Issue Paper on How to Address Disconnected PNodes

Since the start of operations under the new market design on April 1, 2009, when a Pricing Node (PNode) included in the ISO market model has been disconnected, the ISO markets have posted a “$0” Marginal Cost of Congestion (MCC). The software cannot calculate a cost of congestion when the PNode is disconnected from the system. This is because under such circumstances the Power Transfer Distribution Factor (PTDF) associated with the disconnected PNode and the binding constraint is zero. At such times, the optimization does not actually produce a price and therefore the price at that location, issued through the actual market clearing process, is undefined. After the optimization is completed the software inserts a zero value for the MCC at the disconnected PNode location.

The posting of a “$0” MCC and using that value for settlements purposes under such circumstances does not impact the settlement of the markets for energy because the System Marginal Energy Cost applies to all PNodes across the system, and bid cost recovery ensures that market participants will receive at least their bid price in energy settlements. The “$0” MCC does, however, affects the settlement of Congestion Revenue Rights (CRRs) and Inter-Scheduling Coordinator Trades (ISTs). CRRs are settled based on the difference in the MCC between two locations. As some CRRs have settled based on a PNode that has, at times, been disconnected, such CRRs have been settled using a “$0” MCC at the applicable CRR location. The ISO has received a number of disputes for such settlements asserting that “$0” is not the correct price at which the CRR should be settled. Also, some CRRs and ISTs have been settled based on the Existing Zone Generation Trading Hub (TH) prices. The trading hubs consist of a weighted average of LMPs within a defined geographic area. If a disconnected Pnode was associated with a TH definition then it is likely that a “$0” MCC was used in the calculation of the TH price and affected CRRs and ISTs that have been settled based on the TH price.

Reporting a “$0” MCC when there is a disconnected node is a disfavored outcome. As discussed further below, the ISO proposes to change the practice of inserting “$0” when a PNode becomes disconnected and instead insert the MCC of the closest electrically connected PNode.

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1 A PNode may become disconnected due to an outage of facilities on the transmission grid that renders the PNode no longer electrically connected to the rest of the modeled grid.

2 The MCC is one of the three parts of calculating a LMP. The other two components are the System Marginal Energy Cost, which is the same for all PNodes across the system, and the Marginal Loss Component, which is generally calculated as a non-zero value.

3 It should be noted that a MCC price of zero could be a correct solution when a PNode is connected and there is no congestion.
Discussion:

A. Disconnected Node

A connectivity node (CNode) may become disconnected, i.e., isolated from the rest of the grid, when all branches emanating from that CNode are de-energized by opening the corresponding breakers. This event may be the normal outcome of switching operations and bus re-configurations, or it may be due to transmission facility outages. Although PNodes are carefully selected CNodes in a substation that are expected to be connected most of the time, occasional PNode disconnections may occur.

B. Current Practice

As provided by the ISO’s software vendor, the system software was configured to insert the “$0” MCC. Therefore, during market simulations, when a CNode or PNode became disconnected this was the value that the software inserted for the MCC. There was some discussion on this issue in the report generated by LECG on the review of the MRTU dispatch and pricing software. At the time there was no opposition to this practice, so the ISO did not propose changing this before go live.

However, the insertion of “$0” is only the creation of a proxy price at a location where there is no actual MCC defined by the market clearing process. The insertion of the “$0” value provides an administrable solution that enables the ISO to actually settle CRRs and ISTs. Letting the MCC remain undefined would result in the non-settlement of these instruments when a PNode becomes disconnected.

Arguably, the “$0” MCC value is a reasonable reflection of the true cost of congestion at that location because as a result of the disconnection of the PNode the market model measures no actual congestion at that location. Moreover, the “$0” value appropriately reflects the fact that due to the disconnection it is possible that the value of injecting energy at that location is zero. However, in discussions with market participants post go-live, the ISO has determined that the insertion of the “$0” value is problematic from the perspective of settling transactions such as CRRs and ISTs at locations where certain expectations were set regarding LMPs at those locations.

The ISO surveyed practices at other ISOs and RTOs and to the best of its knowledge, no other ISO or RTO adopted the same practice as the ISO. In addition, market participants that engage in such transactions in other ISOs/RTOs indicated that there was a material difference in the resulting settlements for similar instruments elsewhere. Therefore, the ISO evaluated further whether the ISO’s practice could be easily modified to address concerns raised by market participants.

