



# ConOp

## Circuit Breaker

### CONCEPT OF OPERATIONS (ConOp)

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## Introduction

The circuit breaker will be an automated mitigation procedure for the proactive mitigation of energy suppliers who are about to exercise market power with a subsequent price impact. The NYISO currently cannot, except in extraordinary circumstances, mitigate prices retroactively and the current market monitoring procedures can only detect the exercise of market power after the fact. Therefore the current system permits the one-day exercise of market power with minimum consequence to the party exercising such power since such exercise can be detected only after the fact and prices cannot be mitigated retroactively. The circuit breaker will eliminate this opportunity.

The concept of a circuit breaker was discussed with numerous market participants (MP) at a series of meetings. In addition to the conclusions reached by the NYISO during those meetings, this document records many of the concerns, design criteria, and operational aspects voiced by MPs.

## Acknowledgement

Many people both inside and outside the NYISO devoted time and effort to define the circuit breaker, and its parameters, operational characteristics, applications, and limitations. The NYISO gratefully acknowledges the time, effort, and expense contributed by the participating MPs to the protection of the New York's energy markets. The diversity of the group and their insight to the mechanics of the New York energy markets mean that the circuit breaker will be better designed and will have a better chance of successful operation than it might otherwise have had.

## Definitions and Abbreviations

Term	Description
BME	Balancing market evaluation, an hourly re-evaluation of the energy market.
BID-SET	Bid price: the set of prices calculated before bids from eligible units have been replaced by their reference.
CB	Circuit breaker
DA	Day-ahead
ICAP	Installed capacity
LBMP	Locational based marginal price, the cost of energy at a specific location in the network.
LI	Long Island
MP	Market participant
MMP	Market Mitigation Plan
NYC	New York City
NYCA	New York Control Area
NYISO	New York Independent System Operator
REF-SET	Reference prices: the set of prices calculated after bids from eligible units have been replaced by their reference.
RT	Real-time

## **Background**

### **Generator Bid**

A generator may place a bid daily to provide energy and ancillary services in the day-ahead (DA) market, or hourly to provide energy and ancillary services in the real-time (RT) market. Except as noted below, the DA and RT bids may be different for each hour of the day and may contain start up and minimum generation costs. The hourly bids for the RT market of units that can be started in ten minutes or less must have a start up cost of zero.

Qualified generating units may also submit bids in both DA and RT markets for ancillary services. Ancillary services are regulation, 10-minute spinning reserve, 10-minute non-synchronous reserve, 30-minute spinning reserve, and 30-minute non-synchronous reserve.

### **Conduct and Impact Criteria**

Two criteria must be satisfied in order to mitigate a generator's energy bid price. These are the conduct and impact criteria. The conduct criterion compares a generator's energy bid with a reference price that has been established for energy from that generator. The conduct criterion is tripped if the generator's bid exceeds the established reference by a predefined amount.

The impact criterion considers the impact that a high energy bid, as detected with the conduct criterion, will have on energy prices. The impact criterion is tripped if the difference between the energy prices calculated based on the generator's bids and the prices calculated based on the generator's reference bids are larger than a predefined amount. The circuit breaker will not be applied to ancillary services, and the impact test will not be applied to the increment of capacity scheduled to provide ancillary services

### **Detailed Description**

The circuit breaker will automate the conduct test for energy, start-up cost, and minimum generation cost. The circuit breaker process is described in first section below while the following sections provide additional detail on each element of the circuit breaker process

### **Circuit Breaker Process**

The Circuit Breaker would apply to the day-ahead market as follows:

1. When bids are received, the bids are screened for economic and physical withholding per the conduct thresholds from the MMP. Bids exceeding the conduct thresholds, not including the exclusions listed below will be eligible to be mitigated under the circuit breaker ("Eligible Bids"). The following bids will not be subject to being replaced by the Circuit Breaker:
  - a) Bids from non-ICAP suppliers,
  - b) Bids from hydro facilities,
  - c) Bids from bidding organizations with Eligible Bids less than 50 MW,
  - d) Bids from resources selected to provide ancillary services in the first pass of SCUC will not be mitigated,
  - e) Bids that were justified in advance by the bidder. However, these bids will still be subject to the mitigation provisions of the MMP,
  - f) Start-up bids that reflect recovery of certain costs for units that run over midnight,
  - g) All external transactions.
2. Following the first pass of SCUC, including the implementation of the in-city mitigation, any location with an hourly price exceeding the CB threshold will be identified.

