




Demand Response Programs Reduce Energy Costs at Armstrong's Main Campus

Central PA Chapter AEE, Lancaster,
September 27, 2012

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Principal Engineer





**2012
WORLD ENERGY
ENGINEERING CONGRESS**

October 31 to November 2, 2012
Georgia World Congress Center, Atlanta, GA



35TH WORLD ENERGY ENGINEERING CONGRESS At OR 05/05/12
10/31/2012 - 11/2/2012 Georgia World Congress Center, Atlanta, GA
Thursday, November 01, 2012 - 2:30:00 PM - 4:30:00 PM
Track G: Energy Services & Demand Response
Session G3: Demand Response

CHAIR

ID: 17117 Laurie Wiegand-Jackson, C.E.P.
9812 President
North America Power Partners LLC
3008 Harper Drive, Suite 320
Moorestown, NJ 08057
(856) 439-0800 Email: hwj@nappartners.com
jl@nappartners.com

2:30 - 3:00PM

On-Site Generation, Demand Response & Energy Management Technologies Achieve Energy Cost Savings at Corporate Headquarters
ID: 2650 David A. Eberly, P.E., C.E.M., GBE, CSDP, CEA
9860 Principal Engineer, Corporate Facilities Management
Armstrong World Industries
2500 Columbia Ave, PO Box 3001
Lancaster, PA 17604-3001
(717) 396-5666 Email: daeberly@armstrong.com

3:00 - 3:30PM

Practical Strategies for Maximizing the Value of Demand Response
ID: 49163 Gregg M. Dixon, CEM, CDSM, CSDP
9862 Senior Vice President, Marketing & Sales
EnerNOC, Inc.
101 Federal Street, Suite 1100
Boston, MA 02110
(617) 492-2523 Email: gdixon@enernoc.com
lholwing@enernoc.com

3:30 - 4:00PM

Maximizing Demand Response Opportunities
ID: 47 Lindsay P. Audin, C.E.M., C.E.P., LEED AP
5861 President
Energywise, Inc.
221 Cleveland Drive
Croton, NY 10520
(914) 271-4501 Email: Energywise@aol.com





Demand Response Case Study



Presentation Agenda

- Armstrong Corporate Campus
- DR Programs History, background
- Review PJM, PPL DR Programs
- Campus Energy Management
- Implementing DR Events
- Achieved Benefits and Results
- Review and Questions








Corporate Campus



The Place





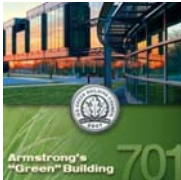


- 600 acre site, about 200 acres developed w/roads, buildings
- 28 buildings, 1,000,000 sf conditioned space, for 900 employees
- buildings constructed between 1950 and 1998



Corporate Campus




LEED™ EB Platinum Certification at Corporate Headquarters, 2007
Energy Star® Labels, 2006, 2008, 2009, 2010, and 2011

Armstrong Corporate Campus



Building 5B-- constructed in 1995 -- AFP, Corporate Purchasing Offices

Building 5B achieved EPA's Energy Star® Label in 2009, 2010, and 2011

Armstrong Energy Star Certifications




In recognition of superior energy performance, the U.S. Environmental Protection Agency awards the ENERGY STAR® to

Armstrong World Industries, Corporate Headquarters, Building 701

Buildings that earn EPA's ENERGY STAR use 35 percent less energy and generate 35 percent fewer greenhouse gas emissions than similar buildings across the nation.

December 14, 2011

Armstrong Energy Star Certifications



In recognition of superior energy performance, the U.S. Environmental Protection Agency awards the ENERGY STAR® to

Building 5B, Armstrong Corporate Campus

Buildings that earn EPA's ENERGY STAR use 35 percent less energy and generate 35 percent fewer greenhouse gas emissions than similar buildings across the nation.

