A536: Real-Time Scheduling

Automated Mitigation Process (RT-AMP)

CONCEPT OF OPERATION (COO)

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Document Locator:
A536_coo_rtamp.doc

Revision History:	
Date:	**Additions, deletions, modifications:**
4/22/2002	Draft #1
5/31/2002	Draft #2

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1 INTRODUCTION

1.1 Goal Statement

Software and procedures are to be developed by ISO staff to automate the real-time detection and mitigation of the exercise of market power.

1.2 Definitions, Acronyms, and Abbreviations

Term	Description
Base-Set	Initial set of bids being evaluated by RTC, RTD, or the Ex-Post Pricing process. The Base-Set may include previously mitigated bids as well as unmitigated bids.
RT-AMP	Real-time automated mitigation process to be implemented as part of the RTS
RTC	Real-time commitment
RTD	Real-time dispatch
RTS	Real-time scheduling (composed of RTC, RTD, and RT-AMP)
Mit-Set	Set of bids after mitigation is finalized. Mit-Set may contain more mitigated bids than Base-Set and fewer mitigated bids than Ref-Set..
Plan	Market monitoring plan
Ref-Set	Intermediate set of bids after mitigation is applied to all bids tripping the conduct test (subject to super-zone telescoping).

1.3 Background

The real-time scheduling process consists of a real-time commitment (RTC) process that runs at 15-minute intervals and a real-time dispatch (RTD) process that runs at 5-minute intervals. Bids from energy suppliers of incremental energy cost and minimum generation level and cost may be updated hourly. This document presents, for discussion purposes only, alternative methods of implementing an automated mitigation procedure. Before an automation option can be selected it must be verified that the automation can be accomplished within the timing constraints of the real time scheduling process. The following options are described:

- Conduct with full impact test every 15 minutes as part of each the RTC run. Mitigated bids would be applied immediately.
- Conduct with abbreviated impact test every 15 minutes as part of each RTC run. Mitigated bids would be applied immediately.
- Conduct with impact test every 5 minutes as part of the ex-post pricing process that follows each RTD run.
- Conduct with full impact test every 15 minutes as a separate parallel process that follows each RTC run. Mitigated bids would be applied to an RTC one or two cycles in the future.

1.4 Business Need

The Market Monitoring and Performance unit has the responsibility to quickly and accurately detect and mitigate the exercise of market power. Automation of tests and screens, consistent with the plan, is the most viable means of accomplishing this responsibility.

1.5 System Impact

The following systems would be impacted:

- Real-time dispatching process
- Real-time commitment process
- Market information system

2 DESCRIPTION

Several alternatives have been identified for an automated real-time mitigation process. The major differences among the options are in determining the impact of economic withholding. Simply, the "impact test" hypothesizes prices and schedules that would happen if there were no economic withholding. The "impact test" determines whether changes to prices are significant. Impact tests of the various options range from a simple check in the ex-post pricing module, to redispatch without recommitment, to a full recommitment with dispatch. There are drastic differences in the computing resources needed to support the various options. Hence all options are all under consideration at this time.

There are many rules, parameters, limits, and thresholds that have to be clearly defined before any automated mitigation process is put in place. It is not the purpose of this document to decide on those rules, parameters, limits, and thresholds. Rather, this document identifies the range of possibilities and considerations preliminary to those decisions.

2.1 Trigger

The "trigger" serves two purposes: (i) to activate automated mitigation only in situations where there is likely to be an impact; and (ii) to identify load pockets or constrained facilities that may require special treatment. In situations where an impact is unlikely, the first of these purposes:

- Allows the ISO to better use the resources that would otherwise be needed to monitor or execute the automated process;
- Minimizes the possibility of delays in the posting of results that might be caused by the automated process;
- Minimizes the possibility of improper mitigation by relegating questionable situations to possible manual investigation.

The pre-processing step mentioned above can consider the effect of constrained facilities in developing the locational extent of mitigation, referred to as "telescoping." It can also determine special thresholds that may be invoked because of transient market concentrations caused by those constrained facilities.

