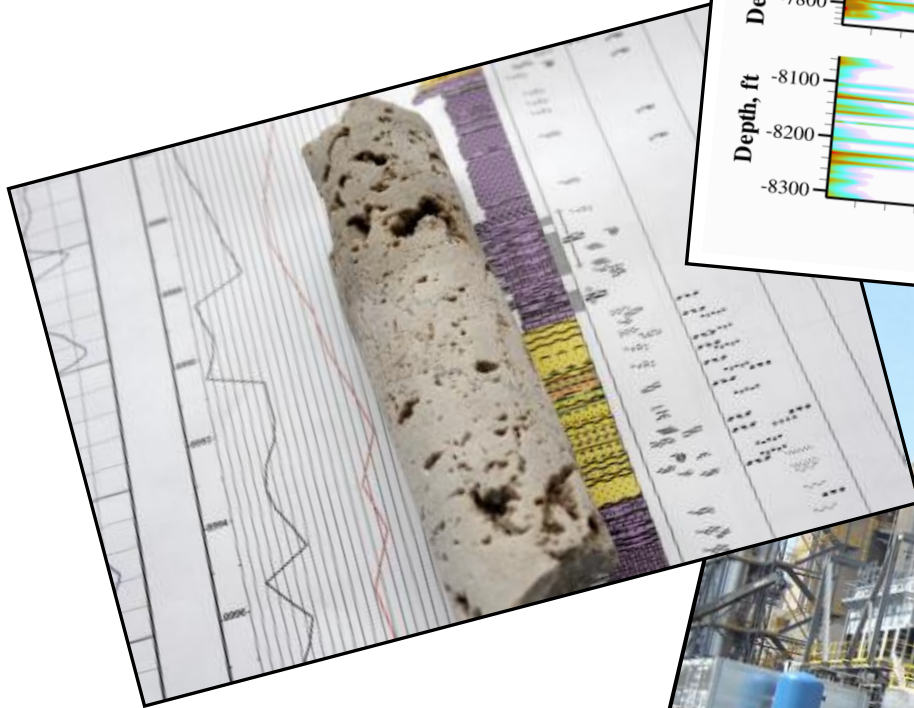
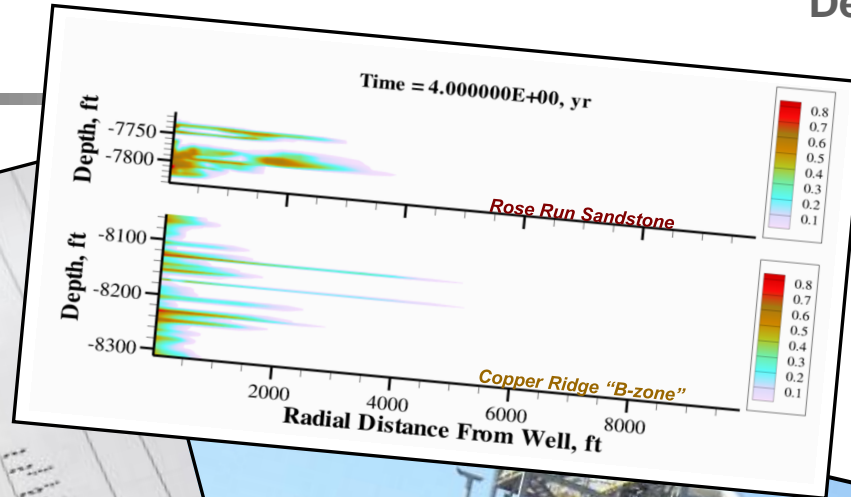


# AEP CCS Program Overview

Gary O. Spitznogle

Director – New Tech Development & Policy Support

December 7, 2010



Characterization...

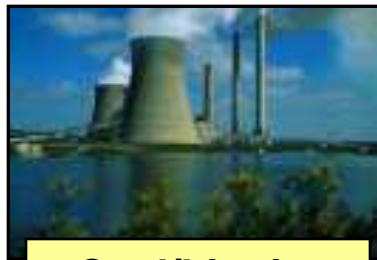
Simulation...

Validation...





# Company Overview



**Coal/Lignite**  
**66%**



**Nat. Gas/Oil**  
**22%**

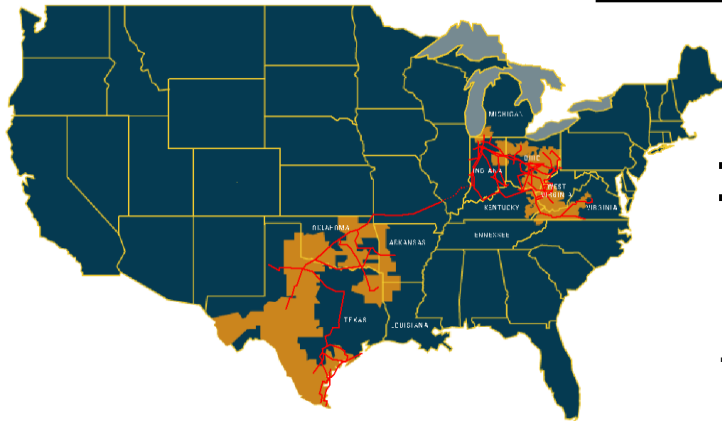


**Nuclear**  
**6%**



**Pumped Storage/  
Hydro/Wind**  
**6%**

**AEP's Generation Fleet**  
**>38,000 MW Capacity**



**5.2 million customers in 11 states**  
**Industry-leading size and scale of assets:**

<u>Asset</u>	<u>Size</u>	<u>Industry Rank</u>
Domestic Generation	~38,300 MW	# 2
Transmission	~39,000 miles	# 1
Distribution	~213,000 miles	# 1



