

Constraint Equations:

- a.  $Gen_g + Reserve \leq GenerationMaximum_g$
- b.  $Gen_g + \sum Reserve_{10} \leq Gen_g^{start} + ReserveMaximum10_g$
- c.  $Gen_g + \sum Reserve_{10+30} \leq Gen_g^{start} + ReserveMaximum30_g$

**Example:**

Generator Starting Output = 200MW

Generation Maximum = 500MW

Ramp Rate Energy = 5MW/min

Ramp Rate OR = 5MW/min

Assume constraint equation a. is non-binding

10M OR is limited to 50MW (5MW/min x 10 minutes)

Total OR is limited to 150MW (5MW/min x 30 minutes)

1. RTU (with no modification):

**This example shows some feasible schedules in the RTU sequence when there is the 3x ramp rate and unmodified constraint equations.**

**All three limits must be met for a feasible schedule**

- Energy ramped is limited to 75MW (5MW/min x 5 minutes x 3x ramp rate)
- b. Energy ramped + 10-minute OR is limited to 50MW (5MW/min x 10 minutes)
- c. Energy ramped + total OR is limited to 150MW (5MW/min x 30 minutes)

Some Feasible Schedules:

E: 200, 10M: 50, 30M: 100

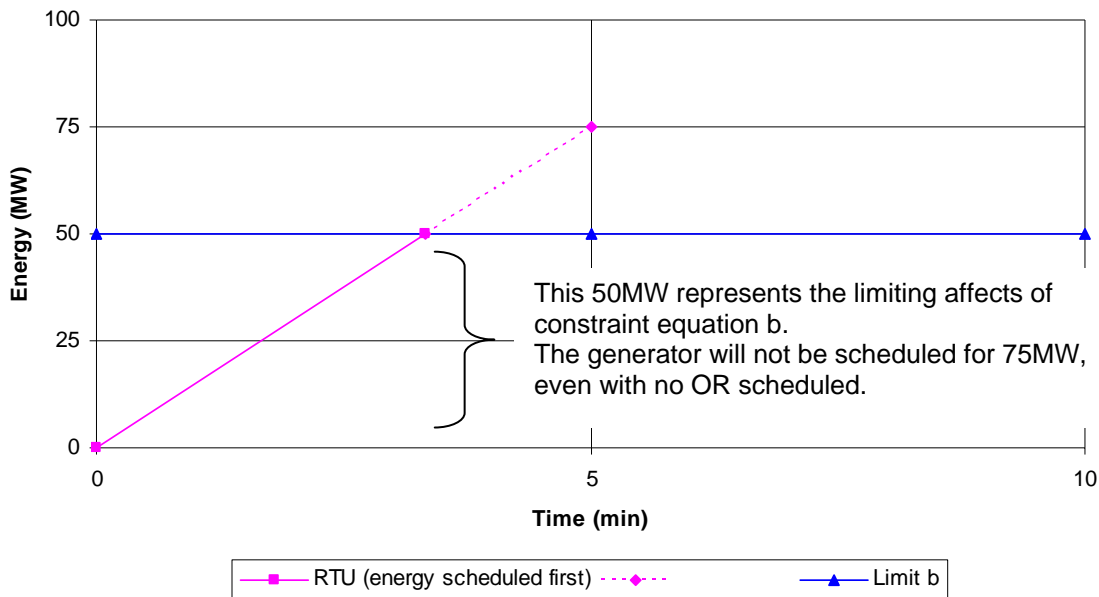
E: 200, 10M: 0, 30M: 150

E: 200, 10M: 25, 30M: 125

E: 250, 10M: 0, 30M: 100

**NOTE: E: 275, 10M: 0, 30M: 0 IS NOT A FEASIBLE SCHEDULE (because of limit b).  
The OR limits are restricting the amount of energy scheduled.**

### RTU with No Modifications



### 2. RTU (with modification):

**This example shows some feasible schedules in the RTU sequence when there is the 3x ramp rate and modified constraint equations.**

#### All three limits must be met for a feasible schedule

- Energy ramped is limited to 75MW (5MW/min x 5 minutes x 3x ramp rate)
- b. Energy ramped + 10-minute OR is limited to 5,000MW (5MW/min x 10 minutes) \* 100
- c. Energy ramped + total OR is limited to 15,000MW (5MW/min x 30 minutes) \* 100

Some Feasible Schedules:

- E: 275, 10M: 0, 30M: 0
- E: 275, 10M: 50, 30M: 100
- E: 275, 10M: 0, 30M: 150
- E: 250, 10M: 50, 30M: 100
- E: 200, 10M: 50, 30M: 100
- E: 200, 10M: 25, 30M: 125

**NOTE: E: 275, 10M: 0, 30M: 0 IS NOW A FEASIBLE SCHEDULE.**

**As a result of the modification, E: 275, 10M: 50, 30M: 150 is also a feasible schedule. This schedule allows for simultaneous ramping for energy and OR.**

**However, in the RTC schedule, there is no 3x ramp rate or simultaneous use of ramping. The generator will only be schedule for its physical capability.**

3. RTC:

**This example shows some feasible schedules in the RTC sequence.**

**All three limits must be met for a feasible schedule**

- Energy ramped is limited to 25MW (5MW/min x 5 minutes)
- b. Energy ramped + 10-minute OR is limited to 50MW (5MW/min x 10 minutes)
- c. Energy ramped + total OR is limited to 150MW (5MW/min x 30 minutes)

Some Feasible Schedules:

E: 200, 10M: 50, 30M: 100

E: 200, 10M: 0, 30M: 150

E: 200, 10M: 25, 30M: 125

E: 225, 10M: 0, 30M: 125

**Proposal:**

The IESO proposes to leave the modifications as they are; however leave this issue open, but on hold, with the intent to consider changing/removing the modifications once the analysis of the 3x impact is completed. Changing/removing the modifications could be the next incremental step to RT pricing.

The analysis conducted supporting the proposed change from 12x to 3x was conducted using the existing modifications. The analysis of the impact of the change to 3x ramp rate multiplies is not yet complete and the IESO has committed to do analysis over the next year. It is prudent to not change any other aspect of RT pricing until that analysis is completed.