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Integrated, Automated Distributed Generation (DG) Technologies Demonstration

Presented by:
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ATK Aerospace Systems

Smart Grid Peer Review, Denver, CO
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Background / Overview

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- ATK conducted a comprehensive plant-wide energy assessment (PWA) in FY07 and FY08.
- In 2008, initiated agreement with DOE/NETL for Phase I of distributed generation (DG) development project
- 2009 into 2010 – Phase I project
- Significant financial and technology adjustments
- 2010 agreement and funding for a Phase I extension

About ATK and the facility:

- What Is ATK?
- Where is the Promontory plant?
- Promontory facts
- Pictures

About the DG project:

- DG original project concepts
- Phase I implementation
- Phase I lessons learned
- Phase I extension project
- Plant demand analysis
- DG project summary

Alliant Techsystems Inc. (ATK)

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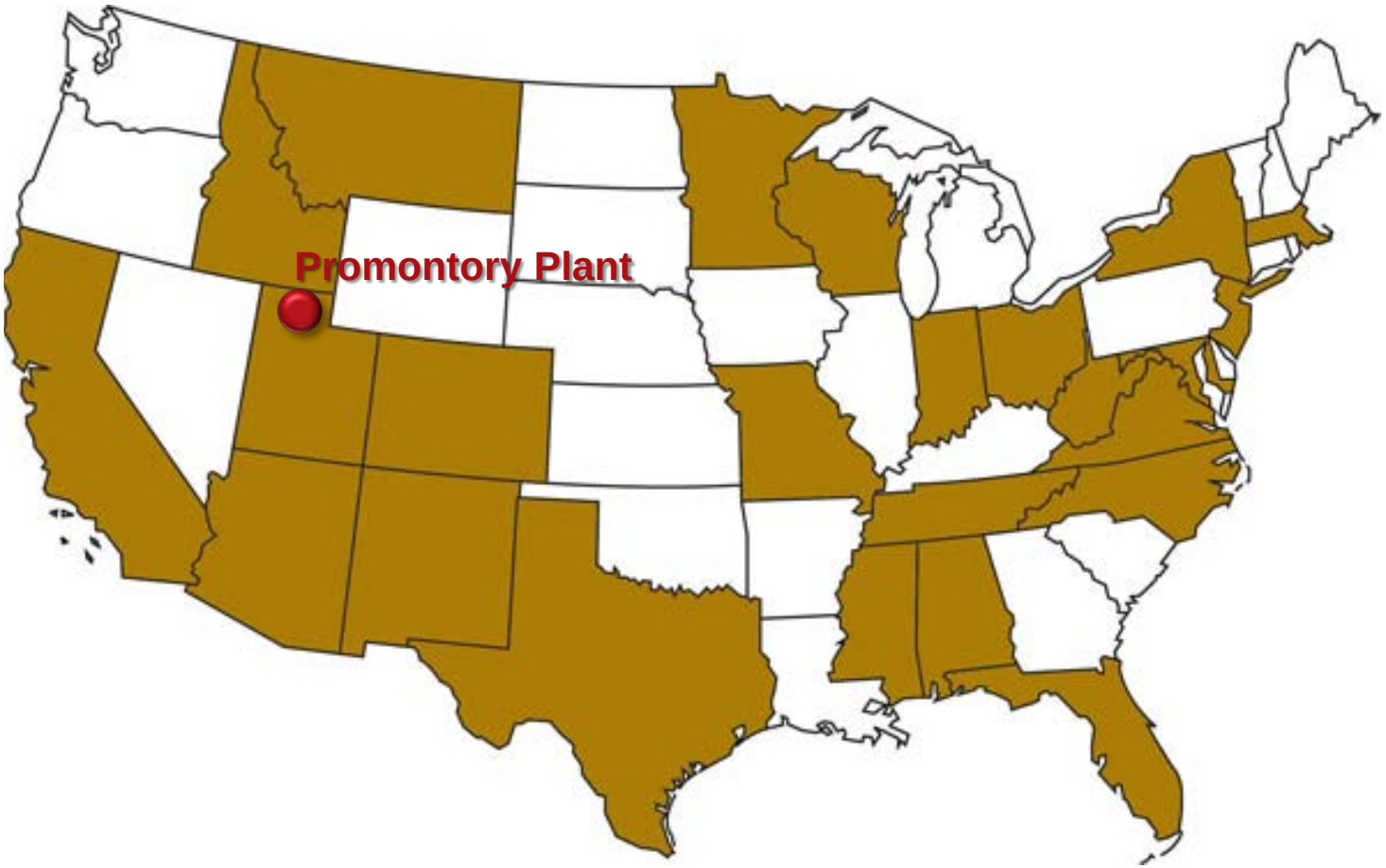

ATK Current Business Overview

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ATK is organized into four operating groups

Aerospace Systems
President: Blake Larson

- Solid propulsion systems
- Advanced composites
- Satellites, subsystems, and components
- Advanced antennae and radomes
- Energetic materials
- Military flares and decoys

Armament Systems
President: Karen Davies

- Small-caliber ammunition
- Medium-caliber ammunition
- Medium-caliber gun systems
- Precision munitions
- Propellants for ammunition and tactical rockets
- Large-caliber ammunition

Missile Products
President: Mike Kahn

- Missile systems
- Solid propulsion and control systems
- Solid rocket motors and warheads
- STAR motors
- Aircraft survivability
- Advanced structures and components

Security & Sporting
President: Ron Johnson

- Small-caliber ammunition
- Gun care and shooting accessories
- Sport shooting accessories and reloading supplies
- Law enforcement accessories and equipment

Where in the World Is Promontory, UT?

