HPC4Materials Collaborations

HPC Analytics of Fused Thermal Plants Data to Optimize Operating Envelope (ORNL)
An Investigation of the Effect of Cyclic Operation on HRSG and Coal-fired Boiler Tubes (NETL)

Comments for Consideration

COVID-19 Impact

Reviewed ORAP data to determine impact of the global pandemic across various gas turbine technologies:

- 20-40MW & 40-60MW Aeroderivative Gas Turbines
- E-Class & F-Class Heavy Duty Gas Turbines

- **There is no substantial difference in the mission profile and performance for these fleets from January-June 2019 and January-June 2020.**
  - Service Hours per Start (SH/ST)
  - Service Factor (SF%)
  - Capacity Factor (CF%)
  - Availability (%)
- **The average Time to Perform and Time Between Maintenance Outages and Forced Outages is consistent between these two periods**.

- **Several plants reported outages specifically related to COVID-19; these include:**
  - Outage to perform emergency sanitation at the plant due to COVID
  - Outage Extension due to COVID-19 restrictions & limitations
  - Decision to shutdown due to lack of spares/maintenance/OEM Support capability during COVID

Who is SPS

Reliability Data & Analytics Company

- Well established and recognized in the Energy Market

Strategic Power Systems, Inc. (SPS)

The Numbers

- 1987 Founded
- 33 Year History
- 2 Offices in USA
- 1 Office in United Kingdom

Operational Reliability Analysis Program (ORAP®)

- Foundation product
- “Data is What We Do”

Users Groups

- Multiple OEMs, technologies, and applications

Team Composition

- SPS wanted NETL and ORNL to take an **unbiased** look at the data
- Strong desire to bring creativity and skills of the labs to bear on the data
- Goal to find new ways to gain actionable insight

Providing Voice of Operator & Data Support
- ✓ Sal DellaVilla – CEO
- ✓ Bob Steele – VP Customer Solutions IT

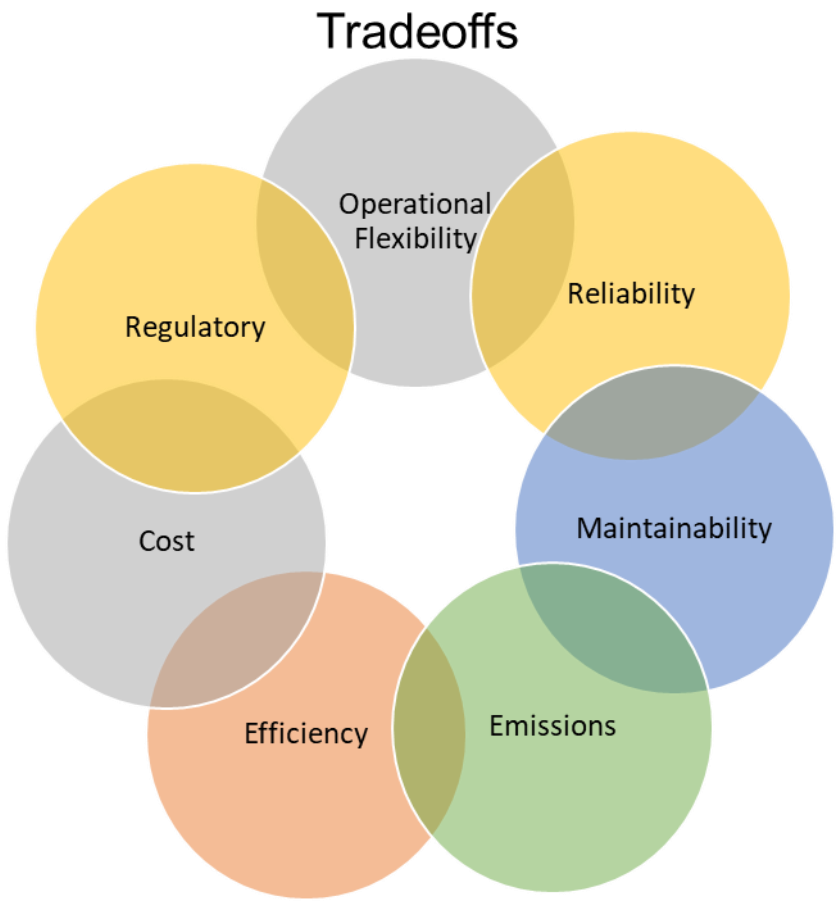
Project Management, Coordination, and Engineering Input
- ✓ Chris Perullo – Supporting technical input & providing SME for modeling
- ✓ Scott Sheppard – Data Analysis

Physics-Based Modeling of Steam Cycle Components
- ✓ David Alman – Leadership
- ✓ Yong Liu – Physics Modeling Lead
- ✓ Youhai Wen - Modeling
- ✓ Tianle Cheng - Modeling

RAM & Process Data Modeling (ML)
- ✓ Edgar Lara-Curzio– Leadership
- ✓ Dongwon Shin – Project Management
- ✓ Matt Lee – RAM Data & Machine Learning
- ✓ Travis Johnson – Real Time Data Analysis
- ✓ Maria Mahbub – Graduate Student-supporting both tasks

