Mine Rescue Drilling

IMCC Meeting

May 11, 2011

Rule #1

- There are drillers --- and then there are drillers
  - Water well drillers do not have the capabilities that gas and oil well drillers possess
  - Selection of the right type of driller for any particular situation can save time and provide improved accuracy.
  - Consider use of directional drillers when appropriate

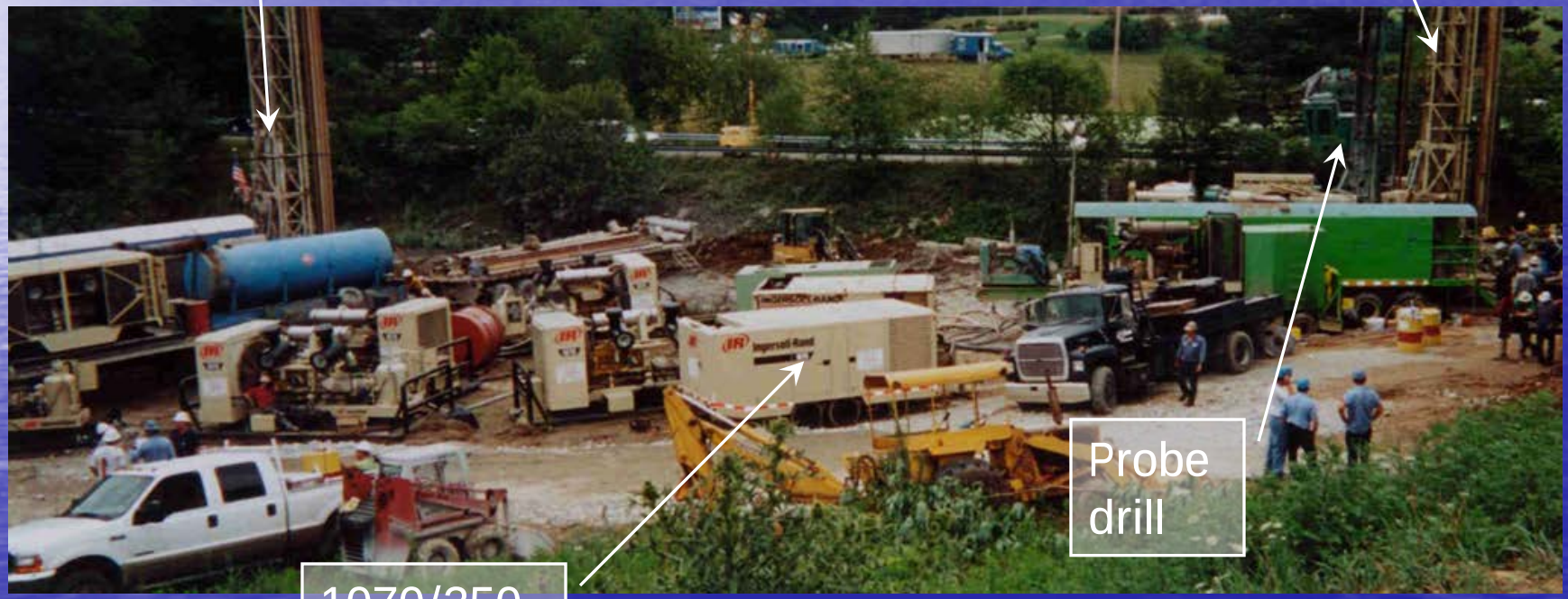
Rule #2

- Mine operators should pre-survey locations on the surface above their mines corresponding to key points underground (refuge alternatives, etc.)
  - Waiting to do this during a mine emergency takes too much time and valuable resources

Rule #3

- During Mine Emergency Operations always require operators to drill multiple probe holes and at least two rescue holes

Quecreek Rescue location



Quecreek Rescue location

RD20 #2

RD20 #1

Yost Doghouse

Probe drill

Atlas Copco CMT's Oil & Gas Rig Line

- **RD20**
  - **Proven machine developed in 1980's**
  - **120,000 LB hookload rating**
  - **Upgrade underway to allow use of oilfield pipe**
    - **Oilfield pipe required for directional or horizontal drilling**
  - **Self-contained unit, though a separate automatic rod loader is being tested**
- **Predator**
  - **New design being tested for release in 2011**
  - **200,000 LB hookload rating**
  - **3 piece system with substructure (for blow-out preventer) and automatic pipe loader**
  - **Fuel efficient carrier with hydraulic drive**
  - **Engineered & Manufactured in Garland, Texas**

