Horizon Sensing (Proposal #51)
July–September 2001 Quarterly Report (3rd)

- **Principal Investigator:** Larry G. Stolarczyk, Sc.D., Stolar Research, Inc.
- **NETL Project Manager:** David M. Hyman
- **Partners:**
  - Los Alamos National Laboratory
  - CONSOL, Inc.
  - RAG American Coal
  - FMC Corporation
  - Lee Ranch Coal Company
- **Total Project Cost:** **$1,860K**
  - DOE Share: $ 900K (incl. $40K to LANL)
  - Participant Share: $ 960K
- **Project Period:** **36 months**
- **Project Start Date:** **20 December 2000**
- **Report Date:** **30 October 2001**
- **DOE Award No.:** **DE-FC26-01NT41050**

Project Objectives

- **To demonstrate the feasibility of real-time stress measurement, bit loading, and horizon sensing on a longwall shearer, boring machine, continuous miner, and loading bucket**

Project Cost Summary

(Amount in Thousands of Dollars)

	First Year		Second Year		Third Year		Total	
	Plan+	Actual*	Plan+	Actual*	Plan+	Actual*	Plan	Actual
Participant	320	1,960	320	3,360	320	3,360	960	
DOE	303		298		298		900	
Total	623		618		618		1,860	

Key:

\+ Planned costs for the full year

* Actual costs through the reporting period. Based on full Stolar Research staff deployment of the Horizon Sensor Project at $280K/month

Milestones and Status

Major Milestones Planned to Date/Status

Planned Milestone	***Status***
– Shock and Vibration Testing	Mar. 02
– Integrate Boom Inclinometer	Apr. 04
– Completed S.A. SABS Certification	Sept. 15
– S.A. In-mine CM Test (S. Africa)	Jul. 01
– Completed U.S. MSHA Certification	Sept. 15
– Anticipated Australian Certification	Jan. 15
– U.S. In-mine CM Test (Exxon)	Nov. 30
– U.S. In-mine CM Test (CONSOL)	Dec. 30
– U.S. In-mine Bore Miner Test (FMC)	Dec. 10
– In-mine Longwall Drum	Jan. 30

Key Accomplishments

Project Progress to Date Highlights

- **Completed HS-2 prototype CM test at CONSOL – February 2001**
- **Drum CM shock and vibration measurements at CONSOL yield 80g shock expectations; Prototype HS-3 designed – March 2001**
- **Completed MSHA certification – September 2001**
- **Integration of cutter-boom inclinometer – April 2001**
- **Sandia National Laboratories shock and vibration tests – May 2001**
- **Fifteen (15) HS-3 systems built for program – thru Oct 2001**
- **Negotiated field test contracts with mining companies – Oct 2001**
- **Completed development of battery-equipped system for low-seam miners and bore miners – September 2001**
- **HS-3 installations with Sasol, EXXON-MOBIL, and FMC – thru Oct 2001**
- **Installations pending with Mid-America, RAHCO, and CONSOL – thru Jan 2002**
- **Longwall system in final developmental stage**

