



# Operating Reserves Rules

RMWG

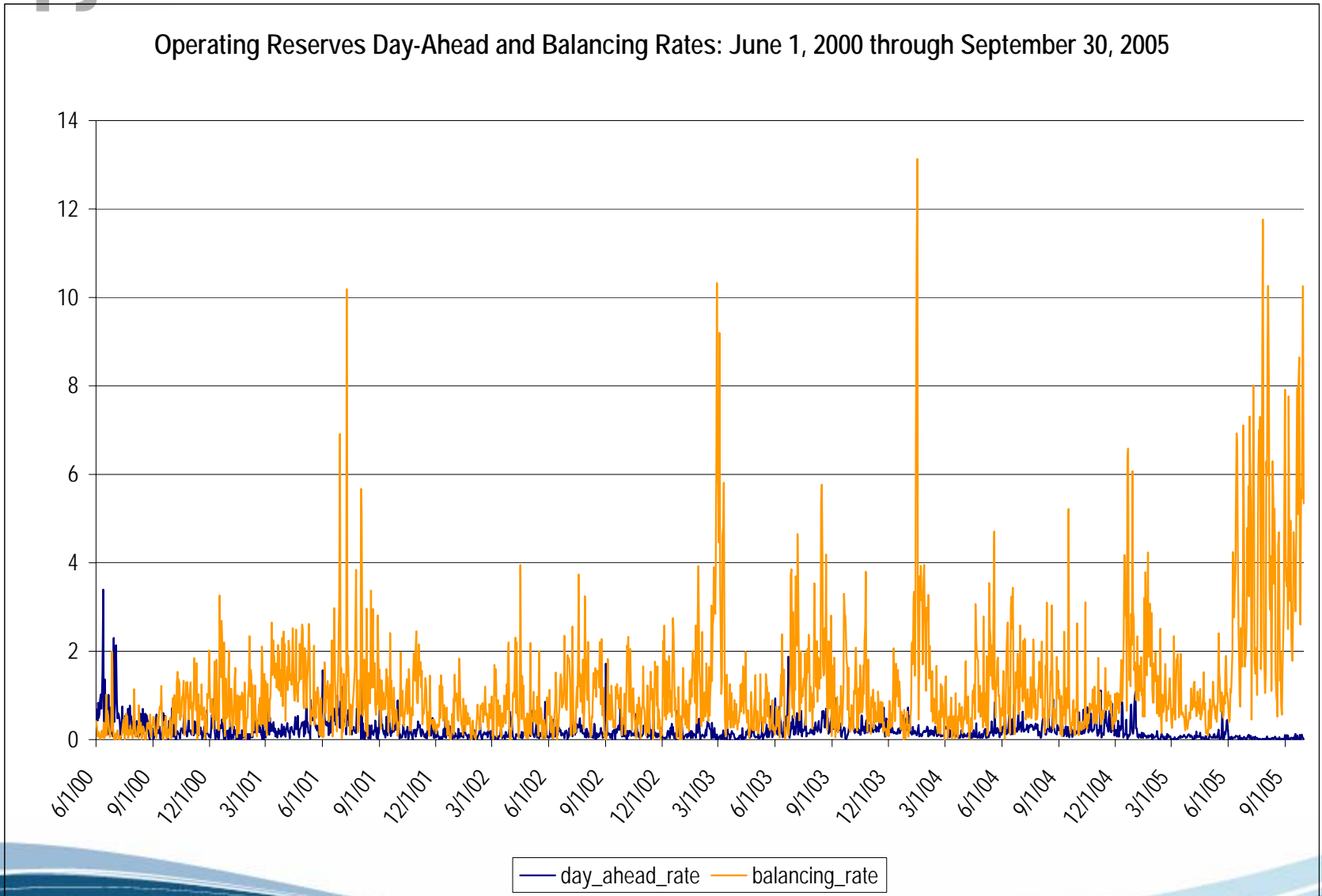
October 20, 2005

Market Monitoring Unit



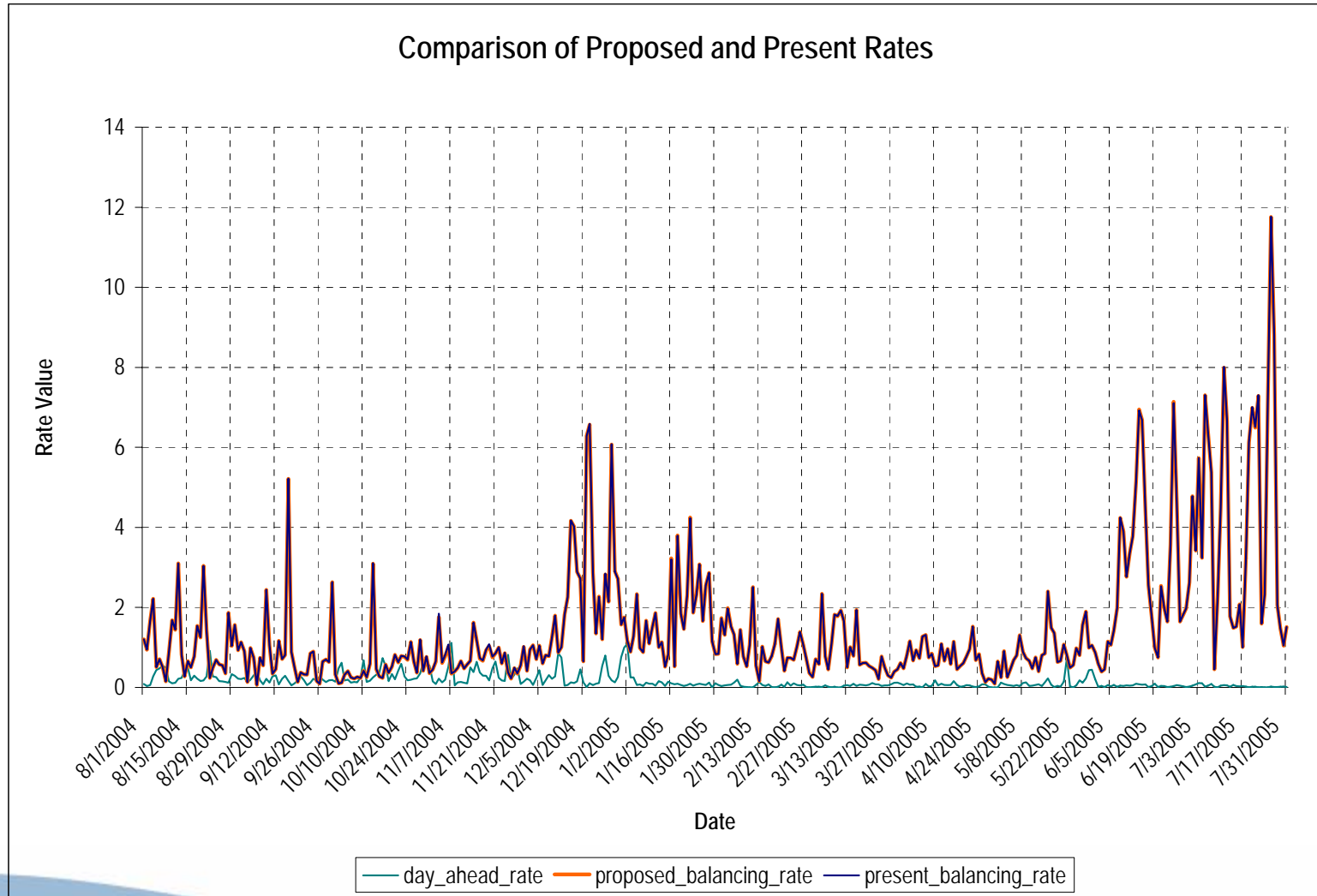
# Percent of Operating Reserves Payments of Total PJM Bill

