Sterling Municipal Light Dept.

AEE Technical Round Table

Best Practices in Battery Storage

November 14, 2017

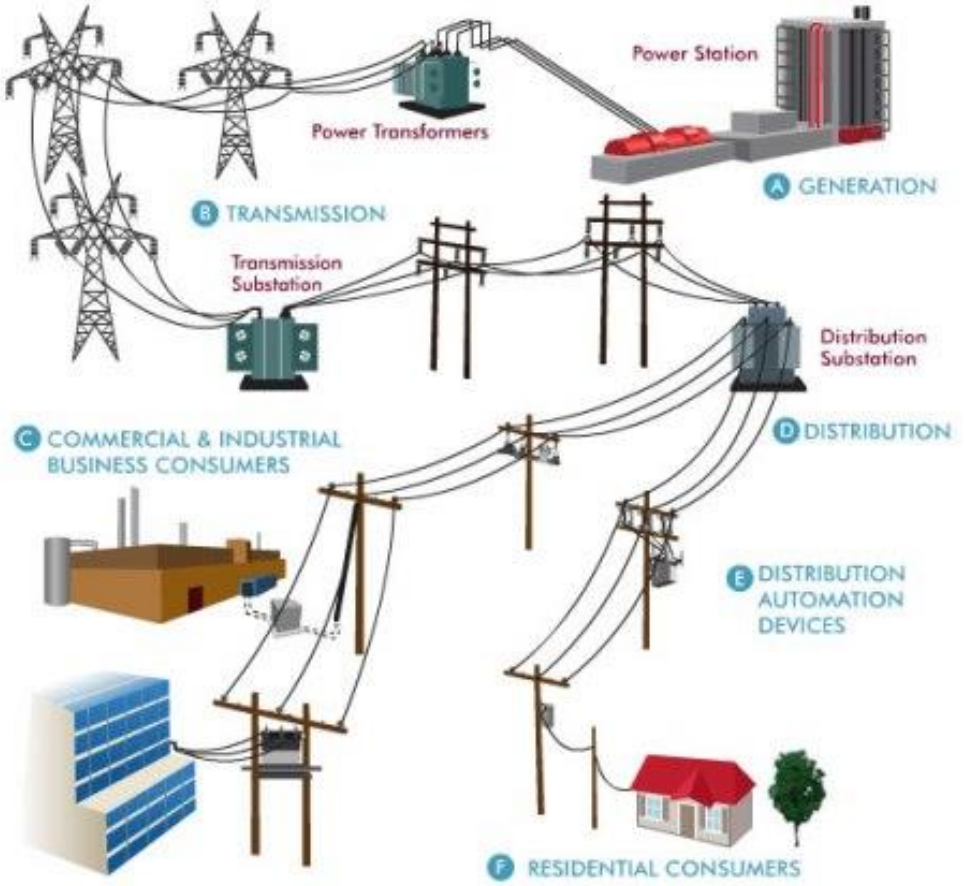
Sean Hamilton General Manager
Presented by Phil Fischer, NEC Energy Solutions

Electricity Grid Basics

NEC ENERGY SOLUTIONS

Introduction

- The **electricity grid** is a complex system that produces and delivers electricity to end users
- The grid can be thought of as composed of these parts:
  - **Generation** (Electricity Producers)
  - **Transmission & Distribution**
  - **Load** (Electricity Consumers)
- The grid was designed with these characteristics in mind:
  - Electricity flows from **Generation** to **Load** and not in the other direction.
  - **Generation** must always match **Load**; there is no storage



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Why Energy Storage for the Grid?

