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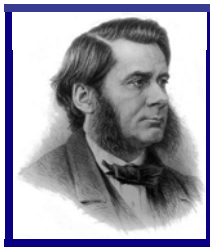
GOLF COURSE IRRIGATION PUMP STATIONS

The Irrigation Pump Station is rightfully called the "Heart of the Irrigation System". It is also the single-most expensive component in the irrigation system.

Pump stations are highly technical in terms of their hydraulics and electrical controls. The variety of pumps and the multitude of configurations adds to the confusion for the lay person.

Hopefully ***this article clears some of that confusion by providing a basic understanding of Golf Course Irrigation Pump Stations.*** However, by necessity, many finer details are left out.



Thomas Henry Huxley (1825 - 1895) - English Biologist / Evolutionist

If a little knowledge is dangerous,
where is the man who has so much as to be out of danger?

1 INTRODUCING THE IRRIGATION PUMP STATION

A pump station (not including ancillary equipment such as filters or fertigation) is an arrangement of:

- Pumps
- Motors
- Manifolds & Valves
- Pump Control System

As with many things in irrigation, the basic concept is quite simple.

In a nutshell, an Irrigation Pump Station for a golf course has two basic functions:

- To provide a specified flow (eg, 100 L/s or 1,587 USGPM) at a specified pressure (say 8.50 Bar or 123 PSI).
- To deliver flow from zero to the specified flow (and all points between) closely regulated to the specified pressure.

2 MAIN TYPES OF PUMPS

In golf course irrigation, the 4 main types of pumps that we consider are:

- Vertical Turbine Pumps
- Submersible Pumps
- Vertical Multi-Stage Centrifugal Pumps
- End Suction (Horizontal Centrifugal) Pumps

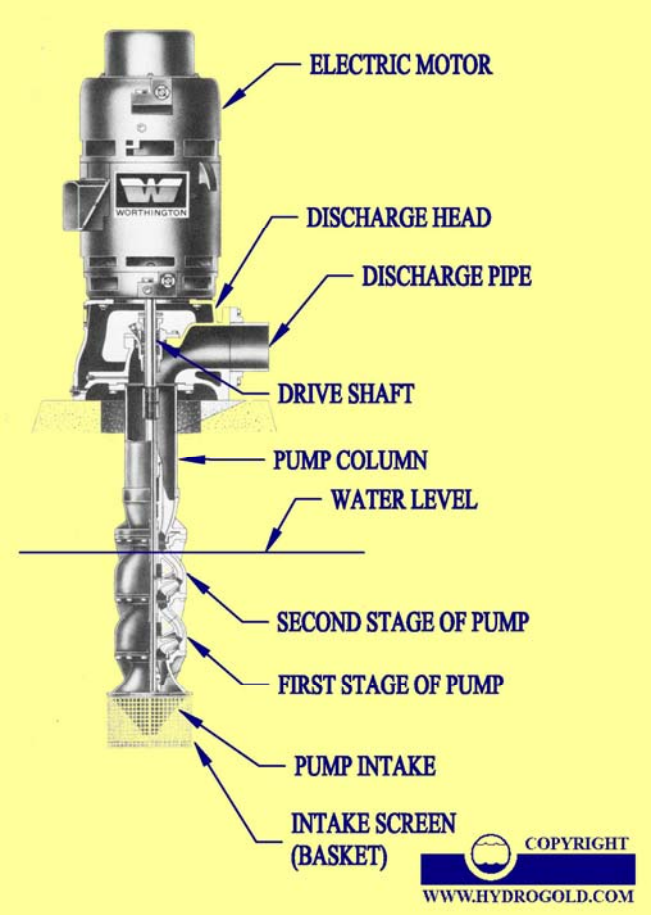
What is a Centrifugal Pump?

A Centrifugal Pump uses a spinning impeller. Water enters the eye (centre) of the impeller and is thrown outward against the housing. The centrifugal force creates the pressure.

All the above-listed pumps are technically Centrifugal Pumps.

In the irrigation industry, the term "Centrifugal Pump" often refers to an End Suction Pump (a more technically precise term). Depending on who you are talking to, the term "Centrifugal Pump" may have different meanings. To avoid confusion, we only use the term to refer to the general class of centrifugal pumps rather than a specific type.

2.1 Vertical Turbine Pumps



This is the most common type of pump we use.
It (typically) offers the Owner the lowest Total Cost of Ownership with its:

- Reliability
- Long Life
- Efficiency
- Low Maintenance

The main drawback is its higher up-front (capital) cost,

If near to residences, the noise level may be a factor.

It is not suitable for flooded suctions (where the water storage is above the pump).

