



MOTION

# Desalination plants

Providing cost-effective solutions to water scarcity

# Benefits of improving efficiency in desalination processes

Seawater is abundant, but converting it into potable water can be energy-intensive and costly. By using the latest technology, fresh drinking water can be brought efficiently to drier regions, creating a safe, secure and high quality water supply for future generations.



## Plant and personnel safety



“We must maintain water quality and quantity requirements, while exceeding safety standards

and complying with legislation.”

Safety manager

### Tackling diverse safety demands...

- High pressure equipment, if not properly operated and maintained, has the potential to put plant operations and personnel at risk. Desalination utilizes hazardous chemicals which must be carefully managed, while contaminants in untreated source water can present health risks.

### ... using best-in-class technology

- **Wheeled module drives** can be rapidly manoeuvred into a panel, eliminating manual lifting which could lead to injury and reducing time exposed to potentially dirty environment.
- **Arc flash mitigation** protects staff by ensuring all panels undergo arc flash testing.
- **Tested, validated solutions** lower risk, save design time and secure implementation.
- **Remote monitoring** support for drives, motors and general machinery using smart sensors and cloud-based technology.
- **Safe torque off** built into variable speed drives (VSDs)/ variable frequency drives (VFDs), brings motor-driven applications to a safe, certified and efficient stop.
- **Globally certified drives and motors packages** protect plant and people and conform to worldwide regulations using tested and certified motors and VSDs/VFDs.



## Energy efficiency



“We must achieve the highest possible energy efficiency to ensure our process is profitable.”

Energy manager

### Knowing where to look...

- Electrical energy is estimated to account for up to 50 percent of a desalination plant's running costs. Desalination processes are energy intensive, and so reducing usage wherever possible is key to increasing profitability and sustainability.

### ... helps to unlock the saving potential

- **Energy optimization** is a dynamic control within a VSD/VFD that adapts to changes in the motor load and reduces the energy needed to deliver the required torque. Adjusting the speed of the general machinery according to the need rather than throttling the flow typically saves 30 to 60% of energy, even up to 80% in some cases.
- **Energy monitor** is built within a VSD/VFD and works out energy savings in kWh, MWh, CO<sub>2</sub> emissions and money saved.
- **High efficiency VSD/VFD-motor package** lowers energy between 20 to 60 percent and reduces carbon dioxide emissions.
- **Up to IE5 efficiency level motors** are among the most efficient available, contributing to further energy reduction.
- **Synchronous reluctance motors** (SynRMs) reduce total losses by up to 40 percent, bringing optimal efficiency and reliability.
- **ABB Ability™ Smart Sensors** for either pumps and/or motors helps to spot energy saving opportunities.



### Productivity and resilience



—  
“We must achieve maximum productivity to address the challenge of water scarcity.”

Production Manager

#### Building in resilience...

- Desalination plants typically operate in areas where water supplies are already scarce. Maximizing productivity while reducing costs is crucial to meet increasing demand for clean water.

#### ... with flexible motor-driven solutions

- Use of VSDs/VFDs together with energy efficient motors reduces cost of running and risks of not running. End result is lower total cost of ownership.
- **Matched VSDs/VFDs and motors packages** ensure correct dimensioning of the VSD/VFD and motor and guaranteed package efficiencies.
- **Harmonics** caused by poor power quality can be mitigated using an ultra-low harmonic (ULH) drive that reduces the losses in the mains supply, improves the mains quality and reduces the risk of disturbance to other equipment connected to the mains. Using ULH drives with generators will reduce the generator size required, compared to a similar standard VSD/VFD.
- **Cyber security** is paramount by ensuring that VSDs/VFDs can be integrated into a system that meets IEC 62443 requirements.
- **Fieldbus communications** offers greater flexibility than point-to-point hardwiring, thereby improving the volume and speed of information sharing between the VSD/VFD and other connected devices.
- **Communications loss backup mode** enables the VSD/VFD to automatically switch to internal PID control, allowing for resilient operation of the system while maintaining accurate control of the process, rather than tripping the drive or even using fixed speed back-up modes, if available.

### Operation and maintenance



—  
“100 percent uptime is crucial for reliable supply of such a precious resource.”

Maintenance Manager

#### Lowering operational overheads...

- Reverse osmosis membranes are sensitive to pollutants in the intake stream. As well as effective pre-treatment, equipment must be robust, with effective visibility of maintenance requirements to ensure minimal downtime.

#### ... by using smart functionality

- **Life cycle assessment** provides a clear understanding of the VSD/VFD/motor installed base, detailing how assets will evolve over the next few years.
- **Preventive maintenance plan** provides regular inspections and component replacements according to a product-specific maintenance schedule.
- **Genuine parts** are available locally and can be ordered online 24 hours a day, helping to maintain 100% uptime.
- **PC tools** provide optimal commissioning and monitoring software that stores VSD/VFD parameter sets and operation and maintenance documentation. Allows customization of the VSD/VFD, reducing the need for a PLC to control small systems.
- **Service agreements** are available that tackle proactive and reactive maintenance needs.
- **Digital services** like remote condition monitoring, automatically and continuously collects performance data from VSDs/VFDs and motors and provides alerts and information to enable issues to be predicted before failure can occur.

# Finding improvements every step of the way

Every stage of reverse osmosis (RO) desalination can be fine-tuned to vastly reduce operating costs.

