Welcoming Address
What We Need from New Power Generation

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Transformation of the Power System

A Resilient, Flexible, and Connected System
Driving a Need for Greater Flexibility
Transformation of the Power System

SCO₂ Compressor and Drive Turbine

Power Turbine

Curtesy - Areojet Rocketdyne

Role of the Central Generating Fleet

Curtesy - Echogen
Power Generation Drivers and Externalities

- Fuel Availability & Price (Natural Gas)
- Renewables
- Emissions Constraints
- Demand Trends
- Water Management
- Economic Viability
- Market Drivers
- Aging Assets
Coal Retirement Forecast

Drivers

• Demand
• Economics
• Availability/Price of Natural Gas
• Environmental Regulations
  – Mercury and Air Toxics Standards (MATS)

MATS compliance is driving a large number of plant closures in 2016


Source: U.S. EIA Annual Generator Report
Polar Vortex: Fleet Response

- Oil units had record runs
- Fleet required maximum flexibility
- Duel fuel switching
  - liquids were cheaper than gas
  - Delivery issues
- High gas prices – gas turndown
- Misalignment between dispatch and demand
- High forced outage rates
  - Fuel curtailments
  - Freezing instrument lines
  - Freezing HRSGs

Event demonstrates the need for fuel diversity
Value of Centralized Generation

- Provides the backbone energy capacity
  - Startup Power
  - Backup Power/Reserves
  - Voltage and Frequency Stability
  - Load Following and Peak Power

Central generating capacity is the backbone for maintaining grid stability and reliability
The Challenge – Your Challenge

Advance the understanding and development of advanced power systems. Systems that are:

• Flexible
• Reliable
• Cost effective and efficient
• Low carbon

Greater Sense of Urgency - While There is Time

SCO₂ Compressor and Drive Turbine
Power Turbine

Curtesy - Areojet Rocketdyne
Cost is the biggest pressure electric utilities are facing today.

EPRI’s Advisory Council is very concerned about the cost impacts of electricity on consumers.

We need new ways to generate power, cleanly and reliably, that will not cause electricity prices to rise.
... Low Emissions including CO$_2$
Are Supercritical CO$_2$ Cycles the Answer?
Together...Shaping the Future of Electricity
The Challenge – Your Challenge

• Advance the understanding and development of advanced power systems

• Impact of the “Polar Vortex” on the northeast United States showed the importance of having a diverse generating portfolio

• But many of the coal plants that were used during the polar vortex are scheduled to be shut down next year
What Do Power Generators Need?

• New technologies to replace the coal plants nearing retirement in the US and Europe & to meet the growing demand for power in developing nations
• These new technologies must offer . . .
...Flexibility

Insights from a Dynamic System

- ~80 days/yr variable generation
- 5% below installed capacity
- Maximum Hourly Ramp ~10 GW
- Maximum Hourly Down Ramp ~7 GW

Hourly PV+Wind Generation (GW)

Data from Klaus Kleinekorte, Amprion, German TSO.
European Power Generation Challenges

- RE deployment
  - Up to 30% by 2030
- Fossil flexibility required to support RE variability
- Fuel prices and risk
- Weak wholesale prices
- Low load factors (e.g., Spain)

What we can learn from our international members
Diversity in the Generation Mix is Critical

- Oil units had record runs
- Fleet required maximum flexibility
- Duel fuel switching
  - In some cases liquids were cheaper than gas
  - Delivery issues
- High gas prices – resulted in gas turndown
- Misalignment between dispatch and demand
- Availability and reliability of coal and nuclear generation fleet exceed natural gas fired, solar and wind generation
- High forced outage rates
  - Fuel curtailments
  - Freezing instrument lines
  - Freezing HRSGs

Large number of coal plant due to be retired by the end of 2016
The Challenge – Your Challenge

• Develop the technology that will enable the power system of the future to evolve in a manner that is *Flexible, Resilient, Reliable, Efficient, Safe, and Environmentally Responsible.*

• The industry has a low risk tolerance and the risk of failure must be minimized

• Significant financial pressures

• Highly diverse opinions regarding technologies

Diversity in the Generation Mix is Critical
The Challenge – Your Challenge

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Diversity in the Generation Mix is Critical
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Coal Retirement Forecast

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  – Mercury and Air Toxics Standards (MATS)

MATS Compliance driver for large number of retirements in 2016
Distributed Fossil Generation Impact on Local Air Quality

- Sources close to people
- Short stacks
- Cooler flue gas alters plume rise & buoyancy
- Strong impact of local micrometeorology and building topology

power.cummins.com

Diesel-powered backup generators, Santa Clara