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Get water ready: tanks, pumps and sprinklers

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How do we build a reliable system? I guess there's three really key components to work with. We need water, and enough of it, we need that water to come out at sufficient pressure to be able to push it everywhere, and it needs to come out through a robust pipe network and spray heads.

If we look at water, the particular amount and the way we store that water is absolutely key. So, a large dam is obviously going to be a fantastic reliable water source. A concrete or steel or underground tank is going to be a really reliable storage of water that can provide that water supply throughout. Noting that I guess once you get down to steel tanks your challenge is that the heat that would normally take out say a plastic water tank is going to affect your steel tank particularly above the water line. So, if this is a drinking water tank it'll actually have a coating on the inside of that steel that that tries to maintain that high water quality for your drinking water tank. Any of that metal above the water line could damage the drinking water plastic coating in that tank and render the tank useless for ongoing use for drinking water. But what it does do is that metal tank will hold water for the duration of your bushfire, and therefore be reliable.

Similarly, very large metal tanks that actually have almost like a pool liner inside them, we've found that they're actually very reliable in a bushfire in holding the water for the duration of the fire and making it useful for fire fighter defence. But the amount of that lining that sits above the water line is vulnerable to being heated under the more severe fires and can burn or melt but it doesn't actually cause the liner to collapse inside the water tank, so it actually does its job but unfortunately there's possibly the price of a new liner and some upkeep for those tanks.

There's probably only one type of metal tank that's ultra reliable and can handle quite a lot of heat, and that is a stainless steel tank. So, it looks very similar to a normal corrugated Colorbond style tank or a galvanised tank but the stainless obviously doesn't need that plastic in a liner to maintain that water quality. So, quite expensive but an interesting option nonetheless.

And, of course, concrete tanks do really well above ground, and below ground. Under really high heating conditions you can get some spalding of those tanks so a bit of the concrete can pop off on the outside. But, in almost all cases that's a little bit superficial and cosmetic and the tanks are great during the fire event and can perform really well as a drinking water and fire fighter storage tank after one, two or many fires.

I've already covered the details around the plastic tank so I won't go into that one. I guess the type of tank's important but also if there's a tank stand involved the tank stands obviously got to be adequate as well. So, things like timber tank-stands are vulnerable in fires and burn through and cause the water tank to collapse and fall off. In this case we're looking at a steel tank-stand but unfortunately they've used that lovely space under your tank for fuel storage or timber fuel storage. That would be quite catastrophic to leave in a steel tank if you put that much fuel load under it.

Let's move on to pressure and how we get a system to work. A typical system I find when I'm doing these post-bushfire surveys or having a look at people's houses is we've got a tank or a dam, we've got a fire fighter pump and a system that gets it to the house. This is a really typical system. Obvious major problems that we've already covered is the fuel tank is quite problematic, there's inadequate protection of the actual pump itself, it's going to operate flat out for x amount of time. Might be half an hour to an hour and need refuelling, and they typically cut out under the worst of the fire conditions that present.

So, lots of issues, and I guess the functional nature of these types of pumps is you've got to ideally put them next to the tank to make them work. They don't like having to try and suck water from a long pipe network, so they're recommended to put near the tanks and unfortunately out near a tank is out in the open and exposed. And those tanks here's an example of one of those pumping systems that's ingested embers during the fire and it suffered a flaming failure of the inlet air filter that's shut the pump down and that won't be functioning ever again.

The actual ember screening of the inlet area is important, as is trying to get these pumps to operate under the really high temperature conditions. And here's a really good example of an attempt to prevent the heat transfer between the exhaust outlet and the inlet and also the exhaust outlet and the petrol tank here. So this is going to mean that this pump's going to push through to a much higher level of ambient exposure before it shuts down so this might get up into the mid 40°C before it shuts down.

But obviously we've still got an issue about embers. So how are we going to solve the embers? Well we could think about putting the entire thing in an ember-proof cabinet. In doing so you have to put a lot of effort into having enough airflow so that the exhaust can leave that enclosure and enough fresh air can get to the enclosure, and the enclosure itself doesn't get too hot as an internal air temperature because it's kind of not able to evacuate that heat.

The degree that you need to ember proof a pump enclosure like this is that you have to be as fastidious as you would with your house itself. So absolutely down to the 2mm gaps and entrance, and I'd probably give this enclosure about 6/10 for detail because there's still gaps and areas where embers can be drawn into this approach. So it's still quite possible that pump could shut down in an ember storm by sucking embers into the inlet.

And I guess the other approach is well you can even try to cool the enclosure or provide some cooling to the surrounding area and you can do that by putting a spray system on the enclosure itself. So like that evaporative cooling effect you get by using evaporative coolers in and around your house you get a similar effect by spraying water around your environment. So this pump might now start enjoying a 10°C drop in what it feels the ambient conditions are so that could also extend the performance of that particular pump.

What the spray systems won't do though is prevent embers getting to and being ingested by that pump. We see time and time again that spraying water around the place just simply doesn't stop the ember storm. The embers don't suddenly go out because there's water around. There's so many embers around you just cannot rely on spray systems to prevent the embers getting into that enclosure. And obviously when you open that enclosure internally that enclosure will be dry for the same reason that your roof cavity or your wall cavities are dry in your house.