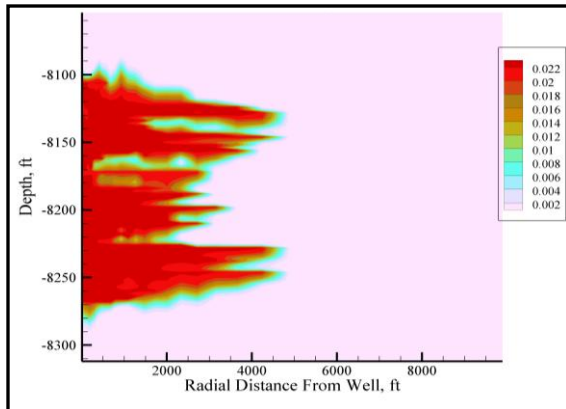
# Site Characterization and Feasibility Study

*The foundational work for AEP's CCS program began in 2003*



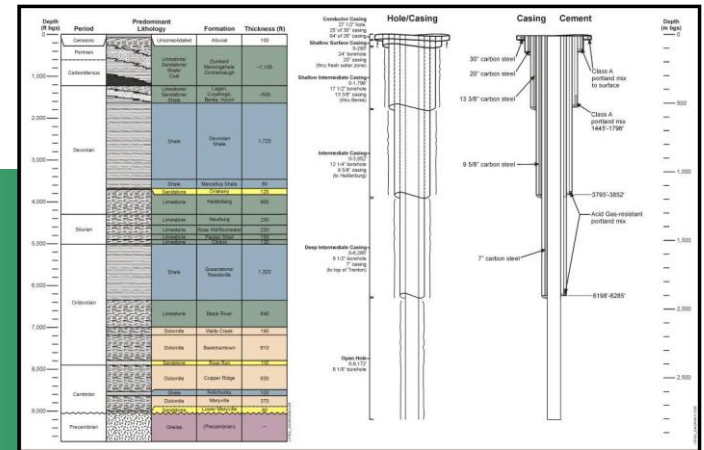
**Seismic Survey  
Summer 2003**

**Drilling and Testing  
2003 - 2005**



**Modeling and Analysis  
2006 - 2007**

**More than \$7.5 million for  
site characterization and  
feasibility assessment  
conducted by Battelle under  
funding by DOE and others**



**Pacific Northwest  
National Laboratory**  
Operated by Battelle for the  
U.S. Department of Energy





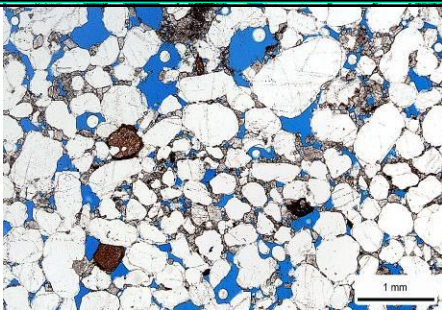


# Rose Run Sandstone Core Analysis

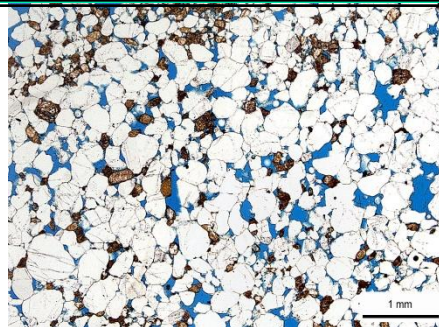
*Rose Run Sandstone - 116 ft total thickness, ~30 ft porous sandstone.*



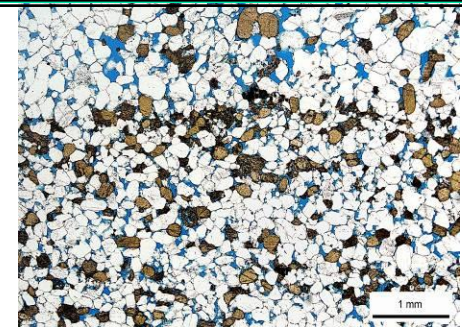
**Hydraulic Core Tests 7763.5 ft**  
Lithology = Sandstone  
Density = 2.68 g/mL  
Porosity = 9.1%  
Permeability ~ 36 mD