## 1 SEAWATER INTAKE

Raw water is delivered by intake pump and sent into the desalination plant.

### Applications:

- Centrifugal and submersible pumps

### Requirements:

- Pumps are required to raise seawater to level of facility
- Raw seawater may have considerable variance in salinity, temperature, turbidity and organic matter depending on seasonal and geographic conditions.

## 2 PRE-TREATMENT

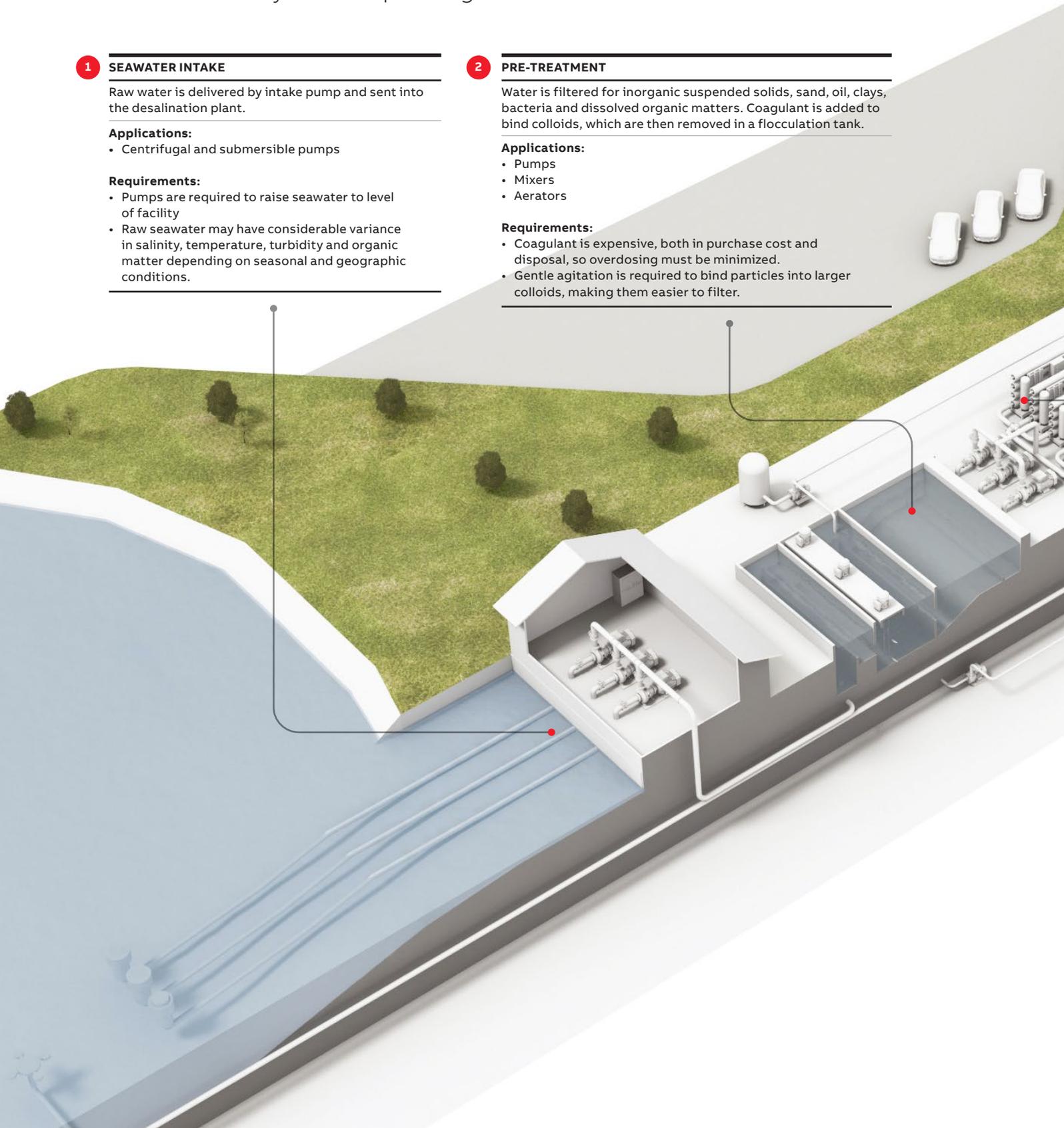
Water is filtered for inorganic suspended solids, sand, oil, clays, bacteria and dissolved organic matters. Coagulant is added to bind colloids, which are then removed in a flocculation tank.