3. For each location identified in step 2, the Eligible Bids in the location will be reduced to the reference price for purposes of conducting an SCUC iteration that would determine the price impact of the Eligible Bids. Eligible Bids for energy would be replaced for only the hours when zonal price exceeds the CB threshold while Eligible Bids for start-up costs and minimum generation bids for the 24-hour period replaced.
4. The new iteration of SCUC with mitigated bids would produce a revised set of LBMPs for the day-ahead market. If the hourly price for any location falls by a pre-defined amount in the price impact iteration, then the circuit breaker is triggered and the mitigated iteration will carry forward through the rest of the SCUC process. That is, all Eligible Bids that were mitigated in the price impact iteration will remain mitigated.

### **Circuit Breaker Threshold**

The circuit breaker will be evaluated if the energy price in the DAM any zone for any hour exceeds a fixed dollar amount ( $CB_1$ ). The circuit breaker will not be invoked when energy prices remain at or below  $CB_1$ .

The value of  $CB_1$  is shown below:

<b>Constant</b>	<b>Value</b>
$CB_1$	\$150.00

### **Conduct Test for Economic Withholding of Energy**

The conduct test for energy price requires a current reference price (\$/MWH) for each generator. The current reference price need not be a single number but may be a curve indexed by instantaneous generation (MW). A generator will trip the conduct test for energy if its bid is:

- Greater than a fixed multiple ( $CTE_1$ ) above its current reference price, or
- Greater than a fixed amount ( $CTE_2$ ) above its current reference price.

The values of  $CTE_1$  and  $CTE_2$  are set in the market mitigation plan and currently have the values tabulated below.

<b>Constant</b>	<b>Value</b>
$CTE_1$	3.0 x Generator Reference Price (300%)
$CTE_2$	\$100.00

### **Default Reference**

Normally the reference price for a generator's energy is based on recently accepted bids for energy from that generator, as specified in the MMP.

### **Seasonal or Ambient Effects on Reference**

The reference price for generating units that operate on fossil fuel will take into account and be indexed by the spot-market price of the appropriate fuel. The effect of other ambient conditions will not be considered explicitly. Spot market prices will be tracked for:

- Natural gas
- Kerosene
- #2 fuel oil
- #6 fuel oil

A generating unit's reference price will be normalized to a constant fuel cost. Energy bids will always be on a current fuel cost basis. When the reference price is needed it will be adjusted to current fuel cost. The reference price, adjusted to current fuel cost, will be used in all comparisons and calculations. Thus price

comparisons such as bid price versus reference price will use only unadjusted bid prices and current reference prices.

### **Description of the Default Reference Price Calculation**

Per the MMP, the reference price is computed including accepted bids over the prior 90 days during comparable periods. The periods are grouped by peak (16 hour weekday period) and off-peak (nights and weekends/holidays).

Reference prices are computed for 10 MW output segments over the full output range of each unit. Hence, a 100 MW unit may have 10 separate reference prices. The reference prices are calculated as follows:

1. For each 10 MW output level, identify every hour during the relevant period (peak vs. off-peak) over the prior 90 days when the unit is scheduled at or above the given level. The bids for each of these hours are “accepted bids”.
2. For each output level, each hour’s bid identified in step 1 is then adjusted to account for the difference between that hour’s fuel price (hour n in the equation below) versus the current fuel price in the following manner:

$$\text{Adjusted Bid Price}_n = \text{Bid Price}_n * (0.9)(\text{fuel price}_{\text{today-1}}/\text{fuel price}_n) + \text{Bid Price}_n * 0.1$$

This adjustment effectively assumes that 90 percent of a resource’s bid is associated with fuel costs while 10 percent relate to other factors (e.g., environmental costs, O&M)

3. Once the adjusted bid prices are computed, the mean and the median of the accepted bids are computed for each 10 MW output level.

