

Synchronous Condensing Costs

CDS

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- **Synchronous condensers incur certain costs when operating in condensing mode. Units operate in condensing mode to provide reserves, reactive support or post contingency operation.**
- **Condensers provide PJM with three operating parameters and three financial parameters as part of their offers. These parameters are:**
 - **Condense Energy Use (MW), Condense Notification Time, Condense to Generate Time.**
 - **Condense Startup Cost, Condense to Gen Cost, Condense Hourly Cost.**

OA References

- **Condensing costs are referenced in five sections of Schedule 1 of the Operating Agreement.**
 - **3.2.3: Operating Reserves (Uplift)**
 - **3.2.3A: Synchronized Reserves**
 - **3.2.3A.01: Secondary Reserves**
 - **3.2.3B: Reactive Services**
 - **3.2.3C: Post-Contingency Operation**

OA References

- **None of the sections include definitions.**
- **Terms used:**
 - **offered prices for synchronous condensing**
 - **condense start-up cost**
 - **cost to provide synchronous condensing**
 - **startup cost of providing synchronous condensing**

Manual 11 References

- **Energy Usage for reserve condensing resources (MW):** This is the amount of instantaneous energy a condensing resource consumes while operating in the condensing mode. The value submitted as part of the Reserve offer must be less than or equal to the actual energy consumed as observed in real time.
- **Condense to gen cost:** This is the cost of transitioning a condenser to generating mode. The value submitted for this cost must be less than or equal to the condensing Startup Cost.
- **Condense Startup Cost:** This is the actual cost associated with getting a resource from a completely off-line state into the condensing mode including fuel, O&M, etc.
- **Condense Hourly Cost:** This is the hourly cost to condense and is equal to the actual, variable O&M costs associated with operating a resource in the condensing mode, including any fuel costs. It does not include any estimate for energy consumed.
- **Condense Notification Time:** The amount of advance notice, in hours, required to notify the operating company to prepare the resource to operate in synchronous condensing mode.

Manual 15 References

- **Section 6.7 (CTs)**
 - **Start-up Costs** if applicable, shall be applied when a unit moves from cold to condensing operations and when a unit moves from condensing operations to energy generation, but shall not be applied when a unit moves from energy generation to condensing operations.
 - **Actual cost of power consumed during condensing operations** at real time bus LMP as determined by Market Settlements. MW consumed must be included in the offer.
- **Section 7.7 (Hydro)**
 - **Condensing Start costs** if applicable, start costs shall be applied when a unit moves from cold to condensing operations and when a unit moves from condensing operations to energy generation, but shall not be applied when a unit moves from energy generation to condensing operations.

Manual 28 References

- **Section 5.2.3 (Credits for Synchronous Condensing)**
 - **PJM calculates each eligible resource's condensing cost for each period by multiplying the duration (in five minute intervals) by the hourly cost to condense plus energy use cost divided by twelve as specified in the offer data.**
 - **When a resource is requested to start condensing from an off state, a condensing credit is provided equal to the resource's condensing startup cost as specified in the offer data.**
 - **PJM calculates the daily synchronous condensing cost for each resource by summing all five minute interval condensing and energy use costs, including applicable startup costs, for the day.**

Manual 28 References

- **5.2.8 Credits for Resources Providing Reactive Services**
 - **Generators operating as synchronous condensers for the purpose of maintaining reactive reliability at the request of PJM, are credited for each five minute interval of condensing an amount equal to the higher of: 1) the Synchronized Reserve Market Clearing Price for the five minute interval divided by 12 multiplied by the amount of synchronized reserve provided (i.e., economic maximum limit of the unit); or 2) the sum of the unit's offered cost to condense, energy use cost, start-up cost, and the unit-specific lost opportunity cost of the resource supplying the increment of Synchronized Reserve divided by 12.**

Markets Gateway Definitions

- **Condense Energy Use (MW):** This is the amount of energy a condensing unit consumes in an hour while operating in the condensing mode.
- **Condense Notification Time (hour):** The amount of advance notice, in hours, required to notify the operating company to prepare the unit to operate in synchronous condensing mode.
- **Condense Startup Cost (\$):** The offer price, in dollars, for starting up the unit to run in synchronous condensing mode. Offer price is capped at cost, as established by the Cost Development Subcommittee CDS.
- **Condense to Gen Cost (\$):** The cost, in dollars, of transitioning a condenser to the generating mode. The value submitted for this cost must be less than or equal to the condense Startup cost.
- **Condense Hourly Cost (\$/hr):** The offer price, in dollars/hour, to run the unit in the synchronous condensing mode. Offer price for condensing is capped at cost, as established by the CDS.
- **Condense To Generate Time:** The amount of time in hours it takes for the unit to be available to generate once it's in a condense mode.

