Advanced Evaporative Coolers

California's electric system peak demand is growing rapidly in the residential sector. The main cause of this is the increased use of air conditioning, largely driven by population growth and migration from coastal areas to the central valley. California's hot dry climate is well suited to evaporative cooling technology. In fact, five percent of the state's population, or approximately 200,000 residences within PG&E's service area, presently use evaporative cooling. PG&E wants to slow peak load growth, so it is desirable to keep existing evaporative cooler users from converting to conventional air conditioners. Also PG&E would like customers without any type of air conditioning to select evaporative cooler technology rather than refrigerant based systems when they choose to add a cooling system to their homes.

HYPOTHESIS: The latest Advanced Evaporative Cooler (AEC) technology is significantly more efficient than conventional evaporative coolers and can, in many circumstances, effectively replace refrigerant-based air conditioners. These AECs, both single-stage and two-stage, use rigid cellulose media, two speed fans, and water management systems to deliver 100% outside air to meet occupant comfort expectations. In the case of the two stage coolers, an indirect evaporative cooling stage is added to reduce moisture and further lower supply air temperature.

SUMMARY: This project evaluated and compared the performance of three evaporative cooler technologies; conventional, advanced single-stage and advanced two-stage.

AEC Single-stage Technology

AEC Two-stage Technology

1. The conventional or "Swamp" cooler is the most common technology but has given evaporative cooling a reputation for poor quality and marginal comfort.

2. The AEC single-stage technology employs an advanced evaporative pad that is thicker and can deliver air at temperatures 5-10 degrees cooler than a conventional evaporative cooler.

3. The AEC two-stage technology uses the same rigid media as the AEC single-stage cooler plus an indirect evaporative cooler or second stage. AEC two-stage coolers deliver air that is 3-5 degrees cooler that an AEC single-stage cooler with less humidity than either conventional or the AEC single-stage coolers.

TESTING PROCESS: The engineers and technicians at PG&E Technical and Ecological Services (TES) in San Ramon monitored performance of the three technologies in an environmental chamber. They subjected all units to temperature conditions that are representative of California's hot dry climate. Data on supply air temperatures for each technology as well as power consumption and water usage was collected under simulated outdoor dry bulb conditions ranging from 80ºF to 110ºF and wet bulb conditions ranging from 65ºF WB to 75º F WB.

The conventional, AEC single-stage and AEC two-stage evaporative technologies had evaporative effectiveness of 46%, 73% and 90% respectively with best performance achieved during low speed fan operation. Based on these results each unit operating in the Bakersfield area on a 104ºF dry bulb 70ºF wet bulb/18% relative humidity design day would, on low speed, supply air temperatures at 85ºF, 77ºF and 71ºF respectively.

CONCLUSION: The AEC single-stage technology with 8 inch media was shown to be 60 to 78% more effective than the conventional cooler. These results show that the AEC technologies can replace conventional cooler and provide increased occupant comfort thereby reducing the need to add conventional air conditioning.

Additional evaluation is needed to determine the effectiveness of advanced systems that utilize 12 inch media. Also, computer modeling is needed to predict the annual kWh consumption of the three evaporative cooler technologies and to compare energy cost with conventional air conditioning.