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## **WATER REUSE – Complete Wet Well-Dry Pit Pump Station Systems**

Basic information on the design of this type of pump station system is provided here.

### **INTRODUCTION**

Wet well-dry pit pump stations have two distinct vessels: a wet well or sump into which the water flows, and a dry underground vault (dry pit) in which the pumps, valves and other equipment are located. Suction lines near the bottom of the sump are connected to the pumps. The sump and dry pit are made of precast concrete or fiberglass. These materials can be mixed, i.e. fiberglass wet well or sump and a concrete dry pit.

For water reuse applications, the principal advantage of wet-dry pump stations over submersible or vertical turbine pump systems is that no part of the pumps are submerged. Access to the pumps is from within the dry pit. If a pump has to be removed for maintenance, it can be lifted out of the dry pit through a hatch located directly above the pumps. Another advantage is that the dry pit can be configured for all sizes of pumps, including large pumps, 50 hp or greater.

The disadvantages of wet-dry pump stations are that they tend to be more expensive than comparable submersible or vertical turbine pump stations, and they also take up more space.

The precast concrete or fiberglass wet well receives industrial process water from a gravity influent line. Suction lines near the bottom of the wet well are connected through the walls of both the wet well and dry pit to the pumps. The dry pit, also made of precast concrete or fiberglass, houses the pumps, valves, piping and other equipment.

Access to the underground dry pit, which is designed for entry by operation and maintenance staff, is by way of a hatch in the top, equipped with a ladder or stairs. The dry pit is typically equipped with lighting and must have adequate ventilation for worker safety.

Since the pumps are not submerged, they can be non-sealed, air-cooled pumps. It should be noted that submersible pumps are frequently used in a dry pit, especially in sites that may be subject to occasional flooding. In designing a pump station for water reuse, the type, size and number of pumps is determined by:

- 1) Characteristics of the water being pumped
- 2) Size of the wet well and manholes, storage vessels and sewer lines upstream from the pump station
- 3) Peak flow to the pump station
- 4) Total dynamic head (TDH) against which the pumps must work

### **Upstream Storage**

The rate of flow from a treatment facility, industrial plant or agricultural operation may vary significantly over time, thus a detention pond or one or more storage vessels are often sited upstream of the pump station to receive and store water. With this upstream storage, a steady rate of flow can be fed to the pump station sump from the pond or storage vessel(s), thus helping to optimize the efficiency of the pumps.

Often, an industrial pump station will be called upon to discharge at a steady rate or to maintain pressure in a discharge line. In this scenario, there should be adequate upstream storage to handle both high and low water flows, thus allowing the pumps to operate at a steady rate.

### **Upstream Debris Removal, Solids Handling**

Depending on the fluid being pumped and other factors in the industrial setting, it is possible for trash, rags, rope sediment, rocks and other solids to enter the flow of water to the pump station. Equipment for removing debris and other solids can be installed in the line(s) upstream of the pump station. How this equipment may affect the flow to the sump must be considered in the lift station design.

Non-clog, solids-handling pumps can handle most of these solids. In extreme cases, chopper pumps that chop solids into small pieces before entering the pump can be utilized. Another option is the installation of a macerator in the influent line ahead of the sump or in the sump itself. This machine pulverizes all solids before they reach the pumps.



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### **Wet Well (Sump)**

If the fluid to be pumped is generally free of solids, there will be no build-up within the sump or wet well. Therefore, the sump can be round or rectangular, vertical or horizontal and made from concrete or fiberglass. If the fluid has a significant amount of solids, especially fat, oil or grease (FOG), then a vertical, cylindrical sump is preferred.

The size and depth of the sump are determined by a number of factors (see below). By utilizing an upstream detention basin or storage vessels, flow into the sump can be regulated, thus reducing the storage requirement of the sump and reducing the size and number of pumps to do the job. When operating, the suction pipes can create vortices in the water. This must be considered in selecting pump and sump sizes, so that pump efficiency is optimized for the sump.

The exact location, angle and diameter of influent and discharge lines are predetermined and can be prefabricated in a complete package pump station. Coring of concrete or fabrication of fiberglass is done at the factory to eliminate the need for field work and ensure precise fit of the influent and discharge lines to the sump. Flexible seals in all sump penetrations are also factory installed.

Depending on the type of sump, other equipment such as influent deflector panels or drop tubes and liquid level sensors can be factory installed or field installed. The sump top includes the access hatch with fall protection. A davit crane for handling the pumps can be mounted on the sump top.

A precast concrete sump is delivered to the project site in sections. The base, one or more barrels or shaft sections and the top are fitted with sealing gaskets, lifted with a crane and stacked in alignment below ground to create the complete sump or wet well.