Cut-Away Section of a Watertronics Single-Stage Vertical Turbine Pump

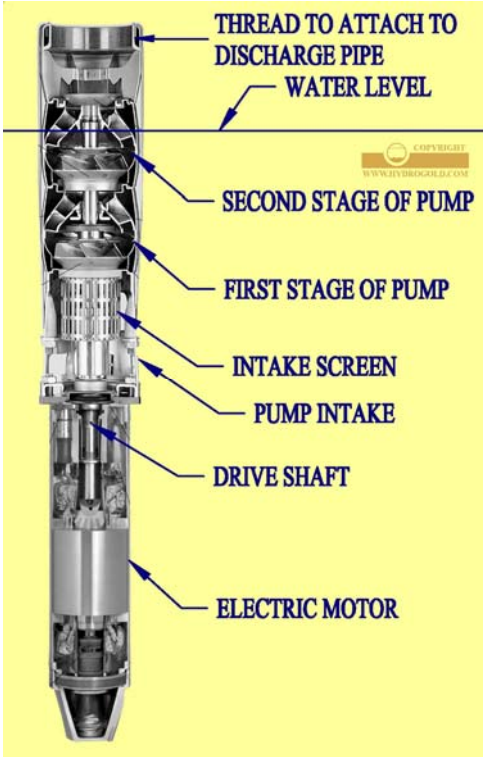
Irrigation Pump Station with Vertical Turbine Main Pumps and a Submersible Jockey Pump

Watertronics Vertical Turbine Pump Station on the Hydrogold-designed irrigation system at Tamarina Golf Resort (Mauritius)

2.2 Submersible Pumps

The Submersible Pump is (essentially) a Vertical Turbine Pump with the motor underneath the pump. Because it is designed to fit down a (relatively) small diameter borehole, its pump and particularly the electric motor is smaller in diameter and elongated.

Its prime advantage is lower Capital (Up-Front Cost). Since the pump and motor are underground, the noise level is low (beneficial if near residences).



Cut-Away View of Submersible Pump with Motor underneath. ***Note the location of the pump intake.***

Submersible Pump with Motor

Submersible Pump with motor (at the bottom) in a bore

Submersible Pump Station on the Hydrogold-designed irrigation system at Marangaroo Golf Course in Perth, Australia

2.3 Vertical Multi-Stage Centrifugal Pumps

Cut-Away View of Pump with Motor on top

Vertical Multi-Stage Centrifugal Pump

This type of pump is similar to the Vertical Turbine Pump in that the motor is above the pump.

However, the biggest difference is that the pump is not submerged like the Vertical Turbine Pump. It typically has more stages.

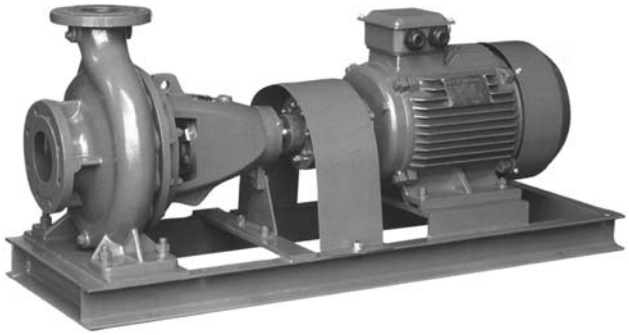
Its main benefit is:

- Lower Capital Cost

The Plad Vertical Multi-Stage Irrigation Pump Station on the Hydrogold-designed irrigation system at Belle Mare Plage Golf Course (Mauritius). It uses a flooded suction. Note the large-diameter, light-grey, intake line on the right.

2.4 End Suction Pumps

In the pump industry, End Suction Pumps are the most commonly used pump. ***In the golf industry, it is not commonly used since they have difficulty generating sufficient pressure and flow efficiently.***



The main benefits are:

- Low Capital Cost
- Low Maintenance

However, they are inefficient and not reliable (loss of prime).

This is the existing Irrigation Pump Station at the Point Walter Golf Course in Perth, Western Australia. The irrigation system is currently being upgraded to a Hydrogold design.

3 LOSS OF PRIME

This does not apply to Vertical Turbine or Submersible Pumps since these pumps are submerged in the water.

When pumps are located above the water, there may be a "loss of prime".

Vertical Multi-Stage and End Suction Pumps are typically located above the water and suffer this problem. Normally this is solved by a good quality foot valve to retain water in the pump's suction (intake) pipe. Another (usually more expensive) option is to use a "*flooded suction*" where the water source is above the pumps.

4 MAXIMUM SUCTION LIFT ("HOW HIGH CAN THE PUMP SUCK WATER")

This does not apply to Vertical Turbine or Submersible Pumps since these pumps are submerged in the water.

