

## High Pressure Water Jet Scaling (RP-4)

Year		1 <sup>st</sup> Quarter	2 <sup>nd</sup> Quarter	3 <sup>rd</sup> Quarter	4 <sup>th</sup> Quarter
-2	Planned deliverable	An assessment of the need for research in developing alternative methods of scaling of loose rocks in mine openings.	A comprehensive literature review covering previous uses of high-pressure water for scaling.	Review of equipment available for testing shotcrete adhesion.	An experiment for quantifying the adhesion strength of shotcrete as a function of the water pressure used to clean the underlying surface designed.
	Achieved	A review of MSHA accident and fatality reports for underground metal/nonmetal mines showed that nearly one quarter of all fatalities were related to rock falls. About one-third involved scaling.	Initial tests at the Swedish mining company LKAB showed an increase in adhesion strength of shotcrete applied to a rock surface cleaned at 3000 psi increases by a factor of three compared to 100psi cleaning.	Sophisticated shotcrete adhesion testing equipment was bought from Sweden. The equipment is designed according to Swedish Standard SS137243 and is believed to be the most advanced available in the world today.	An experiment was set up at the CSM experimental mine using rock and concrete test panels which were cleaned using water pressures of 100,1000, 2000, 3000, 4500, and 6000 psi, and then coated with shotcrete.
-1	Planned deliverable	Quantify the improvement in bond strength of shotcrete applied to rock surfaces treated with high-pressure water.		Begin the assembly of the prototype machine for water jet scaling at the CSM Experimental mine	
	Achieved	Using the Swedish shotcrete adhesion testing equipment, pull tests were performed on the test panels set up at the CSM Experimental Mine. It was found that the bond strength of the shotcrete increased by a factor of four on the panel treated with 3000 psi water compared to the panel treated with 100 psi.		An old shotcrete rig donated to CSM by the Henderson Mine was rebuilt for use as the prototype machine. The rig has a usable hydraulic shotcrete arm that was partially rebuilt. A rebuilt Wheatly Quintuplex 5P-330 high pressure mud pump capable of pressures from 565 to 9055 psi at flow rates of 239 to 15 gpm was purchased.	
0	Planned deliverable	Complete the assembly of the prototype machine for water jet scaling at the CSM Experimental mine.		Outfit the prototype machine with the necessary hoses and nozzle for the Wheatly Quintuplex 5P-330 high-pressure pump, (5000 psi at 28 gpm). Test and refine the prototype machine for water jet scaling. Parameters to be evaluated include water pressure, flow rate, nozzle design, standoff distance, and angle of attack.	
	Achieved	The assembly of the prototype machine for water jet scaling has been completed. The machine has been tested using a small high-pressure pump (3000 psi at 4 gpm).			
1	Planned deliverable	Demonstrate the benefits of high-pressure water jet scaling to underground mining operations in the western United States		Further quantify the improvement in bond strength of shotcrete applied to rock surfaces treated with high-pressure water jet scaling by performing additional adhesion tests on various rock types.	
	Achieved				
2	Planned deliverable	Integration of results of WMRC project "Stereo Vision and Remote Control of Mining Equipment" to allow remote operation of the water jet scaling prototype rig which will further reduce scaling accidents by completely removing the mining from the working area.			
	Achieved				

October 10, 2001