Neenan ASSOCIATES

Memo

To: Dave Lawrence

From: Bernie Neenan

CC:

Date: 6/7/02

Re: Alternative DADRP Program Offerings

Background

At the May 8, 2002 Price Responsive Load Working Group (PRLWG) meeting, Neenan Associates was charged with the task of proposing changes to the penalty feature of the Day-Ahead Demand Response Program (DADRP) that would improve participation rates. There is anecdotal evidence that suggests many potential participants see the penalty as a major deterrent to subscribing to DADRP. This view was confirmed by a survey administered last summer as part of the NYISO's PRL program evaluation. Appendix A provides a synopsis of the results of survey questions that asked why customers chose or eschewed DADRP participation. The non-compliance penalty attribute was mentioned several times as a barrier to joining the Day-Ahead program. Moreover, the penalty generated high negative utility of participation values based on survey results in last summer's choice modeling exercise.

Analysis of Alternative DADRP Designs

We have developed two alternative DADRP designs that specifically reduce the impact of the penalty. They will be compared to the current Day-Ahead program in the analysis that follows.

The first alternative, Program B, eliminates the penalty altogether and provides payment solely based on performance. This in effect makes DADRP participation risk-free, since the most a customer can lose is what it is initially paid for its curtailment bid.[1] This feature is consistent with ISO-NE's Class I Emergency program, and puts DADRP on an equal footing with EDRP, with regard to the non-compliance penalty, which enjoys widespread participation and provides substantial, demonstrated and cost-effective load curtailment capability.

The second alternative we evaluate, Program C, eliminates the 10% penalty adder, and sets the penalty rate equal to the RTM price at the time of the scheduled curtailment. Program C provides scheduled load reduction resources an opportunity to operate in both the Day-Ahead and Real-Time markets on the same terms as generators and LSEs. Unlike the current DADRP program, Program C allows a Participant, that has its bid accepted in the DAM, to forego curtailing usage if the corresponding next day's RTM prices are lower that the scheduled DAM

price, and still realize a positive net settlement position. However, non-compliance with scheduled load reductions will result in penalties if the RTM price is above the Day-Ahead LBMP. This balanced risk exposure may appeal more that the existing DADRP to many customers.

Approach

The choice modeling effort performed in last summer's evaluation of the NYISO's PRL programs provides a rich resource for deriving an estimate of the impact different penalty levels would have on participation rates. A conjoint survey, which was administered to both DADRP Participants and non-Participants, asked them to indicate their program preference from a series of hypothetical programs constructed from different feature levels. Twenty different sets of these choices (which are construed as alternative programs) were posed to each survey respondent in order to provide a large database for the evaluation of stated preferences for alternative program designs. The responses to the conjoint survey were then used to estimate a choice model that related program feature levels to Participant's satisfaction (or more formally, utility). The estimated model allows us to calculate the utility of participation to a wide range of product designs by establishing the relevant feature values and then using the model to determine the equivalent utility or value.

For the purposes of evaluating these two alternative Day-ahead programs, a base DADRP model was first created, later allowing the penalty level to change. A comparison of the calculated satisfaction (utility) levels of an alternative program with the base program can be summarized through an odds ratio, which represents the likelihood of participation in an alternative program versus the base. If features improve the value of participation, then the odd ratio increases, and vice-versa for feature changes that reduce the value of participation.

The program features that we can model are notice, the timing of the event, the event duration, the level of the initial DAM payment, and the non-compliance penalty. To establish a base program, the notice period was set at Noon day-ahead and the Participant is assumed to submit a four-hour curtailment bid for the hours of 1:00 to 5:00 p.m. at a strike price of $250. These features were also used for the alternative programs in order to isolate the impact of the penalty changes we proposed. To complete the program descriptions, the penalty rate implied by the each of the DADRP designs must be specified. This requires interpreting the existing and proposed non-compliance penalty in terms that are compatible with the choice model.

