

Case study | VLT® AQUA Drive FC 202 | High Pressure Pumps, iSave

Industrial desalination **saves energy** with **low energy consumption**

Danfoss' technologically advanced solutions allowed Acciona to create an innovative sea water reverse osmosis (SWRO) modular desalination plant for the Sarlux refinery in Sardinia, Italy, reducing energy consumption compared to traditional solutions.



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Danfoss core technologies in the largest Mediterranean desalination plant for industrial use

Acciona chooses Danfoss solutions to **ensure sustainability** of **ultrapure** water production

The process of seawater desalination is intrinsically energy intensive. Therefore, operating costs related to electricity consumption are very significant and directly impact the sustainability and profitability of a desalination plant.

However, the technological evolution in the field of high-pressure pumps; the introduction of isobaric systems for energy recovery – which are more advanced than the traditional Pelton turbines; the use of the new Low Energy osmotic membranes; and electronic control by means of VLT® drives, have made it possible to change the rules of the game.

In fact, these advances in technology have made new-generation reverse osmosis modular systems for industrial applications economically sustainable, as demonstrated by the successful application implemented at this

refinery site and electricity generation plant, in Sarroch, Sardinia.

Reliable and cost-effective water supply

Pietro Tota, Design and Construction Manager at Acciona Agua explains:

"Following an expression of interest from Sarlux to renew the existing ultrapure water supply process for its industrial plants, we proposed an innovative modular solution housed in containers, based on reverse osmosis desalination. This solution uses the latest generation technologies, which offer the customer a high rate of availability, flexibility, low energy consumption and economy of operation".

On average, a volume of about 1,000 m³/h of water is required for the operation of the refinery and of the electricity generating plant outbuilding

in Sarroch. Previously, this water was supplied by Sarlux from the local aqueduct and several existing desalination plants.

These desalination plants operated traditional multistage technology with phased evaporation, characterized by a high energy consumption of approximately 20 kWh/m³ of water produced.

Thanks to its extensive experience in the field of reverse osmosis desalination, gained in construction of plants of all sizes all over the world, Acciona offered an innovative solution to Sarlux, comprising a six-year full-line supply contract for an ultrapure water supply service. The tariff is economically competitive with the alternative water supply.



Acciona has optimized the overall efficiency of the plant and the space occupied inside the containers, thanks to the unique compactness of VLT(R) AQUA Drive.

Mr Tota continues: "We took care of everything, from the planning of the project proposal to its financing, from the executive project to the construction of the plant, and now of its management and of the scheduled and unscheduled maintenance".

12,000 m³ ultrapure water daily

The solution designed and developed by Acciona includes four modular reverse osmosis desalination lines, which are capable of supplying a total of 12,000 m³ of pure water a day with a guaranteed 97% availability over the entire year.

The structure of each modular line in the plant is similar, and consists of four main sections:

1. Pre-processing with ultrafiltration membranes
2. Reverse osmosis first stage with working pressures of about 60 bar
3. Reverse osmosis second stage for the refinement of the water
4. Final stage of refinement, using ion exchange membranes

The entire modular system is housed in 17 containers, including the one dedicated to the medium-voltage electric substation. Use of the containers has greatly facilitated the construction on site, with no need to build special structures and, above all, with a drastic reduction of construction times.

In fact, Acciona was able to complete the entire Sarroch plant in just six months, which, after the usual certifications and controls by the competent authorities, became fully operational at the beginning of 2018, guaranteeing Sarlux the ultrapure water required to manage its production facilities.

Innovative technology makes the difference

In a reverse osmosis desalination plant, the most energy-intensive process is in the first osmosis stage, where the osmotic pressure due to the salinity of the water is overcome by high pressure circulation. Danfoss innovative high-pressure axial piston pumps, combined with Danfoss iSave isobaric energy recovery devices, proved to be ideal for