January 3, 2012

Armstrong Demand Response Background

Armstrong DR Programs Historical perspective

- IS Rates from 1998 to 2000 to PPL customers
 - firm vs interruptible service savings potential, LP-4 tariff

Rate	Firm kW	Savings	Cost/kwh
Firm	100 %	0%	\$0.061
Interruptible	3,000	3.3%	\$0.059
	2,500	8.2%	\$0.056
	2,000	14.7%	\$0.052
	1,500	19.6%	\$0.049
	1,000	26.2%	\$0.045

- The 26% savings represented \$300,000 annually
- Curtailment generation economic justification

Armstrong Demand Response Background

Generator Project Justification

- Size generation to achieve 1,000 kW import target, estimated annual savings of \$300,000
- Total savings guaranteed through frozen rates by (PUC) until 2009 -- \$2,500,000
- Installed cost of generator less than \$350/kW or \$700,000
- Annual operating costs (fuel, PM) at 200 hours, \$30,000 **

** Fuel Cost @ \$2.00/gallon, Annual PM expense \$2,500

Armstrong Demand Response Background

2 MW Curtailment Generator Commissioned in 2001



- # 1 substation, generator set, step-up transformer, and 20,000 gal fuel tank
- Substation voltages 460, 4,160 , and 12,470 vac
- Cabling distance from revenue/distribution point is 1,800 feet (X2)
- Existing 250 MCM, 15kv cable to #3 substation



Armstrong | Demand Response Background |

Characteristics of Gen System

- 2,000 kW Standby, 1,850 kW Prime rating
- 3,000 hp Detroit Diesel, 16 cylinder engine, fuel injected, turbocharged
- Marathon, 4-pole alternator, 480 volt output
- Kohler PD-100 Integrated controller, LCD operator interface, automatic synchronism & parallel operation
- Water cooled, 150 gal glycol loop, 100 hp fan
- Fuel Consumption, 133 gal/hr at 100 % load

Armstrong | Review DR Programs |

PJM Demand Response Opportunities

- Emergency Demand Response Program
 - Demand Resource (DR) in Capacity Market
- Economic Demand Response Program
 - Day Ahead Dispatch
 - Real Time Dispatch
- Ancillary Services
 - Synchronous Reserves
 - Regulation
 - DA Scheduling Reserves

Armstrong | Review DR Programs |

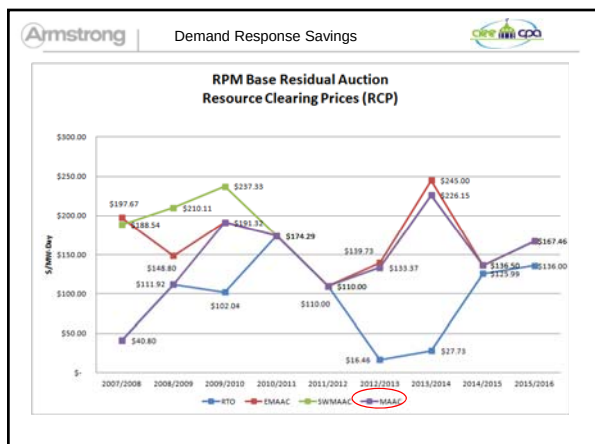
PJM Emergency DSR Program

- The Emergency Program historically called during capacity shortfalls known Emergency Load Response Events
- DR provides capacity and energy during LM Events
- DR paid for capacity based on the PJM capacity market
- DR paid for energy during a LM Event
- DR can be called on a sub zonal, zonal or regional basis at PJM's discretion
- Most popular DR Program
 - High value (depending on location)
 - Modest requirements for DR
 - Annual Registration cycle

Armstrong | Review DR Programs |

PJM Emergency DSR Program (cont.)

- Current DR Qualifications:
 - Must agree to up to ten interruptions per Delivery Year, of up to six hours in length each
 - Must be interruptible with no more than two hours notification
- Load reduction measurement for capacity (Measurement & Verification)
 - Based on load reduction capability or a minimum load requirement
 - Performance test required if no event occurs
- Energy Payment (M&V) for load reductions during LM Events



Armstrong Demand Response Background 

Forecast Demand Response Capacity Payments in MACC

Year	\$ MW per day	Annual \$ per MW
2012/2013	\$133.31	\$48,680
2013/2014	\$226.15	\$82,544
2014/2015	\$136.50	\$49,822
2015/2016	\$167.46	\$61,122
Total – 4 yrs		\$242,168

Armstrong Review DR Programs 

PJM Ancillary Service Markets

- Demand Response resources in PJM can participate in the following Ancillary Service Markets since May 1, 2006:
 - Synchronized (Spinning) Reserve
 - Regulation (some participation to date, high value but difficult operational requirements)
 - Day-Ahead Scheduling Reserves (low value, little participation)
- Resources are paid the applicable clearing price for providing the service
- Markets are cleared hourly throughout the day for Synch Reserves and Regulation; Day-Ahead for Day-Ahead Scheduling Reserves