The survey conducted last summer described the penalty relative to the DAM payment the Participant receives when its bid is accepted in the DAM. We incorporated four penalty levels into the survey design: a penalty of 2.0 times the DAM Payment, 1.5 times the DAM Payment, 1.0 times the DAM Payment, and No Penalty. For example, if a Participant's one megawatt bid was accepted at an LBMP of $250/MW for one hour, which constitutes its initial DAM payment, and it failed to meet its curtailment obligation, then under the current DADRP penalty rules its penalty would be the greater of the DAM payment it received and the RTM price at the time of non-compliance, plus a 10% adder. If the RTM price was $500, then the net penalty imposed on the customer for non-compliance is $300 (the RTM price of $500 plus 10%, less the $250 DAM payment). The result is a penalty ratio of about 1.2, or ($550-$250)/$250. Alternatively, an RTM price of $700, equates to a penalty ratio of about 2.0, or ($770-$250)/$250. By interpreting the alternative penalty schemes in terms of penalty ratios, we can use the results of last summer's analysis to evaluate how DADRP participation would be impacted by the two proposed alternative program designs.

To support modeling the base DADRP representation, we assumed that the penalty ratio customers used to evaluate participation is 2.0, which roughly equates to a RTM price of $750. We chose this high Real-time price for the base model to reflect the implications of customers' risk aversion. If customers are averse to paying penalties, their evaluation of DADRP participation is likely to portray the consequences of non-compliance relative to the most adverse outcomes, as opposed to the average outcome. Based on last summer's results, a $750/MWH RTM price

represents the tail of the distribution of adverse outcomes (RTM prices). It is therefore reasonable to assume that a highly risk-averse customer bidding a DADRP strike price of $250 would use a penalty of $750 as an extreme value to reflect the risks.[2] This penalty also corresponds to a penalty rate of two-times the assumed DAM payment, which is the extreme penalty rate evaluated in last summer's analysis.[3]

The penalty ratios for each of the two alternative programs must also be assigned in order to properly use the choice model to estimate Participant satisfaction levels. With no penalty in Program B, the penalty ratio is simply zero. Program C, however, uses the Real-Time market-clearing price to repay any deficient load curtailment efforts, which does not perfectly correlate into a specific penalty ratio -- the penalty depends on the DAM and RTM prices, as is the case in the current DADRP design.

Under the Program C design, the customer benefits when a scheduled curtailment position can liquidate profitably without actually curtailing, because the Real-Time price is below the Day-Ahead price. The prospect of such potential rewards decreases risks, so the implicit penalty for Program C must be less than that of Program B. To reflect those risks, we set the Program C penalty at one times the DAM payment, which implies an RTM price of $500. This level may actually overstate the risks of Program C for some customers. A participant who is certain it can meet every curtailment requirement profitably (its outage costs will always be below its DAM bid), never faces any adverse impacts—i.e. it will never be penalized. But, the prospect of making money by not having to curtail, when the scheduled DAM price exceeds the RTM price, equates to an as good or even better deal than Program B, where breakeven is assured, thereby preventing gains from the DAM/RTM market spread. For the purposes here, we adopted the conservative posture of assigning a penalty ratio of 1.0 to Program C.

Results

Table 1 compares the existing DADRP design with the two proposed alternatives using the results of the choice model estimated from the responses of last year's DADRP ***non-Participants***. Two sets of results are presented at the bottom of the table. The first row, labeled *Odds of Program vs. DADRP*, contains the odds ratios for comparing the existing DADRP program against the alternatives. The first entry is 1.0, because the comparison is the existing DADRP (the base) against itself. The entries in the next two columns are the odds of participation in Program A and Program B, respectively, relative to the base program as the alternative – the choice set is between two DADRP program configurations.

The second row of results in the table, labeled *Odds of Program vs. No program*, indicates the odds of participation if the indicated program were the only one available. The first entry under DADRP is 0.68, which are the odds of participation if only the existing DADRP is offered. That value makes sense since we are modeling the preferences of customers that knew about, but did not participate in, last year's DADRP. Subsequent row entries are the odds of participation if these customers were instead given the choice to participate in the alternative program, Program B and Program C, respectively. The choice set is between participation in a single program or none.

