Practical Limitations to Demand Response
(formerly presented to FERC)

September 21, 2010

Southeastern Electric Exchange
IRP Task Force Meeting
Atlanta, Georgia

Overview

- **At FERC's November 2009 Technical Conference regarding Demand Response, FPL made the following statement:**

  "*There are practical limitations on the amount of new demand response any utility can and should use.*"

- **On June 14, 2010, FPL met with FERC to discuss this issue in more detail.**

- **The remaining pages of this presentation are essentially what FPL presented to FERC at that meeting.**

Limitation to Demand Response: Background

- **FPL operates one of the nation's largest portfolios of DR programs with a total peak demand reduction capability in excess of 1,700 MW.**

- **According to the latest U.S. Department of Energy data, FPL ranks No. 2 among electric utilities nationwide in electric generation avoided through demand-side management programs.**

- **FPL has implemented DR programs/projects (both load management and rate-based) since the early 1980s (i.e., for almost 30 years).**

- **Therefore, FPL has extensive experience in both the planning and operation of DR programs.**

Limitation to Demand Response: Background

- **As FPL's DR capability steadily grew to become an increasingly larger factor in FPL's system, FPL's resource planning efforts devoted considerable time to examine numerous potential effects which DR might have on a utility system.**

- **FPL has concluded that there are two important practical limitations to account for in utility resource planning:**

1) **There is a "physical limit" to how much DR is actually usable on a utility system.**

2) **There is a "quality of reserves" issue to address in regard to DR's contribution to a utility system.**

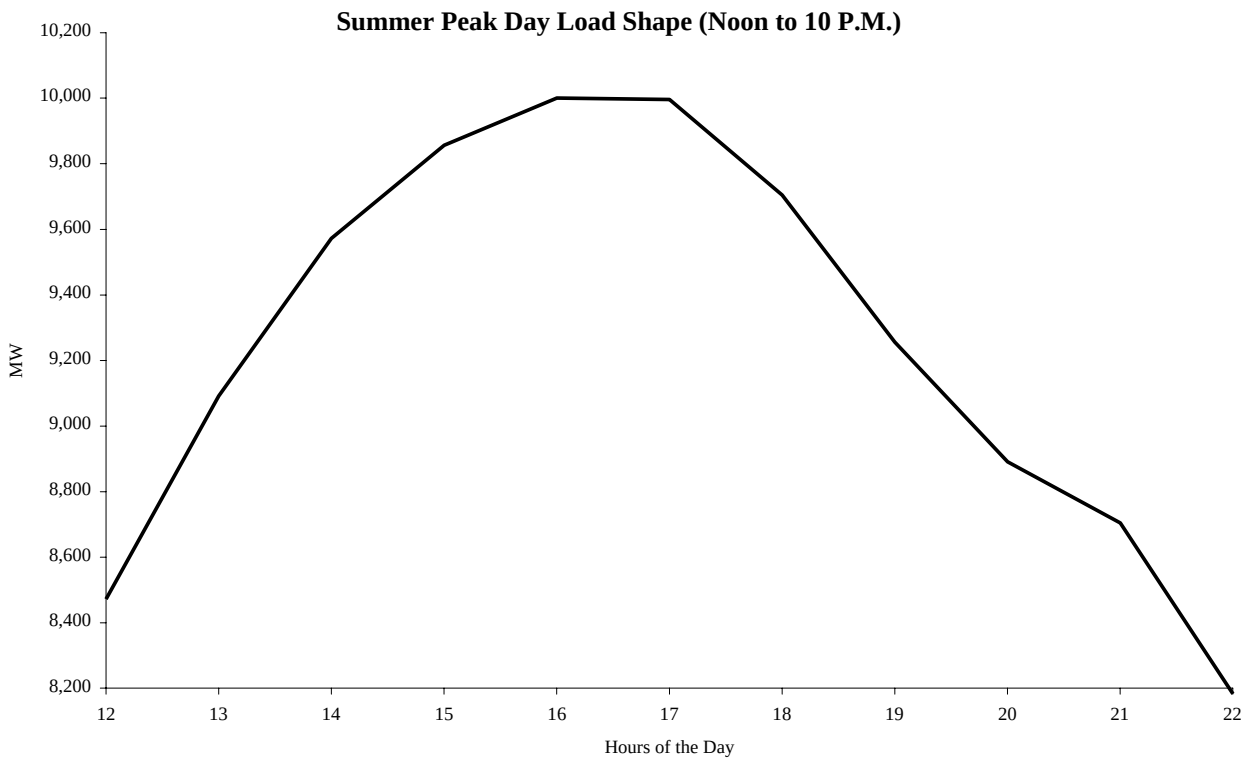
Limitations to Demand Response: Physical Limits

