* 1. ELECTRONIC CONTROLS

Copy "Electronic Controls Paragraph below and re-edit for each type of Electronic Control required.

Insert number to complete drawing designation. Use these designations on Drawings to identify each Electronic Control.

* + - * 1. Electronic Controls <**Insert drawing designation**>: Electronic Networked Water Management System.

Basis-of-Design Product: Subject to compliance with requirements, provide Willoughby Industries; WMSII or a comparable product by one of the following:

Sloan Valve Company.

<**Insert manufacturer's name**>.

Description:

Water Management System: PC-based server (operator workstation) running on Windows 10 or newer operating system. Network communications shall be CANbus based providing proactive, prioritized communications status of the controller inputs/activities to operator workstation. Polling-type networks shall not be permitted. PC shall serve as the operator interface serving single or multiple individual trunks of networked Cell Valve Controllers (CVC's). The PC operator workstation shall display all fixtures and indicate their operation and state graphically. PC shall be equipped with:

Touchscreen Monitor: 21 inch (534 mm) or larger with HD resolution of 1366 by 768 pixels minimum.

RAM: 8 GB minimum.

Hard Drive: 256 GB minimum.

USB Ports: 4 minimum.

CAN-bus network used on Willoughby WMS II requires one interface device for each daisy-chained network of individual cell valve controllers (CVCs) on a network that can have up to 127 controllers on it and control up to 762 valves. A system can have numerous interface devices for even larger networks. However, networks are usually designed to cover only the area and fixtures that will be managed from a single guard station. There is a minimal benefit and likely a disadvantage to have a computer controlling many fixtures outside of a staff' center's area of responsibility.

CANbus interface device(s) for network communication to Cell Valve Controllers (CVC's).

Water Management Software: Installed on PC, configured, and tested prior to installation to provide control and monitoring of security plumbing fixtures flush valves, lavatory valves, and shower valves connected to the CANbus networked control system.

WMSII operator workstation shall be located where indicated on the drawings.

Floor plans, screen layouts, setting navigation regions, and other engineering of the system to a specific facility are done by Willoughby based on layouts and information provided by the customer. These are not end-user-enabled features. Identify who is responsible for supplying the information to Willoughby to enable the system to be designed, configured, and tested.

Screen Graphics: [**Floor Plan Screen Layout - standard**]. Layout information (areas and cell numbers and fixtures controlled by networked system) shall be supplied to system supplier in DWG file format. Based on information supplied:

Level 1 screen shall:

Display top-level layout of defined sections of the facility.

Provide selected areas identified by shape, color, and label to link Level 1 screen to Level 2 screens with enlarged details and fixtures of individual facility sections.

How many fixtures are placd on a screen and whether only a Level 1 screen is employed or a Level 1 screen with multiple Level 2 screens will be a function of the size and resolution of the monitor, the layout onto which fixture icons are being placed, and reasonable spacing between fixtures.

Level 2 screens shall:

Provide magnified detail and fixture icons.

Provide identification of each fixture by location on the screen layout, icon type, and labeling (e.g., cell number of its location).

It shall be acceptable to use only a Level 1 screen if all fixtures can be displayed legibly and logically by functional area on one screen.

Provide graphical indication of fixture status.

Individual microprocessor-driven Cell Valve Controllers (CVCs) shall be located in the plumbing chase(s) and shall control the operation of electronic lavatory valves, electronic shower valves, electronic drinking fountain valves, and electronic-hydraulic flush valves. An option shall also be available to control the operation of master shut-off valve(s) that provide(s) water to an area of several cells or fixtures.

CVC's shall require 24 volts AC for operation. System manufacturer shall supply 120/24 VAC step-down transformers for each CVC supplied. Transformers shall be UL Class 2, overload protected.

Each CVC shall be capable of controlling up to 2 lavatory/toilet combination units (1 hot valve, 1 cold valve, and 1 flush valve for each combination unit), 3 individual lavatories, or up to 2 toilets with overflow sensing (6 toilets without overflow sensing), or combinations thereof up to a total of 6 individual low-voltage solenoid valves. CVC's shall be modular and capable of operating in a fully networked or stand-alone configuration.

Note that there are 12 LED's for monitoring the outputs of the CVC. Six are in parallel across the outputs to monitor the 24 volt AC output itself. Six are status lights that indicate the internal programmatic status of an output. It is important to know when an inhibit state exists that will prevent an output channel from activating when an input switch is pushed.