To prevent damage to a concrete sump from chemical gasses and liquids that may be present in the fluid being pumped, an interior lining or coating can be specified for the concrete. Exterior surfaces of the concrete can also be coated to prevent moisture incursion and to protect the concrete. These materials are installed or applied by Romtec Utilities at the factory, and they are fitted with weld strips and additional sealing in the field.

Fiberglass sumps can be delivered to the site as a single piece with all internal parts fully-assembled. Fiberglass sumps do not require chemical or moisture protection.

Romtec Utilities offers sumps from 4 feet to 12 feet in diameter (ID) and up to 40 feet in depth or length (depending on vertical or horizontal installation). The sump in every Romtec Utilities water reuse pump station is sized for the specific site requirements, which can be quite varied and include:

- 1) Depths of influent pipe and suction pipes
- 2) Current and future average and peak flows to the pump station
- 3) Storage available in wet well and upstream storage pond or vessels
- 4) Pump and suction pipe sizes (physical size and pump power rating)
- 5) Average number of pump starts per time hour for optimum pump efficiency
- 6) Relationship between suction pipe area of influence and sump size

### **Dry Pit**

The dry pit is made of precast concrete or reinforced fiberglass. These assemblies are delivered on trucks and installed in the excavated site with a crane.

The entry and exit points for suction lines and discharge lines are pre-cored or fabricated and fitted with flexible seals. In Romtec Utilities wet-dry pumping systems the pumps, piping, valves and other equipment are factory assembled and pressure tested, eliminating costly construction work in the field.

The depth, length and width of the dry pit are largely determined by the depth of the wet well, size of the pumps, diameter of the discharge lines and any requirements for special valves, flow metering, bypass pumping port or other equipment located in the dry pit.

Access to all equipment within the dry pit is required, so access hatches, ladders, platforms, lighting and ventilation equipment are also included. Romtec Utilities uses all applicable safety requirements governing confined space entry in the design of the dry pit.



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## Pumps

Romtec Utilities offers pumps of virtually every type from the leading manufacturers. The specific type and size of pumps in a package wet-dry pump station for water reuse are determined by many factors. In designing pumping systems for best performance in specific applications, Romtec Utilities supplies pumps based on many criteria, including: best performance and value, customer preference for a particular brand or type of pump, and other factors. Various types of pumps are commonly used:

- 1) Solids-handling, non-clog pumps that pass 3-inch diameter solids
- 2) Grinder pumps with impellers that grind solids
- 3) Chopper pumps, centrifugal pumps with the ability to chop all incoming solids prior to pumping

It should be noted that submersible pumps are frequently used in dry pit applications, especially in sites that may be subject to occasional flooding. These pumps are designed to operate while submerged, so flooding of the site will not damage the pumps.

The pump electrical cables are connected to the pump station control panel through a junction box or pump disconnect panel.

Some wet-dry pump stations have pumps of two different sizes. The smaller pump handles small demand, and the larger pump(s) operates when the flow into the sump or demand for water from the pump station is greater.

In designing a submersible pump station for industrial applications, the type, size and number of pumps are determined by a variety of factors, including:

- 1) Average and peak flows to the pump station and peak demands for water from the pumping system
- 2) Total dynamic head (TDH) against which the pumps must work
- 3) Presence of unscreened solids in the water to be pumped
- 4) Possibility of flooding at the site where pumps and well are located
- 5) Availability of a detention basin or storage vessels upstream from the pumping system

## Piping

The types, diameters and lengths of the pump discharge and force main piping are predetermined and can be prefabricated in a package pump station. Romtec Utilities pump stations generally include all piping from the influent through the last valve before the force main. Romtec Utilities designs pump stations with all common pipe materials: stainless steel, ductile and PVC.

It is common for there to be more than a single discharge point for the pumping system. For example: a recycled water pump station that discharges to a golf course at night can be reconfigured to discharge to an agricultural irrigation pond during the day. Piping and associated valves for multiple discharge points are part of the Romtec Utilities pump station design.

## Liquid Level Sensors

One or more liquid level sensors are suspended in the sump to report the fluid level. This data is used by the pump station controller to turn pumps on or off and, in the event of a pump failure or other problem, to turn on alarms and transmit alarm data. Common types of liquid level sensors are: micro switch floats, multi-electrode probes, pressure transducers and ultrasonic sensors.

The types of sensors used in a Romtec Utilities complete pumping system is determined by customer preference or by the controller chosen for the pump station. Many controllers can operate with any type of level sensor, while other controllers are exclusive to one type of sensor. Romtec Utilities designs with all types of liquid level sensors and controllers.