Rule #4

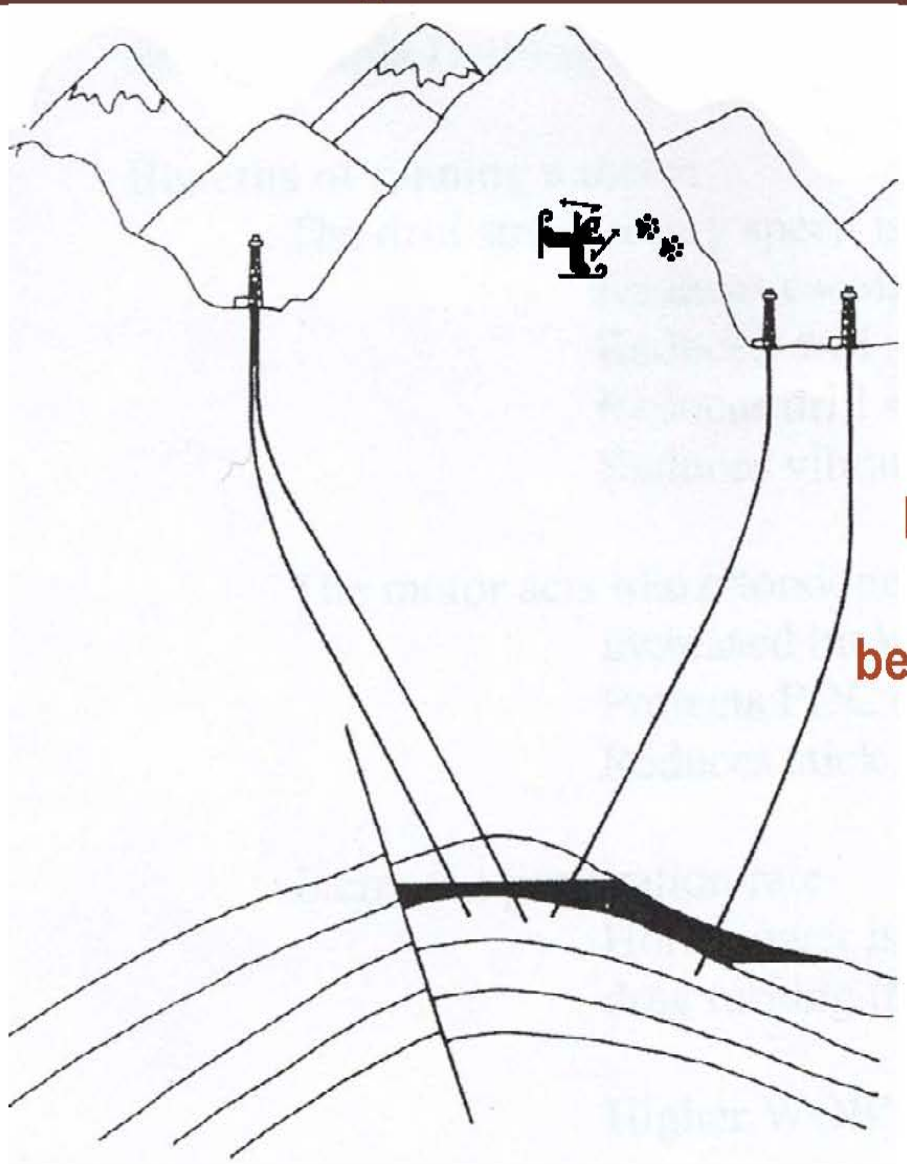
- Operators should review mine plans to assure that refuge alternatives are positioned underground corresponding to accessible locations on the surface (if possible)
  - Minimum drilling distances should be sought to refuge alternatives/other key locations

Probe hole; location..location..location

Probe hole drill pumping air into mine. 6” diameter hole was drilled 12 hrs after accident!

Excavator pushing conductor (starter) pipe for hole #1 after excavating trench.

Directional Drilling - Obstruction



Drilling of directional wells where the reservoir is beneath a major obstruction.

Downhole Solutions

NOV NATIONAL OILWELL VARCO

Rule # 5

- Murphy was an optimist – prepare for the unexpected!