<b>Month</b>	<b>Percent of Operating Reserves Payments of Total PJM Bill</b>
<b>Jun-04</b>	<b>6.13%</b>
<b>Jul-04</b>	<b>4.36%</b>
<b>Aug-04</b>	<b>4.45%</b>
<b>Sep-04</b>	<b>3.68%</b>
<b>Oct-04</b>	<b>4.55%</b>
<b>Nov-04</b>	<b>4.56%</b>
<b>Dec-04</b>	<b>6.95%</b>
<b>Jan-05</b>	<b>4.66%</b>
<b>Feb-05</b>	<b>3.11%</b>
<b>Mar-05</b>	<b>2.02%</b>
<b>Apr-05</b>	<b>1.92%</b>
<b>May-05</b>	<b>1.94%</b>
<b>Jun-05</b>	<b>3.09%</b>
<b>Jul-05</b>	<b>3.77%</b>
<b>Aug-05</b>	<b>2.72%</b>

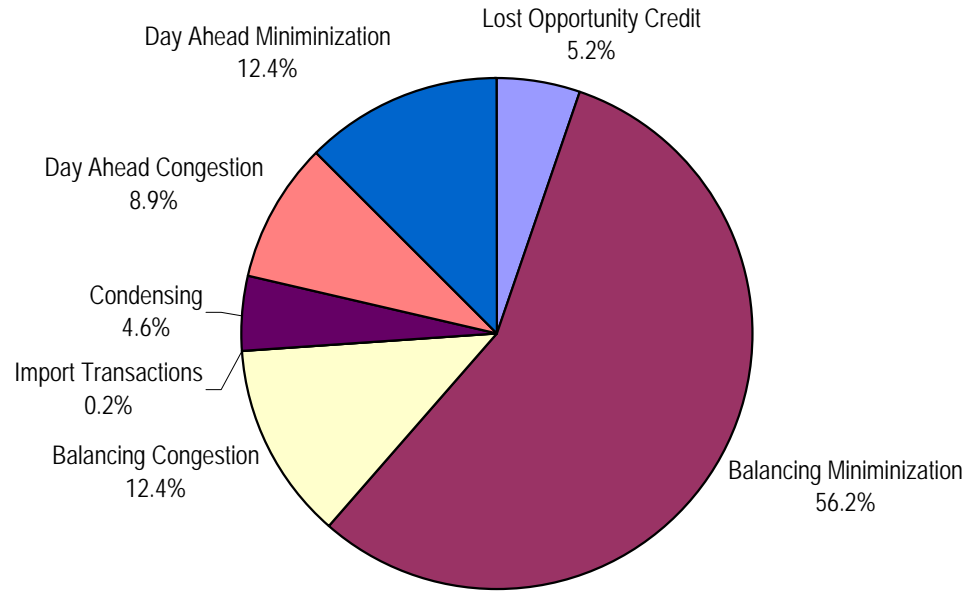


- What is the estimated effect of the proposed changes to the calculation of deviations for allocating Balancing Operating Reserve Charges?
- Proposed change:
  - For all types of units except CTs, where DA MW > Desired MW
  - Use (Desired MW – RT MW) as an allocator
  - In place of (DA MW – RT MW)

- Analysis for August 1, 2004 through July 31, 2005
  - Under Proposed Change:
    - Average Balancing Operating Reserve Rate = (Total Balancing Operating Reserves Credits) / (Desired MW – RT MW) = \$1.4914
  - Under Present Rules:
    - Average Balancing Operating Reserve Rate = (Total Balancing Operating Reserves Credits) / (DA MW – RT MW) = \$1.4926



Operating Reserves Credits: August 1, 2004 through July 31, 2005



Lost Opportunity Credit

Balancing Minimization

Balancing Congestion

Import Transactions

Condensing

Day Ahead Congestion

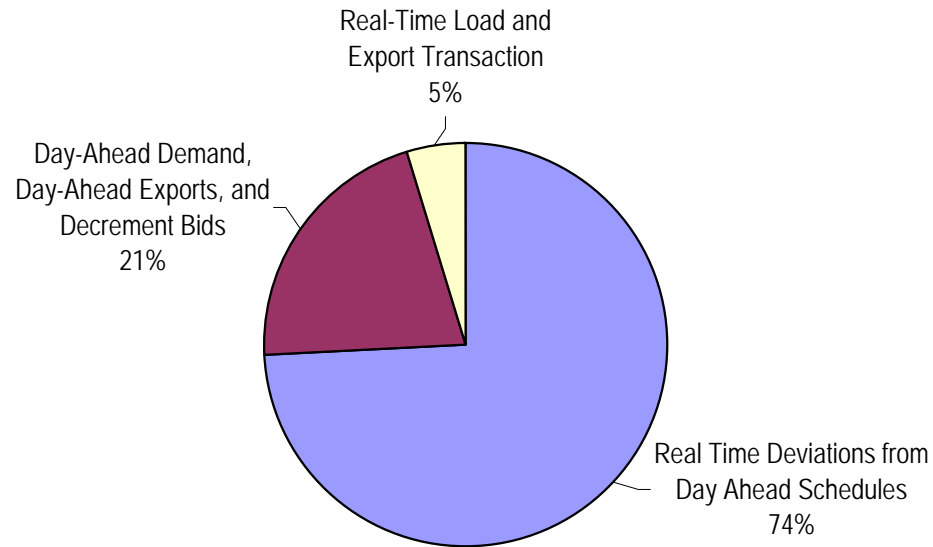
Day Ahead Minimization

- **Day Ahead Congestion Credit** – to units that are offer capped and committed for transmission constraint in DA Market .
- **Day Ahead Minimization Credit** – to units that are committed in Day Ahead Market for minimization of production cost. (All units that are paid Day Ahead operating reserve credits excluding resources that are paid **Day Ahead Congestion Credit**).
- **Balancing Congestion Credit**- to units that are offer capped in Day Ahead, committed for transmission constraint in Day Ahead and running in Real-Time, and to units offer capped in Real-Time.
- **Balancing Minimization Credit**- to units committed in Balancing Market for minimization of production cost. (All units that paid Balancing operating reserve credits excluding resources paid **Balancing Congestion Credit**).
- **Lost Opportunity Credit** – to qualified units that provide regulation at PJM dispatch by increasing or decreasing their output.
- **Condensing Credit** - to units that provide synchronous condensing for purpose other than spinning reserves or reactive services.
- **Import Transaction Credit** – when LMP less than their bid.

