

40 90 01 CAD Drawings

Version	Date	Author	Description
1.0	5/24/2013	NMA	Rough Draft
1.1	7/30/2013	NMA	Rough Draft – moved sections to CSI 2012
1.2	12/9/2013	JM/NMA	Added detail to Kepware, Reporting sections

PART 1 GENERAL

1.1. SUMMARY

- A. The Missouri American Water standard 11x17 Title Block template shall be used.

1.2. DRAWING NAME

- A. The Drawing name shall be constructed as follows:

xxxx y e zz.dwg

xxxx: up to 4 digits of location information (flexible, depending on the location)
(examples: stlm for St. Louis Meramec Plant, foer for Foerester tank site)

y: (optional) further definition of location within a plant

Letter	Plant Area
b	Basin
c	Chemical
f	Filters
h	High Service
I	Intakes / Influent
p	Presed
w	Wash water, tanks

e: Electrical¹

zz: unique sheet # within this category

Drawing Name Example: jefie01.dwg

jef: Jefferson City

i: Intakes

e: Electrical

01: unique sheet #

¹ From cadlend.dgn, other designations for this position are a=architectural, c=chemical, m=mechanical, p=piping, s=structural, v=civil, t=safety

1.3. WIRE COLOR (ON CAD DRAWING)

- A. Within the electrical drawing, all wires within the panel shown shall be black (NOTE actual color of field wires). Field wiring leaving the panel shall be depicted as dashed lines:

--- **FIELD WIRING 120VAC**
--- **FIELD WIRING 24VDC**

1.4. WIRE LABELS: DISCRETE

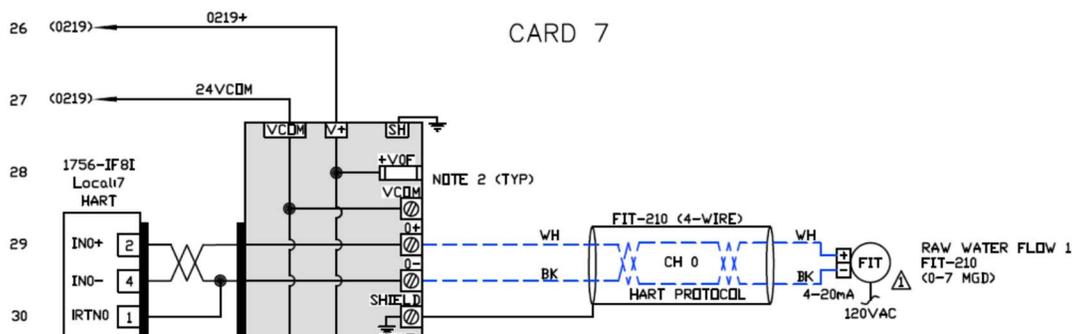
- A. The label placed on a wire is the crucial link to the schematic on which it can be located. The convention for wire labels is as follows:

prefix xx yy suffix

prefix	"UPS" to designate power from a UPS (load side) "H" may be used to indicate "hot" coming into the panel "Px" may be used to designate power coming from a pump control power xfmr
xx	Sheet # the wire continues onto
yy	Line # the wire continues onto
suffix	Use only in the following cases (otherwise omit): <ul style="list-style-type: none"> • "A","B","C" if a wire hits multiple devices on the same line • "N" if the wire is a Neutral conductor • "+" if 24V positive • "COM" if 24V common

1.5. WIRE LABELS: ANALOG

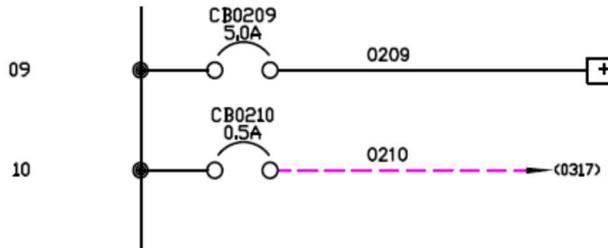
- A. For 24 VDC / 4-20mA analog signals, the loop signal name may be used as a wire label instead of the method indicated in the previous section (Wire labels: discrete). See section "Error! Reference source not found."



- B. Examples: DISC_PRESS (discharge pressure), F1_TURB (Filter #1 turbidity), BLDG_TEMP (building temperature)

1.6. DEVICE LABEL

A. Devices such as circuit breakers, fuses, and relays shall begin with a 2 letter designation and then contain the sheet/line number. For example, a circuit breaker on sheet 02 line 09 shall be labeled “CB0209”. Fuses shall begin with “FU”, control relays “CR”, etc.