“Shanked” 29”bit. Murphy’s law

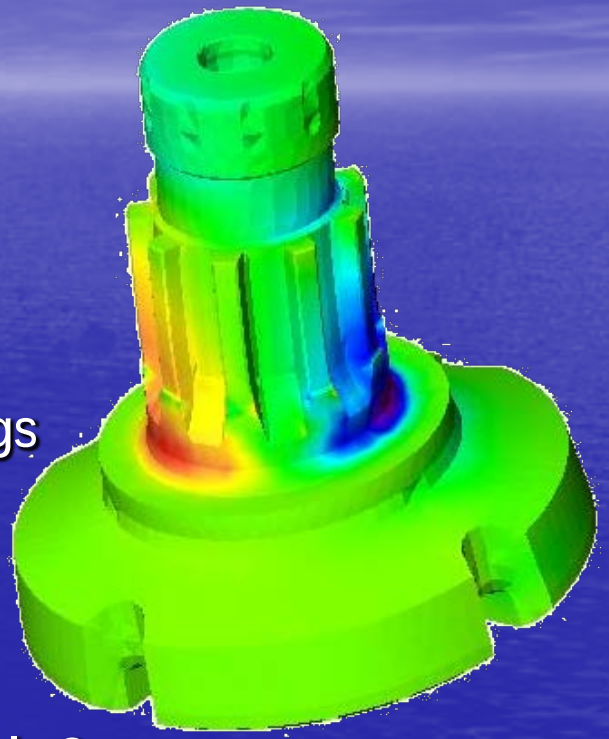
Fishing tool & broken bit head

Broken bit shank in DHD

Stabilizer (straightness)

Bit breakage/shanking

- What caused bit to shank?
  - Little time for planning!!
  - Uneven loading on bit face
    - Geology being drilled
    - Poor stabilization (alignment)
    - Worn tool bit alignment bearings
  - Pre-existing fatigue cracks
    - Corrosion
    - Cyclic fatigue
  - Did the 17 hr fishing delay help?



Rule #6

- Education always pays off
  - We all need to learn more about drilling requirements, and utilize proven drilling resources
  - MSHA is working to identify proven drilling resources and plans to provide this information on MSHA web page

Rule #7

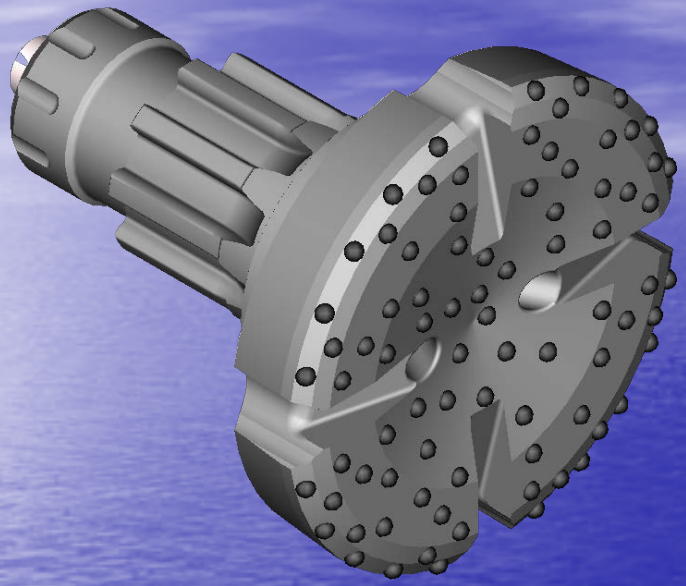
- A drilling tool on hand is worth 10 on the way!
  - We need to work with drillers to pre-position drilling tools/drill pipe that will be needed for mine emergencies

