

**MSHA Ventilation Summit**

**Beaver, WV**

**February 22, 2007**

---

# **Summary of Seal Evaluation Methods at NIOSH's Lake Lynn Experimental Mine**

**Eric S. Weiss**

**Manager, Lake Lynn Laboratory**

**Mining Engineer**



# U.S. Regulations

---

- Requires all worked out areas to be ventilated or sealed (explosion isolation)

# U.S. Regulations

---

- **All coal mine seal designs must be “deemed suitable” by MSHA**
  - **Part of the suitability determination is based on full-scale explosion tests conducted within NIOSH’s Lake Lynn Experimental Mine**

# U.S. Regulations

---

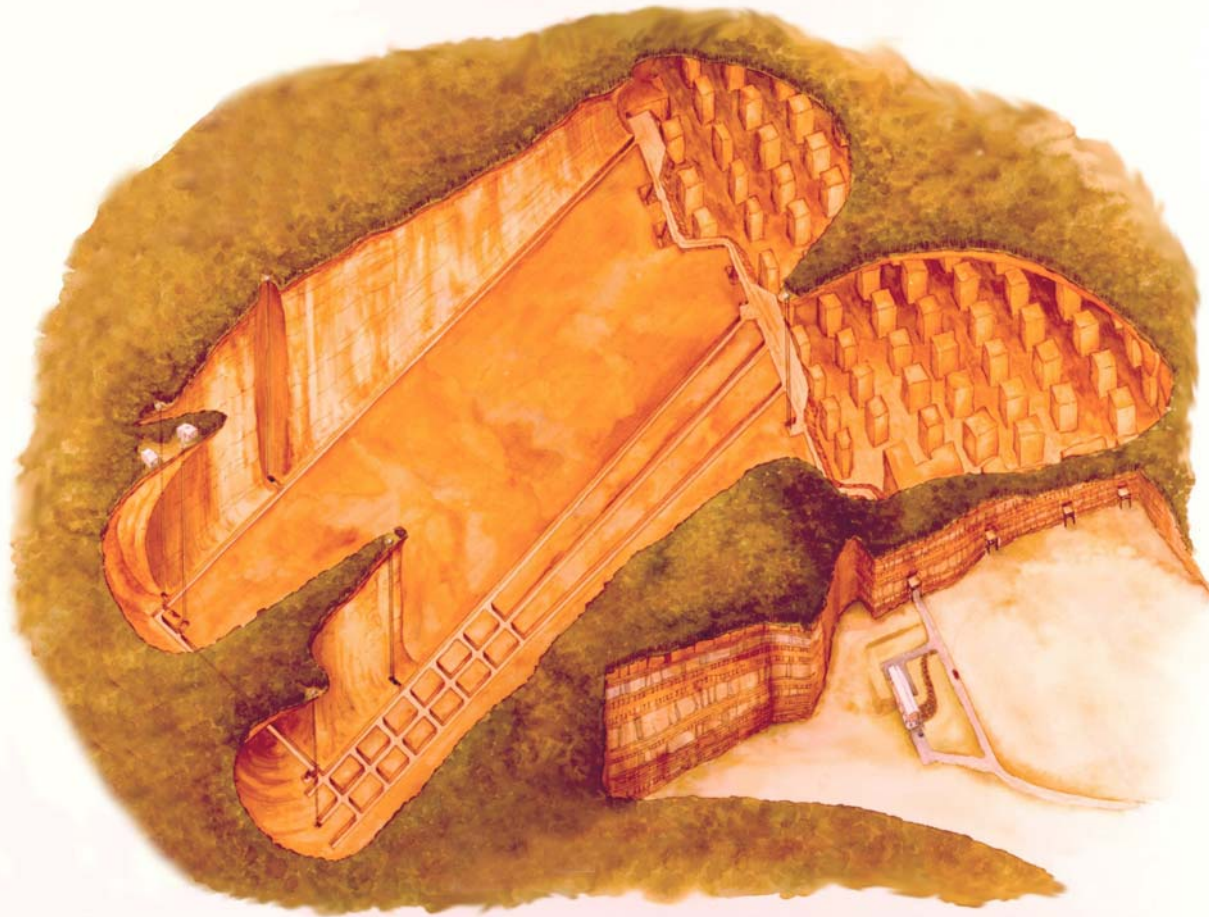
- Prior to July 19, 2006, all seals were required to:
  - Withstand a 20 psi static explosion overpressure
  - Must not leak more than 100 ft<sup>3</sup>/min at 1 in H<sub>2</sub>O pressure differential across the seal