- **There is a "physical limit" to the amount of DR that is actually usable on a given utility system. This limit is essentially driven by the fact that as a utility signs up more and more DR to increase its peak day DR load reduction capability, it must maintain the load reduction effect of DR for longer and longer times.**

- **The following three slides will provide a simple graphic example for a hypothetical utility system on its peak day.**

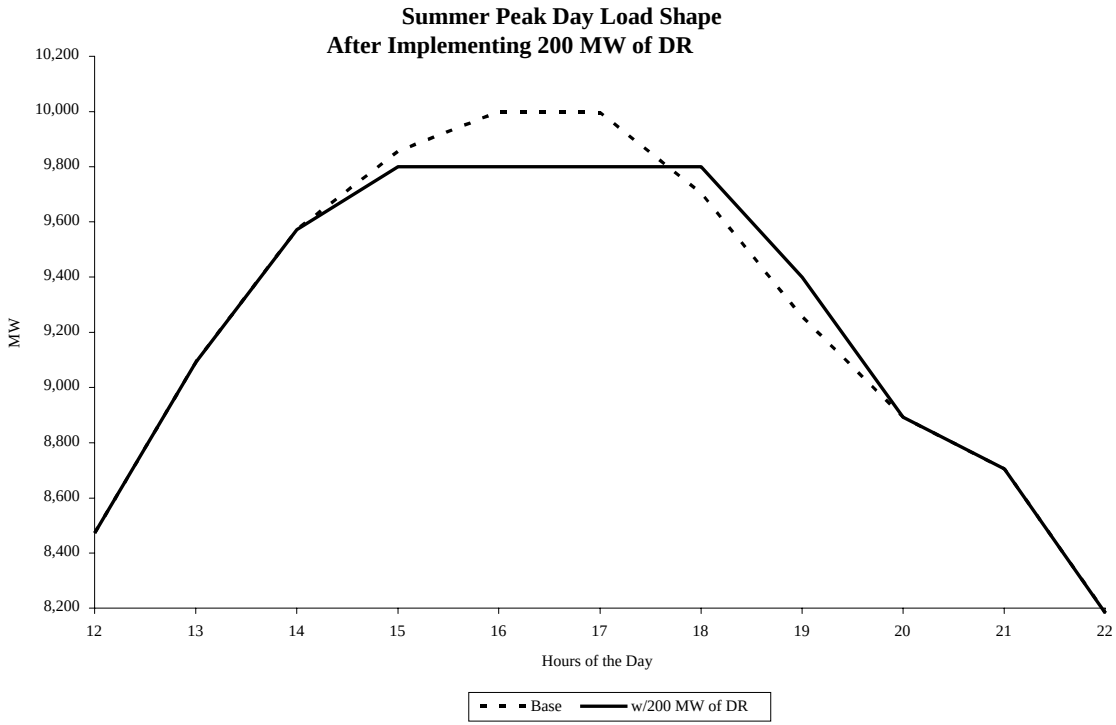
Limitations to Demand Response: Physical Limits

- **In this example, our hypothetical utility's Summer peak day load shape from noon to 10 p.m. is shown using hourly load data.**



