaVal flowmeter that calculates the flow based on valve position and differential pressure.

11. Instrument communications networks are utilized for the Hach series product line and Chemtrac streaming current analyzers/controllers. In SCADA applications this data is accessed by the SCADA server or workstation in addition to the hardwired connections to the PLC. The software resides on the SCADA machine and is utilized for local redundant data logging and diagnostics of critical process values such as turbidity and streaming current.

12. Instrument systems shall utilize HART protocol whenever it is available as an option for instrument configuration and calibration.

13. All instruments are tagged (stamped) with the instrument loop number and ISA tag to distinguish its location and function in the process based on the P&ID drawings.

2.03 PROGRAMMABLE LOGIC CONTROLLERS

A. General

1. PCWA has standardized on the Allen Bradley line of programmable logic controllers for all monitoring and control functions with respect to SCADA based monitoring and local automatic control.

2. The specific PLC type is dependent on the application and complexity of the control systems. In general, the Allen Bradley PLC control systems are utilized based on control function, I/O type, and SCADA access methods.

B. Applications

1. The type PLC system shall be provided based on the following:

    a. Critical monitoring, communications hubs and treatment facilities shall utilize the Controllogix Series Processor, with memory cards for program application back-up and retrieval. The use of Hot-Standby applications shall be deployed for critical applications.

    b. Pump stations and facilities utilizing local automatic control functions shall utilize the Micrologix 1500 Series or SLC-500 in high I/O count or memory intensive locations. In general small pump stations, well sites, Pressure Reducing Stations with control and other applications deploying a local operator interface would utilize these PLC types.

    c. Pressure Reducing Stations (PRS), Reservoirs and Raw Water monitoring stations that provide for monitoring only and limited manual on/off controls shall utilize the Micrologix 1000 series.

2. Specific PLC I/O configurations and communications methods will ultimately determine the final PLC configuration. Specification section 16340 of volume 3 addresses the standard requirements for PLC configuration.

3. PLC Features

   a. PLC memory shall have sufficient memory plus an additional 50 percent capacity implement the project and allow for expansion.

   b. PLC application programs and memory shall be contained on non-volatile memory flash drives and cards.

   c. I/O shall be grouped in fashion that a single I/O module failure will not cause a system shutdown.

   d. Internal PLC registers shall be tagged utilizing the PCWA standard tagging conventions.

   e. PLC I/O shall not exceed 16 points per module and shall be individually fused in banks or groups of 8.

4. PLC functionality

   a. PLC shall be configured to control all aspects of the plant; there are no SCADA control applications other than SCADA manual control.

   b. PLC shall fail to local automatic control in the event of a SCADA failure.

   c. Control interlocks remain in service when operated in SCADA manual.

   d. All parameters in the PLC program shall be setpoint driven. Under no circumstances are there to be fixed variable registers for process tuning, alarming and timing functions.

5. PLC Communications

   a. The Allen Bradley PLC shall communicate with other PLC systems via one of the standard Allen Bradley protocols utilized by PCWA. Other protocol interfaces required to access two wire device networks shall be provided at the PLC level. PCWA has standardized on the Prosoft product line to address communications associated with Modbus applications. Other protocols shall utilize the appropriate protocol module available from Prosoft.

2.04 COMPUTER AND INFORMATION SYSTEMS

A. General

1. Due to the rapid change in technology and varying hardware software needs during the course of construction, PCWA has adopted a hardware/software allowance approach for the use of computer hardware and software. This allowance method is utilized on all large projects that would require 18 months or greater for construction and implementation. For shorter term projects the computer systems shall be specified based on system performance with the recommended hardware and software requirements dictated by the SCADA and associated application software requirements.