Net Positive Suction Head is very familiar to pump experts but most lay people will not have heard of it. However most people know that there is a limit to the distance that you can "suck up water" (more technically called the "Maximum Suction Lift").

4.1 The Technical Explanation… (skip this if you are bored)

With a pump generating a perfect vacuum, the maximum you can "suck up water" is 10.33 m (33.88 ft). Of course pumps are not perfect. So you need to subtract the "Net Positive Suction Head Required" which varies depending on each pump's characteristics.

Then you need to take account of the atmospheric pressure, altitude, water temperature, suction pipe friction losses and a safety factor. Generally a calculation best left to those who know what they are doing.

4.2 For the Lay Person…

The distance that a pump can "suck up water" (Maximum Suction Lift) is typically in the range of 4 to 5 m (13 to 16 ft). It varies depending on many factors - see your Irrigation Consultant.

4.3 Cavitation

If you exceed the Maximum Suction Lift, the pump will cavitate. That is, the water at the eye of the impeller vapourises. As it moves outward to higher pressure areas, the air bubbles implode with great force (violently) thereby damaging (cracking) the surface of the impeller. You will often (not always) hear a loud crackling (pinging) noise.

4.4 Maximum Level of Pump Station Above Low Water Level for Pumping

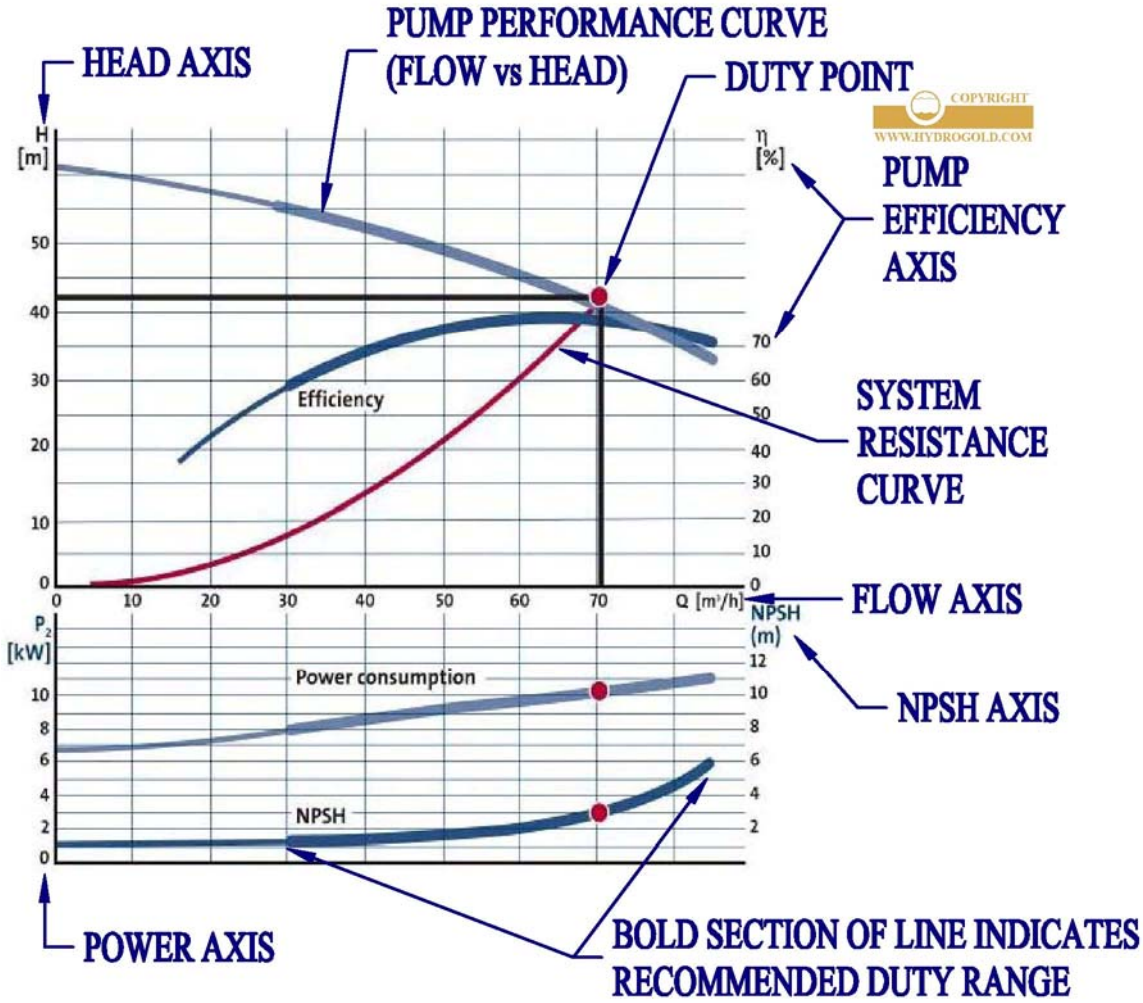
Best to look at an example…

Line	Description	m	ft	Comment
1	Discharge Head Level	5.00	16.40	Typically 0.5 m (20") above the pump station pad
2	Pump Station Pad	4.50	14.76	Typically 1.0 above High Water Level (or Flood Level - whichever is higher)
3	High Water Level	3.50	11.48	
4	Low Water Level for Pumping	0.50	1.64	Typically last 0.5 m (20") of water is unusable.
5	Bottom of Lake	0.00	0.00	
6	Suction Lift (= Line 1 - Line 4)	4.50	14.76	This is about the Maximum Suction Lift for most pumps.

Conclusion: ***If the Pump Station Pad is more than 4 m (13 ft) above the Low Water Level for Pumping, then it will not be technically feasible to use either a Vertical Multi-Stage Pump or an End Suction Pump.*** This is a rule of thumb and should be checked by your Irrigation Consultant for each particular situation.

5 UNDERSTANDING PUMP CURVES (Brief Introduction)

The casual reader may like to skip this important (but technical) section.



The "System Resistance Curve" refers to the irrigation system, not the pump. Where it intersects the "Pump Performance Curve" is the "Duty Point" (indicated by the red dots):

71 m^3/hr (read on the axis marked "Q" - which is universally used for flow)

42 m (read on the axis marked "H" - which is universally used for Head).

"Head" would normally be translated to "Pressure" for the lay person.