Table 1: Participation odds from alternative DADRP

Program Features	DADRP	Pgm B	Pgm C
Payment	$250/MW	$250/MW	$250/MW
Penalty	**2.0**	**0.0**	**1.0**
Start Time	1300	1300	1300
Notice	DA	DA	DA
Event Duration	4 HRS	4 HRS	4 HRS
Odds of Program vs. DADRP	**1.00**	**8.77**	**2.51**
Odds of Program vs. No Program	**0.68**	**5.92**	**1.69**

Beginning with the comparative program analysis, Program B, which imposes no penalty, is clearly favored over the current DADRP design. Customers who chose to forego participation in last summer's DADRP program would be 8.77 times more likely to participate in Program B than in the current DADRP, if given the choice. The elimination of the penalty altogether would have a profound affect on program participation, according to the simulated programs. Revising the penalty so it is more equitable, relative to market outcomes, has a smaller but still important impact on participation rates. Customers prefer Program C 2 ½ to 1 over the existing DADRP. Both of the alternative programs offer improved prospects for DADRP participation. But, can such changes in the program design be rationalized given the NYISO's market structure?

The results, with respect to the odds ratios, are much the same when the alternative programs are compared against the option to not participate in any program. Participation is almost six times more likely if Program B is offered and over one and a half times higher if Program C is offered. These results are especially compelling, as they suggest that either program will increase participation among the informed non-Participants surveyed last fall. Clearly, modifying the DADRP penalty is of high priority. But, which modification is most compatible with the NYISO's market design?

Discussion

DADRP Participants must assess the costs associated with curtailing load in preparing bids to submit to the DAM. Such bids reflect the average (expected) outage costs associated with curtailing electricity consumption the next day during the specified hours. If something subsequently occurs forcing it to not curtail when scheduled to do so, the Participant suffers a net loss under the current DADRP since it is assured of paying a penalty of at least 10%, and perhaps several times, the DAM payment level. The risks associated with these adverse

outcomes will act as a deterrent to participation because customer's fear such possibilities, and will also cause those that do participate to skew their bids upwards to compensate for accepting the additional risk.

Under Program B, Participants may forego their curtailment obligation with no penalty, and as a result more customers will find participation feasible. Moreover, Participants will reduce their curtailment bids to reflect the lower risks. The decision to curtail is unaffected by the Real-time market clearing price, since it has no impact on a customer's performance payment nor penalty. In other words, customers comply based on their prevailing outage costs relative to the DAM payment. This is attractive to customers, but such behavior could adversely impact the efficient operation of the NYISO's Real-Time market.

If the RTM price is below the DAM LBMP, then a cheaper generation resource is available to serve the resulting load if the Participant's does not curtailment as scheduled, thereby lowering the overall market cost of supply. However, under Program B if the RTM price is above that of the DAM, the Participant makes a compliance decision relative to the lower DAM price, resulting in deadweight losses (sales below costs). Since these deadweight losses are measured by the difference between the price the customer responds to and the actual price, in this case the DAM versus the RTM price, one way to mitigate such losses is to impose a floor under the bid price. The current floor is $50/MWH. Perhaps for customers served under Program B, the floor should be $150/MWH or higher to close the potential deadweight loss gap.

In addition, Program B offers opportunities, which also apply to price-following programs, for what might be construed as gaming. A customer could submit a standing bid with no intention of performing, but simply to open the gate for payments if the customer's actual usage happens to drop below the calculated CBL. The current penalty structure discourages such behavior. But, if there is no upside penalty, then customers might be attracted to participation in hopes of garnering windfall gains. The creation of a CBL calculation that takes into consideration past performance might limit such gaming opportunities. The NYISO ICAP Special Case Resource program uses such an adjustment factor to ensure resources are only paid for what they can provide, on average, when called upon. But, under that scheme the restrictions on undesirable behavior come at a high price with regard to program complexity and ease of participation, which are also important factors in a successful design.

