

## Overview

The Mission-managed SCADA system can be used to remotely control devices. It can be used to automatically or manually control a device at one location based on a condition at another location. Automated remote control functions available with the Mission Communications system include: tank and well control, digital interconnect, analog interconnect, pulse interconnect, and temperature interconnect.

Regardless of the remote-control application, a well-designed and operated system can make a temporary failure nearly transparent and minimize side effects from an extended failure. Mission strongly encourages the best practices contained in this document to aid in the design, installation, and operation of systems that perform control functions on remote assets. This document addresses the following:

- Alarms and alerts that aid in operations
- System design for fault tolerance
- Consideration for increasing equipment life and reducing energy costs
- The importance of documentation for staff training and testing

Remote control should not be used for systems requiring frequent state changes and tight timing tolerances, such as lift station control. The remote control of wastewater applications is not permitted unless reviewed and approved by appropriate Mission personnel in writing. Remote control should be used to supplement local control, not replace it.

MyDro 850 remote terminal units (RTUs) are recommended for most applications requiring transducers and all applications that are used for remote control of any kind. These devices include three output relays that are the basis for most remote control. MyDro 50s can be used for tank monitoring when set for two-minute reporting interval. The built-in input/output (I/O) capabilities are fully explained on the respective specification sheets and I/O expansion options are described in the Accessory Catalog.

This document is not an installation or training manual. The document titled “Tank and Well Control Package” is available for a high-level understanding of that system. Likewise, all Mission hardware has a corresponding installation manual. Third party sensors, control panels, and accessories also include owner’s and/or operator’s manuals. Please read and understand those documents. Finally, Mission offers included technical support, training webinars, videos, and more. Registration for these resources is available at [123mc.com](http://123mc.com) under the Support tab.

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## Types of Automated Remote Control

**Tank and well control** relies on the value of an analog level transducer at the tank to open or close one or more relays at RTUs, typically located at well or valve sites.

**Digital interconnect** is used when the value of a digital input on the source RTU should cause a relay to energize or de-energize at the controlled or destination RTU. One example is a high-level at one location causing a diverter pump or valve at another location to operate.

**Analog interconnect** is used to mirror an analog value from one RTU to another. Variable speed drives, proportional valves or chemical dosing pumps that accept 4–20 mA signals are typical applications.

**Pulse-based interconnect** causes a relay state change based on a volume moved over a time frame. Typical use cases are for enforcement of sewage discharge agreements between plants (meat packing, industrial, etc.) and sewerage authorities. For example, after a given number of gallons of flow for the day (as determined by a pulse flow meter) a relay on the Mission RTU will energize. That relay can illuminate a light or siren that notifies the staff that the maximum discharge for the day is approaching and plant cleaning should commence. When a second value is reached, a second relay can be energized causing a discharge valve to close. In these examples the flow volumes and time of day for reset must be entered by Mission personnel.



## Alarms and Notifications

It is vital that the web portal include the names and contact methods of all utility operators. Furthermore, notification rules must be set up. These destinations and settings should be reviewed and tested periodically. Instructional videos are available from the web portal.

Problem resolution can be expedited by assigning specific alarm types to the most qualified staff members. Because it is impossible to know how or when a utility will be compromised during a natural disaster, a full variety of communication methods should be specified in the notification rules. Methods include voice call, text message, email, fax, and page. A variety of staff members should be included in case the primary on-call members are unable to acknowledge the alarm notifications and address the cause.

Mission Technical Support can help with sophisticated notification logic that takes into account compound conditions. For example, users might want to receive alarms when chlorine levels are low, but only when a pump is running. Contact Technical Support to discuss the best approach to complex alarm conditions.

Inconsequential notifications not only waste operator time, but they obscure important alarm events. Multiple nuisance alarm suppression features are available throughout the Mission system, and emailed alerts can be set for non-critical information about the system.

Many of the items discussed in this document can result in alarm notifications to staff when input states are off-normal or analog values are outside normal values. High and low alarm set points must be entered with all analog sensors. This requires that the installation includes all necessary sensors or instruments. For example, pump call-to-run-fail-to-run requires a digital input to sense pump run. The relay state alone is not adequate, as the circuit breaker or Hand-Off-Auto (HOA) switch to the pump could be off. It is also highly recommended to associate an alarm with the HOA switch, which will indicate when it is not in the auto position.

