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SCADA Plan Explanation

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This document was developed to give future Supervisory Control and Data Acquisition (SCADA) system owners a brief justification and overview of SCADA Plans.

Why is a SCADA Plan Needed?

SCADA systems are typically custom combinations of hardware and software. SCADA systems are also relatively complicated. Numerous technical and mostly intangible details must be defined. It follows that a thorough document (a SCADA Plan) defining those details is a prerequisite of successful SCADA projects.

What is in a SCADA Plan?

ITRC develops SCADA Plans as multi-format documents, including narratives, tables and figures, as well as drawings. These serve to provide specifications as well as documentation. Specific examples of a typical SCADA Plan document components and formats are provided in Table 1.

Table 1. Typical SCADA Plan components and formats

SCADA Plan Component	Typical Format
Defines overall and site-specific SCADA system capabilities (functional requirements) in a way that users can understand before accepting bids	Written narrative, charts, and figures
Defines the distribution of tasks and responsibilities between primary/subcontractors, consultants and the water user association (SCADA system owner)	Table
A conceptual wiring diagram (instrumentation diagram) defining signal type, protocols, wiring methods, and component locations in the field and office	Drawing graphic
Technical specifications for all hardware, software, and integration work – including testing, submittals, training and documentation requirements. Also includes defining contractual obligations and administrative constraints	Written
A database of system tags (a digital data register that holds a numerical value)	Table or spreadsheet
User interface screen examples	Graphics

The following sections provide readers with snippets from various ITRC SCADA Plans.

Overview and Functional Requirements

An example of a project-wide overview for a relatively small SCADA system is as follows:

Example

This SCADA project includes work at several different sites:

1. A remote terminal unit (RTU) fitted with a programmable logic controller (PLC) and associated devices/instrumentation will be installed at the reservoir. The reservoir will be networked with the office via multiple radio repeater links.
2. Up to three radio repeater sites will be constructed between the reservoir and the office to provide line-of-sight radio links between endpoints.
3. The office will be fitted with a single user workstation. The workstation will be served by the reservoir touchscreen (acting as a webserver) and provide the user with monitoring, set point adjustments and remote manual control of gate positions.

A site summary is provided in Table 2.

Table 2. SCADA project sites and descriptions

SCADA Site Description	Primary Function	Notes	Latitude (DMS)	Longitude (DMS)	Power Supply
Reservoir	Remote monitoring and remote manual gate control	Existing gates; New Remote Terminal Unit (RTU)			Off-grid solar with 3-phase generator
Repeater 1	Radio repeaters	New sites			Off-grid solar
Repeater 2					
Repeater 3					
Office	User terminal for remote monitoring and adjustment capabilities				Utility

Project maps are provided in Figure A and Figure B.

An example of a site-specific illustration of field instruments and approximate locations is provided in Figure 1. The intent of this section is to highlight key information in a simplified manner for readers to gain a rapid understanding of the overall plan at each site.