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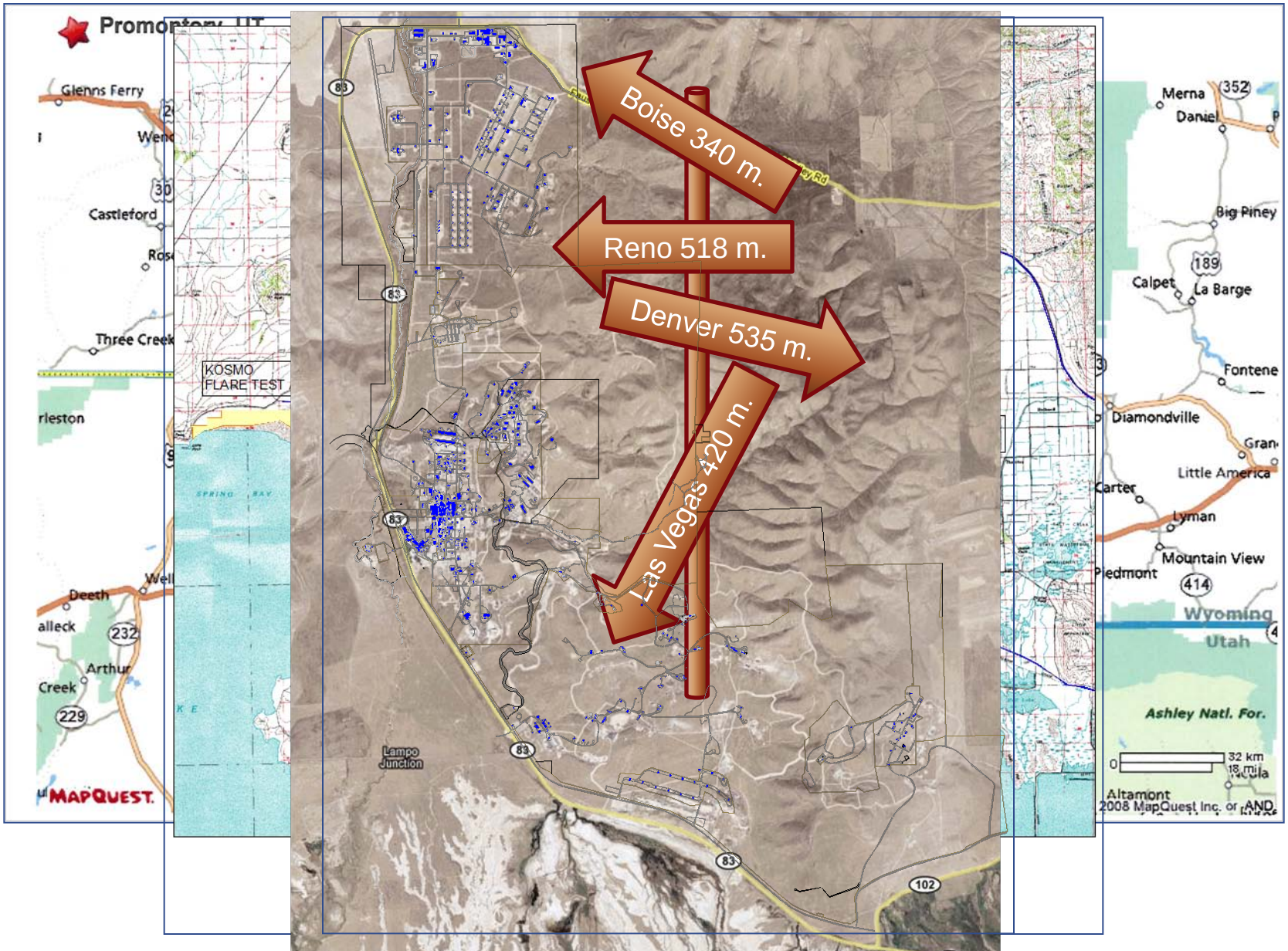

ATK Promontory “City” Facts

- 19,900-acre plant site
- Over 540 buildings
- 75 miles of roads
- 70 miles each of steam, condensate, and compressed air lines
- 60 miles of electrical power lines
- 75 miles of water lines
- Two waste water treatment plants
- 28 boiler houses
- Three main electrical substations
- Annual energy bill over $15,000,000

ATK Promontory Photos

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ATK Promontory Project

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Overall Project Purpose and Objectives

- Develop and demonstrate a diverse system of renewable DG technologies that are integrated into an intelligent system-wide automation system with two-way communications to the utility and that will produce a verifiable, on-demand reduction of at least 15% of substation load with no disruption of facility operations.

Major Milestones

- Design and test renewable DG systems controls
- Design and test the utility/customer gateway
- Engineer and install 2.6 MW of diverse, renewable, distributed generation
- Demonstrate system operations
- Measure and validate savings and systems benefits

Demonstrate that distributed/renewable resources can provide meaningful benefits to customers/users and utility/interconnected grid

ATK Project Original Structure

Project Partners:

- ATK Aerospace Systems – project management/host
- P&E Automation (San Diego, CA) – technology/experience
- Rocky Mountain Power (Div. of PacifiCorp) – interface/incentives

Structure: Phase I – development, Phase II – demonstration

Total Project Cost	$3,769,052	
	Phase I (FY09)	**Phase II** (FY 10 – FY13)
Total Budget	$878,673	$2,890,379
DOE Share 80/50%	$702,938	$1,445,190
P&E Cost Share 5/10%	$43,934	$289,038
ATK Share 15/40%	$131,801	$1,156,152
RMP Incentive (reimbursement)	$0	$700,000
Annual energy savings $800K		

Project Management – milestone based tracking

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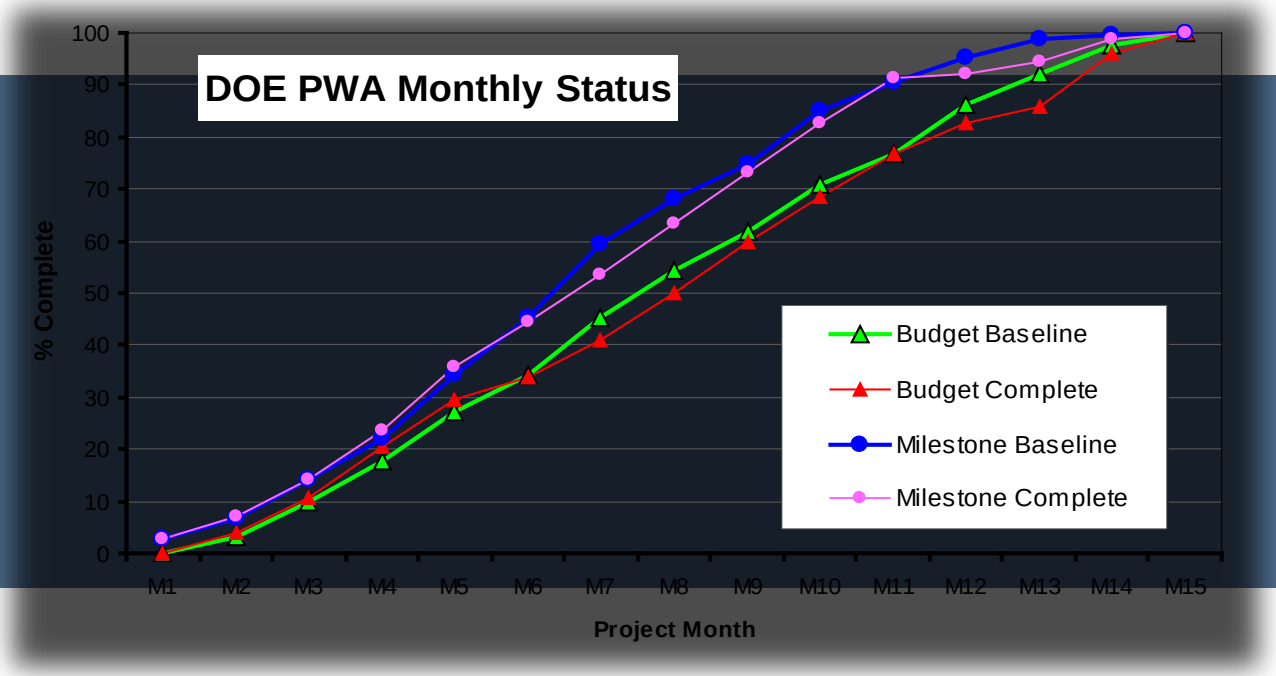

Recent DOE plant-wide assessment

- Tracked budget and task milestones against baselines
- Same management team in place

Tracking metrics alert to deviations BEFORE they impact project success

- Budget plan-to-actual
- Schedule plan-to-actual
- Fine-grained milestone plans — projects can have hundreds of trackable milestones

