

## It Should Start as a Search for a Solution

Before I get into my short introductory article, I'm offering up a great big welcome to the newest additions to Hecla via last summer's acquisition of Klondex. To our 300 or so co-workers in Hecla Nevada, welcome to the team! And, to everyone, welcome to the latest version of the technology newsletter. FYI -- the next issue of the newsletter is already in planning and will include at least one Nevada-focused article (roadheader mining).

To the headline above, here we go. As part of my job and driven by personal curiosity, I subscribe to several periodic technology-focused email newsletters. One of the largest US events that celebrates and often announces new technology products is the Consumer Electronics Show (CES) held every January in Las Vegas. Many of the newsletters I mentioned give much coverage to this event, including making judgments about the 'best of' and 'worst of' the products they discover at the show. This year's CES included products like a motorized, rolling, self-guiding suitcase that follows its owner, roll-up TV's, an automated dog toilet for the home, fold-up smartphones... and the list goes on.

It's easy to get caught up in the newness of all of it (*This is the future... NOW!*) with the energy that the inventor's marketing team puts into the introductory rollout to create that 'new car smell' ambiance. But, as businesspeople, and as consumers, the need to seek out innovation, including new technology, with the potential to acquire or adopt it, should start as a search for a solution to an identified problem. That's the start of the road to success, by thoroughly understanding each business process, knowing where you have pain-points or bottlenecks or other inefficiencies, and then seeking out ways to eliminate those or, at least, better manage their effects. Hey, maybe there is a portion of our population that has been seeking out a creepy, shadowing, rolling suitcase. Perhaps there are those who will be brought joy by owning a thicker, shorter, foldable phone. And it's completely possible that I just haven't yet realized that I have those needs. Beware of shiny objects. But also keep an open mind to the potential serendipity of one item triggering an idea to solve a totally unrelated problem.

Here's my regular warning: there is some 'tech-speak' in the following. We do hope you enjoy and perhaps learn something from this newsletter. Thanks for reading!

Jeff Rosser (Director – Continuous Improvement), February 2019



## Ventilation on Demand

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Developed by multiple technology component suppliers, a comprehensive VOD system can be made aware of underground locations of people and mining machines, on an ongoing basis, and accordingly adjust the amount of air flow delivered to these locations. Key parts of the system are location sensors for people and equipment, status sensors (for up-to-date measurements of airflow, air temperatures, fan electrical current draw, etc.), remote control devices for fans, and the mine's communication network including wireless access. Items such as supplemental fixed-location gas sensors can also be added and linked to the system if desired.

### Where we are using it: Greens Creek; Casa Berardi is developing its plan

**BENEFITS:** VOD technology helps maintain a safe working environment for miners while determining real-time personnel and machine locations and economically distributing the right amount of air to where it's needed. Its ability to refresh the air in an environment prior to people entering the area can clear out accumulated gases that may not get detected by handheld sensors. VOD can reduce overall power consumption and its costs. At Greens Creek, depending on weather's effects on water available for regional hydroelectric power generation by the local utility, power for site operations must, at times, be generated on-island using diesel. VOD's help in reducing demand for the site's self-generated power, with its more expensive cost per kilowatt-hour, contributes more quickly to power savings.

**UPDATED PLAN AND PROGRESS:** As its plan was developed and implemented, Greens Creek was able to use the existing communications network that enabled real-time monitoring and control of some equipment using a SCADA system. GC also made use of its existing system for tracking locations of individual persons and machines underground; this system had been implemented as a safety improvement. Adoption of VOD required purchase of variable frequency drive controllers for fans to allow them to be remotely operated in a range of settings instead of just being 'off' or 'on.' GC now has 15 fans controlled by VOD. In 2019, 18 new similar installations are planned along with 5 'soft start' installations for testing that could possibly further optimize the system.

*Mitch Ammann, Greens Creek*

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## Remote Vein Miner



Produced by Epiroc (formerly known as Atlas Copco), this project is developing a new electrically powered mechanized mining machine which uses a large diameter rotating cutter head to fracture rock and direct it onto an under-mounted transfer belt that carries muck to where it can be handled at the back end of the machine.

### **Where we plan to deploy it: Lucky Friday**

**BENEFITS:** The remote vein miner (RVM) will increase safety by helping move miners farther back from the working face. It will also eliminate the need for drilling and blasting to excavate the rock it moves. It will be built to include its own onboard rock-bolting system that installs self-drilling bolts. The RVM will allow for an improved mining geometry and mining method that will increase ground stability while increasing productivity.