## Operating Reserve :

<u>Credits to</u>		<u>Charges to</u>
Day Ahead Minimization, Day Ahead Congestion	→	Day Ahead Demand , Day Ahead Exports, Decrement Bids
Condensing	→	Real Time Load, Export Transaction
Balancing Minimization, Balancing Congestion, Lost Opportunity Credit, Import Transactions	→	Real time deviations from their Day Ahead schedules

## Operating Reserves Charges: August 1, 2004 through July 31, 2005



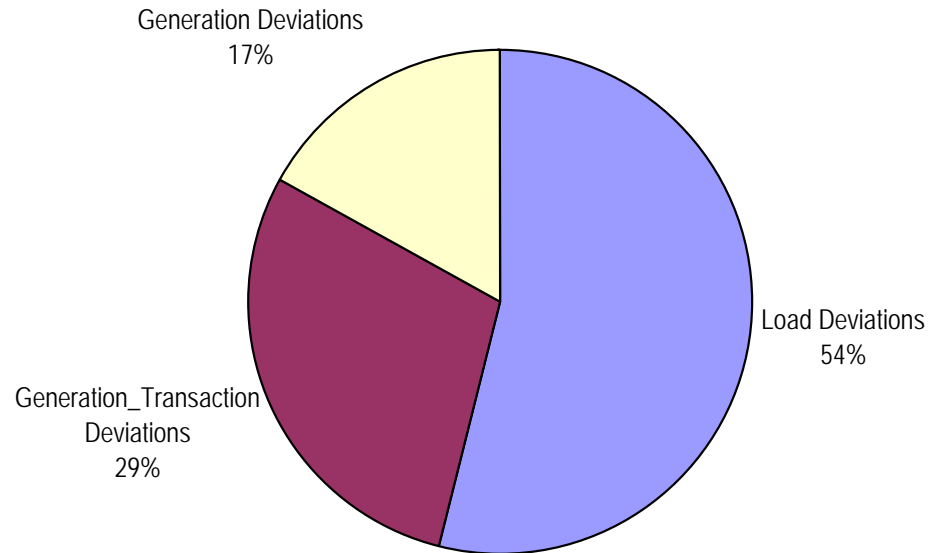
Real Time Deviations from Day Ahead Schedules  
Real-Time Load and Export Transaction

Day-Ahead Demand, Day-Ahead Exports and Decrement Bids

## Balancing Operating Reserve Deviations:

<u>DAY AHEAD</u>		<u>Balancing Market</u>
Cleared Decrements, DA Load, Sales/Export	<p>“Load Deviations”</p> <p>← Net Deviation of total →</p>	RT Load, Sales/Export
Cleared Increments, Purchases/Imports	<p>“Generation Transactions”</p> <p>← Net Deviation of total →</p>	Purchases/Imports
DA Scheduled Generation	<p>“Generation Deviations”</p> <p>← Individual deviation of each generator not following dispatch →</p>	RT Generation

Balancing Operating Reserves Deviations (MW): August 1, 2004 through July 31, 2005



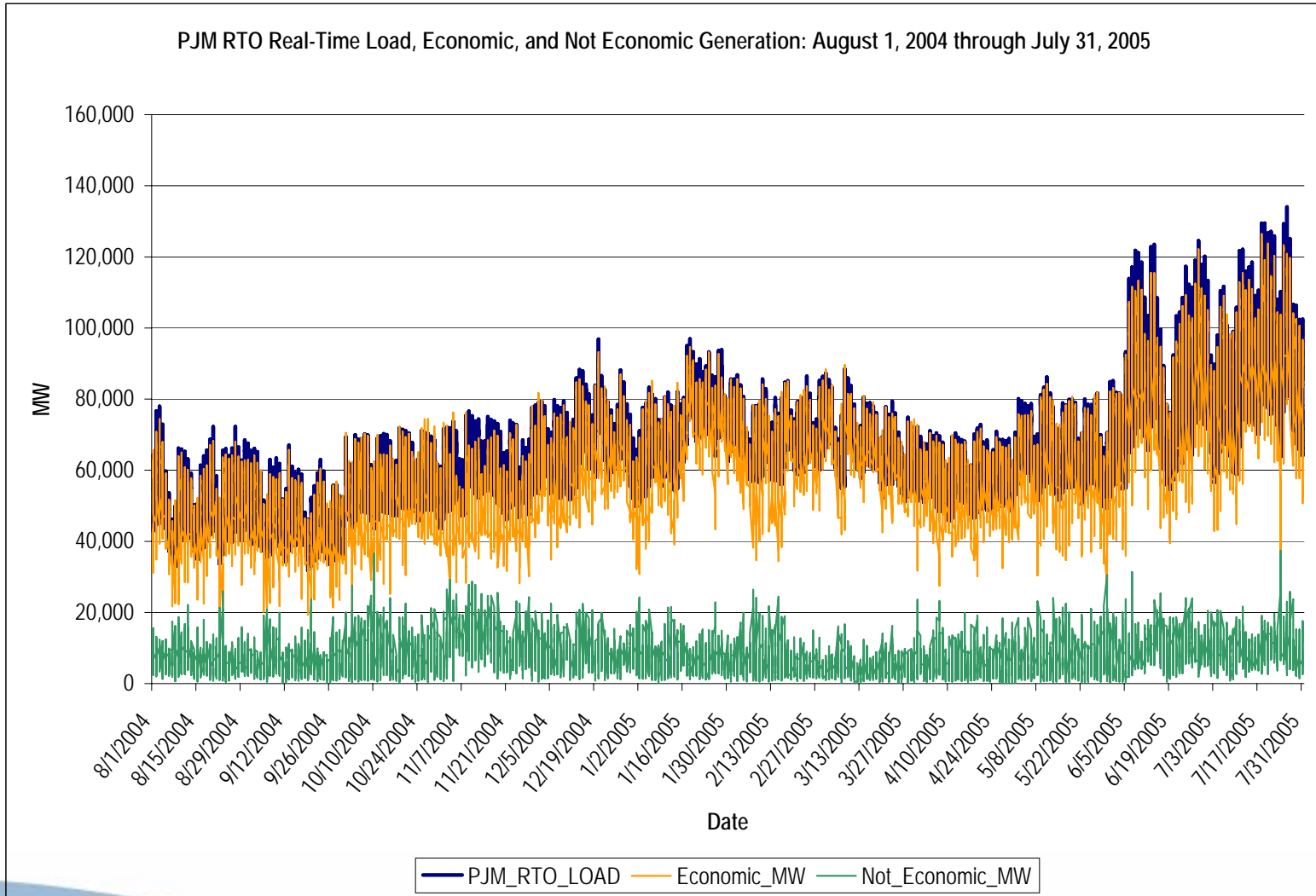
■ Load Deviations ■ Generation\_Transaction Deviations ■ Generation Deviations



