A Suggestion to Slash the Cost of California's Strategic Electricity Reliability Reserve

By
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California's proposed strategic electricity reliability reserve calls for a 5,000 MW pool to help the state bolster its power grid[1]. According to the California Energy Commission (CEC) Vice President Siva Gunda, the incremental capacity will be generated at existing gas power plants.

During hot weather when electric power is in most demand, all gas turbines (GTs) experience reduced capacity as shown in Figure 1. Turbine inlet cooling (TIC) can bring to life the hidden capacity of gas turbines during hot weather. Instead of installing 5,000 MW of new capacity as the strategic electricity reserves, the Turbine Inlet Cooling Association (TICA) recommends California should first consider installing TIC on existing gas turbines. Total capacity made available by TIC significantly reduces the need and cost of installing new power capacity for meeting the grid needs during high demand during hot weather. In addition to losing capacity during hot weather, GT's also experience reduced efficiency as shown in Figure 2. TIC increases the efficiency of GTs, thus reducing fuel cost and carbon emissions for proving a pathway to decarbonization of the grid.

Several TIC technologies are available, including wetted-media evaporative, fogging, wet compression, and chilled water with or without thermal energy storage (TES). The selection of the best TIC technology for each application depends on many factors, including weather data of the plant location and the value of additional capacity provided by TIC. A chilled water system with TES is one TIC technology that can always offer the maximum capacity during peak demand during hot weather. A TES system is like a" big thermal battery." It can store chilled water produced during off-peak periods using any electricity source, including solar and wind power. The benefit of incorporating TES for storing chilled water is that it can completely eliminate the parasitic load of the chillers during the peak demand periods and thus, maximize the available capacity at peak demand. TES can also reduce the chiller capacity need and the related cost. Details of these TIC technologies are available on the website of TICA[2].

TICA has reviewed the gas turbine (GT) database of the CEC[3]. It shows that the total installed capacity in California is 24,918 MW. The description of only a few of these plants includes TIC. TICA knows that the actual number of gas turbine systems that already have TIC is a lot more than that listed in the CEC database. The combined-cycle, simple-cycle, and cogeneration systems contribute 15,899 MW, 7,093 MW and 1,926 MW, respectively.

According to the ASHRAE database for 0.4% dry-bulb temperatures, the average summer design temperature for the five California cities of Los Angles, San Francisco, San Diego, Fresno, and Sacramento is 91^{o}F. Such a temperature may actually be exceeded for 35 hours in a typical meteorological year(TMY), times which are likely to stress the electric grid with maximum demand.

In the absence of information about the specific model of each gas turbine, the Gas Turbine World (GTW) recommends[4] using a change in the capacity of 2.5% for combined-cycle systems with a change of 10^{o}F in the inlet air temperature. GTW recommends using a 4% change in power capacity for simple-cycle systems for the same temperature change. On these bases, if a chilled water system with TES is installed on all GTs, assuming no existing system is using TIC, for cooling the inlet air from 91^{o}F to 50^{o}F, the capacity of the current GT systems can increase by over 3,100 MW. It costs significantly less to generate additional capacity by TIC than that for installing a new gas turbine system. Therefore, TIC can potentially decrease

the need for installing new generation capacity from 5,000 MW to only 1,900 MW and result in significant cost savings.

Since combined-cycle systems are the most efficient for power generation, installing TIC on such systems reduces the need to operate less efficient simple-cycle systems and thus, help reduce emissions of carbon dioxide and regulated pollutants. Examples of the benefits of reducing emissions of carbon dioxide and regulated pollutants by using TIC on a 500 MW combined-cycle system are shown in Figures 5 and 6, respectively. TICA recognizes that the chilled water system with TES may not be the most attractive for all GT installations. TICA recommends that CEC retain a consulting company to determine the best TIC technology and the increased capacity it can provide for each GT system, to estimate the total power capacity increase TIC offers, and use the study results to determine the new capacity needed for the meeting the strategic electric reliability reserve.