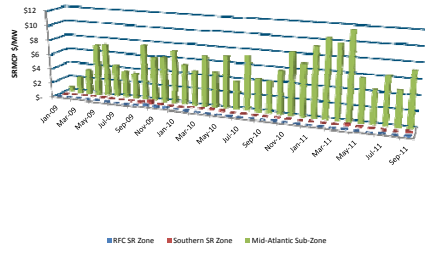
Armstrong Review DR Programs 

PJM Synch Reserve Market

- Capable of reducing load in less than 10 minutes upon automated signal
- One minute interval energy data
- Resources are paid the Synch Reserve market clearing price for providing the service
- Annual average value of about \$35,000/MW-yr based on 8760 hours of participation
- Synch Reserve Events
 - Typically last about 10 minutes
 - On Average events occur about twice per month

Armstrong Demand Response Savings 

PJM SR Historical Pricing



Armstrong SRM Market Earnings, 2011 

Welcome to Enerwise Energy Manager 

Synchronized Reserve - Summary Report
Armstrong World Industries
2011-01-01 - 2011-12-31

Wholesale Markets	WPP, MW Paid	Avg. Market Clearing Price (\$)	Total WPP, Total Earned (\$)	Clearing Price Per MW (\$)
Exceptions	1.49	9.87	9,246.30	6,205.37

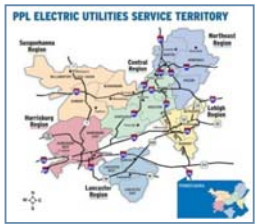
* There can be up to a 30 day lag in PPM posting some data impacting the financial results in the Synch Reserve market.
** and all data should be considered preliminary until 30 days after the end of the period.
*** All financial data are estimates and are for informational purposes only.

Time Interval	Avg. MW Paid	Avg. Market Clearing Price (\$)	Total WPP, Total Earned (\$)	Clearing Price Per MW (\$)
Jan 2011	1.44	9.28	1,356.70	9,420.97
Feb 2011	1.48	10.43	1,543.52	10,430.49
Mar 2011	1.50	9.39	1,408.70	9,393.92
Apr 2011	1.40	12.89	1,804.16	12,893.36
May 2011	1.42	8.42	1,195.50	8,420.79
Jun 2011	1.55	9.81	1,520.50	9,810.62
Jul 2011	1.60	13.49	2,158.40	13,490.19
Aug 2011	1.60	8.31	1,330.00	8,310.00
Sep 2011	1.54	9.12	1,404.48	9,120.06
Oct 2011	1.48	8.43	1,247.84	8,430.73
Nov 2011	1.46	8.66	1,263.56	8,660.65
Dec 2011	1.46	8.57	1,251.42	8,570.79

Armstrong Review DR Programs 

In 2012 PPL Electric Utilities partnered with EnerNOC to help reduce its peak demand

- All PA electric distribution companies required to reduce their peak electricity demand by 4.5% by May 2013
 - Mandated by Act 129, which was signed into law November 2008
- To achieve this, PPL Electric Utilities is working with EnerNOC to create the E-power - Demand Response Program for C&I customers
 - C&I customers can choose how many hours per year they will participate (0-50 hours)
 - Increased compensation is offered to customers who can participate for more hours



Armstrong | Review DR Programs | 

E-power® Demand Response Program Fast Facts

- Coverage: PPL Electric Utilities service territory
- Response types: curtailment and backup generation
- Timing: Summer 2012 (June 1 thru September 30) 10:00 am to 10 pm, with majority of dispatches between 12 pm and 7 pm; excludes weekends and holidays
- Advance Notice: 3 hours
- Event Duration: 1 hour minimum, 6 hour maximum
- Payment Structure
 - \$300/Mwh for first 10 Delivered Performance Hours (DPH)
 - \$400/Mwh for DPH, 11 through 30
 - \$500/Mwh for all DPH greater than 30

Armstrong | Demand Response Case Study | 

Campus Energy Management

- Building Automation – EMCS
Johnson Controls
- Electrical Power Monitoring
Square D PowerLogic

