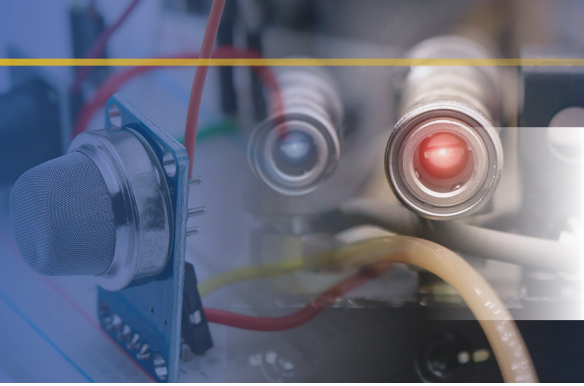
UPISC UNIVERSITY OF PITTSBURGH INFRASTRUCTURE SENSING

COLLABORATION WORKSHOP



NETL NATIONAL ENERGY TECHNOLOGY LABORATORY

Sensing Opportunities and Needs: Industry, University, and National Lab Perspective Panel

Moderator – Dr. Ruishu Wright – NETL

Panelist 1 – Susan Maley, Electric Power Research Institute (EPRI)

Panelist 2 – Dr. Elizabeth Cook, Duquesne Light

Panelist 3 – Dr. David Alman, NETL

Panelist 4 – Gary Choquette, Pipeline Research Council International

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Panelist 1

Susan Maley, Electric Power Research Institute (EPRI)

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Panelist 2

Dr. Elizabeth Cook, Duquesne Light

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NATIONAL ENERGY TECHNOLOGY LABORATORY

Panelist 3

Dr. David Alman, NETL

Associate Director, Materials Engineering & Manufacturing,
Research and Innovation Center
National Energy Technology Laboratory
U.S. Department of Energy

Dr. Alman has a distinguished research career in his nearly 30 years of federal service with the Albany Research Center and NETL, primarily focusing on development of materials for severe service environments. Over the last 15 years he has served in various research management positions within NETL's intramural research organization. In 2015, he assumed the duties as the Associate Director for Materials Engineering and Manufacturing within NETL's Research and Innovation Center. In this capacity he leads NETL's research competency associated with the design, development and deployment of functional and structural materials needed to enable net zero carbon emissions by 2035 in the US power sector and the Nation by 2050. Dr. Alman holds a B.S. from Drexel University and Ph.D. from Rensselaer Polytechnic Institute, both in materials engineering. He is co-inventor of nine US patents, published over 50 peer-reviewed scholarly articles, and is a recipient of two R&D 100 Awards for technology commercialization. In 2009, Dr. Alman's technical contributions were recognized by ASM-International, as he was awarded a society fellowship for the development of novel materials and surface structures for power generation and high temperature applications.