B. Exception: protective devices dedicated to a specific piece of equipment may be labeled to identify it as such.

- i. Example #1: a circuit breaker exclusively feeding Filter 1 Washwater Valve may be labeled “CB-F1WWV”
- ii. Example #2: a motor run relay for a pump may be labeled “RUN”

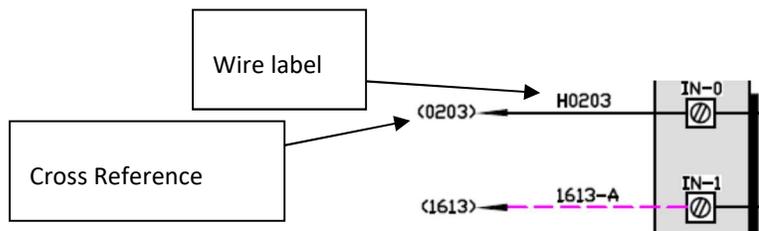
1.7. CROSS REFERENCE BETWEEN LINES

A. Where a wire leaves one sheet and continues on another sheet, a cross reference label shall be used with the following format:

(xxyy)

xx	Sheet # the wire continues onto
yy	Line # the wire continues onto

B. Note the use of parenthesis indicate this is a cross reference, where a wire label does not use parenthesis.



1.8. SHEET ORDER / PAGE LAYOUT

The PLC Drawing Set Shall be in the following order:

- A. Title Sheet, listing subsequent pages and descriptions.
- B. PLC Panel Layout (to scale)
- C. PLC Panel Bill of Material

D. PLC Panel Electrical Distribution

E. PLC Network Diagram (if applicable)

F. PLC I/O Cards

i. Each PLC card shall be represented, along with its corresponding IFM module.

ii. Up to 2 I/O cards per CAD sheet may be depicted.

iii. If the control wiring is leaving an I/O card and connecting to a complex field device (i.e. VFD, control valve, chemical feed pump), then complex field device shall be depicted on a subsequent page with cross reference labels.

G. Devices: Motor control circuits, Valve wiring diagrams, VFD control boards showing interface wiring, etc.

PART 2 PRODUCTS

2.1. SOFTWARE

A. Network (LAN/WAN) diagrams may be created in Visio, Autocad LT, or Autocad, not more than 2 years behind the current version

B. All other CAD drawings shall be created in Autocad LT or full version, and not more than 2 years behind the current version.

PART 3 EXECUTION

40 92 49 Variable Frequency Drives

Version	Date	Author	Description
1.0	7/1/2014	NMA	Initial Release
1.1	3/17/2015	NMA	Added electrical service notes
1.2	5/9/2018	NMA	Added Weg as approved manufacturer, updated electrical system consideration
1.3	3/5/2019	NMA	Removed hard wiring as an acceptable option for control, Weg as an alternate mfg.

PART 1 GENERAL

1.1. COMMUNICATION AND WIRING

- A. Ethernet/IP shall be the approved communication protocol.
- B. Critical interlocks shall be hard wired
- C. The "Run" command, frequency command (Hz), status, diagnostic, and fault information shall all be via Ethernet/IP

1.2. SETTINGS

- A. A hard copy of the VFD settings shall be stored on site
- B. A software file with the VFD settings shall be provided to the SCADA group for long term electronic storage

1.3. PROGRAMMING

- A. VFDs shall be programmed and depicted on HMI screens in Hz, not %. % can be misunderstood as 0% meaning 0 Hz (no rotation) or a minimum pumping rotation, such as 41 Hz. To eliminate the confusion, Hz shall be used consistently throughout the PLC program and HMI screens.
- B. VFD fault codes shall be integrated with the HMI for display on a graphic (i.e. Iconics Statefield)

1.4. LOCAL/REMOTE

- A. A clear method shall be provided for Local control of the VFD for testing or in the case of PLC failure. Some VFDs come equipped with a Local/Remote button, others may need a Local/Remote switch hard wired.

PART 2 PRODUCTS

2.1. APPROVED MANUFACTURERS

- A. Approved Manufacturers: Toshiba, Allen Bradley PowerFlex.
- B. Approved Alternate Manufacturer: Weg (see Corner Grounded Delta section below) is an alternate if the electrical service is Grounded B phase and Toshiba is not a viable option.