**UPDATED PLAN AND PROGRESS:** Hecla and Epiroc agreed on the RVM design criteria and funding was committed to the project in 2018. Fabrication of large components began in 2018, and fabrication is projected to be complete in April 2019. After that, the machine will be field-tested at Epiroc's test mine in Sweden. Field trials there are expected to last five months, followed by shipment to Lucky Friday. Since early 2018, the Lucky Friday team has been developing strategy and tactics that will be needed to deploy and support this unique machine. Underground, a large shop area will be excavated where the RVM will be assembled, commissioned, and launched. The current timeline has Unit No. 1 arriving at site in Q2 2020. You can read more about this machine, the first of its kind for narrow vein hard rock mining, on the Epiroc website; they call it the 'Mobile Miner 40V.'

*Dave Berberick, Corporate and Wes Johnson, Lucky Friday*

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*"... allow for an improved mining geometry and mining method that will increase ground stability..."*

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## Ore Sorting

Manufactured by Rados International, the principle behind automated ore sorting is that in some types of geological settings of potential ore minerals and the waste around it, certain specific differences in physical characteristics between the rock with potential value and the rock without value can be used to classify and sort broken rock so that only the ore gets processed. A key element of this classification is that the differentiation approach, using technologies like x-ray diffraction (XRD), x-ray fluorescence (XRF), x-ray transmission (XRT), etc., must be accurate while being able to be performed quickly in a production environment to classify, map the rock fragment locations in the material flow, and then automatically divert individual waste particles out of the flow. XRF has been an overlooked technology in mineral processing because of its slower speed that limits throughput. But for some precious metal deposits, it can be very effective.



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*"... classify, map the rock fragment locations in the material flows, and then automatically divert the waste particles..."*

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### ***Where we are using it: San Sebastian***

### ***Next location will be Casa Berardi; application potential in Nevada; corporate evaluation for Hosco project, possibly others***

**BENEFITS:** Elimination of waste material reduces the quantity of ore trucked to the mill, reducing haulage costs. These lower transport costs allow some lower-grade material to become ore. By upgrading the ore fed to the mill, higher grade material makes it into the plant. Upgraded ore entering the mill allows processing costs to be spent more efficiently, including costs for crushing and grinding, reagents, etc. These gains allow more mill feed into a plant of a given size, generating less tailings for metal recovered, while putting more demand on the mine for ore supply, and providing a higher potential revenue from metal recovered.

**UPDATED PLAN AND PROGRESS:** Following successful testing of samples that started in 2017, approval was given to design and construct a 'proof of concept' ore sorting plant using XRF technology at San Sebastian in 2018. This plant was commissioned in summer 2018, allowing for the kickoff of an ore testing program necessary to understand the performance of the sorter with oxides and sulfides from various geological settings / sources. Results to-date continue to be positive. The ore sorter at San Sebastian is capable of 20 t/hour while running 2 shifts/day. It has already added value, and more optimization appears possible. Based on this success, Hecla has purchased a second sorter; it has been manufactured and will be delivered to Casa Berardi.

*Tim Martin and Dale Dean, Corporate*

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## ***Remote Monitoring of Mobile Equipment***

*Sold by Newtrax (ISAAC Instruments mining products), this system allows for onboard data collection and storage of selected machine operating parameters. Each equipped machine, such as a haul truck, loader, drill, etc., has the capability to transmit the data wirelessly to a receiving network connected to a central monitoring system with a database. Downloaded data has more value when it can be accessed more often and more easily and placed in context with historical data in comparison / contrast with desired operating ranges. The system includes mobile wireless access points (pictured) which collect data offloads from machines monitored by the system.*

### ***Where we are using it: Casa Berardi (underground); under study at Greens Creek which has a simpler data collection system currently***

**BENEFITS:** Remote equipment monitoring systems provide benefits in multiple dimensions, including machine health, fleet management, insight into operating practices, etc. In terms of machine health, data such as engine oil pressure and engine exhaust temperature can be collected and automatically compared to desired thresholds for performance, identifying possible issues before they become more serious and cause downtime and component damage. Fleet management assistance comes from data collected in the form of events logged by the onboard system. Each event is logged by date and time with readings taken at that moment of specified machine parameters. Time segments can be categorized by summing up the various events, allowing for easier access to real-time status and calculation of business metrics like availability and utilization. Actual operating practices can be made more visible via continuous tracking of machine data while the machine is in use, as it creates records of performance data like vehicle velocity, brake applications, transmission gear selected, oil pressure, etc. Bottom-line benefits from these contributions include longer component life, higher machine reliability, and lower operating and maintenance costs.

**UPDATED PLAN AND PROGRESS:** Casa Berardi's evaluation led to the purchase of supporting infrastructure and 24 onboard systems: 13 for underground loaders and 11 for underground haul trucks. Implementation took place in 2017 and 2018, including the underground communication network. All but one (one loader) of the systems are installed, and the overall system has been collecting and recording equipment data since summer 2018. The system has been successful so far. Some targeted operator habits have improved. Multiple potentially critical (and likely costly) component failures have been prevented by early detection via data trends coupled with prompt intervention.