Demand Reduction / Peak Shaving:

Renewable Distributed Generation

- Mix of renewable technologies
- Integrated monitoring and control
  - Includes automated measurement and verification
  - Can be integrated with future plant-wide system control and data acquisition (SCADA)

Customer/Utility communications: Utility Gateway Application

- Provides utility real-time visibility into customer-owned renewable DG resources
- Two-way Customer <> Utility web interface
  - Real-time behind-the-meter customer generation data
  - *Real-time utility distribution, capacity and quality data*
  - *Extensible to include real-time pricing*
  - Day ahead dispatch notification

DG Implementation Summary

Phase I Development (Year 1 – FY2009)

- Design and testing of reliable and effective DG controls
- Design and preliminary testing of utility gateway hardware and software
- Collect/compile historical baseline data
- Provide full design, engineering, specifications of DG
- Design and installation of sufficient generation equipment to validate Phase II feasibility
  - Two wind turbines (2 kW each)
  - One micro-hydro turbine (10 kW)
  - One compressed air generation/storage device (20 kW)

Decision point: Successful completion of Phase I, mutual agreement to proceed with Phase II

Project Equipment – Wind

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Project Equipment – Hydro

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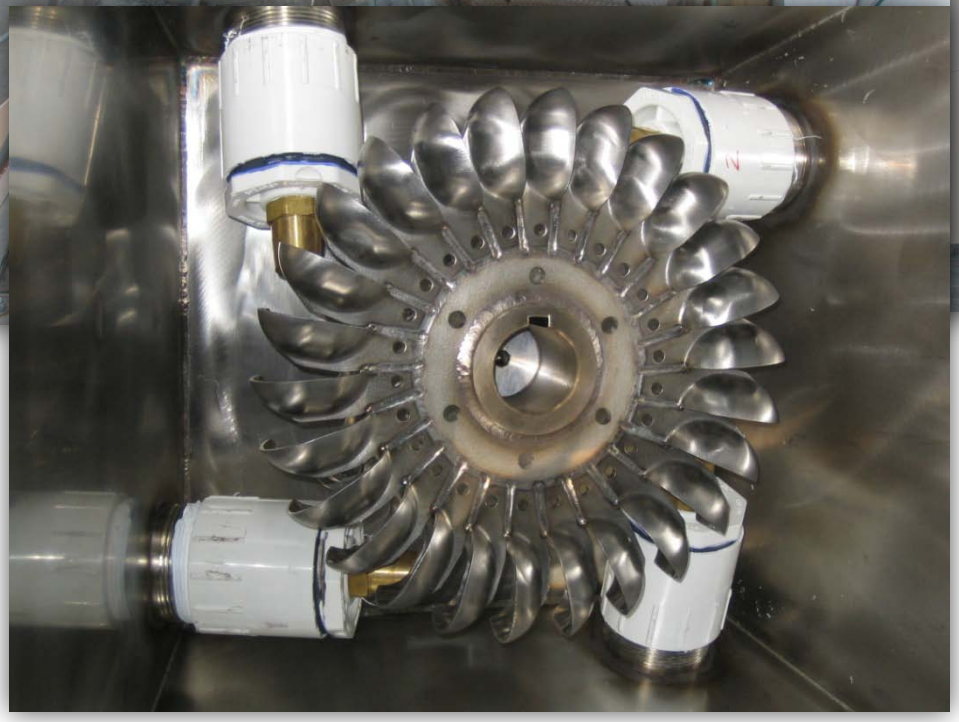

Project Equipment – Compressed Air

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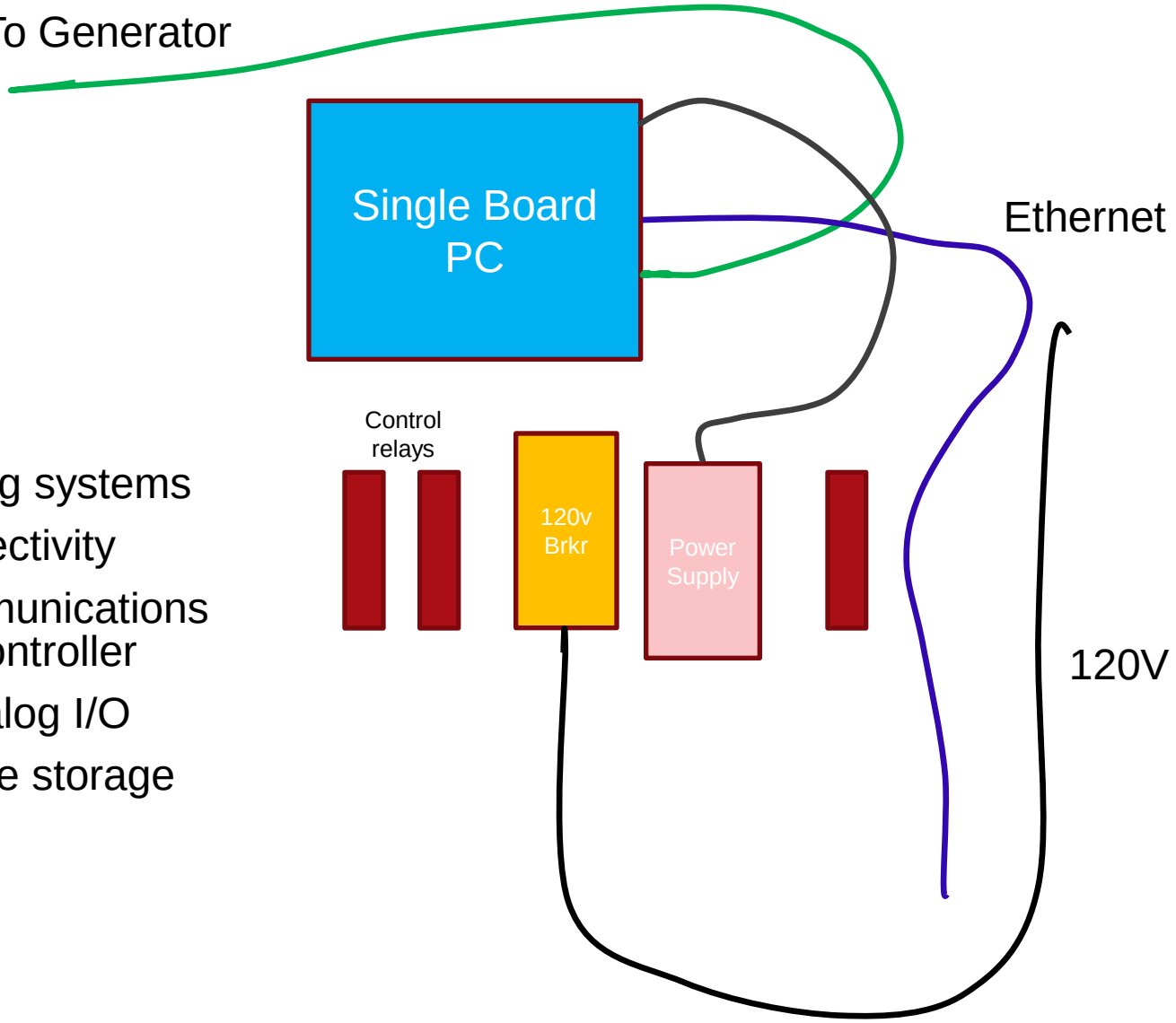
Project Equipment – Controls

