

**Summary of Responses from the March 18, 2009,
Tailings Measurement ERCB / Industry Workshop**

1) Fines in Feed

1a-i) Does the mine block model provide an accurate measure of fines in feed (10% relative accuracy)?

The general consensus from the participants was that the block model was proven for bitumen. Fines modelling used in the same consistent strategy as bitumen modelling could be assumed to be proven as well, provided the sampling quality and quantity are sufficient and mine operations implement consistent selective properties for model development.

Several participants stated that block models were unreliable and did not accurately reflect fines; block models were thought unnecessary if fines measurement occurred at location 2a or 2b.

ERCB response:

The validity of each block model is dependent upon the quantity and quality of the samples taken for a given variability. It is also recognized that the differences exist between the block model estimates prior to mining and what actually is mined and processed. After reviewing the initial tailings and measurement plans, the ERCB will provide further direction with respect to fines modelling and measurements for future submissions.

1a-ii) If not [re: 1a-i], what changes are needed to achieve this accuracy?

Participants stated that accuracy could be improved by increasing sample measurement accuracy, tightening drilling density, taking into account dilution and rejects, using checks and balances, and using a longer study period.

ERCB response:

The ERCB agrees with many of the proposed factors to increase the accuracy and also agrees that the validation of the model is an essential part of the process. To date, the ERCB has not seen detailed data related to fines measurement accuracy and suitable sampling density. After reviewing the initial tailings plans, the ERCB will provide further direction with respect to accuracy requirements for future submissions.

1b-i) How should the block model be verified?*

Participants had various ideas for verification, mostly related to sampling density in the ore body. Ideas included an error versus sample density (jackknife) study, increasing the number of sample points in the ore body, and using a geostatistical model of fines to determine the density of samples needed. Some participants also stated that the bulk density of the ore, water, bitumen, and fines contents should be studied and modelled to ensure the correct fines tonnage in the feed.

Other participants stated that there would be significant difference between the block model fines and the fines measured at locations 2a or 2b. Several participants stated that block models do not need to be verified by additional measurement.

ERCB response:

While the ERCB agrees that additional core hole drilling and sampling should improve the accuracy of the block model, we believe that there are several statements that require more study to validate. After reviewing the initial tailings and measurement plans, the ERCB will provide further direction with respect to block model verification requirements for future submissions.

1b-ii) Is checkpoint number two sufficient to verify the block model?

Several participants stated that location 2b would provide a more representative sample than 2a. To support this statement, it was noted that pipeline sampling is inherently more variable than sampling a fixed, stationary mass, such as an ore body or tailings deposit. Other participants stated that there may not be a good correlation between measurement points 1 and 2; therefore, sampling locations 2a or 2b could not be used to verify the model.

ERCB response:

The ERCB agrees that pipeline sampling may be more variable than fixed sampling (dependent on sampling interval), and believes that more data and study are required to determine whether 2b is a good point to verify the block model.

1c-i) What alternative methods are there to measure fines in feed and how accurate are these methods?

Several participants commented on the use of clay content and the clay-to-fines ratio to help measure fines. Some participants discussed the laser diffraction method and fines correlation with sieve hydrometer. Other proposed analytical tests included on-line fines analyzing, ultrasonic particle distribution, gamma, X-ray, coulter, microtrac, acoustic tomography, and alcohol clay dispersion.

There was limited discussion on the accuracy of different alternative measurement methods.

ERCB response:

More investigation on these methods is required to determine their applicability in measuring fines. Operators must provide supporting data to demonstrate the equivalency of other measurement methods that differ from those stated in Directive 074.

2) Fines measurement in extraction process (to verify fines in feed)

2a) Can fines be determined in oil sands feed to extraction?

Generally, participants believed that fines can be measured in feed to extraction, but the level of inaccuracy would be significant. There was discussion and varying opinions on on-line analyzers and the applicability of these to extraction feed. The + / -10% suggested by the ERCB was generally thought to be very difficult to achieve. The mine block model was generally thought to be not useful presently for accurate prediction of fines in feed (due to the variability of fines in the ore body, mine selectivity, nature of fines in lenses, etc.). Sampling after ablation in hydro transport lines (with subsequent fines and density analysis) was thought to be preferred over block model output. Proportional or auto samplers were described as problematic in these streams, and many believed that it would be difficult to get a representative sample, as this stream is not homogenous. Flow meter accuracy was not discussed in detail, but there was agreement that it is a factor in measurement and a significant contribution to overall accuracy.

There was discussion regarding acceptable lab analysis methods for fines and density, with no agreement on the best method. Some operators stated that there was no correlation between laser diffraction and sieves, while one operator said a correlation exists, as it had developed one.

Verification was not well understood. Operators indicated that the need to verify may require more than reasonable effort.

ERCB response:

Fines can likely be determined in oil sands feed to extraction. The ERCB will evaluate the target accuracy once data have been analyzed to determine if more data need to be collected to achieve the target or if the target requires altering.

2b) Can fines be determined by using current samples and measured flows for production accounting purposes (S23) out of extraction?