Problem Statement

- The definitions of these parameters need to be reviewed, clarified or corrected when necessary, and documented in Manual 15 and the Operating Agreement.
- The references to Condense Hourly Cost were removed from Manual 15 as part of the Reserve Market changes in October 1, 2022.
- Manual 11 and the uplift related sections of synchronous condensing were not revised.

OA References

- **Schedule 1 Section 3.2.3 (i): “offered prices for synchronous condensing”.**
- **Schedule 1 Section 3.2.3A (f) (i): “For a generation resource that is operating as a synchronous condenser, the resource’s unit-specific opportunity cost shall be determined as follows: [energy use for providing synchronous condensing multiplied by DA LMP] plus [the applicable condense start-up cost divided by the number of hours the resource is assigned Synchronized Reserve].”**

OA References

- **Schedule 1 Section 3.2.3A (f) (ii): “For a generation resource that is a synchronous condenser, the resource’s unit-specific opportunity cost shall be determined as follows: [additional energy use in excess of day ahead energy use for providing synchronous condensing in real-time multiplied by RT LMP] plus [any applicable condense start-up costs due to additional condense start-ups in real time in excess of day-ahead condense start-ups allocated to each Real-time Settlement Interval as described in PJM Manuals].”**

OA References

- **Schedule 1 Section 3.2.3A.01 (f) (i): For a generation resource that is a synchronous condenser, the resource's unit specific opportunity cost shall be determined as follows: [energy use for providing synchronous condensing multiplied by DA LMP] plus [the applicable condense start-up cost divided by the number of hours the resource is assigned Secondary Reserve].**

OA References

- **Schedule 1 Section 3.2.3A.01 (f) (ii): For a generation resource that is a synchronous condenser, the resource's unit specific opportunity cost shall be determined as follows: additional energy use in excess of day-ahead energy use for providing synchronous condensing in real-time multiplied by RT LMP plus [any applicable condense start-up costs due to additional condense start-ups in real-time in excess of day-ahead condense start-ups allocated to each Real-time Settlement Interval as described in PJM Manuals]. If the generation resource is operating as a synchronous condenser and also has a Real-time Synchronized Reserve assignment, resource's unit-specific opportunity cost in the Secondary Reserve Market shall be zero.**

OA References

- **Schedule 1 Section 3.2.3B (i): At the end of each Operating Day, to the extent a condenser operated to provide Reactive Services also provided Synchronized Reserve, a Market Seller shall be credited for providing synchronous condensing for the purpose of maintaining reactive reliability at the request of the Office of the Interconnection, in an amount equal to the higher of (i) the Synchronized Reserve Market Clearing Price for each Real Time Settlement Interval a generating unit provided synchronous condensing multiplied by the amount of Synchronized reserve provided by the synchronous condenser or (ii) the sum of (A) the generating unit's cost to provide synchronous condensing, calculated in accordance with the PJM Manuals, (B) the product of MW energy usage for providing synchronous condensing multiplied by the real time LMP at the generating unit's bus, (C) the generating unit's startup cost of providing synchronous condensing, and (D) the unit-specific lost opportunity cost of the generating resource supplying the increment of Synchronized Reserve as determined by the Office of the Interconnection in accordance with procedures specified in the PJM Manuals.**

OA References

- **Schedule 1 Section 3.2.3C (a): At the end of each Operating Day, to the extent a condenser operated in conjunction with post contingency operation also provided Synchronized Reserve, a Market Seller shall be credited for providing synchronous condensing in conjunction with post-contingency operation at the request of the Office of the Interconnection, in an amount equal to the higher of (i) the Real-time Synchronized Reserve Market Clearing Price for each applicable interval a generation resource provided synchronous condensing multiplied by the amount of Synchronized Reserve provided by the synchronous condenser or (ii) the sum of (A) the generation resource's applicable interval cost to provide synchronous condensing, calculated in accordance with the PJM Manuals, (B) the applicable interval product of the megawatts of energy used to provide synchronous condensing multiplied by the real-time LMP at the generation bus of the generation resource, (C) the generation resource's start-up cost of providing synchronous condensing, and (D) the unit specific lost opportunity cost of the generation resource supplying the increment of Synchronized Reserve as determined by the Office of the Interconnection in accordance with procedures specified in the PJM Manuals.**

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