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## **WATER/WASTEWATER TREATMENT – Complete Wet Well-Dry Pit Pump Stations**

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 wet well are connected through the walls of both the wet well and dry pit to the pumps.

In water and wastewater treatment 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 underground dry pit, which is designed for entry by operation and maintenance staff and is equipped with a hatch in the top, a ladder or stairs, lighting and adequate ventilation for worker safety.

If a pump has to be removed for maintenance, it can be disconnected from the piping and lifted out of the dry pit through a hatch located directly above the pumps. Another advantage of a wet-dry pump station 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.

Since the pumps are not submerged, they can be non-sealed, air-cooled pumps. It should be noted that submersible pumps may also be 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, presence of solids
- 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

Wet well-dry pit pump stations are often used in water and wastewater treatment systems. Some common applications and scenarios include:

- 1) Wastewater treatment plant headworks – Two or more pumps deliver raw sewage or liquid effluent into the first stage of the treatment system.
- 2) Transferring effluent within a wastewater treatment plant – Fluids containing solids can be moved efficiently with non-clog pumps.
- 3) Intake to water treatment plant or reservoir – Pumps draw water from a lake, reservoir or river into a water treatment plant or reservoir.
- 4) Site stormwater collection and recycling – Regulations can limit stormwater runoff from various sites such as commercial and industrial developments. Treatment of this water may be required before it can be discharged off site. In such situations, surface water is collected in storm drains, flows underground to the pump station and is pumped to an onsite treatment system before being recycled on site or discharged into a nearby body of water.
- 5) Onsite water treatment/recycling – Water used in industrial processes, such as cooling water, is stored, treated and reused on an industrial site. A pump station receives water from one or more industrial processes and pumps to an onsite treatment system. Another pumping system transfers treated water back into the plant for reuse.
- 6) Biological treatment – A community uses a constructed wetland to biologically treat runoff from precipitation. A submersible pump station is used to maintain the water in the wetland at the optimal level for biofiltration to occur. The treated water can then be reused for irrigation of the community's parks or even delivered to the water treatment plant for further treatment into potable water.

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### **Upstream Storage**

The rate of flow to and from a treatment facility may vary significantly at different times of the day, days of the week and so forth. To even out the flow into or out of the treatment facility, a detention basin or one or more storage tanks are usually located upstream of the pump station. With this upstream storage, a steady rate of flow can be delivered to the pumping system from the basin or storage vessel(s), thus helping to optimize the efficiency of the pumps as they maintain a steady rate of flow into the treatment facility.

Often, a water or wastewater treatment 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 or maintain pressure.

An example of this would be a treatment facility that produces clean water at a steady rate 24 hours a day, but irrigators use this water mostly during the night. A holding basin is necessary to store the water and allow the pump station to deliver water whenever it is required.

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

Depending on the sources of water being pumped and other factors, it is possible for trash, rags, rope and other difficult 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. Romtec Utilities designs pump stations to work with all types of debris removal technologies. How this equipment may affect flow to the wet well must be considered in the system design.

Non-clog, solids-handling submersible 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 a macerator in the influent line ahead of the wet well or in the wet well itself. This machine pulverizes all solids before they reach the pumps.

### **Wet Well**

The size and depth of the wet well are largely determined by the average and peak flows to the pump station, the depth of the influent line(s) and the size and number of pumps required to deliver water or effluent at the preferred rate. By utilizing an upstream detention basin or storage vessels, flow into the wet well can be regulated, thus reducing the storage requirement of the wet well.

The exact location, angle and size of influent and suction lines and other items within the wet well are predetermined in a complete package pump station. To eliminate the need for field work, all coring of concrete or fabrication of fiberglass is done at the factory. Flexible seals in all wet well penetrations are also factory installed. Other equipment such as liquid level sensors can be factory-installed or field installed. The prefabricated wet well top includes the access hatch with fall protection. A davit crane for handling the pumps can be mounted on the wet well top.

Precast concrete wet wells are delivered to the project site in sections. The base, one or more barrels or shaft sections and the top are fitted with sealing gaskets and are lifted with a crane and stacked in alignment below ground to create the complete wet well. Fiberglass wet wells are delivered as a single piece with all internal parts fully-assembled.