# Lake Lynn Laboratory

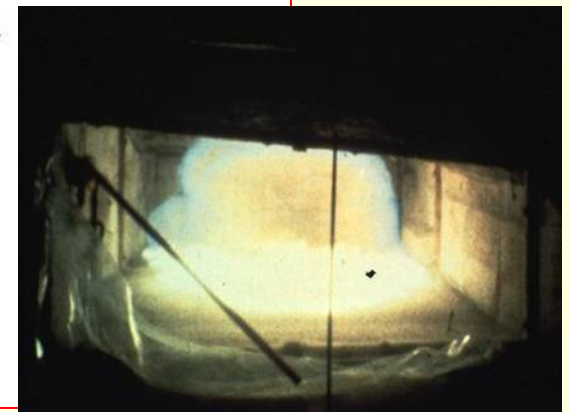
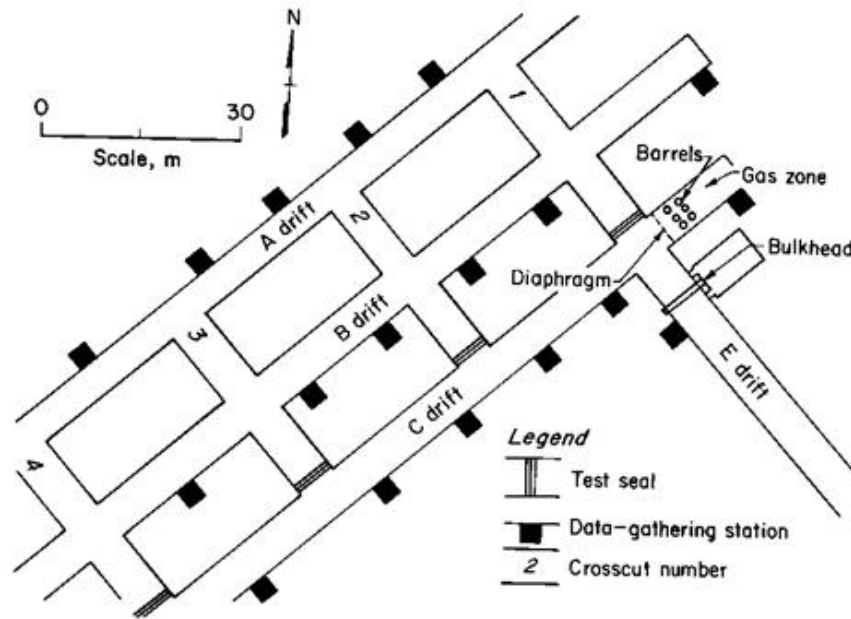


# Lake Lynn Experimental Mine

---



# The unconfined explosion test method addressed the 30 CFR-horizontal “STATIC” pressure requirement



# Construction of seals in crosscuts





# Typical Methane Ignition

---



# Post-Explosion Outcome



# LLEM Results:

---

11 alternative types of seals  
(over 30 designs) have  
'passed' this suitability  
determination through the  
unconfined explosion tests  
(side-on pressure loadings)