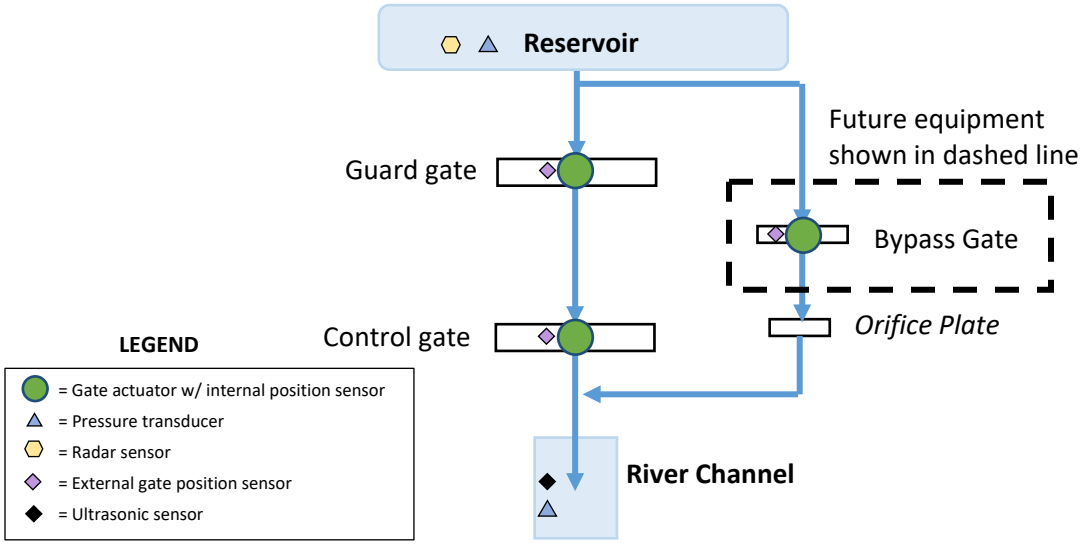

Figure 1. An example of a conceptual, site-specific illustration denoting the quantity, type and relative location of field instruments and other key components

Distribution of Tasks and Responsibilities

It is typical to distribute the SCADA project tasks and responsibilities across several entities that could be described collectively as the "project team." Typical parties in the project are the project owner, consultants, general contractor, subcontractors, integrators, etc.

Category	Major Tasks	SC	CONTR	MID	ITRC	Notes
Electrical raceways	Specify and size (SCADA-related only) conduit			X		
	Furnish and install all conductor raceways, fittings and underground pull boxes per plans		X			
	Inspect and accept electrical raceways			X		SC to approve separations
Power supply, grounding and bonding conductors	Furnish fully functional 3-phase AC utility power, meter, motor control centers (MCC) or starter panels, variable frequency drives (VFD), switch gear and load centers		X			
	Furnish fully functional, 120V nominal single-phase AC power with load center, and circuit breaker(s) sized appropriately for RTUs		X			
	Furnish and pull all conductors and jumpers		X			
	Terminate all power, grounding, and bonding conductors, including jumpers outside of the RTU		X			
	Terminate all conductors entering the RTU	X				
	Terminate all contractor pulled cables/conductors on field instrumentation terminals	X				
	Splice all field instrument cables to contractor pulled cables and conductors	X				
	Furnish and install complete earthing, ground and bonding systems		X			
Field Instrumentation and associated equipment	Furnish and install stilling wells and access tubes		X			
	Furnish and install staff gauges		X			
	Furnish and install all field instrumentation mounts, brackets, and appurtenances necessary to fasten or mount field instrumentation	X				
	Furnish and install RTU door switches	X				
	Furnish and install vandalism door switches	X				
	Terminate all contractor pulled cables/conductors on field instrumentation terminals	X				
	Splice all field instrument cables to contractor pulled cables and conductors	X				
	Configure ultrasonic sensors; document configuration			X		
	Calibrate all analog field instrumentation				X	
	Adjust, configure and verify functions for all intrusion switches	X			-	

Figure 2. An example of the task and responsibility distribution across individual members of the project team

Instrumentation Diagrams

Instrumentation diagrams are used to convey details associated with a single remote terminal unit (RTU), the input and output signal processing unit installed at each SCADA field site.