Operators indicated that they may find it useful to use their extraction mass balances (developed for bitumen measurement and accounting) in connection with S-23 reporting as a platform to complete an extraction fines balance. There was a discussion regarding the use of raw versus reconciled data and the possibility of integration into existing mass balance reconciliation programs. Concern was expressed about the ability to meet accuracy requirements. There were discussions about the requirement to have industry-recognized lab methods with known reproducibility. In addition, the fines results may be skewed, based on the bitumen content in the streams.

ERCB response:

Since S23 reported extraction values are derived from an extraction mass balance, this could constitute a platform to ultimately complete a fines balance. This would require further analysis and possible metering.

2c) Should 2a (before extraction plant) or 2b (after extraction plant) measurement points be used to measure fines? (Points 2a and 2b were specified on the ERCB Suggested Measurement Checkpoints Figure supplied at the workshop.)

Similar comments were made as for question 2a. Recommendations were made that fines in the dedicated disposal area (DDA) could be measured by taking cores and through core analysis. Some individuals felt that measuring fines out of extraction would be more representative, easier to collect and measure, and easier to reconcile the fines reporting to DDA. One concern was that the extraction process may change the fines characteristics.

An engineered tails stream (e.g., leaving a CT plant) was thought to provide a homogenous stream more suited to accurate metering, sampling, and analysis. The 2b stream (non-engineered tails) provides a less attractive stream for fines measurement. Questions arose regarding legacy MFT measurement if that stream was destined for DDA after some processing. A suggestion to hold an initial meeting and share information between operators was made.

Participants questioned where the directive states the requirement for verification of fines in feed.

ERCB response:

The ERCB believes that more representative measurement could be achieved at downstream locations (extraction tailings). The ERCB requires that measurement be verifiable.

3) Fluid Tailings

3a) What is the best way to locate “pond bottom”?

Currently pond bottom is located by adopting CPT, AK97, or other similar techniques used by industry. There were many concerns regarding accuracy, repeatability, sampling density, and measurement grid sizing. More technical assessment and background work are required to develop acceptable sampling campaign plans. The highlighted conclusions of the discussions are the following:

- AK97 (or any other weight drop measurement method) does not have a published standard procedure. There are concerns regarding the accuracy and repeatability of the results.
- CPT is a proven ASTM method to determine pond bottom, but this method is expensive, time consuming, and limited in terms expertise availability.
- It was suggested that AK97 calibrated CPT measurement could be practical and reliable.

Several other methods were suggested and discussed, such as ground-penetrating radar, sonar, seismic, vane shear, and pore pressure measurement.

ERCB response:

Directive 074 requires CPT or equivalent method for pond bottom determination. For any equivalent method or combination of methods, it is necessary for operators to provide a manual,

operating procedures, interpretation guidelines, and supportive data to verify equivalency and satisfy ERCB requirements in advance of annual pond assessments.

3b) How should fluids tailings volumes and fines content (tonnes of dry fines) be determined?

The general suggestion for evaluating fines content was to evaluate fluid tailings volumes and the fines distribution profile. The following methods were discussed:

- Fluid tailings volume can be determined by locating pond bottom and the mud line.
- Sampling is necessary in order to evaluate fines content.
- Sampling density and plan depend on the characteristics of the pond. Technical analysis and assessments are required to ensure representative sampling.

Different measurement methods were suggested to find the mud line, such as sonar and gamma ray. Nitrogen sampler was suggested for sampling.

ERCB response:

The ERCB expects fines evaluation to be carried out with an acceptable level of accuracy. To achieve this goal, operators are required to adopt standard methods in accordance with Directive 074. For any other methods, it is necessary to provide a manual, operating procedures, interpretation guidelines, and supporting data to satisfy ERCB requirements in advance of annual pond assessments.

4) DDA (Formation, Deposit, and Rehandle)

4a) How to determine annual tonnage of dry fines captured in DDA?

A common method suggested for determining annual tonnage was to measure at the entry and exit points of the DDA. The annual tonnage of dry fines would be calculated from the difference between the two measurement points. Another common method mentioned was to build a fines block model of the DDA with sample data from the deposit. Comparing the DDA block model results annually would provide the tonnage of dry fines captured.

ERCB response:

The measurement of flow, density, and fines content at the entry and exit points of the DDA to the satisfaction of the ERCB and using the calculated difference between these two points would be an acceptable method to determine tonnage of dry fines captured for the annual and quarterly reports. The ERCB is aware that quarterly sampling of the DDA deposits may not be practical for all quarters. The ERCB could also accept the annual tonnage of dry fines captured calculated by a verified method based on a fines block model. Annual DDA surveys are required to demonstrate compliance.

4b) How should deposit strength be measured?*

The main measurement techniques mentioned at the workshop to measure deposit strength were CPT, vane shear, bearing capacity, and AK97.

ERCB response:

The assessments of the deposits must be conducted by CPT or other equivalent methods approved by the ERCB.

* Wording in these two questions has been modified from that in the [workshop handouts](#).