C. Other manufacturers may be considered on a project need basis, and ease of integration.

2.2. ELECTRICAL SYSTEM CONSIDERATION

A. If the electrical service is **Corner Grounded Delta**, special considerations need to be made in VFD selection and configuration to avoid a catastrophic failure. Toshiba P9s may not be used. Some Allen Bradley VFDs may be used with the proper internal jumpers set. An isolation transformer may need to be supplied, or the electrical service upgraded to Wye.

When variable frequency drives are used, the drive installation or user manual should be consulted to determine the existence of protection circuitry that is referenced to ground. If these circuits exist, they are typically rated for voltages present on solidly grounded Wye power systems. When drives with these protective circuits are used on ungrounded, impedance grounded, or corner grounded Delta power systems, these circuits must be removed or isolated from ground to prevent their continuous operation and shortening of life that will occur in the presence of higher than expected line-to-ground voltages¹

PART 3 EXECUTION

¹Rockwell Automation Publication Publication 2100-AT0003A-EN-P—April 2007

40 94 43 Programmable Logic Controllers

Version	Date	Author	Description
1.0	5/24/2013	NMA	Rough Draft
1.1	7/30/2013	NMA	Moved sections to CSI 2012
1.2	2/11/2015	NMA	Added Standard Programming section
1.3	10/5/2015	NMA	Clarified security and version sections
1.4	11/6/2015	NMA	Added time synchronization section
1.5	1/15/2016	NMA	Studio 5000 v28
1.6	2/8/2016	NMA	PLC tag naming, NTP
1.7	1/8/2018	NMA	Added providing program to MOAWC

PART 1 GENERAL

This specification shall be used to identify acceptable PLC manufacturer / models, hardware options, as well as core program components. For more detailed PLC panel components please see specification “40 95 13 Process Control Panels”.

PART 2 PRODUCTS

2.1. CPU PROCESSOR

A. The following Allen Bradley PLCs shall be used based on the I/O count and system needs:

I/O Count	Model	Design Considerations
1-5	MicroLogix 1100/1400 Cat:1763	MicroLogix uses Logix 500 software which is extremely limited
1-20	CompactLogix L2 Cat: 1769-L24ER	L2 uses Studio 5000 software with greater flexibility and version upgrades. Use 1769 I/O expansion models. Wire directly to PLC or to terminal blocks (no IFMs).
10-100	CompactLogix L30ER or L33ER Cat: 1769	I/O Cards are not hot swappable CPU and I/O cards may not have the feature set of Control Logix 1756 devices. Use 1769 I/O expansion models. Field wire to IFM modules for clean installation.
50-500	Control Logix 1756-L71 Cat: 1756	I/O cards are hot swappable Greater expansion capabilities to remote I/O Greater specialty module selection Higher cost Field wire to IFM modules for clean installation.

2.2. IFM WIRING HARNESES

A. IFM wiring harnesses shall be used between field wiring and PLC I/O cards on 1769 and 1756 I/O

B. CompactLogix (1769) recommended IFM modules:

I/O Card	Description	IFM Base	IFM Cable
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1769-IA16	DIN CARD 120V 16CH	1492-IFM20F-2	1492-CABxxxA69
1769-OW8I	DOT CARD RELAY 8 CH	1492-IFM20F	1492-CABxxxD69
1769-IF4	AIN CARD 4 CH	1492-AIFM4I-F-5	1492-ACABxxxBD69

Note: xxx = cable length in 0.0 meters, 0.5m = 005, 1.0m = 010

C. ControlLogix (1756) recommended IFM modules:

I/O Card	Description	IFM Base	IFM Cable
1756-IA16	DIN CARD 120V 16CH	1492-IFM20F-2	1492-CABLExxxX
1756-OW16I	DOT CARD RELAY 16 CH	1492-IFM40F-FS120-2	1492-CABLE025Y
1756-IF8	AIN CARD 8 CH	1492-AIFM8-F-5	1492-ACABLExxxTB

Note: xxx = cable length in 0.0 meters, 0.5m = 005, 1.0m = 010

PART 3 EXECUTION

3.1. I/O LAYOUT

A. PLC I/O layout shall be provided to MAWC in the following format:



PLC IO Layout.xlsx

3.2. STANDARD PROGRAMMING

A. **Version:** Programming software shall be Studio 5000 Version 30.

B. **PLC Major Fault:** PLC program shall include a major fault routine that sets a PLC_MAJOR_FAULT tag. This tag allows the operator to see the PLC has faulted and take action, otherwise tags often scan normally and no other indication is given while faulted.