2. The designer shall prepare designs and provide general hardware and software specifications, depicting the SCADA system hardware and software requirements as a part of the design. The information provided by these specifications shall be utilized to prepare a budget (allowance) as a part of the specification for procurement. The allowance shall be provided as a Bid Item in the specifications and will allow for PCWA to select the necessary hardware and software at the time of SCADA system implementation.
3. Smaller projects with shorter implementation schedules will have the hardware and software as a part of the specification requirements. The specifications would address various features and functions that are standard for PCWA and specific to the project needs.
4. In general, PCWA has standardized on several product lines and components that are specific to SCADA system implementations. The designer and system integrator shall utilize these products for SCADA implementation

B. Hardware
   1. SCADA Servers
      a. Dell Server Class Raid 10
   2. SCADA Workstations
      a. Dell Workstation Class
   3. Routers
      a. Cisco
   4. Ethernet Switches
      a. Cisco
      b. HP

C. Software
   1. Operating System
      a. Windows XP
   2. SCADA Software
      a. Intellution Ifix Version 3.5
   3. Reporting Software
      a. Worksmart Automation – Report Builder
   4. Screen Printing
      a. Adobe Illustrator
   5. Communications Driver
      a. Allen Bradley – RS Linx
   6. Alarm Dialer
      a. Wonderware SCADALARM

7. Historical Data Software
    a. GE Proficy Ihistorian
8. Application Software
    a. Microsoft Office Professional
    b. Adobe Acrobat
    c. Virus Protection and Diagnostic
    d. Back-up and Recovery

D. Functionality

1. Network routers and switches are programmed specific to the WAN requirements and not dependent on self discovery and automatic routing algorithms. In essence the switches and routers are programmed to optimize network WAN and LAN communications.
2. The operating system shall be specified to be a complete operating system, not an OEM version that is supplied with the computer.
3. Non-related program applications, games and other applications not specific or necessary are to be removed from the computer system.
4. The computers shall be loaded with the latest versions and service packs, compatible with PCWA's versions of the SCADA and operating system.

2.05 CONTROL PANELS

A. PCWA has established standardized methods, materials and procedures for the design and fabrication of control panels. These methods shall be adhered to for all control panel types. Section 16340, Volume 3 shall be incorporated by the designer as a standard specification for control panels. It shall be modified only to support project specific requirements and referencing.

B. Locations where utility power is required along with an outdoor control panel, the utility service compartment, control panel and local power distribution shall be provided as an integral control panel assembled and tested as a complete system by the System Integrator.

C. Small pump stations shall be provided with Utility Service Entrance, Motor Control Center and Control Panels assembled and factory tested as a complete system.

D. Larger pumping stations and treatment facilities shall deploy control panels as required for system operation. Control panels shall be located in their respective areas of operation and include a local operator interface that is directly connected to the PLC for local monitoring and control of the process in the event of a SCADA system failure.

2.06 OPERATOR INTERFACE PANELS

A. All sites that utilize control for facility automation shall be provided with a graphical operator interface panel (OIP). The interface size and type is dependent on the application. The OIP's utilized by PCWA are Allen Bradley PanelView. The preferred method for OIP communications is Ethernet, although small stations may utilize a direct serial interface.

B. Critical facilities such as large pump stations or water treatment plants shall utilize a windows based operator interface running IFix local workstation and as a client to plant servers via the WAN. Facilities without dedicated SCADA servers shall be configured as a SCADA Operator Interface with WAN access capability via a wireless network or T1 communications link.

2.07 BACK-UP CONTROL SYSTEMS

A. The Agency utilizes independent back-up control systems on critical process applications such that the process will continue to run independent of the PLC control system. The standard back-up controllers utilized by PCWA are the powers 500 series setpoint controllers configured for the specific application.

B. Other back-up control systems are utilized for tank/storage reservoir monitoring in the form of redundant level and float monitoring systems to maintain level control in the event of an instrument failure.

2.08 MOTOR CONTROL

A. In general motor controls are housed in Motor Control Centers (MCC) with starters and components wired and configured for PLC control. In smaller systems one MCC line-up with the PLC control panel shall be provided as an integral part of the MCC for direct monitoring and control of the system. In these applications the System Integrator is required to provide the MCC and controls as a complete system.

B. Variable Frequency Drives (VFD)

1. VFD'S are utilized where precise level, pressure or flow controls are necessary to maintain system operation. Drives systems shall be an integral part of the MCC for horsepower's less than 50. Larger drives shall be self-contained free standing fed from a distribution panel.