NEC ENERGY SOLUTIONS

Preparing Grids For A Renewable Future

Adding flexibility, efficiency, and reliability



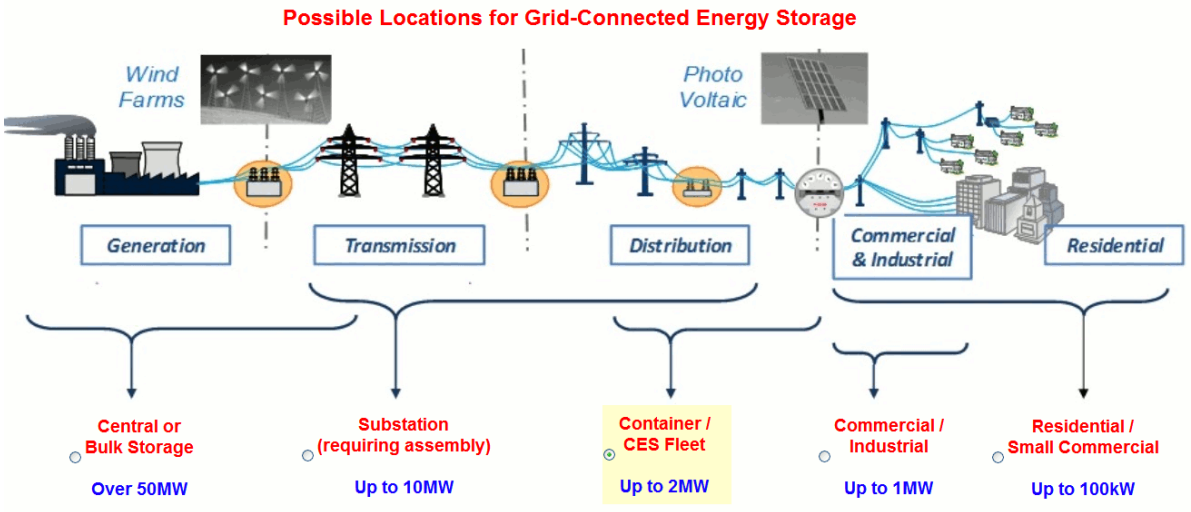




- Today's grids require more flexibility to address:
  - Increased renewable generation
  - Changing load patterns
  - Aging transmission and distribution network
- Energy storage in the grid is a powerful tool
  - Increase capacity utilization for generation, transmission, and distribution infrastructure

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What Can Energy Storage Do?



- Increase capacity utilization for generation, transmission, and distribution infrastructure
- Creating a more renewable, efficient, cost effective, reliable, resilient grid
- Increasing value of renewable energy
  - Matching wind and solar to grid need
  - Allowing more to be part of our energy mix
- Providing peaking capacity, without need for new plants
- Allowing for microgrids to increase resiliency
- Reducing cost by being on-site resource, an asset that is BTM or on premise

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Value of Battery Energy Storage

- **Grid Resiliency-Police and Dispatch Center**
- **Smoothing Intermittent Resources**
- **Regional Network Service (RNS) -Monthly Peak**
  - **Captured 7/9 monthly peaks (to 8/31/2017) for a value of $95k**
- **Capacity Load Obligation Payments –Annual Peak**
  - **Captured Annual Peak (to 8/31/2017) for a value of $244,460**
- **Energy Arbitrage-Value to Date $8k, 16 Round Trip operations**
- **Frequency Regulation**

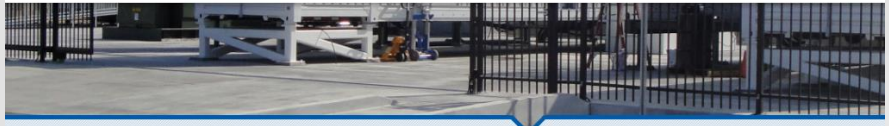


Source: The Value proposition for Energy Storage for Sterling Municipal Light Department

Author Dr. Raymond Byrne, Sandia National Laboratories. www.energysterling.com

Resiliency Benefits
2mw/3.9mwhr -Battery Energy Storage System

1. BESS provides Power up to 12 Days.
2. BESS Located in Main Substation.
3. Substation 2,300’ from Critical Facility.
4. Separate Circuit for BESS and CF.
5. MicroGrid Capable with Solar.
6. Live Test Performed April 27,2017



STERLING, MA

Sterling, Massachusetts – 2MW/3.9MWh GSS®

The Sterling, Massachusetts GSS® is the largest battery-based energy storage system installed in New England and the first utility scale project in Massachusetts. It will improve grid resiliency against weather-related power outages, while providing enhanced clean energy usage and cost savings to the town of Sterling.

