Elk Valley Coal – Coal Mountain Operations Loadout Upgrade

Mine Overview

Elk Valley Coal is the world's second largest exporter of metallurgical coal, producing 20% of the world's seaborne hard metallurgical coal for the international steel industry. Operations include 6 different mines located in Western Canada, with production capabilities estimated at over 25 million tons per year.

5 of the mines are located in close proximity to one another in Southeastern British Columbia. Train cars carry coal between the mine for blending operations, and then travel approximately 700 miles to seaport facilities near Vancouver and Thunder Bay.

The Coal Mountain mine ships approximately 175,000 metric tons per month, which equates to four 110 car trains per week.
**Project Objectives**

In the Summer of 2002 a project was initiated to upgrade an existing 20+ year old coupled in motion (CIM) scale. The primary objectives of the upgrade were:

1. Replace obsolete technology
2. Upgrade from analog to digital load cells for increased reliability
3. Increase the productivity of the operation via faster weighing speeds
4. Install a system that would allow for further increased automation
5. Increase reclaim conveyor system life via variable conveyor speed based on bin level. (When bin is full, conveyor runs at slower speed)

Hinz Automation (Calgary, Alberta) provided the automation system that integrated the Mettler Toledo 9411E CIM scale controller, Ramsey belt scale controller, conveyor, and loadout bin gate.

![Figure 2 – Scale Looking Toward Loadout](image-url)
**Weighing and Loadout Process**

The major components of the loadout system include a PLC, operator interface terminal, PC, conveyor, bin, and bin gate. The rail scale controller and the belt scale controller communicate with the PLC via Allen Bradley Remote I/O protocol (see Figure 3).

![Figure 3 – Load Out System Control Architecture](image)

**A. Pre-Loading Setup**

Prior to a train’s arrival, the loadout operator inputs the manifest information via the “TRAIN” Screen (Figure 4) on an Rockwell Automation PanelView 1000 operator interface terminal (OIT). Parameters that require entries are:

1. Number of Cars and Train ID Number
2. Car Maximum Weight
3. Car Tare Weight (Default Tare Weight)
4. Car Net Target Weight (This is a product of the Car Maximum Weight minus the Car Tare Weight)
5. The % Load (of the Target Weight to be loaded)

Advanced car information is received from the railroad (Canadian Pacific). Items 2 thru 5 can be globally entered via the “CREATE TRAIN” Function Key on the OIT. The quick select variables can be individually edited after this if required.
Trains arrive at the mine either empty or partially filled with coal from another nearby mine (for blending with the coal from the Coal Mountain mine). The train crosses the coupled in motion (CIM) rail scale traveling at speeds of about 1.5 mph.

Weight data from the scale is communicated to the 9411E CIM controller located in the scale house near the loadout, approximately 900’ from the scale. The 9411E communicates the railcar weight and sequence number to a Rockwell Automation ControlLogix 5555 PLC via Allen Bradley Remote I/O (RIO) communications. The tare weight communicated by the scale overwrites the default tare weight (44,000 lb for an aluminum car), however, if for some reason the scale doesn’t communicate a car weight the default tare weight is used.

The operator can view on the OIT to verify that the tare weights and sequence #’s are shown for all cars. A visual alarm is given if the scale is not communicating weight information.

![Figure 4 – Train Setup Screen](image-url)
B. Loading of Train

Once the information for the entire train has been entered the operator presses a “START LOADOUT” F11 function key on the OIT (see Figure 5). The PLC calculates the required fill amount. The % Load and Net Target Weight set points will be displayed on the OIT, indicating how much coal the PLC has calculated will be loaded into the car. At this point, the bin gates are closed and the Loadout Operator can still edit the value (% Load) if he does not like the set point.