UPISC UNIVERSITY OF PITTSBURGH INFRASTRUCTURE SENSING COLLABORATION WORKSHOP

NATIONAL ENERGY TECHNOLOGY LABORATORY

Panelist 4

Gary Choquette, Pipeline Research Council International

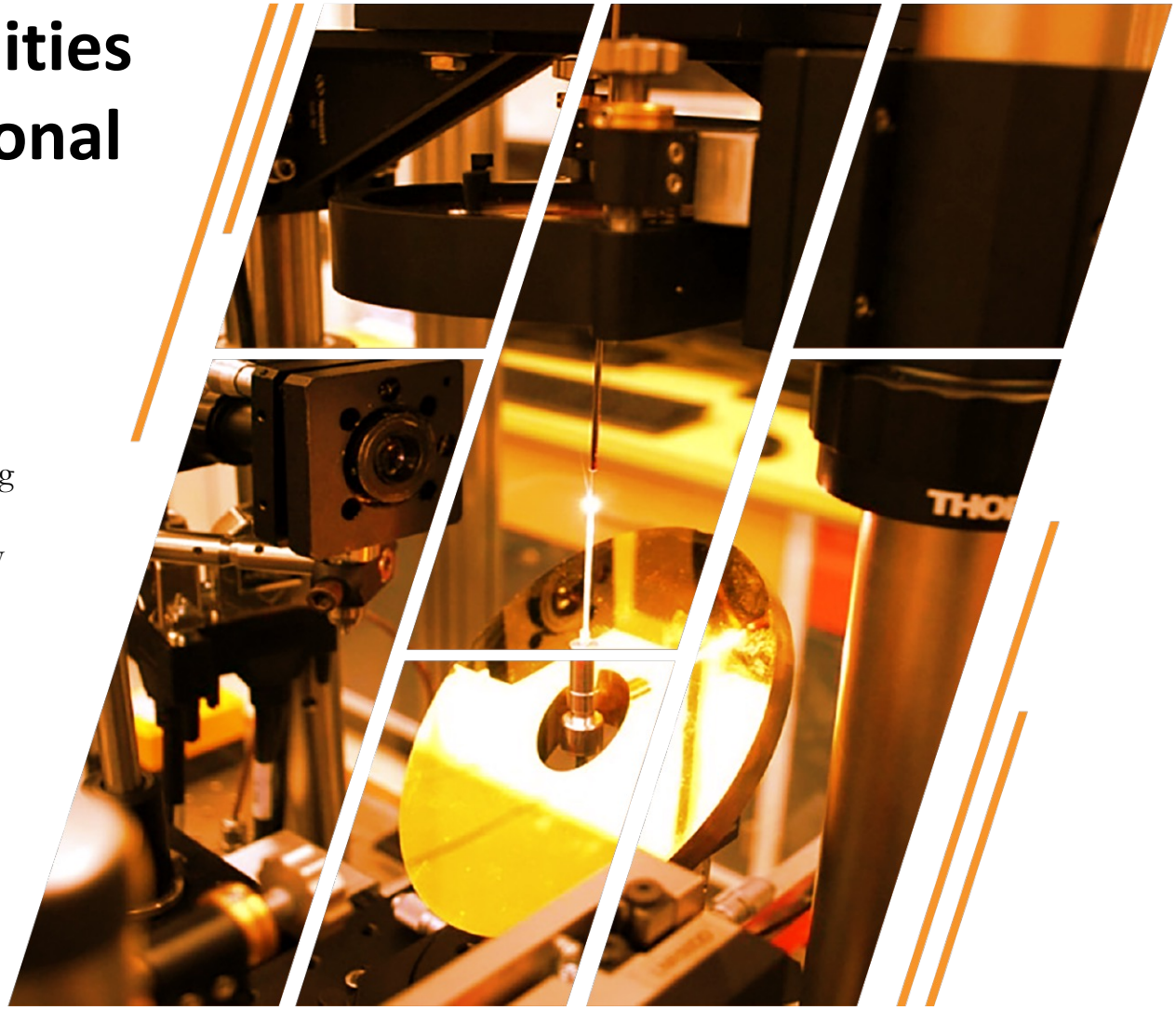
Gary Choquette joined PRCI as a Senior Program Manager in February 2012 and currently is an Executive Director. He has worked in the natural gas transportation industry for more than 35 years. He has experience in facility design, construction, technical support, hydraulic modeling, compression performance, noise, vibration, pulsation, controls, software design, SCADA, gas measurement, and gas control. He has served in management roles in gas measurement, engineering design, construction and right of way, operations software development and SCADA support, and gas control. He has numerous publications related to pipeline hydraulics, controls, and operations. He currently manages the execution of PRCI's research efforts as well as PRCI's information management systems. Mr. Choquette has a bachelor's degree in mechanical engineering from the University of Nebraska and is a registered professional engineer in the state of Texas.

Sensor Opportunities and Needs - National Lab Perspective

David E. Alman

Associate Director
Materials Engineering and Manufacturing
Research and Innovation Center
National Energy Technology Laboratory

University of Pittsburgh Infrastructure Collaboration Workshop
August 25, 2022



U.S. DEPARTMENT OF ENERGY | NATIONAL ENERGY TECHNOLOGY LABORATORY

Sensors for Critical Infrastructure

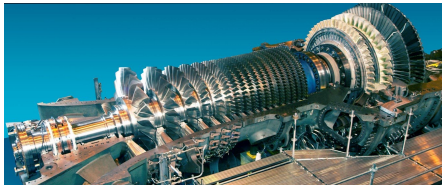
NATIONAL ENERGY TECHNOLOGY LABORATORY

Advanced Sensors for Energy Efficiency, Safety, Resilience, and Sustainability

- ✓ **Monitor systems and conditions**
- ✓ **Improve performance & efficiency**
- ✓ **Enhance reliability & safety**

GENERATION

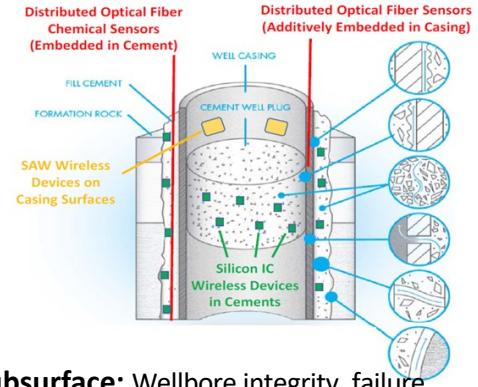
Turbines: Real-time fuel composition and combustion temperature for improved service life and efficiency