2.1.1 Telescoping

The NYCA has previously been divided into nesting locations for automated mitigation. These have previously been called "super-zones" but that terminology seems inappropriate if extended to load pockets with one zone. Shown in Figure 1 is a telescoping set of locations combining those of the current DA AMP and the current real-time, in-city load-pocket mitigation process.

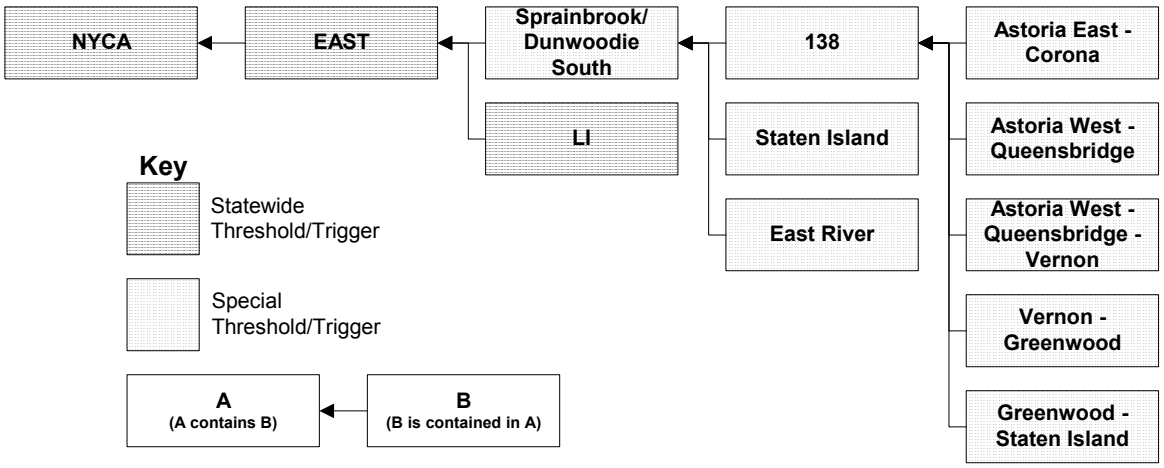

Figure 1. Nesting of Mitigation Zones

A new RT-AMP provides the possibility of extending the concept of "load pocket" to individual constrained facilities (line, cable, transformer, etc.). The set of resources that are able to relieve the facility can be identified in real-time. Hence the "load pocket" and "telescoping" concepts could become dynamic. The idea of "load pocket" would be replaced by a constrained facility. The set generating resources within the load pocket would be replaced with a set of resources that could relieve the constrained facility. The telescoping behavior of these sets of generating resources has yet to be defined; but if used, would change throughout the day and must be determined as part of a pre-processing step.

2.1.2 Thresholds

Statewide thresholds are defined for conduct test and impact tests. In addition, special thresholds are used in situations of recognized market concentration. Thresholds may have to be determined dynamically to accommodate dynamic telescoping and must be determined as part of a pre-processing step.

2.1.3 Exclusions

The day-ahead AMP exempts small amount of economic withholding from automated mitigation. These small amounts have been called the "portfolio exclusion." The concept of "portfolio exclusion" in real-time must be explored. Perhaps, like thresholds, the excluded amount can be tied to market concentration.

2.2 Conduct

The conduct tests compare bids of suppliers for start-up, minimum generation, and incremental energy with references. Differences are compared to thresholds to determine whether conduct suggests the economic withholding of resources or the attempt to exercise market power. A subsequent impact test, see below, tests the market power hypothesis. Conduct tests are established in the Market Monitoring Plan and are not expected to change, other than to define how special thresholds may be applied to sets of generating resources associated with constrained facilities.