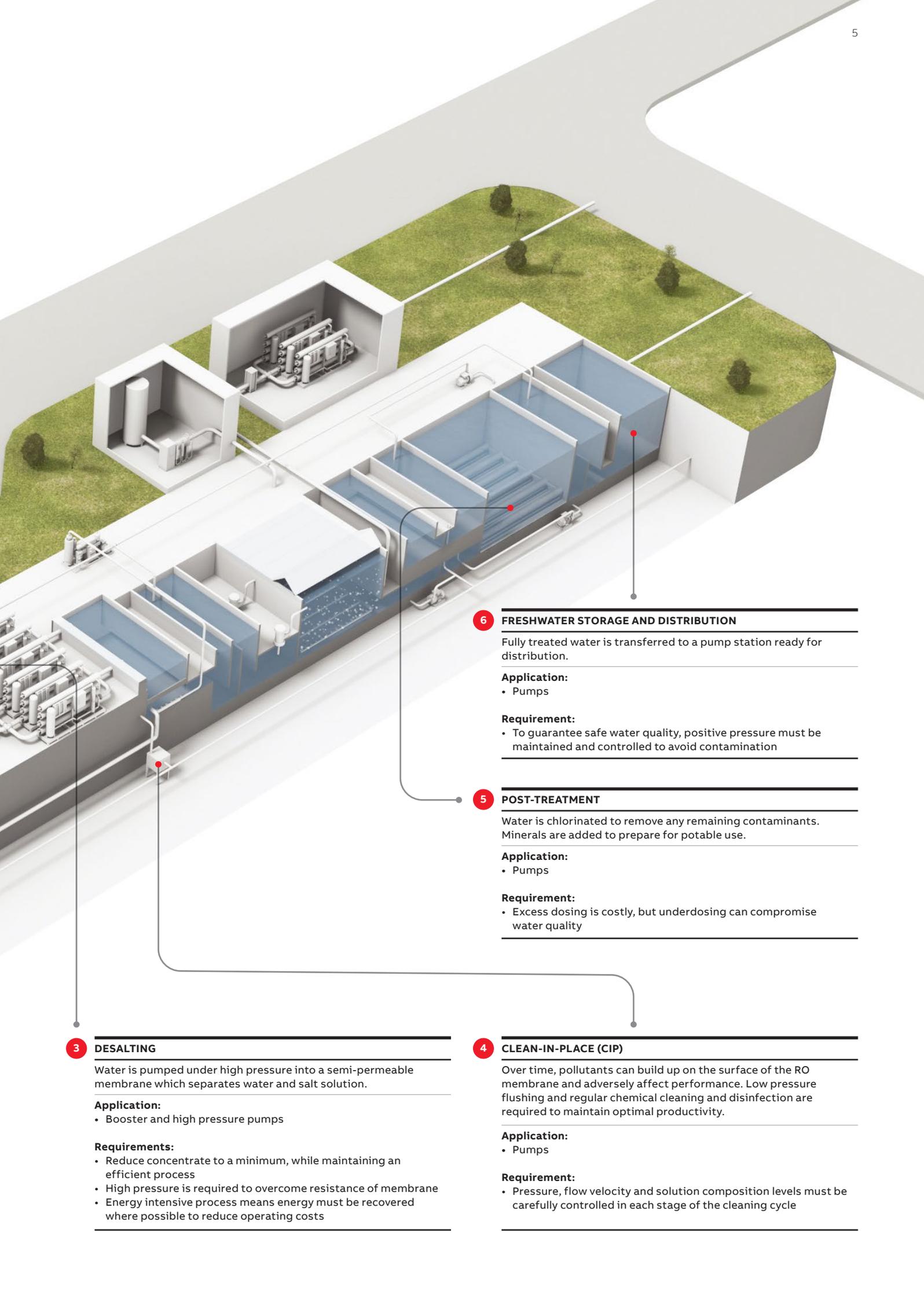
### Applications:

- Pumps
- Mixers
- Aerators

### Requirements:

- Coagulant is expensive, both in purchase cost and disposal, so overdosing must be minimized.
- Gentle agitation is required to bind particles into larger colloids, making them easier to filter.





### 3 DESALTING

Water is pumped under high pressure into a semi-permeable membrane which separates water and salt solution.

#### Application:

- Booster and high pressure pumps

#### Requirements:

- Reduce concentrate to a minimum, while maintaining an efficient process
- High pressure is required to overcome resistance of membrane
- Energy intensive process means energy must be recovered where possible to reduce operating costs

### 4 CLEAN-IN-PLACE (CIP)

Over time, pollutants can build up on the surface of the RO membrane and adversely affect performance. Low pressure flushing and regular chemical cleaning and disinfection are required to maintain optimal productivity.

#### Application:

- Pumps

#### Requirement:

- Pressure, flow velocity and solution composition levels must be carefully controlled in each stage of the cleaning cycle

### 6 FRESHWATER STORAGE AND DISTRIBUTION

Fully treated water is transferred to a pump station ready for distribution.

#### Application:

- Pumps

#### Requirement:

- To guarantee safe water quality, positive pressure must be maintained and controlled to avoid contamination

### 5 POST-TREATMENT

Water is chlorinated to remove any remaining contaminants. Minerals are added to prepare for potable use.

#### Application:

- Pumps

#### Requirement:

- Excess dosing is costly, but underdosing can compromise water quality

# Reverse osmosis process

## 1 SEAWATER STREAM

Pre treated seawater is pumped at high pressure through reverse osmosis membranes.

