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Dynamic Simulation Technoeconomic Model for Power Generation

Sandia National Laboratories has built and successfully tested a dynamic simulation technoeconomic model of the Palo Verde Generating Station that is now being updated to help other US power plants improve operations.

Palo Verde, located west of Phoenix, Arizona, is the largest electricity generator in the US at 4 GW. Palo Verde uses ~ 60 million gallons per day of treated wastewater from Phoenix to cool reactors, and disposes of blowdown in evaporation ponds. The model built for Palo Verde numerically evaluates the economic impact of changing, for example, alternative cooling technologies, water usage and treatment, and influent water chemistry, and is based on detailed accounting of mass, energy, and cash flows. The figure below shows a subset, water mass and chemical flows for Palo Verde.

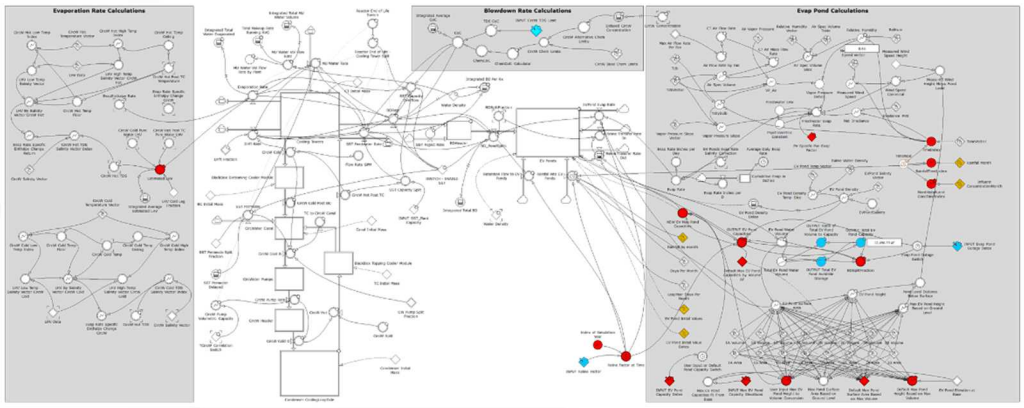

Figure 1. Water and chemical mass balances at Palo Verde.

The model GUI relies on multiple tools (e.g., radio buttons, dropdowns, and slider bars) that make user input easy and intuitive (see figure below).

The Sandia technoeconomic model will save power plants money by pre-screening new processes and technologies for life-cycle impacts before actual piloting at the plant. Palo Verde is currently using the Sandia model to help build a long-term water plan for the plant involving a combination of: new water sources from municipalities west of Phoenix, new water wells on the Palo Verde site, a reverse osmosis plant to treat blow down, and new dry cooling technologies for use when the hub price of electricity is lower than the cost of water to produce the electricity. The model can anticipate climate effects on plant economics by accounting for future shifts in temperature and humidity. The model can also test alternative strategies for maintaining plant operations in the face of increasing salt loads in the Phoenix wastewater.

Sandia is seeking support to adapt the GUI, and the underlying code, so that the model can be applied to any power plant. Key features will include:

- Power generation-specific modules for natural gas combined cycle and coal-fired plants;
- Alternative cooling technologies, including wet cooling towers, once-through cooling, and dry/hybrid cooling, and;
- Water disposal strategies, including evaporation ponds, injection wells, and surface water discharge.

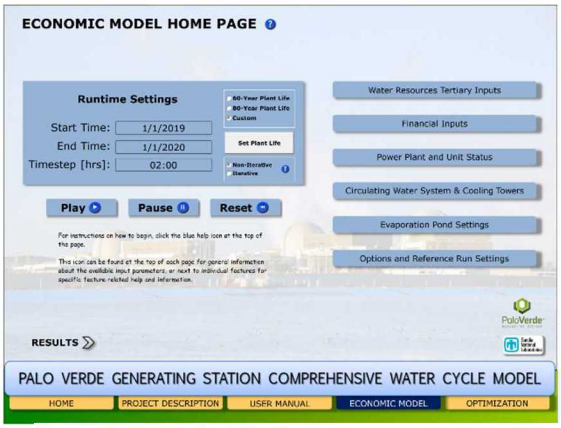

Figure 2. Example GUI

The new model will help power plants face climate change and shifting rate structures, and develop better water recycling approaches. Sandia hopes to complete the Palo Verde-specific model upgrade by 2021.

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