Lou Zarro:

So you should see a picture of some panels and some people...

John O'Connor:

Yep.

Lou Zarro:

And some, so when Jock asked me to put this together, I just grabbed some pictures. Obviously they're just solar panels. Generally speaking, the majority of solar pumping is submersible pumps, obviously extracting groundwater. But, we do do a bit of surface water pumping as well. But I'd have to say, in Australia, it'd be probably around the 70% mark submersible pumps and then 30% surface amount of pumps. And, of course, you don't get much of a picture of a pump in a bore. It's just a hole in the ground.

Lou Zarro:

So, these are examples. The top left hand corner is a site in Albany, in Western Australia, actually the one below it as well. So, that's a pumping system they're using. It's pumping from a tank and it's supplying stock water to a cattle station in Albany.

Lou Zarro:

And the top right hand corner, that was an interesting experience. I was fortunate enough, it was about three years ago, to travel to Samoa. And Samoa is an interesting place. They basically run off diesel power. Is how they generate energy over there. So, they've started to introduce some solar pumping systems. So that was a system we did for water supply to a small Samoan community, that was up in top of the hinterland, beautiful little country. And so, that was a nice little system.

Lou Zarro:

And then, the one in the bottom right hand corner is utilising... So, you're just seeing some pictures of some controllers. It's basically on the left hand side of that bottom picture. My arrow might help, if you can see my mouse. But, you've got the solar inverter here. The big box in the midle is a changeover device. It's an automatic changeover system that can goes, when the sun intensity drops by a certain level, it will switch from DC to solar across to AC, where it will start up a generator to take over. So, that was on a irrigation system in Western Australia.

Lou Zarro:

So there's just some quick examples of some solar...

John O'Connor:

Mm-hmm.

Lou Zarro:

solar systems.

Lou Zarro:

When we look at solar pumps, they're broken down into a couple of categories. We have submersible pumps, which as I said, represents probably around 70% of the mark in Australia. And in those two categories, there's two types of pumps.

Lou Zarro:

On the left hand side there, you'll see it's a slightly different design. It's got this worm-style rotor, which we call a helical rotor. The design works well in solar pumping, especially on low sunlight days because it's referred to as a positive displacement pump. And the idea is, as long as it's turning, so as long as there's enough sunlight to power up the motor, the pump rotates. It will then deliver a minimum amount of water. So, in those low sunlight conditions, the helical rotor pumps are a lot more efficient, than the centrifugal pumps, which is the one next to it. For low flow, high head applications in low sunlight areas, the helical rotor's the pumps of choice by most manufacturers. Generally used in those smaller areas. Stock and domestic, is probably where you see a lot of them.

Lou Zarro:

As we get into bigger pumps, we tend to switch to centrifugals. I'm assuming people understand the difference between centrifugal pumps and helical rotors. Maybe to put it in one term, if you can think of... The centrifugal's got, what we call an impeller, that rotates and needs to achieve a certain speed before it can deliver the water out of the bore to as overcome the actual head pressure.

Lou Zarro:

So, when it comes to higher flow rates, we switch to centrifugal pumps because they're good at pumping volume and head at reasonably low levels. So we don't want to, we're not going to do the really high lifts, if you like. If you're trying to overcome a 100 meter hill or something like that, then a helical rotor would probably better suited. And the centrifugal's then better suited for larger systems. And then, when we get into the irrigation applications, we're generally 100% centrifugal.

Lou Zarro:

Then we have our surface mounted pump types. And here is just a couple of pumps. So, it can be as small as, what we call horizontal multistage. It's got a bunch of impellers in there. Reasonably efficient, ideal for small flows.

Lou Zarro:

And then, we move to what we call a vertical multistage. So these would be just sitting on the banks of a dam or a river, or next to a tank, and pumping water.

Lou Zarro:

Generally speaking, when we move to surface, some manufacturers have integrated motors with inverters, but most of them run an external inverter. And I'll explain that a bit more in just a tick. Then we can run... What the inverter allows us to do is then run basically conventional pumps, so the pumps aren't anything special, they're basically the same pump you'd run on a grid system. But, we use an inverter. There's a picture of one there. And that allows us to convert the DC power to AC and then run conventional AC motors.

Lou Zarro:

When it comes to the actual motors, the technology is a little bit different. And so, motors, we've got submersible motors and then we've got surface mounted motors. In the submersible motors, up to around four kilowatts, it's broken up into three types of motors.

Lou Zarro:

And without trying to get too technical here, essentially we have permanent magnet motors, which tend to be the higher efficiency type motors on the market at the moment. They can convert AC, convert directly by the inverter, built into the motor. So what we actually have... So, I'll get back a step... Is we've got the motor stator and rotor, which is at the top. And then, we've got a bunch of electronics that's actually mounted in the motor itself. And then, it's basically a built-in solar inverter inside the actual motor. Like I said, up to four kilowatt. And what that'll do is take AC or DC directly into the motor, so they can run on solar and then you can switch over to AC during the nights or as a backup, if you haven't got enough sunlight.

Lou Zarro:

Permanent magnet. What we mean by permanent magnet is, normally with the motor, you have magnets in the stator. And then the rotor is just a bunch of copper windings. In this case, we actually put magnets in the rotor as well. So it's basically a full magnetic motor, which makes it more efficient, tends to run cooler. And then, with the electronics, we then have the ability to control that, to run either AC or DC.

Lou Zarro:

From there we move onto the brushless DC motors. Can operate at quite high speeds, they provide a good constant torque, they run purely on DC. Mind you, you can have a transformer at the top that converts AC to DC, and then you can run them that way. But then, that's an extra expense to do that. So basically, DC to DC. It's a little bit of an older design, but the advantage is they tend to be a little bit cheaper. So, they're good from that point of view. And you tend to see a lot of the internet sellers using this style of motor. There is a bunch out there but yeah, I think personally, the permanent magnets are the way to go.