Efficiency is 78%. Find the curve marked "Efficiency" and read off the Efficiency axis.

Power consumption is 10.2 kW. Net Positive Suction Head is 3.0 m (refer to item 4.1 on the previous page).

Though there are many axis, the pump curves are very clear (thanks to Grundfos - a great pump company). Many pump curves are presented in formats not as complete or clear.

What's with all the Different Units for Flow and Head? Some are imperial (US) and the "universal" metric system uses different units to suit the application (or country).

Flow - 100 L/s = 6,000 L/min = 360 m^3/hr = 1585 USGPM

Pressure - 10.00 Bar = 1,000 kPa = 102.0 m (of Water) = 9.87 atm = 145 PSI = 334.5 ft

6 HOW MANY MAIN PUMPS SHOULD THERE BE?

A quick word about the "Jockey Pump". This is a small pump used to maintain system pressure at zero flow or small flow (eg, hand watering). There is only one Jockey Pump on an Irrigation Pump Station. To avoid unnecessary wear and tear on this pump, it is not included as part of the "Total Flow" of the Irrigation Pump Station.

The Total Flow of the Irrigation Pump Station comes from 1 or more "Main Pumps". All of Hydrogold's Irrigation Pump Stations use main pumps of equal duty. Eg. If the Irrigation Pump Station has a Total Flow of 90 L/s (1428 USGPM) and 3 main pumps, then each main pump would have a flow of 30 L/s (476 USGPM).

6.1 Power of Motor for Main Pump

The first factor we consider is the power of each main pump motor. ***The number of main pumps is selected so that each electric motor's power is 75 kW (100 Hp) or less.*** The larger motors are less tolerant of the frequent stopping/starting such as on golf courses. Furthermore, larger motors may cause more disruption on the public supply grid, especially in developing countries.

The above Irrigation Pump Station in Singapore has ***only 2 main pumps****, both of them duty pumps. No filter for the Valve in Head sprinklers either.* ***If one of the pumps fails, then a 10-hour irrigation Watering Window will be extended to an unacceptable 20 hours.*** *This affects the amount of water that can be applied to the golf course (turf suffers) and/or disrupts golfers with day-time watering (reducing revenue).*

You can avoid this by avoiding "free manufacturer designs" and reading over page…

6.2 Watering (Pumping) Window, Number of Pumps and the Standby

Another factor affecting the number of main pumps is the Watering Window. The Irrigation Consultant will have determined a "Watering Window". (Refer to HydroBull No 3 on the Education Centre on our web site.)

Example: ***The Irrigation Pump Station is designed for a Total Flow of 90 L/s for a 10 hour Watering Window.***

Before we look at the scenarios in the table below, we need understand that a Main Pump can be a:

- Duty Pump - This pump is Operational
- Standby Pump - This pump is Not Operational - It is a backup pump.

