Energy Mark, Inc.
334 Satinwood Court North
Buffalo Grove, Illinois 60089
(847) 913-5491

Energy Mark Discussion on the Nature of the Inadvertent Problem

Prepared for NAESB IIPTF

By: Howard F. Illian, President
Energy Mark, Inc.
February 15, 2003

Confidential Material
- Do Not Copy -

Table of Contents

Inadvertent Interchange:

When the North American electric utility industry began restructuring it faced a number of issues resulting from the methods used by the industry to support interconnection reliability and the compatibility of those methods for use within a market structure. One of these issues is the management of inadvertent energy on the interconnections. Specifically, this document discusses the need to settle Inadvertent Interchange financially.

Historical Perspective:

Since the electric utility industry first interconnected systems, the industry has operated under a model that assumed electricity utilities were natural monopolies, and therefore, could only operate efficiently as vertically integrated entities within a price regulated structure. The implementation of this utility model in North America has created a number of factors that contributed to the management of Inadvertent Interchange on the interconnections.

Price Stability:

The models used for price regulation have resulted in electricity prices that have had a high degree of stability over both short and long time intervals. Twenty five years ago it was extremely rare to see hourly dispatch prices that varied by more than a factor of 10 to 1, even between on peak and off-peak periods. This price stability was also reflected in the wholesale markets through the use of pay-in-kind contracts that specified the economic transfer of energy with settlement through pay-in-kind mechanisms. Even with these pay-in-kind mechanisms, the normal practice has been to limit these pay-in-kind transfers to the same period of the day, on or off peak.

This price stability also resulted in the development accumulative Inadvertent Interchange accounting rules that allowed the settlement of Inadvertent Interchange through payback-in-kind mechanisms, both unilateral and bilateral. Considerable efforts have been dedicated to the methods used to manage these accounts.

Cost-Plus Price Regulation:

Another contributing factor to the choice to use accumulative Inadvertent Interchange accounting and payback-in-kind mechanisms was the regulatory environment that used Cost-Plus Price Regulation to determine rates. Under this environment, any transfer of wealth from one utility to another resulting from the payback-in-kind mechanisms could be adjusted for in the Cost-Plus rates. Therefore, the inequities that resulted from the accumulative Inadvertent Interchange accounting and payback-in-kind mechanisms were small as compared to the costs that would be incurred to correct the inequities.

Other Operational Factors:

Over the years, the simplicity of the management of the accumulative Inadvertent Interchange accounting practices has encouraged the development of a whole body of theory around the effective use of these accounts for managing reliability, time error and even markets. The implementation of these other practices has created a great deal of inertia to oppose the elimination of these accounting and operating practices.

The above history provides a perspective that allows us to understand why there is opposition to changing the accumulative Inadvertent Interchange accounting practices around which current operating practices have been developed. Changes in the management of these accounts will also require the redevelopment of new methods to achieve other operational goals. It is this effort that those who are opposing the changing of Inadvertent Interchange management methods see as a necessary component of this change process. I believe that they are just saying, "Let's look at the whole problem, not just the accounting for inadvertent!"

Changing Environment:

The difficulty that we face is that the whole world has changed over the last decade and we as an industry have not kept pace. This is especially true of the management of accumulated Inadvertent Interchange accounts. Most of the characteristics of the electric utility industry that contributed to the development of Inadvertent Interchange accounting practices in their current form have changed. These changes have caused many within the industry to question whether the continuation of these practices is equitable in the new environment.

Price Volatility:

As markets have been developed for the wholesale exchange of electric energy, the price volatility has increased at least 10 fold. It is not unusual to observe electric energy prices that vary by a factor of 100 to 1, as compared to the prices that were observed 25 years ago, and price variations of 1000 to 1 have been observed when the interconnection is under stress. When prices are this volatile, there is no payback-in-kind mechanism that can be considered fair and equitable that also allows the control errors that are normally experienced under industry accepted control practices. Therefore, if we are to continue to practice shared frequency control, new methods must be developed to address the Inadvertent Interchange management problem.

Uneven Cost-Plus Price Regulation:

The development of the wholesale markets has been based on the premise that market pricing can replace the traditional Cost-Plus Regulation that has been used throughout the industry during the past millennium. As soon as two classes of market participants are created, one subject to Cost-Plus Regulation and the other to free market pricing, the issue of market equity must be addressed if they are to compete in the same market. This is because the participant subject to Cost-Plus Regulation has a means to recover any losses experienced from payback-in-kind Inadvertent Interchange while the participant subject to market pricing has no means to recover those losses. Therefore, the simple perpetuation of payback-in-kind Inadvertent Interchange slants the playing field in favor of the Cost-Plus Regulated participant.