Limitations to Demand Response: Physical Limits

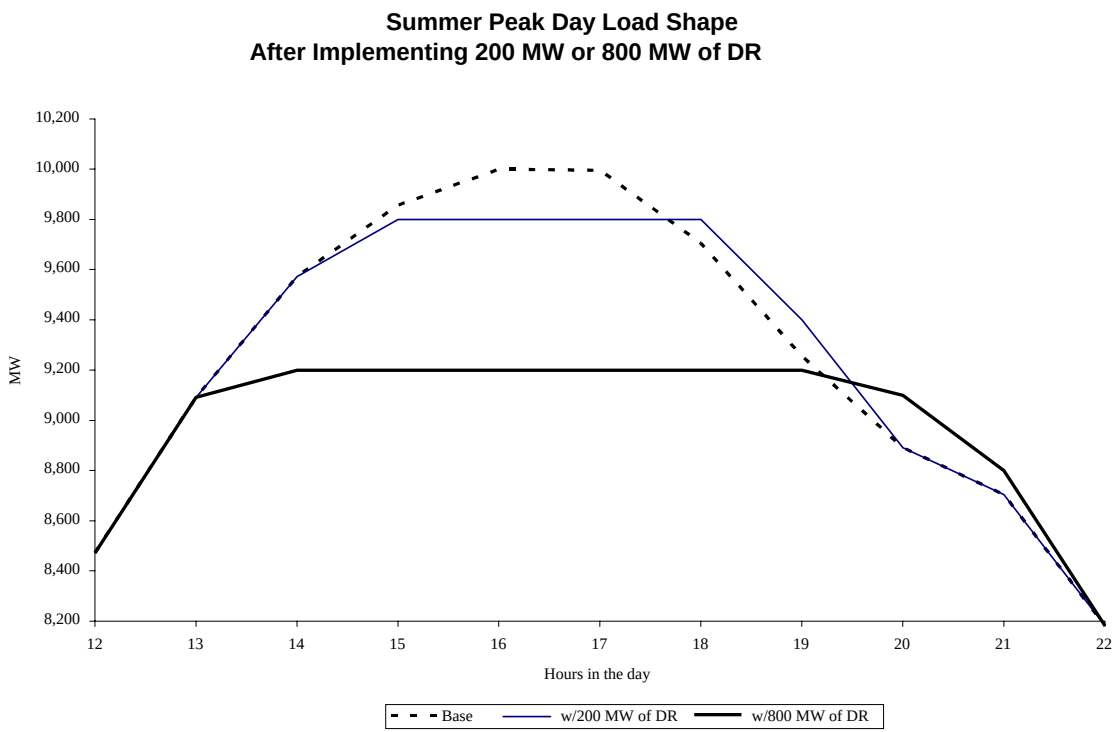
- **Our hypothetical utility now implements 200 MW of DR on this same Summer peak day.**



- **The utility's peak load is lowered, but the load shape becomes flatter. This means that the peak load occurs for a longer period of time and, more importantly, that DR's load reduction must be maintained for a longer time.**

Limitations to Demand Response: Physical Limits

- **Our hypothetical utility now examines how its peak day load shape is affected by increasing its DR capability from 200 MW to 800 MW.**



Limitations to Demand Response: Physical Limits

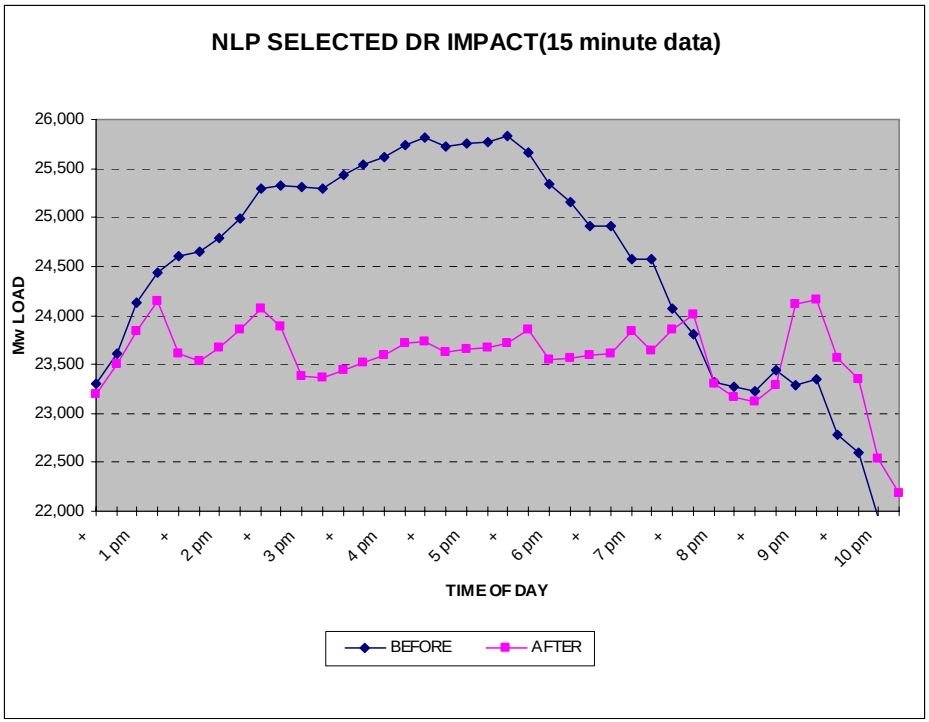
- **The key point is that: the more peak load reduction a utility attempts to achieve with DR, the longer that DR must maintain its load reduction.**