Description	**Unit**	**Scenarios**			
Scenario	No	One	Two	Three	Four
Main Pumps	No	1	2	3	3
Duty Main Pumps	No	1	2	3	2
Standby Main Pumps	No	0	0	0	1
Flow of Each Main Pump	L/s	90	45	30	45
	USGPM	1,429	714	476	714
Total Flow	L/s	90	90	90	90
	USGPM	1,429	1,429	1,429	1,429
Design Watering Window	hours	10	10	10	10
If One Main Pump Fails…					
Total Flow	L/s	0	45	60	90
	USGPM	0	714	952	1,429
Watering Window		**No Watering**	**20**	**15**	**10**
Comment		Totally Unacceptable	Unacceptable	Marginally Acceptable	Best

We have a look at what happens if one of the main pumps fails:

Scenario One (1 Duty Pump, No Standby Pump) is totally unacceptable. With only 1 main pump, a failure means no watering is possible

Scenario Two (2 Duty Pumps, No Standby Pump) is unacceptable in most cases. With 2 main pumps and 1 failed, the Watering Window is stretched to an unacceptable 20 hours.

Scenario Three (3 Duty Pumps, No Standby Pump) is marginally acceptable. With 3 main pumps and 1 failed, the Watering Window is stretched to 15 hours.

Scenario Four (2 Duty Pumps, 1 Standby Pump) is good. With 1 failed main pump, the standby pump is used and the Watering Window remains the same (at 10 hours). The turf will remain in good condition and golfers will not be disturbed (golfing revenue unaffected).

This is the best scenario. The cost of the Irrigation Pump Station will be only marginally higher than for Scenario Three (both have 3 main pumps).

6.3 More about the Standby Pump

6.3.1 The Standby Pump is (In Effect) an Operational Spare Pump

That is, if one of the main pumps fail, the pump station is still able to pump at full capacity. This is an extra cost to the pump station but it allows watering to continue at full capacity when one duty pump fails. This is particularly important during hot, dry periods or where there is likely to be a long time before the failed pump can be repaired or replaced (eg. Areas remote to service centres).

6.3.2 Extended Pump Station Life

The standby pump is rotated among the main pumps to distribute wear and tear evenly between all the main pumps (thereby reducing the Total Cost of Ownership). Eg, Adding 1 stand-by pump to 2 duty pumps will reduce the workload of the individual pumps by 33% (thereby adding 50% to the potential working life).

6.3.3 Why Not Just Store a Spare Pump and Motor Separately?

We strongly recommend against this. It is likely to be years before a pump or motor will fail. ***Often, the spare pump and motor are lost*** (used for another purpose, misplaced? or damaged). So the Owner paid for the pump but it is not available when needed.

The standby pump is always there and immediately operational.

6.3.4 Do Not Operate All Duty and Standby Pumps Simultaneously

The electrical controls of the Irrigation Pump Station must not be over-ridden to operate all main pumps (duty and standby) simultaneously. The pipe system has not been designed to cater for this added flow capacity and failures (breaks) are likely to occur.

Running all these pumps simultaneously would be a significant additional cost (larger mainlines) - essentially a revision of the Watering Window - one of the Basic Irrigation Parameters.

6.3.5 Eliminating the Standby Pump?

While the Irrigation Consultant may include a standby pump, the Owner may decide to eliminate the standby pump to reduce cost. ***If the standby pump is eliminated, then considerations need to be given to the extended Watering Window (see Scenarios 2 and 3 previously).*** Factors to consider when making this decision are:

a) ***Impact on golfers (and revenue)*** of the day-time watering.

b) ***Impact on the turf of reduced watering*** (particularly during the peak irrigation season).

c) ***Time to repair pumps/motors.*** Depending on location, the best case scenario is for the repair to be completed in 2 or 3 days (but more likely a week). In areas with poor support services (eg, remote locations), repairs will be significantly costlier and slower (say, around a month, maybe longer).

7 MOTORS

The motors used are critical for the efficiency and long life of the Irrigation Pump Station.

7.1 Speed

The most common (nominal) speed for electric motors is 2900 RPM. The actual RPM will vary slightly depending on the base frequency of the electricity (US - 60 Hz, most other countries 50 Hz). ***The other speed we use is 1800 RPM.***

At 2900 RPM, the pumps are cheaper since they require fewer stages to achieve the required pressure. However it is important to note that ***the higher speed dramatically increases (more than doubles) the rate of wear for the pumps (in particular) and the motors.***

Consequently the1800 RPM pumps are preferable when considering the Life of the System (Total Cost of Ownership).

