Why an Energy Imbalance Market Will Make the Western Interconnection More Reliable

To date, most of the discussion and analysis regarding the benefits of a West-wide Energy Imbalance Market (EIM) has focused on the economic advantages of such a market. It’s important to also consider the reliability-related functions of an EIM. During the recent Crossroads meeting in Portland, speakers representing SPP and MISO both reported that the reliability benefits of their real time markets outweighed the economic benefits. SPP went on to say that the reliability benefits alone justified establishing their EIM… the economic benefits were secondary.

Reliability benefits are difficult to quantify, but they are easy to understand. As an example, consider the following case-study:

An outage event impacted the Western Interconnection in February 2008. This event involved a large loss of generation, over 2500 MW. In order to comply with NERC Disturbance Control Standards, the deficit BA needed to replace the lost generation and restore their contingency reserves. The deficit BA called for activation of contingency reserves, and as is typical in the Western Interconnection, initial replacement generation assistance was supplied by their Reserve Sharing Group (RSG).

The deficit BA then had to initiate replacement power purchases from other generation sources to prepare for termination of the reserve-sharing assistance. Their system operators were dependent on manual communication methods such as phone calls, to find over 2,000MW of replacement power.

*Had an EIM been in place, available replacement generation options would have been automatically identified by the EIM dispatch software.*

Next, the deficit BA needed to verify that contract path transmission capacity was available between those replacement generators and their BA.

*Had an EIM been in place, the EIM software would have automatically verified that transmission was available. An EIM would also have gone one step further, evaluating and confirming actual available transmission capacity, rather than contract path capacity. This extra step may have identified additional transmission which was not posted on OASIS.*

Once the replacement generation sources and contract path transmission capacity were identified and verified, the system operators had to schedule the replacement transactions using E-tags. During the actual event, the operators ran into problems getting those E-tags approved by the affected parties.

*Had an EIM been in place, this problem would have been avoided, because EIM transactions are dispatched directly without the need for E-tags.*

About 90 minutes into the event, prior to the system operators completing their replacement generation arrangements, RSG support automatically terminated, leaving the BA short of generation. As a result, the BA ended up having to shed over 74,000 customers.

*Had an EIM been in place, it would have detected the shortfall caused by the loss of RSG support and automatically redispatched available generation. Firm load shedding could have been avoided.*

This event caught the attention of the FERC, resulting in an investigation of what happened and whether any reliability standards were violated. The final report has not been issued, but examples from other regions suggest that if reliability standard violations are found, substantial fines may result.

*Had a West-wide EIM been in place, problems identifying available replacement generation, E-tag approval problems, and the imbalance resulting from the loss of RSG support would have been automatically mitigated by the EIM. The subsequent shedding of firm load could have been avoided… perhaps also avoiding a FERC investigation and the risk of fines.*

Other case studies could demonstrate similar events where extreme operating conditions involving other WECC-member Balancing Authority Areas have resulted in outage to firm load supply.

Some have questioned why a reliability organization such as WECC should be involved in an EIM market. The simple answer is obvious from the example above. These examples are just a few of the potential reliability benefits which can be derived from a West-wide EIM. The remainder of this white paper will discuss EIM reliability-related benefits in greater detail.

**Congestion Management**

Congestion of transmission is typically referred to by system operators as an SOL (System Operating Limit) violation. The WECC RCs recently reported that during the previous 12 months they had seen over 700 SOL violations occur. When an SOL violation occurs, operators have a brief time window in order to take actions which will mitigate the violation, or they will be in violation of NERC reliability standards.

Currently WECC uses a congestion management process known as USFMP, the Unscheduled Flow Mitigation Plan. The software tool that supports the USFMP has a number of significant weaknesses, the most obvious of which is that it currently only applies to six transmission paths in the entire Western Interconnection. When the Reliability Coordinator Strategic Plan was developed in 2006, all three RCs indicated that upgrading the USFMP process to apply to all paths was a critical need. Proposed upgrades to the WECC congestion management tool will allow this to coordinate congestion management response on any transmission element in the Western Interconnection. Then within the EIM footprint, the congestion management response is upgraded further through the market dispatch.