# Chamber Approach for Evaluating Seals

---

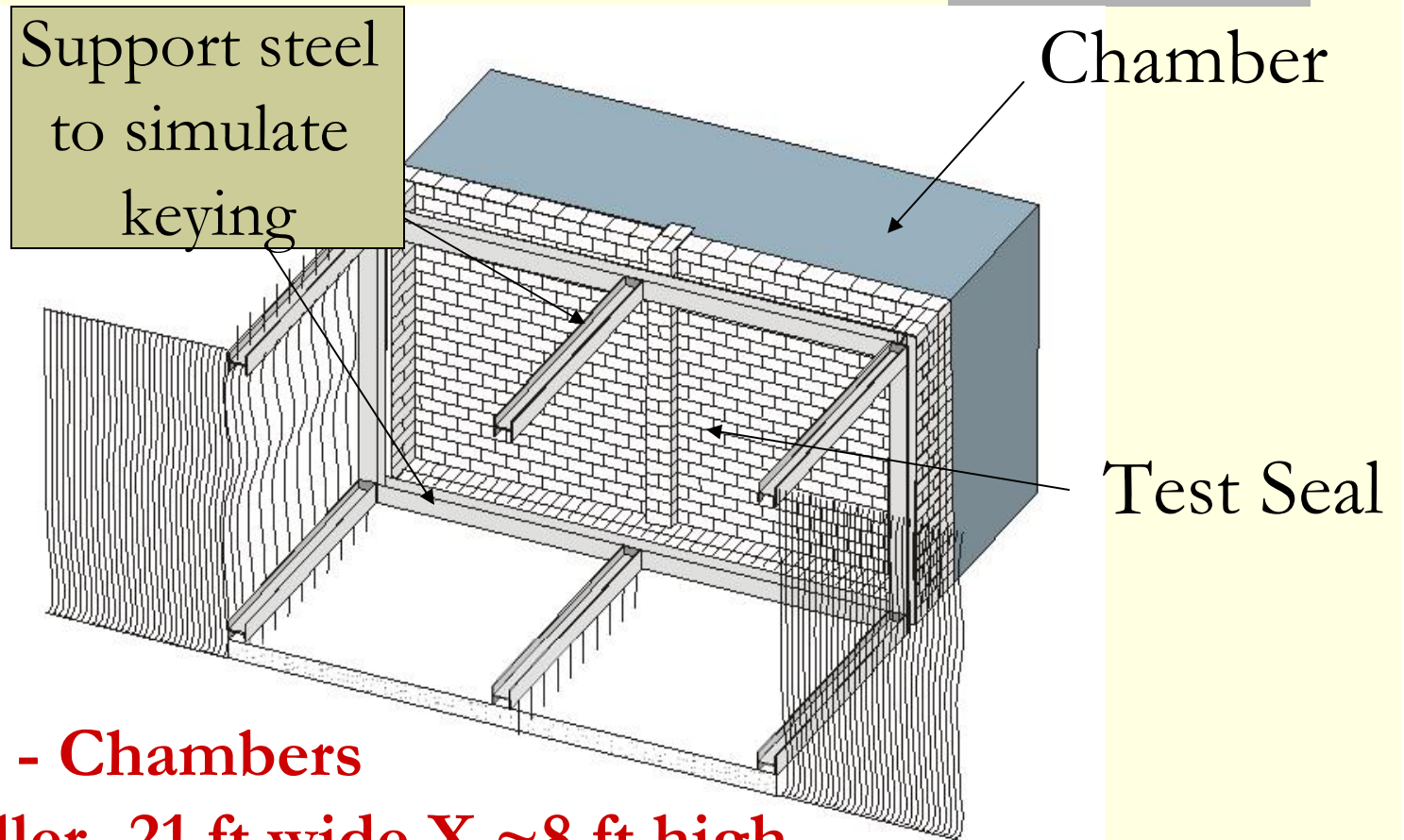
Develop an alternative methodology for evaluating the strength characteristics of mine seals that was consistent with the intent of 30 CFR 75.335

# Chamber Approach for Evaluating Seals

---

- Compare results between current approved method (LLEM) and alternative methodology
- Determine seal design safety factor
- Develop geometric seal sizing relationships
- **Determine as-built strength in coal**

# Chamber Approach



**Two - Chambers**

**Smaller- 21 ft wide X ~8 ft high**

**Larger - 30 ft wide X 16 ft high**

# Pressure Loading Methods for Closed Chamber Studies

---

- **Compressed air**
- **Methane-Air Explosions**
- **Water**

# Chamber Evaluations





# Chamber Results:

---

- In-situ pressure loading with water shows promise as an alternative to full-scale explosion testing of mine seals
  - Results comparable with LLEM explosion test