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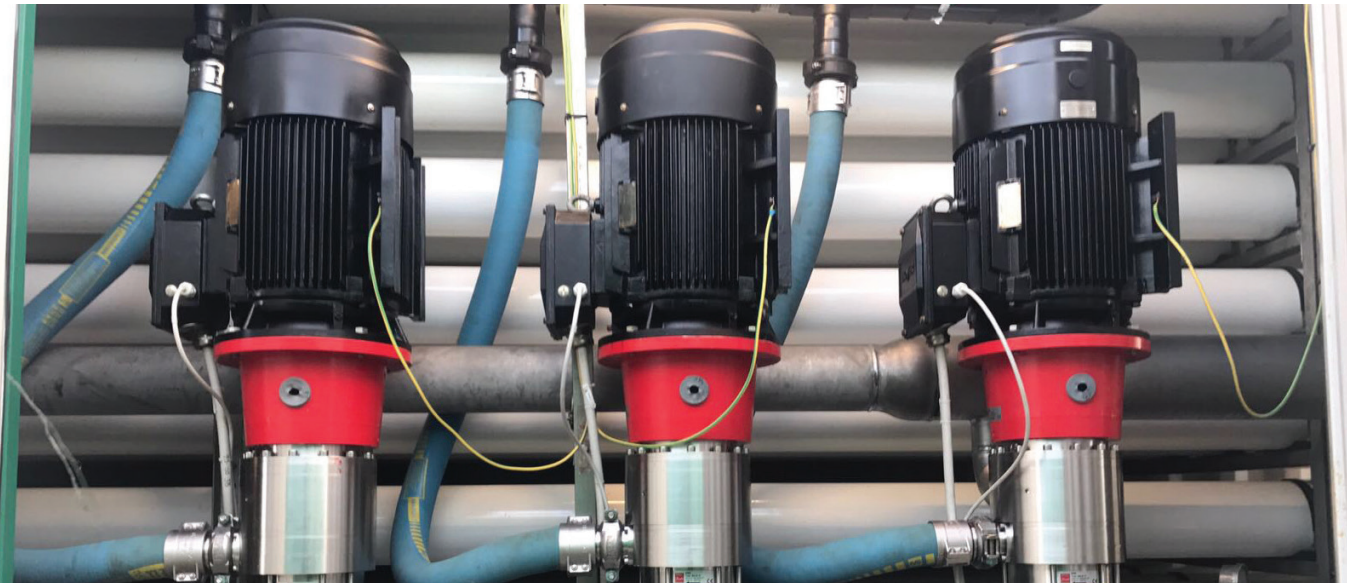
creating a modular plant in containers of the size expected by Acciona for the Sarroch refinery.

Mr Tota explains: "The volumetric technology of Danfoss high-pressure pumps enables us to create systems that are not only energy-efficient but also extremely compact and can be placed in a container. Thanks to their small size and

simplified internal design, they can therefore be installed even when space is limited and, just as importantly, they require very little periodic maintenance. iSave devices, which recover the hydraulic energy of the reverse osmosis process discharge flow, drastically reducing energy consumption, are also extremely compact and can be integrated with Danfoss high-pressure pumps".



The extremely powerful and compact VLT® AQUA Drive in enclosure size D regulates flow rate, and is a fundamental component in minimizing energy consumption.



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Powerful and 68% more compact AC drives

AC drives used to regulate the flow rate are another fundamental component for minimizing energy consumption. Also in this case, the adoption of technologically advanced products, such as those of the Danfoss VLT® AQUA Drive family, allowed Acciona to optimize the overall efficiency of the plant and the space occupied inside the containers, thanks to the particular compactness of the drives, which is unique in the category.

The extremely powerful and compact VLT® AQUA Drive was installed in enclosure size D, with a power rating of 200 kW. Up to 68% more compact than the previous versions, for power range from 90 to 315 kW, these drives feature integrated RFI filter and inductors on the intermediate circuit as standard.

Mr Tota adds: "It is obvious that the VLT® AQUA Drive has been specifically designed for pump control, and integrates relevant features as standard, making it simple and intuitive to use".

Thanks to the combined design of the control and flow regulation system carried out jointly by Acciona and

Danfoss, the resultant system significantly improved the energy efficiency in all operating conditions, depending on the flow rate, environmental conditions and level of salinity of sea water.

Flexible, reliable and low-cost management

The construction of the desalination plant in a modular format delivers clear advantages in terms of operating flexibility and reliability. In fact, when preventive or corrective maintenance activities have to be performed, it is not necessary to completely stop the water supply, which avoids potentially critical consequences for water consumers.

Instead, it is possible to intervene on only one of the modules, leaving the others active. In addition, the four lines built by Acciona for Sarlux have a redundant structure, which keeps the water supply going at a reduced flow, even when maintenance is being performed on some components.

"The high-pressure pumps are extremely easy to maintain, and this is one of the most valuable features of Danfoss technology", confirms Mr Tota. "Unlike traditional centrifugal pumps, which

typically need to be shipped to an authorized workshop for maintenance tasks, we are able to perform maintenance of these Danfoss volumetric high-pressure pumps directly in Sarroch within a couple of hours, with obvious benefits in plant availability".

The first months of system operation have already proved the effectiveness of the technologies used, in reducing energy consumption. While the main stage of a typical reverse osmosis desalination plant based on centrifugal high-pressure pumps and energy recovery devices typically requires around 2.7 kW per m³ of water produced, the volumetric high-pressure pumps and iSave isobaric energy recovery devices enable the production of ultrapure water with energy consumption as low as 2.4 kW/m³. This reduction represents 11% savings in energy consumption.

Mr. Tota concludes: "We have great confidence in the technological partners chosen for the construction of the Sarlux modular desalination plant, the largest in the Mediterranean. We have come up with an innovative solution that Danfoss' advanced technologies have helped us to implement with success - and full satisfaction of the end customer".