- **Because DR programs are typically constrained by tariff restrictions (such as with LC programs), and/or by customer tolerance (such as with both rate-based and LC programs), there is a limit as to how long a utility can maintain the load reduction through DR. Consequently, this limits the amount of demand reduction that can be achieved with DR.**

- **To illustrate this, we look at current projections of the amount of usable DR for FPL's system using non-linear programming (NLP) techniques.**

Limitations on Demand Reduction: Physical Limits

This summary from a recent FPL analysis (using 15-minute load data) shows that FPL can make use of approximately 2,099 MW of DR by the year 2019.

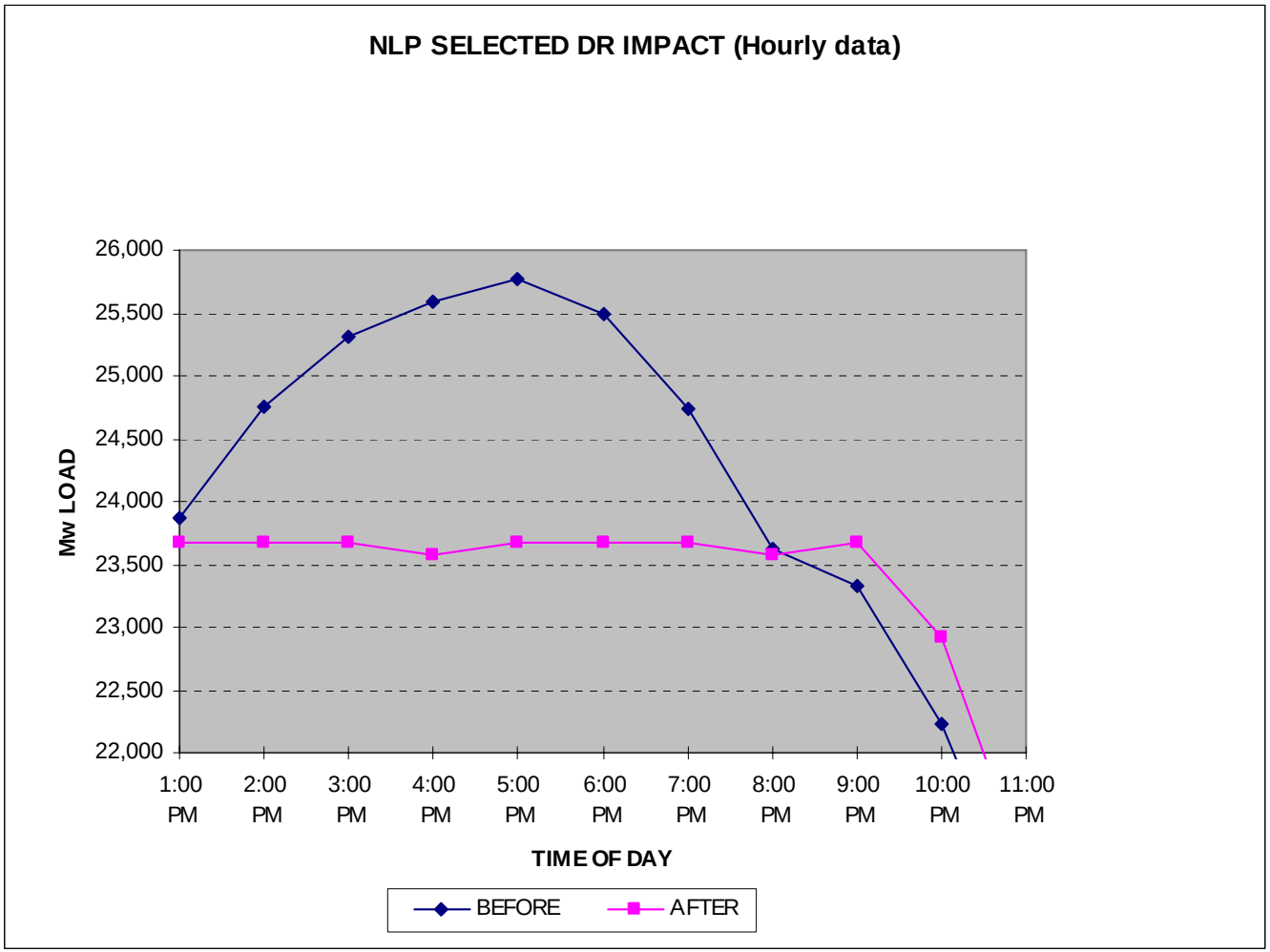


SUMMARY OF DR IMPACTS

	Mw	Time
Peak without DR =	25766	
Peak with DR =	23668	
DR reduction =	2097	
Shifting of peak =		

	Duration of Control in 15 min. Intervals	Blocks Available (1 block 1,000 parts.)	Blocks Used	Mw Reduction Potential (4-5 p.m.)