### Application:

- Centrifugal or positive displacement pumps

### Requirements

- High pressure is required. When combining with high volume of water, high energy costs arises

## 2 BRINE HANDLING

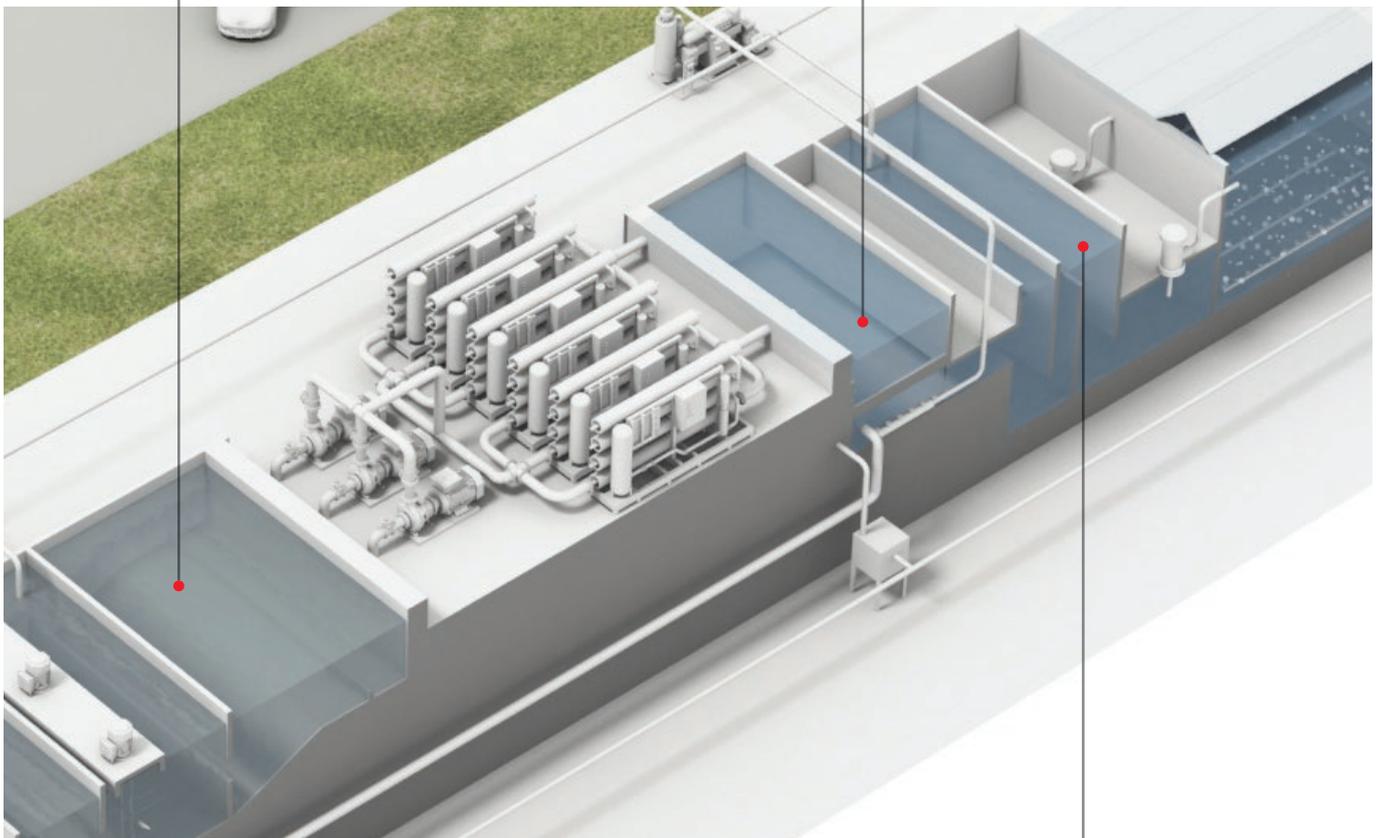
Salt and water is returned back to the sea after passing through the reverse osmosis process.

### Applications:

- Centrifugal or positive displacement pumps

### Requirements:

- Special pumps for brine handling require typically low power, when compared to main pumps



## 3 ENERGY RECOVERY

Energy Recovery Device (ERD) captures hydraulic energy from the high pressure reject stream and transfers the energy back into the system.

### Applications:

- Turbine

### Requirements:

- A generator is required to convert the hydraulic energy back to the power supply.

# Motor-driven applications help produce water efficiently

With electricity accounting for some 50 percent of the operational costs of a desalination plant, energy efficiency and life cycle cost optimization are critical challenges for utilities and developers. ABB variable speed drives and motors lie at the heart of maximizing plant efficiency and productivity levels.

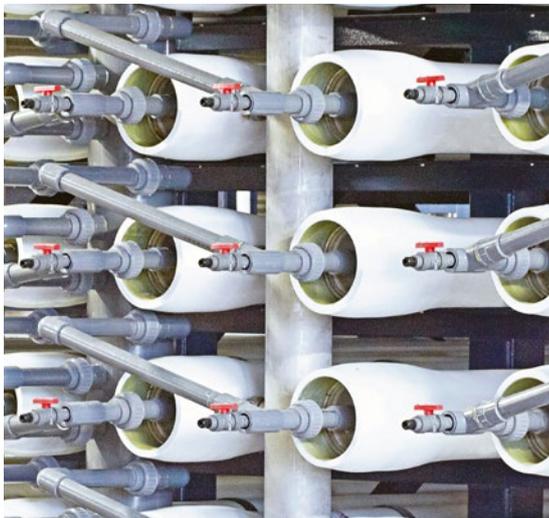
In the last few decades, production costs in desalination plants have fallen fourfold thanks to the emergence of highly efficient electrical equipment. ABB variable speed drives (VSDs)/variable frequency drives (VFDs) and motors, for instance, are used to control the flow rate of pumps with a typical 30 to 60 percent savings in energy consumption. While improving the efficiency of the entire water cycle, VSDs/VFDs and high efficiency motors reduce the mechanical and electrical stress on pumps and aeration equipment, significantly lowering maintenance costs.

