Air Blast Chiller (ABC)

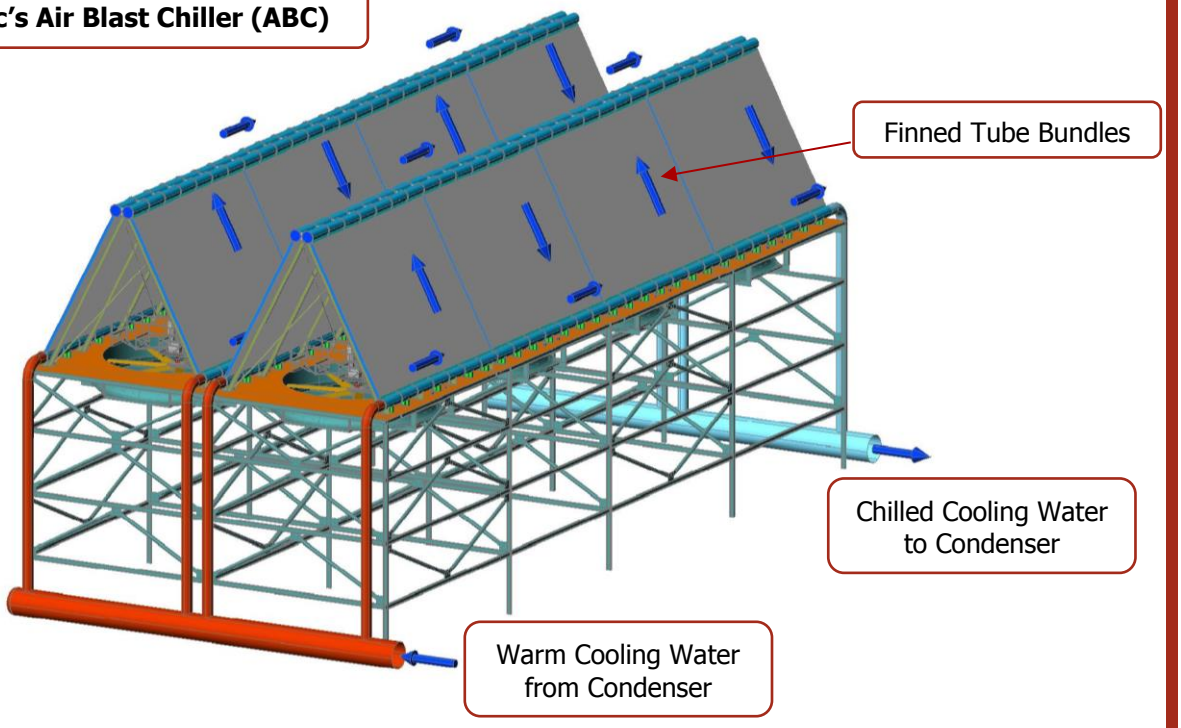
An Innovative Solution to Free Power Plants from Dependence on a Natural Water Source

A conventional power plant is a voracious consumer of water which it needs to reject the waste heat. To meet the water needs, power plants are traditionally sited close to a natural source of water. However, as water has become increasingly scarce, many jurisdictions are adopting a variety of measures to discourage or even limit its consumption by power plants. The development of Holtec's Air Blast Chiller (ABC) technology was prompted by the rapidly growing need to eliminate a power plant's historic dependence on a local water source. Eliminating dependence on huge quantities of water means: (1) no cooling towers and associated vapor plumes and (2) no dumping of the plant's waste heat into the lake, river or sea (as the case may be). Rather, the ABC is engineered to deliver a plant's waste heat directly to the ambient air.

Eliminating the historic nexus of a power plant to a water source makes it possible to locate a new plant virtually anywhere. Indeed, any land, no matter how arid or unsuitable for other purposes, becomes available for building power plants. Besides lowering the cost of the land by increasing the number of potential candidate sites, locating the plant away from the coastal sites will reduce the cost of the plant's construction. This is because coastal sites typically have poor structural grade soil and require extensive remediation (including expensive pilings) to build plants over them. An away-from- water site on the other hand, can be selected on the basis of its sub-grade's load bearing strength, thus reducing the cost of construction.

The ABC is an open air heat exchanger that cools the cooling water of the plant's main surface condenser heated by the latent heat of the exhaust steam. The heat energy acquired by the "condenser's cooling water" is removed in the ABC by circulating it inside its finned tubes, as depicted in Figure 1. Thus the ambient environment becomes the ultimate repository of the plant's waste heat and the need for a proximate natural body of water, such as a lake, river or sea is eliminated.