# Zonal Generation Credits and Charges as a percentage of Total Balancing Credits and Charges

Date	PJM Classic		Other		Generation Charges as % of Total Balancing Charges	Generation Credits as % of Total Balancing Credits
	Charge	Credit	Charge	Credit		
Aug-04	9%	61%	3%	30%	11%	92%
Sep-04	11%	57%	2%	18%	13%	75%
Oct-04	8%	78%	9%	15%	17%	94%
Nov-04	6%	79%	12%	12%	19%	91%
Dec-04	10%	93%	6%	4%	16%	97%
Jan-05	7%	87%	7%	10%	15%	97%
Feb-05	9%	86%	10%	11%	18%	97%
Mar-05	8%	71%	9%	23%	18%	93%
Apr-05	8%	58%	11%	31%	19%	89%
May-05	9%	60%	11%	32%	20%	92%
Jun-05	9%	71%	11%	23%	20%	94%
Jul-05	8%	78%	10%	13%	18%	91%
<b>Average</b>					<b>Average Total</b>	
	8%	73%	8%	18%	17%	92%
<b>Share of Average Total</b>						
	50%	80%	50%	20%		

PJM Classic Area includes PS, PE, PL, BC, JC, ME, PN, PEP, AE, DPL zones



\* Economic: Bid  $\leq$  RT\_LMP and Not Economic: Bid  $>$  RT\_LMP

- Current:
  - No rules that address the operating parameters of units selected for operating reserves
- Proposed:
  - Maintain unit parameters at levels based on physical characteristics
  - Notification of PJM in instances of parameters change
  - PJM defines a set of unit parameter level
  - Operating Reserves Credits limited to units with defined parameters
  - Exceptions



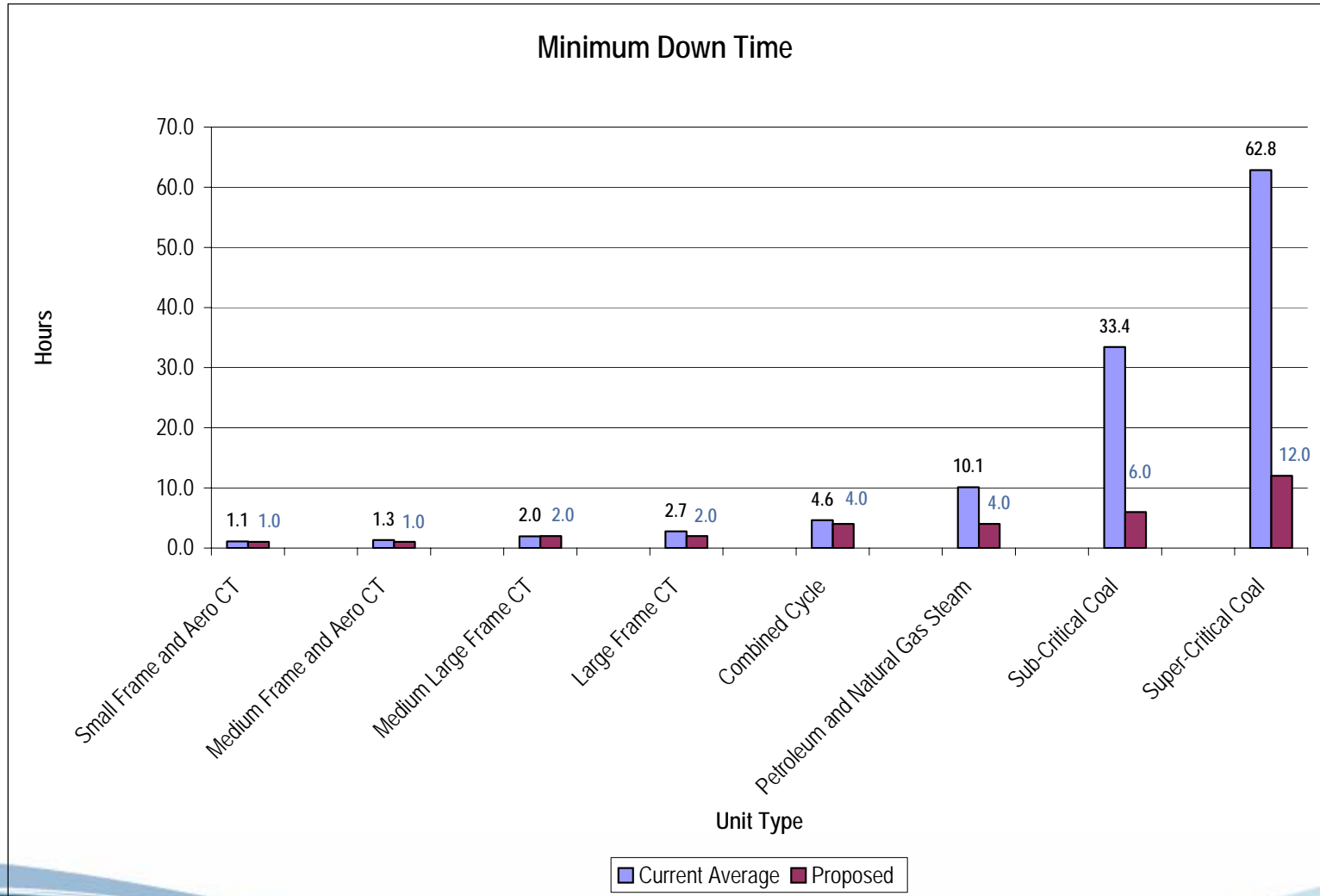
# Number of Units Analyzed for Proposed Changes