- i. PLC_MAJOR_FAULT Bit is Latched within routine "PLC_Major_Fault_Handler" (set to execute once as controller faults)
- ii. PLC_MAJOR_FAULT Bit is Unlatched in the last rung of the Main Routine (will reset as soon as normal scan begins)
- iii. PLC_MAJOR_FAULT should be added as an alarm to the corresponding HMI AlarmWorx to alert the operator

C. **Tag Description Location.** Studio 5000 version 21 and higher allow tag descriptions to be stored in the PLC. This feature shall not be used, as it lags PLC online communication to Studio 5000, especially to remote sites via radio. The "Download Project Documentation and Extended Properties" box shall be Unchecked. This is checked by default and requires a program download to turn this feature off.

D. **Tag Naming.** Tags shall follow the naming convention in "40 90 00 Process Control Introduction, Definitions, References". Tags used internal to the PLC (i.e. one-shot, calculation tags, MSG control) should start with an underscore. Tags intended for Read/Write by the HMI should be all caps.

Examples:

_MSG_Read_From_PLCR3
DISC_PRESS

TANK_LEVEL

E. **Ladder Logic Only.** All code shall be in Ladder Logic.

F. **Unacceptable formats.** Structured text, function block, and other methods are not acceptable, as MOAWC does not own licenses for or support these programming languages.

G. **Security.** All programs, Add On Instructions (AOIs), User Defined data Types (UDTs), routines, and other components within the program shall be in the unlocked state with no password protection or encryption.

H. **Add On Instructions.** American Water standard programming blocks shall be used wherever possible. Integrator AOIs may be used if pre-approved by the SCADA Manager in writing, and unlocked for future editing.

AOI Name	Description
AB_PID ver X.X.L5X	Generic PID loop (SP, PV, CV)
AI_Alarm (AOI) ver X.X.L5X	Generic AI alarm for internal PLC control (every alarm doesn't need this)
AI_Scale_and_Fault_ver X_X_AOI.L5X	AI scaling, fault for internal PLC control (every alarm doesn't need this)
ClockNTP_and_DST (Rungs).L5X	Time set in PLC via NTP, NTP server to be local Cisco switch
Day of Week (Routine).L5X	Day of week (returns integer)
DI_Switch_Alarm_AOI ver X.X.L5X	DI alarm, used for internal PLC control only (every alarm doesn't need this)
Flow_Totalizer_AOI ver X.X2.L5X	Flow total over time - hourly, daily, monthly, etc.
Lead_Lag_PMP_Control ver X.X.L5X	Lead/lag pump control with rotation
ModbusTCP v2_5 from Mike D 2014-12-02.zip	Standard Modbus TCP read/write block
Plant_Usage_H2O_Meter ver X.X.L5X	Plant water tracking
Pump_AOI ver X.X.L5X	Pump control - input status, alarms, HMI control
Runtime_AOI ver X.X.L5X	Tracks runtime - hourly, daily, monthly, etc.
Sequencer_AOI ver X.X.L5X	Sequencer
Toshiba_ASDG9ETH ver X.X.L5X	Toshiba VFD
Valve_Analog_Output_AOI ver X.X.L5X	Valve (modulating) control - input status, alarms, HMI control
Valve_Discrete_Dual_Output_AOI ver X.X.L5X	Valve (dual output with mid-hold) control - input status, alarms, HMI control
Valve_Discrete_Single_Output_AOI ver X.X.L5X	Valve (single output with open/close only) control - input status, alarms, HMI control

I. **Time Synchronization.** Logic shall be added to automatically set the PLC clock using NTP, via the "ClockNTP_and_DST (Rungs).L5X" rung import identified above. By default this sets the PLC time once an hour (including Daylight Savings time). The Time Zone still needs to be set manually.

Location	IP Address
Local Plant LAN	Plant Cisco Switch IP address (i.e. St. Joseph Plant is 10.25.203.2)
Cellular Site	10.252.4.1 (the Craig Rd cellular MPLS router)

J. **Program delivered to MOAWC.** PLC programs in standard Allen Bradley format shall be provided to MOAWC via email at the end of the project before final invoicing is sent.