An often overlooked weakness in the current tool is the fact that when congestion occurs, USFMP only addresses half the problem. To fix a congestion issue, system operators must reduce flows across the constrained path by redispatching generation. Redispatching generation requires reducing generation on one side of the constraint and increasing generation on the other side of the constraint. One must reduce and increase generation in equal amounts in order to maintain the balance of load and supply.

USFMP calculates how much each scheduled transaction must be reduced in order to mitigate an actual or potential SOL violation. This information can be roughly interpreted to identify which generation needs to be reduced, but it does nothing to identify the optimal generation increase in order to maintain the balance of load and supply. This can leave the transaction participants scrambling with a manual process to identify and schedule generators to correct the grid loading problem without causing the anticipated, or new, SOL violations to occur. Path Operators complain that the original transactions are curtailed, but the manually-developed replacement transactions may put them right back in the same imperiled reliability situation.

An EIM can address this weakness. An EIM does not rely on curtailments to manage physical congestion. Instead the EIM provides counter flows to the actual or potential SOL violation. It does so by determining exactly which generators to reduce and which to increase in order to create an offsetting flow on the constrained path. By using optimized offer (price) curves to select the generation to increment and decrement, it not only mitigates the SOL violation from a reliability perspective, it does it from an economic perspective as well, automatically providing the least cost physical solution to the congestion.

Because an EIM utilizes software known as Security Constrained Economic Dispatch to model transmission flows when it dispatches generation, it will not dispatch generation in a way which creates new congestion problems. Unlike USFMP, which can only analyze tagged transactions, an EIM can analyze all generation in the network. The counter flow dispatch identified by the EIM is initiated at the next five minute dispatch interval, considerably faster than the response times observed under today’s USFMP process or through manual scheduling responses.

**Variable Generation Curtailments**

Variable generation such as wind and solar inherently result in actual production which differs from forecasted and scheduled levels. Balancing Authorities (BAs) must maintain supply/demand balance by carrying additional amounts of balancing reserves which can be incremented or decremented in order to offset these differences between actual and scheduled output. If a BA underestimates the amount of balancing reserves needed, the BA may run short, resulting in violations of NERC Reliability Standards and a risk to the interconnection. In response, some BAs require curtailments of variable generation sources when their balancing reserves are depleted.

An EIM can address the imbalances caused by variable generation in at least two distinct ways. First, an EIM will aggregate variable generation imbalances within the footprint. It does so by creating a single virtual BA for real-time balancing purposes. Because the variable resource imbalances that are in different directions offset the aggregate balancing requirement, the EIM will result in a lower net imbalance, and less commitment and use of balancing reserves.

Second, when a residual net imbalance occurs, an EIM can redispatch available generation on a West-wide basis, thereby reducing the risk of an individual BA running out of balancing reserves. As an additional benefit, any imbalance-related redispatch will be made on a least cost basis. This reduces the risk that the costs of balancing energy might create an economic impediment to the development of variable generation sources in some BAs.

During the Crossroads Meeting in Portland, the speaker from the SPP reported that since the implementation of their EIM, there have been no variable generation curtailments due to balancing reserve shortfalls. The current SPP imbalance market footprint includes approximately 4,000 MW of wind resources with approximately 45,000 MW of peak footprint demand.

**Contingency Response**

As described in the case study example found in this white paper, BA operators in much of the Western Interconnection rely on manual communication methods to identify and schedule replacement generation when supply contingencies occur. Unfortunately, it can occur that BAs are unable to manually to locate replacement generation and associated transmission service rights within the time limits imposed by NERC Standards. In some cases this has resulted in shedding interruptible and firm load customers.

Evidence from several past Western Interconnection events showed replacement generation was available that could have been used to avoid shedding load, but finding it with phone calls, emails and OASIS-based transmission reservations within the allotted time was not possible. This provides examples where an EIM can make a major reliability improvement within the Western Interconnection. When a generation source must be replaced after the contingency reserve deployment period, the EIM software can detect the resulting supply/demand imbalance and can dispatch available offered replacement generation from the least cost source, with dispatch ramping beginning in the next five minute dispatch interval.