Lou Zarro:

And then, of course, we've got conventional induction motors. So these are the types of motors you'll see on your standard range of submersible borehole pumps. Safe, they can run either AC or DC. And how they're controlled from a solar point of view is, we use an inverter, and the inverter converts the DC from the solar array to AC. These motors are just a standard induction AC motor.

Lou Zarro:

And if we move to the surface mounted motors, we're using conventional induction motors. So, these are the types of motors you'd see on your normal irrigation pumps out in the marketplace. So with the, with inverters, we convert the DC to AC, and then we can just run the conventional three phase motors or single phase motors. From there, you can go up to kilowatts. There's inverters of motors, obviously. I've put a number in there. There's 250 kilowatts, but they can go bigger than that. And I'm sure there's examples of solar systems bigger than that.

Lou Zarro:

Yeah so, and this is just a quick picture of a system layout. So essentially, we've got the solar array, which would be sized to the application. I tend to stress that because there are a lot of internet sellers trying to sell solar pumps at the moment. And they're giving very generic information. And customers are, I think, getting for want of a better term, sucked into the lower price. But really, these systems have to be sized for the applications.

Lou Zarro:

What I mean by that is how much water they really need, for if it's livestock or irrigation, working out the hydraulic losses in the pipeline, the heights they have to overcome. So, those pumps have to be sized to make sure they can achieve that. And if they're not done correctly, then I think you'll find the customers will be really disappointed.

Lou Zarro:

So essentially, we've got the solar array, an inverter, or if it's a pump with an integrated and for small motors with the integrated permanent magnet with the controls, then it's just straight from the solar array down to the motor. They'll obviously have some sort of DC isolation, to be able to isolate the pumps from the array so they can pull it up and work on it. And some companies have some control, so then they can run pressure switches. So, when the tank fills up or the stock trough filled and the system will shut down automatically.

Lou Zarro:

And then, when we get to the bigger systems, we've got external inverters and running conventional pumps. And that would depend on the size. So, as we get bigger, we tend to move away from the integrated solution to an external inverter.

Lou Zarro:

I just put this slide in. So, these are the challenges we see in the marketplace, when it comes to solar pumping. And I emphasise this, but it's a big thing. It's correctly designed systems. A lot of people, like I said, with the internet sellers, tend to think a system will work, and under all circumstances. But, correctly sizing a system to suit the application is critical.

Lou Zarro:

So, making sure you've got all the calculations for frictionalised heads and the amount of flow they need. And making sure, is it the worst case scenario they are allowing for? Some people might decide that they want the flow in peak summer. Some might want it in peak winter. So, understanding the application and size in the system correctly is critical. Making sure you've got enough water. So, at no point saying I need 10,000 liters a day, if the bore's only capable of producing 5,000, and you over pump the bore and the pumps then run dry. And then, of course, that could cause some issues with the product.

Lou Zarro:

Correctly size system, I've said that. The array frame design, obviously there's some companies out there that specialise in array frames. But, there's also people out there that will just make their own system up. They do have to be careful. Obviously, structural standards, for the structural... Wind-loaded and soil types, then the array frame has to be certified for those applications. You don't want the thing falling over or blowing away and causing some issues. So, a good array frame is critical. Dealing with someone that provides the installation and the commissioning.

Lou Zarro:

Oh yes. I put in there, backup AC. This is a contentious issue in solar pumping in the moment. Me and Jock spoke about it briefly when we caught up the other day. It's more about when we get to larger systems, so as we move from stock and domestic. The great thing about stock and domestic is that the energy source is at it's most available when the stock are drinking the most. The hotter the day, the more sun's out. The pumps tend to suit the application quite well.

Lou Zarro:

When we move on to larger systems that we're talking about, irrigation or water supply in the... Continuity of supply is pretty critical, and they can't really afford to have a drop-off because some cloud cover's come over. What they do is they want to have some backup systems. They want those backup systems to be automatic. And then there's some challenges. So, if the automatic backup system is from mains power, it's fine. You can switch over and you can blend, which is a term we use at the moment. So that's where you use predominantly DC, and you blend a little bit of AC into the system.

Lou Zarro:

But if you're using a diesel backup, a diesel generator backup, then there's challenges because you don't want to be partially loading diesel generators, because that causes issues with the actual generator itself. Being partially loaded can cause the gauze to glaze up. And then you're talking about adding additional load to the generator. My experience is, the best way to do it is, to switch from one power supply to the other directly. So you either run all AC, or you switch across to DC and you run all DC. So, rather than doing the blending thing there is...

Lou Zarro:

I know the Clean Energy Council has some issues with blending and they've written some standards around that, but some people do blend and I have some of the feedback I've got from manufacturers of inverters is that the inverters do suffer as a result of using the two power supplies into it. I don't understand the technical aspects of the actual reasons behind that, but they do say it can degrade the life of the inverter by blending. My personal experience is, you switch from one power supply to the other power supply cleanly. You use a properly designed system, and you won't have any issues.

Lou Zarro:

The other things, obviously which are critical, is the support and backup. Solar pumping is a specialised product and it does need that support. And obviously, if you're dealing with a particular retailer and making sure of the manufacturer, then obviously warranty is important to make sure you don't get that backup long term.

Lou Zarro:

And the other thing is, I just wanted to point in is, avoid online resellers. At all cost. We're hearing quite a few horror stories out there. An incorrectly sized system, or product not working, and that type of thing.