Rule Name	Device Group	Input/States	Actions
City Center Stations	W. Park Street LS - 4G, Washington Street LS	Input/States (ok)	[Calendar] [Trash] [List]
West Side Lift Stations	Herbert Hoover BVT	Input/States (ok)	[Calendar] [Trash] [List]
Solar Alarms	2nd Solar MyDro- 4G, Solar MyDro - Cat M1	Input/States (ok)	[Calendar] [Trash] [List]
Chlorine Residual	Nature Preserve Reservoir - Cat 1	Input/States (ok)	[Calendar] [Trash] [List]
Lift Stations Near the Lake	Aqualand Marina - Cat 1, Lakeside Drive LS - Cat M...	Input/States (ok)	[Calendar] [Trash] [List]
All Alarms	All Devices	All Inputs	[Calendar]

## Users, Security, and Logins

Unique user credentials (full name, email address, and intended access level) should be assigned to each operator. Mission can assign Superadmin users from the utility who need access to create new users and control specific privileges and credentials.

Notifications about system configuration changes can be sent to management users via email. Set up this feature by going to: Start Menu → Setup → Reports → Configuration Alerts. Control options like Tank and Well can be selected from the list of system options. The manager should verify and test that any changes yield the expected results.

Mission supports enforcing of Two-factor Authentication (2FA), strong passwords, mandatory password resets, failed login tracking and lockout protection on 123SCADA. These are highly recommended to better protect critical infrastructure like water supply systems.

Review the login list periodically and remove access for staff members who are no longer with the organization. For security reasons, some system settings must be set by Mission Technical Support staff.

## Nuisance Alarm Suppression Options

Digital inputs can be set with debounce settings to delay alarm call-outs so that a bouncing float can commit to the closed or open state.

Suppress notifications on AC failure (AC override) is available for inputs that will result in an alarm if power is lost. Since the Mission system can alarm on AC failure, some operators choose to suppress the alarm notices from other digital instruments.

Alarm notifications can be disabled for an entire unit or a specific input anywhere from a few minutes to an indefinite amount of time. Mission discourages disabling an entire RTU for alarm call-outs indefinitely. If a sensor is problematic, disable only that input and utilize the timer so that it will re-engage after the anticipated repair period. The web portal includes a report of disabled inputs. Review this list periodically and properly resolve the root cause.

Device Name	Input	Input Description	Disabled Until
Pump Station	Digital 5	Grinder Failure Alarm	4:30 PM
	Comms	There is a communications fault. There will be no alarms or remote control from this unit until it returns on line.	4:30 PM

Utilize the Daily Station Summary Report and configuration alerts to keep management informed about changes to RTU and Notifications.



## Communication Considerations

The source data (tank level, digital input state, etc.) is transmitted by the RTU, analyzed as it is received, and stored on Mission servers. Commands are dispatched to the destination RTU(s) as a result of the conditions and desired set points. Automated remote control functions are dependent on both the source and destination RTU(s) being online and the related I/O functioning.

The cellular radios utilized by Mission RTUs automatically connect to the most appropriate tower in the area. By following the best practices for antenna placement, as described in the installation manual, the RTU is likely to have multiple towers in range and therefore superior connectivity.

Cell towers are built to withstand natural disasters and most include uninterruptible power supplies or local generators. However, carriers periodically perform system maintenance. When antenna best practices have been followed, additional towers may be in-range and a tower issue is more likely to be transparent to the RTU.

The overall system (size of tanks, set points, etc.) should be configured to accommodate short duration communication failures and notify the operator of extended outages.

In all cases, the system should be set up to fail in the best mode possible. For example, if a destination RTU at a well site was completing a fill cycle and it were to go offline, what should happen? Under user direction, Technical Support can page the RTU so that output relays experiencing communication failure continue in their current state or de-energize. Contact Mission Technical Support by phone or by submitting a ticket via the web portal to make changes to the relay behavior on communications failure. On MyDro units, the communications failure behavior can be set individually for each relay at the RTU touch screen by way of the Config menu.