So, what's a better system to the typical one? Well, why not electric? Electric pumps can be far more tolerant. They can handle a lot higher temperatures, they can be mounted in situ or remotely from the tank. But obviously you've taken the engine, the internal combustion engine, off the actual pump itself and replaced it with an electric motor. But how are you going to reliably provide electricity to that motor? And what you actually need is either a remote generator, which can be put in a far more convenient location any distance away from the tank. So there's a big improvement, that you've got flexibility for a really nice enclosure in your preferred location for your generator. Or you can think a bit more outside the square and think about a battery storage system and an inverter and both of those things can be safely mounted in an appropriate shed or in your house itself or in a basement, and of course they can work quite synergistically with the solar system and whatnot. So it's a bit of thinking about quite an advanced solar system and looking for a bit of battery backup and surviving through those blackouts, here's a really obvious and interesting extension of that idea to move to an electric system.

The other side benefit of having an electric pump system is that point that was raised in the questions about automatic activation. And it's obviously a lot easier to automate the activation of an electric pump compared to having a starter battery and whatnot to get an internal combustion

engine up and running on your system. So, I would say that that's inherently more reliable, and of course the gold standard system is to use some form of gravity-feed approach.

And if you're lucky enough to be in an area like Marysville that actually has gravity-feed town water supply system, then you can start to think about having quite reliable water pressure. That being said, Marysville actually had a failure during the Black Saturday events from its gravity-fed water system, and that's because a car actually burned over a service manhole that was some critical valve in the system that shut the whole thing off, so just like Malcolm's pine-tree root story for his main water supply, there's always potentially some weird and wonderful way you can take out an otherwise really reliable system.

And as I mentioned earlier ideally, if you've got 15m of height between your tank and your house that gets you well and truly there. If you're less than that then you're going to have to really think carefully about whether you can use the right types of low-pressure sprinkler heads and whatnot to get an adequate system. But when you're designing those systems, it's about the pressure that you get at the end of the pipe, not the pressure you've got ideally supplying the system. There's always loss in a pipe. So if you are working around those margins of having enough, just enough water head or pressure, you really need to really think about nice big pipes and having a low-loss system to work effectively.

And on to pipes and spray heads. So, anything above ground, I would say, metal is the way to go. You can go with the galvanized pipe approach although the downside of that is they rust over time and end up choking up that pipe diameter during that life and that all comes down to soil type and water quality and whatnot that's inside the pipes. I would say copper is really reliable and I would put copper standpipes coming out of the ground with no problem. I've seen really reliable systems with copper exposed to direct flame contact and it's fine.

I would err against using timber even if it's hardwood as the backing post like in this example. Especially not treated pine. Preferably not hardwood, more like a steel support backing pipe for your standpipes would be more appropriate. I like this design in that it's got like an all-metal impact sprinkler on the top, and I guess you probably wouldn't expect these plastic fittings to potentially be there if there was a significant heat source nearby.

Yes so something like this style of impact sprinkler they come in all manner of forms. And it's really interesting to watch these in operation, particularly when farms are irrigating their fields with these types of sprinklers under extremely windy conditions. They really hold up against the worst of the winds and deliver water irrespective of those wind speeds.

And, of course, placement. We have to really think about placement and what we're targeting, and whether they're going to be adequate. And the percentage of loss from even those impact sprinklers that we're going to lose to the wind. Because anything that gets picked up and carried by the wind simply isn't going to be effective for your house. It might be more effective to your neighbour but it's more or less lost water once it gets to that fine droplet size and gets carried away.

I guess there's other types of sprinklers that are more dispersive sprinklers. This is the example that's actually on the top of that pumping shelter. And what you really find is this is a really fine dispersive sprinkler, so under really windy conditions this is going to have most of the water carried away from the area rather than deluge back onto that shelter or its immediate environment. And yes you certainly can't rely on that type of spray system to be persistent in that particular area, and you can't rely on that preventing embers getting to your pump approach. So, I'd I think probably differently about a more effective way to get water onto that system.

And, I guess, the particular standpipes and the way they're protected is key. Even the threaded fittings between them, you really have to focus that on an all-metal approach.

And, I guess, there's a few places where you really do have to compromise and potentially consider using a flexible plastic pipe. And one of those is actually the entry and exit to the pump itself. So because the pump vibrates if it's an internal combustion engine pump, there's quite a lot of vibration. And to deal with that vibration, you can't really mount a hard metal connection to that pump. It'll eventually fatigue through and break and it's not recommended in the installation instructions.

So if you're going to have to use certain sections of plastic piping like in this example what we really recommend you do is wrap it in some type of high temperature lagging. This is like an exhaust wrap that you get from an automotive shop so that's actually a ceramic fibre woven bandage or wrap that'll prevent embers and heat affecting the plastic too much. And then the ideal finish is to then wrap that again with a reflective aluminium covering that then repels the radiant heat and gives you a really good protection for those limited areas where you really have to use plastic.