Program C provides Participants the opportunity to enjoy the same risks and rewards as generators who bid and are scheduled in the Day-Ahead market. Although this program may not improve the value of participation as much as Program B, it still is preferred over the current DADRP by a factor of two. By paying the Real-Time market-clearing price, Participants in the program could be categorized as "Scheduled Price-Followers". Curtailments are scheduled based on DAM bids, which reflect the Participant's expected outage costs but its performance, curtailing or operating, depends upon prevailing Real-Time Market prices. During periods of high Real-Time LBMPs, the Participant has an incentive to drop load as scheduled thus helping the market mitigate any effects of short supply conditions. However, if the RT price drops below the DAM LBMP, the Participant can close its position at a profitable rate, with little adverse impact on the market. As discussed above, for some customers this second aspect may make Program C preferable to Program B.

Conclusions

The non-compliance penalty was cited in last summer's survey as one of the largest barriers to participating in DADRP, and there are indications that current subscription is suffering because of an aversion to the current penalty structure. Our analysis of two alternative penalty structures indicates a change to the non-performance penalty could dramatically improve participation in DADRP. A modification to the penalty rate that either reflects the price a Participant is paid for scheduling load or the price paid for closing out a long position in the market, would result in

customers being far more inclined to join the Day-Ahead program than previously seen.

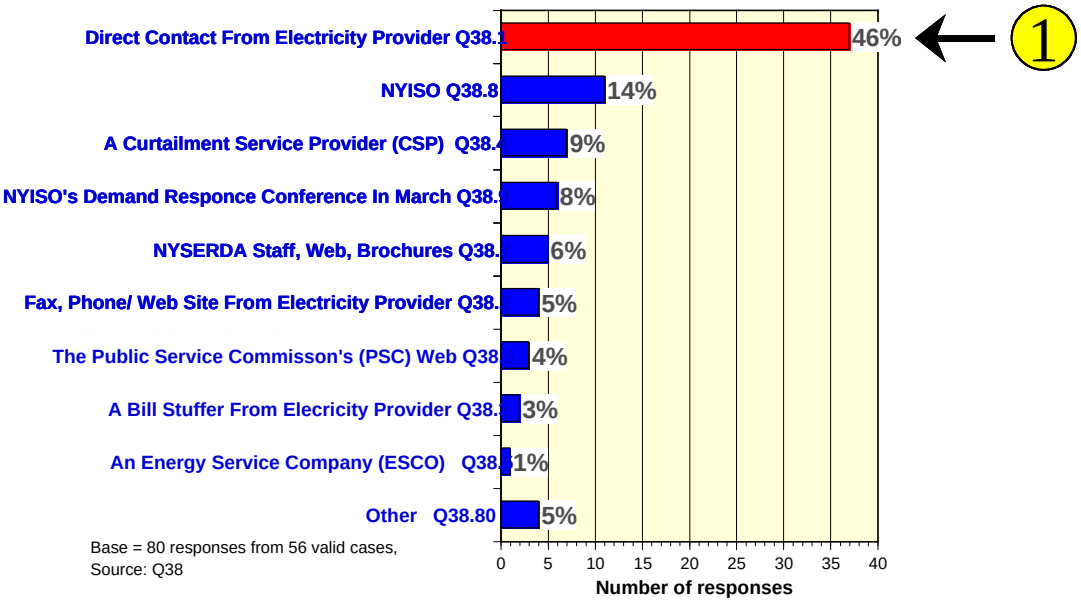
In order to provide a more detailed recommendation for program alterations that will dramatically affect program participation, a more rigorous assessment of customer preferences for alternative program options must be performed in this year's PRL program evaluation. First, a clearer and more precise definition of the penalty rate is required to derive more accurate results since the current data analysis is based on our interpretation of how customers understood the penalty rates in the survey. The conjoint survey can be revised to more accurately portray the role of the penalty in the DADRP participation decision process and the decision to comply, once a curtailment is scheduled. Second, the range and nature of penalty rates employed in the conjoint survey needs to be expanded to accommodate the range of market price outcomes and new alternative designs, like those introduced above. In addition, an analytical technique that does not confine the explanation of marginal benefits to an odds ratio should be reviewed. Third, the sample frame needs to be expanded to provide for more robust modeling capability. Last summer's survey was limited to a few sub-populations.