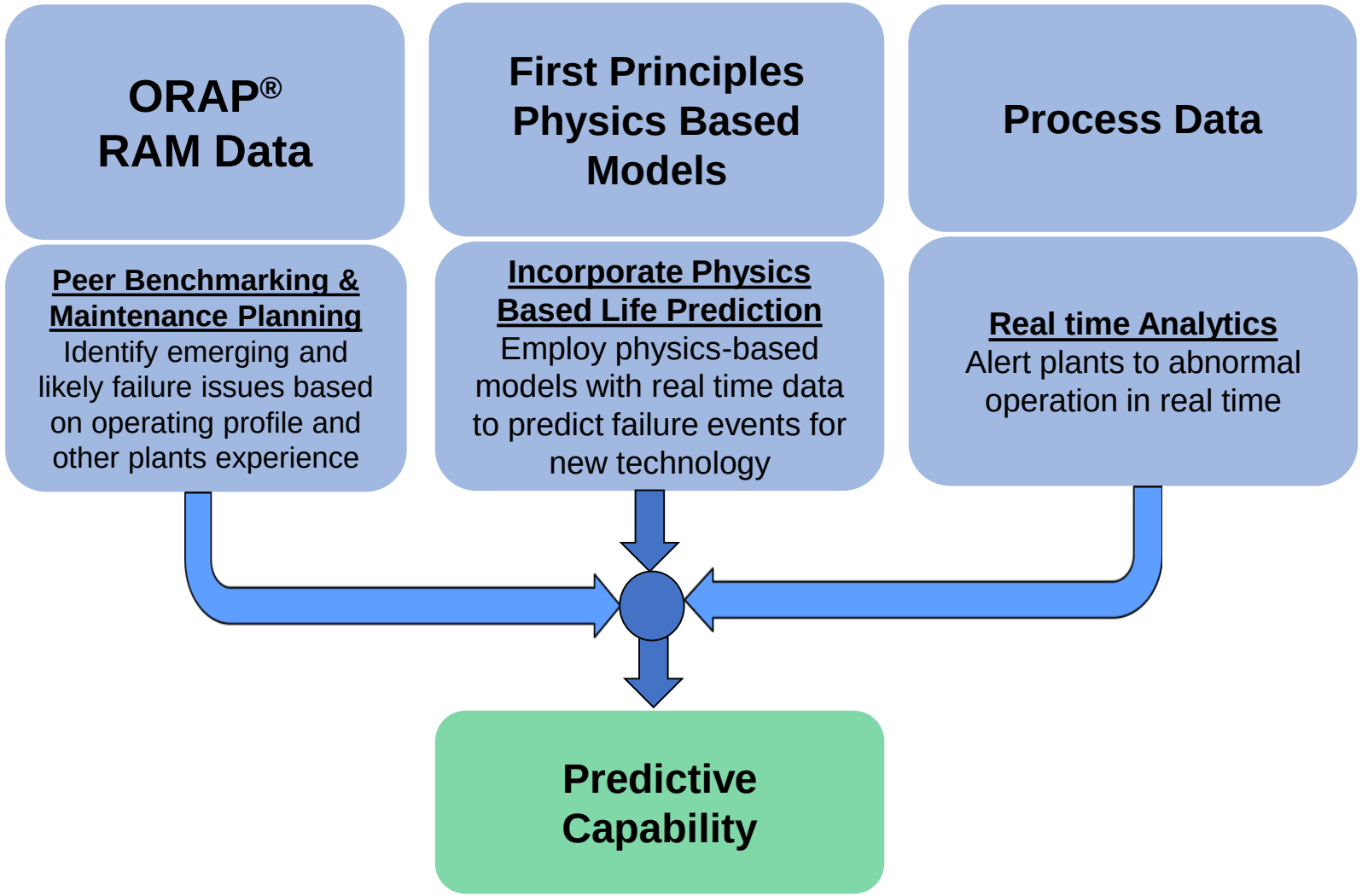
Challenges Facing Plant Operators (Problems)

- Responding to Faults During All Phases of Lifecycle
- Anticipate and Eliminate Impending Failures
  - ✓ Complex technology & total plant
- Predicting Future Equipment Capability and Performance
  - ✓ How quickly can we look back at data for analysis, use and decision-making?
  - ✓ M&D Evolved to mitigate OEM risks… not to be predictive



Original Vision

Data Fusion =



Emphasis on Data Fusion to Provide Sufficient Time and Guidance to Provide Cost Effective Corrective Action

Project Goals

ORNL

- HPC Analytics of Fused Thermal Plants Data to Optimize Operating Envelope
- Process Data
  - ✓ A focus on "time series data"
  - ✓ Integrating process data for predicting outage and impact
  - ✓ An opportunity to test ML, Neural Networks, NLP

NETL

- The Effect of Cyclic Operation on HRSG and Coal Fired Boiler Tubes
- Failures Induced by High Thermal Stress and Component Fatigue
- An Opportunity for Predictive Maintenance

Impact & Future Collaboration

Company Impact

- Collaborating with the labs has enabled SPS to perform analysis and investigations that would not have been feasible as a small business
- Working with ORNL has provided access to the resources and talents, adding subject matter expertise in AI and ML
- The ability to assess the tools and techniques developed as part of the project provides an opportunity to incorporate the methodology into the ORAP system for commercial use.
- Step towards better informed operational decisions, reduced disruptions or forced outages, and meeting the needs of changing service demands based on increased needs for operational flexibility

National Impact

- If successfully commercialized the tools and techniques developed will enable:
  - Both large and smaller, independent power producers to continue to use existing capital investments in fossil-based energy generation
  - Maintains highly skilled labor
  - Help to reduce operational and maintenance costs leading to upgrades of capital equipment
  - Maintain competitiveness in the marketplace.