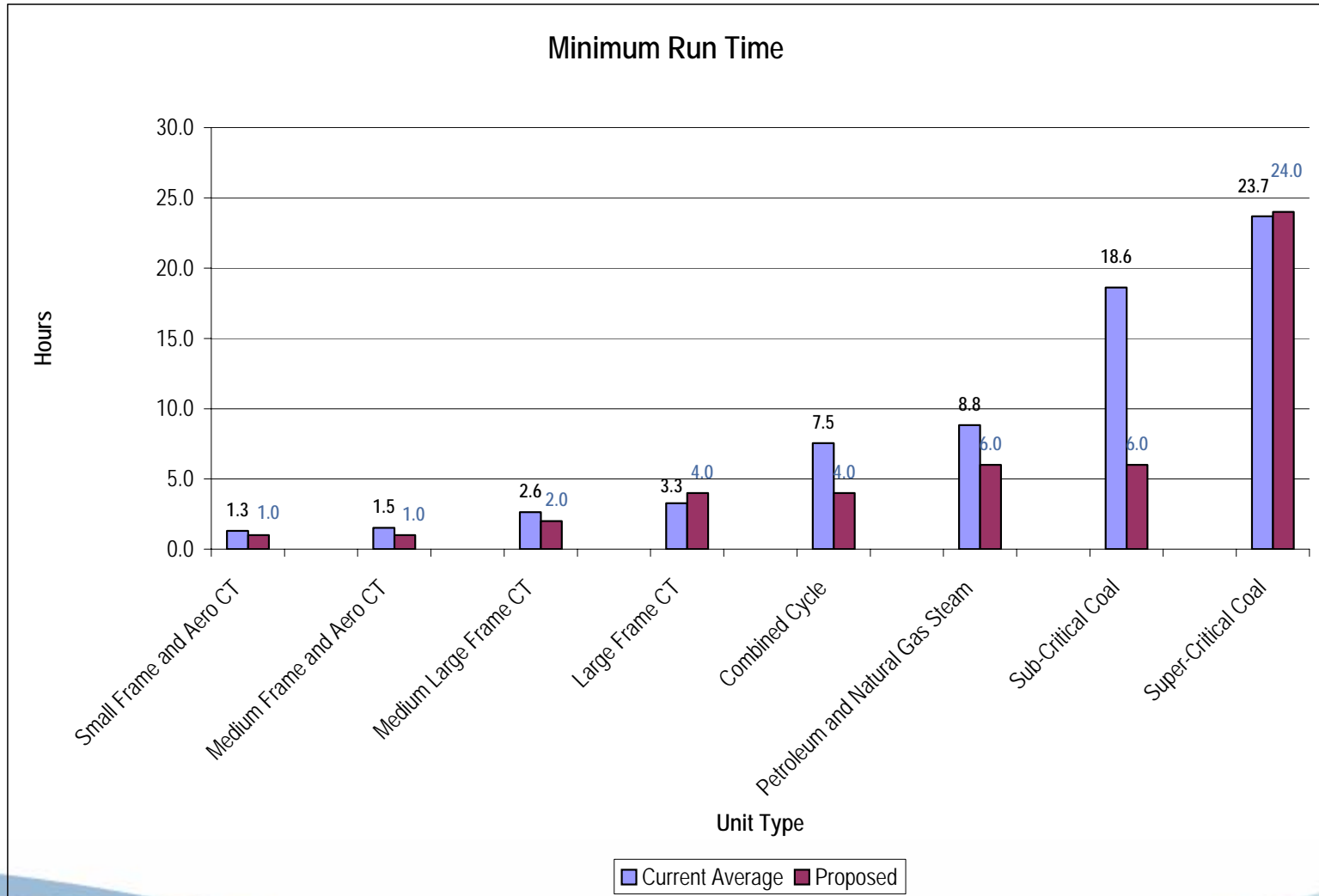
Units Category	Number of Units Surveyed	Total ICAP Capacity (MW)
Small Frame and Aero CT Units to 29 MW	133	2,462
Medium Frame and Aero CT Units 30 Mw to 65 MW	154	7,190
Medium Large Frame CT Units 65 MW to 125 MW	99	8,907
Large Frame CT Units 135 MW to 180 MW	66	10,346
Combined Cycle Plants	42	18,594
Petroleum and Natural Gas Steam Plants	91	12,835
Sub-Critical Coal Plants	194	44,647
Super-Critical Coal Plants	38	24,601
Total	817	129,582

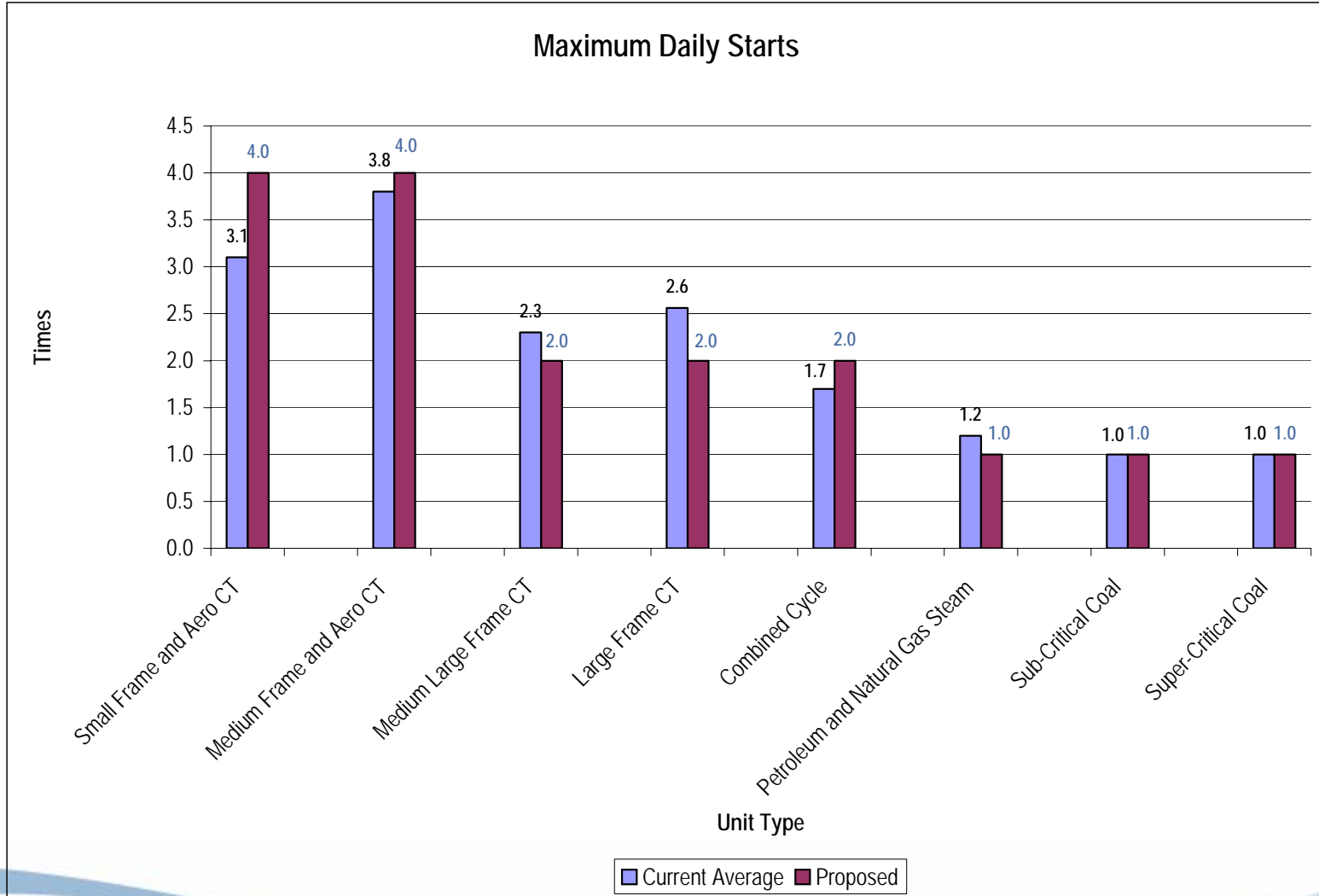
- **Minimum Down Time** — The minimum number of hours between starts, calculated as the difference between when the unit shuts-down and the next time the unit is put online, as measured by telemetry available to PJM.
- **Minimum Run Time** — The minimum number of hours a unit must run, from the time the unit is put online to the time the unit is shut down (as measured by PJM's state estimator).
- **Maximum Daily Starts** — The maximum number of times that a unit can be started in a day under normal operating conditions.
- **Hot to Cold Time** — The amount of time, in hours, after shutdown that a hot temperature state unit takes to cool down to cold temperature state.
- **Hot to Warm Time** — The amount of time, in hours, after shutdown that a hot temperature state unit takes to cool down to warm temperature state.
- **Warm Start Time** — The time interval, measured in hours, from the actual unit start sequence to the unit breaker closing for a generating unit in its warm temperature state.