2. Drives shall be provided with status and control parameter for PLC monitoring and control as follows:

   a. Drive Fail

   b. Drive Speed

   c. Drive Running

   d. Drive In Auto

   e. Drive In Hand

   f. Drive Speed Control

   g. Drive Start/Stop

   h. Drive Reset

3. Acceptable drive manufacturers are:

   a. Allen Bradley

   b. Toshiba

   c. Cutler Hammer

C. Small motor applications shall provide for basic monitoring and control functionality utilizing motor thermal, moisture and overload for basic monitoring and shutdown capability. Status and control provisions shall be provided to signal the PLC when the motor has:

   1. Failed (Thermal Overload)

   2. Is in Auto

   3. Is in Hand

   4. Is Running

D. Medium size motor applications and VFD's shall utilize additional protective circuitry such as power monitoring for phase loss, undervoltage.

E. Large size and critical motor applications such as medium voltage and horsepower's greater than 300 HP shall deploy motor protective circuitry for thermal, vibration and voltage protection.

F. MCC communications shall be provided for larger motor configurations and power monitoring. Acceptable communications for MCC shall be Allen Bradley (Ethernet), Modbus/Modbus TCP or Profibus. The appropriate protocol conversion modules or adapters shall be provided at the PLC level to provide for direct communications with the equipment.

PART 3 IMPLEMENTATION

3.00 COORDINATION

A. The Designer and Integrator shall coordinate the requirements for design and implementation of the SCADA and PLC control systems with PCWA Technical Services, Operations and Information Systems. The requirements from these departments shall form the basis of the operational requirements for SCADA system integration.

B. Information Systems (IS)

   1. The designer and integrator shall coordinate the requirements of Wide Area Networking, Global SCADA system requirements and Computer based systems with PCWA IS.

   2. In general IS shall coordinate the requirements for the following

      a. ADN and T1 connectivity with the serving Utility (A,T&T)

      b. IP addressing and RTU address assignments.

      c. Global SCADA system programming requirements.

      d. Historical Data System Logging and Reporting

3. The System Integrator shall coordinate all global SCADA programming efforts with IS.

C. Operations

1. As the owner of the facility, operations would coordinate the requirements for instrument and equipment locations, equipment control methods and SCADA graphical displays.

2. PCWA operations play a significant role in the development of graphical displays for monitoring and control by the SCADA.

3. The integrator shall coordinate the development of all graphical and operator interface displays associated with facility operations.

4. The designer shall establish the requirements in the specifications for graphical display development meetings, submittals and demonstrations with the System Integrator to insure that the system is being developed in accordance with the standards covered in volume 2.

D. Technical Services

1. The designer shall coordinate technical requirements with PCWA.

3.01 SYSTEM INTEGRATION

A. A single Systems Integrator (SI) or Control System Supplier (CSS) shall be contracted by the Contractor to provide all instrumentation and control systems specified. The SI shall furnish, test, and place into service the operating process instrumentation, control systems, and all appurtenant work, all in accordance with the requirements of the Contract Documents and PCWA standards.

B. PLC programming, local and remote SCADA, WAN and communications system configurations shall be provided by the System Integrator (SI). The SI shall be responsible for PLC and OIP programming, and the configuration of communications systems and components. The SI shall be responsible for all programming and integration services required to integrate the system as fully operational facility monitored and controlled via the PCWA SCADA WAN.

C. The SI shall be a qualified system integrator that meets the minimum qualifications established by PCWA to perform SCADA and PLC integration services. Only qualified SI firms/contractors shall be specified and utilized on projects that require the use of SCADA monitoring and control systems.

3.02 INSTALLATION

A. The requirements for electrical and control system installations are covered in volume 3. The designer shall incorporate these requirements and utilize the following guidelines for installation when developing project plans and specifications.