3.3. APPROVED INTEGRATORS

A. Unauthorized integrators shall not log into or attempt connection to Missouri American Water control systems - servers, network, PLC, etc.

B. The following integrators are approved for work on Missouri American Water control systems:

- McEney Automation (Fenton, MO)
- Langetech (Chesterfield, MO)
- A.W. Schultz (Shawnee, KS)

40 95 13 Process Control Panels

Version	Date	Author	Description
1.0	5/24/2013	NMA	Rough Draft
1.1	7/30/2013	NMA	Rough Draft – moved sections to CSI 2012
1.2	12/9/2013	JM	Section organization
1.3	1/21/2014	NMA	Updated UPS backup systems
1.4	3/17/2015	NMA	Added Newmar 24V DC UPS systems, motor control
1.5	2/11/2016	NMA	Added Phoenix 24VDC UPS, Ambient temperature sensor updates
1.6	2/9/2017	NMA	Added 120VAC harsh environment UPS, SNMP updates

PART 1 GENERAL

1.1. UL LISTING

- A. All PLC control panels shall comply with and be listed under UL 508A “Industrial Control Panels”. A sticker shall be applied to the inside of the panel denoting compliance.

1.2. SAFETY CONSIDERATION - MIXED VOLTAGES

- A. PLCs shall under NO circumstances be included in the same panel with 480V components. A separate panel shall be utilized.
- B. Pre-fabricated pump stations and OEM machines with a PLC in the same enclosure with 480V components will not be accepted.
- C. Where 480V and above motors are utilized, each motor control circuit shall have its own 480VAC/120VAC control power transformer to allow safe disconnect of the 480V enclosure or MCC bucket. Any PLC I/O shall originate from this circuit and land on dedicated PLC I/O card(s).
- D. 24VDC control is preferred, and reduced PLC components and 24V instruments & sensors shall be utilized whenever possible to lower risk of electric shock to service personnel.

1.3. UNINTERRUPTIBLE POWER SUPPLY (UPS)

- A. Unless otherwise specified, UPS systems shall be installed to allow the PLC and select devices to stay energized during a brief power outage. This should allow several minutes to several hours of uptime to display status to an operator, perform output functions, or maintain power until a backup generator can come online.
- B. A 24VDC UPS is preferred.
- C. If a 120VAC UPS is required, a “true online” UPS system shall be utilized to ensure a seamless power transition from utility power to battery, and to offer a high level of transient voltage protection.¹
- D. If a 120VAC UPS is required, the product selection is based on the environment – HVAC Controlled vs Industrial/Harsh

¹ See <http://pcguide.com/ref/power/ext/ups/types.htm> for explanation of UPS types

- E. If a 120VAC UPS is required UPS systems shall have a make-before-break bypass switch installed according to the table below. The switch may be mounted in a 19" rack (with custom offset brackets), panel mounted, door mounted, or free standing. This allows the UPS to be removed for servicing without shutting down the PLC panel and corresponding process equipment.

1.4. SURGE PROTECTION DEVICES

- A. Surge protection devices shall be installed where there is a potential for electrostatic discharge from an outside source such as lightning, atmospheric conditions, rotational equipment, etc. Locations specifically required within this are:
 - i. Incoming 120V power to every PLC panel
 - ii. PLC I/O that has a high potential for field originated surges to damage the PLC backplane, such as:
 - a. tank overflow switches (critical)
 - b. outdoor sensors/equipment not in same building as PLC
 - c. underground flowmeters
 - iii. Circuit feeding sensitive electronic equipment such as Radio, Pressure or Flow Transmitter
 - iv. Radio coaxial cable

1.5. POWER SOURCE FOR REMOTE MOTOR CIRCUITS

- A. For motor control circuits in enclosures that also have 480VAC and above, there are 2 acceptable methods to achieve PLC monitoring and control.
 - i. For motor control circuits with dedicated 480VAC/120VAC control power transformers, the source power for PLC inputs must be the control power transformer. The PLC shall have a dedicated input card for each motor to receive these inputs. This allows the motor starter disconnect to completely kill power when working near the 480VAC components, and minimizes back feed.
 - ii. It is also acceptable to have low 24V from the PLC panel pick up digital dry contacts in the motor circuit panel, the wires shall be blue to designate low voltage.
- B. It is NOT acceptable to have 120VAC originate in the PLC panel and feed into the 480V motor enclosure. This creates an unsafe work environment of a disconnect handle being pulled with live circuits still in the motor enclosure.
- C. Always have personnel check for stray voltage, even with the disconnect handle in the OPEN position, when working in electrical panels before removing PPE to work on components de-energized.