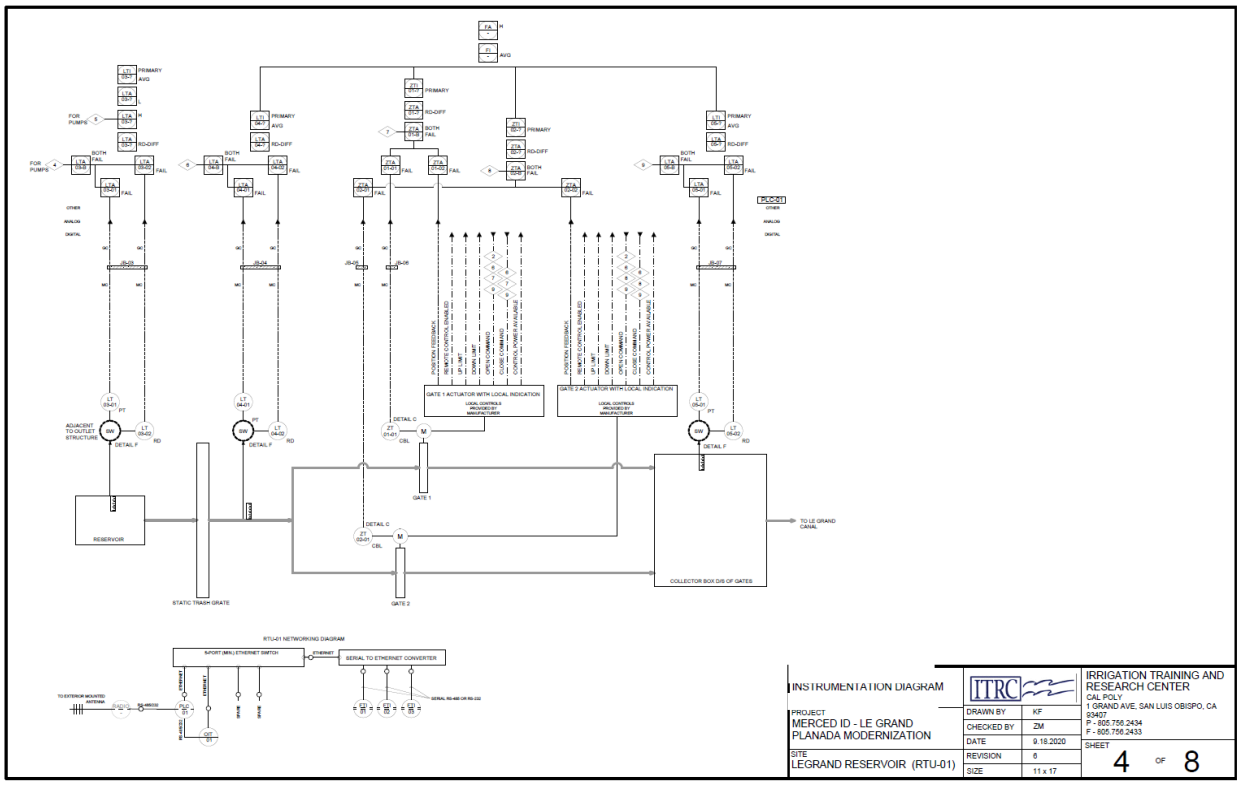

Figure 3. Example instrumentation diagram showing all RTU inputs and outputs, signal types and relative locations of sensors, etc.

Site-Specific Details

Each field site will have figures and photos that show where specific sensors and actuators and other equipment will be located. Details of installation for that site (e.g., the design of a stilling well for water level measurement, how a particular sensor must be mounted, vandalism enclosure requirements, etc.) are also provided in text and tables. For ITRC projects, any automation code is typically written in advance so that the SCADA details for a site will appropriately match the automation/monitoring software and needs.

Specifications

The specification section of a SCADA Plan generally mirrors the format of most civil specifications. The first half deals with administrative and contractual obligations. The second half of the specifications define individual hardware technical requirements as well as installation, testing and commissioning requirements. Most specification sections are at least 60 pages in length.

Tag Database

The tag database helps the integration (SCADA) contractor get a sense for the size, scope and configuration details required of the SCADA project at each site. These tags are the data points passed between the field and office and user display values/buttons.