PC

- Std IT operating systems
- Ethernet connectivity
- Two-way communications to generator controller
- Digital and analog I/O
- Std IT database storage
- Low cost



Project Presentations

- DOE Peer Review – Red Bank, NJ – Oct 2008
- Energy Congress – Atlanta – Apr 2009 – Voldness
- Energy Solutions Center – Salt Lake City – Jun 2009
- Utah Public Service Commission – Jul 2009
- Questar Annual Customer Meeting – Sep 2009
- FMA Congress – Chicago – Sep 2009 – Gosen
- International MicroGrid Symposium – San Diego – Sep 2009
- Utah Energy Users – Salt Lake City – Oct 2009
- Utah Energy Forum – Utah State Capital – March 2009
- Utah Public Service Commission – Promontory site visit – May 2010
- MicroGrid Update – Teleconference – May 2010

Lesson Learned

Interconnection agreement

- First meeting – $100K cost two years
- Application process and fast track process
- Approval – utility is in control and can be a huge impediment

Utility interface and cooperation

- No tariffs, no way to ensure recovery of costs
- Look other way, allow us to hook up with appropriate technical personnel

Viability of large-scale hydro storage

- No viable “run of pipe” installation locations (large pipe, small flows)
- Must have upper and lower storage capacity for effective demand capacity

Lesson Learned

Viability of compressed air storage

- Better to eliminate sources of waste compressed air versus generating, knowing when excess can be stored, collecting waste, amplifying, and storing at high pressure
- Generating unit had significant “parasitic” loads; not yet found way to de-energize and then operate properly when needed

Viability of compressor waste heat for electric generation

- Waste heat from compressors is too low temperature to efficiently use in an ORC unit

Use of standard IT equipment and operating systems for monitoring/control/data collection

- Successfully used standard single board, solid-state-storage PCs running Lynex operating systems; to talk to the generation equipment and then process and send data to a central database for storage
- Database source of all data for control and measurement and reporting
- Used existing plant Ethernet for communication to PCs and database

Lesson Learned

15% demand control with planned mix/type of resources

- Study of plant kW curves
  - 76% avg load factor
  - 15% demand reduction required 10 – 12 hours per day of peak resource operation
    - Compressed air resources limited to less than one hour per day operation
    - Hydro resource maximum of three hours per day
  - Needed to re-plan an effective 15% demand reduction generation equipment mix

Utility scale battery storage options

- Investigated battery storage option
- 500 kW capacity for five hours per day
- Use of wind and boiler waste heat recovery for re-charging battery
- Good match for a 3 – 4% demand reduction

Phase I Extension approach

- Battery can provide 500 kW for up to 5 hours per day
  - Battery system are fully self contained requiring minimal installation and integration costs
- Steam boilers stack waste heat is a viable source for current Organic Rankine Cycle technology (temperatures above 300 F)
  - Will provide waste heat operating experience that should prove useful for potential future geothermal generation (Phase II?)
- Wind generation can be scaled to provide energy to recharge battery for a true renewable resource
- Waste heat capacity will provide energy for battery recharge.
- Battery charge/discharge cycles will be tested to optimize cycle versus simple full daily charge and discharge.
- Utility off-peak energy price differential to on-peak may also prove to be a cost effective source of battery recharge ($.022518 versus $035858/kWh, 59 percent higher not including peak demand or facility charges)

DG Implementation – Phase I Extension

Two-year project – Oct 2010 to Sep 2012

Project cost $1.8M; DOE $1,445K, ATK $361K

- Project scope
  - One wind generator – 100 kW
  - Two waste heat recovery generators – boiler stack – 50 kW ea – 100 kW
  - One battery storage unit – 500 kW

- Data collection
  - Utility gateway two-way communications
  - Automated measurement & verification
  - Automated optimization of DG resource usage (3.4% demand reduction)
    - or RMP system peak reduction
  - Validate operational savings – $150K/year

Promontory Demand Profile

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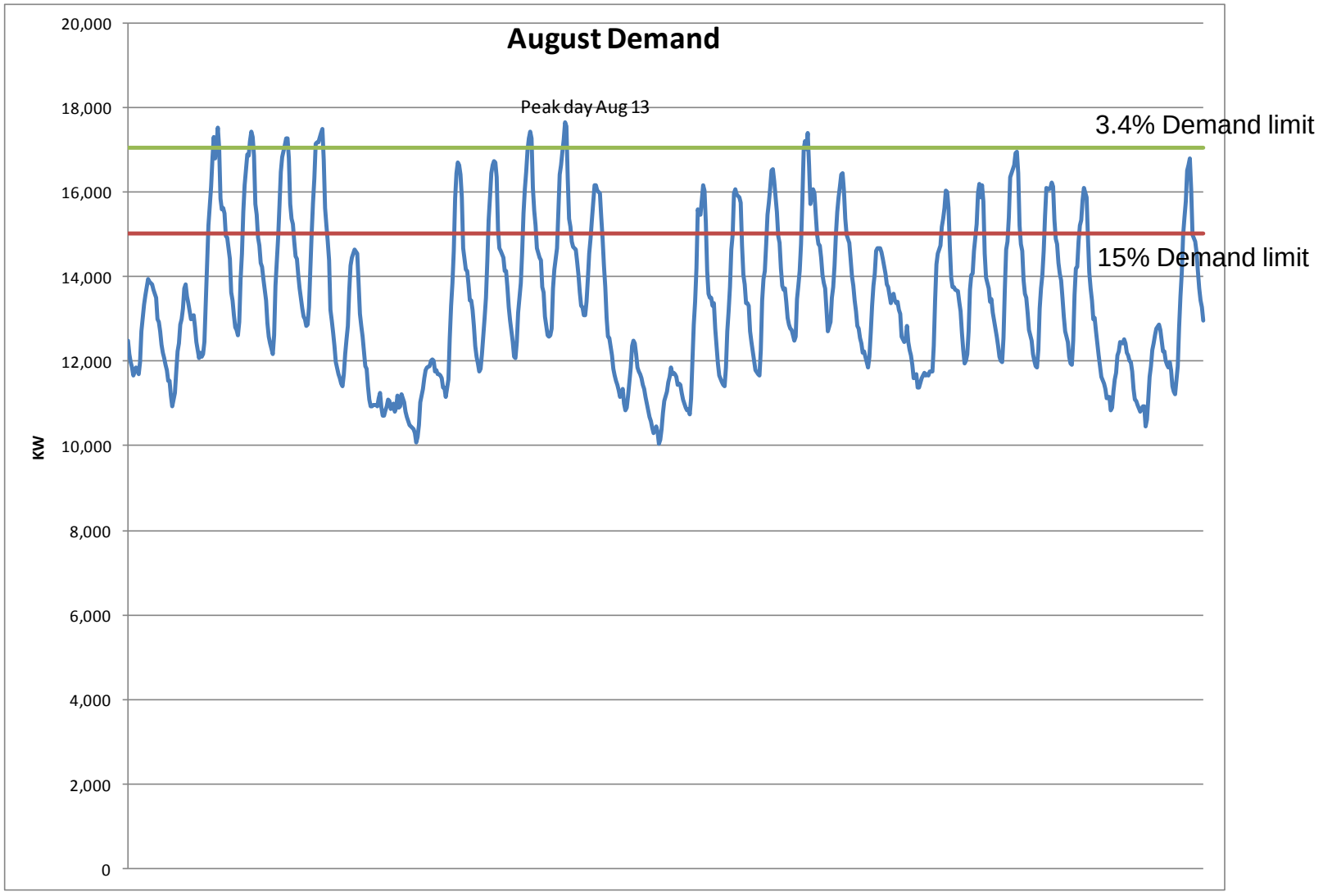