## **Algeria: one of the large desalination plants (500,000 m<sup>3</sup>/day)**

The solution includes 33 medium voltage VSDs/VFDs that reduce plant electrical losses from the benchmark target of 5 percent to only 3 percent. In addition, the VSDs/VFDs speed up the long plant start-up process after maintenance or power-failure related shutdowns, reducing the length of plant downtime compared with the more traditional method of mechanical control.

## **Australia: Gold Coast 125.000 m<sup>3</sup>/day RO desalination plant**

ABB supplied motors and VSDs/VFDs and was selected for best compliance with the lowest harmonic distortion, fastest switching response, smallest footprint and highest motor efficiencies, lowest noise levels and fastest delivery.



# Features and functions benefiting desalination plants

Drives, motors, PLCs, softstarters and service all play a vital part in keeping desalination processes flowing. Choosing the right product feature for the right environment is essential in ensuring an optimized production.



## Variable speed drives/ variable frequency drives

### Energy efficiency

- Control operating costs by seeing energy costs in local currency, kWh and CO<sub>2</sub> emissions

### Communication

- Control the process driven with drives by adjusting the speed and process setpoints. Monitor the system performance, flow rates, energy consumption, specific energy and other figures through fieldbus communication connecting the VSD/VFD to plant control systems

### Ingress protection

- Drive variants that offer up to IP55 for wet and corrosive environments



### Functional safety

- Safely stop pumps using built-in safe torque off (certified safety level SIL3/PLe)

### Low harmonics

- Eliminate supply disturbances that could trip production with built-in active supply unit and integrated low-harmonic line filter

### Flow and pressure protection

- Protection solutions reducing stress on the RO process



## Softstarters

### Prolong pipe and pump life

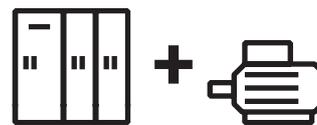
- Uses torque control to gently open and close valves and reduce water hammer during starts and stops

### Protect pump system

- Motor preheat ensures a dry and warm motor, prolonging pump life and increasing uptime
- Coated boards and IP66 / UL Type 4x externally mounted keypads for harsh conditions

### Simplify use

- Application wizards simplify commissioning and control of pump



## Drive and motor packages

### Synchronous reluctance motor (SynRM) and drive

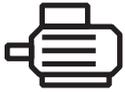
- Save energy across the water treatment process with IE5 synchronous reluctance motors and drive packages

### Drive and powertrain solutions

- Accessing from one source the drive, motor, transformer, switchgear and filters for mitigating harmonics and improving the quality of the network

### Globally certified drives and motors packages

- Protect plant and people and conform to global regulations using tested and certified motors and drives for potentially explosive atmospheres



## Motors

### Designed for harsh environments

- Protection against external conditions
- IP55-IP56 protection against wet and corrosive environments
- Wide range of surface treatment and corrosion protection solutions available

### Energy efficiency

- High efficiency to support emissions reduction – up to IE5 efficiency levels for low voltage motors
- Suitable for frequency converter operation
- High power density and efficiency reduces cost of ownership

### High reliability and compact design

- Robust design
- Bearing locked at D-end to avoid axial play
- Bearings can be regreasable, fitted with grease relief systems
- Optimal pump shaft speed
- Compact design – same output power with a smaller frame size – less weight, a smaller installation footprint and lower costs

### Easy installation

- Oversized terminal box as standard for ease of installation
- Flexible cabling solutions
- Horizontal or vertical mounting



## Programmable logic controllers (PLCs)

- Comprehensive range of scalable PLCs, I/Os and robust HMI control panels delivering performance, quality and reliability
- Remote access helps reduce commissioning time
- One integrated engineering tool for programming, simulation and commissioning for PLCs, safety, drives, control panels and network
- Flexible choice of network and fieldbuses to integrate I/O's, drives, HMI, Scada and 3<sup>rd</sup> party devices
- S500 I/O System:
  - Cost efficient remote I/Os supporting different fieldbus protocols
  - Hot-Swap I/Os for increased availability
  - Fast integration into existing environment
- IIoT gateway functionality onboard the PLCs and control panels offer secure connection to cloud
- Cyber Security with AC500: Secure components with certified international standards (IEC 62443-4-1)
- High availability of AC500 HA prevents downtime and enhances system availability
- AC500-XC for eXtreme Condition (humid environments, high altitudes, vibrations, hazardous gases and salt mist)
- Automation Builder support configuration of drives and motion



