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Continuing Education Course #317  
What Every Engineer Should Know About  
Combined-Cycle Gas Turbine Plant Cooling Towers

1. What is the main reason for today's increasing economic failure of nuclear and coal-fired power plants?
  - a. Increasing costs associated with implementation of Federally-mandated pollution controls
  - b. The low price of natural gas
  - c. Competitive energy generation from wind and solar power
2. What CCGT Plant component is comprised of a system of water and steam tubes that removes heat from the exhaust of a gas turbine and generates high-pressure steam that is piped to a conventional steam turbine generator to produce electrical power?
  - a. Heat Recovery Steam Generator
  - b. Steam Condenser
  - c. Evaporative Cooling Tower
3. A typical 500 Mw CCGT plant requires how many full-time employees, approximately?
  - a. 500
  - b. 30
  - c. 100
4. Why was wood deterioration not considered to be a serious problem in cooling towers prior to 1948?
  - a. Because all clear heart redwood was readily available and inexpensive
  - b. Because wood-structured cooling towers were rarely used prior to 1948
  - c. Because Douglas Fir lumber was plentiful
5. Today's preferred Douglas Fir preservative chemical is composed of:
  - a. antimony, copper, and chromium
  - b. creosote, chromium, and copper
  - c. copper, arsenic and chromium
6. Why is high efficiency, cross-corrugated PVC fill specified for usage in many CCGT plant cooling towers?
  - a. In order to ensure reliable cooling tower thermal performance efficiency
  - b. In order to minimize the physical size and cost of the cooling tower
  - c. Because high efficiency, cross-corrugated PVC fill is inexpensive and readily available
7. The original cross-corrugated film-type cooling tower fill material was developed in which country?
  - a. France
  - b. Sweden
  - c. Germany
8. The main source of fill fouling problems is:?
  - a. Fungi
  - b. Bacteria

- c. Algae
9. Although pultruded composite FRP structures have approximately the same tensile strength as steel, how does the weight of pultruded FRP compare to the weight of steel?
- a. FRP weighs 80% less than steel
  - b. FRP weighs 50% less than steel
  - c. FRP weighs 20% less than steel
10. The “flutes” of a PVC fill module refer to what geometric characteristic of the fill design?
- a. The after-forming thicknesses of the thermo-formed PVC sheets that form the fill module
  - b. The angle of the PVC fill corrugation with respect to the vertical
  - c. The openings in the fill module through which air and water flow
11. Why is microstructure added to the surface of film-type PVC cooling tower fill?
- a. In order to increase thermal performance efficiency
  - b. In order to increase the structural integrity of the PVC fill modules
  - c. In order to reduce the potential for fill fouling
12. The original Anti-Fouling Non-Contact Sheet type PVC fill design was developed circa 1982 in what country?
- a. Germany
  - b. The United States of America
  - c. Belgium
13. Approximately what percentage of the heated liquid water that enters a cooling tower is evaporated?
- a. 0.5% to 1.5% is evaporated
  - b. 3% to 3.5% is evaporated
  - c. 8% to 9.5% is evaporated
14. How are the effects of recirculation taken into account in the thermal design of new recti-linear mechanical draft cooling towers?
- a. A design margin is added to the fan airflow rate
  - b. A design margin is added to the fill water loading
  - c. The design point wet bulb temperature is increased by one or two degrees Fahrenheit
15. How many circular, single fan mechanical draft cooling towers were constructed in Germany by Maschinenbau Aktiengesellschaft Balcke between the 1930s and the 1980?
- a. 55
  - b. 255
  - c. 335
16. Why is the water vapor plume emitted by a circular mechanical draft cooling tower more buoyant than the vapor plume emitted by a recti-linear mechanical draft cooling tower?
- a. The smaller surface-to-volume ratio of a circular cooling tower plume causes the plume to lose its stored heat less quickly
  - b. Circular cooling tower plumes tend to have more momentum than recti-linear cooling tower plumes
  - c. Vapor plumes from circular cooling towers are less turbulent than vapor plumes from recti-linear cooling towers
17. Why do circular mechanical draft cooling towers recirculate less than recti-linear mechanical draft cooling towers?
- a. In circular cooling towers the vertical distance between the air inlet and top of fan stack is greater
  - b. In cross-winds circular towers have a smaller negative pressure wake region on the leeward side
  - c. The exit air velocity from circular cooling towers is greater than the exit air velocity from recti-linear cooling towers.

18. What is the projected life expectancy of pultruded FRP cooling tower structures?

- a. 50 years
- b. 35 years
- c. 20 years

19. What is the projected life expectancy of vertical-fluted AFNCS PVC cooling tower fill material?

- a. 15 years
- b. 20 years
- c. 40 years

20. Future Combined-Cycle Gas Turbine Plant cooling towers should be constructed of pultruded composite FRP, should utilize low-fouling PVC fill, and should be environmentally nonintrusive (circular). Cooling towers that include these three design features are presently in service at which power plant?

- a. Duke Energy's Crystal River Energy Complex
- b. Georgia Power's McIntosh Combined Cycle Gas Turbine Plant
- c. Duke Energy's Anclote Plant

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