Frequency Control Responsibilities:

The justification for the maintenance of the accumulative Inadvertent Interchange accounting practices has been the additional responsibilities that are performed by the participants that use these payback-in-kind methods. This has been accepted as a reason for continuing these practices but is has not been accepted as being equitable because no one could determine whether the costs of frequency control were less than or greater than the potential benefits that result from using payback-in-kind methods.

Some have suggested that the interconnection simply change to Constant Net Interchange control, but this change would result in a significant degradation in interconnection reliability due to greater variations in interconnection frequency and would eliminate the considerable savings that result from sharing this control responsibility. Therefore, one of the limits on the ultimate solution must be the perpetuation of shared interconnection frequency control.

These basic changes in the electric utility industry that come as the direct result of the restructuring process require the removal of the restrictions on the methods that can be used to settle Inadvertent Interchange. The maintenance of interconnection reliability cannot be used as an excuse to restrict the effective operation of the market when newer methods to support reliability can be implemented that do not limit market effectiveness.

Why Financial Settlement?

Before presenting an example of how payback-in-kind can be used to a Balancing Authorities financial advantage, the stage must be set with respect to how control performance limits constrain the use of Inadvertent Interchange as a financial tool.

NERC Control Performance Standards:

NERC currently has three standards that provide guidance to Balancing Authorities on how much control they are expected to provide to meet their share of interconnection frequency control responsibilities. These standards are Control Performance Standard 1, **CPS1**, Control Performance Standard 2, **CPS2** and the Disturbance Control Standard, **DCS**. These standards have been written with the intent of defining the minimum performance expected from each Balancing Authority to maintain interconnection reliability.

CPS1:

CPS1 simply requires that each Balancing Authority balance the amount of frequency control help that they receive from the interconnection with the amount of help they provide to the interconnection when the interconnection is off schedule. Epsilon 1 limits the amount that they receive over the amount that they provide over a long period, 1-year, thus assuring reliable interconnection operation.

CPS2:

CPS2 simply measures the average ACE error over a 10-minute periods and requires that 90% of those average ACE errors lie within a 90th percentile limit, $\mathbf{L_{10}}$, calculated from a normal distribution and historic frequency performance of the interconnection derived from 10-minute frequency error averages.

DCS:

DCS requires a Balancing Authority to restore its ACE to zero within 15-minutes following the sudden and unexpected loss of significant resources, usually the tripping of a large generating unit.

Because the interconnections have historic high levels of reliability, these standards leave considerable room to relax control over short intervals and still meet the standards for most Balancing Authorities. The problem of Inadvertent Interchange occurs precisely because many Balancing Authorities exceed these reliability standards by considerable amounts.

The Inadvertent Interchange Problem:

Any Balancing Authority that is easily meeting the above performance standards can choose to reduce their control at times when prices are very high or very low and use the Inadvertent Interchange payback-in-kind rules to create a financial advantage for themselves. At the same time since the Inadvertent Interchange will sum to zero over the interconnection, their financial advantage will result in the interconnection incurring an equal and opposite financial disadvantage that will eventually be distributed among other Balancing Authorities on the interconnection that were performing correctly.

When prices are very high the Balancing Authority can under-produce and lean on the interconnection to meet some of its needs that would otherwise be very costly. At a later time when prices are much lower, the same Balancing Authority can repay this energy in-kind completing its energy balancing commitments. When a Balancing Authority takes advantage of others on the interconnection, its CPS1 and CPS2 performance will decline, but with planning that decline can be limited to an amount that will still allow the Balancing Authority to meet the performance standards.

When prices are very low the Balancing Authority can over-produce and inject excess energy into the interconnection. This action may allow that Balancing Authority to avoid incurring the large cost of shutting down and restarting a generating unit. At a later time, when prices are higher, the same Balancing Authority can then lean on the interconnection instead of generating its own energy to recover the energy in-kind that it is owed by the interconnection creating yet another benefit while completing its energy balancing commitments. These actions will also lead to a decline in the control performance of the Balancing Authority, but with good planning the Balancing Authority will still meet the performance requirements.

Raise the Standards?:

It has often been argued that, if Balancing Authorities are taking advantage of reasonably set reliability limits, then tightening those limits will reduce their ability to disadvantage others economically. The following example will demonstrate the limitations associated with this assumption.