7.2 Efficiency

Aside from the motors for Submersible Pumps (see below), electric motors (typically) have an efficiency of 85 to 90%. Often there is an option of using a "*premium motor*" with an efficiency in the range of 90 to 95%. ***Normally the marginal extra cost of high efficiency motors is worthwhile in terms of the savings on electrical costs over the Life of the System*** (say 20 years in the case of a Vertical Turbine Pump running at 1800 RPM).

7.3 Temperature

A prime factor in the life of the electric motor is the temperature. ***Ideally the ambient (pump house) temperature should be less than 30 C (86 F). Above 40 C (104 F), the life and efficiency of the motor dramatically decreases.***

So where we have such high temperatures, cooling of the motors is necessary. Depending on the actual temperature, this may involve ventilation, the use of thermostatically controlled fans or in more extreme conditions, air-conditioning of the pump house.

See following for special notes on cooling of Submersible Pump motors.

7.4 A Special Note on Submersible Pump Motors

7.4.1 The Design Focus of the Submersible Pump Motor

The focus of Submersible Pump motor design is not durability or efficiency. The prime driver in the design of Submersible Pump motors (and pumps) is to fit down a (relatively) small diameter bore (say 100 to 200 mm or 4 to 8 inches). See graphic to the left.

7.4.2 Durability

Normal motors are not constrained on the diameter as Submersible pumps are. One consequence of the elongated design of the Submersible Pump motor is that it is not as durable as the standard motor. That is, ***Submersible Pump motors have a significantly shorter life than a standard motor.***

7.4.3 Cooling of the Submersible Pump Motors

a) The Infamous Shroud (Not Turin)

The Submersible Pump was developed to run in a relatively small diameter bore (refer to the upper right hand photo on page 4).

When used in an open water situation (such as a wet well or directly into a lake), then a shroud needs to be fitted over the motor (refer to the upper right hand photo on page 3).

This shroud forces the water to flow over the motor's surface and cool it. The size of the shroud is important.

b) Variable Frequency Drive

The application of Variable Frequency Drives on Submersible Pumps has a chequered history and continues to be problematic.

We have come a long way since 1995, when an early Submersible Pump Station (in Penang, Malaysia) had 4 Submersible Pumps fail in 6 months. But there is still a way to go.

When the Variable Frequency Drive reduces the speed (flow) of the Submersible Pump motor, it also reduces the cooling effect of the water flowing by it. This (typically) results in an increased operating temperature which reduces the life of the motor. Too often there is a catastrophic failure of the motor.

7.4.4 Making Submersible Pump Stations Work

Attention to detail can make a Submersible Pump Station workable. That means using someone who has *successfully* done it before. It means using the best quality motors (Grundfos), sizing the shroud to provide the right cooling, electrical design, etc.

8 MANIFOLD AND VALVES

8.1 Each pump unit should have its own:

8.1.1 Slow-closing check valves to prevent backflow during operation.

8.1.2 Isolation valve for maintenance of individual units without shutting down the pump station.

8.2 The manifold will have:

8.2.1 A fast-acting Pressure Relief Valve capable of discharging the full flow of the Irrigation Pump Station. ***The Pressure Relief Valve is an emergency pressure relief from the system in case of the failure of the Pump Control System or Operator error*** (when operating manually).

8.2.2 Threaded bosses should be provided for fitting of:

a) Pressure and flow sensors

b) Injection Pipes. Even if there is no Fertigation Unit, this should be provided in case of retrofitting.

c) A 25 mm hose cock for washing down of the pump house or filling of the fertigation tanks (if any).

This old Irrigation Pump Station uses the dinosaur technology of the "CLA" Valve with a hydro-pneumatic tank. See item 9.2 over page.

9 PUMP CONTROL SYSTEM

This is an item that does not receive the attention it deserves since it is poorly understood. ***By providing the required flow (to match system demand) at the right pressure, a good Pump Control System prevents catastrophic failures of the pipe system while also extending the pipe system life (decreasing Total Cost of Ownership).***

9.1 Variable Demand - A Distinguishing Feature of Golf Courses

Refer back to page 1 to the second basic function of an Irrigation Pump Station:

> "***An Irrigation Pump Station on a golf course must be able to deliver flow from zero to the specified flow (and all points between) closely regulated to the specified pressure.***"

A good Computerised Central Controller will optimise flow during a full irrigation cycle(typically overnight). However, this is not the case (typically during the day) when there is watering for maintenance (eg, fertilising), special programs (eg, syringing greens) or ad hoc watering ("I just want to add some water to the 6th Green").

Many pumping applications are simplistic - a "single-point demand". Eg. Supply 90 L/s at 8.50 Bar. But, ***an Irrigation Pump Station for a golf course needs to supply 10 L/s at 8.50 Bar, 45 L/s at 8.50 Bar, 60 L/s at 8.50 Bar, etc.*** This is a distinguishing feature of a golf course Irrigation Pump Station.

