

# ROCK GROUP



# Panel

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# Goal

- Supergrid
  - Support
  - Facilitate

# Status of Industry

- Industry: small engineering firms and contractors, risks high, projects must stand on their own.
- Major development of pressurized face TBMS, real time readouts
- Innovations on HDD and Micro-tunneling: small projects and operators
- Government funding has not been available.
- Few bidders on large tunnel contracts (200+ million).

# Opportunity to jump start the supergrid civil and construction work

- Supergrid project will generate industry interest
- Development projects will improve industry capabilities
- Tailor research/development to specific issues of tunneling on the supergrid.
- Tunnel demonstrations on supergrid demonstration projects
- Tunnel demonstrations on other tunnel projects:
  - provide funds for development that support innovations by machine manufacturer, contractor and tunnel designer
  - Ultimately: supergrid application



- Engage the tunneling industry
  - Engineers
  - Machine manufacturers
  - Contractors
  - Research organizations
  - Students
  - Advisory panel
- Concept studies
- Specific research objectives & demonstrations
- Competitions

# 3 Ways to be more efficient/ cost effective

- 1. Increase advance rate
- 2. Reduce crew size
- 3. Reduce Risk
  - To Bidder/Construction Contractor
  - Better Contracting Practices
  - Reduce delays/ cost overruns
  
  - Robust tunneling equipment
  - Improved exploration, sensing and response to ground
  - Methods insensitive to variable ground conditions

# Contracting practices

- Major project, multiple contracts
- 1000 km:
  - 10 km contracts: 1 year: shafts & mob., 6 month tunneling at 2 km / month.
- Opportunities for true incentives (cost and schedule)
- Mobilize capabilities of private industry
- Contracting practices, site investigations, construction management that **reduce risk.**



# Research & development topics

## ■ Exploration

- Horizontal core drilling and sampling over significant length of tunnel project. Major contribution to defining tunneling conditions.
- In hole testing including borehole televiewer (acoustic log showing fracture orientation and openness of joints). Technology available.
- Geophysical exploration
  - Needs to be very focused and specific
  - Surface, Cross hole tomography

# Construction monitoring & sensing

- **Ground conditions: ahead of face and around shield**
  - .e.g. GPR, seismic
  - Voids created by tunneling: Ground loss and ground replacement volumes.
  - Boulders
  - Evaluate soil properties that are related to use of conditioners and slurries to support the tunnel face.
- **Volume excavated with respect to volume of advance.**  
Slurry volume in and out. Weighing, laser profiling of muck on belt.
- **Sensing** of cutter wear
- **Increased linkage** of sensors and readouts of machine functions **with operation**

# Repair, access at face

- Reduce risk to crew and schedule
- Robotics
- Complete seals around cutters. Change cutters from back without requiring exposure to the ground
- Detection of wear, seized disc cutters
- Televiewers, video of conditions ahead of face

# Ground loss

- More accurate and immediate sensing of ground loss.
- More reliable control of the face
  - Reduce dependence on operator
  - Rapid response of face support (conditioners, pressures) to changing ground conditions
  - Reduce sensitivity of face support to variable ground conditions

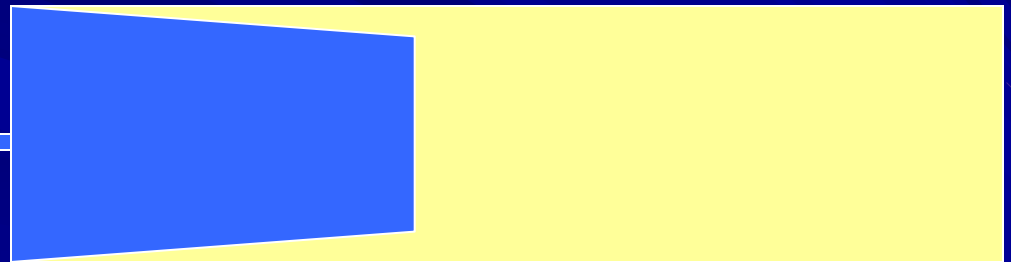
# Tunnel lining

- **Rapid** ring building
- Ring building independent from shield advance.
- Automation of ring installation process
  - Rapid coupling, fewer and larger ring segments
- Materials: fiber concrete, other.
- Precast or Slipformed linings
- **Improved reliability** of seals and gaskets for the ring segments



# Build on TBM & Directional drilling technologies

- Pilot drill hole with sampling.
- Pull TBM through



# Nuclear

- Cavern construction and ground support
  - Large chambers in salt
- Reactor and energy conversion system layout in the underground
- Reactor Chamber ventilation
- Energy conversion heat rejection.

# Existing underground

- Tunnels

- Storage

  - assess

# Tunnel Advance Rates

	Excavation time	Lining Erection	Utilization	Advance / day
5-ft segments	15 min	30 min	75%	100 ft
10-ft segments	15 min	5 min	75 %	450 ft