Combined Cycle integrated Thermal Energy Storage using surplus renewable energy & improving power plant flexibility

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Siemens Energy Inc.
Orlando, Florida
April 6th, 2021
Combined Cycle integrated Thermal Energy Storage CiTES
DoE Project DE-FE0032029

- Prime Recipient: Siemens Energy Inc.
- PI: Thorsten Wolf  tnwolf@siemens-energy.com
- Partner:
  - Exelon Corporations: Host (plant, market data)
  - Siemens Gamesa Renewable Energy: Technology
- Location:
  - for Engineering work: Orlando, FL
  - Plant: modern, utility-sized Combined Cycle (t.b.d.)
  - Market: ISOs in the United States (several)
- Feasibility Study:
  - Conceptual design of integrated Thermal Storage
  - Cost Estimation on turnkey level
  - Techno-economic simulation of annual (one full year) performance in different markets
- Budget: $200,000 DoE; $50,000 Siemens Energy

CiTES supports fossil generation by: storing and using surplus renewable energy and makes fossil assets more flexible for the changing operational profile
Combined Cycle integrated Thermal Energy Storage CiTES
The Concept

- **Take an existing** combined cycle plant
- A thermal storage system using solid thermal storage material stores heat is added
- **Charging = plant is in shutdown**
  - An electric heater is using surplus renewable energy to heat up the storage
  - An electric blower push the air through the thermal storage core
- **Discharging = plant is in operation:**
  - Cold gas is extracted at stack
  - Fans push the gas through the storage
  - Hot gas is injected into the HRSG
- The bottoming cycle of the plant is converting the thermal energy into electricity
- **Flexibility Improvement:**
  - hot air taken from storage keeps HRSG warm
  - Converts every cold start in a hot-restart
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Our Partners

Technology for Thermal Storage
- Siemens Gamesa Renewable Energy
- Thermal storage technology based on volcanic rocks
- 10+ years experience in thermal storage
- Testing facility and 130MWh_\text{th} (440MMBTU) pilot plant in Hamburg, Germany

Operational Experience and Market Knowledge
- Exelon Corporation
- One of the cleanest electric power producers in the US
- Present in all major competitive power markets
- Generation assets including nuclear, fossil and renewables
- Contributes the “host” Combined Cycle Plant
  - Technology: realistic plant performance under commercial operation conditions
  - Market data and expertise of all major US ISOs

130 MWh pilot plant in Hamburg, Germany, 2019

Exelon
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The Objectives

- With renewable generation increasing, losses of due to curtailment become painful, see CAISO chart
- The California duck curve teaches us that gas-base generation is needed to back-up the grid (may be Hydrogen plus natural gas).
- Batteries integrated in PV are acceptable for 4 – 6hrs
  - but don’t help the fossil fleet
  - don’t provide rotating inertia like a power plant
- Thermal Energy Storage material is cheap, it has the potential to become an economic viable solution for mid-term storage: 10 – 20 hours as target range
- Cost Target: Released energy from thermal storage for the same costs as generated with natural gas.
- Hurdles:
  - who gets the renewable credits? Surplus generation or storage?
  - is surplus renewable energy for free?
- **Contact:** Thorsten Wolf, tnvolf@siemens-energy.com
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