



STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES

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LOGISTICS FOR DEPLOYING MOBILE WATER DESALINATION UNITS

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Mobile water desalination units provide emergency water supply wherever and whenever needed. The units can be easily moved (via air, land, or marine transport) and deployed to drought stricken and water stressed areas. Mobile desalination units provide a very flexible way of supplying potable water to communities by hooking-up to existing municipal water storage and delivery systems. They can also be quickly and easily decommissioned or moved to other locations should drought conditions ease.

What is a Mobile Water Desalination Unit?

Mobile water desalination units are water treatment units – generally, Reverse Osmosis (RO) mobile desalination units – that can be truck-mounted or air-lifted enabling the provision of short-term emergency water supply as well as supplemental supply for drought stricken or disaster areas. These units can be rapidly deployed to water stressed localities to generate potable water from contaminated local sources or from ocean water in coastal communities.

Mobile desalination units, also called 'Reverse Osmosis Water Purification Units' (ROWPU), provide potable water from non-potable water sources. The units can produce fresh water from a variety of raw water sources such as wells, lakes, seas, lagoons, rivers, and oceans. The units, resembling a large trailer, come in a variety of sizes and use a variety of chemical treatments and membranes to filter and purify water and make it suitable for human consumption.

These mobile self-contained water purification units are widely used by the military. Some models are containerized; some are mounted on trailers or directly mounted onto vehicles. Water is pumped from its raw source into the mobile desalination unit, where it is treated with a polymer to initiate coagulation. Next, it is run through a multi-media filter where it undergoes ion exchange. It is then pumped through a cartridge filter which is usually spiral-wound cotton. This process clarifies the water of any particles larger than 5 micrometers and eliminates almost all turbidity. The clarified water is then fed through a high-pressure pump into a series of reverse osmosis modules. The product water is free of 90 to 99.9% of the raw water's Total Dissolved Solids (TDS). The product water is then disinfected with chlorine before it is used.



Skid-mounted Reverse Osmosis Mobile Water Desalination Unit
(Source: Aquatech)



A Military 3,000 gal/hr Reverse Osmosis Mobile Desalination Unit Deployed in New Orleans in the Aftermath of Hurricane Katrina

Why Deploy Mobile Desalination Units?

Mobile water desalination units can provide emergency potable water supply for towns and communities during droughts or in response to an abrupt disruption of their water supplies. These units can provide a flexible solution to water shortages as they can be quickly and easily deployed. Unlike permanent desalination plants, temporary mobile units can be commissioned, installed and put into production in a short period of time. These units can be deployed for emergency, supplemental, or extended term supply to meet user needs.

Following hurricane Katrina, where storm surges damaged municipal water supplies leaving many communities without access to safe drinking water, the US Navy as well as many other agencies and organizations involved in relief efforts provided a number of mobile water desalination units to provide drinking water to the disaster affected areas.

Mobile water desalination units can provide the necessary treatment of water to prevent various waterborne diseases, such as typhoid and dysentery. Treatment processes control certain chemical, physical, and biological characteristics of water, such as salinity, hardness or unpleasant taste. Hence, the function of these units is to treat available water sources to make the water safe for human consumption.

Time to Deploy Mobile Desalination Units

Unlike permanent desalination plants, which can take years to build, mobile desalination units go into production in a matter of few months if not weeks.

A recent example showing the quick deployment of such units involves the delivery of a two-train mobile desalination unit by GE Water Mobile Seawater Desalination Solution to Valero Energy in Aruba within 5 weeks from the order date. Each train was capable of producing 300 gpm of high purity water from seawater. (GE Water & Process Technologies, Press Release: April 3, 2008).

In 2005, the UNICEF Water and Environment Team delivered in a short period of time some 23 mobile desalination units to the Maldives as part of the United Nation's relief efforts to the tsunami stricken islands. Each unit was capable of producing about 8000 gal/day of desalinated seawater. 18 of those units were installed on the most affected islands, whereas the remaining 5 units were moved around by boat in order to provide fresh water for various smaller islands.



A Reverse Osmosis Mobile Desalination Unit Being Lowered onto a Barge for Transport Unit Delivered by UNICEF to the Tsunami Stricken Maldives' Islands
(Source: UNICEF)

Transporting Mobile Desalination Units

Mobile desalination units are totally self-contained containerized desalination plants. The containerized construction concept allows these units to operate as stand-alone portable water treatment plants. All needed treatment stages and equipments including pre-treatment and post-treatment are furnished as part of the container housing the unit. Depending on the production capacity of the unit, it can be housed in a standard 20-ft or 40-ft commercial steel container (cargo shipping container) that can be easily handled and transported. These containerized units can be crane lifted and transported by truck, barge, or airlifted (see typical sizes and weights in Table 1 below).



Truck Mounted, Containerized Reverse Osmosis Desalination Unit
(Source: GE Water)



Crane Lifted Containerized Mobile Desalination Unit
(Source: Applied Membranes Inc.)

Acquiring Mobile Desalination Units

Several water treatment and purification companies provide mobile water desalination units (mostly reverse osmosis units) for purchase or lease. Depending on the product water quality requirements, these systems can be equipped with single-pass or dual-pass reverse osmosis stages.