Demand Reduction – Data Analysis

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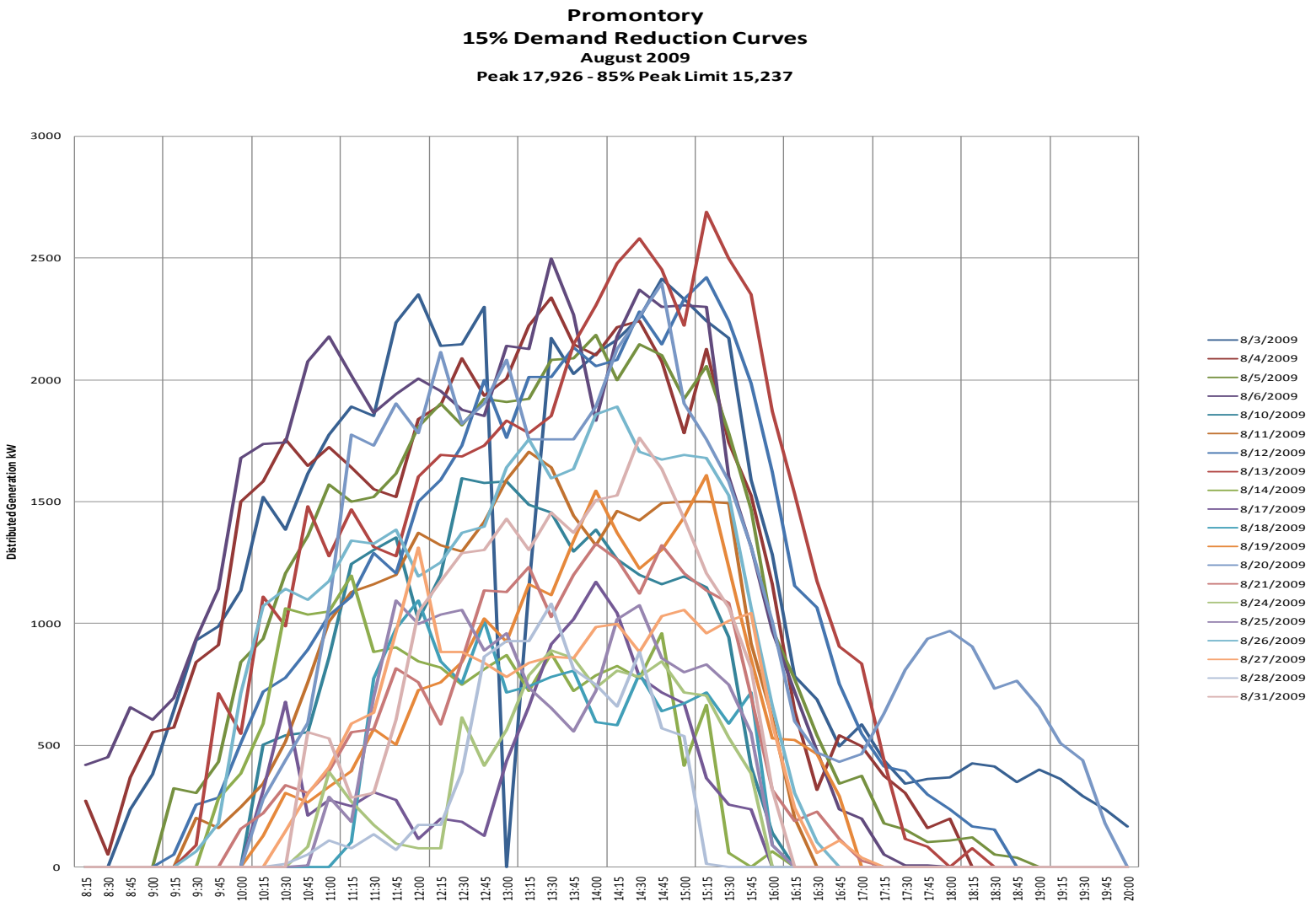

Demand Reduction – Data Analysis

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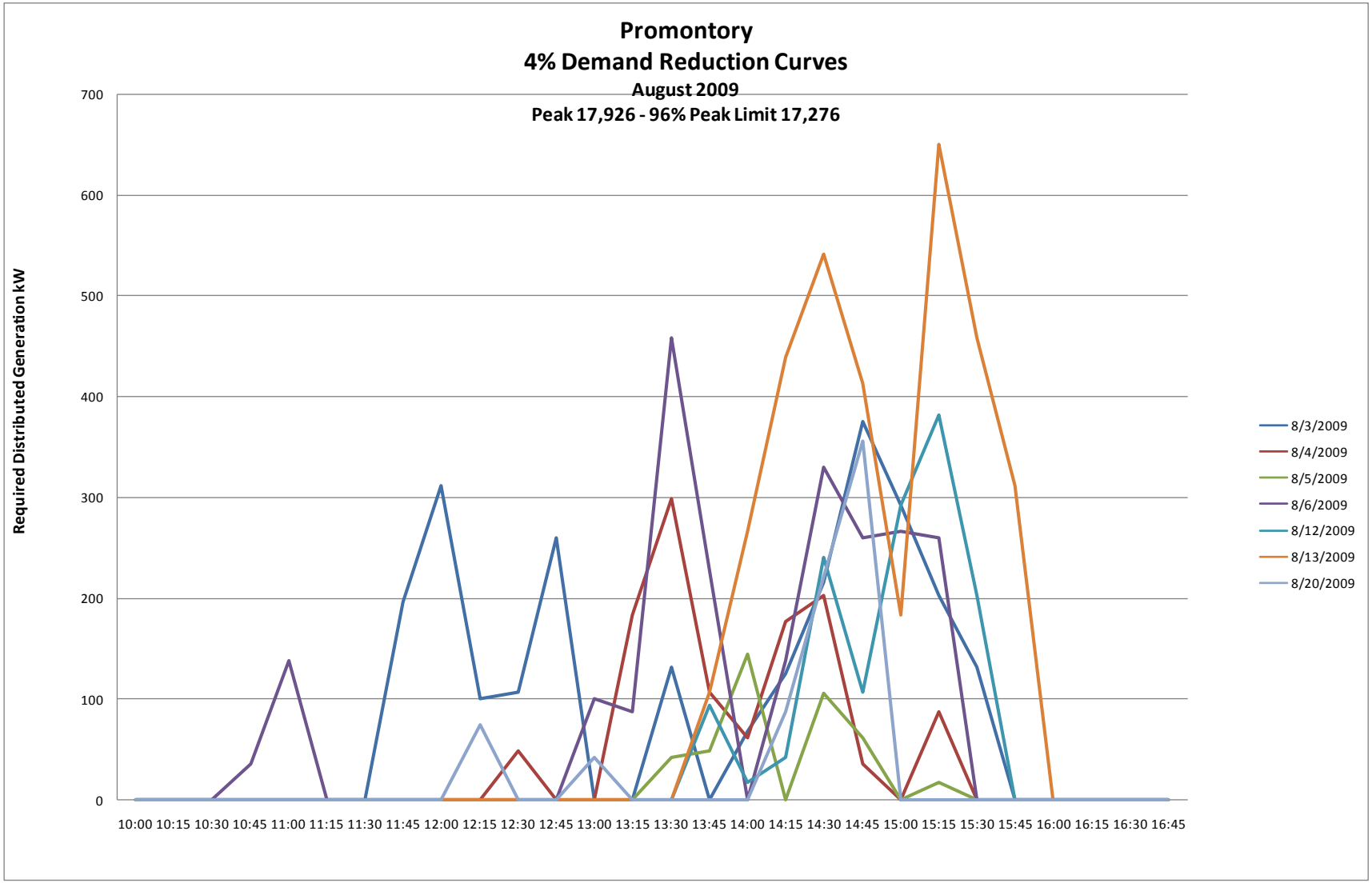