### **Fuel Price Data**

Fuel price data is chosen that most closely reflect fuel prices in New York. Currently, the sources for this data include:

Natural Gas: Bloomberg, Gas Daily (Transco Zone 6 price)  
Fuel Oil 2: Platts, Bloomberg, Petroleum Argus  
Fuel Oil 6: Platts, Bloomberg, Petroleum Argus  
Kerosene: Platts, Bloomberg, Petroleum Argus

All prices are daily prices and do not reflect the cost of intraday purchases. The prices from these source are averaged to produce a single daily price, ensuring that an anomalous price from one source will not have a large effect on the reference price adjustment. We have not identified a reliable source of daily coal price data. Generating units with other primary fuels are currently unadjusted.

Currently, we plan to use a fixed mapping of the primary fuel burned by each unit. We would be open to a mechanism for each generator to indicate which fuel it is burning, or a proportion for those burning more than one fuel type. This would address the fuel-switching capability of some units.

### **Other Adjustments to Reference Price Calculations.**

The NYISO recognizes that several factors beyond changes in fuel prices may impact operating costs thus warranting adjustments to fuel price calculations. Among these:

1. Environmental Costs (e.g. NOx Emissions Limits)
2. Seasonal Variations in Plant Operating Efficiencies
3. Situations where facilities powered by dual fuels cannot switch to the most economic fuel type.

The NYISO will review and give consideration to requests for reference price adjustments for the situations noted above, based upon a detailed review of engineering information furnished by the Generator owner, on a case-by-case basis.

The information must be furnished to the NYISO at a minimum of two (2) business days before they are to be included in the DAM Offers.

**Day-Ahead Impact Test for Energy Price**

The NYISO will directly estimate price impacts using an additional security constrained unit commitment (SCUC) pass during the day-ahead market evaluation. The process is illustrated in Figure 1 and compares prices (BID-SET) calculated using generator bids with prices (REF-SET) calculated using a second, temporary set of bids. A generator’s reference prices are used for select hours in the second set for any generator that triggers the conduct test. Prices in REF-SET should be lower than those in BID-SET. If they are significantly lower the impact test will have triggered and bids for generators that have triggered the conduct test will be mitigated. BID-SET and REF-SET each has prices for each hour of the day.

The impact test for energy will trip if the LBMP from BID-SET is:

- Greater than a fixed multiple ( $ITE_1$ ) above the LBMP from REF-SET at the same zonal location for any hour of the day, or
- Greater than a fixed amount ( $ITE_2$ ) above the LBMP from REF-SET at the same zonal location for any hour of the day.

The values of  $ITE_1$  and  $ITE_2$  are set in the market mitigation plan and currently have the values tabulated below:

Constant	Value
$ITE_1$	2.0 x Zonal Day-Ahead LBMP (200%)
$ITE_2$	\$100.00

Other alternatives were proposed to serve as impact criteria that would trigger the circuit breaker, including an excess capacity test and a market share test. These are inferior to direct calculation of the price effect associated with the economic withholding.

**Mitigation of Start-up and Minimum Generation Costs**

If the impact test for energy prices is satisfied, start-up costs and minimum generation costs will be evaluated against reference values and mitigated if the screening criteria a satisfied.

**Conduct Test for Start-up Cost**

The conduct test for start-up cost requires a reference cost (\$) for each generator. The reference cost is a single number. A generator will trip the conduct test for start-up cost if its bid is:

- Greater than a fixed multiple ( $CTSU_1$ ) above its reference start-up cost, or
- Greater than a fixed amount ( $CTSU_2$ ) above its reference start-up cost.

The values of  $CTSU_1$  and  $CTSU_2$  are set in the market mitigation plan and currently have the values tabulated below.