- T&D Support Application
- 2 MW Power Capability
- 3.9 MWh Energy Capacity
- Battery container w/integrated cooling
- Power conversion system
- Operational December 2016










Police & Dispatch Facility
Chocksett Substation
Wiles Rd 2 MW solar array
Micro Grid Capable
Village Ln
Sandy Ridge Rd
Northeast Blvd
Chocksett Rd
Albright Rd
Pratts Junction Rd
Wiles Rd
Redstone Hill Rd
12
62
© 2014 Google
Imagery Date: 9/20/2010 42°27'00.86" N 71°44'14.78" W elev 434 ft

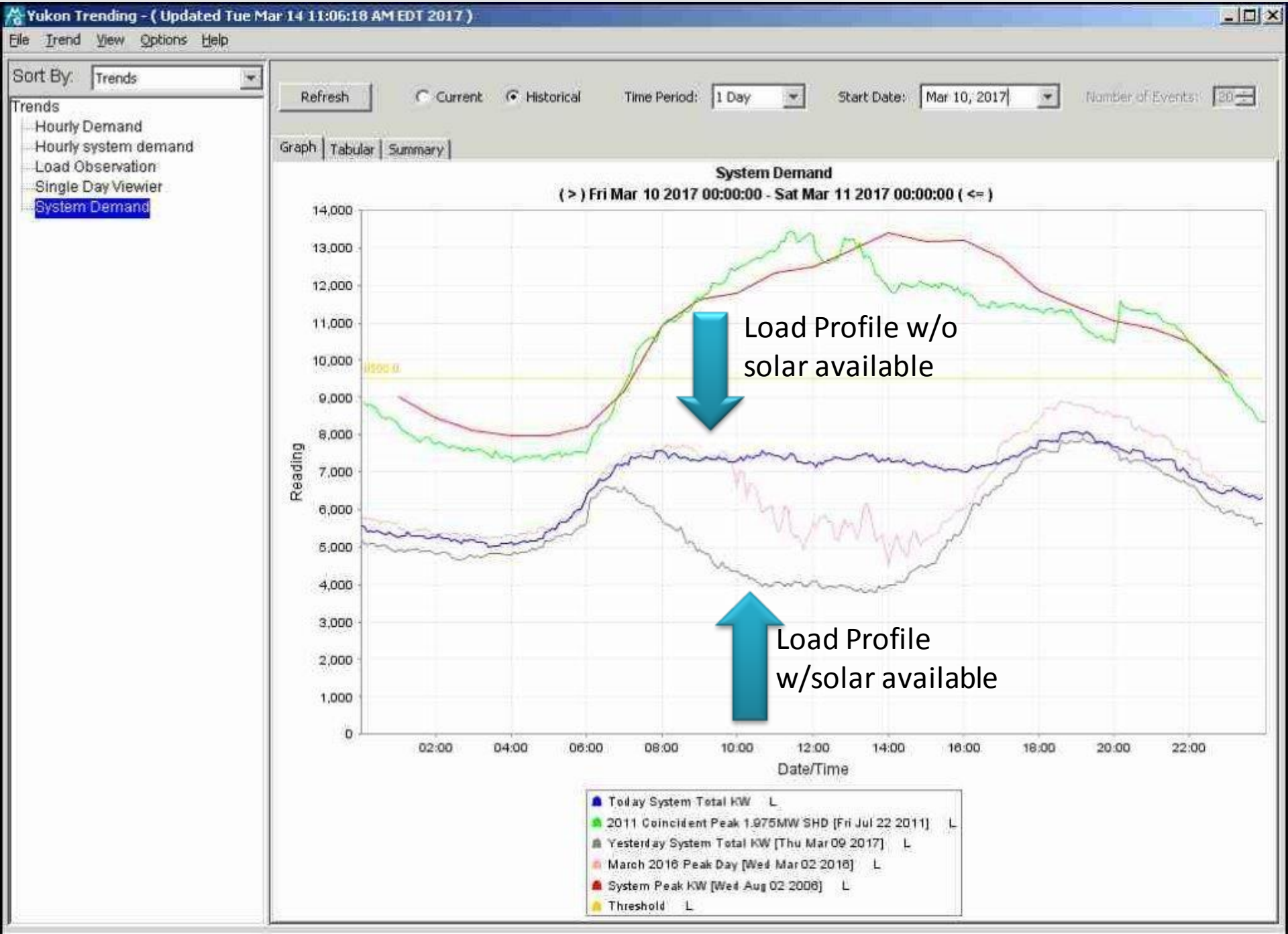
SEPA Solar Watts Per Customer Comparison

