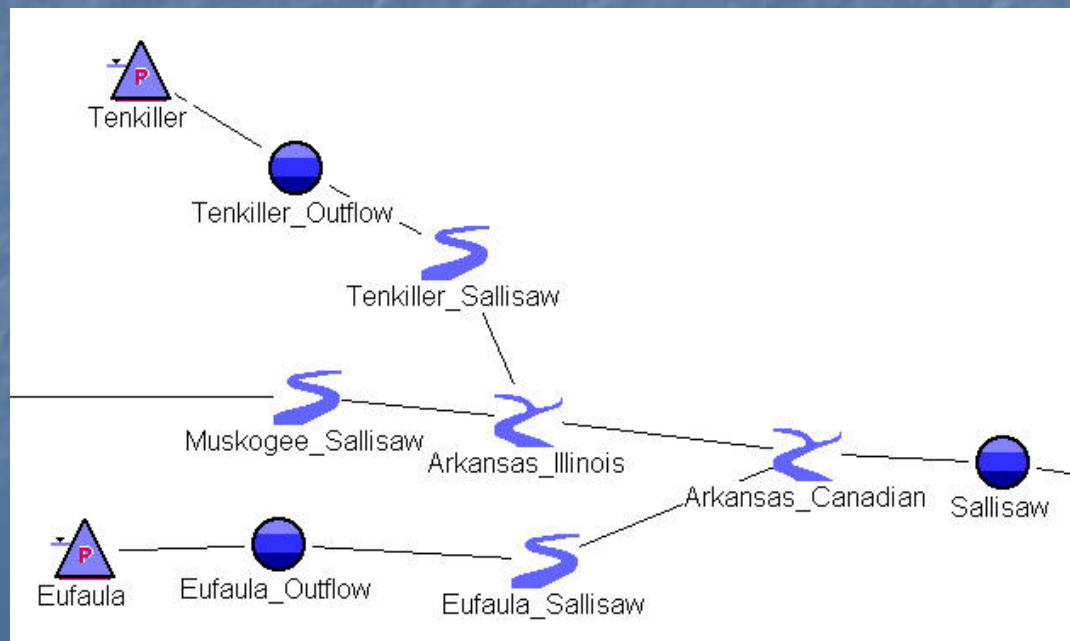# New Hydropower Methods for Corps of Engineers

Overview

➢ Purpose: Develop methods and rule functions to duplicate the methodology used by USACE in the SUPER program

➢ Enhancements made:

- Method to calculate required Load
- Power calculation method
- Method to calculate additional power release
- Predefined rule function to limit releases to prevent additional downstream flooding

➢ How does this all work?

Load Methods

- Load Calculation Category
  - New Methods:
    - Input Load – user input timeseries
    - Annual Load – time series of annual load with disaggregation factors
    - Periodic Load – periodic slot containing load
    - Seasonal Load – periodic slot containing the load as a function of time and pool elevation

New Power Method

➢ Peak Power Equation with Off Peak Spill

- Input Slots:
  - Head Loss
  - Maximum Power Pool Drawdown
  - Minimum Power Elevation
  - Net Head vs. Plant Efficiency
  - Net Head vs. Generator Capacity

New Power Methods

- Output Slots:
  - Peak Release -> Release at Generator Capacity
  - Peak Time -> Time at peak release
  - Peak Spill -> Spill that occurs during Peak Time
  - Off Peak Spill -> Spill that occurs during off peak time

$$\text{Peak Release} = \frac{(\text{Generator Capacity})}{(\text{Net Head})(\text{Efficiency})}$$

$$\text{Peak Time} = \frac{(\text{Turbine Release})(\text{Timestep Length})}{(\text{Peak Release})}$$

New Power Methods

➢ Additional Hydropower Release Calculation category

- Meet Hydropower Load method:
  - Additional Hydropower Release – incremental release to meet Load
  - Load – Energy to be met

New Predefined Function

➢ HydropowerRelease(STRING subbasin)

- Prioritizes the reservoirs by load shortage

- Loops through each reservoir in the basin and calculates the proposed release to meet the load.

- Calculates portion of the proposed release that will not cause additional downstream flooding

- Returns the Outflow and Additional Hydropower Release in {slot, value} pairs for each reservoir

How does this all work?

➤ Start of timestep: calculate Load

➤ Surcharge and flood control rules calculate Outflows

➤ Objects dispatch to calculate Energy production (using new power method) and flows at control points

➤ HydropowerRelease() function executes:
  - Sorts reservoirs based on load shortage
  - Calculates the additional release to meet the load
  - Limits release to not cause additional downstream flooding (i.e. routes water down to control points)

How does this all work?

- Rule assigns Outflow and reservoir re-dispatches to calculate energy, peak release, and off peak spill

- Off-peak spill slot is used to look at minimum flows during off peak periods