WESTERN COAL GENERATION AND GRID RESILIENCY
NERC Has Yet To Settle on a Definition of Resiliency
RESILIENCY

Our generation system’s ability to respond to upset conditions in a way that ensures reliability
2003 Eastern Seaboard Blackout

- The 3,500 megawatt power loss affected 45 million people in eight states

- During the outage, more than 508 generating units at 265 power plants shut down
What Was the #1 Component or Commodity Needed To Recover From the Blackout?

• Repairs to Power Lines?
• Repairs to Substations?
ELECTRICITY....

Megawatts!
DURING THE POLAR VORTEX OF 2019

Gas Companies asked consumers to lower their thermostats to 55 degrees.

They instructed them to turn on electric space heaters to make up the difference.
Why?

And where did that electricity come from?
Electricity Production Must Be More Than Reliable

• It Must Be Resilient
ANOTHER DEFINITION
EQUIVALENT
AVAILABILITY FACTOR

A Measure of Maximum Generation Available Over Time
Most prevalent utility-scale electricity generation fuel by state (2007 and 2017)

2007

2017

number of states

2007 2017
coal

natural gas

nuclear

hydro

petroleum

28 18
11 16
6 9
4 6
1 1

Source: eia
My cautionary tale is not about coal unit retirements.

It is about the health and equivalent availability of units in the West **NOT** scheduled for retirement.
OUR NATION’S COAL FLEET IS THE RELIABLE OLD PICKUP TRUCK OF ENERGY GENERATION

Gas Plants (HRSGS) are at the mercy of pipelines and supply

The Nuclear Fleet is Nearing End of Life

(Three Mile Island)
DURING THE NEXT UPSET CONDITION OF THE GRID, WHERE WILL THE MEGAWATTS COME FROM?
What If I Drove This Truck Differently?
Accelerator to the Floor
Stomp the Brake
Partly Because of Renewables We Are Stomping the Gas And Stomping the Brake of Our Coal Fleet
What’s Going On Inside this Mammoth Facility to Generate those Precious Megawatts?
For this discussion we will focus on one type
Boiler Tube

- Tube Wall
- Boiler Water Flow
- Tube/Water Interface Layer
Tube Temperature Versus Flow

Proper Flow is ESSENTIAL to Maintain Tube Temperature
Boiler Tube Wall / Water Interface

Tube Wall

Magnetite
Nucleate Boiling

Magification of Magnetite Layer

Tube Wall Metal
Aggressive Chemistry at the Surface of the Bubble
Magification of Boiler Chemistry

Tube Wall Metal
Under Cyclic Operation Conditions, Generating Unit Cycle Chemistry Upsets Become More Prevalent.
At the Same Time We Have Less Than Optimum Chemistry in the Boiler Feedwater

- Examples:
  - Iron and Copper Are Being Dissolved
  - Called Corrosion Products
  - Leads To Corrosion Product Transport
Corrosion Product Transport + Dirty/Occluded Tubes

Tube Temperature Versus Flow

Proper Flow is ESSENTIAL to Maintain Tube Temperature
YET WE HAVE ONLY DISCUSSED ONE TYPE OF FAILURE MECHANISM

And that mechanism may lead to Economic Failure
But not catastrophic failure
We Have Not Even Discussed:

• Hydrogen Damage
• Creep
• Small Particle Impingement
SADLY, THE IMMEDIATE DAMAGE IS ONLY PART OF THE CONCERN

What Chronic Damage Has Been Done to Our Non-Retirement Coal Fleet??
Policy Makers and Utility Execs.

Should Take These Potential Failure Mechanisms Into Account When Making Decisions That Impact Resilience