Key Accomplishments

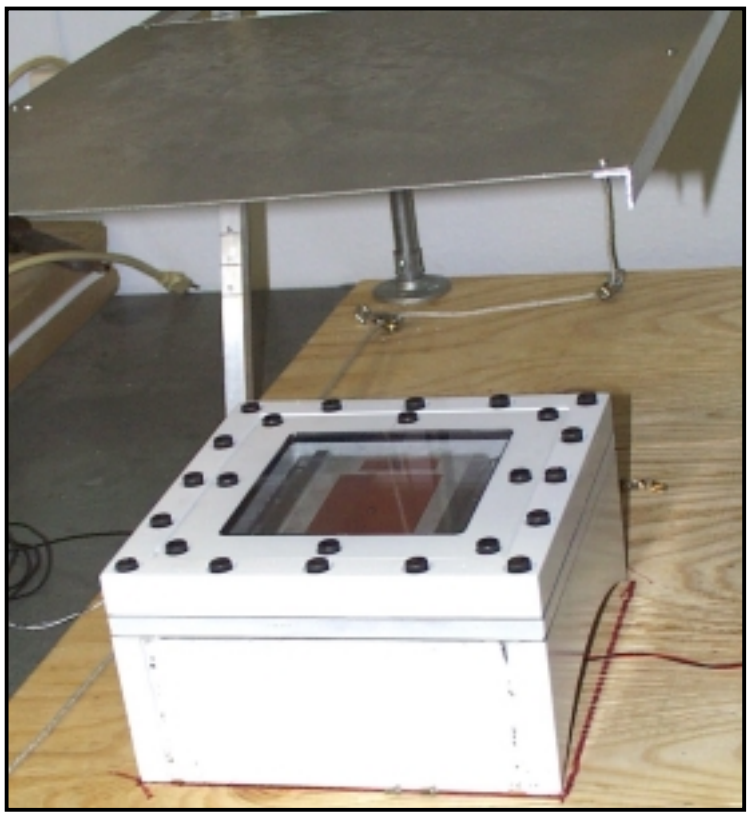
Technical Progress to Date Highlights

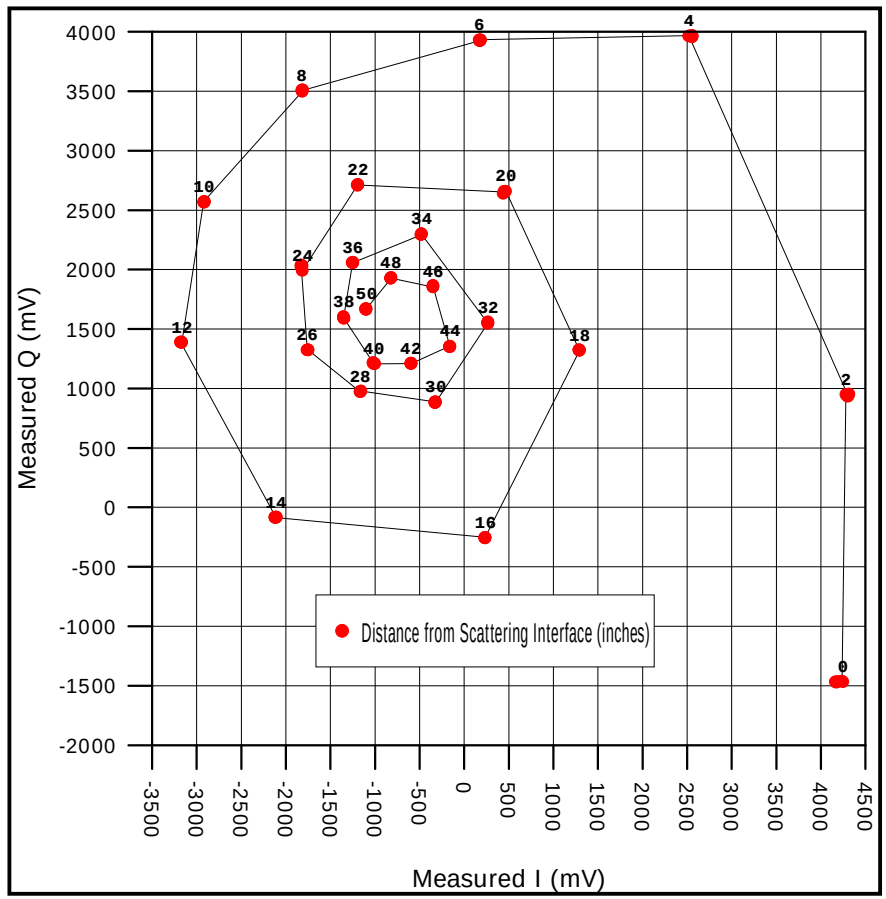
- **Increased measurement sensitivity to scattering interface**
- **Decreased measurement sensitivity to cutter-drum water spray**
- **Reduced size of patch antenna element**
- **Reduced thermal response of sensor components**
- **Increased data transmission capability and reliability due to modem antenna tuning**
- **Advancements in prediction software and data filtering/storage**
- **Design, assembly, and testing of high-capacity battery pack for cutter-drum installation**
- **Quality control and production efficiency in assembly and testing of HS-3 modules and sub-modules**

Key Accomplishments

Technical Progress to Date Highlights

- **Increased measurement sensitivity to scattering interface**





Good News!