**Hydraulic Core Tests 7775 ft**  
Lithology = Sandstone  
Density = 2.64 g/mL  
Porosity = 10.4%  
Permeability ~ 49 mD



**Hydraulic Core Tests 7819 ft**  
Lithology = Sandstone  
Density = 2.63 g/mL  
Porosity = 11.5%  
Permeability ~ 36 mD

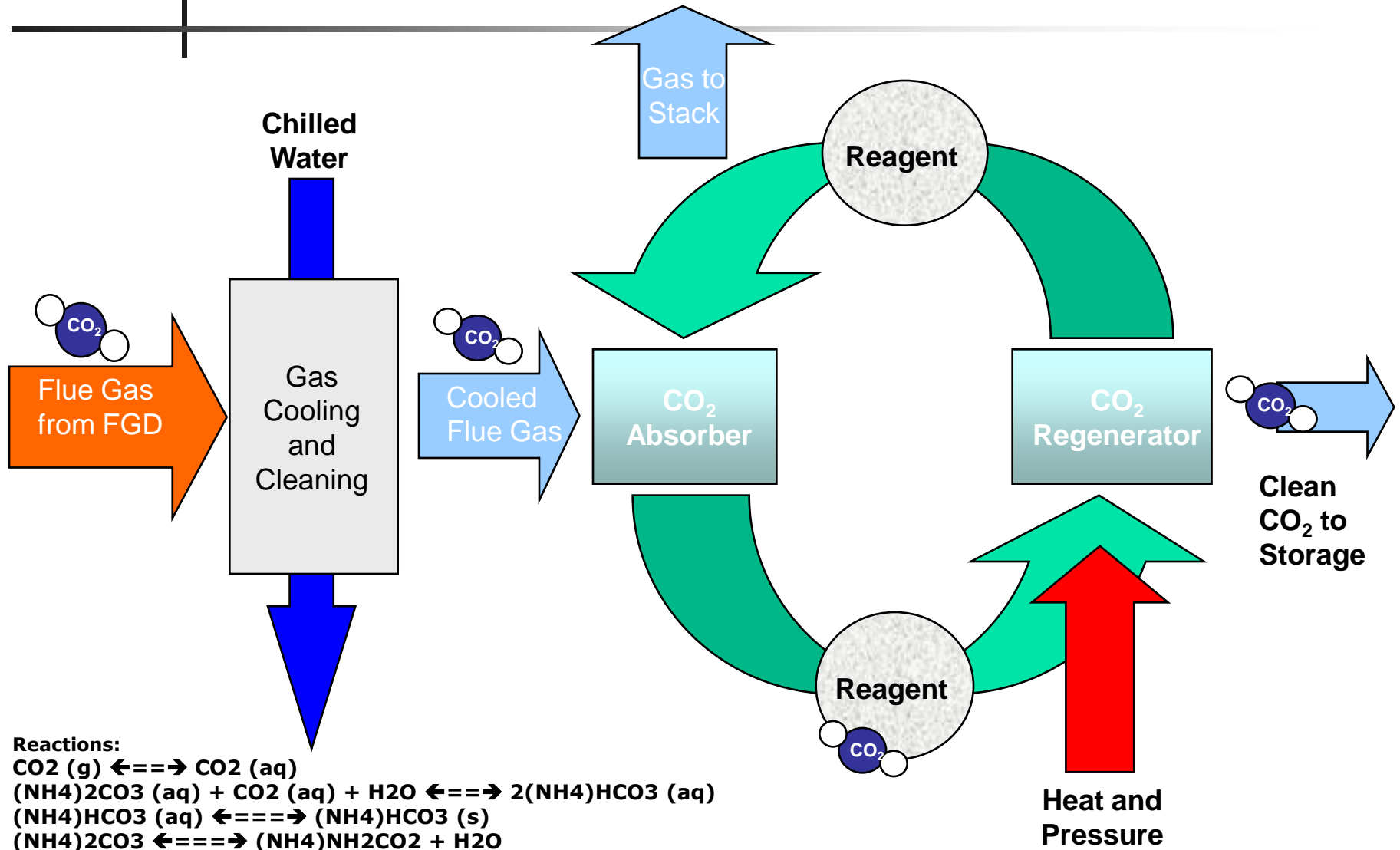






# Alstom's Chilled Ammonia Process

## Post-Combustion Capture







# AEP CCS Validation Facility

*1,300 MWe Mountaineer Plant, New Haven, WV*

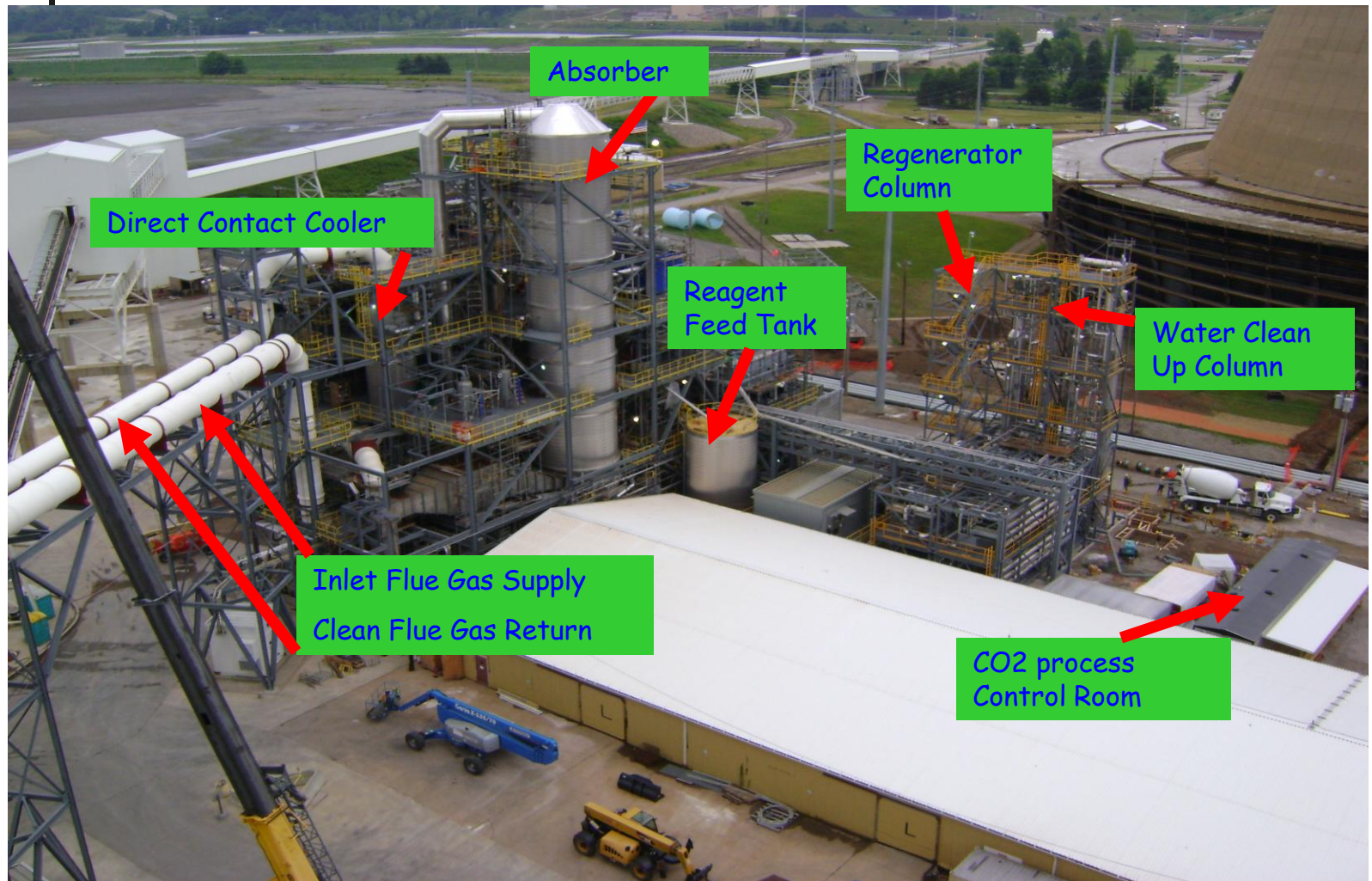


- **Scale:** 20 MWe slipstream
  - ~1.5% of power plant flue gas
- **Cost:** >\$100M
  - Project initiated in September 2007
  - Funding by AEP, Alstom, RWE, & EPRI
- **Capture:** Alstom Chilled Ammonia Process
  - Ammonium Carbonate/Bicarbonate Reaction
  - >85% CO<sub>2</sub> capture rate
- **Sequestration:** Deep saline formation storage
  - ~100,000 tons CO<sub>2</sub> per year
  - ~1.5 miles below the plant surface
- **First CO<sub>2</sub> Capture:** September 1, 2009
- **First CO<sub>2</sub> Storage:** October 1, 2009
- **Planned operation:** 1 to 5 years