*Jeremie Frenette, Casa Berardi*



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## Automated Truck Haulage

Produced by Sandvik, this technology is an integrated system for remote control and remote supervision of truck haulage activities. The system being installed is called AutoMine (like the automated loaders / trucks at Greens Creek described in the next article), using wireless communication, onboard cameras and a navigation system to keep track of and control unmanned haul trucks. Haulage routes are isolated with barriers to ensure no interactions with personnel or other machines. The truck operator is based remotely, in an office, where a duplicate set of machine controls allow that person to intervene in truck operation as needed. Other related infrastructure can be equipped to be remotely operated including rock breakers, loading chutes, etc.



### Where we are using it: Casa Berardi (underground)

**BENEFITS:** This technology allows continued cycling of haulage trucks with minimal interruption of operation. Time gained by use of unmanned trucks includes that which would otherwise be lost while operators travel to and from the workplace at the ends of shifts as well as time which would be nonproductive during lunch and other breaks. This technology removes operators from the workplace, allowing one remote operator to run up to three machines. At Casa Berardi, this system works with the automated hoisting system installed a few years ago.



**UPDATED PLAN AND PROGRESS:** The Casa Berardi system is now complete and fully operational with control provided from a new mine operations control room at the West Mine shaft surface offices. The first of two new 40-t haul trucks began operating autonomously in the 985 drift in November 2017. The second truck was commissioned in January 2019; the addition of the second truck included testing of traffic management logic within the control system to ensure two trucks could safely operate together when needed. Currently, material transport needs in the 985 drift can be met by one of these haul trucks. Project economics were assisted in 2018 by a Quebec government subsidy established to encourage industrial productivity improvements; 2019 will see a smaller boost from that program.

Dave Descoteaux, Casa Berardi

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## Automated Remote Mucker

Produced by Sandvik, this technology is an integrated system for remote control and remote supervision of loader activities. Greens Creek now has two versions of the AutoMine system in use. The initial version purchased in 2016 is Multi-Lite Remote. Its design requires 3D pre-mapping of intended travelways to 'train' the loader for each upcoming mission. A second type of Automine system, the Tele-Remote version, was acquired in 2018. The Tele-Remote version does not require pre-mapping but instead depends on its onboard cameras and navigation system that uses lidar sensing of its surroundings to safely travel through tunnels isolated for that purpose. Both types of systems are critically reliant on wireless communication to maintain a control link with the loader operator based remotely, in an office, where a duplicate set of machine controls allow the operator to intervene in loader operation as needed.

### Where we are using it: Greens Creek

**BENEFITS:** One of the biggest benefits of automated remote mucking is that it can do work in its assigned location while miners are in transit, away from the workplace near the start and end of shifts. Getting the mucking done in these 'between shift' periods allows the mining cycle to continue with little interruption, with the miner able to get back to work more quickly breaking more rock. Over time, this will increase the average feet of mining advance achieved per day and help sustain production at target levels. The technology can enable one operator at a control station to operate up to three remote machines at a time.

**UPDATED PLAN AND PROGRESS:** By the end of Q1 2019, Greens Creek will have installed systems for automated remote operation on four loaders. Additionally, two haul trucks have the AutoMine Multi-Lite system installed. Two remote operator stations are installed in the mine office on surface. Much has been learned about this technology and how to use it at the mine. An automation engineer joined the mine engineering staff in 2018 to help support this project and other automation projects in the mine. A target for the system's usage is set (200 t/day for 2019). Coming opportunities for system usage are identified as early as they can so that the overall system and its many parts can be ready to perform. The underground communications network with its many wireless access points continues to be expanded into additional areas of the mine to support the future deployment of the system per the mine plan. 2019 should bring opportunities for remote haul truck operation; a future newsletter article will focus on that application.



*Bob Weeden, Greens Creek*

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## **Coming Up / Contact**

*Please direct any corrections for this issue and suggestions for future issues or other feedback related to technological innovation in Hecla to Jeff Rosser at the Coeur d'Alene Corporate office at [jrosser@hecla-mining.com](mailto:jrosser@hecla-mining.com)*

*Don't feel left out.* This internal publication has been envisioned as a quarterly newsletter. Although we would like to mention every single one of the company's technology projects in each issue, the newsletter would be too long and would take too much of your time to read. Our list of topics for upcoming issues remains a long one, with updates on projects including...

Casa Berardi – mine operations control center, ore sorting, drill targeting systems, drones

Greens Creek – ruggedized underground tablets, paperless pre-shift inspections

Lucky Friday – RVM and other technology to support it

San Sebastian – ore sorting, drones

Nevada – roadheaders for mining, drill targeting systems

... and other interesting and value-adding projects across all of Hecla. Future issues will include articles on projects underway or upcoming in our operations groups as well as within support functions throughout the company.

*Thank you and acknowledgments.* I would like to thank all the project key contacts whom I have pestered (and will continue to pester for future updates) for their time in gathering and sharing information on their projects. We will be in touch – keep up the wonderful work in advancing these valuable tech projects!

