

Best Practices for Control Applications

OVERVIEW

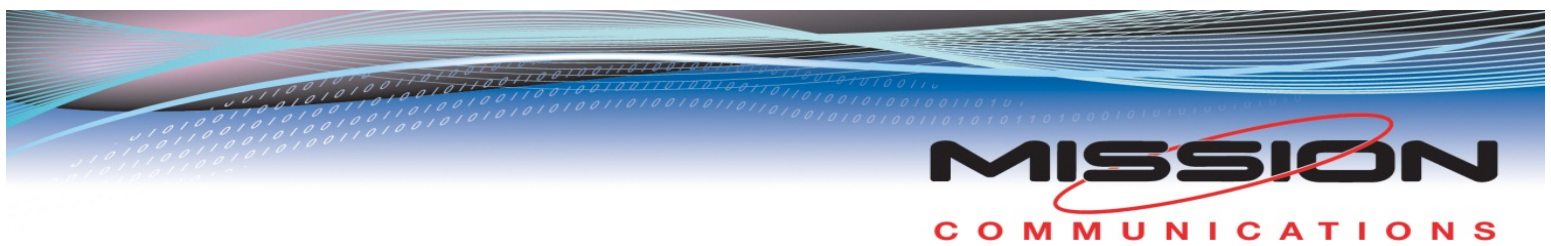
The Mission managed SCADA system can be used to control something at one location based on a condition at another location. These control functions are generally described as: Digital Intertie, Tank and Well Control and Analog Intertie.

Digital Intertie uses the value of a digital input on the source remote terminal unit (RTU) to cause a relay to open or close at the controlled RTU. Tank and Well control relies on the value of an analog level/pressure sensor at the tank to open or close relay(s) at well RTU(s). Analog Output is where a 4-20 mA signal is generated at the remote RTU by way of manually paging it, or automatically by “mirroring” an analog value obtained at the source location.

Before reading this document, refer to the “Tank and Well Control Package” document, the RTU Installation Manual, and the Web User’s Guide for general installation and web setup instructions. Third party sensors, control panels, and accessories should also include owner’s/ operator’s manuals. Please read and understand those documents.

The objective is to aid you in the design, installation and operation of systems that perform control functions. A well-designed and operated system can make a temporary failure nearly transparent and give an early warning of an extended failure. In this document, we will discuss:

- system design for fault tolerance
- alarms and alerts that function as an early warning system
- how to use the system to maximize equipment life
- how to use the system to minimize energy costs
- the importance of staff training
- the importance of testing



COMMUNICATION TOLERANCE:

The source data (tank level, digital input status, etc.) is communicated to Mission, analyzed, and then commands are dispatched to the destination RTUs. The system relies on the cellular data network for these communications. In other words, control functions are dependent on both the source and destination RTU being online and functioning.

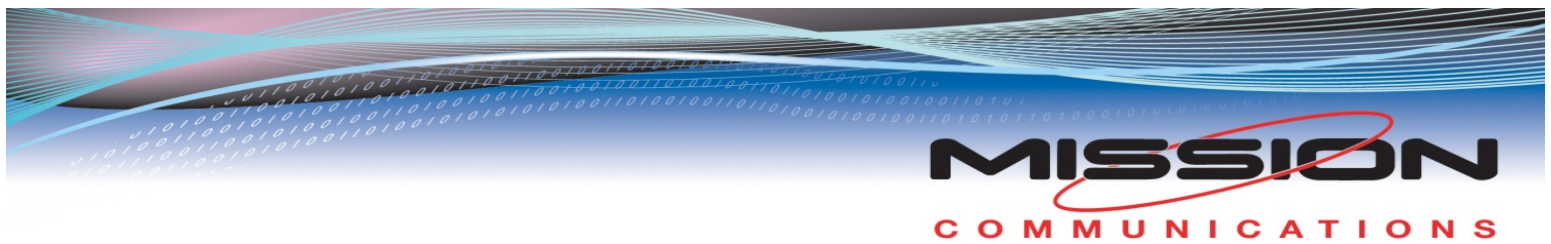
The cellular radios, utilized by Mission, automatically connect to the “best” tower in the area. By following the antenna placement guidelines in the installation manual, you will increase the chances that the RTU has more than one tower within range with which to communicate.