9.2 History - The CLA Valve and Hydro-Pneumatic Tank

Up to about 1990, the pump discharge pressure was regulated by a cumbersome Pressure Regulating Valve (called a "CLA" valve). A large hydro-pneumatic tank (pressure vessel) was used to absorb pressure spikes. The valve was notoriously difficult to set and maintain and the pressure vessels rarely received attention.

The unfortunate result was poorly regulated discharge pressure and a shorter life for the pipe system.

9.3 The Variable Frequency Drive (VFD)

This is the fundamental piece of equipment that allows us to vary the speed of the motor and therefore its flow/pressure). Over the past 20 years we have seen these units grow in reliability and plummet in cost. They are now the dominant method of flow/pressure regulation.

While Variable Frequency Drives are often (questioningly) promoted as energy saving devices, their main benefit is prolonging the life of the pipe system.

9.4 Programmable Logic Controller (PLC)

This is the brain of the Irrigation Pump Station. It is (essentially) a simple (industrial) computer that allows a programmed response to input parameters (system pressure, system flow, speed of the pumps, settings of the VFD, etc).

9.5 Rotation of Main Pumps

The Pump Control System should rotate the Main Pumps (Duty, Lead and Standby) so that all main pumps achieve equal run-time. This extends the system life (and reduces the Total Cost of Ownership). Notably, European pump stations often do not do this.

10 WATER QUALITY

While it is an important topic, it is also a diverse and complex one. So it will only be covered briefly (in what is already a lengthy newsletter).

For the vast majority of our golf courses, there are no special provisions needed to the Irrigation Pump Station or the Irrigation System. However, ***water tests must always be done.***

The source of water is important. Each (eg. treated, river or underground water) has their own peculiarities to consider.

Typically if the water is suitable for irrigating standard varieties of turf (not including the salt tolerant varieties), then there is unlikely to be a problem for the Irrigation Pump Station. Specifically, ***a pH between 6 and 8 with and Electrical Conductivity below 1.56 mS/cm (Total Dissolved Solids - TDS below 1,000 ppm) is unlikely to cause a problem.***

When water quality falls outside these ranges, commercial aspects need to be considered. The shortened lifetime of the Irrigation Pump Station needs to be balanced with the higher capital costs of higher grade materials used in the construction of corrosion resistant Pump Stations.

A pH of 3 (particularly combined with high salt levels) can destroy a normal pump station in terms of months. Electrical Conductivity above 1.56 mS/cm (TDS above 1,000 ppm) accelerates corrosion.

To repeat, while we have not covered it in depth, water quality is important. Contact your Irrigation Consultant for the range of tests that you should be conducting on your water.

11 TOTAL COST OF OWNERSHIP

This is a concept strongly promoted by Hydrogold.

Total Cost of Ownership ($ per Year)	=	Capital Cost + Running Costs / Life of System (in years)

11.1 Hydrogold's Quality Chain

With many projects there is too much emphasis on the Capital (Up-Front) Cost. Hydrogold promotes considering all aspects of the project (at the Planning stage) to minimise the Total Cost of Ownership.

For more information on this concept, please refer to HydroView No 1 available at the Education Centre on our Web Site.

11.2 Motor / Pump Speed - Lower Speed is Better

The single-most important factor affecting the Life of the System is the motor / pump speed. ***A higher speed (2900 RPM) dramatically increases (more than doubles) the rate of wear for the pumps (in particular) and the motors compared to the lower speed (1800 RPM)***. Refer also to item 7.1 on page 12.

11.3 Total Cost of Ownership - A Case Study

Based on our experience, we compare the options of Vertical Turbine Pump (**VTP**), Submersible Pump (**SUB**), Vertical Multi-Stage Centrifugal Pump (**VM-SCP**) and the End Suction Pump (**ESP**).

TOTAL COST OF OWNERSHIP (Case Study)					
Pump Parameters					
Pump Type		**VTP**	**SUB**	**VM-SCP**	**ESP**
Flow	L/s	90			
	m^3/h	324			
	USGPM	1,429			
Pressure	Bar	8.50			
	kPa	850			
	PSI	123			
Average Run Time	hours / day	5			
	hours / year	1,825			
Pump Efficiency	%	85%	75%	70%	60%
Motor Efficiency	%	90%	85%	90%	90%
Motor Speed	RPM	1,800	2,900	2,900	2,900
Total Cost of Ownership - The Calculations					
Capital Cost	US$	160,000	120,000	112,000	104,000
Electricity Cost	US$ / kW.h	0.15	0.15	0.15	0.15
	US$ / year	27,392	32,870	33,262	38,805
	US$ / 20 years	547,839	657,407	665,234	776,106
Maintenance	US$ / year	6,000	12,000	6,000	6,000
System Life	years	20	12	12	15
Total Cost of Ownership	**$ / year**	**41,392**	**54,870**	**48,595**	**51,739**
	20 years	**827,839**	**1,097,407**	**971,900**	**1,034,773**
	% of VTP	**100%**	**133%**	**117%**	**125%**

How the Highest Capital Cost delivers the lowest Total Cost of Ownership:

The System Life is a significant contributor.