2.3 Impact

The sections below describe various methods of estimating energy prices with a hypothetical (mitigated) set of bids, the first step in verifying impact. RTC simulates a rolling 2½-hour interval every 15 minutes. The meaning of "impact" must be defined in the context of multiple intervals. Possibilities range from examining any single interval, to examining multiple intervals, to examining some average of multiple intervals. Once defined in the context of multiple intervals, any of the processes described below could be used to implement an "impact test."

2.3.1 Impact Test in RTC

Placing the full impact test in each RTC cycle mimics operation of the day-ahead AMP procedure. The process, illustrated in Figure 2 and Figure 3, involves running three unit commitment evaluations each RTC cycle.

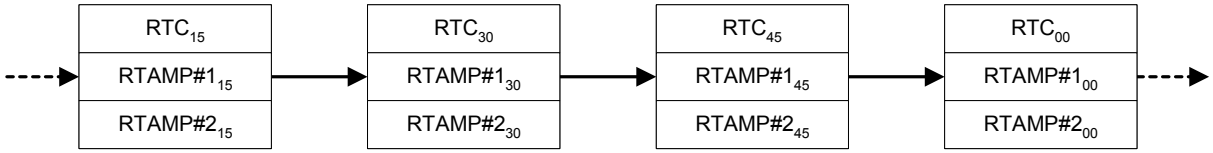

Figure 2. Impact Test in RTC

The automated mitigation would be consistent with the Plan. Automated mitigation would:

- Determine the optimal unit commitment with an initial (Base-Set) of bids; and calculate resulting prices
- Determine the optimal unit commitment with portions of bids tripping the conduct test replaced by reference, consistent with super-zone telescoping, (Ref-Set); and calculate resulting prices.
- Test impact by comparing the two sets of prices
- Determine the final set of mitigated bids (Mit-Set). Those tripping both conduct and impact tests will be mitigated; others will be unmitigated
- Determine the optimal unit commitment using the final set of mitigated bids

Each unit commitment evaluation is a time consuming process and there may not (most probably will not) be enough time in each RTC cycle for the two unit commitment evaluations needed to support the impact test.

