

Increasing Tunnel Advance Rates at Procon Forrest Kerr



Project Summary

IMPROVED UNDERGROUND DEVELOPMENT PRODUCTIVITY WITH OVERALL LOWER COST

Procon Group was challenged to meet their tight tunnel advance schedule, mining a large heading, 9.6m wide by 9.8m high, with 5m deep rounds using conventional NONEL[®] LP initiation system, Spartan 90g primers and Titan 7000 RU. With 144 holes in each round and only 19 delay periods, many holes had to be initiated on the same delay time. Various burn cuts using LPs and various breaker holes were tried in order to improve the inconsistent pull rates and resulting perimeter over break.

One solution was to evaluate the DigiShot[®] electronic initiation system in order to provide greater detonator accuracy and delay timing flexibility to help increase advance rates. While the detonator cost per unit is greater, the overall per meter of advance cost was reduced with less over break, increased advance rates, and fewer booted holes to drill around.

Background

HYDROELECTRIC TUNNEL PROJECT

Procon is responsible for executing all the underground rock works for AltaGas's Forrest Kerr project, a 195 MW run-of-river hydroelectric project. The project is located in British Columbia, approximately 1,000 km northwest of Vancouver.

The project will capture a portion of the Iskut River energy produced by the natural water flow and elevation drop to produce and deliver clean, renewable electrical power to the grid at Bob Quinn Lake via British Columbia Hydro's 287-kV Northwest Transmission Line. DigiShot electronic initiation system are being used for 5m deep rounds for approximately 2,000m of the 9.6m wide x 9.8m water diversion tunnel.



Initially a smaller 5 x 6m relief tunnel was conventionally blasted in the top middle section of the larger tunnel excavation.

Project Goals

INCREASE TUNNEL ADVANCE RATE

The principal goal was to demonstrate DigiShot initiation could be construction miner friendly and efficient to improve the overall advance rate of the underground tunnel. Faster advance rates would also result in overall lower operating costs and help the project better meet project timelines.

Technology Applied

USING THE DIGISHOT ELECTRONIC INITIATION SYSTEM

Improved productivity is realized using high precision timing from DigiShot electronic initiation system. The accuracy of the DigiShot detonator is 0.02% over the entire timing range (0 – 20,000ms) compared to NONEL, which is in the order of 2% variance of the period delay time.



Groundbreaking Performance

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Key features of the DigiShot initiation system:

- The ability to check the status of all detonators before programming, arming and firing allows the blaster to address any problems prior to the blast event
- To pre-program the timing of the development rounds based on engineer recommendations and experience
- The ability to make adjustments at the face based on lost holes and misplaced drill holes

These features provided Procon with no priming failure errors and no surface hook up errors compared to conventional initiation systems. The development rounds were able to be primed, loaded, hooked up, and tested for leakage and failures within the same amount of time.

Value Added

MINER FRIENDLY WITH GREATER BLASTING CONTROL AND EFFICIENCY

Using the DigiShot electronic initiation system, the underground tunnel advance rate was increased with the elimination of 1m booted holes. The rounds consistently pulled >95% with half barrels visible on nearly most perimeter holes. Compared to traditional NONEL LP timing, the DigiShot system was able to deliver a number of important benefits including:

- Reduced scaling time (average scaling time went from three hours to less than one hour).
- Increased fragmentation, resulting in faster mucking times and higher bucket fill rates.
- Reduced overbreak, half boreholes were consistently visible on nearly all perimeter holes within the round, the only time the perimeter half boreholes were not visible was due to overbreak to a geological fault running within 1m of perimeter wall.
- Simplified inventory (only 1 detonator product instead of 19 delay periods).
- Improved fragmentation provides an opportunity to reduce the amount of holes drilled and loaded, increasing overall productivity while reducing drilling and loading costs, without increase time.



DigiShot initiation system helps yield consistent results by:

- Improved loading accuracy, timing pattern provides double check to insure all drilled holes are loaded, (using conventional LPs, 1 to 2 holes on average were being missed).
- Eliminating miners variability in timing of rounds (same times are used for all rounds, they are pre programmed into blast box).
- Insuring all loaded detonators are connected using the electronic initiation equipment for testing and verifying of detonators (on random audits using conventional LPs, 1 hole on average was not hooked up and 2 to 3 holes were hooked up in an unreliable initiation position).

The DigiShot electronic initiation system proved to be miner friendly for this large civil construction project and dramatically increased the overall efficiency of the tunnel advance rate while improving safety with improved perimeter control and reduced booted holes.



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