Assume an interconnection where all Balancing Authorities are compliant with CPS1 and the CPS1 scores vary from 110% to 180%. Under these conditions, any of the Balancing Authorities at the upper end of the compliance scale could choose to used some of their control compliance margin to manipulate their Inadvertent to their financial advantage. Since their Inadvertent is exchanged to their benefit, and total inadvertent for the interconnection must sum to zero over any hour, it can be concluded that the other Balancing Authorities lost economic value on their Inadvertent. Any Balancing Authority that chooses to do this would at the same time see a reduction in their CPS1 score but could limit that reduction to a range in which they remain compliant with CPS1.

If the CPS1 limits for the above example were reduced in an attempt to improve equity, the result would fail to do so and could make things worst. If the CPS1 limit were reduced, the Balancing Authorities that had the lower scores would be non-compliant with CPS1 and would either have to pay penalties or purchase additional control from other Balancing Authorities or both, potentially those same Balancing Authorities that the CPS1 limit reduction was intended to affect. Although the ability of the most compliant Balancing Authorities to use Inadvertent to their financial advantage would be limited, their position in the market to make control sales to the non-compliant Balancing Authorities would more than offset that limitation. At the same time, more total resources would be expended unnecessarily on additional control reducing the economic efficiency of the interconnection.

The above example illustrates that it is best to set minimum reliability limits to maintain interconnection reliability and let the equitable distribution of the economics be determined by market mechanisms that are either in the process of being implemented or are yet to be developed. All that setting reliability limits beyond the minimum required to maintain reliability will achieve is the expenditure of more resources on reliability than is justified and a reduction in the economic efficiency of the interconnection. In other words, reliability limits should be set only to maintain reliability and market mechanisms should be developed to create equity. Achieving this requires the development of market compatible reliability measurement methods. This is a difficult enough task in itself.

Although the above discussion strongly suggests that the commercial considerations should not be included within the reliability standards, it does not prevent the data that is collected for reliability purposes from being shared with the market to allow the best data to be used to support market settlement. The most equitable alternatives may require that data be collected, corrected for error and used for reliability assessment and then be passed to the market participants for equitable settlement.

The Solution:

Although many suggestions have been made with respect to how the interconnection can eliminate this opportunity to use Inadvertent Interchange to the financial advantage of a Balancing Authority, the only method that meets the requirements of fairness and maintaining a level market is to require that the value of the Inadvertent Interchange be captured on a short interval basis, for example the market pricing interval, and require that value to be used to financially settle the energy exchanged.

Unfortunately, settling the energy component of the Inadvertent Interchange will not resolve the problem of maintaining interconnection reliability. The financial settlement only addresses the value of the energy exchanged. It does not address the value of reliability that was supplied when the Inadvertent Interchange was provided.

In simple terms, requiring only the financial settlement of the energy component of Inadvertent Interchange provide energy pricing that is detrimental to reliability. Unless the other components of Inadvertent Interchange, the reliability components, are properly addressed, the implementation of financial settlement of energy alone could lead to a significant decline in interconnection reliability.

Change Other Operating Practices:

Unfortunately, the development of methods that effectively maintain interconnection reliability without requiring the use of accumulative Inadvertent Interchange accounting methods will not remove the restrictions on how the Inadvertent Interchange can be settled unless all of the other operating practices that are also based on the existence of accumulative Inadvertent Interchange accounts are also replaced with new operating practices that work effectively without the information contained in those accounts. This could require the rewriting of numerous local operating procedures to enable the removal of these restrictions.

The fact that the removal of restrictions on the methods that are available to settle Inadvertent Interchange may require other operating practices to be modified must be an accepted part of any Inadvertent Interchange management solution.

Reliability Decomposition:

The solutions to the Inadvertent Interchange problem that have been offered by the JIITF are derived from a single concept. That concept is that if the reliability component(s) of Inadvertent Interchange can be separated from the commercial energy component of Inadvertent Interchange, then the limitations that restrict the settlement of the energy component can be removed. The market will then be free to determine how to settle the energy component without restriction. It has be suggested and supported that there are two reliability components associated with Inadvertent Interchange: 1) a Frequency Control Component and 2) a Transmission Loading Component. Each of these components is addressed separately from the energy component and discussed below.