Armstrong | Application of Best Energy Practices | 



Measure -- Measure -- Measure

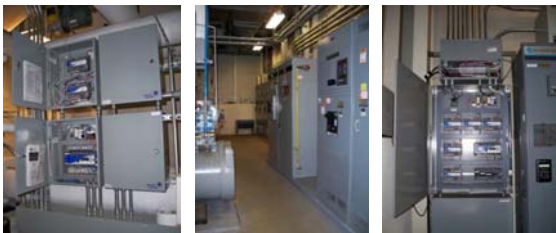
Armstrong | Demand Response Savings | 



Johnson Controls Workstation and Installed Hardware

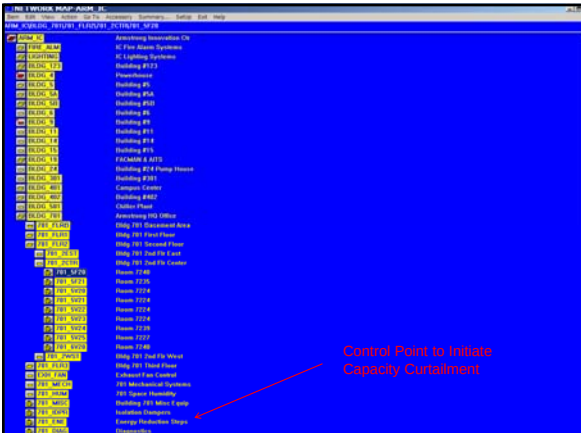


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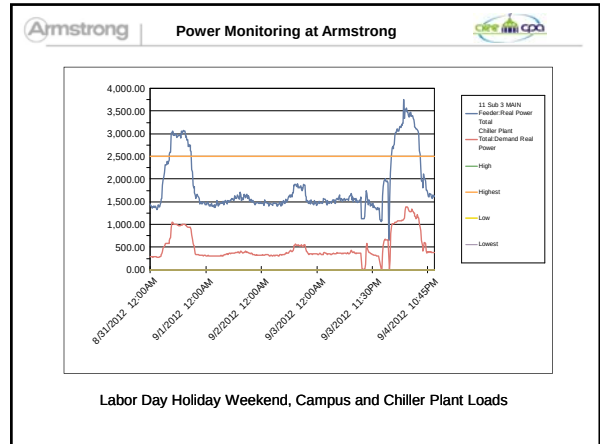
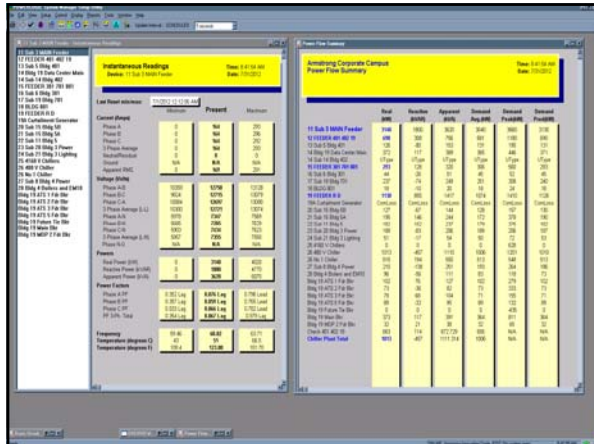


