

FINAL TECHNICAL REPORT  
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Project Title: **REMOTE UNDERGROUND COAL MINING**

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Principal Investigator: E. Bane Kroeger, Southern Illinois University  
Project Manager: Joseph C. Hirschi, Illinois Clean Coal Institute

ABSTRACT

The remote underground coal miner (RUCM) conceived in this project would involve the modification and use of a highwall mining system underground to remotely mine coal. To assess the technical feasibility of the RUCM, conceptual changes to the highwall mining system have been described and conceptual images of the equipment pieces provided. A mining plan was created to use the RUCM for primary production and continuous miners for RUCM panel development. A list of equipment needs and costs for the RUCM mining plan were compiled.

The mining plan created indicates that three continuous miners would be needed to develop areas for the RUCM. Working two production shifts a day, five days a week, the continuous miners would produce 1.5 million raw tons a year. At a reject rate of 40%, 900,000 clean tons would be available for sale. In the mining plan, the RUCM would work three production shifts a day, five days a week resulting in 1.0 million raw tons of production. Assuming a significantly better reject rate of 20% for the RUCM coal yields an additional 800,000 clean tons for a total of 1.7 million clean tons per year. Almost half of this production comes without any costs associated with roofbolting. To run the continuous miner development units, 65 workers would be needed at the face each day. Because the RUCM is more automated, only 21 workers would be needed each day, for a total of 86 workers a day.

RUCM costs were compared to costs for a typical room and pillar mining plan. To produce 1.7 million clean tons each year at a 40% reject rate, six continuous miners would be needed. To run this equipment, 119 workers would be needed each day. Operating costs calculated for the two mining plans included costs for labor, supplies, power, preparation, and waste disposal. All were estimated on a monthly basis. The monthly cost for the room and pillar mining plan was \$1,835,000 and the cost of the RUCM plan was \$1,332,000. On a cost per ton basis, the room and pillar mining plan had raw and clean production costs of \$7.49 and \$12.49 per ton, respectively. The RUCM plan had raw and clean production costs of \$6.27 and \$9.22 per ton, respectively. The largest cost differences between the two plans were in the categories of labor and supplies. This was due to the reduced number of workers and the lower amount of roof bolting supplies consumed per month by the RUCM plan.

## EXECUTIVE SUMMARY

The objective of this research was to determine the technical and economic feasibility of a new remote underground coal mining process. The project team explored the use of a highwall mining system underground. Highwall miners have been used on the surface for more than 40 years with great success. A cutterhead is pushed forward from a large machine sitting at the base of the highwall followed by a series of transfer cars that form continuous haulage of coal from the cutterhead. The cutterhead can be thrust forward using transfer cars reliably to depths of 750 feet.

There are several different highwall mining systems on the market, with Addcar and Superior systems being the most widely used. Although their functions are essentially the same, the two systems are quite different. The Addcar system uses a conventional tracked continuous miner followed by open conveyor belt cars that transfer the load to the cutterhead and the coal to the surface. The Superior system uses a skid mounted cutterhead followed by closed beams that have internal augers to transfer the coal to the surface. The choice of mining system chosen should match the conditions of the mine. In the Illinois basin, unstable top and soft bottoms are often encountered, so the enclosed, skid mounted Superior system would seem to be the best fit. Given this, conceptual changes modifying the highwall mining system for underground use focused on the Superior system.

A team of individuals from academia, coal companies, consultants, and equipment manufacturers was assembled to complete this work. The team focused on the issues of putting the Superior highwall mining system underground. Issues were discussed during formal and informal meetings and solutions to those issues were developed and are described in this report. Initial tasks in this process were to identify conditions necessary to successfully use a remote underground coal miner (RUCM) and changes that needed to be made to a highwall miner base frame (launch vehicle) to allow the machine to fit in an underground mine opening. Mine conditions believed to work the best for the RUCM were a seam at least six feet thick that is relatively flat with a fairly competent roof. Because of the issues involved with permitting entries wider than 22 feet, the team set the length of the base frame to 20 feet. With these height and length restrictions, conceptual designs of the base frame, cutterhead, and auger drive unit were developed.

Once mine and system constraints were known, the next task was to develop a mine plan. Determining the size of RUCM panels was mainly a function of minimizing the development needed for the RUCM and the logistics of moving push beams to and from the RUCM and storing push beams when not in use. As a starting point, the project team decided on RUCM panels that were 500 feet wide and 5,000 feet long. The mine plan used the RUCM as primary production and continuous miners for development of RUCM panels. The plan showed that three continuous miners would be needed to develop mains, submains and RUCM panels. Working two production shifts a day, five days a week, the continuous miners would produce 1.5 million raw tons per year and could develop a RUCM panel in 3.5 months. At a reject rate of 40%, 900,000 clean tons would be available for sale. An additional maintenance shift would also be needed to make belt

and power moves and complete other catch-up work. In the mining plan, the RUCM would work three production shifts a day, five days a week producing 1 million raw tons. The RUCM would mine a panel in 4.3 months. At a reject rate of 20%, another 800,000 clean tons would be available for sale from the RUCM, providing a total of 1.7 million clean tons per year. Nearly half of this production would not require any roofbolting. To run the continuous miner development units, 65 workers would be needed at the face each day. Because the RUCM is more automated, only 21 workers would be needed each day, for a total of 86 workers a day.

The final task was to compare production costs for the RUCM plan to other conventional underground coal mining techniques. A room and pillar mining plan was developed and associated costs were estimated. To produce 1.7 million clean tons each year at a 40% reject rate, 6 continuous miners would be needed. To run this equipment, 119 workers would be needed each day. Operating costs estimated for the two mining plans included costs for labor, supplies, power, preparation, and waste disposal. The monthly cost to operate the room and pillar mining plan was \$1,835,000 and the cost of the RUCM plan was \$1,332,000. Monthly costs for each plan were then divided by monthly raw and clean production numbers to obtain a cost per ton. The room and pillar mining plan had raw and clean production costs of \$7.49 and \$12.49 per ton, respectively. The RUCM plan had raw and clean production costs of \$6.27 and \$9.22 per ton, respectively. As expected, the largest cost differences between the two plans were in the categories of labor and supplies. This was due to the reduced number of workers and the lower amount of roof bolting supplies consumed per month by the RUCM plan.

For existing mines in Illinois that have equipment available, the roughly \$6 million investment in a RUCM will be recovered in about 12 months. The personnel and some of the equipment can be moved to operate the RUCM section. For larger mines in Illinois that are operating 6 or more continuous miners, they may be able to support two RUCM units with their existing equipment and personnel. One or two of the continuous miners could be shut down and the personnel moved to two RUCM units. This could nearly double annual production from a single large mine (from 1.7 million clean tons using traditional room and pillar mining to 3.3 million clean tons using RUCM) and should reduce production costs at the mine by over 33%.

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