PART 2 PRODUCTS

2.1. CIRCUIT BREAKERS – DIN RAIL MOUNT

- A. Acceptable Manufacturer: Allen Bradley
- B. UL Listing: 489
- C. Product Line: 1489

Model #	Description
1489-M1C005	CIRCUIT BREAKER UL-489 0.5A
1489-M1C020	CIRCUIT BREAKER UL-489 2.0A
1489-M1C050	CIRCUIT BREAKER UL-489 5.0A
1489-M1C150	CIRCUIT BREAKER UL-489 15A

D. Specifications:

- Rated voltage: UL 277VAC / 48VDC
- Rated interrupting capacity per UL 489: 10 kA
- Reference temperature for tripping characteristics: 40 °C
- Electrical endurance 6,000 operations (AC and DC); 1 cycle (1s - ON, 9s - OFF)

2.2. CIRCUIT SUPPLEMENTARY PROTECTION – DIN RAIL MOUNT

A. For circuits where branch circuit protection is not necessary and there are no critical load bearing devices (i.e. PLC 24VDC discrete input card), the following supplementary circuit protection is acceptable:

B. Acceptable Manufacturer: Allen Bradley

C. UL Listing: 1077

D. Product Line: [1492-SP](#)

Model #	Description
1492-SP1C005	CIRCUIT BREAKER UL-1077 0.5A
1492-SP1C020	CIRCUIT BREAKER UL-1077 2.0A
1492-SP1C050	CIRCUIT BREAKER UL-1077 5.0A

E. Specifications:

- Rated voltage: UL 277VAC / 48VDC
- Rated interrupting capacity per UL 1077: 10 kA
- Reference temperature for tripping characteristics: 30 °C (derate for higher temperatures)
- Electrical endurance 6,000 operations (AC and DC); 1 cycle (1s - ON, 9s - OFF)

2.3. UPS – 24VDC (PREFERRED)

A. The preferred power source for PLC and panel devices shall be 24VDC. This provides a safer work environment for personnel, and eliminates energy waste associated with 120VAC UPS systems converting to DC and back to AC.

B. Acceptable Manufacturer: Phoenix Contact, model #s below:

Manufacturer	Model	Description
Phoenix Contact	2866323	TRIO POWER SUPPLY 120VAC-24VDC 10A
Phoenix Contact	2320225	QUINT UPS 24VDC-24VDC 10A
Phoenix Contact	2320306	UPS BATTERY/VRLA/24VDC/3.4AH

2.4. UPS – 120VAC IN OFFICE / HVAC CONTROLLED ENVIRONMENT

A. Acceptable Manufacturer: Tripp Lite

B. Product Line: [SmartOnline Double Conversion](#)

Model #	VA	Watts	Mounting	Dimensions H x W x D (in)	Input Plugs
SU1000XLCD	1000	900	Tower	10 x 6.8 x 13.2	NEMA 5-15P
SU1000RTXLCD2U	1000	900	19" Rack 2U	3.5 x 17.5 x 12.5	NEMA 5-15P
SU1500XLCD	1500	1200	Tower	10.2 x 9 x 19.5	NEMA 5-15P
SU1500RTXLCD2U	1500	1200	19" Rack 2U	3.5 x 17.5 x 18.5	NEMA 5-15P
SU3000XLCD	3000	2400	Tower	10.2 x 9 x 19.5	NEMA L5-30P
SU3000RTXLCD3U	3000	2400	19" Rack 3U	5.2 x 17.5 x 26	NEMA L5-30P

Note: As a panel space saving method, the 1500VA or less rack mount models may be custom mounted by panel shop on the PLC enclosure door.