Valve output LEDs on the CVC shall provide the status of all valve outputs. An additional set of status LEDs shall indicate the presence and type of any inhibiting or lockout condition on valve function.

WMS II CVC also has four additional "Diagnostic LEDs".

Diagnostic LEDs: Provided on CVC to indicate the presence of incoming AC control power, that the CVC is operational, communication status, and input status.

HB LED (heartbeat): Flashes to show controller is not only powered, but that the program in the controller is running. It flashes on and off.

COM LED: Indicating when there is network communications activity occurring.

ERR LED: Indicating a communication error occurred.

IN LED: Indicating one of the input switches is closed. (It can be used to diagnose input switch problems.)

Diagnostic pushbuttons on the CVC shall be provided to enable maintenance personnel to manually activate valves and overflow functions from the controller in the plumbing chase.

Pushbuttons are selected with the fixture, but the subparagraph below further defines the characteristics of all the electronic pushbutton choices: [**EPB Electronic Push-Button**] [**EPBH Electronic Ligature-Resistant Push-Button**] [**PZPB Piezo Electric Push-Button**].

Valve activation shall come from vandal-resistant stainless steel internally sealed pushbuttons.

Pushbuttons shall require less than 5 lbf (22.2 N) to activate.

Pushbutton housings shall be electrically isolated from system voltages.

All solenoid valves shall be non-hold open (normally closed), but all metering times shall be independently adjustable.

Metering time shall be:

Adjustable from one (1) to sixty (60) seconds for each lavatory valve.

Adjustable from one (1) to ten (10) seconds for each flush valve.

Adjustable from one (1) second to nine (9) minutes and fifty-nine (59) seconds for each shower valve.

Metering cycles shall be interruptible with a second pushbutton activation.

All settings shall be programmable for a single fixture or a group selection of all fixtures of the same type on the operator workstation screen.

Valve timing settings can be changed from the standard settings, but the standard settings are given as a beginning template.

Each controller shall be programmed at the factory with the following settings:

Lavatory Valve Cycle: Fifteen (15) seconds hot water run time, fifteen (15) seconds cold water run time.

Flushometer valve actually takes approximately 10 seconds to complete its cycle, but the time indicated below is for the electrical pilot valve that triggers the flushometer.

Flush Valve Cycle (Water Closets and Urinals): Two (2) seconds on time.

Shower: Upon initiation, two (2) minute run time. If the user finishes the shower before the two (2) minute period, user may press pushbutton a second time to terminate the cycle. Pressing the pushbutton during the run time shall not extend the cycle.

All other system features (initiate delay, re-initiate delay, overuse control, FlushGuard, non-use, schedule permits) will not be enabled unless specified. They can be easily activated at commissioning time. However, If desired, they can be added in this section. There is a disadvantage to activating automatic system inhibits before a system is commissioned because inhibits (fixtures not permitted to function by the control) appear as a system failures until one understands how control inhibits functions.

Re-initiate and initiate delays may be set for all fixture types on WMS II systems. Some systems only provide the feature for flushing fixtures.

A programmable re-initiate delay feature function (toilets, urinals, lavatories, showers, and drinking fountains) shall be provided to control the amount of use to a preset threshold, after which the function will be locked out for a preset period of time of up to four hours.

A programmable initiate delay feature for the fixture function (toilets, urinals, lavatories, showers, and drinking fountains) shall be provided to enable a timed delay between the pushbutton switch activation and the subsequent valve activation.

The overuse feature is available for all types of standard plumbing fixtures - not just toilets. Showers have also been a significant area of abuse in cells containing both a combination unit and a shower. At 1.5 to 2.5 GPM (0.10 to 0.15 L/s) typical shower flow rates, a large amount of water can be accumulated with persistent running of the shower and plugging of the drain.

Because of the application of initiate delay, re-initiate delay, and overuse control to all fixture types; the maximum settings are determined by fixture type - number of valve activations for flushing devices and amount of on-time for all other fixture types.

System shall provide overuse control consisting of:

Individual toilet, urinal, lavatory, shower, and drinking fountain use limits.

Programmable response to overuse condition of notification at the operator workstation, latched lockout of fixture, or auto-limit of fixture operation to prevent its overuse. All overuse notifications shall appear on the operator workstation.

Configurable overuse limitation to a given number (adjustable) of valve actuations for flushing devices or a given amount of cycle-on time (adjustable) for showers, lavatories, and drinking fountains within a given time period (adjustable) of up to 24 hours.

Concurrent operation with other use-control features of the system.

The operator workstation shall be capable of networks of up to 508 CVC nodes and up to 3,048 valves.