Cellular providers occasionally perform system maintenance on their towers in the early morning hours. These outages are generally less than 30 minutes in duration. Other problems, like natural disasters, can cause outages of longer duration. The system should be designed to transparently accommodate short duration communication failures and have the ability to notify operators of extended outages. In all cases, the system should fail in the best mode possible.

In the event of a communications failure at the controlled site, the Mission system can be set to fail with relays in the same state or to return to the normal state. Generally, pumps are wired to run when a relay is energized.

- **Pumps Running:** Appropriate if tanks can “spill” but local control should insure that the well pumps do not operate if dry.
- **Pumps Not Running:** Appropriate in a pressurized tank system, but requires human intervention to assure water is available when communication link is not present. The overall system design must include adequately sized tanks to accommodate worst-case scenarios.
- **Current State:** This may be appropriate, if tank spills are not a problem, and tank capacities are large enough to accommodate demand until the problem is resolved.

Communication failure at the tank results in the wells continuing to operate based on the last tank reading. The operator must manually operate the pumps via the tank and well web page (or locally.) In other words, the well pumps should be taken off of “AUTO” mode until the tank level reading is reporting properly.



Contact Mission Technical Support or enter a ticket from the web portal to make changes to the relay position on loss of communications. It should be noted that a hardware failure of the Mission RTU effectively results in a communication failure, but would likely cause the output relays to default to their normal deenergized position.

Upon AC power failure, the Mission RTU will operate on battery power and cause an AC failure alarm to be dispatched after 5 minutes. Active devices, like analog transducers and relays powered from the Mission system, will affect the available time the RTU can operate on battery power alone, whereas digital sensors (floats) do not. Battery capacity decreases with age and temperature. Batteries larger than the standard 12V 5AH battery are available from Mission or local sources. We recommend that batteries be tested annually and replaced every other year.

LOCAL CONSIDERATIONS

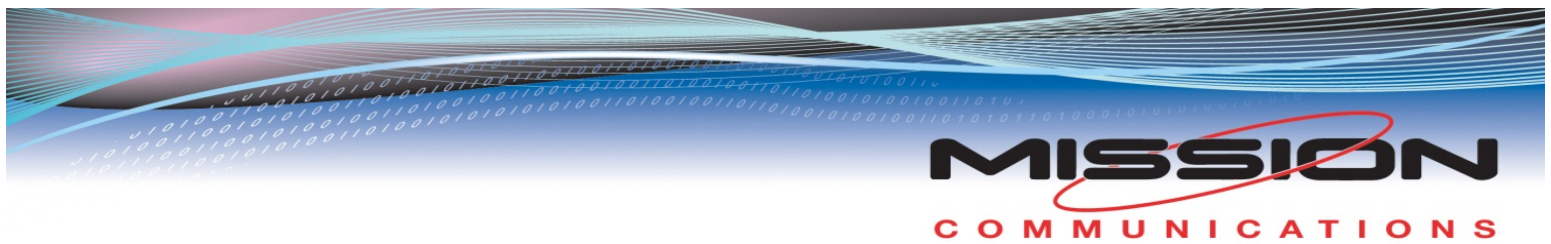
It is common practice to include local control components in a redundant or fail safe mode. For example, local mechanical pressure switches can be installed to force well operation if local line pressure falls below a preset point. Similarly, a local mechanical pressure switch can be included to turn well pumps off if line pressure becomes too high. Some pumps include thermal switches to indicate a dry, running pump. This can be used locally to turn a pump off before damage is done. Local alarm lights and buzzers can also be included for additional notification.