However, changing the non-compliance penalty and other program features without responding to other factors that limited DADRP participation will still result in rates of participation below what is attainable. Last summer's program evaluation pointed out that customers expressed a relatively low understanding of DADRP program features in addition to the penalty. The survey uncovered a profound lack of understanding of the demand response bidding process - a complaint subsequently raised by customers and customer representatives. In addition, the long time between when customers incur the costs of curtailment and when they are compensated was also cited as a major deterrent to participation, along with the requirement for one-megawatt bids. To achieve the full potential from DADRP curtailment bidding, these factors must also be addressed.

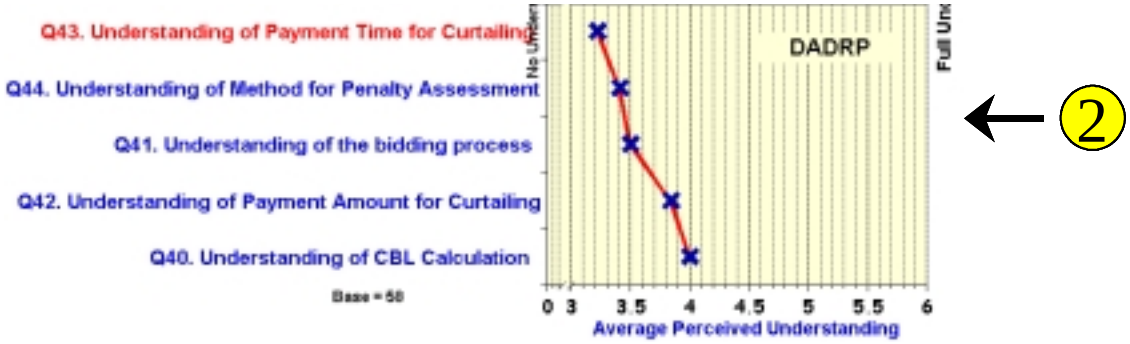
Appendix A
2001 PRL Evaluation Survey Summary Results

1. The **Penalty for Non-Compliance** was the single biggest stated deterrent to DADRP participation
2. The number of customers who **Definitely Would** join the program increased by 3% with the removal of a penalty.
3. 13% stated they **Probably Would** participate in DADRP this year if the penalty were removed, which represents a change of heart for many of the 49% of survey respondents who originally stated they would **Probably Not** participate in DADRP this year.
4. Those who expressed an intention to **Definitely Not** sign up for DADRP were staunchly against participating, regardless of this program feature change.
5. Removal of penalty clearly has a definitive impact on program participation rates.

Sources of Information About DADRP



Understanding of DADRP Program Features



1. Information on DADRP was received by a plurality of survey respondents via**Direct Contact from Electricity Providers**.
2. The provided educational information proved to be insufficient for potential Participants to fully understand the program, and therefore possibly limited participation rates.
3. Better-informed customers make better decisions!

This ignores any downstream penalties imposed by the LSE/CSP that sponsors the customer's participation.

[1] A risk-neutral philosophy is to use the average or expected value to reflect uncertain prospects. Risk aversion results in the individual using a more extreme value to represent outcomes, to protect against those possibilities the results of which are unacceptable. The more risk averse an individual, the more it tends toward evaluating the prospect against the tail of the distribution of outcomes. In this analysis, the most risk averse individual would assume a RTM price at the market cap of $1,000/MWH.

[2] The results are less reliable when feature values outside the range of those included in the conjoint survey are used.