If the tank is non-pressurized and can spill without causing damage, the best choice may be “no relay state change on communications failure.” On the other hand, a pressurized tank might rupture or the pump may burn out when using that setting. It is best to include a pressure switch into the local control circuit for the well pump to de-energize before the critical pressure is reached, even if the Mission relays are energized. Better yet, it may be possible to operate this system entirely locally, with Mission strictly performing monitoring and alarming functions.

The source RTU at a tank site can also lose communications as a result of a cellular problem or extended loss of power. The Mission notification system should be set to notify operators about these conditions. In general the alarm notification will say: “there has been a communication fault at [site name].” The tank and well system must be operated manually until the communications link has returned. This notification will be repeated once every four hours while the source system is offline.

The operator can manually operate any online well pumps via the tank and well menu within the web portal. The virtual HOA switches can be used to cycle the pumps on (hand) and off based on a combination of typical fill cycle durations and visual inspection of tank levels. The system should be returned to auto mode when the tank level reading is reporting properly.

It is vital that there is an active alarm rule for communication loss. It should be noted that a hardware failure of the Mission RTU

effectively results in a communication failure but would generally cause the output relays to default to their de-energized position as would a loss of both power and battery to the Mission RTU.



**Note:** Generally, pump motor starter coils are wired to the normally open (N/O) contacts of the Mission single pole double throw relay to cause the pump to run when a relay is energized. Mission discourages the use of the normally closed (N/C) contact. If it is used, carefully consider the implications since the device would be left in an operating status in many failure modes including loss of power/battery, communications failure, and even RTU failure.

If Analog output features are being used considerations during communication failures and RTU reboots should be considered. Server side logic is included with analog output services, such that once the RTU returns on line the analog output value will be re-sent to the RTU. While the RTU is offline no (0 mA) analog output signal will be available.

## Power and Solar Considerations

In the event of an AC power failure, the Mission RTU will operate on battery for a period of time and cause an AC failure alarm to be dispatched.

Battery capacity declines with age and temperature. Batteries larger than the standard 12-volt, 5-amp-hour battery are available from Mission or local sources. Mission recommends batteries be tested under load twice annually and replaced every other year. The MyDro RTU has a sophisticated battery circuit that tests the battery under load each hour. The battery test function can be manually engaged under the Config menu from the LCD touch display. Low battery alerts will be dispatched via email if the battery voltage drops below 11.5 VDC any hour during the previous day.

RTUs at tanks are often solar-powered. Solar-powered systems lose capacity during the winter months and inclement weather. Size solar panels and batteries for the most extreme situation. Tasks should be scheduled for trimming trees, cleaning the glass and adjusting the panels to account for the lower angle of the sun during the winter. Provisions for clearing snow off of panels should be included. Various mobile apps and Mission training videos are available which discuss these variables.

Active devices like analog transducers and relays powered from the Mission system will affect the available time the RTU can operate using battery power. Many digital sensors like floats have negligible effect on the available time under battery power. Size batteries and solar panels based on all of the factors described.



## Related Inputs

For service and safety reasons, most systems include a local HOA control switch for the primary components. An additional set of contacts may be added to many HOA switches. The additional dry contact can be wired to an unused Mission digital input and an alarm rule created for the circumstance “HOA switch not in auto.” An alarm delay of a few minutes can be set on that digital input (DI) so that an operator can perform a site visit and briefly test a pump by toggling the local HOA switch to hand or off. An alarm notification will only be dispatched if HOA switch is not returned to auto before the expiration of the delay. In other words, a notice will be dispatched if the operator forgets to return it to the auto position in a timely manner.

An energized Mission relay does not necessarily mean the pump is running. The Mission strap-on current sensing switch can be utilized to sense pump run with more certainty than interposing relays or auxiliary contacts. The Mission current sensing switch senses the magnetic field around a load wire to the pump when greater than ~5 amps of current is flowing to report the pump state. That pump state is relied on by the Positive Relay Feedback features described in other parts of this document. Reasons a pump may not run even though Mission is calling for it to run include:

- No AC power at the site
- The pump is burned out or the breaker is blown
- The local HOA switch set to off
- A local safety lock-out or wiring problem related to the motor starter circuit

Secondary methods of level detection should be considered. For example, high and low floats can be included to complement analog level sensor alarm set points. Those can be adjusted to alarm prior to or after alarm thresholds are breached but independent of the analog instrumentation.