C. UPS systems shall have an Ethernet network management card installed supporting SNMP for remote management.

i. Model: [SNMPWEBCARD](#)

2.5. UPS – 120VAC IN INDUSTRIAL / HARSH ENVIRONMENT

A. Acceptable Manufacturer: [Falcon](#)

Model #	VA	Watts	Mounting	Dimensions H x W x D (in)	Input Plugs	Temperature
SSG1.5KRM-1	1500	1050	Tower	11.1 x 7.6 x 18	NEMA 5-15P	-4°F to 131°F
SSG1.5K-1T	1500	1050	19" Rack 2U	3.5 x 19 x 22.5	NEMA 5-15P	-4°F to 131°F

B. UPS systems shall have an Ethernet network management card installed supporting [SNMP](#) for remote management.

i. Model: [USHA](#)

2.6. UPS – 120VAC HOT SWAP POWER DISTRIBUTION UNIT

A. Acceptable Manufacturer: Tripp Lite

B. Product Line: [PDUB Hot Swap PDUs](#)

Model #	Max Current	Dimensions H x W x D (in)	Input Plugs
PDUB15	15A	9.25 x 20.23 x 6.1	NEMA 5-15P
PDUB20	20A	9.25 x 20.23 x 6.1	NEMA 5-20P
PDUB30	30A	9.25 x 20.23 x 6.1	NEMA L5-30P

2.7. POWER SUPPLY

A. Note: This product is not needed if the 24VDC UPS & power supply is utilized.

B. Acceptable Manufacturer: Sola

C. Model: [SDN 10-24-100P](#)

2.8. SURGE PROTECTION – INCOMING 120V TO PANEL

A. Acceptable Manufacturer: Sola

B. Model: [Sola STV25K-10S](#)

C. General Specifications

- i. Input current rating: 20A
- ii. 50,000 amps of surge protection
- iii. Sine wave tracking and all mode protection provide consistent and reliable protection on all electrical paths
- iv. Thermal fusing prevents MOV overheating caused by excessive current levels

2.9. SURGE PROTECTION – PLC I/O

A. Acceptable manufacturers: Erico, Phoenix Contact, Allen Bradley

B. Models – Digital 120VAC (i.e. Outdoor overflow switch on a ground storage tank)

i. [Erico UTB11ODP](#)

ii. Phoenix Contact Plugtrab Base = 2839282, Module = 2839334

C. Models – Analog or Digital 24VDC (i.e. 4-20mA loop Flowmeter in vault, outdoor sump switch)

i. [Erico UTB30DP](#)

ii. Phoenix Contact Plugtrab 2800976 (direct ground connection from shield terminal)

D. General Specifications

- i. TVSS shall protect all modes via L-L & L-G (Differential and Common Mode).
- ii. Each mode of the TVSS shall be rated to withstand single shot of 20kA 8/20 μ s per ANSI/IEEE C62.45 applied (L+L)-G without failure.
- iii. SPD shall feature multiple stages of protection employing primary Gas Arrester with secondary MOVs and tertiary silicon protection. Each stage shall be decoupled by series impedances to ensure no stage is damaged with tested per requirements (B) above
- iv. Gas Arrester and MOV protection shall provide L-L and L-G protection while silicon stage shall only provide L-L protection to allow SPD to survive earth potential rise situations.
- v. Loop resistance of SPD shall not exceed 1 ohm.
- vi. Maximum line current capability of 1.5A shall be provided
- vii. Circuit frequencies of 0 to 0.5MHz shall be supported
- viii. For devices operating on 33V or less automatic over-current protection shall be provided.

ix. Enclosure shall:

- d. Be non-metallic.
- e. Provide screw terminal connection
- f. Grounding connection shall be via terminal and automatic ground connection to DIN rail
- g. Mount to 35mm DIN rail with width of 18mm or less.
- h. Feature replaceable module removable from fixed base

2.10. SURGE PROTECTION – RADIO COAXIAL CABLE

A. Acceptable Manufacturers: Erico, Polyphaser

B. Models

- i. Erico [CSP1NB90](#) (N-Female/N-Female, transmitter output power < 20W)
- ii. Erico [CSP1SMA90](#) (SMA-Male/SMA-Female, transmitter output power < 20W)
- iii. Polyphaser

2.11. AMBIENT TEMPERATURE TRANSMITTER

A. Specifications: Ambient temperature transmitters shall have the following features:

- i. integrated LCD display in °F
- ii. 4-20mA output to the PLC
- iii. Be loop powered (no external power needed)
- iv. Scaling of 4-20mA output shall be 0 to 160 °F

B. General notes: These transmitters are used in buildings, control panels and vaults. To clarify ordering, ACI has specific part numbers for Missouri American Water to have the scaling factory set at 0 to 160 °F. There are two basic units- one for room/panel temperature and one for a vault or remote locations requiring a temperature transmitter.