Eng Float Analog Inputs - 32-bit

Tag Name	Variable Type	Modbus Address	Needed in ClearSCADA	Optional in ClearSCADA	Description	Units	Range (min)	Range (max)	Trended	NOTES	Max value for trending
FLOW_HI_SP_CALC	REAL		X		Flow control - High flow alarm set point calculated	CFS	0.0	999.9			
FLOW_LO_SP_CALC	REAL		X		Flow control - Low flow alarm set point calculated	CFS	0.0	999.9			
MDSL_1_AVG	REAL	X	X		Gate DS WL - Sensor 1 averaged value	Ft	0.00	9.99	X		10.00
MDSL_1_INST	REAL			X	Gate DS WL - Sensor 1 instantaneous value	Ft	0.00	9.99			
MDSL_2_AVG	REAL	X	X		Gate DS WL - Sensor 2 averaged value	Ft	0.00	9.99	X		10.00
MDSL_2_INST	REAL			X	Gate DS WL - Sensor 2 instantaneous value	Ft	0.00	9.99			
MDSL_AI_1	REAL			X	Gate DS WL - Analog input for Sensor 1	N/A	0	99999			
MDSL_AI_2	REAL			X	Gate DS WL - Analog input for Sensor 2	N/A	0	99999			
MDSL_AI_C	REAL			X	Gate DS WL - Analog input for primary selected	N/A	0	99999			
MDSL_C_AVG	REAL	X	X		Gate DS WL - Primary averaged water depth	Ft	0.00	9.99	X		10.00
MDSL_C_INST	REAL			X	Gate DS WL - Primary instantaneous water depth	Ft	0.00	9.99			
MDSL_1_ELEV	REAL			X	Gate DS WL - Sensor 1 averaged water surface elevation	Ft	0.00	999.9			
MDSL_2_ELEV	REAL			X	Gate DS WL - Sensor 2 averaged water surface elevation	Ft	0.00	999.9			
MDSL_C_ELEV	REAL	X		X	Gate DS WL - Primary averaged water surface elevation	Ft	0.00	999.9			240.00
MG1_AI_P1	REAL			X	Gate 1 - Analog input for Position Sensor 1	N/A	0	99999			
MG1_AI_P2	REAL			X	Gate 1 - Analog input for Position Sensor 2	N/A	0	99999			
MG1_AI_PC	REAL			X	Gate 1 - Analog input for Primary Sensor	N/A	0	99999			
MG1_CD_CALC	REAL			X	Gate 1 - calculated flow coefficient	N/A	0.0	9.99			
MG1_POS_C	REAL	X	X		Gate 1 - Opening from Primary sensor	Ft	0.00	9.99	X		10.00
MG1_POS_P1	REAL	X	X		Gate 1 - Vertical gate position from P1	Ft	0.00	9.99	X		10.00
MG1_POS_P2	REAL	X	X		Gate 1 - Vertical gate position from P2	Ft	0.00	9.99	X		10.00
MG1_Q_AVG	REAL	X		X	Gate 1 - Flow rate averaged	CFS	0.0	99.9	X		70.0
MG1_Q_INST	REAL			X	Gate 1 - Flow rate instantaneous	CFS	0.0	99.9			
MG1_Q_VOL_DAY	REAL			X	Gate 1 flow - Volume totalizer, daily	AcreFt	0.00	99999.9			

Figure 4. An excerpt from a tag database. This represents about 3% of a typical tag database.

User Interface Screen Examples

User interface examples provide screen developers with a variety of information including standardized numerical display boxes, user data entries, indicator lights, and navigation buttons. The examples also assist developers with the color and font pallet, data organization, etc.

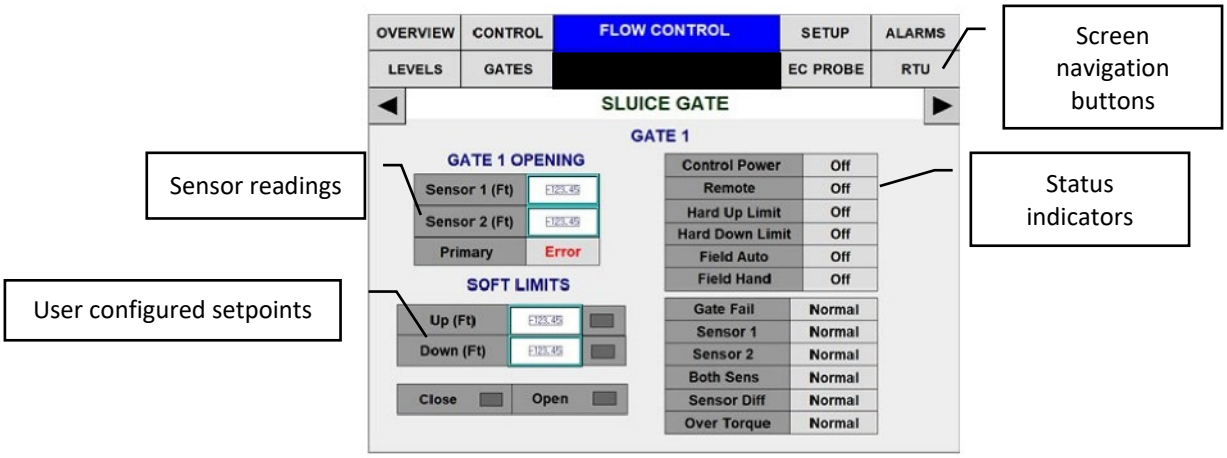

Figure 5. An example of a field user interface screen displaying the status of a sluice gate with some object descriptions

Summary

There are a vast number of details embedded within a SCADA system design. SCADA Plans are intended to capture project details in a written/visual record for discussion during the design, accurate integrator bidding and post-project verification. In other words, SCADA Plans are critical for SCADA project success.