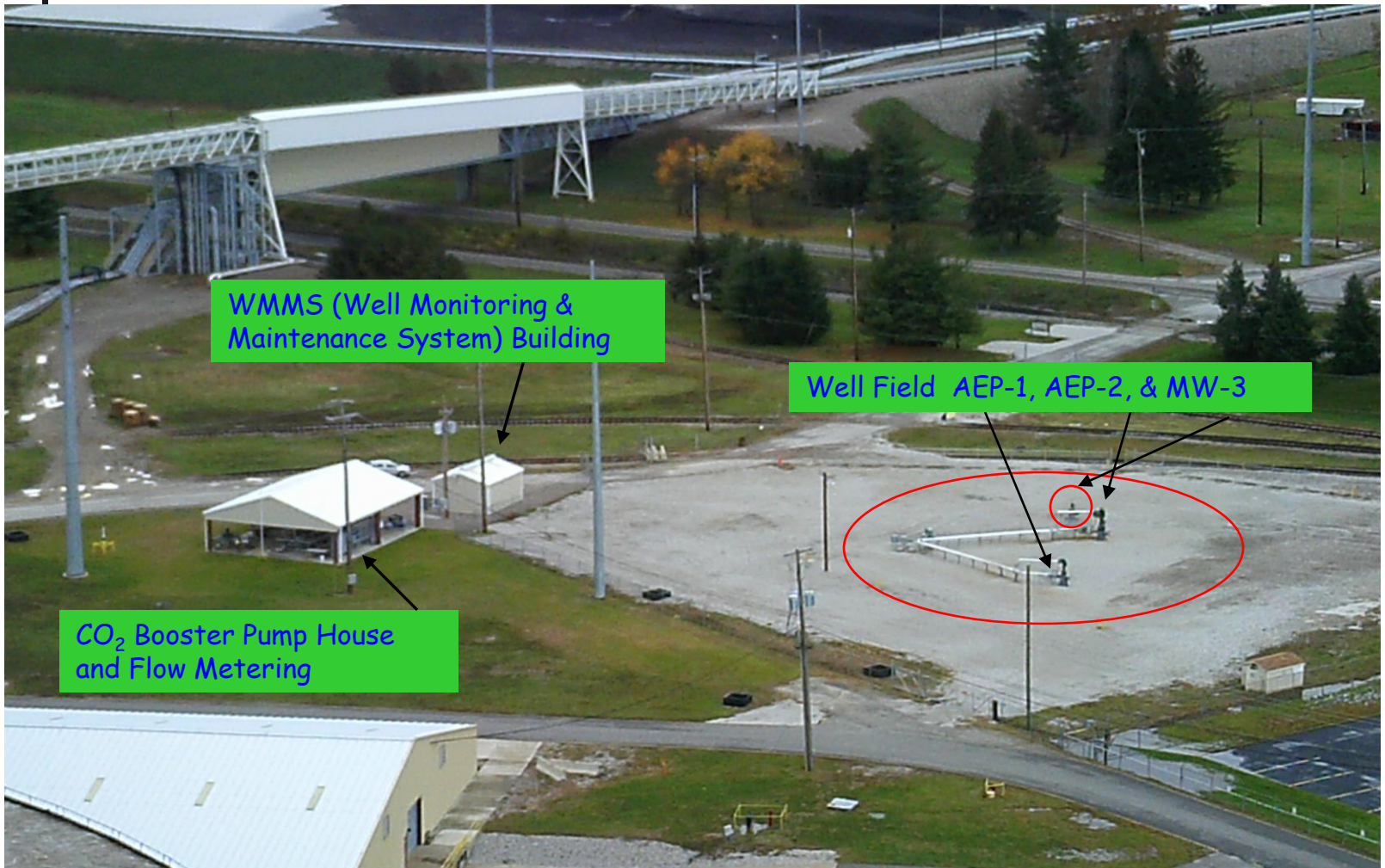
# Alstom's Chilled Ammonia - CO<sub>2</sub> Capture Process (20 MWe Equivalent or Approximately 1.5% of Unit Flue Gas)