Network Wiring: Twisted 3-pair cable of CAT3 or better rating shall be used for all network wiring (provided by others). Installer shall follow system manufacturer's instructions for installation and verification testing. Each network shall not exceed 3,000 feet (915 meters) in total length from operator workstation to the last CVC in the network string.

WMS II uses non-volatile flash memory to retain settings in the event of a power failure. Others use a battery-backup to provide memory retention. Batteries at some point will have to be replaced. Also, if the battery is inadvertently removed from a battery-backed-up system, all settings will be lost.

In the event of a loss of network communications or loss of power, system programming shall be retained in each CVC to allow fixtures to operate in the same way that they operated prior to the loss of power or the loss of network communications.

Refer to color brochure on the Willoughby Industries website for a photo description of details. Installation is greatly simplified by use of color and connector gender. Also, controls are manufactured with control side connections already completed.

Input/Output Ports Cabling:

Each input/output shall be clearly identified by the use of harness location, color coding of wires, gender of connectors (1/4 inch (6 mm) fully insulated male tab connections for inputs and 1/4 inch (6 mm) fully insulated female tabs for outputs), and supplied documentation.

All input/output cables shall be supplied with cables attached to the CVC and only outboard switch and valve connections to be plugged in by installer.

If longer cable lengths are needed, specify at the time of order. Common crimp connections are used, so they can also be easily made by installation or maintenance personnel.

Supplied valve and switch cabling from the CVC control board shall each be 8 feet (2.4 m) with the option to add extensions if necessary.

The networked system shall be capable of:

Enabling or disabling an individual fixture or an entire group of fixtures from the operator workstation.

Controlling the maximum number of simultaneous flushes (adjustable from 1 to 999) that can occur within a given time period (adjustable from 1 to 60 seconds).

Automatically flushing a toilet or actuating a non-flushing fixture after an adjustable period of non-use has passed to prevent drying out or creating stagnate water.

Allowing for remote actuation of fixtures from the operator workstation.

Providing ability from the operator workstation to dynamically lock or reset (unlock) a fixture.

Schedule permits (lockouts) are set by fixture. Which fixtures are set to a specific schedule is at the discretion of those with sufficient security-level access to those parameters.

Providing up to 4 scheduled permit time periods per day and week for selected fixtures.

Providing indication and reset capability of overflow alarms.

Logging of time, date, and function of all valve activity chronologically, including:

On and off times of each fixture function.

Lockout times.

Network status changes by node.

The networked system shall provide 4 levels of security accessed via user name and password depending on system settings (Each level includes the functions of the previous lower level).

View-only Security Level:

Move between display screens.

Observe fixture activity on screens.

Observe any loss of communications to fixture controllers.

Log into a higher-security level.

Operator Security Level:

Remote valve actuation.

Fixture lockout/reset.

Clear alarms (overflow and overuse).

Supervisor Security Level:

Set and adjust valve timing.

Set and adjust initiate and re-initiate delays.

Set and adjust permit (lockout) schedules.

Set and adjust overuse limits and responses.

Set alarm display options.

Enable/disable and set FlushGuard to limit simultaneous flushes.

Access fixture event log (if enabled by administrator).

In the "Event Log" if it is enabled, fixture events are logged to enable further post processing to calculate water consumption. Duration would be a calculation that could be made with the time stamp associated with the on and off events of any fixture function.

Use log files to analyze water-consumption history.

Enable and disable sound effects.

There is also a separate "User Activity" log that records user events based on the log in. The who, what, and when of any changes to settings or general user activity is logged in this file.

Access system user activity log files (if enabled by administrator).

Optional selection of a 24-hour point at which all overuse counts will be reset.

Supervisor and Administrator Levels have been aligned to give supervisor control over use of system for fixture control, but IT functions (logging, networking, and user logins) are controlled at Administrator Level.

Administrator Security Level:

Create system user accounts with user name, password, and security level defined.

Set and adjust network communications settings.

Enable and configure remote client connections to operator workstation.

Configure fixture event log files and user activity log files.

Set sound files to be used when sound feature is enabled.

A generic description of the PC equal that specified earlier for the central operator workstation will be adequate for a client PC that connects to the Willoughby Industries server (operator workstation), but a system integrator should be employed to verify different systems will marry together successfully other PCs that are configured and supplied by a firm other than Willoughby Industries.

Client-server Networking System shall be capable of linking client sessions on other Windows-based PCs to the main operator workstation via an Ethernet network. Control and monitor functions possible on the central operator workstation may be performed on a client PC based on user security level.