Constant	Value
$CTSU_1$	2.0 x Reference Value (200%)

**Default Reference for Start-up Costs**

Normally the reference price for a generator’s start-up cost is based on recently accepted bids from that generator. In the event that such data are unavailable a default reference cost for start-up is established either (1) by negotiation with the generator, or (2) by an estimate of cost.



### **Conduct Test for Minimum Generation Cost**

The conduct test for minimum generation cost requires a reference cost (\$) for each generator. The reference cost is a single number. A generator will trip the conduct test for minimum generation cost if its bid is:

- Greater than a fixed multiple (CTMG<sub>1</sub>) above its reference minimum generation cost, or
- Greater than a fixed amount (CTMG<sub>2</sub>) above its reference minimum generation cost.

The values of CTMG<sub>1</sub> and CTMG<sub>2</sub> are set in the market mitigation plan and currently have the values tabulated below.

<b>Constant</b>	<b>Value</b>
CTMG <sub>1</sub>	3.0 x Reference Value (300%)
CTMG <sub>2</sub>	\$100.00

### **Default Reference**

Normally the reference price for a generator's minimum generation cost is based on recently accepted bids from that generator. In the event that such data are unavailable a default reference cost for minimum generation is established as specified in the MMP.

## SCUC Process

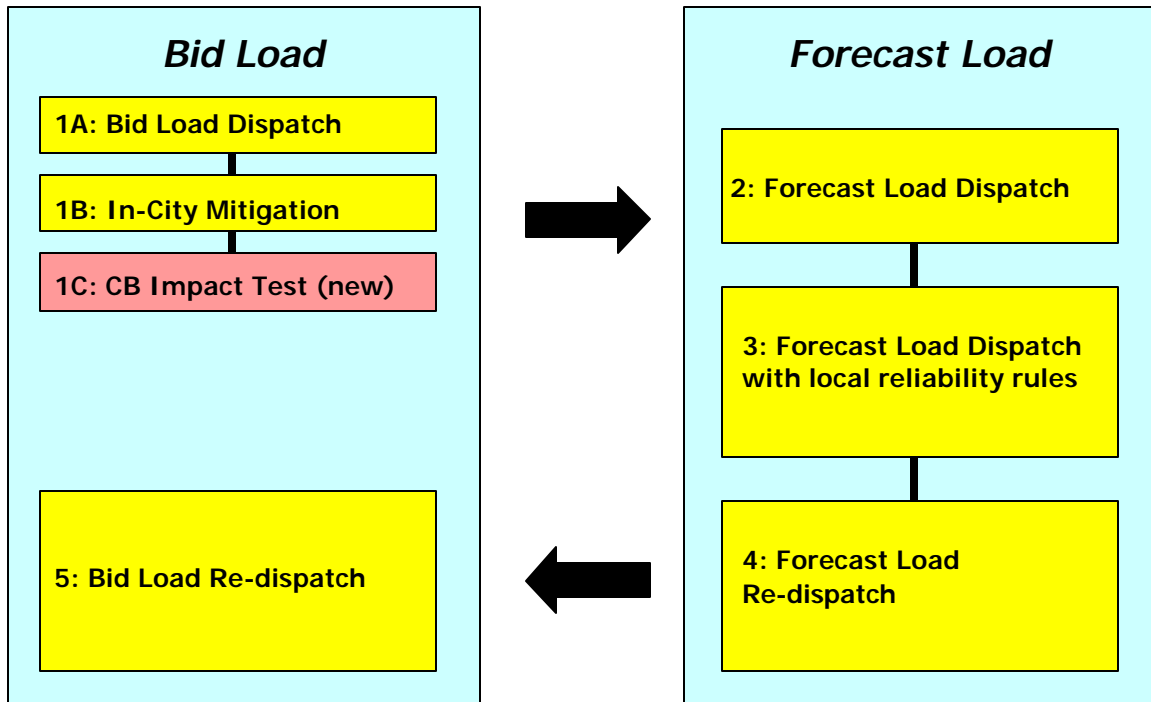


Figure 1. SCUC Process

### Pass #1A and #1B – Bid Load Commitment

The first pass (1A) of SCUC solves for supplying the Bid Load and securing against the normal NYISO bulk power system contingency and monitored facilities. Once this commitment run has converged, the market power mitigation evaluation (1B) is performed for the In-City mitigation, including a recommitment/redispach. This commitment/dispatch is evaluated by security analysis. Additional iterations of unit commitment (with In-City mitigation) and security analysis are performed until convergence is again achieved. An unmitigated solution (BID-SET) is produced at the completion of pass 1A and 1B.