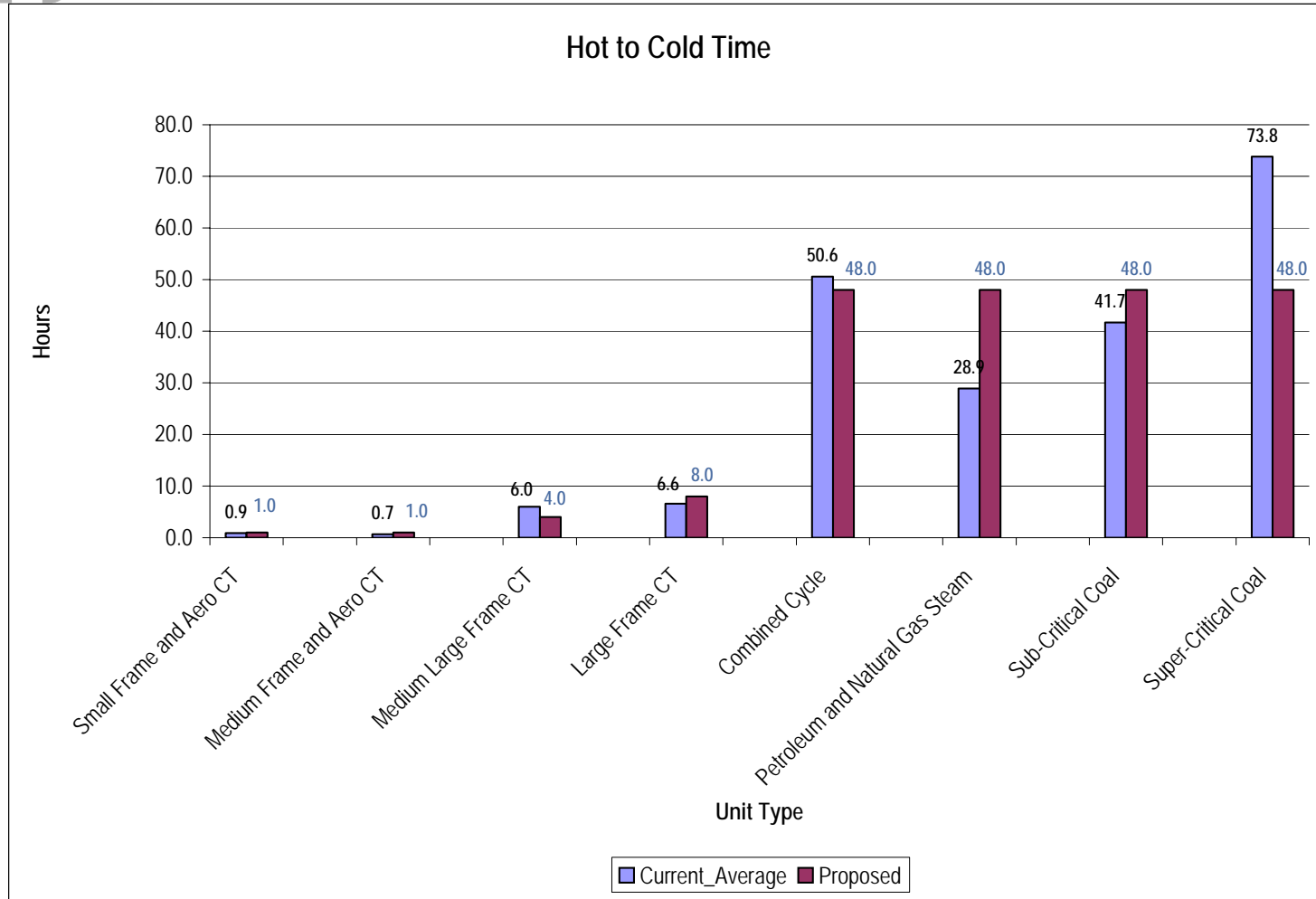
- **Cold Start Time** — The time interval, measured in hours, from the actual unit start sequence to the unit breaker closing for a generating unit in its cold temperature state.
- **Hot Start Time** — The time interval, measured in hours, from the actual unit start sequence to the unit breaker closing for a generating unit in its hot temperature state.
- **Warm Notification Time** — The time interval between PJM notification and the start sequence of a generating unit that is currently in its warm temperature state.
- **Cold Notification Time** — The time interval between PJM notification and the start sequence of a generating unit that is currently in its cold temperature state.
- **Hot Notification Time** — The time interval between PJM notification and the start sequence of a generating unit that is currently in its hot temperature state.
- **Ramp Time** — Change in MW per minute as a percent of ICAP capability in a generators output level.