- **Structural analysis and vibration testing of the HS-3 Horizon Sensor has paid off with improved longevity and life span of cutter-drum-mounted modules (sensor and generator).**
- **HS-3 installed on Sasol 12CM-31 has survived 3 months (to date) with no system failure due to mining condition, shock and vibration, or heat and moisture.**
- **HS-3 enclosure modules installed on EXXON-MOBIL 12CM-12 has survived 2 months (to date) with little to no Sensor Module abrasion damage.**
- **Design of low-profile Battery Module has allowed installation on smaller-sized *low-seam* mining machines (20"–28" cutter drums). Recently permitted use of solid-core lithium batteries has extended battery pack life 500% and reduced pack size 50%.**

Important Issue!

- **The deployment of electronic systems in methane-rich underground mine atmospheres requires two types of federal certification (MSHA scrutinized).**

1) **Explosion-Proof (X/P) certification, which ensures all electronics are packaged in steel enclosures possessing the proper flame-arresting/suppression characteristics. This certification process includes Design Review and Gas Explosion Testing. Process takes 6 to 10 months. This must be done for all the individual enclosures of a system. Process never needs to be repeated once design is approved (unless design is changed).**

X/P certification began for the HS-3 System enclosure in January 2001 and was completed September 2001.

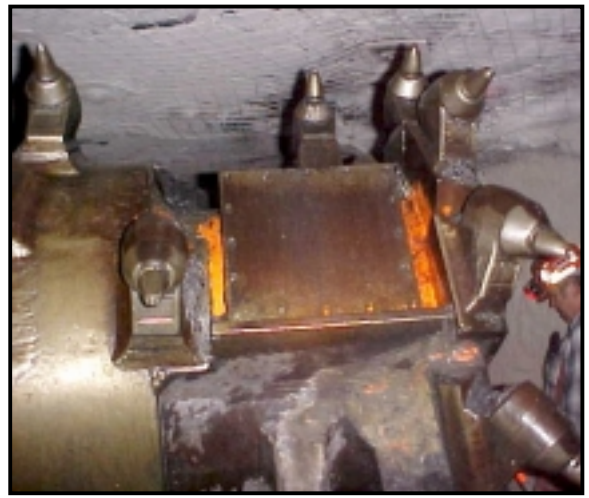
2) **Field Modification (RAMP) certification, which ensures that the combination/integration of X/P units on a mining machine does not compromise the Explosion-Proof characteristic of the electronic system or mining machine itself. This certification process includes Schematic Review of cable interconnects/entry glands, Enclosure Assembly Review, and Field Inspection. Process takes 6 to 10 weeks. This must be done for each field installation and mining machine. Process must be repeated for every underground installation.**

RAMP certification began for the HS-3 installations at EXXON-MOBIL and FMC in October 2001 and will be completed November 2001.

NETL

Photo Library

HS-3 installed on Joy CM-12



Low abrasion on sensor module

Back view of sensor enclosure

Dust cover protecting generator

Photo Library

Assembly of display module

Assembly of power generator

Assembly of sensor module

System simulator

Project Recognition

- **Trade show booth featuring HS-2 at MINExpo 2000**
- **Trade show booth featuring HS-2 at SME 2001 Annual Meeting**
- **Trade show booth featuring HS-3 at 2001 Longwall USA**
- **Trade show and televised news conference featuring HS-2 in Albuquerque, 2001**
- ***World Coal* Magazine feature article May 2001, “The World of Smart Mining”**

Project Assessment
(Internal DOE Use Only)

- **Open issues and/or problems**
  - None noted

- **Overall assessment**
  - Off to a good start