# From the factory floor to the cloud and beyond

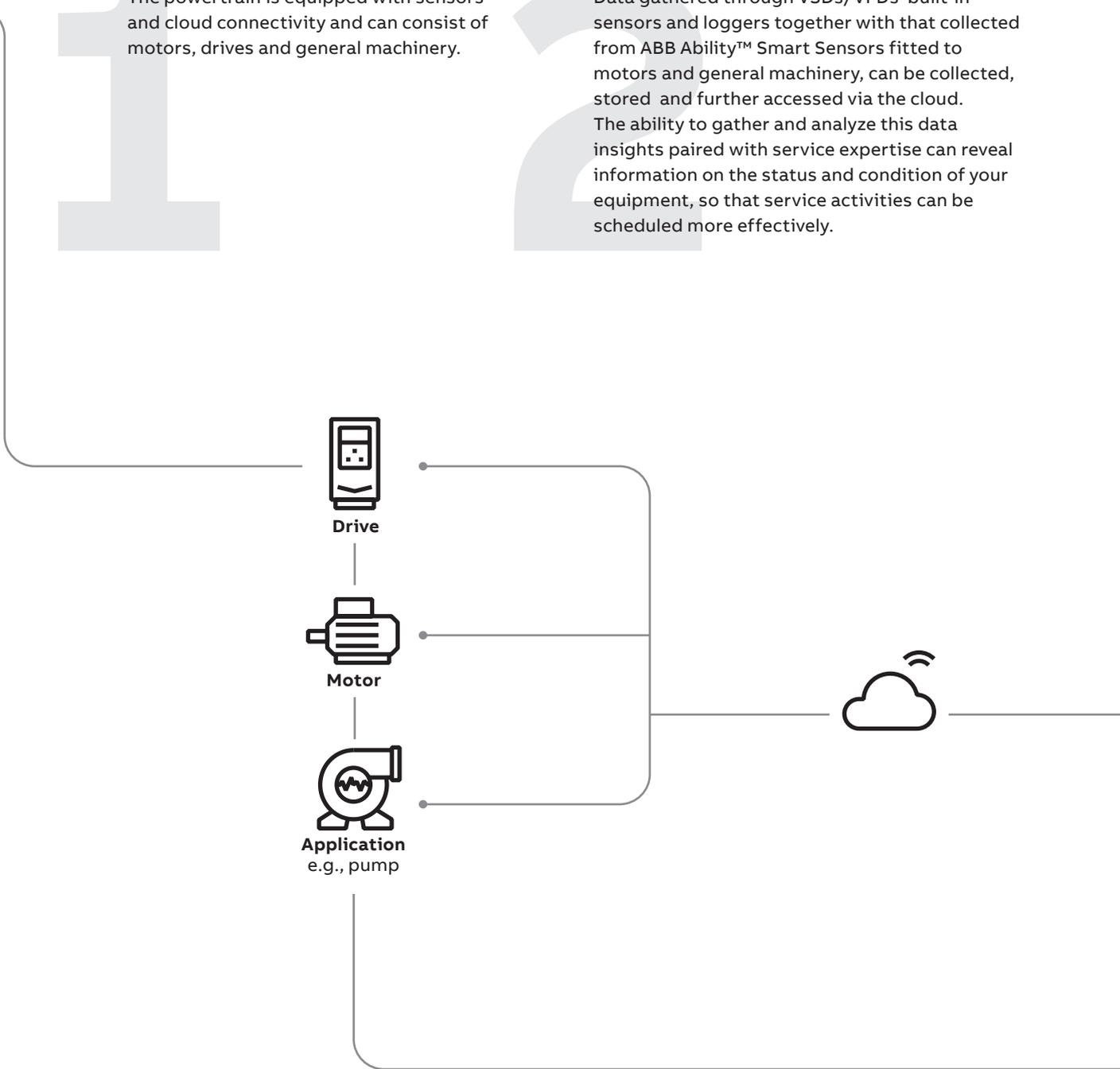
ABB Ability™ Condition Monitoring for powertrains optimizes the performance and efficiency of electric motor-driven rotating equipment. It enables better decision making by providing real-time access to data on all parameters for drives, motors and general machinery.

## Intelligent powertrain

The powertrain is equipped with sensors and cloud connectivity and can consist of motors, drives and general machinery.

## Turning data into valuable insights

Data gathered through VSDs/VFDs' built-in sensors and loggers together with that collected from ABB Ability™ Smart Sensors fitted to motors and general machinery, can be collected, stored and further accessed via the cloud. The ability to gather and analyze this data insights paired with service expertise can reveal information on the status and condition of your equipment, so that service activities can be scheduled more effectively.



### Accessing data for analytics

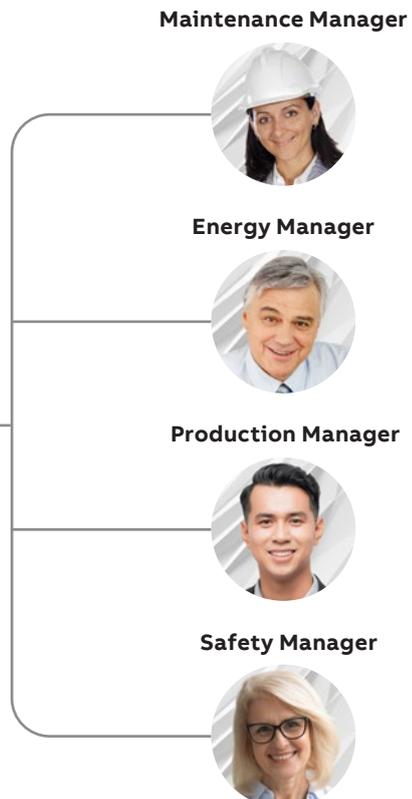
Detailed information can be extracted into a company's portal and systems. Information on many aspects of the desalination process is available, including the ability to know exactly when and how production equipment was cleaned. Detailed dashboards give full transparency so that you can take actions that lead to less downtime, extended equipment lifetime, lower costs, safer operations and increased profitability.

### Gain a digital advantage

While the data is always at your disposal, ABB service experts can work with you to provide help on how you analyze the data and define the steps for improving your operations.