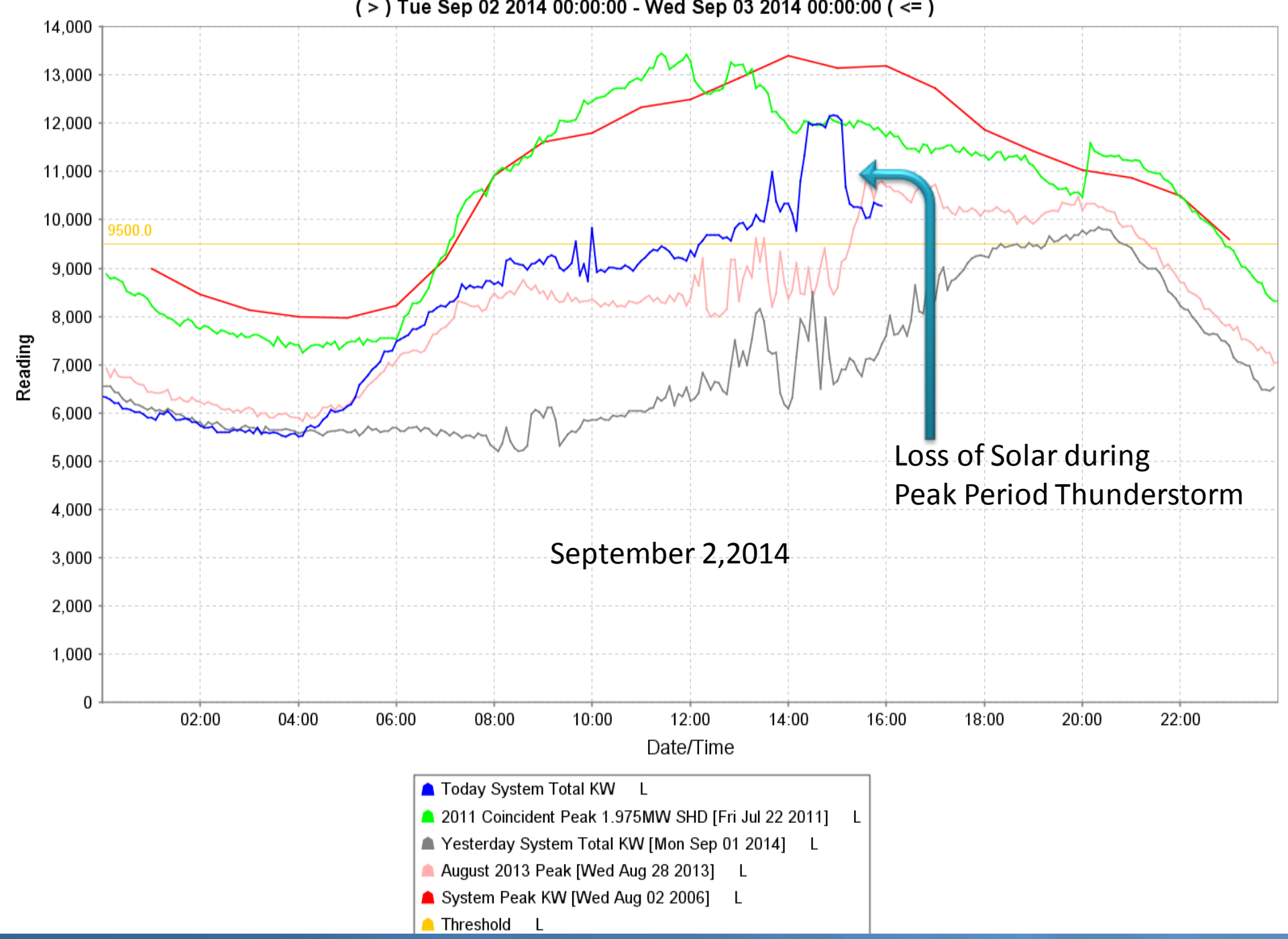
SEPA 2013

Rank	Utility	W/C
1	Sterling Municipal Light Dept (MA).	831
2	San Diego Gas & Electric Company (CA)	461
3	Silicon Valley Power/City of Santa Clara (CA)	427
4	Arizona Public Service (AZ)	368
5	Hawaiian Electric Company, Inc. (HI)	329
6	Pacific Gas and Electric Company (CA)	281
7	Hawaii Electric Light Company (HI)	182
8	Maui Electric Company Ltd (HI)	178
9	Kauai Island Utility Cooperative (HI)	167
10	Imperial Irrigation District (CA)	159