Operator workstation will be located where indicated on drawings.

Water management software shall be installed, configured, and verified by system integrator with assistance from water management software supplier.

Solenoid valves used on WMS II are 24 VAC, 5.5 watt and coils with 1/4 inch (6 mm) wide male tab terminals.

Solenoids compatible with voltage, power, and mating connections of the outputs of the CVC.

Supply shut off valve: One valve for each water supply.

The WMS II controller has been designed to provide barriers (walls and spacing) to stop water from periodic drips or spray leaks from reaching the circuitry in the enclosure. (Our experience has shown that the number one problem with mixing leaking plumbing and electronic controls is exposed electronic connectors at the edge of controls. WMS II has all control box connections placed well inside of the enclosure.)

Controller (CVC) Housing: Water resistant enclosure.

* + - * 1. Electronic Controls <**Insert drawing designation**>: Electronic Standalone Water Management System.

Basis-of-Design Product: Subject to compliance with requirements, provide Willoughby Industries; WMSII or a comparable product by one of the following:

Sloan Valve Company.

<**Insert manufacturer's name**>.

Description:

Individual microprocessor-driven Cell Valve Controllers (CVCs) shall be located in the plumbing chase(s) and shall control the operation of electronic lavatory valves, electronic shower valves, electronic drinking fountain valves, and electronic-hydraulic flush valves.

A portable programmer is required if field changes to system settings need to be made on site.

Portable programmer [**Yes**] [**No**]. If supplied, portable programmer will be equipped with the following:

Portable device running Windows 10 or newer.

Portable device with keyboard and pointing device (touchpad or external mouse).

Screen: HD resolution of 1366 by 768 pixels minimum.

USB Ports: 1 minimum.

Hard Drive: 256 GB minimum.

WMSII software installed with configurations of all CVCs in the facility.

CVCs shall require 24 volts AC for operation. System manufacturer shall supply 120/24 VAC step-down transformers for each CVC supplied. Transformers shall be UL Class 2, overload protected.

Each CVC shall be capable of controlling up to 2 lavatory/toilet combination units (1 hot valve, 1 cold valve, and 1 flush valve for each combination unit), 3 individual lavatories, or up to 2 toilets with overflow sensing (6 toilets without overflow sensing), or combinations thereof up to a total of 6 individual low-voltage solenoid valves. CVCs shall be modular and capable of operating in a fully networked or stand-alone configuration.

Note that there are 12 LED's for monitoring the outputs of the CVC. Six are in parallel across the outputs to monitor the 24 volt AC output itself. Six are status lights that indicate the internal programmatic status on an output. It is important to know when an inhibit state exists that will prevent an output channel from activating when an input switch is pushed.

Valve output LEDs on the CVC shall provide the status of all valve outputs. An additional set of status LEDs shall indicate the presence and type of any inhibiting or lockout condition on the valve function.

WMS II CVC also has four additional "Diagnostic LEDs".

Diagnostic LEDs: Provided on CVC to indicate the presence of incoming AC control power, that the CVC is operational, communication status, and input status.

HB LED (heartbeat): Flashes to show controller is not only powered, but that the program in the controller is running. It flashes on and off.

COM LED: Indicating when there is network communications activity occurring.

ERR LED: Indicating a communication error occurred.

IN LED: Indicating one of the input switches is closed. (It can be used to diagnose input switch problems.)

Diagnostic pushbuttons on the CVC shall be provided to enable maintenance personnel to manually activate valves and overflow functions from the controller in the plumbing chase.

Pushbuttons are selected with the fixture, but the subparagraph below further defines the characteristics of all the electronic pushbutton choices: [**EPB Electronic Push-Button**] [**EPBH Electronic Ligature-Resistant Push-Button**] [**PZPB Piezo Electric Push-Button**].

Valve activation shall come from vandal-resistant stainless steel internally sealed pushbuttons.

Pushbuttons shall require less than 5 lbf (22.2 N) to activate.

Pushbutton housings shall be electrically isolated from system voltages.

All solenoid valves shall be non-hold open (normally closed), but all metering times shall be independently adjustable.

Metering time shall be:

Adjustable from one (1) to sixty (60) seconds for each lavatory valve.

Adjustable from one (1) to ten (10) seconds for each flush valve.

Adjustable from one (1) second to nine (9) minutes and fifty-nine (59) seconds for each shower valve.

Metering cycles shall be interruptible with a second push of the button.