Data Center Comms Chiller Plant, Bldg 501





Control Point to initiate Capacity Curtailment



Demand Response Savings

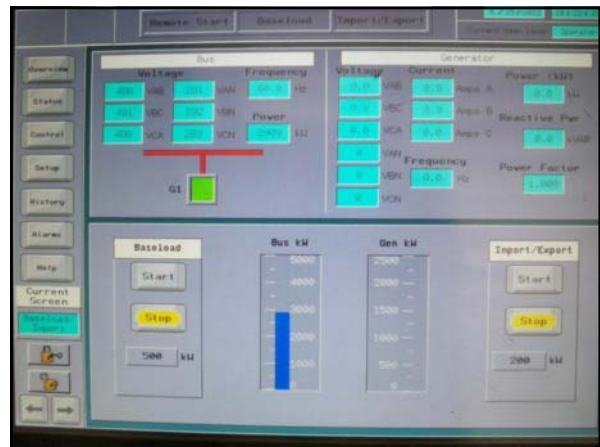
Implementing DR Events

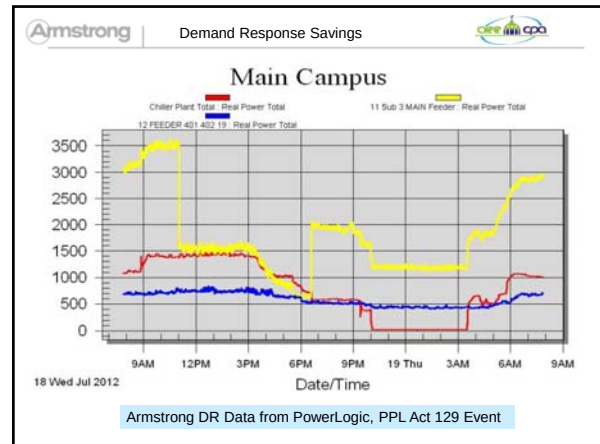
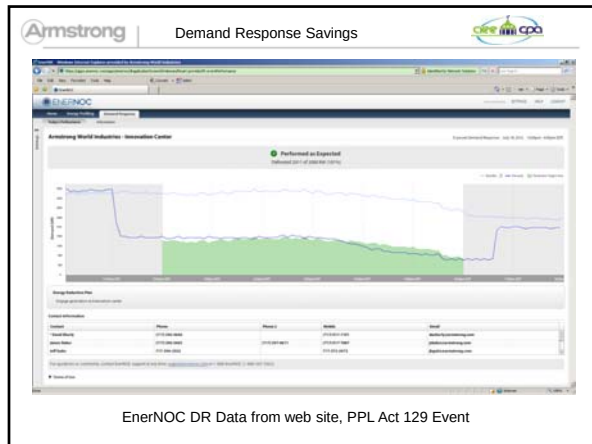
- PPL Act 129 *E-Power*® event
- Synchronized Reserve
- PJM ELRP Capacity event

Demand Response Savings

PPL Act 129 *E-Power*® event

- Main Campus contracted for 60,000 mWh (30 hrs) for the 2012/2013 season
- Capacity is provided only using Campus curtailment generator
- Manual dispatch by site team
- EnerNOC provides 2 hour advance notifications by telephone and email
- Real time event monitoring





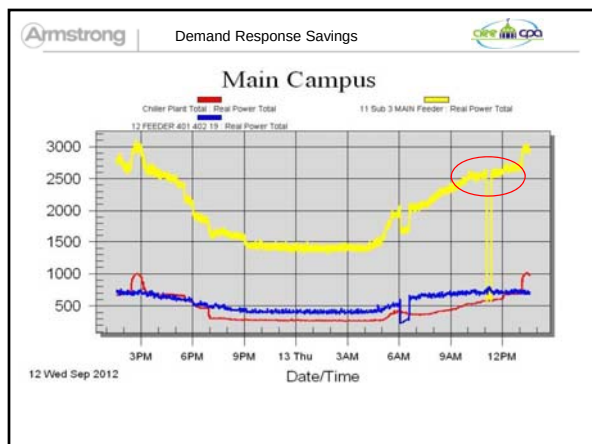
Armstrong Demand Response Savings

PJM Synchronized Reserve Event

- Market participation using only the Campus 2 MW curtailment generator
- Enrolled capacity is seasonal, time of day sensitive
- Generation remotely started and stopped by CSP
- Response time of ≤ 10 minutes, manual response not practical
- Dispatches by CSP automated telemetry
- SR events typically of short duration, < 15 minutes

Armstrong Demand Response Savings

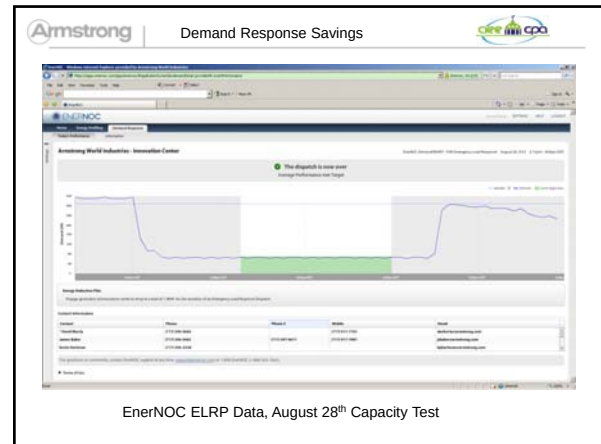
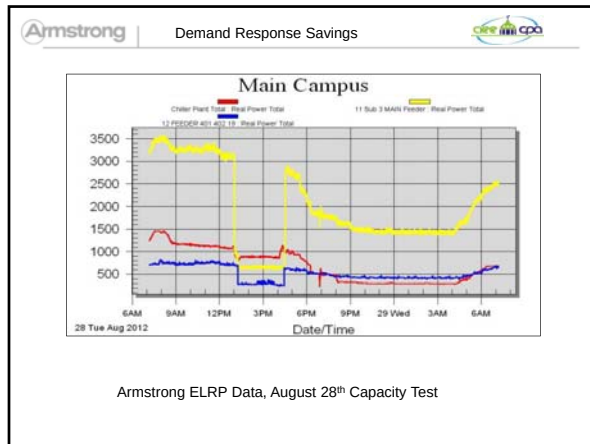
Dispatch and Alarming Telemetry installed at Curtailment Generator



