From: Barkley, Richard
Sent: Monday, January 09, 2012 5:54 PM
To: 'Debbie Grinnell'
Subject: Simple Description of a Generator Stator Cooling System

Always glad to provide simple descriptions to the public – I teach math at a local university at night, so I am pretty good at it.

Sorry I didn't send you a short acknowledgement on your incoming letter – Letters sent to the Chairman's office get such a short reply letter from SECY, but their actual reply letter typically takes longer to issue than ours. We are very good at replying to letters from the public, and typically do so within 30 days, so I very rarely send out such acknowledgements. However, a short email acknowledgement would have been courteous on my part.

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As for the quote you read:

"According to Sheehan, the nuclear power plant at Seabrook has been at reduced power since Dec. 15, but that the reduction is not related to the alkali-silica issue. Initially, power was reduced by about 70 percent, but yesterday it was running at 64 percent power, Sheehan said. Sheehan said the reduction is due to the need to address corrosion identified in piping for the plant's "generator stator" cooling water system."

The excerpt below from Wikipedia gives a simple description of what the generator stator cooling system does. Power plants produce electricity by turning a magnet (a rotor) inside a coil of wire (a stator). Since that process is not 100% efficient, heat is created in the generator. Large generators remove that heat using hydrogen gas that blows around the inside of the generator, then through a water-cooled radiator. Very large generators not only use such a system, but also run pure water through copper tubes in the stator. This system is identical to what you would see at a large station fueled by coal, oil, or natural gas. Its operation is essential for the plant to make electricity, but is totally unrelated to the nuclear reactor or its safety systems.

Water inside of such a system does slowly cause some corrosion of the copper tubes. This corrosion breaks free and collects on filters in the cooling system. However, it can build up to the point of limiting water flow in the tubes. At that point, it must be chemically cleaned from the system. That process is ongoing at this time

as Neil indicated. While water flow in the generator stator cooling system is restricted, the generator must operate at a lower power level – Otherwise, the generator will overheat.

I hope I explained this well – It is similar to a process a mechanic once used to clean out the copper tubes in a car radiator I had many years ago. These days, your car radiator is made out of aluminum and plastic (which is lighter and cheaper) – It is typically scrapped when is develops a leak or becomes plugged.

Hydrogen-cooled turbogenerator

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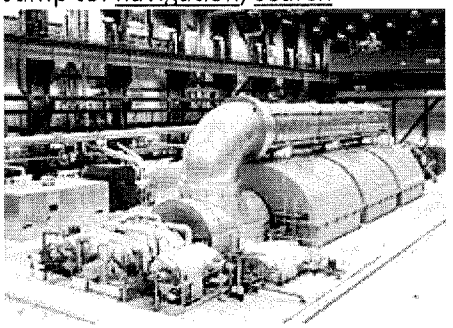
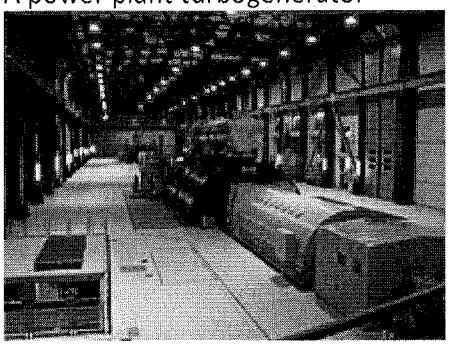


A power plant turbogenerator



A power plant turbogenerator; the yellow cylinder is the electrical generator, the blue device is the steam turbine, the yellow rectangular object in front is the excitation generator

A **hydrogen-cooled turbo generator** is a turbo generator with gaseous hydrogen as a coolant. Hydrogen-cooled turbo generators are designed to provide a low-drag atmosphere and cooling for single-shaft and combined-cycle applications in combination with steam turbines.[1] Because of the high thermal conductivity and other favorable properties of hydrogen gas, this is the most common type in its field today.

[edit] History

Based on the air-cooled turbo generator, gaseous hydrogen went into service as a coolant in the rotor and the stator in 1937 at Dayton, Ohio, in October by the Dayton Power & Light Co[2] allowing an increase in specific utilization and a 99.0 % efficiency.

[edit] Design

The use of gaseous hydrogen as a coolant is based on its properties, namely low density, high specific heat, and highest thermal conductivity of all gases; it is 7-10 times better coolant than air. Another advantage of hydrogen is its easy detection by hydrogen sensors. A hydrogen-cooled generator can be significantly smaller, and therefore less expensive, than an air-cooled one. **For stator cooling, water can be used.**

Generally, three cooling approaches are used. For generators up to 300 MW, air cooling can be used. Between 250-450 MW hydrogen cooling is employed. **For the highest power generators, up to 1800 MW, hydrogen and water cooling is used; the rotor is hydrogen-cooled, the stator windings are made of hollow copper tubes cooled with water circulating through them.**

Hydrogen gas is circulated in a closed loop to remove heat from the active parts then it is cooled by gas-to-water heat exchangers on the stator frame.

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