Peak Demand Reduction – 15%

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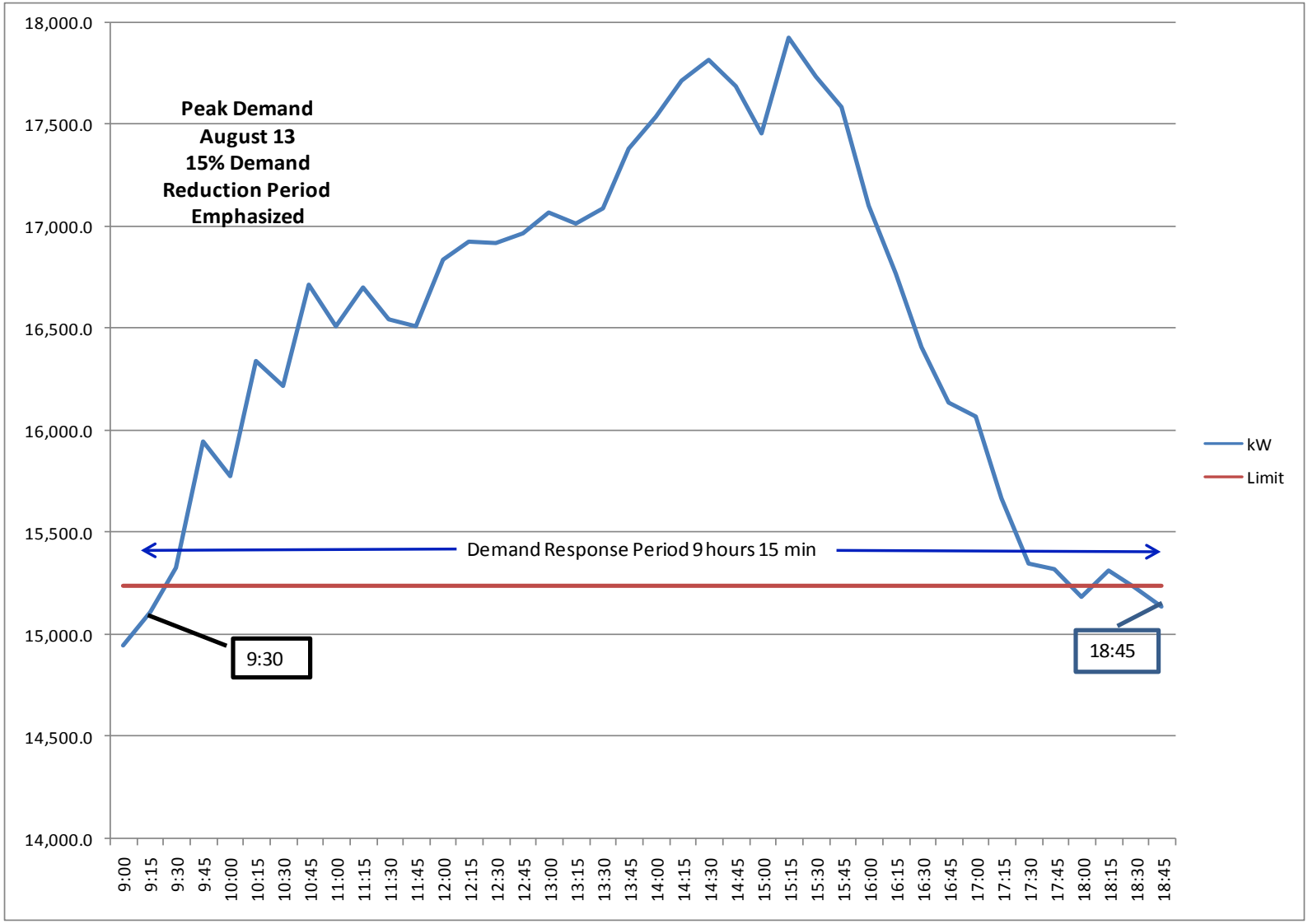