The Loadout Operator presses the “Weigh Bin Open Pushbutton” located on the Operator Interface Enclosure. The train can now move forward to receive the coal. The Loadout Bin gates open and the belt will fill with the “set point amount of coal” as calculated by the PLC. The dispensed weight is calculated by the Ramsey scale, communicated to the PLC via RIO. This value resets after each car. The metric tons per hour (mtph) and the accumulated metric tons for the train being loaded are displayed on the OIT. The total accumulated weight is reset for every new train, but is retained until the next train is prepared for loading (NEW TRAIN Function Key).

The gates shut when the set point weight has been reached. The Loadout Operator visually inspects the coal loaded in the first car. If there is not enough or too much coal loaded in the first car he adjusts the “Preact Value”. The Preact Value indicates at what point in the filling the gates should close, ie. at what % of the target fill weight the gate should close.

Once the next car reaches the loadout the PLC opens the gate, and the cycle repeats. Trains are typically loaded at speeds of about 0.5 mph. Outbound trains are not weighed by the CIM scale. Cars are profiled and then a separate system sprays dust suppressant liquid onto the loaded cars.
C. Other Functions

If, while loading (but before opening the gate), the Loadout Operator does not want to load the next car for some reason he presses “SKIP CAR” Function Key on the OIT. That car will total up as zero and not load.

If the Loadout Operator sees a problem while the car is loading he presses “EMER GATE CLOSE” Function Key on the OIT. The gate then closes immediately and only the amount of coal that has gone over the scale will total for that car.

If the operator needs to stop loading, but wants to continue loading the present car later, they can leave the loadout in a safe condition by pushing the SUSPEND button. This shuts the gate and leaves the belt running. When they want to resume loading, the RESUME button is be pushed, the gates open and the car finishes loading.
D. End of Train and Reports

When the train is completely loaded, the Loadout Operator presses “END TRAIN” Function Key on the OIT. This copies the Loadout End Date for the just completed train in the PLC to the proper PLC memory storage location.

The file for the Train Loaded information remains in place in the PLC memory storage location. This can be edited at any time until the “NEW TRAIN” Function Key is pressed. Once the train is loaded all the information is copied to separate PLC files. The PLC retains two complete manifests of previously loaded trains.

After train loading is complete and the “End Train” key has been pressed, the operator presses the “Download DB” key. Data is transferred from the PLC to an Access database on a local PC using Rockwell RSLinx. A report is printed from the local PC that provides the car and total train weight. This report is submitted manually to Elk Valley Coal’s accounting department for payment to Canadian Pacific.

Invoicing of coal to Elk Valley’s customers is part of the port operations, as coal is loaded from coalyards at the ports for shipment to specific customers, rather than directly from railcars.

Process Improvements

Several improvements in the operation were realized. Inbound trains containing coal for blending previously could only be filled at speeds of about 0.2 mph. With the new system the cars requiring blending can be filled at speeds up to 1.5 mph. 75% of the outbound cars are blended. The level detector that was added to the loadout bin signals the PLC the coal level in the bin. This information is used by the PLC to determine how quickly the reclaim conveyor should stop. Under full conditions the conveyor is assumed to have a larger weight of coal on it, so the conveyor is stopped more slowly, placing less wear on the conveyor motor. This will lead to longer conveyor motor life.

Rollback detection and recovery was added to the scale software, allowing for accurate weighing if the train reverses direction during the process.

Rail Scale Upgrade

One element of the project involved replacing the existing analog load cells and mechanical wheel detectors. Four 90 metric ton (200,000 lb) Mettler Toledo POWERCELL® digital load cells (Figure 6) were installed with custom spacers to fit into the existing space below the weighbridge main beams. Load cell cables were terminated in a stainless steel junction box, with scale home run cable routed to the scale terminal in the scale house, approximately 900’ away. New conduits for the load cell cable and wheel detector cable were installed.
POWERCELL® load cells offer enhanced signal strength and immunity to electrical interference compared with the previous analog load cells. The performance of the load cell is constantly monitored and can be displayed remotely at the scale terminal, allowing for fast and easy diagnostics when needed. Stainless steel hermetically sealed construction and rugged glass to metal quick connect load cell cable interface helps assure long life in harsh environments such as often found in rail scale applications.