Some companies providing mobile desalination units include:

GE Water
www.gewater.com

RODI Systems Corporation
www.rodissystems.com

US Canadian Clear Watertec
www.uscanadianclear.com

Veolia Water
www.veoliawaterst.com

Seven Seas Water
www.7seaswater.com

Applied Membranes
www.appliedmembranes.com

GeoPure Water Technologies
www.geopurewt.com

Also, and as noted in other sections, mobile desalination units are widely used by the Military and other emergency and relief agencies. State and Federal emergency bodies, in coordination with various branches of the Military and the National Guard, can provide logistics for deploying such units in emergency situations.

Operating and Maintaining a Mobile Desalination Unit

Mobile desalination units are delivered fully assembled and ready to operate. Most providers of such units offer field service representatives for onsite operation and maintenance. Local agency personnel can also be trained to operate these units in a short period of time. Depending on the options installed, most units come equipped with automated features allowing automatic operation and control that can be remotely monitored. Remote controlled units require no daily on-site person, and the flows of the feed, the booster, and the high pressure pumps can be controlled and adjusted remotely. Various parameters (e.g., water temperature, salinity, and pressure at various points within the process) can be recorded and remotely monitored in real-time.

How is a Mobile Desalination Unit Powered?

Mobile desalination units (mostly using reverse osmosis technology) require electric energy for operation. These units can run on standard single phase electricity power from the grid. However, to make these units autonomous to operate in places where

electric power might be disrupted or unavailable, an optional power module using diesel generators can generally be provided as part of the unit.

The latest models of mobile desalination units are generally equipped with up-to-date energy efficient pumps and energy recovery devices making them require only about 11 to 13 kWh/1000 gallons of desalinated water.

Site Requirements for Hosting Mobile Desalination Units

Mobile water desalination units can be deployed anywhere with minimal site preparation requirements. However, an ideal site for hosting a mobile desalination unit will need to:

- be in proximity of the feedwater source
- have access to existing water delivery and storage infrastructure
- have access to electrical power if not equipped with a diesel power generator

Water Sources Mobile Desalination Units Can Treat

Mobile desalination units are equipped with a full water treatment train similar to conventional desalination plants. These units can therefore produce fresh water from virtually any feedwater source including seawater, brackish groundwater, and contaminated water sources.

Mobile Desalination Units Production Capacity

Mobile water desalination units come in various models and capacities. Depending on the need, these units have various production capacities ranging from several hundreds of gallons per day to few million gallons per day.

The following table (from Rodi systems) provides an idea on the size and weight of the unit depending on its production capacity (which is also dependent on the feedwater source since the recovery ratio is a function of the treated water salinity.)

TABLE 1. Capacity, Size, and Weight of Containerized Mobile Desalination Units

Nominal Production Capacity (at 77 °F)		Size (L x W x H)	Weight
Brackish Water	Seawater		
5,000 GPD	4,000 GPD	20 ft x 8 ft x 8.5 ft	8,000 lbs
25,000 GPD	16,000 GPD	20 ft x 8 ft x 8.5 ft	15,000 lbs
50,000 GPD	33,000 GPD	40 ft x 8 ft x 8.5 ft	30,000 lbs
150,000 GPD	100,000 GPD	40 ft x 8 ft x 8.5 ft (two containers)	30,000 lbs (per container)
300,000 GPD	200,000 GPD	40 ft x 8 ft x 8.5 ft (two containers)	35,000 lbs (per container)

(Source: Rodi Systems)

It is important to note that mobile desalination units, similar to conventional reverse osmosis desalination plants, are modular; hence additional capacity can easily be accommodated by adding additional modules and containers as needed.

Permitting requirements for Deploying a Mobile Desalination Unit

Permits that may be needed to deploy mobile desalination units include: an intake permit (especially for units withdrawing water from the ocean), a concentrate discharge permit in the form of a National Pollutant Discharge Elimination System (NPDES) permit, and a Department of Public Health permit for operation of a plant as a potable water supply.

Membrane manufacturers generally do pre-certify their membranes with the Department of public health to get approval for using them to provide potable water. In addition, agencies considering to deploy desalination units can take advantage of certain build-own-operate (BOO) options that some suppliers provide. With a BOO contract, the provider of the plant generally takes the burden of permitting, ownership, and operation of the unit.

The Costs of Acquiring and Operating Mobile Desalination Units

The cost of such units varies depending on the production capacity and the options included (e.g., diesel generator for a stand-alone power supply, level of automation...). In addition to the aforementioned factors, initial cost for acquiring such units (capital cost) also varies by manufacturer.

Some providers of such units advertise online price tags of \$700,000 and \$3 million for containerized Seawater mobile desalination units with production capacities of 200,000 gpd and 1 million gpd, respectively.

In terms of the cost of production, some references show that the US Military incurs a cost of up to \$5.00 per gallon of bottled water, whereas mobile desalination units can produce potable water at less than ¢10 per gallon.



A DOE funded mobile desalination unit project for treating oilfield produced water carried out by GeoPure Water Technologies and Texas A&M University (9/03-12/06)

How to Store Mobile Desalination Units When not in Use?

Without proper care, RO membranes are susceptible to degradation and fouling when not in use. Short-term storage for periods where the RO plant must remain out of operation for more than five days but fewer than thirty days includes flushing the RO membranes with permeate water at five-day intervals. Long-term storage - for periods where the RO plant must remain out of operation for more than thirty days - includes cleaning of the membranes and flushing them with a biocide at 30-day intervals (15-day intervals should be considered when the temperature is above 80 °F). Prior to installation, new membrane elements are typically stored with a preservative solution (generally sodium bisulfite, with or without propylene glycol) and enclosed in vacuum sealed bags.