C. Acceptable Manufacturer: ACI

D. Model Numbers:

- i. Room/Panel Temperature Part Number

Combined LCD display with onboard temperature sensor:
MAW/TT100-R-4-LCD-PS

- ii. The Vault or Remote Area requiring both a remote sensor and LCD display:

Temperature Sensor:
MAW/TT1K-SP-R

LCD Display & Transmitter:
A/LCD-R-4-20mA

PART 3 EXECUTION

All PLC panel designs shall be submitted to the Missouri American SCADA project engineer or manager for written approval (email is acceptable) before construction.

References:

NEC 310.12 "Conductor Identification"
NEC 200.6 "Means of Identifying Grounded Conductors"
UL 508A "Industrial Control Panels"

40 95 33 Process Control Networking

Version	Date	Author	Description
1.0	5/24/2013	NMA	Rough Draft
1.1	7/30/2013	NMA	Rough Draft – moved sections to CSI 2012
1.2	12/9/2013	JM/NMA	Added detail to Kepware, Reporting sections
2.0	8/2/2018	NMA/EL	Updated Ethernet Switches

PART 1 GENERAL

PART 2 PRODUCTS

2.1. ETHERNET NETWORKS

A. Allen Bradley Device Level Ring (DLR)

To run an [Allen Bradley Device Level Ring](#) inside a plant, a 1783-ETAP module may be utilized with integrated copper 100BaseTx or Fiber 100BaseFx ports. Non-compliant DLR devices may not be placed in the ring itself, and must be isolated with a 1783-ETAP or other DLR compliant module.

Newer Control and Compact Logix PLCs have 2 copper ports that support DLR without an external ETAP module. If fiber optic is a requirement, use the ETAP module.

B. Modbus RTU to TCP

Devices that communicate via Modbus RTU on RS232 or RS485 physical media shall be converted to Ethernet/IP (ODVA) for use by Allen Bradley PLCs by a [Digi IAP](#). Protocol conversion is seamless and programming is greatly simplified, see the document below for setup information:



Digi IAP
Modbus-Allen Bradley

C. Cabled Process Control Networks

Cat6 cable shall be used within buildings, certified test results for each cable to be provided to Missouri American Water.

D. Fiber Optic

E. Cabling – from end points throughout building into main patch panel

Please refer to the *American Water Infrastructure Wiring Bid Specification*, latest version.

SCADA copper network cables shall be **GREEN**.

F. Ethernet Switches / Media Converters

Depending on the environment and number of interfaces needed, refer to the table below.

Manufacturer	Model	Managed	Environment		Interfaces		Mount
			Office	Harsh	Copper	Fiber	
Cisco	WS-C2960+24TC-L	Layer 3 static	x		24	2GE/SFP	19" Rack
Cisco	WS-C2960+48TC-L	Layer 3 static	x		48	2GE/SFP	19" Rack
Allen Bradley	Stratix 5700 line	Layer 2 or Layer 3 static		x	Varies	Varies	DIN Rail
Allen Bradley	Stratix 2000 line	Unmanaged		x	Varies	Varies	DIN Rail
Allied Telesis	MC101XL-ST	Unmanaged	X		1 FE	1 FE MM ST	19" Rack
N-Tron (single port)	102MC-ST (or similar)	Unmanaged		X	1 FGE	1 ST	DIN rail

G. SFP Modules

If an SFP module is required, use the same manufacturer as the switch – Cisco or Allen Bradley. Refer to the table below, and verify with the manufacturer’s latest compatibility chart.

Manufacturer	Model	Environment	Interface
Cisco	GLC-FE-100FX=	Office	MM FE LC
Allen Bradley	1783-SFP100FX	Harsh	MM FE LC

H. Fiber connectors

I. LC connectors shall be used wherever possible.

J. IGMP Snooping

If Ethernet/IP protocol shall be utilized to allow networked devices to communicate, Unicast packets shall be used as a default. If multiple devices need to share sub-second information (very rare in the water industry) via Multicast packets, select the “Advanced Features”. In this case, “IGMP Snooping” must be enabled to minimize packets flooding to all devices.

2.2. DAISY CHAIN NETWORKS

A. DeviceNet

DeviceNet may be utilized for process level devices such as VFDs, feed pumps, power monitors, motor overloads, etc. An interface card shall be utilized for Compact or Control Logix PLCs.