Peak Demand Reduction – 3.4%

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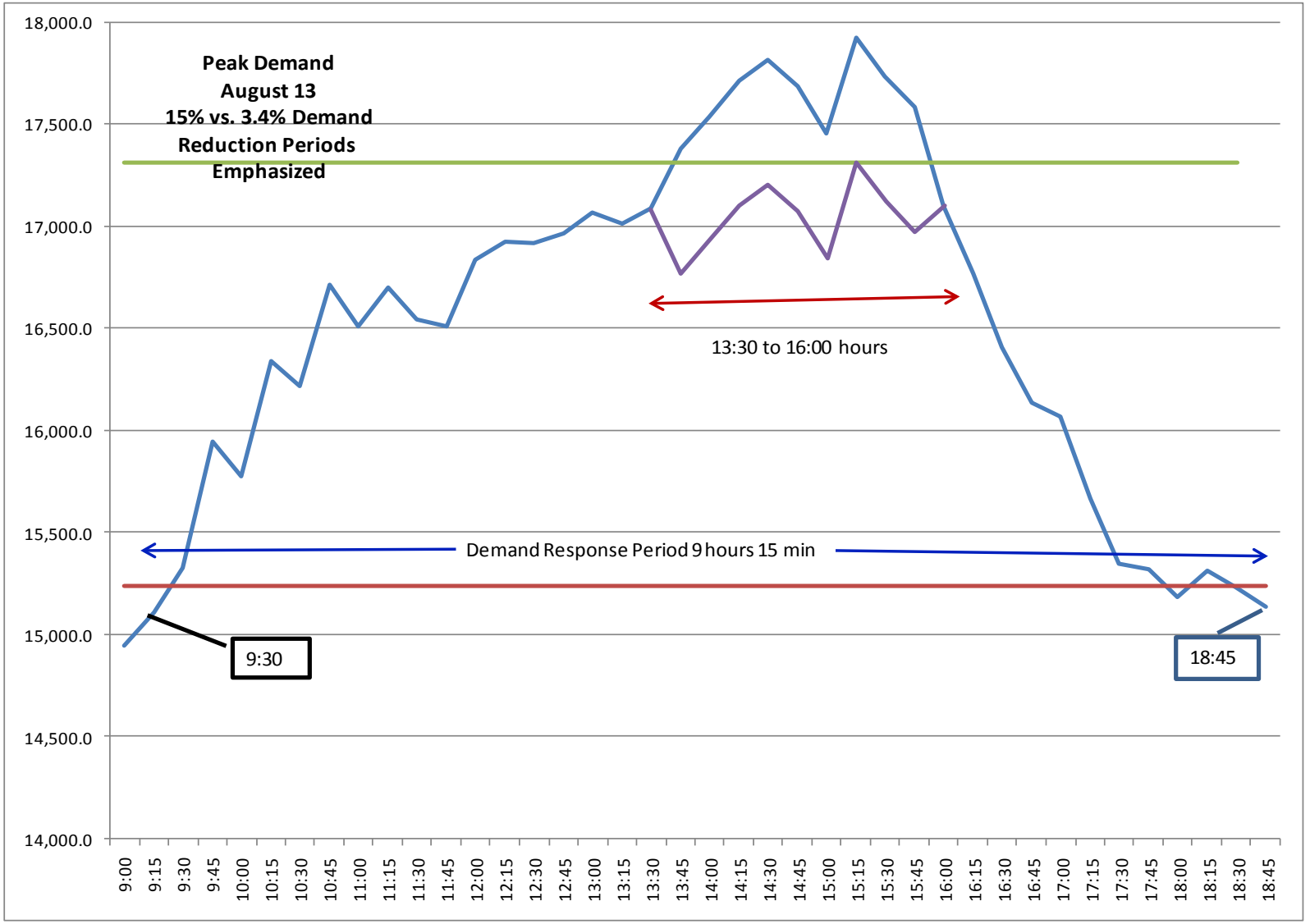

Demand Reduction – Fixed Resource

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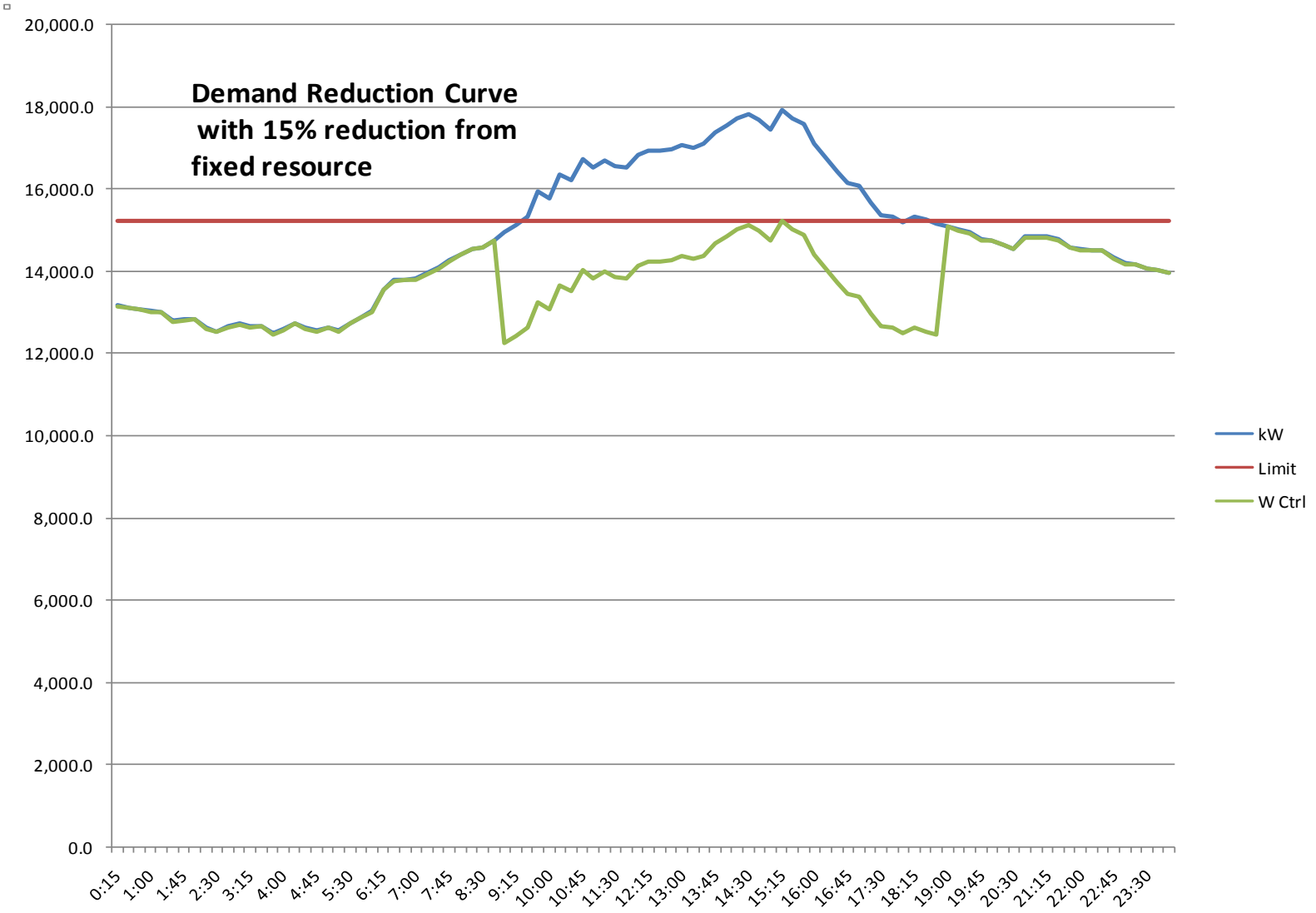