<u>But the startling fact is the amount of electricity consumed over 20 years (say US$ 547,839 for the VTP) compared to the capital cost (US$ 160,000 for the VTP)</u>. It is why we look at Total Cost of Ownership and not just Capital Cost.

Electricity is the most significant cost contributor. And the largest factors governing electricity cost are Pump and Motor Efficiency. High Efficiency Motors that save 5% of electricity (US$ 27,392 over 20 years) are essential.

This is why Vertical Turbine Pumps are normally our recommendation. But each case needs to be considered individually by your Irrigation Consultant.

12 GOLF COURSE IRRIGATION PUMP STATIONS - FEATURE COMPARISON GUIDE

Important Notes: ***This is a generic table that provides indicative generic information. Each pumping application has its own special needs that must be considered by a professional Irrigation Consultant.***

Estimates of system life and efficiency are based on our experience and will vary with different site conditions.

Feature	Vertical Turbine Pump	Submersible Pump	Vertical Multi-Stage	End Suction
Total Cost of Ownership (Typical) (refer to pages 16 & 17)	Lowest	High	Low	High
Capital (Up-Front) Cost	Highest	High	Low	Lowest
Maintenance Cost	Low	High	Low	Low
Indicative Pump Efficiency	80 to 85%	70 to 75%	65 to 70%	55 to 60%
Indicative Motor Efficiency (refer to pages 12 & 13)	90 to 95%	80 to 85%	90 to 95%	90 to 95%
Electricity Cost (refer to page 17)	Lowest (by far)	Low	High	Highest (by far)
Indicative System Life	20 plus years	8 to 12 years	8 to 12 years	10 to 15 years
Loss of Prime (refer to page 6)	Submerged Intake - Not a problem	Submerged Intake - Not a problem	Loss of Prime Problems - Unless flooded suction	Loss of Prime Problems - Unless flooded suction
Maximum Suction Lift (refer to page 7)	Not a problem	Not a problem	About 4.5 m (14 ft) Typically cannot pump from lakes deeper than 3 m (13 ft).	About 4.5 m (14 ft) Typically cannot pump from lakes deeper than 3 m (13 ft).
Variable Frequency Drive Compatibility	Good - Steep pump curves. Easy to correlate flow / pressure.	Problematic - Lower motor life and frequent failures (refer to page 13)	Okay	Problematic due to flat pump curves. Difficult to correlate flow / pressure.
Noise (for residences)	Can be a problem	No problem	Typically Insignificant	Typically Insignificant

13 IN SUMMARY…

The Irrigation Pump Station is the single-most expensive piece of the irrigation system.

The above technical information will help you understand the complexity of an Irrigation Pump Station. ***The advice of an experienced Irrigation Consultant with their specific industry knowledge is invaluable in assessing the many options available.***

A pumps station is not just pumps. A pump station consists of Pumps, Motors, Manifolds & Valves and a Pump Control System. This needs to all be designed into one integrated package. ***And that package needs to be integrated with the needs of the irrigation system.***

As with all products, it takes time (product development cycles) and years of proving in the field to establish a good reputation as a reliable pump station manufacturer. Your choices:

- Use the experience of an established pump station manufacturer
- Experiment with new entrants to the market.

Look at the Total Cost of Ownership rather than just the Capital (Up-Front) cost (refer to item 10). ***Particularly consider its efficiency and the anticipated Life of the System.***

Electricity is often the single-largest cost (see page 17). So it is critical for the Irrigation Consultant to calculate the right flow and pressure. They need to consider the sprinkler operating pressure, frictional losses, safety margins, etc. ***If the Irrigation Consultant is out only 5%, the cost of the extra electricity over a 20-year period will be US$ 27,392 - it puts the cost of the Irrigation Consultant in a different perspective.*** (Did I mention you need a good Irrigation Consultant?)

Installation of a VTP Irrigation Pump Station through the roof of the pump house. Discovery Bay Golf Club in Hong Kong. Irrigation renovation designed by Hydrogold