# CO<sub>2</sub> Sequestration at Mountaineer Plant Site

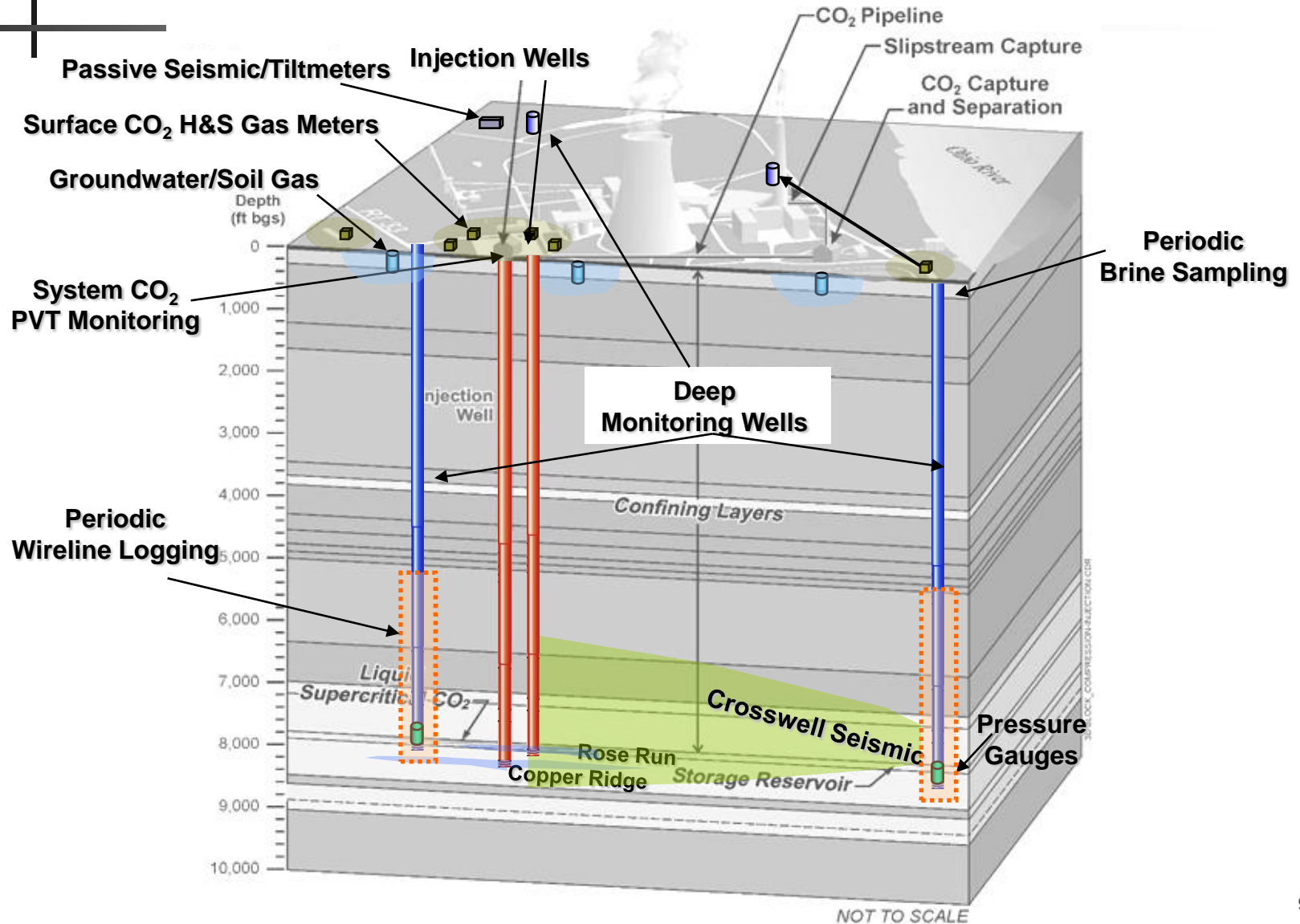






# Monitoring System Design At Mountaineer Plant

**Battelle**  
The Business of Innovation



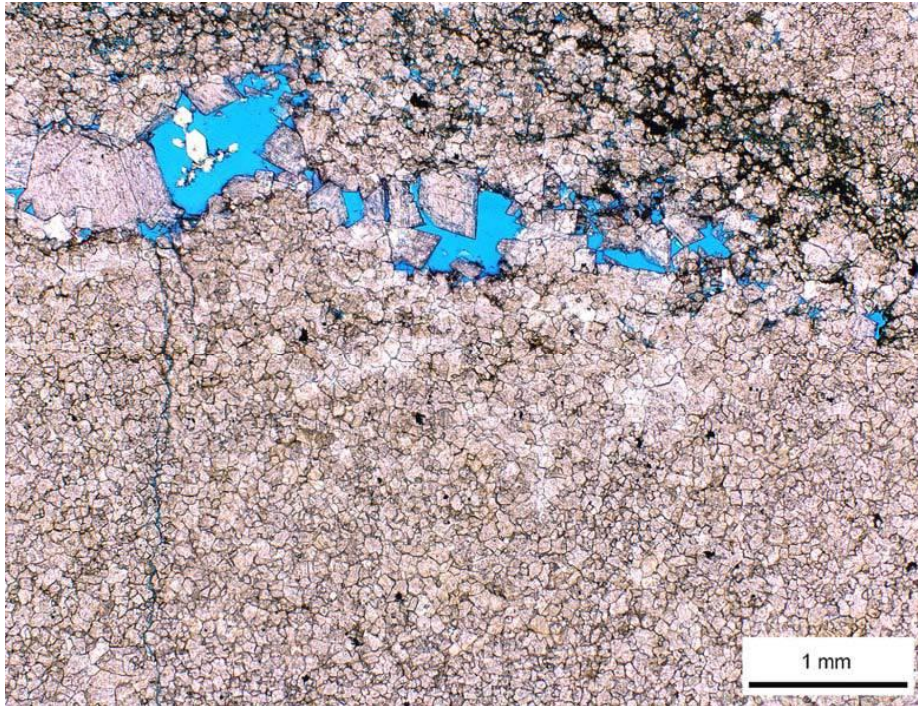




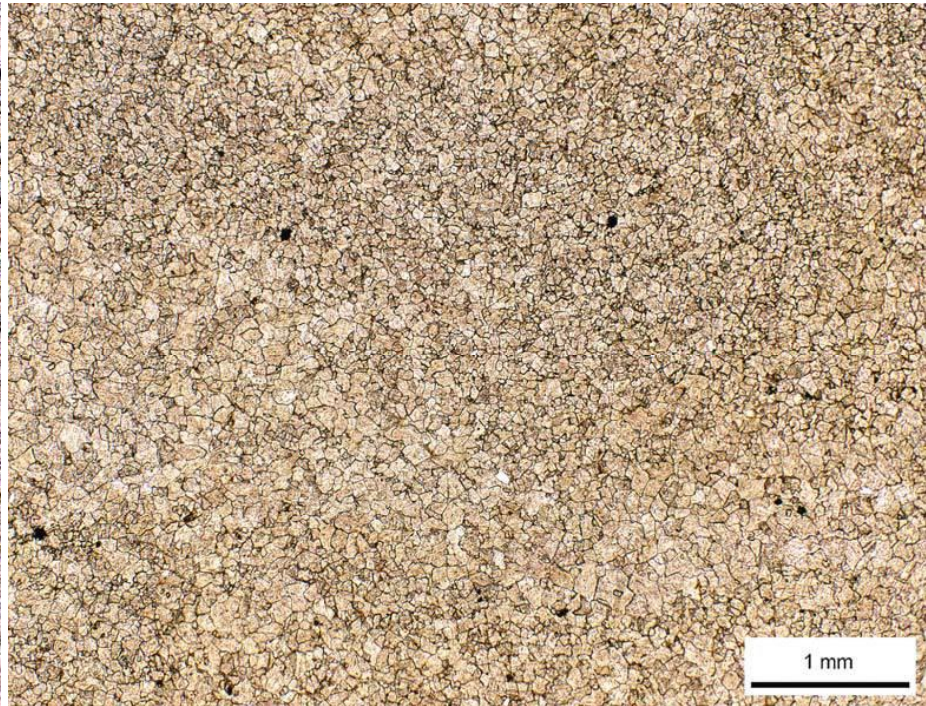
# Copper Ridge Thin Sections

## *Vugular Porosity vs. Crystalline Dolomite*

**Battelle**  
*The Business of Innovation*



Sidewall core from depth of 8,177 feet  
just below a proposed perforation interval