The Tariff does not specifically address what actions the ISO should take to settle CRRs or ISTs in the event that the model has a disconnected node that is used as the source or sink for that CRR or is one of the constituent nodes included in the Trading Hub where an IST is settled. Nor does it explicitly specify the actions that it

4 This report can be found at: http://www.caiso.com/2067/2067769c1c5a0.pdf
cannot take under such conditions. The current practice, therefore, does not violate the provisions of the tariff.

C. Alternatives

The ISO considered two plausible alternatives to using zero as the MCC of a disconnected PNode: 1) list an LMP for the affected PNode as “Not Applicable” and not settle CRRs using the affected location for the hours when the PNode was disconnected; or 2) insert the price of the closest electrically connected PNode.

The first alternative poses no technical difficulty in that the ISO would simply turn off the current rule to insert the “$0” value and it is also not explicitly prohibited by the tariff. However, this alternative would result in the non-settlement of CRRs and ISTs for those intervals where the ISO markets produce no MCC as a result of the disconnected PNode. These CRRs would not be settled because the MCC would be non-defined at least one of the CRR locations. The ISTs would be settled during those intervals because the Trading Hub LMP would still be calculated. However, to the extent that a disconnected PNode is part of the Trading Hub, the Trading Hub LMP would be affected by the null MCC value. In addition, the ISO believes that a non-numeric value would undoubtedly cause complications elsewhere in the ISO’s systems and processes that are currently only prepared to accept numeric values through the various payloads.

The second alternative provides the ability to insert a proxy LMP, including all three components (SMEC, MCC and MCL), that is cleared at a location that is electrically closest to the PNode that is disconnected in any given interval. CRRs would be settled based on the MCC calculated at that proxy LMP. From the perspective of CRR settlement, this is preferable to the “$0” value because the proxy price is closer to what the LMP would have been at the affected location but for the disconnection. Certain market participants have already indicated that this is a preferred alternative to the current practice. Settlement of ISTs would also be affected by this proxy price to the extent the affected PNode is a constituent of the affected Trading Hub.

The second alternative is also not prohibited by the current tariff provisions because the tariff is silent as to how the ISO should price CRRs and ISTs in the event that a PNode is disconnected and there is not a MCC produced by the software. Based on the ISO’s discussions with representatives from other ISOs, this is the approach that other ISOs and RTOs have taken in similar circumstances.

The ISO has developed the following methodology to determine the closest electrically connected node, which will serve as the location from which the ISO will select the LMP for the disconnected node. The entire LMP would be selected along with its various components. The methodology consists of a recursive search starting from the disconnected PNode and traversing the network along the FNM branches to locate a connected PNode. The branches that emanate from the disconnected PNode are traversed in ascending priority order with respect to their admittance, which is used as a measure of electrical closeness.
Proposed Tariff Change

27.1.1 Locational Marginal Prices for Energy.

The LMP for Energy at any PNode is the marginal cost of serving the next increment of Demand at that PNode consistent with existing transmission facility Constraints and the performance characteristics of resources. The LMPs calculated in the IFM, the HASP for Scheduling Points, and the RTD are based on Energy Bid Curves. The LMP at any given PNode is comprised of three cost components: the System Marginal Energy Cost (SMEC); Marginal Cost of Losses (MCL); and Marginal Cost of Congestion (MCC). The IFM calculates LMPs for each Trading Hour of the next Trading Day. The HASP, which is an hourly run of the RTUC with the Time Horizon that starts at the beginning of the next Trading Hour, calculates fifteen-minute LMPs (HASP Intertie LMPs) for that Trading Hour. The simple average of the four fifteen minute LMPs for the Trading Hour computed at each Scheduling Point produces hourly LMPs for HASP Settlement of Energy at that Scheduling Point. The Real-Time Dispatch runs every five (5) minutes throughout each Trading Hour and calculates five-minute LMPs for the next Dispatch Interval. The CAISO uses the Resource-Specific Settlement Interval LMPs for Settlements of the Real-Time Market. In the event that a Pricing Node becomes electrically disconnected from the market model during a CAISO Market run, the LMP, including the SMEC, MCC and MCL, at the electrically closest Pricing Node will be used as the LMP at the affected location.