### Remote Analog Output (Analog Interconnect)

An unused analog input can be wired in the same current loop as the analog output module so that the result of the analog output is reported back to the Mission system. If an unused analog input is available, it can be wired in parallel to the primary input to obtain additional alarm set points.

## Tank and Well

From the Tank and Well area of the web portal, pumps can be put in automatic, on, or off modes. Lead and lag set points can be changed. Lead, Lag 1, Lag 2, Lag 3, and Lag 4 pump roles can be assigned and changed.

The pump icons indicate the status of the Mission relays. Use the Positive Relay Feedback (PRF) alarm to notify staff members of a discrepancy between the relay state and pump run status. The virtual alternator can be switched on or off. Please note that the alternator will alternate all configured pumps or valves set to the auto position of the local HOA switch.

Users can select a maximum runtime for each pump, to help equalize runtimes across all pumps. Once the first pump reaches the maximum runtime, the system will alternate to the next pump. This feature allows pumps to rest so that groundwater sources can recover.

## Positive Relay Feedback (PRF)

There are several reasons a pump or other device may not run when commanded to do so. Some examples include:

- Circuit breaker or HOA switch is set to off
- Phase loss
- Thermal overload blown or tripped (often built-in to a motor starter)
- Device is defective
- Control circuit to device is defective
- Controlled RTU is offline

The Positive Relay Feedback (PRF) alarm is a set of business logic that tests several conditions and alarms if something is not operating as expected. These conditions include:

- Pump failed to run—the relay is closed, but the pump does not start before the feedback delay times out.
- Pump failed to stop—the relay is open, but the pump does not stop before the feedback delay times out.
- Pump started prematurely—the relay is open, and the pump is stopped. For some reason, the pump starts to run when the relay is still open.
- Pump stopped prematurely—the relay is closed, and the pump is running. For some reason, the pump is stopped when the relay is still closed.
- Pump stopped and is now operating normally—the relay is open. For some reason, the pump is still running. As soon as the pump is stopped while relay is still open, operators on the alarm call-out list will receive the alarm.
- Pump started and is now operating normally—the relay is closed. For some reason, the pump is not running. As soon as the pump starts running when the relay is still closed, operators on the alarm call-out list will receive the alarm.

PRF requires a digital input be wired so the state of the controlled device is known. This can be accomplished with any dry contacts that operate consistently with the pump. Additionally, Mission strap-on current sensing switches may be considered. These determine pump run status by the magnetic field surrounding a pump load wire when it draws more than ~5 amps. It is a more accurate indicator of pump status than dry contacts since it is after any safety lockouts.

With the PRF alarm set, a notification will be dispatched if the pump or device did not operate as expected. The root cause of the failure can include:

- The pump is locally set to off or hand at the HOA switch
- A breaker tripped or burned out a pump
- A local wiring problem that causes the pump to never start
- A local lock-out is engaged (over-temp, low well level, etc.)
- The pump is under control of two competing control methods
- The MyDro unit or Wet Well Module has a faulty current sensing switch.
- The MyDro unit may be misconfigured and cannot enable the current sensing switches properly
- AC power failure or phase fault will prevent pumps from running. Connect a phase monitor to a digital input to detect phase faults.
- Oxidized dry contacts (auxiliary or relay) can cause the pump to appear to not be running even when it is running. Contacts should be gold-plated or -flashed to ensure no oxidation can occur
- A local alternator is used to select and run the pumps. PRF cannot be implemented if there is not a direct correspondence between output relays and feedback inputs.

In general, these practices relate to the recommended N/O wiring. Diagnostics related to PRF will be easier if sensors related to safety lock-outs are actively monitored by the Mission RTU. These are discussed in other parts of this document and include HOA switch, thermal overload, seal fail, etc.