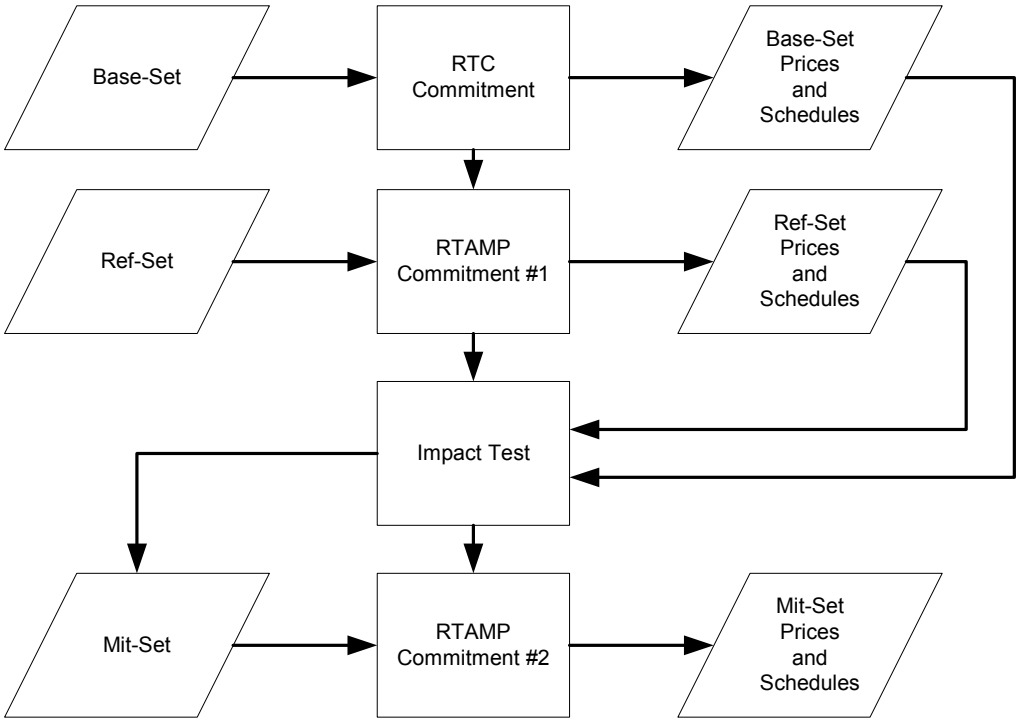

Figure 3. Detail of Impact Test in RTC

2.3.2 Partial Impact Test in RTC

The partial impact test in each RTC cycle mimics operation of the initial day-ahead AMP procedure with an additional dispatch to avoid the limited ability to accommodate spatial and temporal impacts inherent in this design. The partial impact test might result in a sub-optimal commitment however. That is, there is no assurance that the commitment is consistent with the final set of mitigated prices. The process, illustrated in Figure 4 and Figure 5, involves running two unit commitment evaluations each RTC cycle followed by a dispatch.

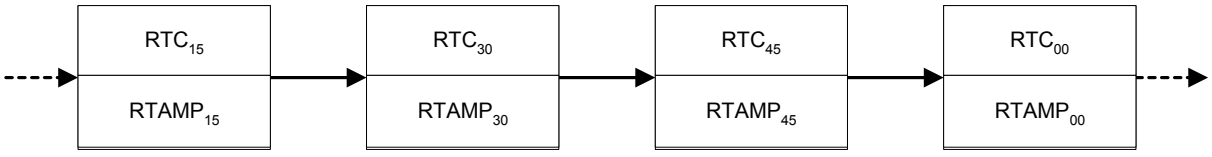

Figure 4. Partial Impact Test in RTC

The automated mitigation would be fully consistent with the Plan except that the unit commitment might not be optimal. Automated mitigation would:

- Determine the optimal unit commitment with an initial (Base-Set) of bids; and calculate resulting prices
- Determine the optimal unit commitment with portions of bids tripping the conduct test replaced by reference, consistent with super-zone telescoping, (Ref-Set); and calculate resulting prices.

- Test impact by comparing the two sets of prices produced above
- Determine the final set of mitigated bids (Mit-Set). Those tripping both conduct and impact tests will be mitigated; others will be unmitigated
- Re-dispatch the system with the final set of mitigated bids.

Each unit commitment evaluation is a time consuming process and there may not (most probably will not) be enough time in each RTC cycle for the additional unit commitment evaluation needed to support the impact test.