Ensuring that the right person is exposed to the right information at the right time brings:

- Appropriate response to production challenges, lowering operating costs and product waste.
- Greater insight into various aspects of the desalination process, thereby improving quality and reducing variations, errors and waste.
- Maximum material traceability helps fulfil regulatory compliance.
- Lower risk of production failure and change the maintenance from reactive to predictive.



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# Our service expertise, your advantage

ABB Motion Services helps customers around the globe by maximizing uptime, extending product life cycle, and enhancing the performance and energy efficiency of electrical motion solutions. We enable innovation and success through digitalization by securely connecting and monitoring our customers' motors and drives, increasing operational uptime, and improving efficiency. We make the difference for our customers and partners every day by keeping their operations running profitably, safely and reliably.

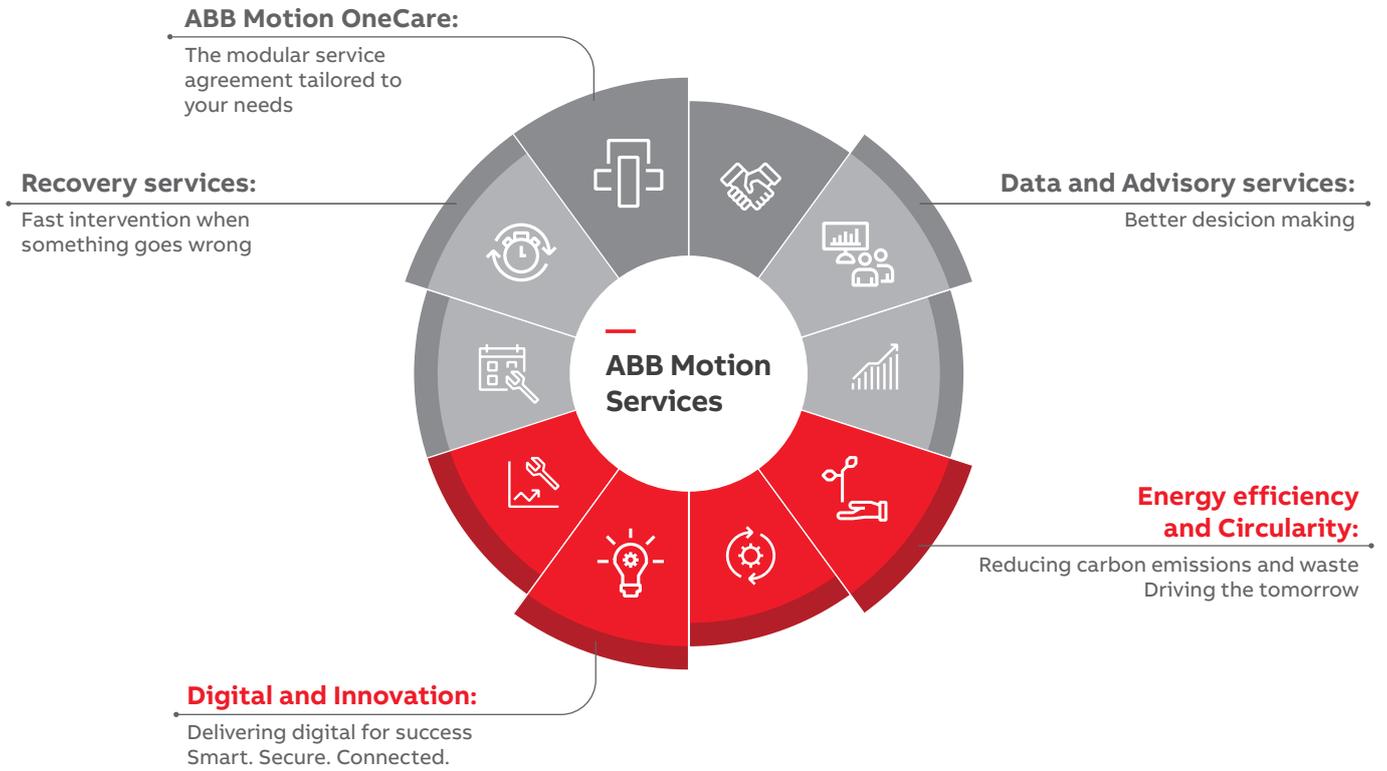
With a service offering tailored to your needs, ABB Motion Services maximizes the uptime and extends the life cycle of your electrical motion solutions, while optimizing their performance and maximizing your energy efficiency gains throughout the entire lifetime of your applications. We help to keep your applications turning profitably, safely, and reliably.

Digitalization enables new smart and secured ways to prevent unexpected downtime while optimizing the operation and maintenance of your assets. We securely connect and monitor your motors, drives or your entire powertrain to our easy to use cloud service solutions. Connecting your applications also gives you access to our in-depth service domain expertise.