## Maximize Equipment Life and Energy Savings

### Nightly Force Fill

Nightly force fill is an energy cost saving feature that is useful if electricity rates have a time of day cost differential. Contact Mission Technical Support to enable this feature. The technician will need to know the time of day that the rate changes.

### Pump Start Notifications

Pump start notifications can be set to alert or alarm on a user-selectable number of starts per hour. Similarly, an alert can be dispatched based on a variance of normal pump runtimes. By properly understanding and acting on these occurrences, users may be able to extend equipment life or perform preventive maintenance at a convenient time.

## Infrastructure

Each system is unique from a hydraulic and mechanical standpoint.

- Tanks that are plumbed in parallel and have valves can impact the placement of sensors. Include what-if scenarios in training initiatives to anticipate system behavior related to various valve settings.
- Larger tanks that stay nearly full have more water available if a communication failure were to occur. However, they offer less leeway before a spill.
- Tanks that utilize the off-peak energy saving features are not always as full. This means less reaction time.

## Analog Interconnect

An Analog Output Expansion Module (for use with MyDro units) is required for remote analog output. A 4–20 mA signal can be sourced at the RTU as a result of a command (page) from the web portal or by automatically mirroring an analog input at a different RTU. Setup for this must be completed by Mission Technical Support.

Positive feedback of an analog output can be achieved by wiring a Mission analog input into the same loop as the output. The output can then be verified via the web portal under RTU Data > Analog Data or on the map pop-up.

Considerations should be made for the controlled device operation when the RTU(s) is offline.

## Local Considerations

Perform as much local control as possible. Nothing is more reliable.

If a well pump or clear well were to run dry, a local control should be included to lock out the operation of that pump that pumps out of the well or other vessel. For deep wells, this can be accomplished locally with a submersible level sensor or pressure switch that yields a digital output based on an analog value. For ground storage tanks this may be accomplished with a float driving a lock-out relay. OP750 SMP can be used in lockout applications. See the sidebar to learn more.

Consider including complementary local control components. For example, a local pressure switch can be used to lock-out well operation if local line pressure exceeds a desired value. A thermal sensor can be included on the volute of the pump to prevent seal or bearing damage due to high temperatures. Local alarm lights and buzzers can be included.

Consider semi-redundant complementary instruments or sensors. For example, point level instruments, such as high or low floats, can be used as secondary methods to alarm in addition to analog alarm thresholds.

## Safe Module Plus MyDro Expansion



Mission offers the Safe Module Plus MyDro Expansion Module that can be used as a lock-out relay.

By wiring a N/O float (not included) in series with the pump control circuit, a lock-out can be included and reported through the Mission system. As long as the storage tank is at the appropriate levels, the float will be tipped, thereby energizing the interposing relay, and allowing the automated system to control the pump. If the level drops, the float hangs free and the circuit opens, thereby locking out the pump.

The module includes user-selectable time delays to minimize short pump cycles associated with a bouncing float. If flow measurements are desirable, the included pulse inputs may be used with a pulse-based flow meter.

Key benefits:

- Reduce installation time and complexity
- Float circuit designed for Class I, Division I (methane) hazardous locations
- Dispatches high wet well alarms even if AC power fails
- Spawn float signal for multiple purposes
- Supports 4 pulse channels

## Environmental Considerations

In addition to the seasonal factors discussed in the power and solar section of this document, other conditions should be considered.

### Freezing Conditions

The required level sensor for tank and well applications is a precision electro-mechanical device that can fail as a result of freezing, lightning strike, water penetration, or mechanical strike. A spare should be available in the case of a transducer failure. Once installed, a spare can be quickly put into active mode with a phone call to Mission Technical Support.

The pipe stub serving in-line pressure transducers can be one of the first items to freeze because of minimal flow in a stub. A freeze condition will render the instrument temporarily or permanently inoperable. Installation below the frost line, heat tape, mineral oil and/or grease-filled isolation glands are possible precautions.

Submersible transducers located in above-ground tanks can freeze in place. Consider a mixer or bubbler to keep the water moving so the hanging cable won't be constrained by a sheet of ice. Cable enclosed in PVC pipe may prevent ice from trapping the cable for short time. If the pipe extends to the top of the transducer, it will prevent the transducer from moving with an entrapping ice layer. The PVC pipe must be anchored in place to prevent a frozen layer from moving the pipe and affixed transducer up and down inside the tank.