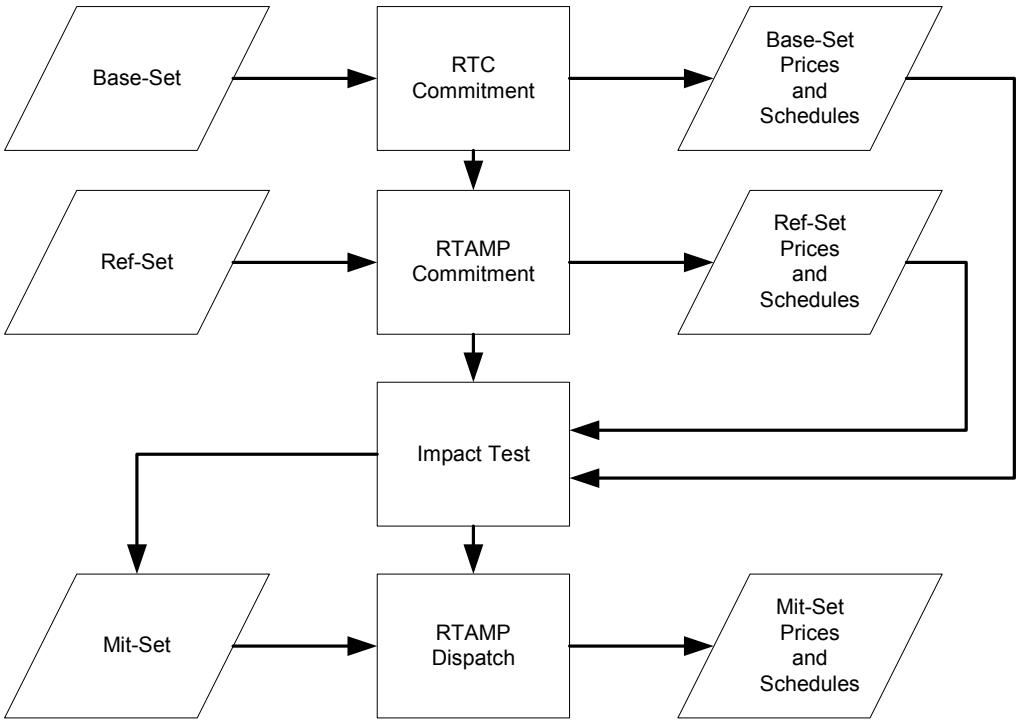

Figure 5. Detail of Partial Impact Test in RTC

2.3.3 Impact Test in Ex-Post Pricing

An impact test can be implemented in the ex-post pricing process as shown in Figure 6. Such a test would apply only to units that have already been committed and could not detect the use of economic withholding to avoid commitment. The impact test would be conducted each RTD cycle (every 5 minutes) by computing prices in two ways:

- Calculate prices with original bids
- Calculate prices with mitigated bids for units failing the conduct test

The impact test would then compare the two sets of prices and, if significantly different (using thresholds from the plan), would apply mitigation. As with the other mitigation options, the impact test is dependent on both location and congestion patterns.