Figure 1: Holtec's Air Blast Chiller (ABC)

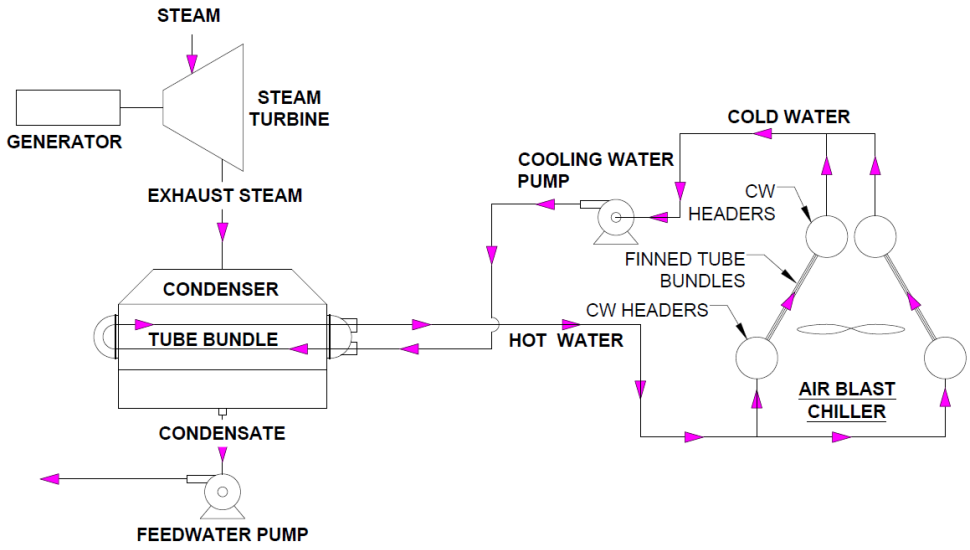


Note: Arrows indicate water flow. Horizontal arrows are top/bottom header flows and angled arrows depict multipass water flows in the finned tube bundles.

The main feature of Holtec's ABC technology is to efficiently cool the condenser's cooling water using an array of finned obround tubes arranged in a multi-pass flow configuration by driving ambient air in cross flow across the tube bundles using a set of large blowers. The innovation that makes the ABC technically and commercially feasible is the use of multi-tube pass flow arrangement which enables a well-developed turbulent flow to be developed in the unit leading to high heat transfer rates. Because the condenser's cooling water circulates in a closed loop, as depicted in Figure 2, the condenser's cleanliness factor and its service life are significantly improved.

Another crucial benefit of the ABC is that can be installed as several sub-units on small multiple parcels of land at a site with the sub-units working in parallel. This flexibility is most valuable in converting an existing land-challenged plant site that uses once-through or a cooling tower to rid waste heat. The ABC should be viewed as a more economical, less spatially disruptive successor to the conventional ACC (Air Cooled Condenser) technology, which has struggled to displace cooling towers for decades with mixed results.

Figure 2 Air Blast Chiller (ABC) System Thermal-Hydraulics



Holtec's ABC differs from classical ACC technology in several key aspects:

- The plant's sub-atmospheric steam remains within the controlled environment of the power plant whereas an ACC requires the entire flow of the exhaust steam to exit the plant's confines to be condensed outdoors.
- In contrast to an ACC, retrofitting an existing power plant with an ABC is unobtrusive and uncomplicated since virtually all construction work occurs outside the plant's physical structure. Connecting a newly installed ABC to a plant's cooling system should take no more than the normal time duration needed for an outage.
- In an ABC system, the ducts and finned tube bundles transport closed loop cooling water under a slight positive pressure. In an ACC, the ducts and finned tube bundles transport and condense turbine exhaust steam under a deep vacuum. Any defect or damage in the steam confinement boundary, such as welds or the thin walled tubes, creates a source of air leakage which can increase turbine backpressure, and in cold climates, cause mechanical damage to the bundles.
- Because air removal in an ACC occurs subsequent to condensing, the expulsion of non-condensable is inherently less effective than that in the main surface (water cooled) condenser where the exposure of the condensate to the air-rich vapor is minimized.
- Because the condensing of low pressure steam into water involves a drastic reduction in specific volume, the thermal-hydraulic performance of an ACC is inherently less stable than that of an ABC, which is single phase flow equipment.

The novel design features of the ABC are protected under US and international patent laws, USPTO EFS number 23267379.