SEPA 2015

	Village of Minster (OH)	2,104
2	City of Palo Alto Utilities (CA)	1,846
3	Roseville Electric Utility (CA)	1,416
4	Carey Municipal Electric Utility (OH)	1,351
5	Vineland Municipal Electric Utility (NJ)	1,318
6	Ashburnham Municipal Light Plant (MA)	1,079
7	Sterling Municipal Light Department (MA)	848
8	Imperial Irrigation District (CA)	750
9	Guam Power Authority (GU)	710
10	Silicon Valley Power (CA)	613


Yukon Trending - (Updated Tue Mar 14 11:06:18 AM EDT 2017)
File Trend View Options Help
Sort By: Trends
Trends
Hourly Demand
Hourly system demand
Load Observation
Single Day Viewier
System Demand
Refresh
Current
Historical
Time Period: 1 Day
Start Date: Mar 10, 2017
Number of Events:
Graph
Tabular
Summary
System Demand
(>) Fri Mar 10 2017 00:00:00 - Sat Mar 11 2017 00:00:00 (<=)
Reading
14,000
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11,000
10,000
9,000
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6,000
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10:00
12:00
14:00
16:00
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20:00
22:00
Date/Time
Load Profile w/o solar available
Load Profile w/solar available
Today System Total KW L
2011 Coincident Peak 1.975MW SHD [Fri Jul 22 2011] L
Yesterday System Total KW [Thu Mar 09 2017] L
March 2016 Peak Day [Wed Mar 02 2016] L
System Peak KW [Wed Aug 02 2006] L
Threshold L