One of the concerns recently heard in an OC/RC discussion regarding emergency assistance is the difficulty of ensuring that a transmission path is available. Not only does an EIM locate the least cost replacement generation source(s), the SCED algorithm will ensure that the replacement generation is deliverable by the transmission grid without creating other problems.

Another concern heard in the OC/RC discussion was the difficulty in getting E-tags entered and approved during emergency events. Once again, an EIM solves this concern, by dispatching the replacement generation directly without the need for E-tag creation or approval.

To some degree, an EIM creates a virtual BA for the entire participating footprint in the western grid interconnection. An EIM does not eliminate the need for immediate contingency reserve response from existing RSGs, but can be designed to coordinate with the services provided by existing RSGs in the West and facilitate the resupply from available resources at the end of the reserve activation period.

**Energy Emergency Alerts**

NERC Emergency Operating Procedures include a series of Energy Emergency Alert (EEA) levels which are used to define varying degrees of supply shortfalls. Triggering an EEA is an indication of a significant risk to reliability, and that assistance is needed to avoid the risk of shedding load. EEAs are issued by the RCs based on communications with BAs who indicate they anticipate or are unable to meet their operating reliability requirements and have been unable to locate additional sources of supply using manual communication methods. Just in the past year, recognizing the inefficiency of manual communications for locating additional supply in a large interconnection, the WECC MIC initiated a Merchant Alert Protocol (MAP) for broadcasting email alerts of potential supply shortages throughout the interconnection, in an effort to mitigate the frequency of EEAs within the Western Interconnection.

An EIM would serve as a further upgrade to this new protocol and facilitate the process of finding and dispatching additional sources of supply. When a BA’s supply was not meeting internal demand, the resulting imbalance would trigger additional dispatch from offered resources throughout the EIM footprint. The deficit BA or its Load-Serving Entity (LSE) would have an option for receiving least cost energy, quickly and without the need for manual communications or negotiation. This type of coordinated dispatch option is expected to reduce the frequency of EEAs within the Western Interconnection.

**Defining the value of EIM reliability related benefits**

It is difficult to assign a specific dollar value to reliability benefits associated with an EIM due to the speculative nature of what outages might be avoided by the reliability improvements described above. However, some indications of the order of magnitude of EIM reliability related benefits can be derived by looking at the benefits calculated for WECC by its consultant (E3) as part of the WECC Synchrophasor Project proposal.

A West-wide EIM will result in more supply coordination options and hence help to avoid interruptions of both firm and interruptible customers following supply contingencies and other energy shortfall events.

*The WECC Synchrophasor Project proposal concluded that reducing customer interruptions by just 2 events affecting 500,000 customers during the next 40 years is worth approximately $30-87.5 million/year.*

A West-wide EIM will likely increase transmission utilization on some transmission paths by dispatching energy using actual flows rather than scheduled flows.

*E3 concluded that increasing transmission utilization of one major transmission path by just 100 MW is worth $0.9-1.9 million per year.*

A West-wide EIM will likely increase utilization of variable generation by automatically identifying economically feasible delivery alternatives for variable energy and reducing the need for forced curtailments.

*E3 concluded that increased utilization of variable generation is worth $8-90 million per year.*

And finally, a West-wide EIM will likely reduce the amount of balancing reserves needed in the Western Interconnection by aggregating variable resources into a single virtual BA.

*E3 concluded that reduced balancing reserves for variable generation would be worth $7.6-15.7 million per year*

The reliability related benefits described above would add up to range of approximately $50 million to $195 million per year.

**Final Comments…**

This white paper demonstrates the fact that an EIM is not just about economic benefits. Potential EIM related reliability benefits are substantial and will benefit the WECC organization, its members and their end-use customers. The proposed EIM can serve as another important reliability tool to assist the WECC Reliability Coordinators, while upgrading WECC to the next level in fulfilling its core reliability mission.

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