### Pass #1C – Circuit Breaker Impact

Pass #1C incorporates the circuit breaker impact test. Unit commitment and dispatch calculations are performed to meet bid load using reference bids for units in high priced locations that triggered the conduct test. The resulting schedules and energy costs are saved as REF-SET. The circuit breaker compares energy costs in REF-SET with those in BID-SET (pass #1B) to see if the impact test is triggered.

### Pass #2 – Bulk Power System Forecast Load Commitment

The next pass solves for supplying the forecast load. At the beginning of this pass, generator limits and commitment statuses are modified to ensure that the units selected in the bid load pass will not be decommitted or dispatched below their pass #1 value. Units selected in the bid load pass can be dispatched higher, and additional units can be committed and dispatched. This pass evaluates for capacity, and therefore uses incremental uplift costs and does not use energy costs. This second commitment supplies the forecast load and secures against the bulk power system contingencies and monitored facilities.

### Pass #3 – Local Reliability Rules Forecast Load Commitment

The final commitment is performed in this pass as an extension of the pass #2. The program secures for the Local Reliability Rules contingency and monitored facilities.

#### **Pass #4 – Forecast Load Redispatch**

In pass #4, the set of generators from the final commitment is dispatched using the original energy bids. The dispatch supplies the forecast load and is limited by the bulk power system constraint set produced in the pass #2 commitment. The unit capacities (energy + 30 minute reserve + regulation) from this dispatch are used to calculate the forecast reserve for economic dispatch. The power flows are created for the transmission providers' review and the interface transfer flows to be evaluated in the non-firm transaction selector.

#### **Pass #5 – Bid Load Redispatch:**

In this pass, the final dispatch is to supply the bid load and is limited by the bid constraint set produced in the pass #1 commitment. The quick start units selected in either of the forecast runs will not be dispatched. After this dispatch, the market power mitigation process is run to evaluate reserve price caps.

#### **Day-Ahead Mitigation**

Selection of Eligible Bids for the day-ahead energy price impact test will be done on a locational basis recognizing the bottlenecks in the New York bulk transmission system. Figure 2 illustrates the locations.

They are also defined in the following table:

<b>Location</b>	<b>NYCA Zones</b>
EAST	F, G, H, I, J, K
HV (Hudson Valley)	F, G, H, I
LI (Long Island)	K
NYC (New York City)	J
NYCA	A, B, C, D, E, F, G, H, I, J, K
WEST	A, B, C, D, E

Bids exceeding the conduct threshold for energy price will be candidates for mitigation if the zonal price at that location exceeds the CB threshold. Eligible Bids will be replaced by their references on a locational basis as described in the steps below. The new set of bids is used by SCUC pass #1C to calculate REF-SET. The procedure follows:

1. For any hour when the zonal LBMP from BID-SET is above the CB threshold for any zone in WEST all Eligible Bids in NYCA will be replaced by their respective references.
2. For any hour when the zonal LBMP from BID-SET is above the CB threshold for any zone in HV all Eligible Bids in EAST will be replaced by their respective references.
3. For any hour when the zonal LBMP from BID-SET is above the CB threshold in both NYC and LI all Eligible Bids in NYC and LI will be replaced by their respective references.
4. For any hour when the zonal LBMP from BID-SET is above the CB threshold in NYC but not LI all Eligible Bids in NYC will be replaced by their respective references.
5. For any hour when the zonal LBMP from BID-SET is above the CB threshold in LI but not NYC all Eligible Bids in LI will be replaced by their respective references.
6. Otherwise, no bids are replaced by their references and SCUC pass #1C is bypassed.

