

Purpose: Combined Cycle modeling

Objective: Model Combined Cycle units based on capabilities

- Recognize parameters of each component
- Recognize startup costs on individual CT's
- Recognize Heat Rate degradation during 1 x 1 operation
- Model duct burning as separate component
- Re-Offer capability if unit not fully committed day ahead

Key Assumptions:

- Unit Identifiers defined
 - CT 1 = 1 CT in Simple Cycle Configuration
 - CT 2 = 1 CT in Simple Cycle Configuration
 - CT1S = 1 CT + % of Steamer
 - CT2S = 1 CT + % of Steamer
 - CT12S = 2 CT + Steamer
- Example assumptions
 - The unit was not running the previous day
 - CT2S is in an outage until HE14
- Numbers are for example only
- Following examples assume 2 x 1 combined cycle unit type
- Assumes steamer is linked to CT. CT's can operate without the steamer, but the steamer cannot operate without CT
- 3 Main configurations
 - Two simple cycle CT's
 - Two 1 x 1 combined cycles
 - One 2 x 1 combined cycle unit
- All configurations offered daily. PJM can select the configuration that is optimal.

- In Simple Cycle and 1 x 1 -configuration the combined cycle is treated as individual units. There are separate Unit parameters, limits, and offer curves for each CT plus associated portion of steamer as applicable. In 2 x 1 - configuration the unit is modeled as one unit to recognize the efficiency. When the 2 x 1 configuration is used there is only one set of limits and one offer curve. However, parameters and startup costs need to be recognized for individual CT's if the unit configuration is changed.
- All configuration parameters are valid for the same day and time period. The CT components are separate, but interact when changing configurations (i.e. parameters not additive).
- Assumes Duct burning limits are only valid if the CT's are at full load. When duct burners are in service the eco min is raised to eco max without duct burners and is unable to dispatch down based on min run time of duct burners

General Concept

The general concept of this model would be to recognize each component of the unit and allow the parameters of the unit to be taken in to consideration when unit is awarded or dispatched. The market participant will offer all configurations that are available daily. This will allow PJM to evaluate all configurations and select the optimal solution. The key is recognizing that each component has different capabilities. Each component has separate parameters, limits, and costs. If for any reason the configuration is transitioned in to a new configuration the parameters of the units will need to be recognized as well as the cost associated with making this change. The examples in the spreadsheet will lay out how each configuration is offered in to the market.

Simple Cycle Example

Market participant offer:

The market participant will offer each CT. Each CT will have separate parameters, limits, and offer curves. In the example the Eco Max and the duct firing limits are reduced to recognize the steamer is not available in the Simple cycle configuration. Note: CT 2 is not available he1-13.

PJM Option:

PJM has the option to pick up each CT independently. They will view each CT's parameters, limits, and Cost information.

1 x 1 – Configuration example

Market participant offer:

The market participant will offer each CT + % of steamer in to the market. Each CT will have separate parameters, limits, and offer curves, to include its associated portion of the steamer and duct burners. Note: CT2S is not available he1-13.

PJM Option:

PJM has multiple options based on the offers. They include: select CT1 only, select CT2 only, select CT1S only, select CT2S only or select both units in a 2 x 1 configuration starting he14. PJM will need to recognize the parameters, limits, startup costs, and offer curves of each CT.

2 x 1 – Configuration example

Market participant offer:

The market participant will offer the 2 x 1 configuration unavailable for he1-13. Based on the unit outage this configuration is not available. Starting he14 both CT's are available and can be considered available for a 2 x 1 configuration. This configuration has one set of limits, parameters, and offer curve. This allows the efficiencies of running the unit in 2 x 1 to be recognized.

PJM Option:

PJM has multiple options when selecting this unit. They include: select CT1 only, select CT2 only beginning HE14, select CT1S only, Select CT2S only beginning HE14, or select CT12S beginning HE14. In the example, PJM would recognize that CT2S is unavailable through HE13. If economic, PJM would select CT1S and view the unit as a 1 x 1 configuration recognizing CT1S parameters, limits and offer curve. Starting HE14, CT2S becomes available. PJM would recognize this through the limits and the 2 x 1 configuration becoming available. PJM would evaluate the costs and parameters of CT2S and make a decision on starting the unit. If PJM decides to start CT2S the market participant will be compensated. PJM would switch to a 2 x 1 configuration and dispatch the unit similarly to how it is done today.