Sidewall core from depth of 8,178 feet in  
non-perforated interval

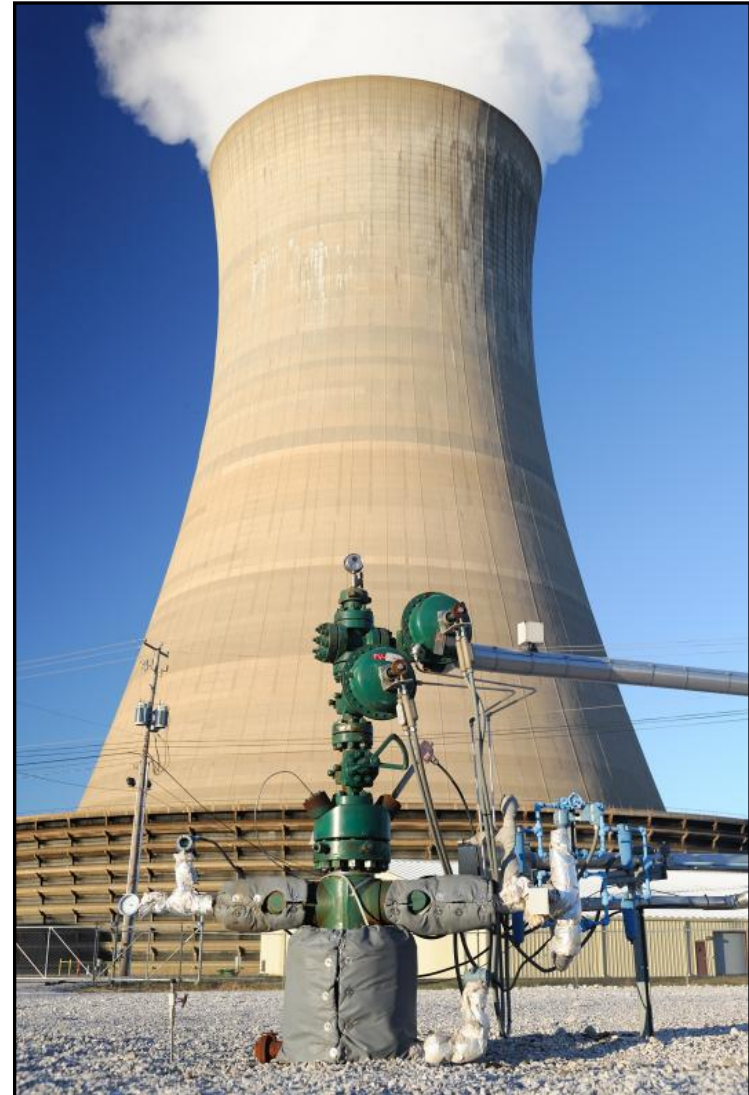




# Validation Facility Progress Update

*First Year of Operation*

- **~4,400 hours operation**
- **~21,000 metric tons captured**
- **~15,000 metric tons stored**
  - **~13,500 into AEP-1**
    - Copper Ridge
  - **~1,500 into AEP-2**
    - Rose Run
- **Process availability approaching 100%**
  - **Both capture and storage**
- **>90% CO<sub>2</sub> capture rate**