WH	16	577	577	104
PP	16	93	93	57
AC-C	24	747	747	680
AC-S	12	99	99	226
CILC	24	510	510	510
BOC	24	36	36	131
CDR	24	391	391	391
TOTAL	---	2453	2453	2099

Limitations to Demand Response: Physical Limits



Limitations to Demand Response: Physical Limits

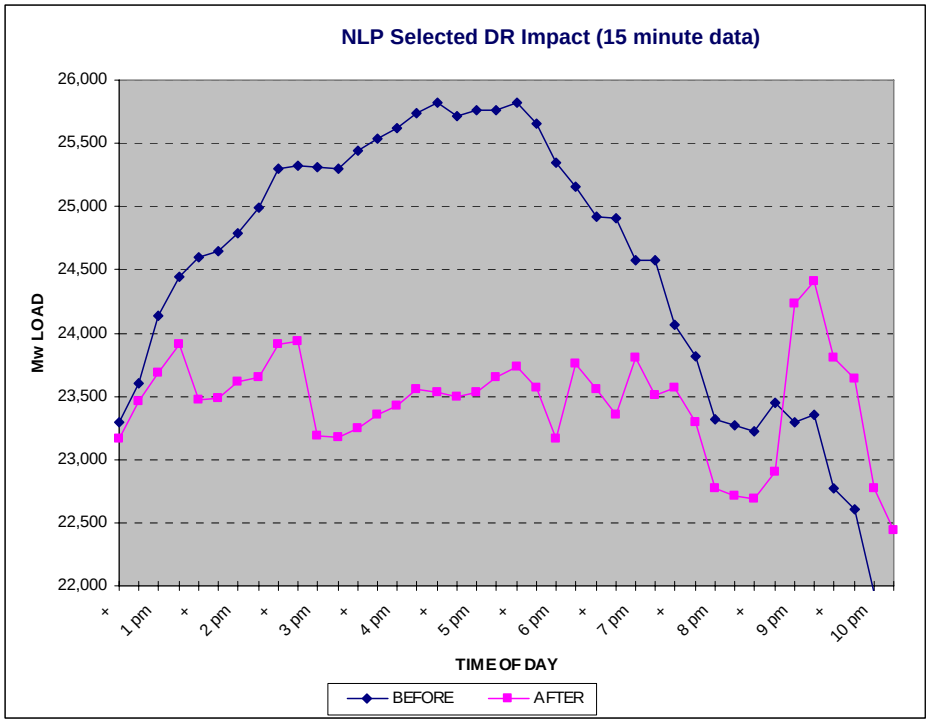
This information can be summarized in tabular form as follows:

Summary of Projected Demand Response Impacts for FPL for Summer 2019

	Scenario 1
I. Potential DR MW Reduction (based on signups):	**2,099**
- Additional DR Peak Reduction Compared to Scenario 1 (MW) =	**0**
II. Potential DR MW Reduction (based on NLP analysis):	
a) Projected Peak Day Load without DR (MW) =	25,766
b) Projected Peak Day Load with DR (MW) =	23,668
c) Projected DR Peak Load Reduction (MW) =	**2,097**

Limitations to Demand Response: Physical Limits

Here are the analysis results when FPL examined an increase of 500 MW of additional DR capability for the same year:

