California Independent
System Operator Corporation

Memorandum

To: ISO Board of Governors

From: Keith Casey, Vice President – Market & Infrastructure Development

Date: October 20, 2011

Re: **Decision on Multi-Stage Generating Unit Modeling Enhancements**

This memorandum requires Board action.

EXECUTIVE SUMMARY

Management proposes to implement several enhancements to the multi-stage generating unit modeling. Management has developed a proposal that increases accurate and flexible modeling of these units. Pending approval from the Board of Governors and FERC, Management is targeting spring 2012 for implementation.

This memorandum proposes enhancements to modeling multi-stage generating unit modeling that would:

- Improve multi-stage generating unit modeling to allow more efficient real-time dispatch;
- Increase economic participation of flexible generating resources; and
- Aid in the ISO's ability to reliably operate the grid.

Moved, that the ISO Board of Governors approves the policy to implement multi-stage generating unit modeling enhancements as described in the memorandum dated October 20, 2011; and

Moved, that the ISO Board of Governors authorizes Management to make all the necessary and appropriate filings with the Federal Energy Regulatory Commission to implement this policy.

DISCUSSION AND ANALYSIS

Within the fleet of resources available to the California Independent System Operator Corporation, several resources are characterized by multiple operating configurations. These resources are termed multi-stage generating units. Typically, multi-stage generating units are in fact comprised of two or more generating units that can be operated separately or in concert. A good example is combined-cycle units which have interconnected gas and steam turbines generating electricity. The gas turbines generate electricity and, in so doing, create heat which is in turn used to boil water. The resulting steam then turns another turbine which generates additional electricity. Combined cycle generating units are built with different combinations of generating units. For example, a three by two (3x2) design has three gas turbines combined with two steam generators. As a result, these units can operate in several different configurations that consist of the various combinations of gas turbines and steam generators. There is great synergy and flexibility created by this arrangement, but also complexity. The ability to operate in multiple configurations makes multi-stage generating units more flexible than those with a single configuration from the standpoint of operating the physical plant. However, it also requires comprehensive modeling of the various configurations in order to take advantage of that flexibility, and to avoid the infeasible dispatch of the resources.

In December 2010, the ISO implemented modeling functionality that optimizes the commitment and dispatch of generating units that, by their physical nature, have multiple operating configurations. The multi-stage generating unit modeling functionality is designed to take advantage of the inherent flexibility of these resources while respecting their operating characteristics and the costs of their operation. To employ the multi-stage generating unit modeling functionality, a market participant registers with the ISO the various operating configurations – and their associated operating parameters – and then bids those configurations into the ISO market individually. The ISO, through its market optimization software, determines which configuration is most economic given those bids while respecting the configurations' operating constraints. In short, the multi-stage generating unit modeling enables the market software to support the efficient and feasible economic dispatch of generating units with multiple operating configurations.

Through experience gained since deployment of the multi-stage generating unit modeling functionality, the analysis of commitment, dispatch, and market outcomes for multi-stage generating resources, and with the help of stakeholder feedback, Management has identified potential refinements to the modeling functionality. The enhancements are designed to improve modeling that allows for more efficient real-time dispatch. This suite of enhancements addresses several stakeholder concerns and, in so doing, is anticipated to increase economic participation of the flexible generating resources in the ISO market.

After careful consideration of input from stakeholders and ISO software developers, Management recommends that the enhancements to the multi-stage generating unit modeling functionality listed below be incorporated into the ISO systems and, as applicable, into the tariff. Our recommendation considers stakeholder feedback and system software constraints while providing flexibility in economically bidding multi-stage generating units into the ISO market. The enhancements to multi-

stage generating unit modeling described below will help improve the modeling functionality's efficiency. In so doing, it will aid in the ISO's ability to reliably operate the grid.

Management recommends the following five enhancements to the multi-stage generating unit modeling functionality:

1. *An increase from three to six configurations that a multi-stage generating unit may bid into the real-time market.*

   Currently each multi-stage generating unit can have three configurations bid into the real-time market. We propose to allow all multi-stage generating units to have up to six configurations bid into the real-time market. Being able to bid in more configurations will give market participants more flexibility and will aid the real-time market in optimizing the dispatch of multi-stage generating units in situations of under- and over-generation.

   One of the strengths of the multi-stage generating unit modeling is that it takes into account the costs and operational constraints associated with transitioning between operating configurations. However, the more possible transitions among configurations that the optimization must consider, the longer it takes that software system to reach a solution. In order to offer market participants the ability to offer bids for six configurations into the real-time market while not compromising software performance, Management recommends a limitation of two transition paths for multi-stage generating resources with more than six registered configurations.

   Both the recommendation to increase the number of configurations that can be bid into the real-time market, and the limitation on the number of transition paths, are based on experience with the multi-stage generating unit model. Based on that experience and considering stakeholder feedback, Management has determined that increasing real-time configurations and limiting transition paths achieves a balance that enhances flexibility for market participants without compromising performance of the modeling software. While Management would ideally not have any limitations on configurations or paths, some limits are needed to ensure that the software can perform as required in the real-time. Management anticipates that the need for such limitations will wane over time as the software is continually tuned to achieve greater performance.