The required level sensor for tank and well applications is a precision electro-mechanical device that can fail as a result of normal wear and tear, freezing, or a lightning strike.

Alarm set points can be entered for analog sensors on the web portal. For reasons described above, a secondary method of level detection can be considered and alarm set points can be set for that sensor rather than to the primary sensor.

Alternately, high and low floats can be included for alarming purposes independent of the level sensor readings.

Carefully follow the installation guidelines supplied with analog devices. Generally, shielded wire is recommended with the shield connected to ground on one end (Mission RTU). Cable should not be run in close proximity to AC wires;



this can cause induced voltage. If signal or control wires must cross AC wires they should cross in a perpendicular fashion.

Consider all weather extremes when designing your system. Pressure transducers can freeze, rendering them temporarily or permanently inoperable. Extreme rainfall conditions can flood a service pit and damage components. Solar powered RTUs lose capacity during the winter months and in inclement weather.

You may consider additional analog sensors for flow, chlorine levels, etc. The analog option board expands the Mission RTU from two analog inputs to six.

Every infrastructure is unique from a hydraulic and mechanical standpoint.

- Tanks that are plumbed in parallel, but have valves, can impact the placement of sensors and training
- Larger tanks that stay nearly full allow more reaction time if a communication failure is to occur.
- Tanks that utilize the off-peak energy saving feature at times are less full and therefore allow less reaction time

NOTIFICATIONS AND DESTINATIONS

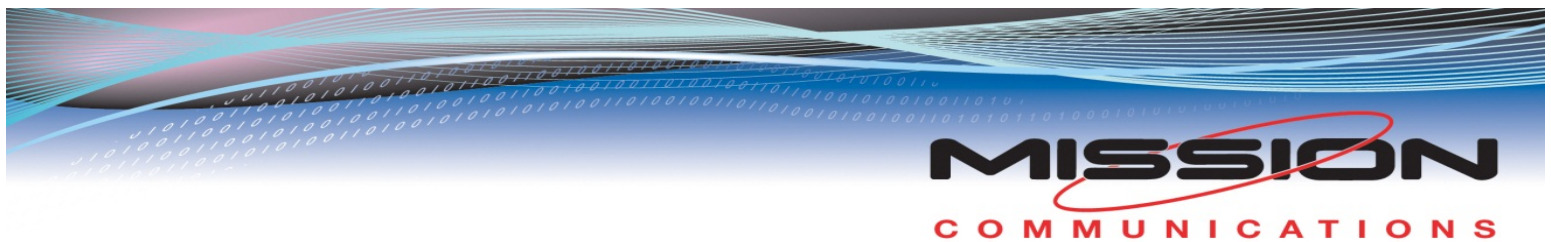
The Mission system should be set to notify (cell phones, pagers, email, SMS, etc.) operators in the event of an alarm condition such as a communication failure. The call out schedule should include a combination of delivery methods, personnel and cycles.

There are several reasons a device (generally a pump) may not actually run when commanded to do so:

- Circuit breaker or HOA switch is off
- Device is defective
- Controlled RTU is off-line

The Call-To-Run-Fail-To-Run alarm is an option that Mission technical support can enable. However, it requires positive feedback from the controlled device (well pump, for example) by way of a digital input wired to sense pump run. With this alarm set, a notification will be dispatched if the pump or device does not start within a user settable time of the command (generally one minute).

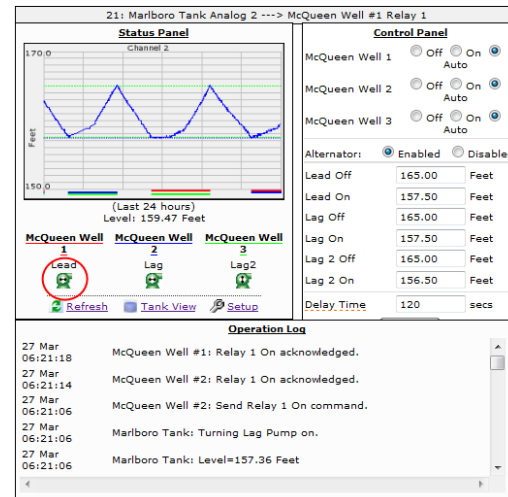
The recipients of the notifications must understand how the system and tools work.