Armstrong Demand Response Savings

PJM ELRP Capacity Event

- Main Campus contracted for 700 kW Firm Service Level (FSL) level from PPL during ELRP dispatches
- Load curtailment process developed utilizing EMCS to implement Campus reductions
- Process encompasses reducing Chiller plant loads, equipment shutdowns, and Campus generation
- 80% of total Campus load can be shed in less than 2 hours with minimal noticeable change to employees



Demand Response Savings

Achieved Benefits and Results

- Synchronized Reserve
- PPL Act 129 *E-Power*® events
- PJM ELRP Capacity

Armstrong Demand Response Savings Summary

Year	SRM	ELRP Capacity	PPL Act 129	Totals
2008	\$19,700	\$40,850	N/A	\$60,550
2009	\$48,733	\$69,832	N/A	\$118,565
2010	\$62,351	\$83,164	N/A	\$145,515
2011	\$85,277	\$97,186	N/A	\$182,463
2012	\$42,000*	\$97,632	\$32,000*	\$171,632 **
TOTALS	\$258,061	\$388,644	\$32,000	\$678,725

- Demand Response Program Earnings
- 2012 earnings budgeted at \$200,000 **

Demand Response Savings

Forecast – 2013 and Beyond

- Earnings potential
- Capital project to reduce FSL
- RICE – NESHAP Regulations ?

Armstrong DR Forecast

Earnings Potential in Existing DR Programs

Year	Annual \$/MW	Campus \$ at 700 kW FSL	SRM Estimate	Budgeted Savings
2012/2013	\$48,680	\$97,360	\$70,000	\$167,000
2013/2014	\$82,544	\$165,000	\$70,000	\$235,000
2014/2015	\$49,822	\$99,600	\$70,000	\$170,000
2015/2016	\$61,122	\$122,200	\$70,000	\$192,000
Totals – 4 yrs	\$242,168	\$484,000	\$280,000	\$764,000

Armstrong DR Forecast

Earnings Potential – by reducing FSL

Year	Annual \$/MW	Campus \$ at 2013 Fuel Price ¹	SRM Estimate	Budgeted Savings
2012/2013	\$48,680	\$97,360 N/A	\$70,000	\$167,000
2013/2014	\$82,544	\$206,200 (\$41,200)	\$70,000	\$276,200
2014/2015	\$49,822	\$124,500 (\$24,900)	\$70,000	\$194,500
2015/2016	\$61,122	\$152,700 (\$30,500)	\$70,000	\$222,700
Totals – 4 yrs	\$242,168	\$580,700 (\$97,000 +)	\$280,000	\$861,000

EPA Regulations What are the Differences?

- ▶ RICE NESHAP (National Emission Standards Hazardous Air Pollutants)
 - Applies to **existing**, new, and reconstructed stationary engines (both CI and SI)
 - Focus is **air toxics (HAP)**
 - Established under CAA section **112**
- ▶ CI/SI ICE NSPS
 - Applies to new, **modified**, and reconstructed stationary CI/SI engines
 - Focus is **criteria pollutants**
 - Established under CAA section **111**

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RICE NESHAP – Update

- ▶ 40 CFR part 63 subpart ZZZZ
- ▶ Regulates HAP emissions from stationary RICE at both major and area sources of HAP
 - All sizes of engines are covered
- ▶ **Current NESHAP, effective May 2013, CI engine use in emergency DR is capped at 15 hours annually**
- ▶ NOPR proposed June 7, EPA would allow:
 - 100 hours of emergency DR (includes testing and maint.)
 - 50 hours of non-emergency DR, peak shaving thru April 2017
- ▶ **ONLY EXEMPTION:** existing emergency engines located at residential, institutional, or commercial area sources
- ▶ Decision due late November; required by Dec 14th

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QUESTIONS ?

