DRY FLEXICYCLE™
THE POWER GENERATION SOLUTION THAT
USES 96 PERCENT LESS WATER
As the threat of droughts continues to grow around the world, water issues are once again climbing up the social and economic agenda. With the US Geological Survey estimating that thermo-electric power withdrawals currently account for 49 percent of total water use, Wärtsilä has developed an alternative power generation solution that has the capacity to produce the same profits as a system based on a Combined Cycle Gas Turbine (CCGT), using 96 percent less water.

More than 95 percent of the world’s large gas- and liquid fuel-fired power generation uses gas turbine technology, predominantly CCGTs,” explains Jaime López from Wärtsilä Power Plants Marketing. A gas turbine and a steam turbine arranged in series combine to create a highly efficient, cost-effective way of generating energy.

“The drawback of this technology is that its cooling system also requires large quantities of water. In hot, dry climates, the turbines struggle to maintain their output and need water to be sprayed at the inlet – significantly increasing the need for scarce water,” he continues.

Three years ago, Wärtsilä developed a technology known as Flexicycle – a solution based on a gas or multi-fuel reciprocating engine power plant combined with a steam turbine. As Flexicycle power plants can operate both in highly efficient, combined cycle mode and in dynamic, fast simple cycle mode, they are ideally suited to support power grids where efficiency and flexibility are paramount. Wärtsilä currently delivers 2.7 GW of power around the world using Flexicycle plants.

Dry Flexicycle is a new technology from Wärtsilä that combines all the benefits of Flexicycle technology with drastically reduced water requirements. Where conventional CCGT or Flexicycle technologies use water for their cooling systems, Dry Flexicycle uses ambient air in a water-cooled condenser connected to the radiator closed-loop cooling circuit. This system extracts the heat from the cold leg of the steam cycle, by means of a heat exchanger that dissipates it through radiators boosted by fans, to ensure efficient heat transfer.

“Energy that would usually be dumped to the disposal water is instead dumped to the ambient air,” explains López. “While this solution is not quite as efficient as water cooling, preliminary data indicates that the energy loss is actually quite small. According to the Flexicycle engineering team, it actually amounts to less than one percent.”

López goes on to explain that Dry Flexicycle is particularly well suited to geographical locations in which water use is restricted due to environmental concerns, such as in California during the current drought, or where water is in short supply – such as in arid areas or deserts.

“In countries with deserts, power tends to be used extensively for the desalination of water. However, it makes no sense to waste water, in order to make water!” says López.

“Nowadays, if you want to generate power and you have no access to water, you can generally say goodbye to your project,” he continues. “However, with Dry Flexicycle, that doesn’t have to be the case.”

A study conducted by the California Energy Commission has compared four different scenarios, with four different
climatic conditions that correspond to real-life locations, looking at the various factors that impact energy generation in each case. California is one of the few places in the world where one can find four radically different climates in a relatively small area, making it the ideal location in which to perform a valid analysis that can be extrapolated to most regions in the world. In California, it is possible to look at the performance of a power plant in the arid Colorado Desert or in subtropical Los Angeles, just 250 miles away.

The study examines the output and profit that each power plant would generate throughout its lifecycle, accounting for the capital and operational expense and examining environmental issues such as availability of water. Meanwhile, at Wärtsilä, Jaime López has conducted another study, using the four scenarios from the California Energy Commission’s study, during the same 2014-2040 time frame, but comparing the cost and output in the event of CCGT technology being replaced by Dry Flexicycle.

“In my research, I’ve looked at water consumption, power output, cost and profit, condensing my results in a novel metric that compares the number of litres of water required to generate one U.S. Dollar of profit,” explains López. “What I discovered surprised even me.”

According to López’s findings, a CCGT plant requires on average 59 litres of water per dollar. For conventional Flexicycle technology, the number is 29 litres. Meanwhile, Dry Flexicycle uses only two litres of water per dollar generated in profit. When retrofitting an existing gas turbine with a dry cooling system, the number goes up very slightly – to 2.9 litres per dollar.

“The payback time is similar across all three technologies,” he continues. “However, Dry Flexicycle works equally well across all locations, in all kinds of climates, but requires considerably less water to yield the same profit. For a plant with projected revenues of more than 100 million dollars a year, every drop counts!”

Given these results, the question remains: Why are power plants the world over not converting to Dry Flexicycle? According to Jaime López, there are a number of explanations.

Firstly, Dry Flexicycle technology is completely different to anything that has existed before. While 95 percent of the gas- and liquid fuel-fired power generation market uses gas turbines, Wärtsilä is the only company that currently offers a viable, air-cooled alternative based on reciprocating engines.

In addition, energy is typically generated by state or investor owned companies, which build generation assets through public tenders. These tend to contain very specific criteria, often including technology requirements. These days, it is very rare for tenders to be technology-neutral and, when a particular technology is preferred, it is almost always CCGT or another form of gas turbines.

According to Jaime López, while the adoption of Dry Flexicycle offers significant benefits and rewards, it will require a change in mindset from energy companies around the world.

“CCGT is well-known technology that has been in use since the 1960s,” he says. “In most cases, it’s simpler to keep buying the same solution – you know what you’re getting and who you’re buying it from; your engineers understand the system and how to maintain it; it doesn’t require a change in culture. However, you may end up paying a hefty price for that resistance to adopt new technology, in the form of lost revenues and extra damage to the environment.”
Wärtsilä is a global leader in complete lifecycle power solutions for the marine and energy markets. By emphasising technological innovation and total efficiency, Wärtsilä maximises the environmental and economic performance of the vessels and power plants of its customers. Wärtsilä is listed on the NASDAQ OMX Helsinki, Finland.