TANK AND WELL CONTROL SYSTEM

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, and Lag 2 pump roles can be assigned and changed.
- The alternator can be switched on or off.



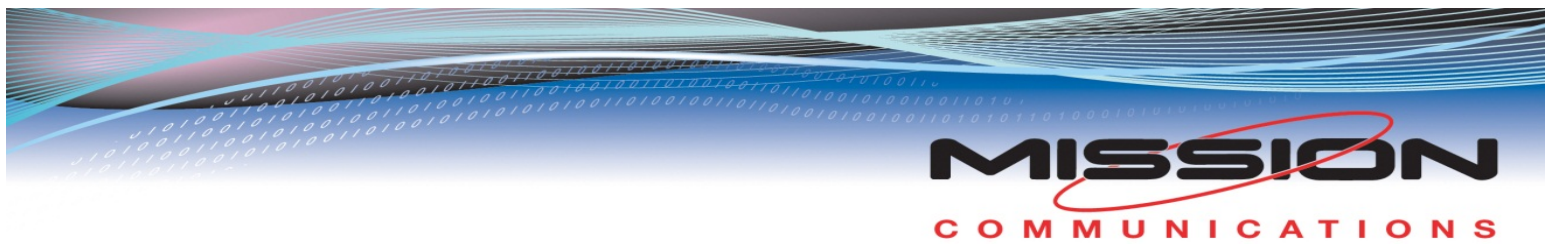
Please note that the alternator will alternate all configured pumps. When properly wired, the run status of controlled devices can be viewed.

Note that the pump running indicator icon (circled in red) on the Tank and Well page indicates that the pump has been commanded to run, not that it is actually running. See the upper section on Call-To-Run-Fail-To-Run above for positive feedback.

The Mission system allows an admin user to directly page a device for current readings or to control a relay. The tank and well system will override any manual pages to a relay. Therefore, any “Off”, “On” or “Auto” settings must be made at the Tank and Well or Interconnect control page.

A message time delay can be set at the web portal to minimize nuisance notifications. For example, a properly designed system should be able to accommodate a brief communication or power failure, but if the problem is not automatically resolved after a certain period of time an operator should be notified. This setting is a function of the speed at which your tank and distribution system normally fluctuate as well as how long it takes your technician to respond (travel). We generally recommend a 30 minute delay before the automated alert is generated.

Unique user credentials (user name and password) should be assigned to each operator. Mission has the ability to setup a “SuperAdmin” user to control specific privileges and credentials. Technical support can attach an administrator's email address to the system so that every time a change is made to an operational



setting a "before/after" email is sent to the administrator. The administrator should verify and test that the change yields the expected result.

For security reasons, some system settings must be set by Mission Technical Support (877-993-1911, option 2).

ANALOG INTERTIE

The analog output option board puts out 4-20 mA as a result of a page to the RTU (Commands menu) or automatically by way of mirroring a source RTU analog input. Initial setup must be complete by a Mission technician.

Positive feedback of the 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 Data/Analog Data or on the map pop-up.

Considerations should be made for the controlled device operation when the Mission RTU is offline.