If any bid is replaced by its reference, the resulting set of bids is used as input to pass #1C of the SCUC process. That set of bids will be retained for all subsequent SCUC passes if the difference in LBMP between BID-SET and REF-SET exceeds the impact threshold in the any NYCA zone. Otherwise the original bids will be used for all subsequent SCUC passes.

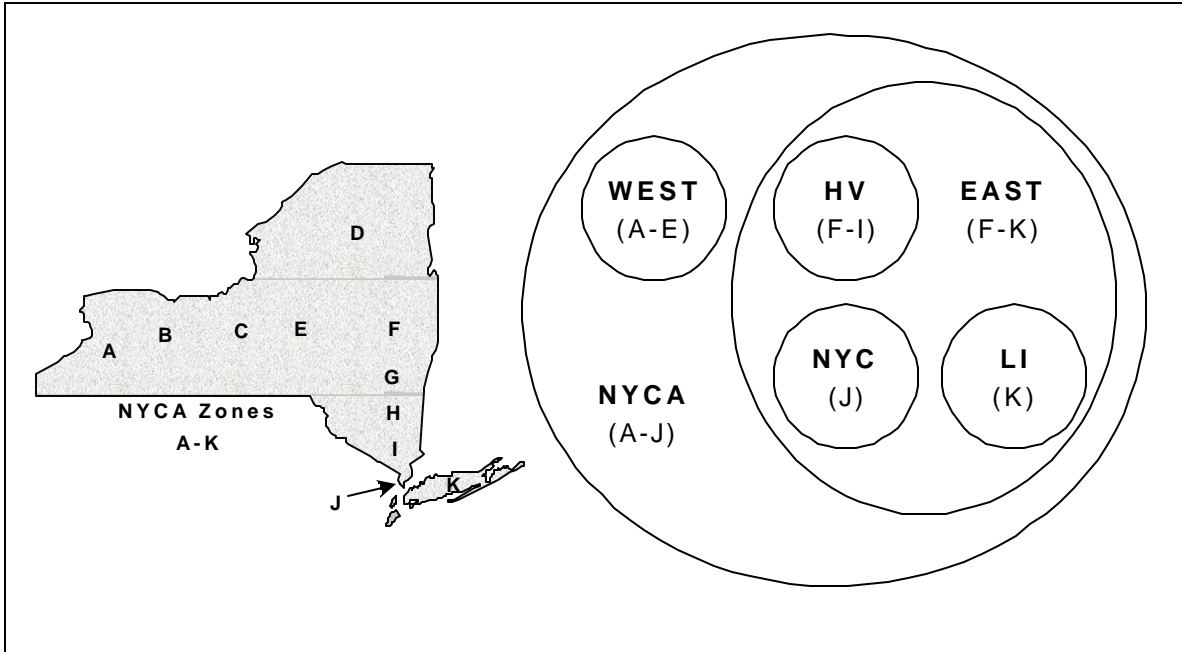


Figure 2. Locations

## Preliminary Software Impact Identification

### MMU

- Maintain fuel cost index
- Maintain reference prices

### MIS

- Prepare a set of generator reference bids for use in SCUC.
- Notify MPs when their bids have been mitigated.

### SCUC

- Replace bids with reference bids for Eligible Units after pass #1A and #1B
- Adjust reference bids of units selected after pass #1A and #1B to supply reserve
- Implement pass #1C, the check for energy price impact

## Appendix A: MP Concerns

Market participants voiced a number of concerns or questions regarding various aspects of the circuit breaker. Many of the issues had no clear consensus among MPs. Indeed, with some of the issues one group of MPs took a position opposite that of other MPs. In resolving the issues the NYISO tried to achieve a CB that was workable, certain, understandable, and fair. Resolutions of the MP concerns are documented in the following sections.

### **(1) Will the CB apply to non-ICAP suppliers?**

The CB will only apply to ICAP energy suppliers within the NYCA.