Frequency Control Component:

The basis of including a Frequency Control Component derives from the fact that shared frequency control requires that reserves and energy that those reserves can produce be supplied in response to changes in interconnection frequency. Since the use of this energy is not scheduled in advance, it is appropriate to require that those using this energy be held accountable for that unscheduled use including all of the costs associated with standing-ready-to-supply the energy as needed, costs that are considered costs of frequency control. It is also appropriate that those supplying this unscheduled energy be rewarded appropriately for the not only the cost of the energy provided but also all of the costs associated with standing-ready-to-supply the energy as needed, costs that are considered costs of frequency control. In this way the reliability based Frequency Control Component can be separated from the market priced energy component. The details are provided in the JIITF White Paper. It is recognized that this solution is only a temporary solution to address the symptom of the basic control problem, but it is also recognized that changes must be made in the management of Inadvertent Interchange that cannot wait for markets in the frequency control services to be developed.

Frequency Control Market:

The most desirable way to address the issue of Frequency Control would be through a market in Frequency Control Services. Unfortunately, there are no effective markets in the Frequency Control Services that can currently be used as a basis for capturing the economic price signals associated with errors in frequency control that result in Inadvertent Interchange. When these markets are developed, it would be appropriate to use them to drive the pricing for the Frequency Control Component of unscheduled energy.

Transmission Loading Component:

The basis of including a Transmission Loading Component derives from the fact that Inadvertent Interchange has the same loading effect on the transmission system as any other energy flows. In an unconstrained interconnection, this Transmission Loading Component would have a cost based on the cost of scheduling transmission. This cost basis is required because it is unacceptable to have a market that charges for scheduled transmission use but does not charge for unscheduled transmission use. The implementation of a market with that rule set would send strong price signals to the market participants to avoid scheduling transactions. This would be inconsistent with **Reliability Principle 1** – Interconnected bulk electric systems shall be planned and operated in a coordinated manner to perform reliably under normal and prescribed abnormal conditions.

Additionally, when the transmission system is congested, the Inadvertent Interchange displaces MW for MW correctly scheduled interchange. Therefore, capturing the reliability component on a congested system must include either the economic cost of those that scheduled correctly and were interrupted by implementation of a TLR resulting from the Inadvertent Interchange, or the economic cost of redispatch that eliminates the need for TLR, or the economic costs of both when the constraint is relieved using both methods. These costs are appropriately considered reliability costs associated with transmission loading. Failure to capture these costs and assign them to the unscheduled Inadvertent Interchange will also send a strong price signal to the market to avoid scheduling energy and would also be inconsistent with Reliability Principle 1.

Redispatch Market:

As with the Frequency Control Component, the most desirable way to address this issue would be through the implementation of a Transmission Redispatch Market. Since the services that would support a Transmission Redispatch Market are a subset of the services necessary to support a Frequency Control Market, the same arguments apply to the development of the Redispatch Market as the Frequency Control Market. Some markets are capable of implementing this alternative immediately because they have implemented a form of Locational Marginal Pricing which provides the necessary information to develop the Transmission Loading Component, but this alternative is not available universally on the North American interconnections. Although this is the most desirable solution, it is inappropriate to hold the energy market hostage when an interim alternative exist.

It is also important to note that, although some regions have chosen to combine the Energy Market with the Transmission Market in their implementation of LMP, this has not been accepted as a universal market design. There are other alternatives that avoid combining these two markets that can provide the solution the Inadvertent Interchange – Transmission Loading Component without requiring that the Energy Market and the Transmission Market be combined. These methods use only the Redispatch Market and the system loading to determine pricing for the transmission flows and loading associated with the Inadvertent Interchange. They do not require that the entire Scheduled Energy Market and Scheduled Transmission Market be included in the solution. As with the Frequency Control Component, the Transmission Loading Component is developed incrementally and as a result can be separated from the energy component, thus separating the reliability and commercial components.

Necessity for Local Solutions:

It is expected that North American markets will initially implement a number of different market designs for the trading of energy, transmission and ancillary services. It is already known that some markets have chosen to combine the Energy and Transmission Markets as part of their implementation of Locational Marginal Pricing. It is expected that other markets will implement designs that do not combine the Energy and Transmission Markets. It is necessary that the Transmission Loading Component of the Inadvertent Interchange be managed on a consistent basis with the local market design to be effective. This means that unless or until the markets are all modified to a single design, the Transmission Loading Component must be determined locally using a method compatible with the local Transmission Market design.

These local solutions may not be apparent in some regions, because those regions have not developed economic redispatch solutions to the congestion problem or have not experienced significant congestion. In these regions the local solution to the Transmission Loading Component may be trivial or may have to await the development of a robust Transmission Market design that addresses all of the transmission loading issues. The Transmission Loading Component may have to be implemented as part of the Transmission Market design.

The fact that the Transmission Loading Component is initially insignificant as compared to the other two components does not reduce the necessity that it be acknowledged and that provisions need to be made for its eventually implementation as part of the Transmission Market.