B. Conduit Systems

1. Exposed, wet and damp locations

   a. PVC Coated RMC

2. Chemical Rooms

   a. PVC Coated RMC

3. Underground

   a. Schedule 40 PVC

4. Indoor Dry Areas

   a. Rigid Metallic Conduit (RMC)

5. Transition from underground (earth, in-slab or beneath slab) to above ground or into vaults shall be made with PVC Coated RMC including the elbow to a minimum of 12" above grade exposed and 2" within a control panel.

6. All conduits shall be tagged with a unique conduit tag at both ends.

C. Equipment

1. Equipment shall be anchored in accordance with Seismic Zone 4 requirements.

2. Equipment shall be mounted on house keeping pads.

3. All cabinets shall be sealed at the base to prevent the intrusion of dust, animals and insects.

4. Equipment where possible shall be oriented in a fashion to minimize direct sunlight on the operator interface and equipment displays. Where this cannot be achieved, the control panel shall be provided with a sunshield.

5. Electrical and control panels shall be consolidated as a single panel configuration with all metering, control and distribution housed in a compartmentalized structure.

D. Conductors

1. Signal and control conductors shall adhere to the standard color codes. These color codes are contained in the guideline specifications.

2. All field conductors shall be rated for 600 VAC.

3. Conductors shall be routed from end to end without splicing or intermediate termination.

4. All conductors are to be labeled in accordance with the standard guideline specifications.

5. Communications conductors shall adhere to the standard color code.

6. Minimum conductor size #14 for control, # 18 for signal TSP.

7. Provide 20 percent spare conductor capacity.

3.03 INSPECTIONS

A. All work or materials covered by the Contract Documents shall be subject to inspection at any and all times by PCWA.

B. Work shall not be closed in or covered over before inspection and approval by PCWA

3.04 STORAGE AND PROTECTION

A. Provisions shall be made in the specifications to provide adequate protection for all equipment and materials during shipment, long term storage and construction. Equipment and materials shall be completely covered with two layers of plastic and set on cribbing six inches above grade so that they are protected from weather, wind, dust, water, or construction operations. Equipment shall not be stored outdoors without the approval of the Engineer. Where equipment is stored or installed in moist areas, such as unheated buildings, etc., provide an acceptable means to prevent moisture damage, such as a uniformly distributed heat source to prevent condensation.

3.05 SYSTEM TESTING

A. Factory Test

1. PLC and SCADA control systems shall be factory tested complete. Prior to the factory test, a factory demonstration of the SCADA application shall be provided to review graphic screen configurations, navigation and general control system operations.

2. Factory testing shall be conducted on a working system that utilizes actual field events that are simulated through the use of signal generators and jumpers. The use of software simulation is not acceptable.

B. Operational test

1. The entire system shall be exercised by the System Integrator to verify all monitoring and control functions are complete.

2. The operational testing shall be witnessed by PCWA and their representatives.

C. Final Acceptance Test

1. The system shall undergo a Final Acceptance Test whereby the system functions without hardware failures or software problems during a 30 day trial period, to the satisfaction of the PCWA.

3.06 SPARE PARTS

A. Spare parts shall be provided for all instrumentation and control systems. In general spare parts shall be provided as follows:

1. PLC Components

a. Processor

b. One of each module type

c. Since PCWA maintains a number of spare PLC parts, the type and quantity of spares shall be coordinate with PCWA on a project by project basis to prevent overstocking of PLC equipment at PCWA

2. Controls

a. Bulbs, one box of each type

b. Fuses, box of five for each size

3. Instruments

a. Coordinate instrument spare requirements with PCWA.