All settings shall be settable for a single fixture or a group selection of all fixtures of the same type on the PC screen.

Valve timing settings can be changed from the standard settings, but the standard settings are given as a beginning template.

Each controller shall be programmed at the factory to the following settings:

Lavatory Valve Cycle: Fifteen (15) seconds hot water run time, fifteen (15) seconds cold water run time.

Flushometer valve actually takes approximately 10 seconds to complete its cycle, but the time indicated below is for the electrical pilot valve that triggers the flushometer.

Flush Valve Cycle (Water Closets and Urinals): Two (2) seconds on time.

Shower: Upon initiation, two (2) minute run time. If the user finishes the shower before the two (2) minute period, user may press pushbutton a second time to terminate the cycle. Pressing the pushbutton during the run time shall not extend the cycle.

All other system features (initiate delay, re-initiate delay, overuse control, non-use) will not be enabled unless specified. They can be added later with the use of a portable programming device running WMS II software.

Re-initiate and initiate delays may be set for all fixture types on WMS II systems. Some systems only provide the feature for flushing fixtures.

A programmable re-initiate delay feature for fixture function (toilets, urinals, lavatories, showers, and drinking fountains) shall be provided to control the amount of use to a preset threshold, after which the function will be locked out for a preset period of time of up to four hours.

A programmable initiate delay feature for the fixture function (toilets, urinals, lavatories, showers, and drinking fountains) shall be provided to enable a timed delay between the pushbutton switch activation and the subsequent valve activation.

The overuse feature is available for all types of standard plumbing fixtures - not just toilets. Showers have also been a significant area of abuse in cells containing both a combination unit and a shower. At 1.5 to 2.5 GPM (0.10 to 0.15 L/s) typical shower flow rates, a large amount of water can be accumulated with persistent running of the shower and plugging of the drain.

Because of the application of initiate delay, re-initiate delay, and overuse control to all fixture types; the maximum settings are determined by fixture type - number of valve activations for flushing devices and amount of on-time for all other fixture types.

Caution should be used in using this feature in a standalone mod since there is no easy way to easily monitor its workings - only its effect - a fixture is locked out. It can be cleared by pressing the reset pushbutton on the controller in the chase.

System shall provide overuse control consisting of:

Individual toilet, urinal, lavatory, shower, and drinking fountain use limits.

Programmable response to overuse condition of latched lockout of fixture, or auto-limit of fixture operation to prevent its overuse.

Configurable overuse limitation to a given number (adjustable) of valve activations for flushing devices or a given amount of cycle-on time (adjustable) for showers, lavatories, and drinking fountains within a given time period (adjustable) of up to 24 hours.

Concurrent operation with other use-control features of the system.

WMS II uses non-volatile flash memory to retain settings in the event of a power failure. Others use a battery-backup to provide memory retention. Batteries at some point will have to be replaced. Also, if the battery is inadvertently removed from a battery-backed-up system, all settings will be lost.

In the event of a loss of power, system timing parameters shall be retained in each CVC to allow fixtures to operate in the same way that they operated prior to the loss of power.

Refer to color brochure on the Willoughby Industries website for a photo description of details. Installation is greatly simplified by use of color and connector gender. Also, controls are manufactured with control side connections already completed.

Input/Output Ports Cabling:

Each input/output shall be clearly identified by the use of harness location, color coding of wires, gender of connectors (1/4 inch (6 mm) fully insulated male tab connections for inputs and 1/4 inch (6 mm) fully insulated female tabs for outputs), and supplied documentation.

All input/output cables shall be supplied with cables attached to the CVC and only outboard switch and valve connections to be plugged in by installer.

If longer cable lengths are needed, specify at the time of order. Common crimp connections are used, so they can also be easily made by installation or maintenance personnel.

Supplied valve and switch cabling from the CVC control board shall each be 8 feet (2.4 m) with the option to add extensions if necessary.

Solenoid valves used on WMS II are 24 VAC, 5.5 watt and coils with 1/4 inch (6 mm) wide male tab terminals.

Solenoids compatible with voltage, power, and mating connections of the outputs of the CVC.

Supply shut off valve: One valve for each water supply.

The WMS II controller has been designed to provide barriers (walls and spacing) to stop water from periodic drips or spray leaks from reaching the circuitry in the enclosure. (Our experience has shown that the number one problem with mixing leaking plumbing and electronic controls is exposed electronic connectors at the edge of controls. WMS II has all control box connections placed well inside of the enclosure.)

Controller (CVC) Housing: Water resistant enclosure.