# Chamber Results:

---

- Technique also allows for the determination of the ultimate strength or design safety factor
- In-situ validation of seal/strata interface within 'unique' coal mine geologies

# 2006 Mine Disasters

---

**MSHA and WVOMHST  
requested NIOSH  
assistance in the  
investigations of seal  
failure at the Sago Mine**

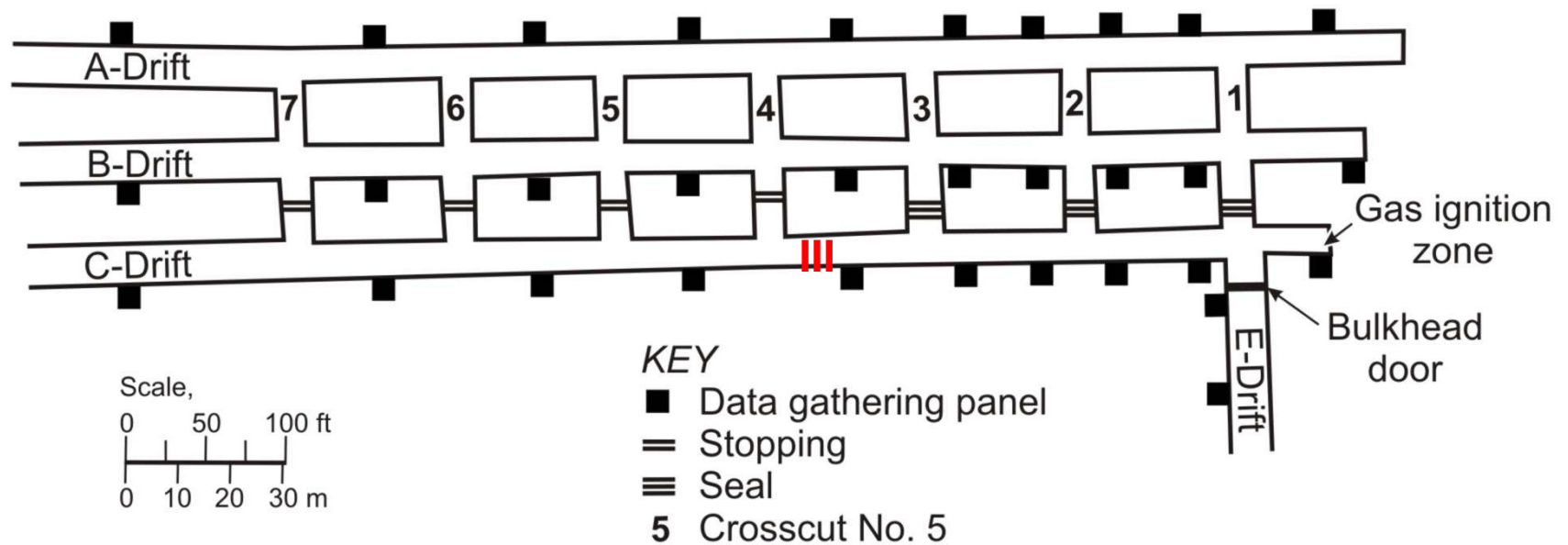


# 'Head-on' Pressure Loading

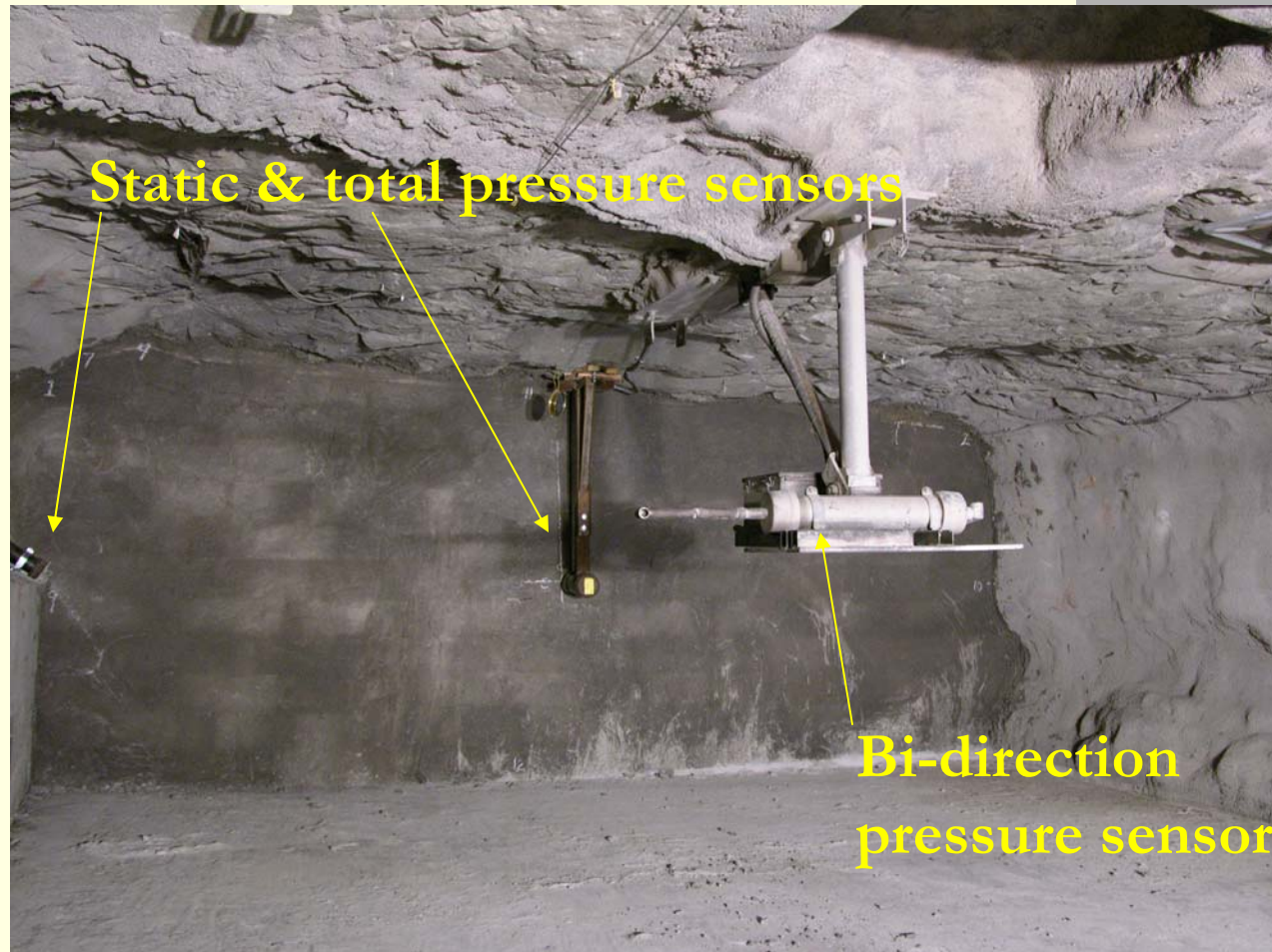
---

- Confined explosion
  - Longer duration – higher impulse
- Uniformly loaded across entire seal face
- Developed a reflected pressure pulse
  - ~3 times the approaching pressure pulse

# New LLEM Test Configuration



# Seal Across C-Drift (Inby Side)



# Results of 'head-on' explosions

---



**20-psi overpressure**



**50-psi overpressure**

# Ongoing LLEM Efforts:

---

**NIOSH is evaluating  
'generic methods' to  
improve the strength of  
in-situ seals.**



# Thank you

---

**Eric S. Weiss**

Manager, Lake Lynn Laboratory

[EWeiss@cdc.gov](mailto:EWeiss@cdc.gov)

412-386-5050



The findings and conclusions of this presentation are those of the author and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

