

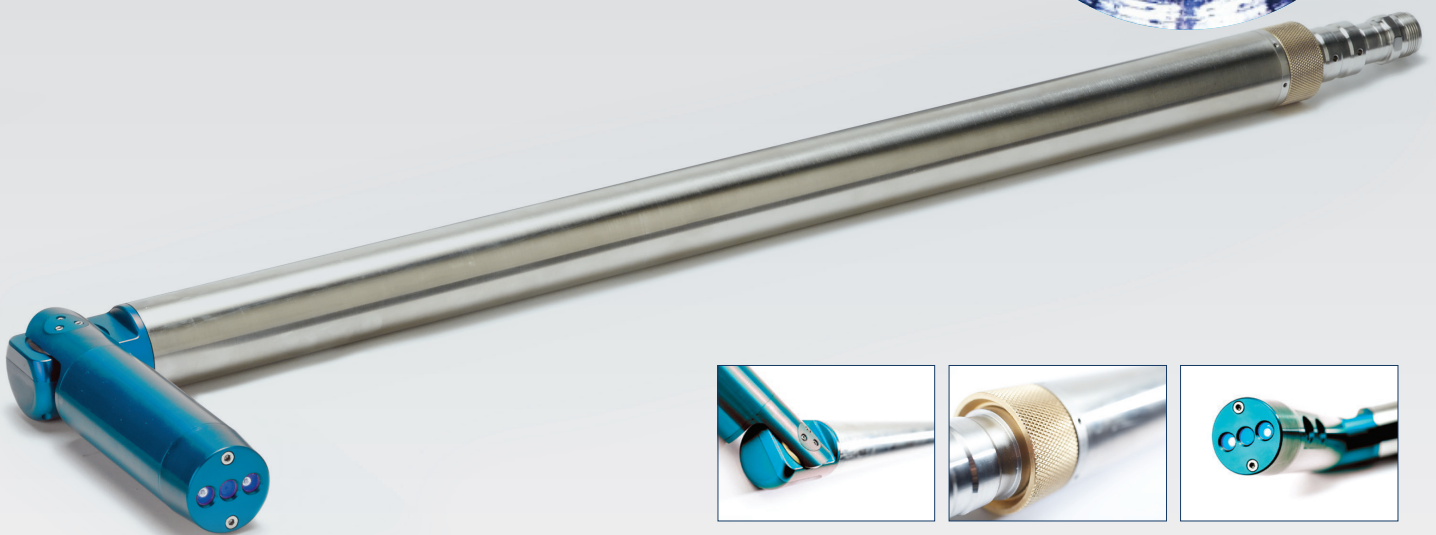
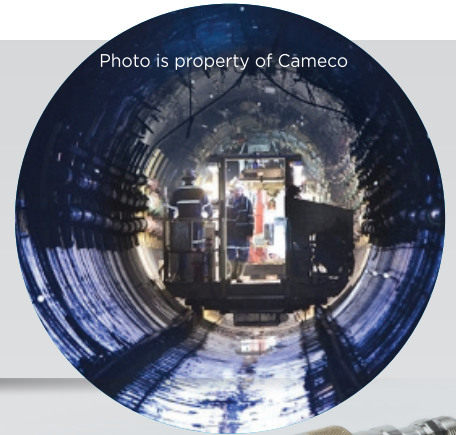
# Carlson C-ALS<sup>®</sup> Gyro

## Case Study

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Photo is property of Cameco



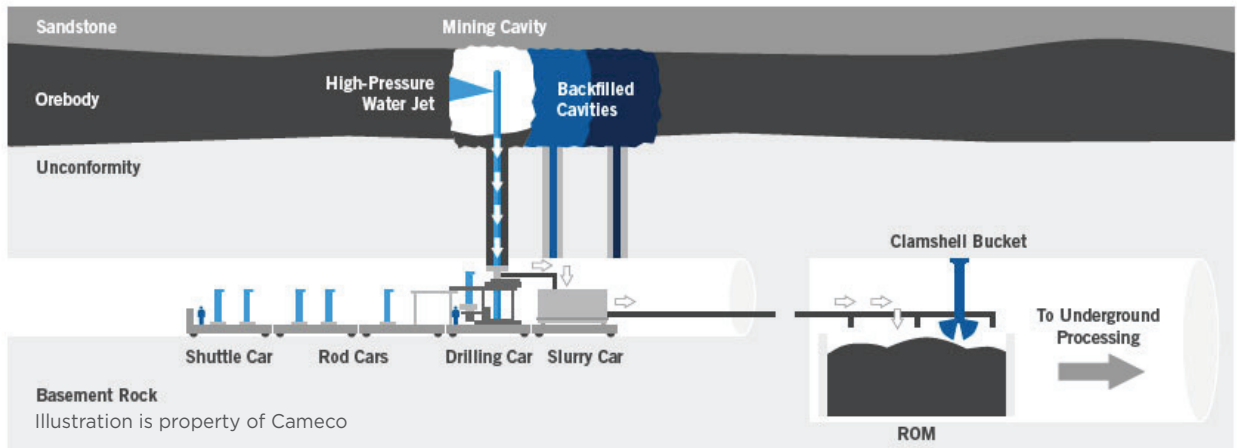
The new **Carlson C-ALS Gyro** is being used to support the extraction of high-grade uranium at one of the largest deposits in the world, the Cigar Lake Mine in northern Saskatchewan, Canada. A development of the standard C-ALS system, the **C-ALS Gyro** provides more accurate and reliable navigation of the probe as it is deployed.