Romtec Utilities offers wet wells 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 wet well in every Romtec Utilities pump station is sized for the specific site requirements, which can be quite varied and include:

- 1) Depths of influent and suction lines
- 2) Current and future peak flows to the pump station or demands for water from the pump station
- 3) Storage available in upstream and downstream detention pond or storage vessel(s)
- 4) Pump sizes (physical size and power rating)
- 5) Average number of pump starts per hour for optimum pump efficiency

If designed for pumping wastewater, the interior walls of the wet well base are angled to help direct solids to the pump impeller. This feature helps prevent the build up of a solid layer of fat, oil and grease (FOG). Romtec Utilities wet well bases can be lined with fiberglass or PVC plastic or coated with epoxy sealer to provide a slick, non-porous surface that discourages collection of FOG.

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## 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 many instances the pumps, piping, valves and other equipment can be 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.

## 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 are determined by many criteria, including: best performance and value, customer preference for a particular brand or type of pump, overall value and other factors.

Several types of pumps are commonly used in wet-dry pump stations:

- 1) Solids-handling, non-clog pumps that pass 3-inch diameter solids
- 2) Grinder pumps with impellers that grind solids
- 3) Chopper pumps that macerate difficult solids such as rags

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

The pump electrical cables and sensor wires are connected to the pump station control panel through a junction box or pump disconnect panel. Romtec Utilities designs these connections to meet all applicable electrical codes.

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 wet well or demand for water from the pump station is greater.

An example of this type of pump station is for a golf course using recycled water from a wastewater treatment plant for irrigation and equipment maintenance. During the day, if a hose at the course is opened to wash down a mower, only the small pump is required to maintain pressure in the line delivering water to the course. When the fairways and greens are being irrigated at night, the larger pumps are used to maintain pressure and/or fill irrigation basins at the golf course.

## Piping

The type, diameter and length of the pump discharge and force main piping are predetermined in a package pump station. Romtec Utilities pump stations generally include all piping through the last valve connected to the pump station end of the force main. Common pipe materials are stainless steel, ductile and PVC.

It is common for there to be more than a single discharge point. For example: a treated effluent pump station that discharges to a golf course at night can be reconfigured to discharge to an agricultural irrigation pond during the day.

## Liquid Level Sensors

One or more liquid level sensors suspended in the wet well 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 problem, to turn on alarms and transmit alarm data. Types of liquid level sensors are: micro switch floats, multi-electrode probes, pressure transducers and ultrasonic sensors.

The type of sensors used 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**

Most Romtec Utilities package pump stations are equipped with a check valve and isolation or plug valve for each pump. Valves and other equipment in the pump discharge lines must be protected from freezing. They can be located in an underground vault or above ground in a secure, insulated enclosure.

A single non-contact pressure sensor is located in the force main, although some pump systems require individual pressure sensors for each pump discharge line. Other devices can be located in the force main. Often specified for water and wastewater treatment 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 recycled water being discharged from a wastewater treatment plant
- 3) Equipment for monitoring and balancing the pH of recycled water

### **Flow Calculating & Metering**

Some 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 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 volume of water or effluent pumped over a period of time. An electromagnetic flow meter can be located in the force main. To allow maintenance of the flow meter without disabling the pump station, a bypass line with piping and valves to pump around the flow meter is included in the design.

A flow readout device, usually located at the pump station control panel, receives electronic flow data and reports it to a display panel. Transmission of flow data to a remote computer 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 supply power to the pumps, control the pumps, receive operational and fault data from sensors within the pumps and the wet well, 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 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 report operational data to remote sites, such as an online computer terminal at the water authority office, 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 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.

Generators using natural gas, propane or diesel can be permanently located at the site and wired to the control panel through an automatic transfer switch that senses the loss of grid power and switches the generator on automatically.



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The generator can be housed in a sound-attenuating enclosure. 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**

Romtec Utilities designs pump stations that accommodate various specialized equipment required by the customer or regulatory agencies. All design parameters to accommodate optional equipment are predetermined, so the optional equipment is integral to the complete pump system design.

#### **Shelter or Building**

A structure to shade the control panel enclosure and provide shelter from weather for operation and maintenance personnel may be required. It may also be necessary to house the pump station electrical control panel, generator and other equipment within a building designed 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.