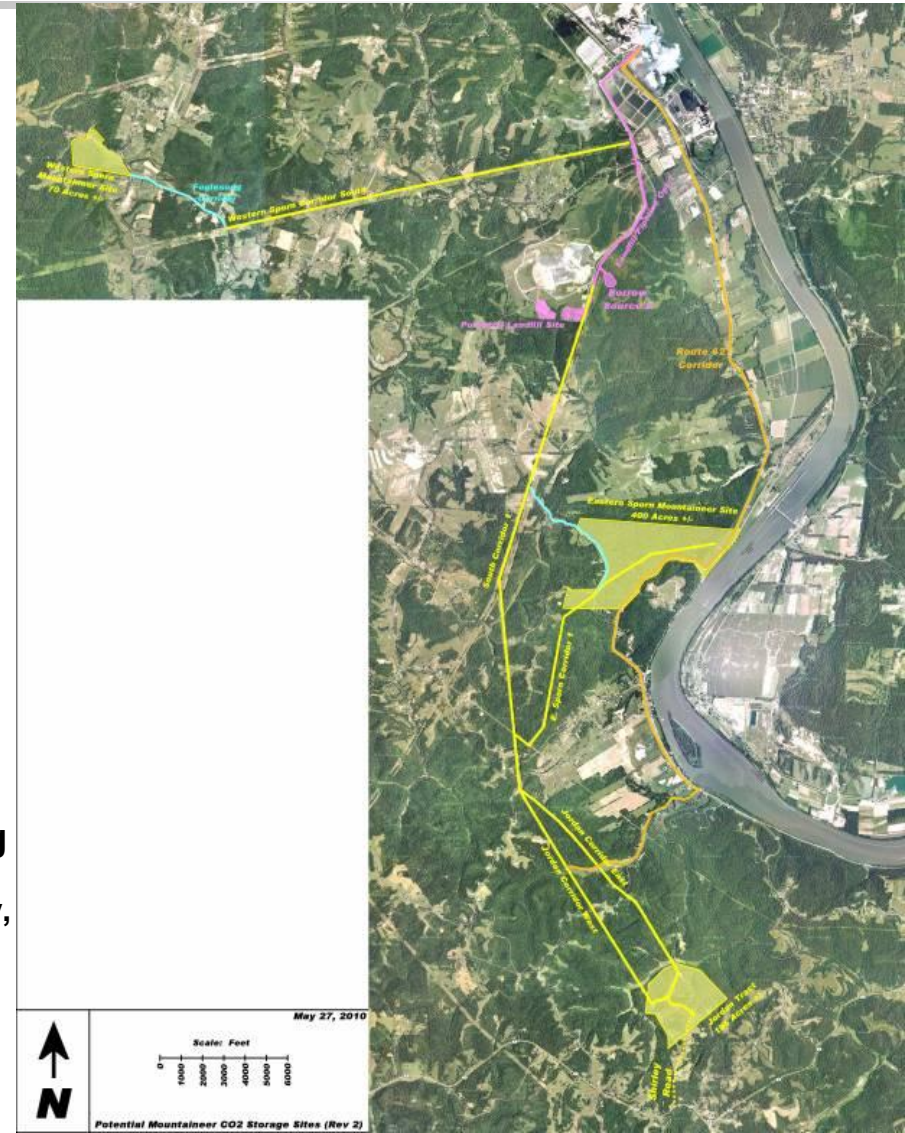




# AEP CCS Commercialization Project

## 1,300 MWe Mountaineer Plant, New Haven, WV

- **Scale:** Full commercial demonstration
  - 235 MWe Slipstream
- **Cost:** ~\$668M
- **Funding:** CCPI Round III Selection
  - DOE awarded 50% cost share, up to \$334M
  - Cooperative agreement signed in January, 2010
- **Capture:** Alstom Chilled Ammonia Process
  - ~90% CO<sub>2</sub> capture rate
- **Sequestration:** Battelle is Storage Contractor
  - Deep saline reservoirs
  - ~1,500,000 tons CO<sub>2</sub> per year
  - ~1.5 miles below the surface
  - Pipeline system with off-site wellheads
- **NEPA Process Underway**
- **Geologic Experts Advisory Group: Actively Meeting**
  - Battelle, Schlumberger, CONSOL, MIT, Univ. of Texas, Ohio State, WVU, Virginia Tech, LLNL, WV Geo. Survey, OH Geo. Survey, WV DOE, NETL, RWE, & CATF
- **Planned Operation:** Startup in second half of 2015







# Remaining Challenges



## Capture Process:

- CO<sub>2</sub> absorption
- Steam requirement for liberation of CO<sub>2</sub>
- Power plant integration and optimization
- Parasitic load

## CO<sub>2</sub> Storage:

- Property rights
- Liability
- Permit requirements
- USEPA designation of CO<sub>2</sub>
- State cooperative agreements/consistency