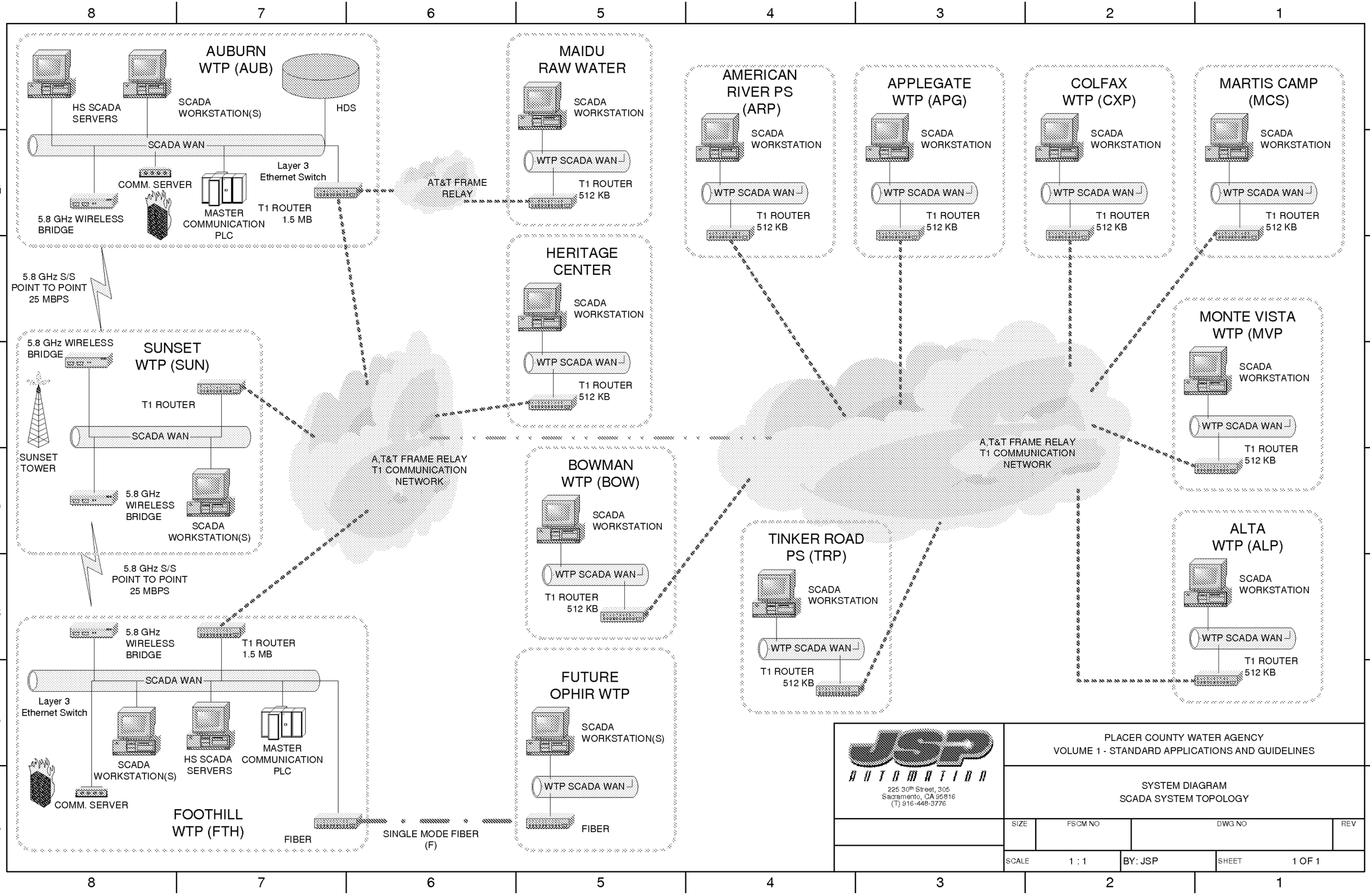
3.07 WARRANTY

A. All system shall be warranted for a minimum of 1 year.

3.08 SUPPORT CONTRACTS

A. The Agency utilizes several companies/consultants with respect to services and support for the design, maintenance and configuration of their SCADA system. The designer and integrator shall coordinate with these entities additional requirements as required for design, implementation and operation of SCADA related systems.

END OF SECTION



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PLACER COUNTY WATER AGENCY
VOLUME 1 - STANDARD APPLICATIONS AND GUIDELINES

SYSTEM DIAGRAM
SCADA SYSTEM TOPOLOGY

SIZE	FSCM NO	DWG NO	REV

SCALE	1 : 1	BY: JSP	SHEET	1 OF 1