Thermoelectric Water Demand and Forecasting Technical Work Group: Agenda & Key Questions

January 23, 2013 10:00 a.m. – 12:00 p.m.

Meeting Purposes:

1. Provide a detailed overview of the draft thermoelectric water demand forecast methodology.
2. Identify and discuss major factors ("drivers") to include in the quantification of current and future thermoelectric water use.
3. Obtain support from the Thermoelectric Water Demand Technical Working Group to have CDM Smith begin the path forward in the development of the scenarios and assumptions, and completion of the draft thermoelectric water demand forecast.

The role of the Technical Working Group is to review the draft methodology, provide input and information, and work with the consultant to ultimately develop the draft thermoelectric water demands for the Arkansas Water Plan Update.

Agenda:

10:00 a.m. – 10:15 a.m. – Review of December 17th demand methodology meeting

10:15 a.m. – 10:45 a.m. – Outline of thermoelectric water demand forecast methodology, available data, and preliminary assumptions

10:45 a.m. – 12:00 p.m. – Discussion/Questions

Initial Approach and Assumptions:

Our intent is to identify and quantify water requirements for thermoelectric power generation within the state. This excludes water needs for hydropower generation, which is a separate in-stream flow consideration. The power generating facilities considered in this statewide analysis also excludes small, private generating facilities of on-site industrial use.

The water requirements examined in this analysis consist of both water withdrawals and water consumption. Gross water withdrawals are important to quantify in relation to water availability by source, while net water consumption accounts for water discharged after use.

Power generating facilities can be categorized by fuel type, prime mover, and cooling system (e.g., coal-fired with steam turbine and once-through cooling; natural gas with steam turbine

and cooling tower). Water requirements (withdrawals and consumption) vary by the various system combinations.

It should be noted that the draft methodology white paper is to serve as an initial outline for approaching water demand forecasting for the Arkansas Water Plan Update. Any assumptions presented may be adjusted or revised based upon the input and expertise of the Technical Working Group and incorporation of data and new information as we conduct data collection and analysis.

There are a variety of social and economic drivers that could be argued to impact the demand for power generation and, consequently, the water required to generate that power. A few factors that could impact the demand for power include, but are not limited to: population growth or decline, economic growth or decline, new or changing regulatory requirements, changes in national policies, price of fuel, availability of water, and technological advancements.

It is anticipated that it will be difficult to establish specific probabilities of occurrence with any specific individual or combination of drivers and their associated effect (increase or decrease) on thermoelectric power generation. With these points in mind, CDM Smith recommends the following as the starting point for the approach to the forecast:

- Baseline water demands: It is recommended to analyze multiple years of data in the ANRC Water-Use Registration Database (WUDBS) to derive baseline thermoelectric water withdrawals statewide and by county by facility type. Water use among power generating units of the same facility type within the same county may be summed by location. Literature-based water withdrawal rates (gallons/kWh or gallons/MWh) times reported power generation (U.S. Energy Information Administration (EIA)) by facility type will be used as a cross-check of reported withdrawals.
- Future power generation: We recommend applying EIA power generation rates of growth (or decline) by fuel type and by Electricity Market Module Regions to derive future statewide power generation. EIA has developed "reference" case, "high growth" and "low growth" scenarios for future regional power generation.[1]
- If projected power generation by fuel type exceeds capacity of existing facilities operating at maximum sustainable capacity factors, then assumptions will need to be made about generating type and location of additional needed capacity.
    - Without guidance from the work group on location and type of facility for future development, we will assume that additional generating units of similar types will

[1] Please see the Energy Information Administration report: *Annual Energy Outlook 2012: With Projections to 2035* for information on scenario assumptions. http://www.eia.gov/forecasts/aeo/pdf/0383%282012%29.pdf.

be added at existing locations, as we have no basis for making any other judgments.

  - If data permits, we will attempt to distinguish between base load, intermediary, and peak-load generating facilities, and a reasonable expansion of each.