eMKT User Guide - <http://www.pjm.com/etools/downloads/emkt/ts-userguide.pdf>

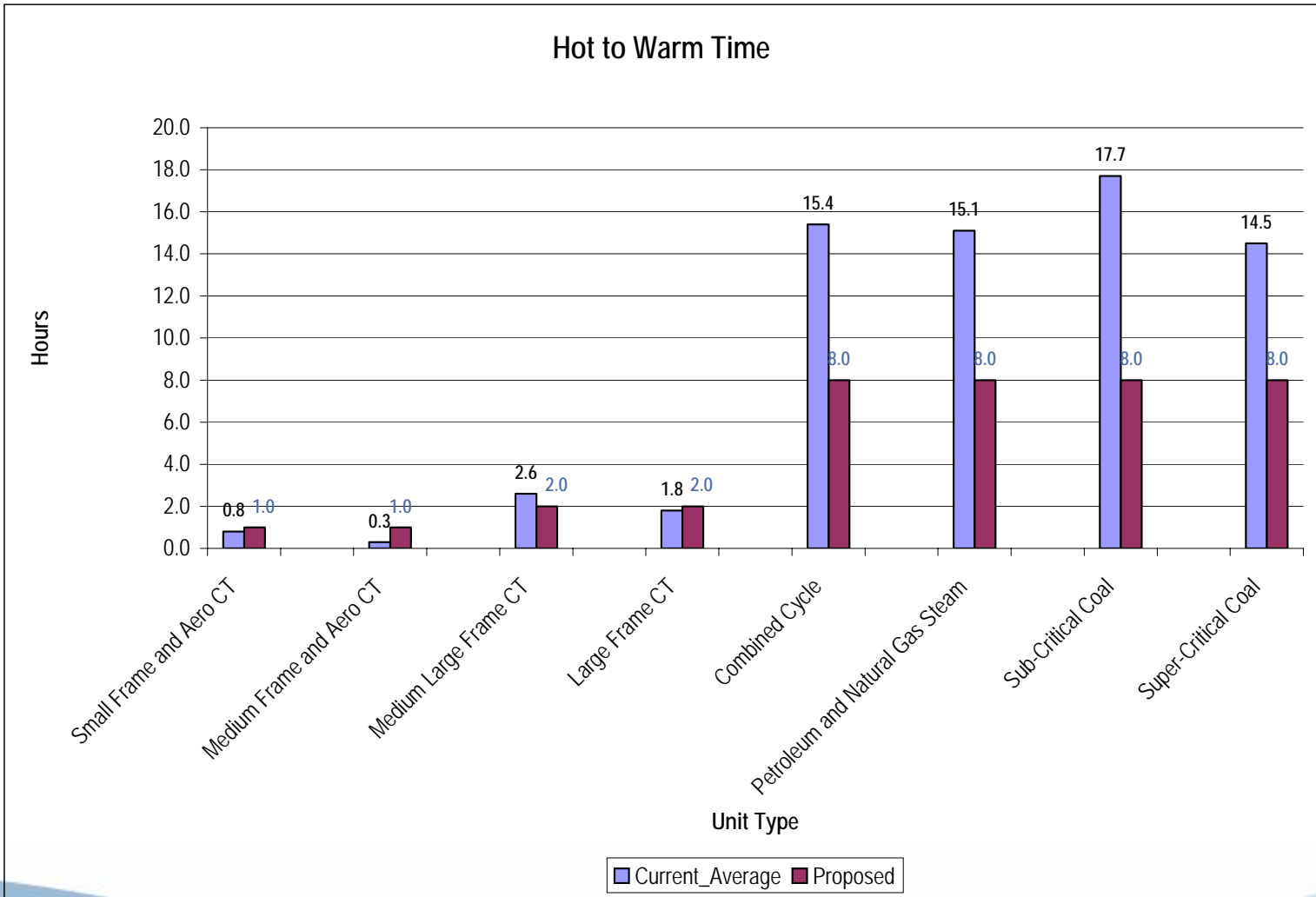




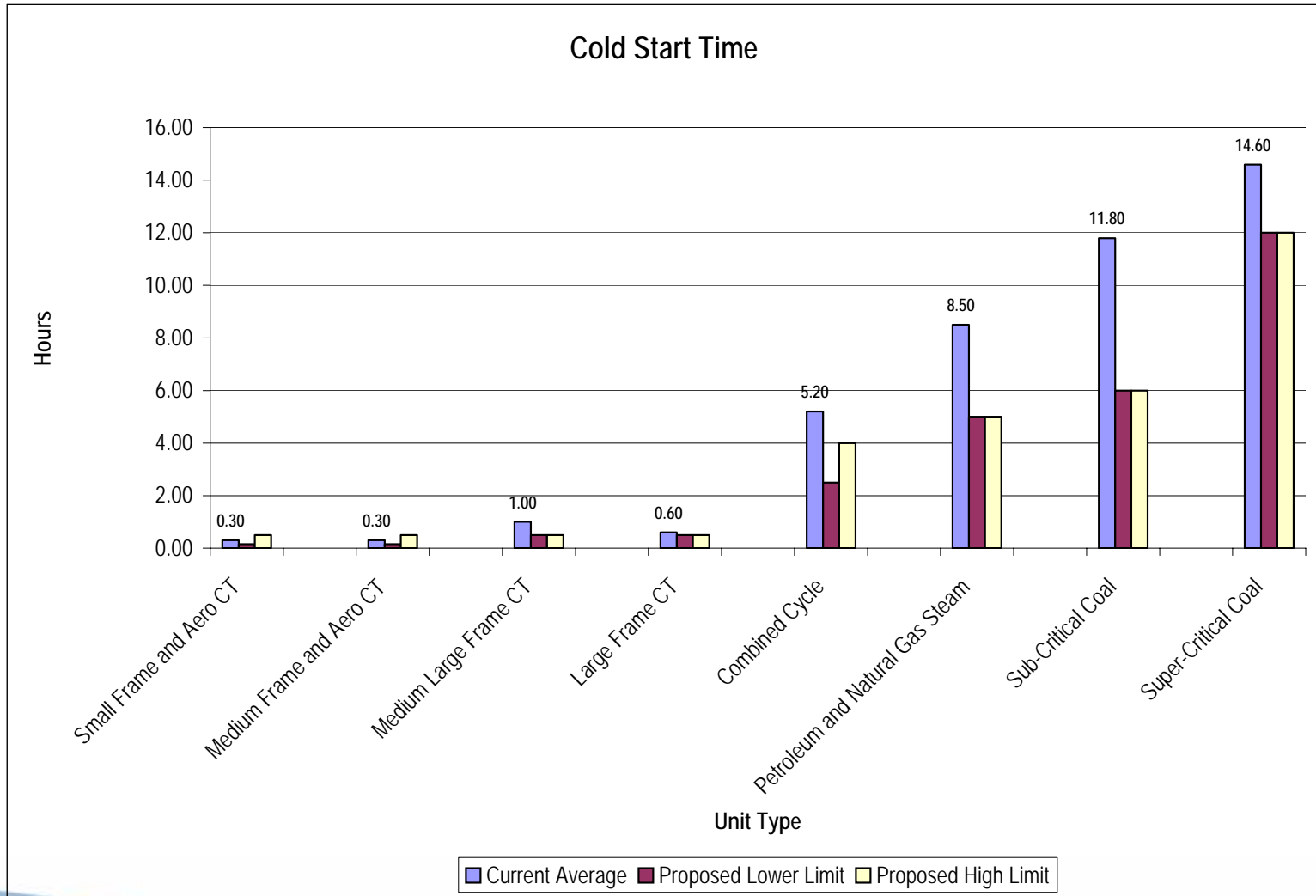


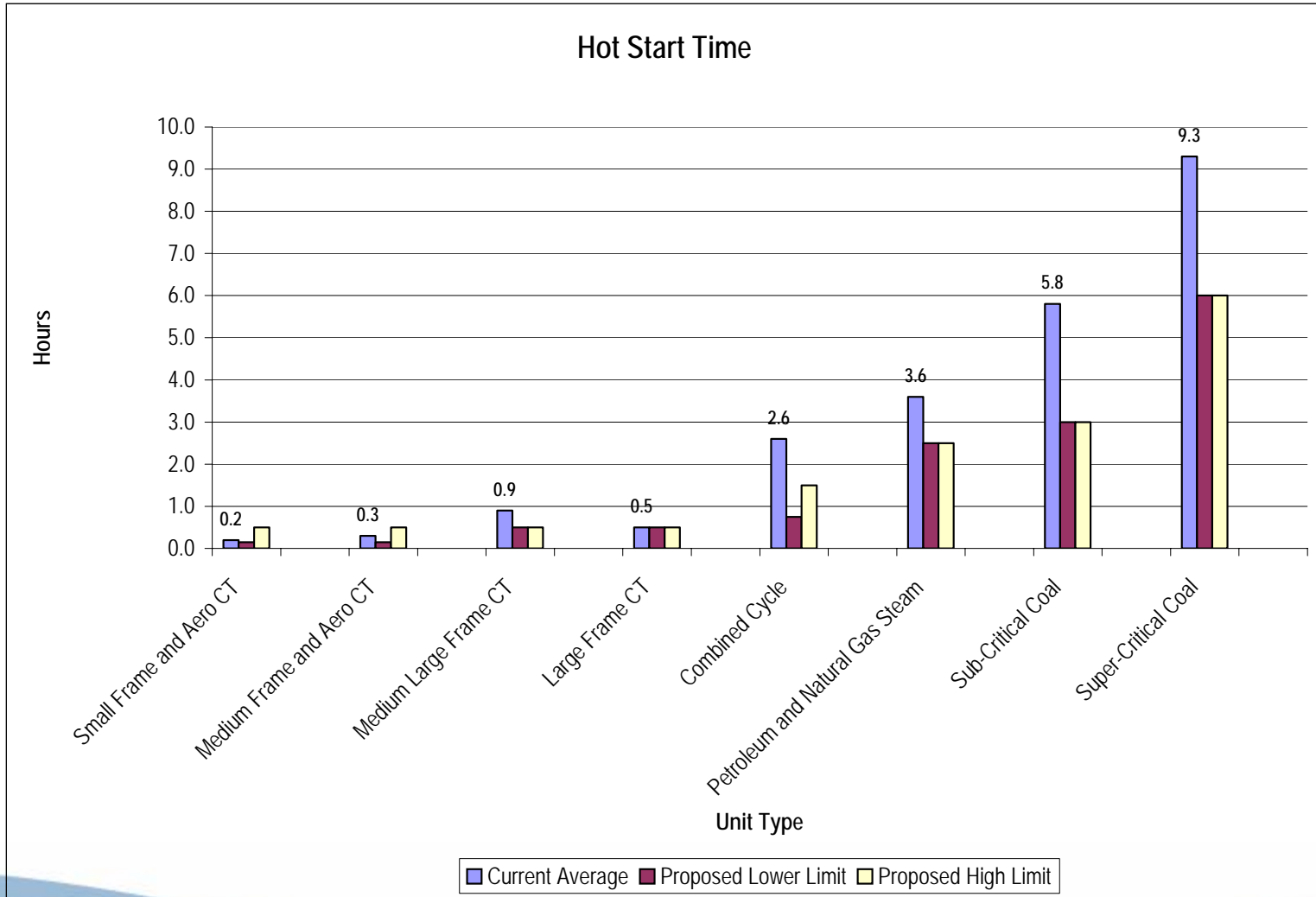


\* For Large Frame CT proposed value based on GE7FA units, for other types of Large Frame CTs it could be less









Unit Category	Ramp Time %ICAP per Minute	
	Current Average	Proposed
<b>Small Frame and Aero CT</b>	37.1%	
Small Frame CT		8%
Small Aero CT		23%
<b>Medium Frame and Aero CT</b>	19.2%	
Medium Frame		8%
Medium Aero CT		23%
<b>Medium Large Frame CT</b>	8.8%	8%
<b>Large Frame CT</b>	6.6%	8%
<b>Combined Cycle</b>	2.0%	
Combined Cycle Hot Start		2%
Combined Cycle Cold Start		1%
<b>Petroleum and Natural Gas Steam</b>	11.7%	
Petroleum and Natural Gas Steam Hot Start		1%
Petroleum and Natural Gas Steam Cold Start		1%
<b>Sub-Critical Coal</b>	3.8%	1%
<b>Super-Critical Coal</b>	0.6%	1%

- Operating reserve payments concentrated among a relatively small number of units/owners
- The top ten units generally have:
  - Relatively high mark ups
    - Price offer over cost offer
  - Relatively inflexible operating parameters
    - Long minimum run times
    - Small number of starts per day
    - Long minimum down time
- Need to understand selection process for units providing operating reserves
  - Aggregate market
  - Locational issues

	Top Units' Markup	Steam Percent of Top 10	Steam Markup	Combined Cycle Percent of Top 10	Combined Cycle Markup
2001	0.03	60%	0.02	40%	0.07
2002	0.11	54%	0.08	46%	0.20
2003	0.17	50%	0.19	50%	0.11
2004	0.03	12%	0.00	88%	0.05

(SOM 2004; Table 2-45; Energy Section, page 98)

- The top ten units receiving operating reserve payments
  - Average = 41 percent of total operating reserve payments over last four years
  - Maximum = 47 percent
  - Minimum = 32 percent
- The mark up for all top ten units
  - Average = 9 percent
  - Maximum = 17 percent
  - Minimum = 3 percent
- The maximum mark up among the top ten units receiving operating reserve payments
  - Average = 44 percent over last four years
  - Maximum > 40 percent in each year

- Potential market power
  - Potential ability of unit owners to exercise market power in operating reserves markets
- Payment for flexibility
  - Pay operating reserves only to units that provide flexible operations
  - Flexible operations are determined by unit operating parameters