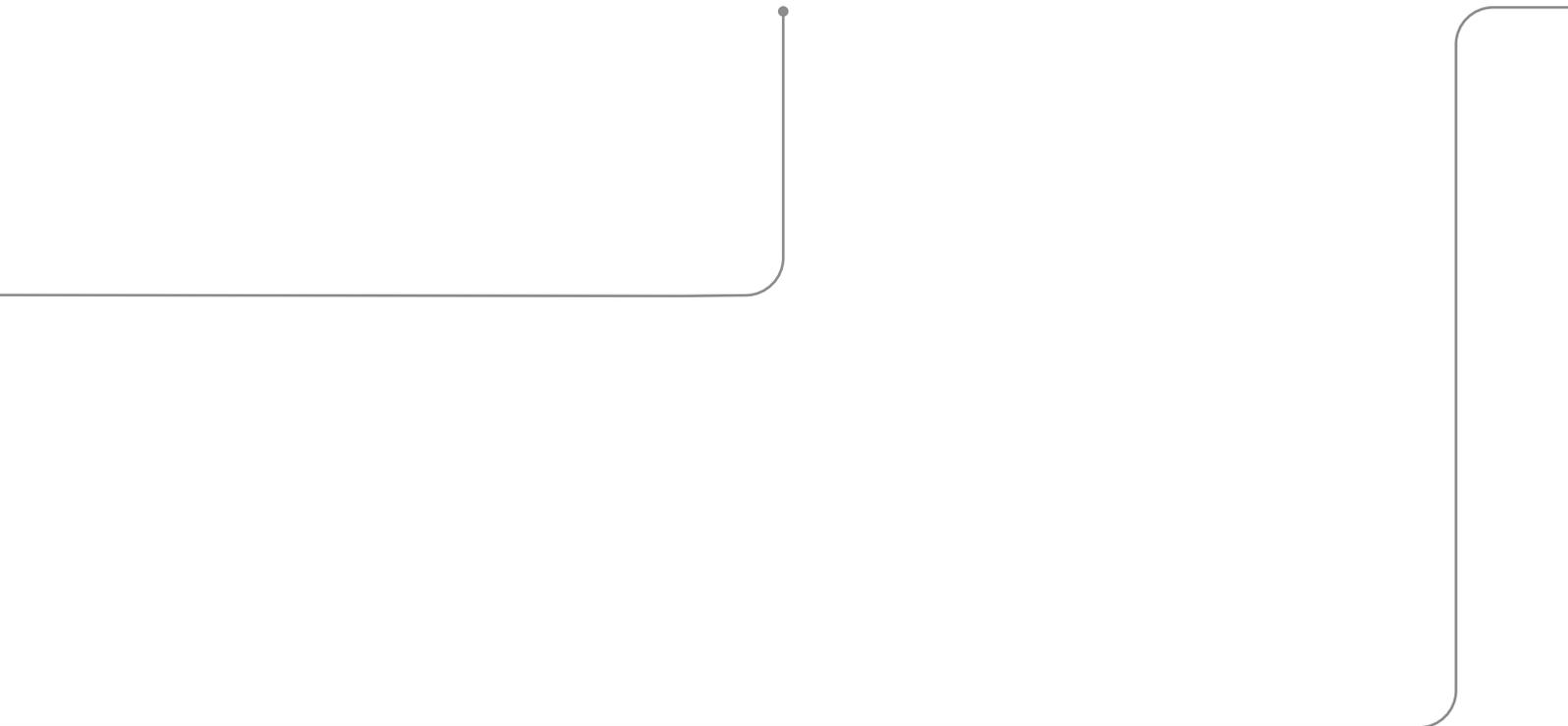
We quickly respond to your service needs. Together with our partners, local field service experts, and service workshop networks, we provide and install original spare parts to help resolve any issues and minimize the impact of unexpected disruptions.

Our tailored to your needs service offerings and digital solutions will enable you to unlock new possibilities. Not only are we your premier supplier of motion equipment, we are your trusted partner and advisor offering support throughout the entire life cycle of your assets. We ensure your operations run profitably, safely and reliably and continue to drive real world results, now and in the future. Our service teams work with you, delivering the expertise needed to keep your world turning while saving energy every day.





**OUR EXPERTISE**  
**YOUR ADVANTAGE**



# With you, wherever you are in the world

Partnering with ABB, gives you access to some of the world’s most innovative technology, expertise and solutions.

### Global reach

ABB operates in over 100 countries with its own manufacturing, logistics and sales operations together with a wide network of local channel partners that can quickly respond to your needs. Stock availability is good, with short delivery times for many products backed by 24-hour spare parts delivery.

In addition, we work closely with the desalination industry to develop custom products, services and solutions to help standardize processes across multiple sites and streamline your supply chain.

We have several global R&D centers with thousands of technologists and considerable investments annually on innovation.

### End-to-end product portfolio

Alongside its variable speed drives (VSDs)/ variable frequency drives (VFDs), motors and soft starters, ABB’s automation offering includes a wide range of scalable PLCs, a selection of HMIs, instrumentation and robotics. With functional safety options, from built-in safe torque off in drives to safety PLCs, you can readily implement safety requirements.



ABB's offering includes:

- End-to-end **power and automation solutions**, from power distribution, raw material receipt, to process and machine control, to end of line packaging
- **Power protection and power quality solutions** to safeguard equipment and processes
- Industry leading **robotic automation solutions** that improve your speed-to-market, flexibility and help make packaging a differentiator
- A complete range of **protection, connection and wire management solutions** that

withstand harsh environments and extreme temperature swings, and provide the reliability needed for continuous operations

#### Streamline sourcing

ABB's end-to-end product and services portfolio streamlines your sourcing and purchasing activities and standardizes production across multiple sites, saving you money on spare part inventories while reducing maintenance costs.





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For more information, please contact  
your local ABB representative or visit

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