2. *Multi-stage generating units will be required to bid the capacity from the overall minimum operating capacity of the resource up to the resource adequacy capacity or highest bid-in capacity. For such capacity not bid into the market, the ISO will insert cost-based generated bids.*

   Since the deployment of multi-stage generating unit modeling functionality, resources have been able to bid in any unit configuration to which the resource can start directly. This can result in the plant owner bidding a configuration option that leaves the capacity below the minimum operating level of that configuration unavailable to the market optimization. As a consequence, the market solution may not have the option to dispatch resources at their

lower capacity levels when the resource is bid into the market at its highest resource adequacy capacity requirement. This can result in the inability to make full use of a multi-stage generating resource's resource adequacy capacity and is not consistent with the treatment of non-multi-stage generating resources for which the optimization can consider operating levels from the plant-level minimum operating level up to the maximum bid-in capacity.

The recommendation provided herein will give the ISO the authority to insert cost-based generated bids for multi-stage generating unit configurations from a resource's overall minimum operating capacity up to its resource adequacy capacity or highest bid-in capacity.

Importantly, to date, not having this requirement in place has not posed a problem, as multi-stage generating resources have been providing the needed bids. However, Management recommends that this requirement be formalized to ensure that resource adequacy and bid-in capacity are available to follow the economic dispatch of the multi-stage generating unit.

3. *The number of ramp-rates that can be specified per multi-stage generating unit configuration will be increased from one to two.*

   The current multi-stage generating functionality allows only one ramp-rate to be defined and bid-in per configuration. This creates limitations for some resources. Experience with the modeling functionality has shown that this enhancement will not encumber the performance of the software.

4. *Market participants will be able to self-schedule a multi-stage generating unit in the real-time market into a configuration different from that scheduled in the day-ahead market.*

   Under current practices, if a multi-stage generating resource has a day-ahead energy schedule or ancillary service award in one configuration, then the resource can only self-schedule in real-time in that configuration. In actuality, there can be more than one configuration capable of supporting that day-ahead schedule and ancillary service award. This enhancement would allow a multi-stage generating unit to self-schedule into the real-time market in a configuration different from that scheduled in the day-ahead market so long as the real-time configuration can support the same awarded ancillary service or residual unit commitment capacity.

5. *When a multi-stage generating unit does not reach the configuration (given the tolerance band) to which it is dispatched upward, the minimum load costs of the lower configuration will be included in the bid-cost recovery calculation. If the resource is dispatched downward into a lower configuration, it is recommended that the minimum load costs for the target configuration be used in the bid-cost recovery calculations.*

   Today, if a multi-stage generating unit is dispatched upward by the ISO into a configuration, its minimum load costs will be included in the bid cost recovery calculation provided that the meter is within the tolerance band around the configuration's minimum output level.

However, if the resource falls short of the tolerance band, no minimum load costs are considered in the bid cost recovery calculation for that settlement interval. The resource in this case may still be operating above the minimum load of a lower configuration, and if so, is legitimately incurring some minimum load costs.

The current practice is to the disadvantage of the market participant bidding in the multi-stage generating unit, and is misaligned with minimum load cost accounting for other generating resources. Management recommends that the multi-stage generating unit have the next lower configuration's minimum load cost considered in the bid-cost recovery calculation in the case that it does not meet the target configuration in an upward dispatch.[1]

Furthermore, Management recommends that when a multi-stage generating unit that is dispatched downward into a lower configuration by the ISO but does not leave the operating range of the higher configuration, the resource will not be eligible for the minimum load costs of the higher configuration. Instead, the minimum load costs for the target configuration would be included in the bid-cost recovery calculation.[2]

POSITION OF PARTIES

The suite of multi-stage generating unit modeling enhancements recommended herein received nearly unanimous support from stakeholders as can be seen in the attached stakeholder matrix. Also as discussed in the Department of Market Monitoring Board memo, DMM is supportive of the proposed enhancements noting that they can benefit both the ISO system and multi-stage units by dispatching these resources more accurately and efficient.

At the start of the stakeholder process on this policy initiative, the ISO proposed one additional change to the modeling of multi-stage generating units. Stakeholder feedback on that element – namely, a change from the existing methodology for determining allowable transition costs – did not receive stakeholder support. As a result, the change to the transition cost rules was removed from the group of enhancements ultimately proposed.

MANAGEMENT RECOMMENDATION

This memorandum describes multi-stage generating unit modeling enhancements designed to improve increasingly efficient real-time economic dispatch. Management anticipates that implementation of these enhancements will increase the economic participation of flexible generating resources and thereby improve the ISO's ability to reliably operate the grid. For these reasons, Management recommends that the Board approve the enhancements to the multi-stage generating unit modeling described above.

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[1] The lowest minimum load cost of the two configurations will be used. In practice it is expected that the lower configuration would have a lower minimum load cost, however, if this is not the case then the lower minimum load cost of the higher configuration will be used in the bid cost recovery calculation.

[2] Similar to footnote 1, the lowest minimum load cost of the two configurations would be used in the bid cost recovery calculation.