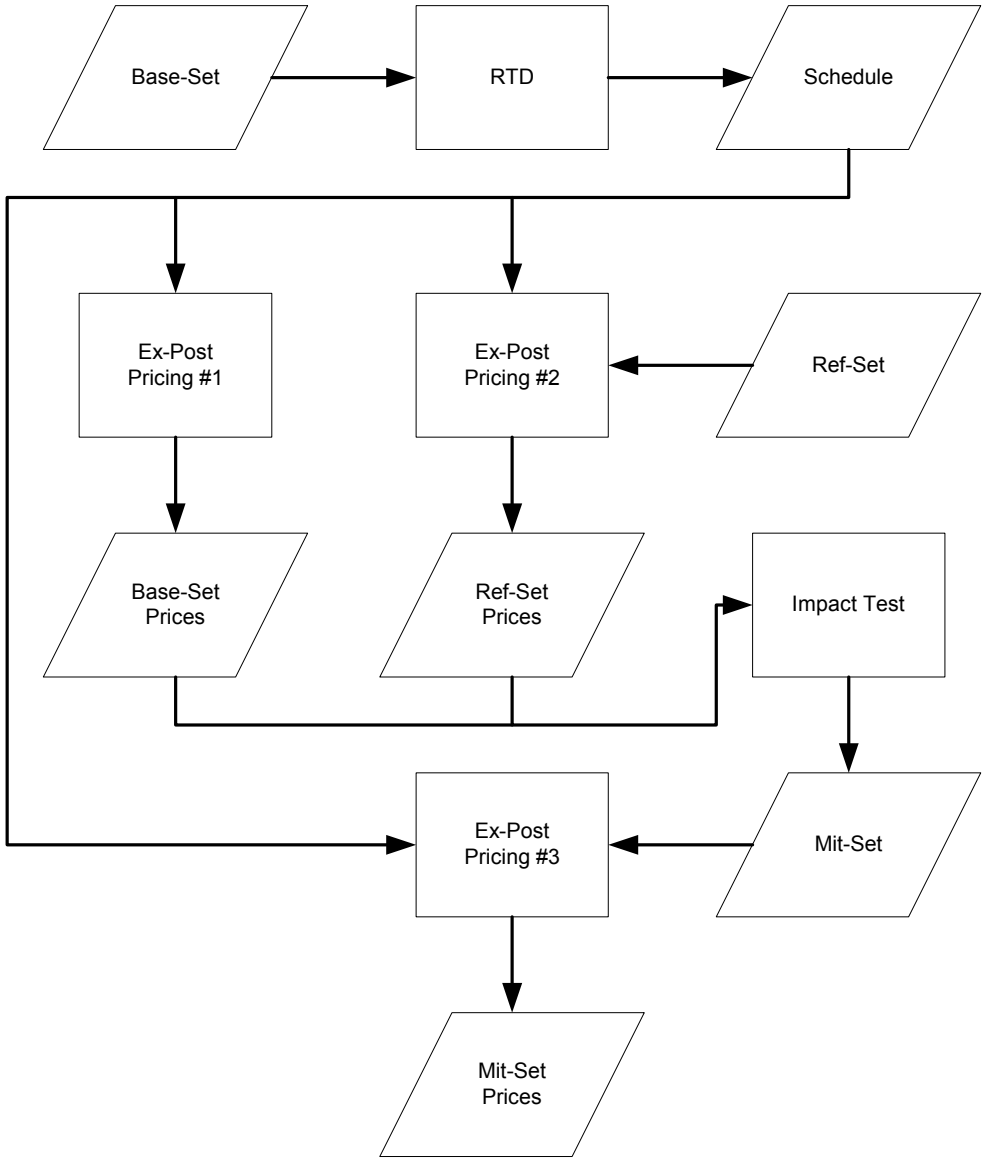

Figure 6. Impact Test in RTD

Mitigated bids would immediately feed back into RTD as well as into future ex-post price calculations. Mitigated bids would feed back into RTC as soon as possible. Units that are not mitigated and that follow dispatch instructions will continue to be eligible to set prices. If the price was set in RTD by a unit that should have been mitigated the resulting ex-post price may or may not be set by the same unit depending on what other units are mitigated and what other units were eligible to set the price. Mitigation applies to the end of the hour spanned by the minimum run time or the current hour if the unit is out of its minimum run time.

2.3.4 Parallel Impact Test

The execution time of three unit commitments is likely longer than the RTC interval (15 minutes) so the impact test most likely cannot be run as a part of each RTC interval. The impact test can however be executed as a separate process parallel to RTC as shown in Figure 7. The advantage is that a full RTC cycle (15 minutes) can be used to evaluate impact; hence timing concerns are minimized. When done in parallel, the possibility of mitigation would be

tested for the next RTC cycle (15 minutes) in the future. RTC_{15} and $RTAMP_{15}$ would perform unit commitment evaluations simultaneously. RTAMP15 would then evaluate impact and, if mitigation were necessary, provide mitigated bids for RTC_{30}. Mitigation of bids for RTC_{15} would have been decided by $RTAMP_{00}$.