Should a load cell fail, a replacement load cell can typically be installed without having to recalibrate the scale due to the calibration factor for each load cell being stored in the scale terminal. POWERCELL® load cells also offer performance advantages over analog load cells in situations where temperature variation across the deck occurs, such as if part of the scale is exposed to sun while other parts are in the shade, or if there is deflection in the decking.

![Figure 6 – 200,000 lb POWERCELL® Digital Load Cells](image)

Four non-contact inductive proximity wheel detectors (figure 7) were mounted to the scale top cover plate. These wheel detectors sense the trains direction, car type, and speed. Due to their design, no maintenance adjustments are needed and high reliability is ensured. Wheel detectors were terminated in a NEMA 4X stainless steel junction box, and then connected via 14 AWG shielded cable to the 9411E scale instrument in the scale house.

![Figure 7 – New Proximity Wheel Detectors](image)
The scale was initially statically calibrated using 22,000 lb of test weights. Later, a 80,000 lb Canadian Pacific test car and 260,000 lb monitor car were used to verify calibration and accuracy. No adjustments from the initial calibration were required. Additionally, dynamic testing at 0.5 mph of 10 empty cars was made.

In early October 2003 the annual scale test was performed, with no static calibration adjustments being required. A dynamic test indicated 0.34% error for a 10 car train, at which point the dynamic calibration factor was adjusted. A subsequent test resulted in an 0.009% error for the 10 car train.

**Scale Instrumentation Upgrade**

The existing Ramsey scale instrument was replaced with a Mettler Toledo 9411E coupled in motion rail scale controller. The 9411E includes a JAGXTREME scale terminal, which can be used with either digital or analog load cells. The 9411E includes a single board microprocessor that provides the interface between the JAGXTREME, the wheel detector inputs, outputs to optional traffic lights, an optional remote host PC, an optional AEI reader, and the operator keypad.

![Figure 8 – Mettler Toledo 9411E Coupled In Motion Rail Scale Controller](image)

For this application one of the key requirements for the 9411E was the ability for the scale instrument to provide output to the Allen Bradley PLC via Remote I/O (RIO) communications protocol. The 9411E, via its JAGXTREME scale terminal, is able to provide communications via several protocols including RS232 or RS422/485 serial, TCP/IP ethernet, EthernetIP, Modbus Plus®, Profibus®, Allen Bradley ControlNet®, and Allen Bradley Remote I/O®.
The RIO option card allows for communication to the PLC or fieldbus via “blue hose” shielded 20 AWG seven conductor cable, transmitting at baud rates up to 230.4kbps. Cable lengths of up to 2500 feet at 230 baud rates can be used. Configuration of the communication PLC protocol is easily set up via the JAGXTREME front keypad and display. The JAGXTREME ethernet communications capability and embedded webserver also allows for remote scale terminal setup and diagnostics, as well as remote upload and download of files via ftp.

**Conclusion**

While the life of high quality, well maintained hardware such as scale weigh bridges and conveyors can exceed 20 years or more, upgrading to the latest digital load cell technology new control systems can often provide high return on investment. The Elk Valley Coal Mountain Operations upgrade met the objectives and has positioned this mine for future productivity improvements.

When considering whether a scale can successfully be upgraded to digital load cells, Mettler Toledo considers several important factors:

1. Are the scale foundation, understructure, approach rails, and sub-base of adequate condition, without mechanical deficiencies?
2. Is the loadcell baseplate of adequate design and strength?
3. Does the scale instrument support digital load cells?

In many cases load cell upgrades can easily be made without any major civil works. The advantages of POWERCELL® load cells, along with the communication flexibility of the 9411E rail scale controller with integral JAGXTREME scale terminal, allow for existing scales to be integrated into the latest process technologies.