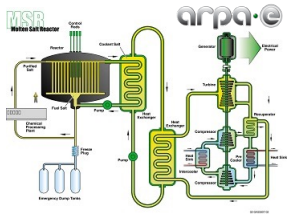
ENERGY DELIVERY & STORAGE

Pipelines: Monitor corrosion, gas leaks, T, acoustics to predict/prevent failures. NG, H_2, CO_2

Grid: Transformer, powerline failure prediction, fault detection, state awareness

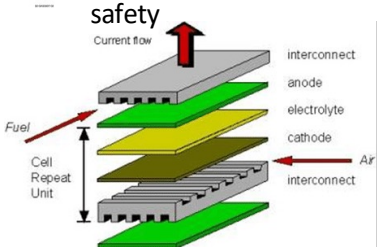


Subsurface: Wellbore integrity, failure prediction, leak detection. Geologic storage of CO_2, H_2/NG, or abandoned wells.



Nuclear: Core **monitoring and molten** salt temperatures for reactor fuel efficiency & reactor safety

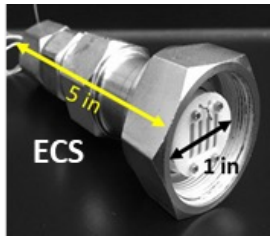
SOFCs: Fuel concentration & temperature gradients for improved lifetime and efficiency

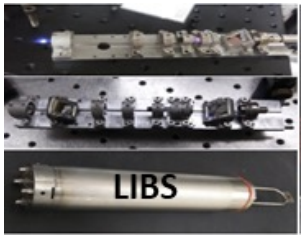


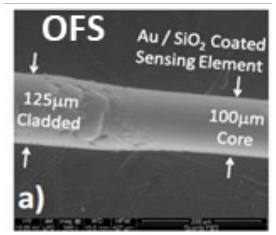
Opportunity – Do things better

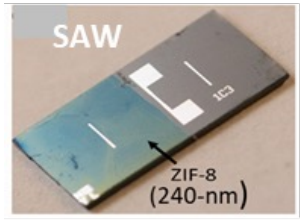
Transformation to net-zero carbon emissions

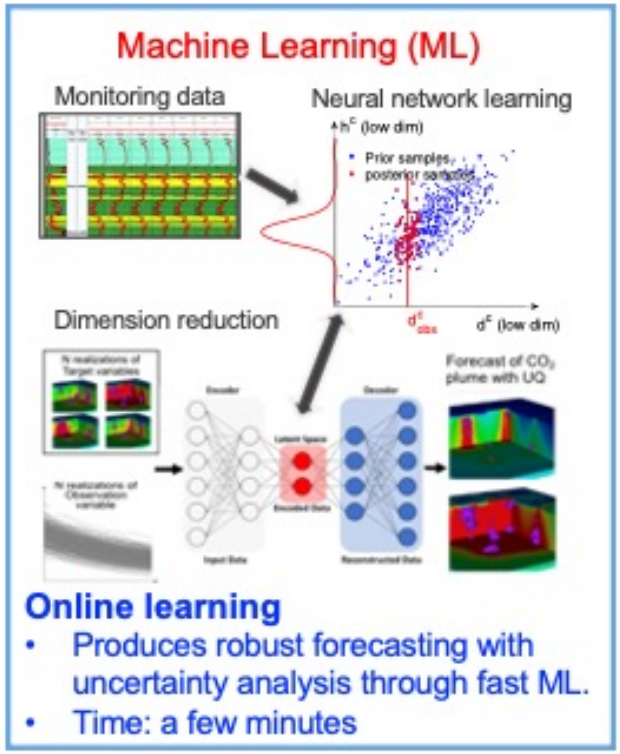
- ★ Example: large scale hydrogen production, transportation and storage.
- ★ Materials & manufacturing to enable ireless, multi functional sensors and platforms.
- ★ Materials development Composite nano-materials, thin films & fiber optics, sensor devices development,
- ★ Computational materials and HPC to accelerate development.
- ★ Digital twins for predicting system health, reduced order models and workforce development.











Pipeline of things – IoT/IIoT adapted for the pipeline industry

- Requirements
  - Intrinsically safe
  - Private/virtual private SMS protocol
  - Interfaces to conventional SCADA
  - Plug and play
  - Low power
  - Low cost
  - Secure
  - Low bandwidth
  - On demand and report by exception
  - High reliability
  - Timestamped data

- Applications
  - Geohazard monitoring
    - RTK differential w/ IMU
    - Strain measurement
    - Seismic vibration
  - Leak detection
    - Ambient sensors
    - Valve sensors
    - Slack line pressure
  - Valve management
  - Flow calculation
  - Fluid properties/quality
  - Cathodic protection monitoring

- Advanced in-line inspection tools
  - Pipe material properties
  - Crack identification and sizing, internal and external
  - IMU path tracing – lower cost alternatives