- Water withdrawal and consumption rates (gallons/kWh or gallons/MWh) by facility type will be applied to statewide power generation projections to derive a statewide thermoelectric water demand. Depending on data availability and quality, these rates of withdrawal and consumption may be empirically-derived or literature-based. Additional discussion of these rates to follow.

- Allocation of forecasted water demand: It is recommended that forecasted statewide thermoelectric water demands be allocated to planning regions and counties based upon a baseline ratio of county to statewide power generation by facility type. For instance, if the power generated by a natural gas combined-cycle plant in County A represented 20 percent of total statewide power generated by natural gas combined-cycle facilities during the base year, it is assumed that 20 percent of the forecasted statewide water demands for natural gas combined-cycle power generation will occur in County A.

  - This assumes that all facilities with the same fuel/cooling type combination generate power and use water in the same manner (i.e., have identical rates of withdrawal and consumption per unit of power generated).

- Source of water supply: It will be assumed that the water supply source for projected thermoelectric power production will remain unchanged through the planning horizon.

  - If future generating capacity is required to meet the projected statewide power generation needs, it is assumed that this additional capacity will utilize water supply sources for existing thermoelectric power generation. If sufficient credible information regarding additional planned capacity at a site not utilizing a water supply source currently used for thermoelectric power generation is identified and available, the future mix of water supply sources can be adjusted.

Discussion Items/Key Questions

- Future generating capacity:
  - Are there plans for additional capacity?
    - Permit applications (air quality or otherwise)?
    - Where, when, plant type?
  - Facility retirements (i.e., loss of capacity)?

- Water withdrawals vs. water consumption:
    - In our forecasting of thermoelectric water demands we will distinguish water withdrawal demand (total diversions/pumping) from water consumption demand (consumptive use). Our reporting will compare and contrast these values including their implications on water supply availability.
- Baseline water consumption:
    - Water consumption volumes are not reported by facility to the ANRC WUDBS. Therefore, it is recommended to apply literature-based estimates of water consumption (gallons/kWh or gallons/MWh) times reported power generation (EIA) by facility to estimate baseline thermoelectric water consumption demand. We have identified the following literature sources for water consumption rates:
        - Electric Power Research Institute (2002)[2]
        - Texas Water Development Board (2008)[3]
        - Macknick et al. (NREL) (2011)[4]
        - Any other sources of information we should be aware of?
    - Annual water discharge data have been obtained from the Arkansas Department of Environmental Quality (ADEQ). Therefore, it may be possible to compare reported water withdrawals with reported discharges to derive annual consumption volumes by facility. Please note that these data have not been fully explored and quality of the data will determine the feasibility of this approach.
- Regulatory implications:
    - How might the 2015 EPA emission standards for coal-fired power plants impact water use at these facilities?
- Renewable energy:
    - What are likely scenarios for renewable energy development in Arkansas?
        - What technologies are likely to emerge?
        - Will biomass continue to be the predominant source of non-hydro renewable power generation in the state?
        - What portion of overall power generation will they represent?

[2] http://www.circleofblue.org/waternews/wp-content/uploads/2010/08/EPRI-Volume-3.pdf
[3] http://www.twdb.state.tx.us/publications/reports/contracted_reports/doc/0704830756ThermoelectricWaterProjection.pdf
[4] http://www.nrel.gov/docs/fy11osti/50900.pdf

- Base load vs. peak load facilities:
    - As mentioned above, forecasted statewide thermoelectric water demands will be allocated geographically using a baseline ratio of county power generation by facility type to statewide power generation by facility type. This approach will capture the variation in power generation and, consequently, the variation in water needs of base load vs. peaking facilities. Using this ratio to allocate forecasted water demands carries forward an assumption that base load facilities will continue to operate as base load facilities and peaking facilities will continue to operate as peaking facilities throughout the planning horizon.