### **(2) Will reference prices reflect seasonal or ambient influences?**

Reference price for energy from a generating unit will be automatically adjusted to reflect spot market price of fuel. There will be no other automatic adjustments of reference price. Manual adjustment of the reference for other specific issues will be done by the NYISO after notification and explanation of the issue.

### **(3) Should Bid in Load or Forecast load be used?**

Bid load will be used to determine impact of the generator energy bids that trigger the conduct test and whose bids are replaced with their reference.

### **(4) How will Imports/Exports be treated?**

Imports and exports will be explicitly modeled when evaluating “impact” with the security-constrained unit commitment software.

### **(5) Should ancillary prices be mitigated?**

Ancillary prices will not be automatically mitigated, at least in the initial implementation of the circuit breaker. The exercise of market power will still be subject to current mitigation measures.

### **(6) Will the circuit breaker be applied to start-up and minimum-generation costs?**

Yes, the circuit breaker will be applied to start-up and minimum generation costs, when the price impact threshold for energy is tripped.

### **(7) What will be the threshold levels for applying mitigation?**

Threshold levels for automatically applying mitigation with the circuit breaker will be the same as are used with the current system of manual mitigation. The question of changing threshold levels is independent of circuit breaker implementation. Whatever threshold levels are defined for manual mitigation measures will also be used for automatic mitigation with the circuit breaker.

### **(8) Should there be reference price adjustments?**

See issue (2) above.

### **(9) Should there be retroactive compensation of generators through uplift if a generator establishes that the mitigated price caused it to incur and operating loss?**

Yes.

### **(10) Should CB mitigation be applied in BME and Real-Time?**

Initially the CB will not be applied in the hour-ahead market evaluation. The CB will be considered for hourly implementation after its day-ahead operation has been verified. In the mean time, hourly bids for the real-time market may still be mitigated, as they are today, when abuse of market power is detected.

**(11) Will thresholds cause incentive for generators to raise prices?**

Automatic application of the thresholds that are currently applied manually will cause no change in the incentives generators have to raise prices. This issue seems irrelevant to circuit breakers.

**(12) How should price sensitive load be treated?**

Price-sensitive load will be explicitly modeled when evaluating “impact” with the security-constrained unit commitment software.

**(13) How should a reference price for plants without history be calculated?**

Where no reference price exists, a reference price will be determined (1) by negotiation, or failing that (2) by the NYISO’s estimate of the unit’s costs.

**(14) Should the circuit breaker be applied to New York City and Long Island?**

The current market power mitigation within New York City (NYC) will continue and will precede evaluation of the circuit breaker. The circuit breaker will be evaluated in a manner that recognizes the major bottlenecks within the NYCA. The following regions will be analyzed in applying the circuit breaker: NYC, Long Island, East above NYC, and West.

**(15) Should the mitigation be applied before or during SCUC?**

This is an implementation issue. Most likely the day-ahead operation of the circuit breaker will be done in two parts: (1) the “conduct” test will be done before SCUC, and (2) the “impact” test will be done during SCUC by implementing an additional pass.

**(16) Should mitigation be applied for the hour or for the day?**

Day-ahead energy bids will be mitigated only for hours when price is above the CB threshold. Start-up and minimum load bids will be mitigated for the entire day.

**(17) How should the economic withholding level be established?**

The circuit breaker will be implemented using an additional pass within SCUC, so determining the level of economic withholding will not be necessary.

**(18) Possible impacts on power flows?**

The application of the circuit breaker will not cause anomalous power flows in the day-ahead market. This issue is irrelevant to circuit breakers.

**(19) Should the \$1,000 bid cap be retained?**

Yes, at least until effective operation of the circuit breaker has been verified.

**(20) Should the circuit breaker examine the ability of groups to exercise market power?**

The additional SCUC pass to evaluate the “impact” test will determine impact considering the bids of all market participants. Thus the circuit breaker will indeed examine the ability of groups of market participants to exercise market power.

**(21) What will redress procedures be?**

Retroactive adjustments, see (9) above, will be handled through the NYSE’s normal dispute resolution process. Proactive adjustments, see (2) above, will be made by contacting the NYISO.