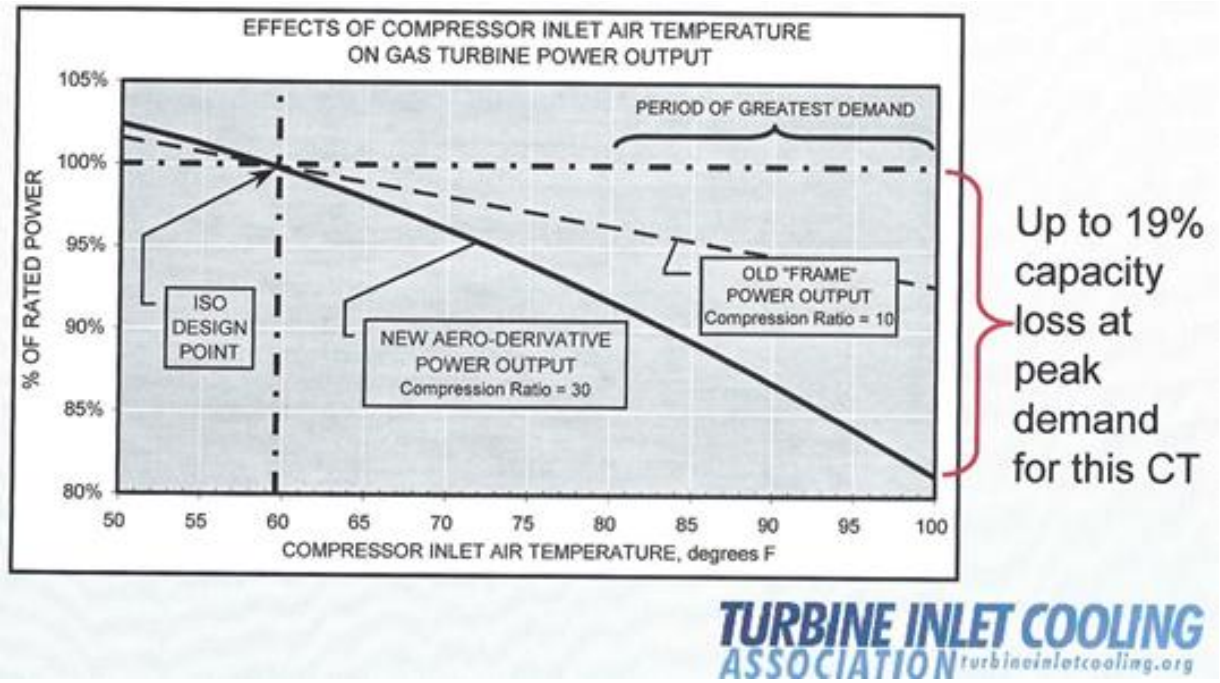

Figure 1. Examples of the Impact of Increased Ambient Temperature on Reducing the Capacity of Two Types of Gas Turbines

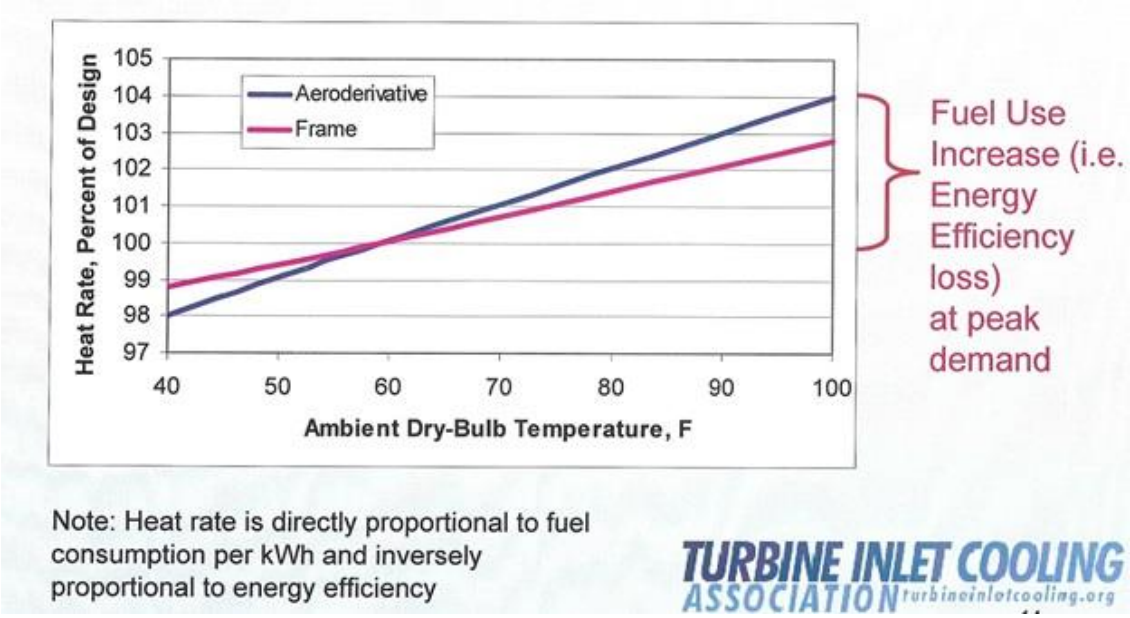

Figure 2. Examples of the Impact of Increased Ambient Temperature on Reducing the Efficiency of Two Types of Gas Turbines