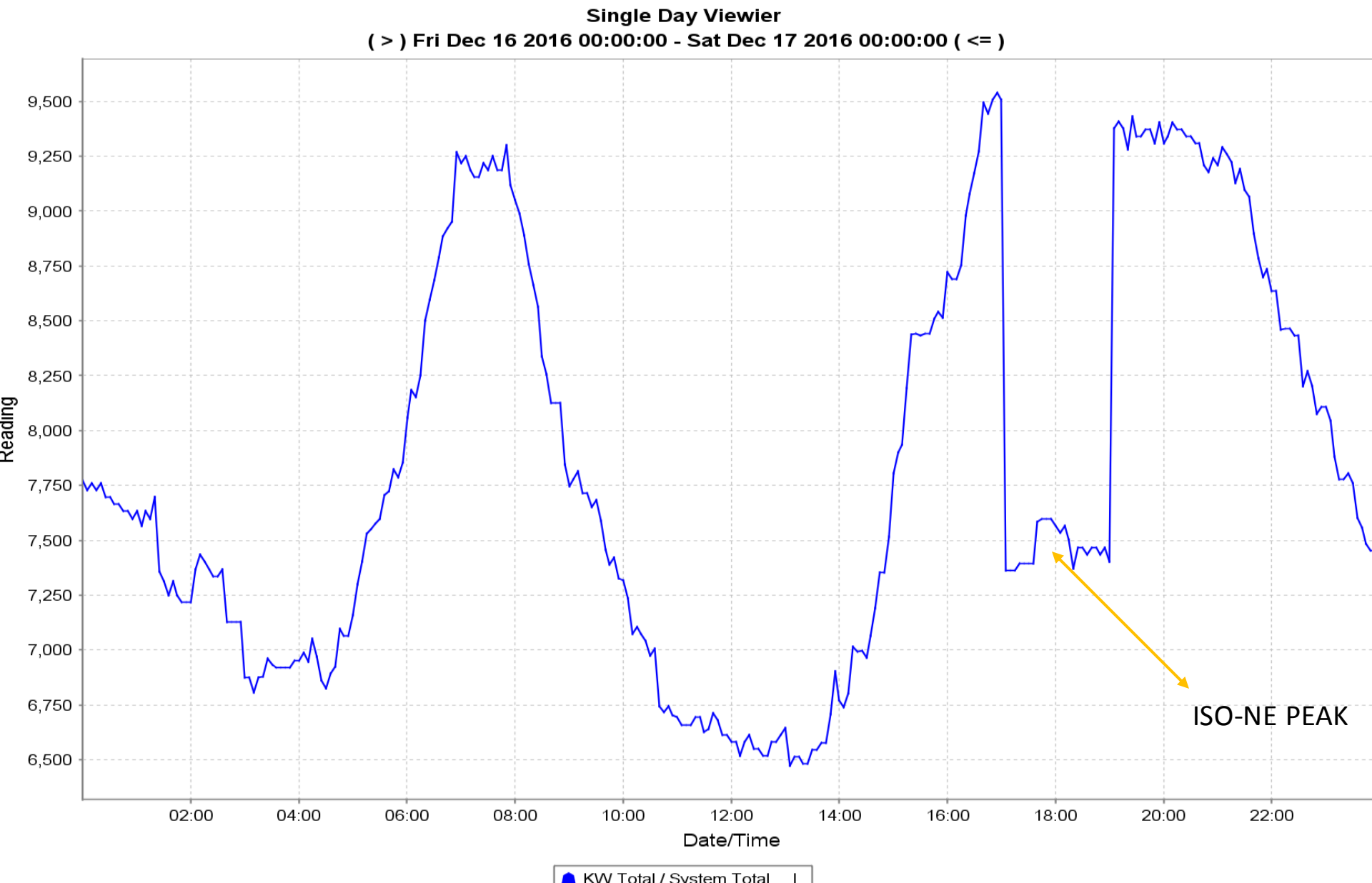

(>) Tue Sep 02 2014 00:00:00 - Wed Sep 03 2014 00:00:00 (<=)
14,000
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Reading
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04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
Date/Time
Loss of Solar during
Peak Period Thunderstorm
September 2,2014
Today System Total KW L
2011 Coincident Peak 1.975MW SHD [Fri Jul 22 2011] L
Yesterday System Total KW [Mon Sep 01 2014] L
August 2013 Peak [Wed Aug 28 2013] L
System Peak KW [Wed Aug 02 2006] L
Threshold L

Final Real-Time Locational Marginal Prices ($/MWh) 9/2/2014

Note Hour 14 During Thunderstorm

Hour	HUB	WCMA	NEMA	SEMA	CT	RI	NH	VT	ME
1	44.23	44.35	44.48	44.03	44.40	44.39	43.85	43.75	41.88
2	38.15	38.31	38.22	37.84	38.36	38.17	37.74	37.75	36.11
3	32.98	33.11	33.01	32.68	33.09	32.96	32.67	32.54	31.54
4	28.23	28.34	28.26	28.01	28.26	28.19	28.02	27.90	27.13
5	28.06	28.19	28.07	27.83	28.17	27.97	27.89	27.81	26.98
6	32.97	33.10	32.98	32.67	33.11	33.09	32.86	32.82	31.77
7	37.33	37.46	37.49	37.03	37.51	37.24	37.44	37.29	36.38
8	40.87	40.99	41.07	40.62	41.05	40.90	41.01	40.86	39.96
9	35.01	35.09	35.25	36.10	35.06	41.63	35.25	34.96	34.33
10	45.85	45.99	46.13	46.51	46.09	50.20	46.07	45.92	44.34
11	73.81	74.12	74.15	73.39	74.69	73.55	74.11	74.15	71.31
12	89.80	90.11	90.35	89.45	93.48	89.51	90.14	89.86	86.67
13	185.70	186.25	187.11	185.44	190.47	185.53	186.15	184.95	178.01
14	554.71	555.62	560.77	555.12	558.00	555.55	555.69	551.95	530.00
15	206.54	206.72	209.37	207.47	308.93	207.60	206.72	205.66	196.51
16	70.45	70.57	71.51	70.86	158.68	70.91	70.15	70.67	65.38
17	86.23	86.34	87.48	86.72	168.94	86.71	85.96	86.14	80.60
18	133.90	134.22	135.05	134.18	174.45	134.14	133.38	133.73	126.21
19	72.92	73.14	73.35	72.90	107.74	72.81	72.65	73.38	68.10
20	75.16	75.35	75.60	75.14	82.61	75.08	75.14	75.41	71.28
21	74.36	74.62	74.61	74.20	75.75	73.96	74.14	74.76	70.18
22	55.07	55.27	55.32	54.86	55.76	54.56	54.81	54.91	52.16
23	38.60	38.75	38.82	38.36	39.02	38.21	38.48	38.42	36.99
24	54.55	54.76	54.98	54.15	55.00	54.01	54.41	54.12	52.48
AVG	88.98	89.20	89.73	88.98	104.53	89.45	88.95	88.74	84.85

