




Refuelling of Hydrogen Fuelcell Vehicles in Underground Mining Applications



Fred C. Delabbio, Doug Eastick
HATCH Mining Technology Unit
Marc C Bétournay
Mining and Mineral Sciences Laboratories, CANMET

 MDEC – 2004
Toronto, Canada  1



Pending project - summary

- Based on mining and government support, a large amount of research has been completed on fuel cells in mining
- A number of hydrogen applications for mining (existing and pending)
- No existing overall system developed for delivery of hydrogen underground (risks and \$)
- An overall system is required before specific business cases can be developed by industry
- This project will provide answers to a number of the business cases questions to be used by industry.


 MDEC – 2004
Toronto, Canada  2

Presentation Summary


- Outline background to this project
- Discuss industry and government support
- What is the proposed project plan
- Open discussion

Canada MDEC – 2004 Toronto, Canada HATCH 3


Existing and Pending Fuelcell Mining Applications



Pending – LHD 123 kW



Pending – Utility, John Deer Gator



Existing – Locomotive 15 kW

Canada MDEC – 2004 Toronto, Canada HATCH 4




Active Support

- 2003 Fuelcell workshop – Montreal CIM
 - Mobile equipment suppliers - mining
 - Mining companies
 - Ontario Ministry of Labour
 - Mining industry consultants
 - Canadian government research organizations
- Post workshop support -> soon to be approved project with funding and in-kind support from
 - Canadian government
 - Mining companies
 - Mining industry consultants




MDEC – 2004
Toronto, Canada





Phased Approach- proposed and accepted

- Phase 1 – Scope Definition (meeting with industry representatives)
 - Generic scenario (hydrogen requirements)
 - Description of refuelling concepts
 - Preliminary regulatory review
 - Concept design and 3D image of overall layout
- Phase 2 – Study Completion
 - Risk review and mitigation plans
 - Estimate capital and operating costs
 - Summary of advantages and disadvantages




MDEC – 2004
Toronto, Canada






Generic Mine Scenario



- One general mine scenario will be used as the basis of the concept review
- Scenario developed through discussions with mining companies and project team


 MDEC – 2004
Toronto, Canada  7



Generic Mine Scenario


- Scenario will outline:
 - access to mine (shaft),
 - number of levels, etc
 - Type of mining (bulk or selective)
 - operating depth and associated heat,
 - ventilation requirements,
 - excavation costs,
 - electrical cost \$/kWh,
 - number of hydrogen units per level (hydrogen consumption rate/day),

 MDEC – 2004
Toronto, Canada  8





Potential Hydrogen Delivery Concepts

- Concept 1
 - Electrolyser on surface,
 - Hydrogen storage on surface
 - Piped hydrogen underground as required
- Concept 2
 - Electrolyser on surface
 - Hydrogen piped to underground storage
 - Hydrogen removed from storage as required
- Concept 3
 - Electrolyser underground
 - Hydrogen storage
- Concept 4
 - Electrolyser underground
 - No hydrogen storage
- Concept 5???




MDEC – 2004
Toronto, Canada





Deliverables for each Concept

- Description of concept
- 3D image of concept
- Advantages and disadvantages
- Regulatory concerns and mitigation approach
- Capital and installation costs (engineering and excavation)
- Estimate of operating costs





MDEC – 2004
Toronto, Canada






Regulatory Review



- A risk assessment will be conducted for each concept
- Risk mitigation plans will be developed for unacceptable risks along with associated cost estimate for mitigation


 MDEC – 2004
Toronto, Canada  ¹¹



Cost Estimate


- Capital and Operating costs will be estimated with input from all team members for each concept

 MDEC – 2004
Toronto, Canada  ¹²





Schedule and cost

- Estimated 6 month schedule starting within 2 months
- Estimated cost \$100k CAD plus in-kind from team members




MDEC – 2004
Toronto, Canada





Project Resources - proposed

Vehicle Projects	Funding management
Vendors (Teledyne or Stuart)	Electrolyser input
Vendors (Hera or Hydrogenics)	Hydrogen storage
NRCAN - CANMET	Business case report assistance, previous fuelcell business cases, etc
Placer Dome, Newmont, Inco, Goldcorp ??	Mine operations input
Hatch	Project management, risk assessment, principal business case compiler
Input from others	
<ul style="list-style-type: none"> -Ontario Ministry of Labour (MOL) -MASHA -University of Nevada 	



MDEC – 2004
Toronto, Canada





Thank You

Questions ?

Canada

MDEC – 2004
Toronto, Canada

HATCH 15