
The AQUILA DL Series Dragline Products

AQUILA is currently developing a suite of dragline products for production release in the second quarter of 2002. Four products will be available as standalone modules or in certain user selected combinations:

- DL1 – Production Monitoring
- DL2 – Load Weighment
- DL3 – GPS Navigation
- DL4 – 3D Bucket Positioning

DL1: Dragline Production Monitoring

The DL1 monitors the following production data in real-time:

- Angle of the current swing in motion
- Last swing angle
- Time into current cycle
- Last cycle time

The following is data recorded for subsequent production reporting:

- Average swing angle
- Average cycle time, including a breakdown into the cycle components;
 - Preparation to drag
 - Dragging
 - Loaded swing
 - Dumping
 - Empty swing
- Running productivity (either estimated through the number of bucket loads in the shift or, if the DL-2 Load Weighment option is installed, the actual productivity will be measured)
- Dig depth relative to the point sheaves
- Dump height relative to the point sheaves
- Number of steps made while walking
- Downtimes or delays as entered by the operator

Operator exceptions such as the number of hoist dependent swings (i.e. swings that are paused because the bucket had to be hoisted higher to clear the spoils) can also be recorded by the DL1.

DL2: Load Weighment

The DL2 module builds on the DL1 system by enabling a calculation of the bucket load weight during the loaded swing cycle. The expected accuracy of the load weighment module is +/- 5%. The load weighment module allows running productivity and total shift productivity to be calculated in actual tons as opposed to a theoretical cubic yardage.

DL3: GPS Navigation

The DL3 provides basic GPS navigation of the dragline by displaying a scaled icon of the dragline on a map of the dragline's surrounding work area. The map can be customized by the mine office to meet the particular needs of the operation, at a minimum, the map will include design information on; the bench, key, cut, spoil pile area, and any obstacles the operator needs to be aware of. A graphical sidebar on the operator's map display shows grade information as wells as the current position of the dragline, in mine coordinates.

If the DL3 (GPS Navigation) and the DL1 (Production Monitoring) modules are both enabled, the system will record and display the approximate drag and dump locations. The drag locations are calculated based on the dragline geometry and resolvers on the swing gear, hoist drum, and drag drum. Dump locations are approximated based on the changing load in the bucket, swing momentum, and the swing position. A DL1 / DL3 combination also allows operator exceptions such as swinging over an obstacle to be detected and recorded.

DL4: 3D Bucket Positioning

The DL4 with 3D Bucket Positioning builds on the DL3 GPS Navigation and DL1 Production Monitoring systems to provide the operator with a graphical window that shows the profile view of the dragline and the cut being excavated. This profile view of the cut includes the dragline body, boom, hoist and drag ropes, and bucket position. The mine can include the bench, cut, key location, and final location in the profile view as well.

All map objects and material types (e.g., rehandle, overburden, coal seams etc.) are color configurable by the mine.

With the DL4, the initial map of the area the dragline is to work is loaded on the dragline by the mine as a DXF file. As rehandle or overburden is removed, the system determines the excavated volumes and updates the map accordingly.

Operator Interface

All AQUILA DL systems use a single touch sensitive, color LCD display in the operator's cab through which the operators:

- Log on and off of the dragline.
- Enter operational and maintenance delays.
- View on-line DL1 Productivity screens that summarize productivity throughout the shift.
- View full or partial screen views of the DL3 GPS Navigation map.
- View full or partial screen views of the DL4 3D Bucket Positioning screen.

Partial screen viewing allows the operator customize his display to view windows from several modules at one.

Data Communication

The DL Systems are intended to work with a data radio network in order to take advantage the DL system's real time data and reporting capabilities. The systems can interface to a number of radio solutions and are fully compatible with Caterpillar's TC900 and CAES Office components. At CAES sites, the draglines are simply added as additional "CAES Machines".

Data-basing and Office Reporting

AQUILA provides office tools (AQ2DB and AQReports) which enable the automated uploading of all DL system(s) data to a mine database and subsequent report generation. AQUILA's AQReports provides a flexible means of developing customized reports to meet the precise needs of the mine.