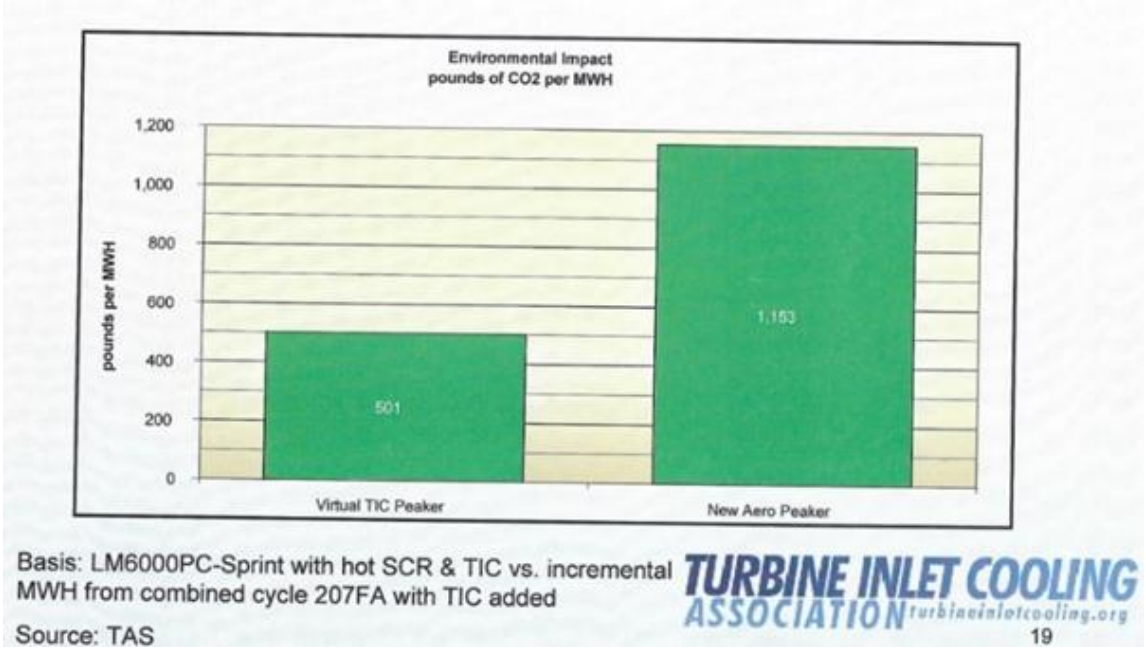

Figure 3. Comparison of Carbon Dioxide Emissions by using TIC to Boost the Capacity of a 500 MW Combined-Cycle by 50 MW, in Lieu of Operating a 50 MW Simple-Cycle System without TIC

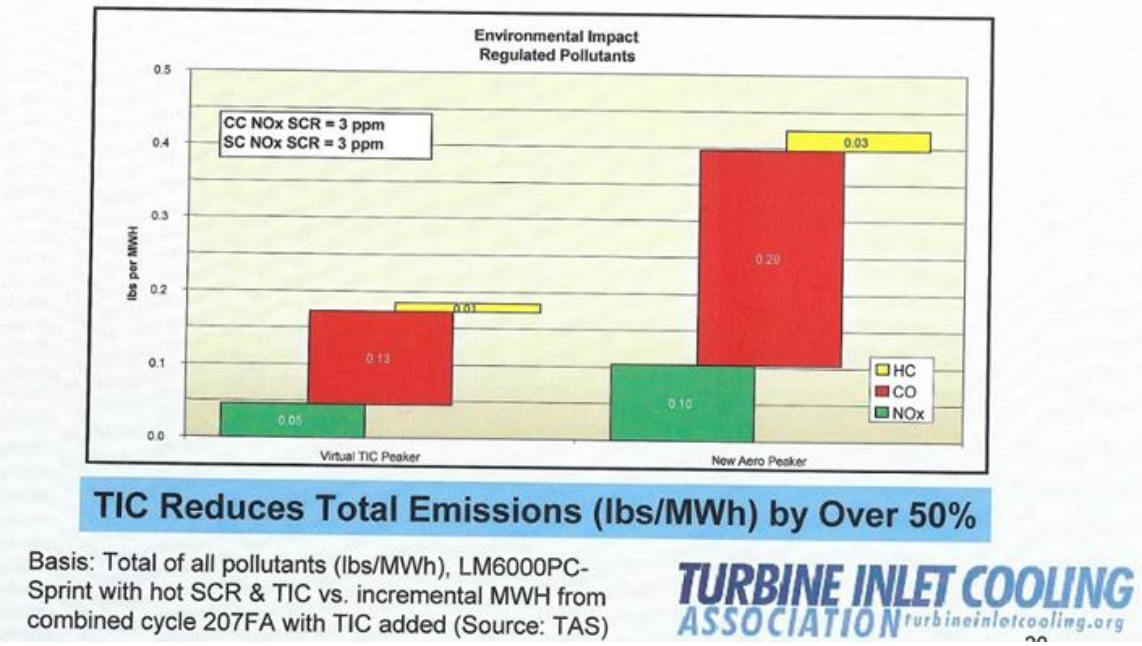

Figure 4. Comparison of Regulated Emissions by using TIC to Boost the Capacity of a 500 MW Combined-Cycle by 50 MW, in Lieu of Operating a 50 MW Simple-Cycle System without TIC

Foot Notes:

1. https://www.utilitydive.com/news/not-backsliding-on-clean-energy-officials-say-californias-proposed-5-gw/625323/
2. https://www.energy.ca.gov/programs-and-topics/topics/power-plants/alphabetical-power-plant-listing?
3. https://www.turbineinletcooing.org
4. https://gasturbineworld.com/