NAVFAC Naval Facilities Engineering Command
Engineering Expeditionary Warfare Center
Port Hueneme, California 93043-4307

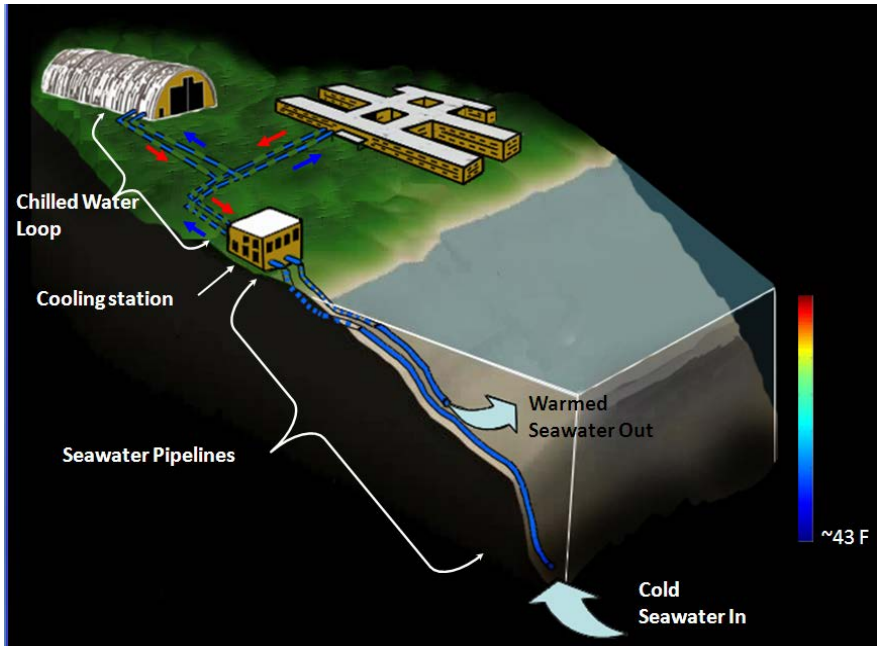
TechData Sheet

TDS-CIOFP 1401 December 2013

Sea Water Air Conditioning

Technology Description

Sea Water Air Conditioning (SWAC) is an alternative cooling system that uses the deep cold seawater as the chilling agent for a closed-loop fresh water distributed cooling system. Once installed, SWAC systems typically operate at approximately 15% of the power consumption of conventional chillers. A SWAC system basically consists of deep seawater intake and return pipelines, titanium heat exchangers, seawater and freshwater pumps, and a distribution system for the chilled fresh water. All of these components are commercially available, and have proven track records.



Notional Seawater Air Conditioning System

The fundamental process behind SWAC involves replacing the many chiller units found in conventional air conditioning with a freshwater district cooling system originating at one seawater heat exchanger. Cold seawater is pumped from its source (≈ 700m water depth) to a heat exchanger, where its low temperature is used to chill fresh water, for distribution to air handling units in buildings on base.

Value to the Warfighter

The value of SWAC is making use of a local, renewable resource to significantly reduce the fossil fuels required to operate a naval facility. At naval facilities where SWAC is viable, SWAC can reduce the air conditioning power requirements approximately 85%, which can lead to overall base energy savings of approximately 40%. This dramatically decreases the reliance on imported fossil fuels, and increases a base's energy security situation. Also, by replacing 100's of disparate HVAC chiller systems with a single

chilling station, maintenance and repair (in climates typically harsh on outside machinery) is reduced to only upkeep of a small number of water pumps.
In addition, SWAC enables:

- Elimination of chemicals needed for chiller machinery
- Elimination of cooling tower water usage
- Reduction in noise; and reduced need for on-site machinery space
- Reduction in emissions, and greenhouse gases

The disadvantages of SWAC are:

- Relatively large capital costs
- Greater environmental planning requirements
- The offshore pipeline is single point of failure (earthquake?)
  - o can mitigate with emergency standby chillers

Economics of the Technology:

Implementing SWAC requires a large capital cost, but the tremendous energy savings lead to large annual savings in base electricity usage costs, as well as reduced maintenance costs. The major factors which drive the economic viability of SWAC are:

- Distance to cold water
  - o long lengths of pipelines can be cost prohibitive
- Size of cooling demand
  - o cooling load must be substantial for efficiency/economy of scale
- Concentration of cooling needed
  - o centralized buildings require fewer distribution pipelines
- Local electrical costs
  - o electrical rates affect payback period

The economic advantages of SWAC are:

- Large energy savings (~85% reduction in HVAC chiller electricity usage)
- Large life cycle cost savings (30+ year system life)
- Stabilized future operating costs (very small effect from energy inflation)
- Reduced operations and maintenance costs

Shown in the table below are some basic parameters from five naval facilities studied for SWAC economic viability.

Naval Facility:	A/C Load (tons)	Elec. Saved (kWhr/yr)	Elec. Cost (/kWhr)	Pipeline Length	Capital Cost	Simple/Discounted Payback (yrs)
Diego Garcia	4,000	19.3M	$.501	2.2 miles	$158M	14 / 19
GTMO	6,100	27.5M	$.273	1.1 miles	$151M	16 / 21
NB Guam *	8,400	32.6M	$.272	2.5 miles	$168M	16 /
Andersen AFB *	12,000	46.6M	$.272	1.9 miles	$216M	17 /
JBPHH	28,600		$.238	4.5 miles	$360M	17 / 25

		79.0M				

* From CH2MHill study

Technology Transition Documentation

This is a Transition 4 category; by improving technology capability and knowledge for Navy Energy Managers. Technology transfer documentation is available to DoD employees and their contractors.

Site Implementation

Site implementation will consist of converting most all of the disparate air conditioning systems on base into one district cooling system, with a centralized chilling station. A pipeline from shore out to deep water is installed for bringing in cold seawater; and a shorter offshore pipeline for returning the seawater. The chilling station is constructed which includes titanium heat exchangers, seawater pumps, and fresh water pumps.

Specific Applications

In certain locations around the world, it is possible to dramatically reduce the amount of energy required to run air conditioning chillers. Locations which are best suited for SWAC systems have close access to deep (cold) water, expensive electricity rates, a substantial amount of air conditioning, and a warm climate. The naval facilities with the most viability for implementing SWAC are listed in the table above.

For additional information, contact: Mr. Nate Sinclair, EXWC CI-OFP, 805-982-1005, nate.sinclair@navy.mil