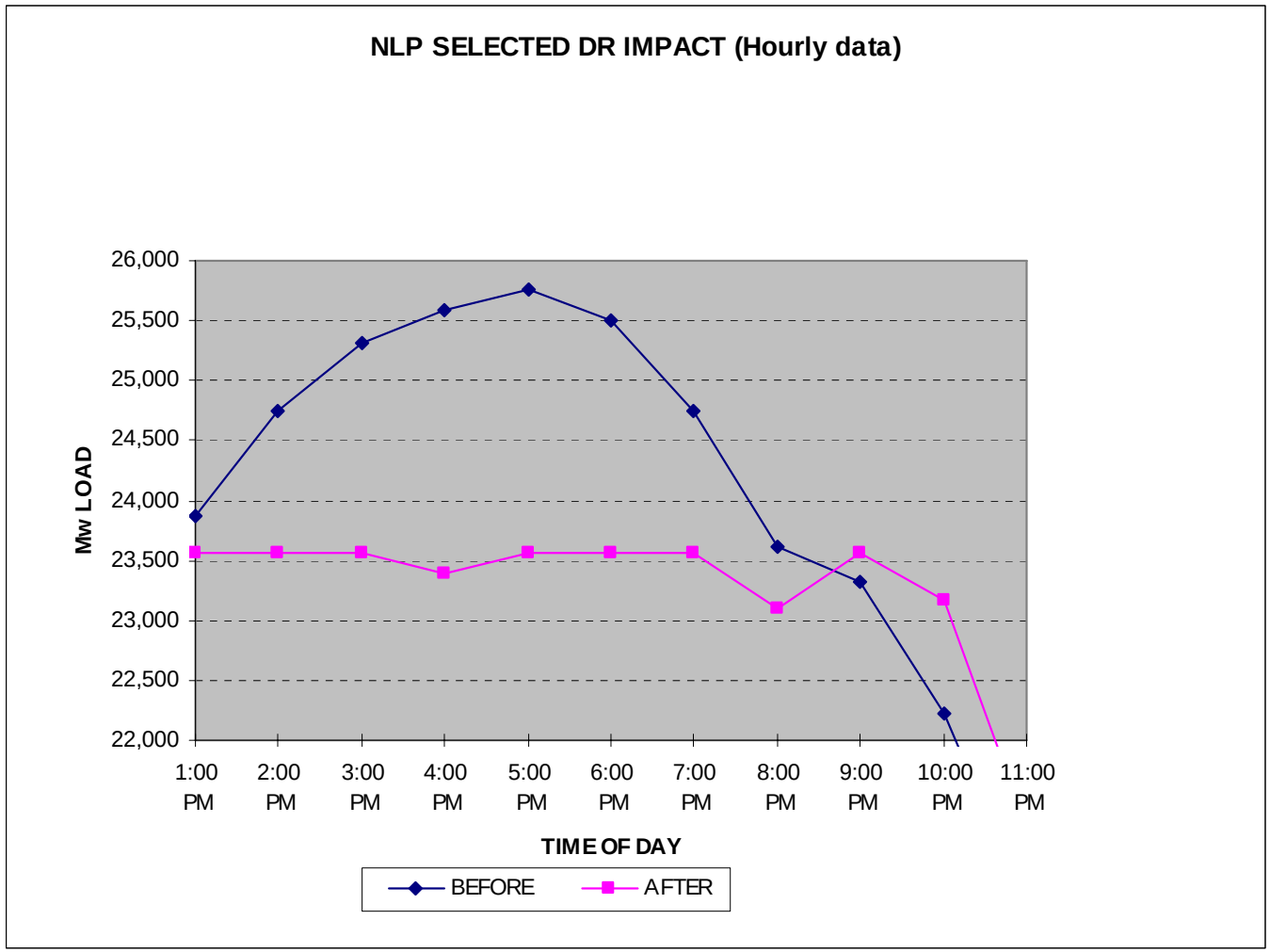


SUMMARY OF DR IMPACTS

	Mw	Time
Peak without DR =	25766	
Peak with DR =	23554	
DR reduction =	2212	
Shifting of peak =		

	Duration of Control in 15 min. Intervals	Blocks Available (1 block 1,000 parts.)	Blocks Used	Mw Reduction Potential (4-5 p.m.)
WH	16	848	848	153
PP	16	137	137	84
AC-C	24	1098	1098	999
AC-S	12	146	105	332
CILC	24	510	510	510
BOC	24	36	36	131
CDR	24	391	390	391
TOTAL	---	3164	3123	2599