- Limit exercise of local market power in operating reserve market
  - Limit mark up
- Limit exercise of market power in aggregate operating reserve market
- Ensure that only flexible units are paid operating reserves
  - Require flexible operating parameters

- When units have local market power
  - Limit operating reserves payments to the higher of LMP or cost-based offer
- Issues
  - Definition of local market is unclear
  - Definition of local market is determined by operator actions
- Proposal
  - Local market power exists for units when they are used for operating reserves on a regular basis
  - Mark up should be limited for units taken for operating reserves on a regular basis

- Proposal
  - When units are taken repeatedly for operating reserves
  - When units increase mark up above a competitive level
  - Pay units for Operating Reserves Credits per cost-based offers
  - When defined test for “taken repeatedly” is met
  - When Offer Price > Cost-based offer for three days during 20 consecutive called days

Capped Flag	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1			
P>(MC+10%) Flag	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1		
Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	1																								
2	1	1																							
3	1	1	1																						
4	1	1	1	0																					
5	1	1	1	0	0																				
6	1	1	1	0	0	0																			
7	1	1	1	0	0	0	0																		
8	1	1	1	0	0	0	0	0																	
9	1	1	1	0	0	0	0	0	0																
10	1	1	1	0	0	0	0	0	0	0															
11	1	1	1	0	0	0	0	0	0	0	0														
12	1	1	1	0	0	0	0	0	0	0	0	0													
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16	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0									
17	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
18	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0							
19	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0						
20	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
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23				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
24					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1

- Operating reserve payments are payments for flexibility
- Proposal
  - Limit operating reserve payments to units with operating parameters based on the physical characteristics of the units
  - Specify operating parameters range for unit classes