The **C-ALS Gyro** is deployed vertically upwards for around 70m until it enters the uranium cavity where it can scan and survey a newly mined void. This happens after Cameco's Jet Boring System (JBS) has been deployed. JBS extraction for uranium begins with freezing the ore and rock, located nearly 450 meters below the surface, to provide stability and prevent water from entering the mine. The JBS platform is then deployed and uses highly pressurized water to cut through the ore. The ore is then transported through a series of pipes to be processed.

There is no mechanical control over the rotation of the JBS platform so the **Carlson C-ALS Gyro** is deployed to provide a

correctly orientated, final scan of the mined-out area. When the C-ALS is used to produce a 3D model of a cavity, it is crucial for mine surveyors to know not just the shape and size of the void but also how it fits into the surrounding mine infrastructure.

A C-ALS is usually deployed along a borehole to access the cavity. The system must be able to track the path of the borehole from a known starting location to the probe's final scanning position so the position and orientation of the model can be established in the mine's local coordinate system. The internal gyro within the **C-ALS Gyro** ensures this can be done without using a magnetic compass and without needing to rely on any mechanical alignment devices. With the **C-ALS Gyro**, the inclination and heading of the probe can be established at any angle whether the probe is being deployed downwards, upwards, or in a horizontal hole. The data recorded provides the production team with information needed to optimize and monitor the operation.



Jet boring involves freezing the ore and surrounding rock in order to mine safely at Cigar Lake. Brine, chilled to -40C, is piped underground to the deposit. The brine is circulated through large pipes, freezing the surrounding rock in about one year. When ready, a mining machine bores through the frozen rock to create the production tunnel.

The jet boring system enters this tunnel and drills a pilot hole through the orebody. Then the jet boring nozzle is inserted in the pilot hole and the system begins boring through the rock using a high-pressure jet of water. Loose ore is flushed down the pilot hole. After a series of processes, ore is pumped to the surface in a slurry form.

| C-ALS Gyro   |   |
|--|---|
| <b>Laser module</b>  |   |
| Laser classification (BS EN 60825-1 : 2014)  |   |
| (21 CRF 1040.10 and 1040.11 except for deviations pursuant to Laser No 50, dated 24 June 2007) | <b>Class 1</b>  |
| Type   | InGaAs laser diode  |
| Wavelength (typical)   | 905 nm  |
| Resolution   | 1 cm  |
| Maximum range to a passive target*   | Up to 150 m   |
| Minimum range  | 0.5 m   |
| <b>Angle measurement</b>   |   |
| Type   | Opto-electronic encoder   |
| Encoder Accuracy   | 0.2°  |
| Encoder Resolution   | 0.1°  |
| Range  | Vertical: -90° to 90°<br>Horizontal: 0° to 360°                             |
| Mechanical motion  | Servo-driven gear system in both axes with manual clutch override of motion |

| IMU (inertial measurement unit) |                         |
|---------------------------------|-------------------------|
| Inclination measurement         | Triaxial accelerometers |
| Inclination accuracy            | ± 0.2°                  |
| Inclination range               | 360°                    |
| Angular measurement             | Triaxial MEMs gyro      |
| Angular drift                   | <1° per 20 mins         |
| Rotational limit                | 400°/sec                |

| Physical data                 |  |
|-------------------------------|--|
| Construction                  | Machined aluminium and stainless steel   |
| Water and dust resistant      | IP67   |
| Operating temp. range         | Probe: 0° C to +60° C<br>Surface Unit: 0° C to +50° C  |
| Dimensions                    | Probe: 1100 mm x Ø50 mm<br>Probe with extension piece: 2179 mm x Ø50 mm<br>Surface Unit: 270 mm x 245 mm x 170 mm  |
| Weight                        | Stainless steel probe: 5.9 kg<br>Single-section steel extension piece: 3 kg<br>Main C-ALS cable: 0.18 kg/m<br>1 m Boretrak rod: 0.4 kg<br>Surface Unit: 4.1 kg |
| External power input          | 12-15 V dc and 110-240 V ac  |
| Power consumption during scan | 0.8 to 2.0 A   |