MAXIMIZE EQUIPMENT LIFE & ENERGY SAVINGS

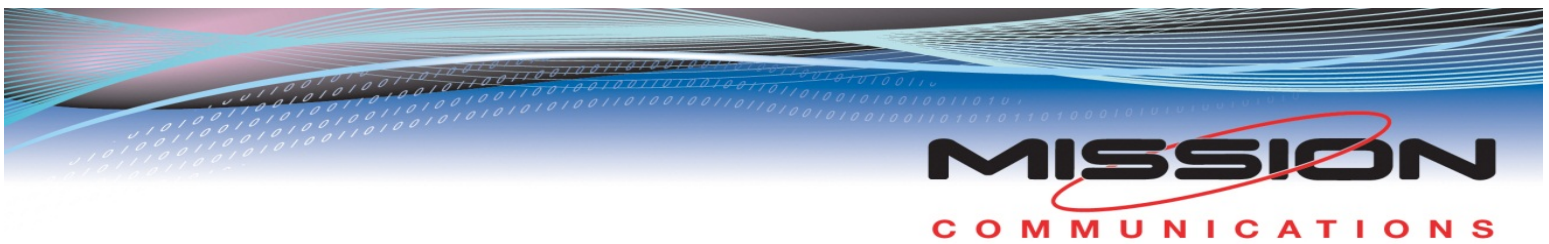
Nightly force fill is an energy cost saving feature used to fill a tank at night if electricity rates have a time-of-day cost differential. Contact Mission Technical Support for information on the setup of this feature.

Pump Start notifications can be set to alert or alarm (email or phone respectively) on a user selectable number of starts per hour. Similarly, an alert can be dispatched based on a variance of normal pump run times. By properly understanding and acting on these occurrences, you may be able to extend your equipment life or perform preventive maintenance at a convenient time.

TRAINING AND DOCUMENTATION

Operators, managers and supervisors should periodically attend the Mission webinars for training on the web portal and the wealth of diagnostic information it provides.

System documentation should be consistent and unambiguous. An input in the Mission system labeled as Pump #1 should be described that way on the drawing as well as in the pump house.



A training plan should be established so that all stake holders understand the system operation and limitations.

The following checklist can be used as part of your training program

ITEM	DESCRIPTION	DESIGN/BUILD	TRAIN OPERATORS	TEST/ INSPECT FREQUENCY
Failure mode	Define how system should operate if communications is lost			
Local control	Consideration of "fail-safe" precautions (local control) if primary system does not respond as expected			
Secondary sensors	High/ low level floats installed and appropriate for worst-case alarm purposes?			
Documentation	Design schematic, "as-built" drawings, appropriate diagrams/ manuals located at each location and the main office			
Training	Staff trained on overall system, web User Interface, maintenance procedures. Training of new staff.			
Installation	Verify professional workmanship, test operation			
Service	Critical spare parts available, technicians trained			

Pump set points (analog "run" settings)	Tank level, lead/lag for all pumps, alternator settings			
Alarm set points (analog alarm settings)	Alarm thresholds are entered for the tank level analog channel. Should the wells not run for an unknown reason, or there is a large leak, the tank may drain more quickly than the wells can fill it. Appropriate alarm set points can notify your personnel of this condition.			
Digital	Proper input type (Runtime, alarm, status) set, Inputs labeled.			
Communication alert time	Be sure that the alarm thresholds are entered for the tank level analog channel. Should the wells not run for an unknown reason, or there is a large leak, the tank may drain more quickly than the wells can fill it. Test these thresholds at least annually.			
Call list	Operators' names, schedules, contact method, up-to-date, enough depth in lists to accommodate vacations etc.			

Operator Credentials	Unique login credentials set for each operator, individual "service" keys issued, login privileges set. System "expert" defined as administrator or Superadministrator.			
Web User Interface	Operators trained on UI. RTU installation questionnaire completed and sent to MISSION so that all items are clearly described on web page (text-to-speech, input names, location, etc.)			
Full system tests	Inspect, calibrate, test, system end-to-end by manually tripping appropriate inputs and verifying that messages are delivered according to your call out schedule and results are as expected. Check backup battery.			

If you have any questions, please free feel to contact Mission Technical Support at (877) 993-1911 opt. 2 or [submit a ticket](#) through your web portal.