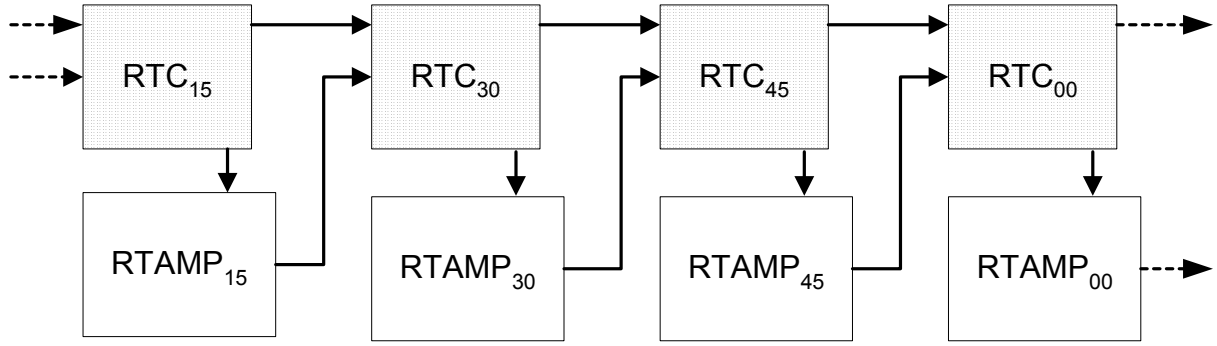

Figure 7. Parallel Impact Test

As noted above, the full impact test requires three unit commitment executions. When the test is conducted in parallel, only one, instead of two, additional unit commitments are required in each RTC cycle. As shown in Figure 8, for the time period 15 to 30, Base-Set and Mit-Set are identical. RTC_{15} provides the base case unit commitment. Simultaneously $RTAMP_{15}$ calculates the reference unit commitment, conducts the impact test, and determines the actual set of resources whose bids are to be mitigated (Mit-Set). Finally, RTC_{30} ensures that the commitment is consistent with the set of mitigated bids. Subsequently Mit-Set is used as the Base-Set and RTC_{30} would provide the base case for $RTAMP_{30}$ and so on.

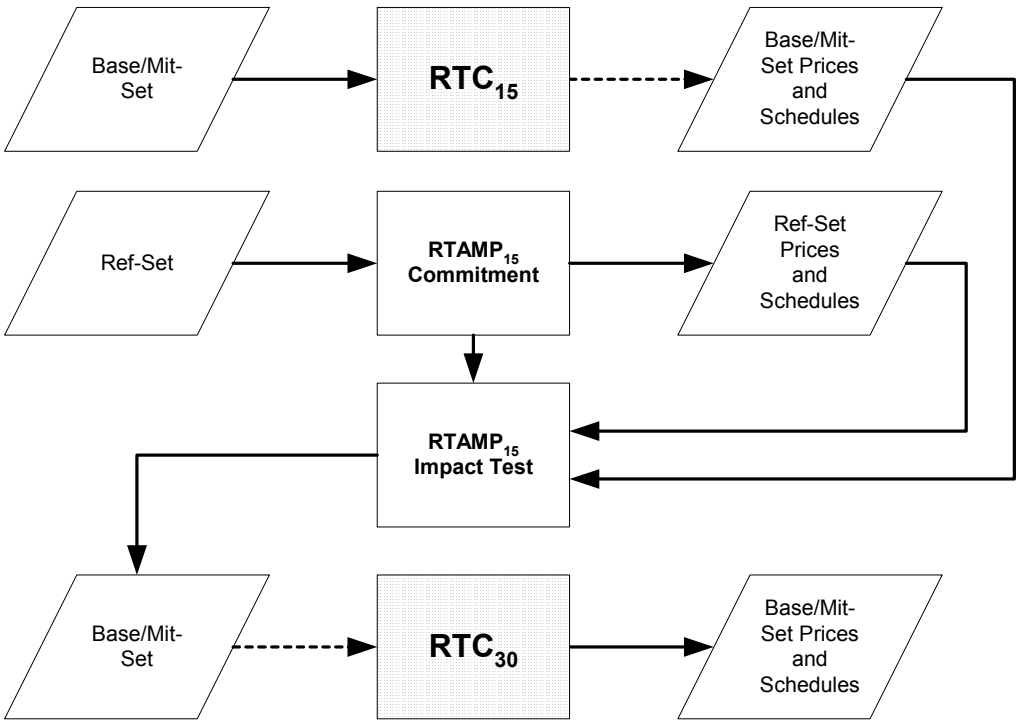

Figure 8. Parallel Impact Test 15 to 30 Minutes

The parallel impact test requires an additional processor with which to perform the test. However, it makes use of the full impact test possible as part of the commitment process.

2.4 Duration

Being able to detect when mitigation should be lifted is as important as being able to detect when mitigation should be imposed. Several strategies can be used. Possibilities are:

- Let mitigation “time-out”
- Remove mitigation when associated facilities become unconstrained.
- Other

This serves a place holder for an important decision that must be made prior to implementing a RT-AMP.