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### **Valves, Pressure Sensor, Bypass Pumping Port, Odor Control, Other Devices**

Valves and other equipment in the pump discharge lines are usually located in the dry pit. They can also be located above ground or inside an insulating enclosure. The packaged pump station is usually equipped with a check valve and an isolation or plug valve for each pump.

A single non-contact pressure sensor is located in the force main, although some pump systems require individual pressure sensors for each discharge line. Other devices can be located in the force main. Often specified for water reuse pump stations are equipment such as:

- 1) A bypass pumping port for connecting an emergency pump, in the event of a major failure within the pump station
- 2) Chemical injection for reducing odor in the recycled water
- 3) Monitoring and chemical injection for adjusting the pH of the recycled water

### **Flow Calculating & Metering**

Some industrial pump stations must measure the volume of fluid being pumped over a period of time. An easy and inexpensive way to accomplish this is by calculating the flow. This is done by multiplying the volume of water pumped with each pump start by the number of pump starts.

Flow metering may be necessary for proving the discharge volume. Romtec Utilities supplies a number of flow metering systems from leading manufacturers, as part of our complete industrial submersible pump stations.

An electromagnetic flow meter is inserted in the force main after the check and plug valves. The meter and associated piping and valves can also be preassembled in a separate vault. To allow maintenance of the flow meter without disabling the pump station, piping and valves to bypass the flow meter are also located in the flow meter vault.

The flow readout and reporting device, usually located at the pump station control panel, receives electronic flow data and reports it to a display. Transmission of flow data to a remote computer terminal is also available.

### **Control Panel & Electrical Power**

Typically, the electrical controls of the pump station are located in a control panel within a weatherproof enclosure. Various devices provide power to the pumps, control the pumps, receive operational and fault data from sensors within the pumps and the sump, report elapsed operational time for each pump and report operational status and alarm conditions both locally and to remote sites through telephone circuits, radio transmissions and other means.

The control panel in a Romtec Utilities pump station can be placed in a variety of locations, generally wherever the customer wants and needs it to be. As an important part of the design process, Romtec Utilities produces a scale drawing showing the equipment layout on the site. No two pump stations have the same equipment layout.

The source and type of electrical power to the pump station site is an important design factor. Romtec Utilities can design the pump station for whatever type of single-phase or three-phase power is available to the site. Generally, the control panel is designed to operate just the pump station. Other electrical demands at the site, such as yard lights and building heat are not considered in the pump station design, unless specifically required by the customer.

### **SCADA**

Pump stations can be equipped with SCADA (Supervisory Control and Data Acquisition) devices to both report operational data to remote sites, such as an online computer terminal in the plant operations center, and to receive operational instructions and requests for operational data from the same computer or other computers or mobile data devices. This two-way communication capability provides many benefits to pump station operators. Romtec Utilities designs industrial pumping systems to work with all kinds of communications hardware and software.

### **Electrical Generator**

A standby electrical generator that operates the pump station during power outages may be required. The generator is usually sized to operate just the pump station; however a larger generator can be specified for operation of the pump station plus other equipment, such as space heaters and exterior lights.



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A generator using natural gas, propane or diesel fuel can be permanently located at the pump station site and wired to the control panel through an automatic transfer switch that senses the loss and return of grid power and switches the generator on or off accordingly.

The generator can be housed in a sound-attenuating enclosure. This is an important feature if the pump station is located where sound from the generator would be a problem for nearby residents, businesses, schools and the like. The generator can also be installed within a building equipped with a ventilation system.

Alternatively, a portable generator can be brought to the site and plugged into the control panel to temporarily supply electricity until grid power returns.

### **Other Optional Equipment**

All design parameters to accommodate any additional optional equipment are predetermined in the design of a Romtec Utilities package pump station. The optional equipment is thus integral to the complete pump system design for function, power requirements and other factors. Romtec Utilities specializes in designing pump stations that utilize specialized equipment required by the customer or by various regulatory agencies.

### **Shelter or Building**

A structure to shade the control panel enclosure and provide shelter from weather for operation and maintenance personnel is a good idea, and it may be required. It might also be necessary to house the pump station electrical control panel, generator and other equipment within a building for equipment security and shelter. Romtec Utilities supplies a wide range of shelters and buildings that can be custom fitted to the specific requirements of any pumping system.

### **Treatment Systems**

Increasingly, within the U.S. and abroad, the treatment requirements for industrial process water are not so different from the treatment requirements for wastewater. Romtec Utilities can integrate the pump station into a complete system that sends water to a treatment system, samples the treated effluent to ensure it meets regulations and discharges the treated water to a variety of locations.