Demand Resource – Load Following

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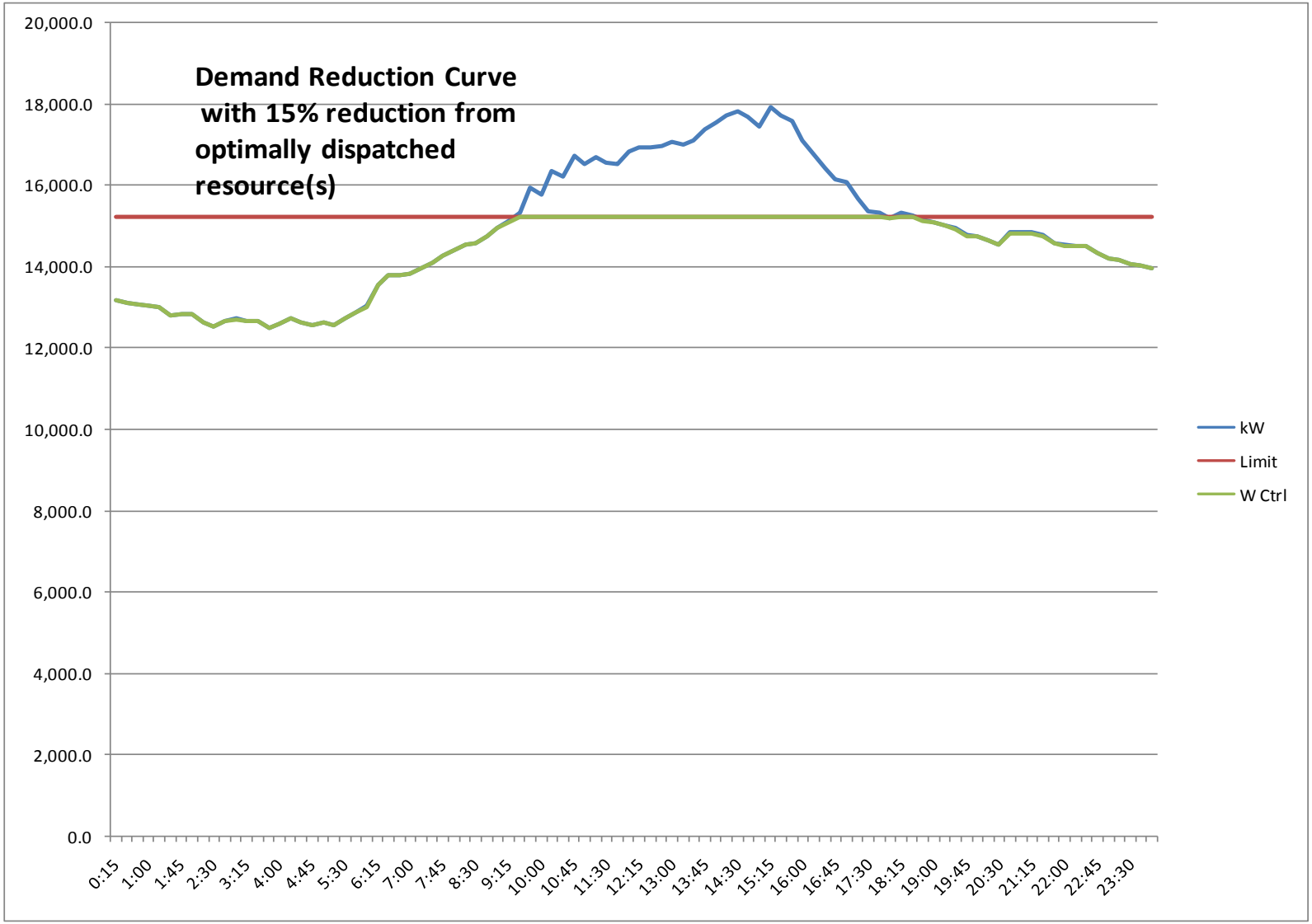

Demand Resource – Utility Dispatch

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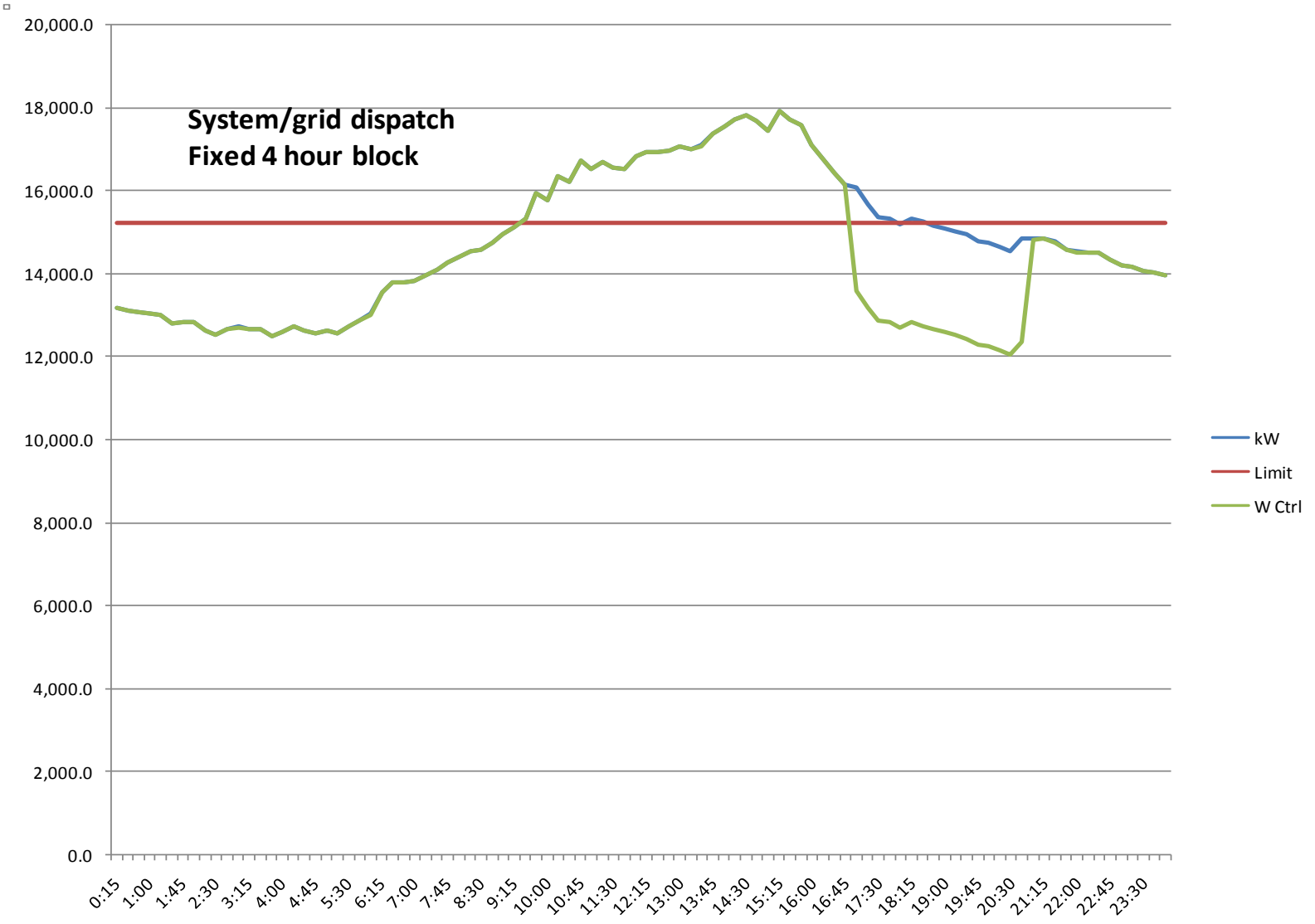

Summary/Benefits

Project will provide NETL with extensible technologies

- Gateway application provides utility with real-time visibility to customer renewable and storage DG capacity
- Controls based on open, IT standards for portability to other utilities and customers
- Use of utility grade battery system for renewable energy storage and demand control
- Use of boiler waste heat for electric generation using ORC

Unique monitoring/control application optimizes mixed DG for demand control

- Application to determine real-time optimal usage of DG resource based on
  - resource availability (wind)
  - peak load
  - available stored energy
  - on and off peak energy cost differentials
  - utility dispatch

Contact Information

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