Ventilation tubes should be terminated in a breather box with a regularly maintained desiccant inside. The desiccant should periodically be dried in an oven and replaced into the breather box to ensure that moisture does not condense inside the ventilation tubes. A frozen plug of ice will affect the accuracy of the pressure readings. The breather box should also be sealed well to prevent small insects from entering the box and ventilation tube.

### Flood Conditions

Flood conditions can swamp a service pit and damage components. Some transducers are built to survive flooded conditions. Wire terminations should also be considered.

### Lightning Conditions

Surge suppression, lightning protection, and best wiring practices can reduce the chances of failure due to lightning. Carefully follow the installation guidelines supplied with analog devices. Shielded wire is recommended, with the shield connected to the ground at the Mission RTU. Surge suppressors are generally installed as close to the instrument as is practical. Control cables should not run parallel to AC wires due to induced voltage that will cause spikes. Instead, they should run in a separate conduit. If AC and control cables must cross, do so at 90-degree angles. Lightning protection, consisting of lightning rods surrounding the RTU and tank that are attached to driven ground rods, should be considered as a preventive measure.

### Physical Issues

Instruments should be protected from mechanical strike. Wires should be properly secured with tie wraps. Tie wraps are susceptible to UV degradation and should not be relied on when located outside. Conduit should be used particularly for outside cable runs or where rodents are prevalent.

## Testing and Troubleshooting

Various failure modes should be tested periodically in a controlled manner. For example, while onsite, completely fill the tank so that the exact spill level is known. Consider running the following system checks:

- Confirm that high analog alarm thresholds are appropriately lower than the spill height, and higher than the Tank and Well off operating point. If the output of transducer or transmitters do not agree with the signal Mission is receiving, calibration may be required.
- Simulate PRF conditions and confirm alarm call-outs occur as expected.
- Fail the power and communications at both ends of a pump cycle long enough to confirm fail-safe conditions are as expected.

Reports are available on the web portal that include time stamps of the various data inputs and commands to RTUs. By carefully looking at the time stamps of digital data, analog data, and the operations log, users can determine the cause/effect relationship of the variables.

## Known Limitations

Automated remote control functions rely on a combination of real-time programs that evaluate data (typically every two minutes for 800-series RTU analog values) and check-up programs that periodically verify conditions are as they should be, based on the database information. Most of the time, three minutes is appropriate for the changes to take effect since 800-series RTUs report analog values every 2 minutes, and a five percent or higher change will cause the analog data to be sent immediately.

The Mission system allows an Admin user to directly page a device for current readings or to control a relay. The automated remote control systems cycle through the various settings and within about a minute will override any manual pages (commands) to a relay. Because of this, any hand, off, or auto settings should be made to the virtual HOA switch on the Tank and Well or Interconnect menu screens of the web portal.

Changes to the alarm set points and scaling for analog 1 and 2 will be recalculated and paged to the RTU. This does not apply to changing tank and well set points.

## Training and Documentation

Local system documentation should be consistent and unambiguous. Label all stations, inputs and wire terminations consistently and clearly for all operators. An input in the Mission system labeled as Pump 1 should be described that way on drawings as well as on the pump itself. If possible, control Pump 1 by Relay 1 to avoid confusion and name it something like "Relay for Pump 1" or "Coil for Pump1."

Operators and recipients of the notifications must understand how the system works and the tools at their disposal. All stakeholders are encouraged to attend and ask questions at the free weekly webinars hosted by Mission. Sign up at 123mc.com.

A training plan should be established so all stakeholders understand the system operation and limitations. The checklist on the next page can be used as an example of a training checklist.

Item	Description	Design/Build	Train Operators	Inspection Frequency
Alarms and Notifications				
Users, Security, Logging				
Communication Considerations				
Power and Solar Considerations				
Related Inputs				
Tank and Well				
Positive Relay Feedback				
Maximize Equipment Life and Energy Savings				
Infrastructure				
Analog Interconnect				
Local Considerations				
Environmental Considerations				
Testing and Troubleshooting				