Drilling tools

Drilling Tools on location

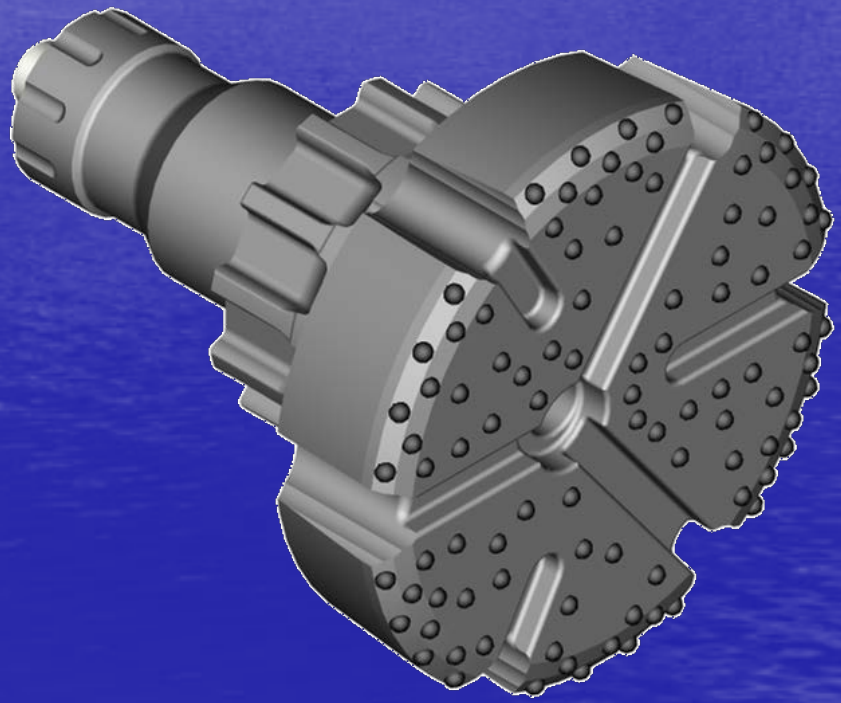
QL200S with 29” bit

26” & 30/29” Rescue Bits



26” Rescue bit

30” Rescue bit



Drilling Tools

Drilled 26” break-through hole

QL200 Down Hole Drill

- 3850 lbs (with bit)
- 17-1/2 to 26” hole
- 800-900 BPM
- 5000 cfm @ 250 psi
- 620 lb piston

Drilled 30” second rescue hole

QL200S Down Hole Drill

- 5210 lbs (with bit)
- 28 to 36” hole
- 800-900 BPM
- 5000 cfm @ 250 psi
- 620 lb piston

- **Drill Pipe**
  - **Large diameter drill pipe**
  - **4-1/2” drill pipe**

Rule #8

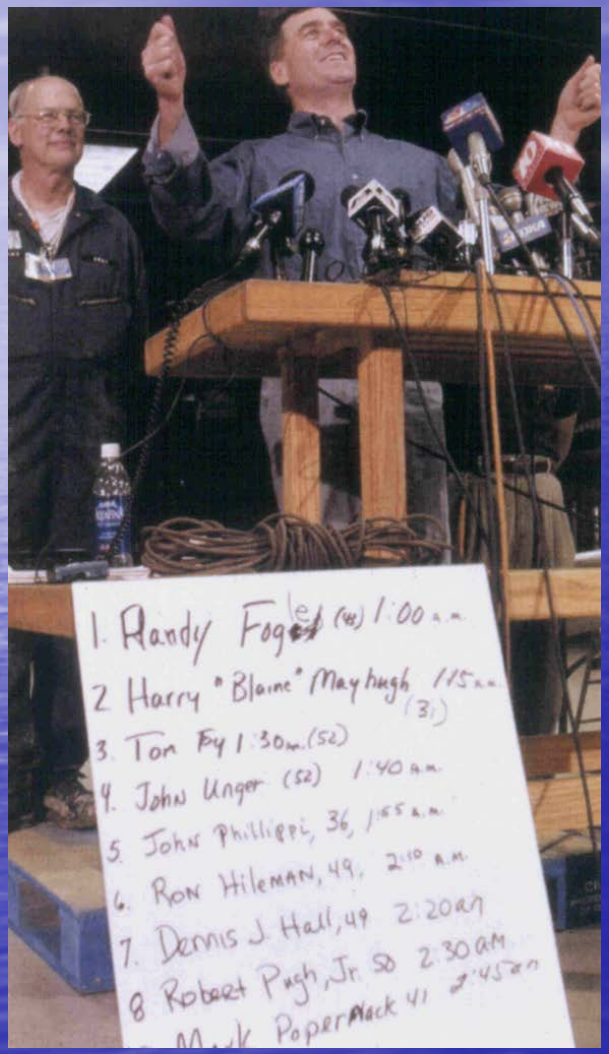
- Rescue capsules may need wheels!

Rule #8

- Saving miners lives is our business – we need to get better at it!

Results!

Results!


1. Randy Fogle (4) 1:00 a.m.
2 Harry "Blaine" Mayhugh 1:15 a.m.
(3)
3. Tom Fry 1:30 a.m. (52)
4. John Unger (52) 1:40 a.m.
5. John Phillippi, 36, 1:55 a.m.
6. Ron Hileman, 49, 2:10 a.m.
7. Dennis J. Hall, 49 2:20 am
8 Robert Pugh, Jr. SO 2:30 AM
Paper Mack 41 2:45 am

Results!

Results!

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Results!