Limitations to Demand Response: Physical Limits



Limitations to Demand Response: Physical Limits

The previous table is now expanded to summarize the results of FPL's analyses of 2,099 MW of DR, an additional 100 MW of DR, and an additional 500 MW of DR:

Summary of Projected Demand Response Impacts for FPL for Summer 2019

	Scenario 1	Scenario 2 Scenario 1 plus 100 MW of Additional Residential DR Signups	Scenario 3 Scenario 1 plus 500 MW of Additional Residential DR Signups
I. Potential DR MW Reduction (based on signups):	**2,099**	**2,199**	**2,599**
- Additional DR Peak Reduction Compared to Scenario 1 (MW) =	**0**	**100**	**500**
II. Potential DR MW Reduction (based on NLP analysis):			
a) Projected Peak Day Load without DR (MW) =	25,766	25,766	25,766
b) Projected Peak Day Load with DR (MW) =	23,668	23,634	23,554
c) Projected DR Peak Load Reduction (MW) =	**2,097**	**2,132**	**2,212**
III. Non-Usable Additional DR:	---		
- Non-Usable Additional DR MW =	---	**67**	**387**
- Percentage of Additional DR MW that is Non-Usable =	---	**67%**	**77%**

Limitations to Demand Response: Physical Limits

- **Therefore, there is a limit as to how much DR is actually usable on a utility system (i.e., when 1 MW of additional DR no longer results in 1 MW of additional load reduction).**

- **This "physical limit" must be determined in order to avoid:**

  (i) overstating the utility's system reliability, and (ii) spending customers' money on additional DR that has become dramatically less cost-effective.

- **The physical limit is definitely utility-specific. It will vary based on a number of factors including: load shape, types of DR offered, payback characteristics of the affected electrical appliances/equipment, and applicable tariffs.**

- **The physical limit issue will become increasingly important as the amount of DR that is implemented increases.**

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Limitations to Demand Response: Quality of Reserves

- **As DR capability increases for a utility, DR becomes an increasingly larger component of a utility's reliability planning.**

- **As a result of DR, new generation options are either deferred or avoided and DR plays a larger role in reserve margin/LOLP/LOLH/etc. analyses of system reliability.**

- **However, unlike new generation options, DR has a "voluntary customer" aspect that should be taken into account.**

- **The majority of customers who choose to participate in DR programs are typically not bound to continue their participation with DR programs for any extended length of time (from a utility planning perspective).**

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Limitations to Demand Response: Quality of Reserves

- **A prime example of the problems that can occur with a high level of reliance upon DR for maintaining system reliability is the experience of Florida Power Corporation (now Progress Energy Florida) in the mid-1990s.**

- **As a result, FPL and other utilities have examined ways to analyze how much of their projected future reserves are really made up of DR (and energy efficiency/EE) resources.**

- **FPL's analytical methods have included:**
  - **reserve margin calculation scenarios in which 0%-to- less than 100% of the projected DR contribution is assumed; and,**
  - **LOLP-based projections of the monthly frequency with which LC programs will be dispatched.**

- **Through these analyses, FPL seeks to maintain a balance between DR (and EE) resources and generation resources to ensure system reliability.**

Limitations to Demand Response: Quality of Reserves

- **The quality of reserves issue can also be compounded if the physical limits to DR are not correctly accounted for in a utility's resource planning.**

- **And, similar to the physical limits, the quality of reserves issue is heavily a utility-specific issue. The quantity of DR, the type of DR, and the reserves sharing capabilities and characteristics of neighboring utilities may result in differing importance in the quality of reserves issue from one utility to another.**

- **However, the greater the amount of DR that is implemented by a utility, the more important this issue becomes.**

Limitations to Demand Response: Conclusions

- **FPL's experience over almost 30 years with one of the largest DR portfolios in existence has taught valuable lessons in regard to DR planning and implementation.**

- **One lesson is that there is a physical limit as to how much DR is actually usable on a utility system.**

- **Another lesson is that a utility can become too dependent upon DR resources in regard to system reliability. Therefore, care must be taken not to reach that point.**

- **A third lesson is that both the physical limit and quality of reserves issues are: (i) highly utility-specific, and (ii) increasingly important as the amount of DR on a utility system increases.**