Began Construction 10-12-2016
Reduces RNS Peak on 12-16-2016



Monthly Peak Alert Notice	
Date:	12/15/2016
ISO Projected Peak:	19,500
ISO Projected Hour:	18
Threshold:	18,282
Alert Rating:	5
Turn on Battery?	yes
Hours to Run:	18-19

Alert Ratings Explained		
Rating	*Definition*	*Advice*
0	Projected peak is below the threshold by greater than 1,000 MW.	Take no action. This will not be the peak day.
1	Projected peak is below the threshold by an amount between 500 and 1,000 MW.	Take no action. Barring a dramatic miss by ISO this will not be the peak day.
2	Projected peak is below the threshold by an amount less than 500 MW.	Be aware of the situation. Peak load is approaching threshold, but will most likely not be the peak.
3	Projected peak is above the threshold by an amount less than 500 MW.	Send alert. Today has a chance of being the peak day
4	Projected peak is above the threshold by an amount between 500 and 1,000 MW.	Send alert. There is a strong chance that today will be the peak day
5	Projected peak is above the threshold by an amount greater than 1,000 MW.	Send alert. There is an extremely high probability that today will be the peak day.



UTILITY ENERGY STORAGE RANKINGS

TOP 10 ANNUAL WATTS-PER-CUSTOMER

1	Sterling Municipal Light Department	533 Watts-per-customer
2	Glasgow EPB	248 W/C
3	Imperial Irrigation District	198 W/C
4	American Samoa Power Authority	109 W/C
5	Indianapolis Power & Light Company	42 W/C
6	Duke Energy Ohio	23 W/C
7	Maui Electric	17 W/C
8	San Diego Gas & Electric	12 W/C
9	Green Mountain Power	8 W/C
10	Commonwealth Edison, an Exelon Company	6 W/C

Secure | https://www.neces.com

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NEC ANNOUNCES DALE POWER SOLUTIONS AS ITS FIRST QUALIFIED DISTRIBUTED ENERGY STORAGE PARTNER IN THE UK

Dale Power to Promote and Sell NEC's DSS® Distributed Storage Solution

LEARN MORE +



STERLING, MA IS SAVING $400K/YEAR WITH THEIR BATTERY STORAGE SYSTEM FROM NEC ENERGY SOLUTIONS

WATCH THE VIDEO HERE +



OVER 250MW INSTALLED, UNDER CONSTRUCTION, OR IN LATE STAGES OF DEVELOPMENT

NEC Energy Solutions has extensive experience installing and commissioning GSS grid storage installations globally serving applications that include peak shaving, renewable integration (ramp management), frequency response, frequency regulation and voltage regulation.

VIEW OUR PROJECT INSTALLATIONS +



NEC TO SUPPLY 18 MW ENERGY STORAGE SYSTEM TO MAJOR SWISS UTILITY

Project will be largest energy storage system in Switzerland

LEARN MORE +

CONTACT US

https://youtu.be/w3lt2lwLCm4

10:54 AM
10/11/2017

Special Thanks to :

- SMLD Commissioners/Operations - For their support of this project
- Town of Sterling - For their continued support
- Judith Judson – MA DOER Commissioner
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- Sandia National Laboratories - Daniel Borneo PE., Dr. Raymond Byrne
- Todd Olinsky-Paul - Director of CEG and CESA.
- MMWEC - Market Analysis
- Scott Reynolds, OPM and Mike Barrett, PLM, Design Engineering
- Jared Carpenter, Jim Frawley-Grant Technical Information

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