Our Oct. 17 summary described four issues with the Crone data. These are listed below in order of importance, along with our response to Crone's comments on the issues.

1) Differences in Decay Rates with Different Coils

In our tests comparing the surface and borehole (XY and axial) coil Hz response on the ground, we found that there were major discrepancies in the decays inside the loop. This is the most significant issue discussed in this report. The results were repeated at numerous stations for two different loops. In our opinion, Crone has not satisfactorily addressed this issue. While the differences in the decays are quite significant and indicate different geology, Crone considers these differences to be small. Furthermore, Crone's explanation of the differences between the axial and XY decays is contrary to what is observed in the data.

a) Axial vs. Surface Coils

Crone acknowledges that there are "slight" differences between the axial and surface coil decays inside the loop after accounting for timing differences. However, we do not consider these differences to be slight in any way! (See Figure 1.) The axial data have much slower decays at mid-late times; they indicate a conductor at depth whereas the surface data do not.

These significant differences in decays would be of concern in most geophysical applications. We would expect mid-late time decays be consistent with different coils. Indeed, at a test site where we had TEM data from three airborne surveys and two ground surveys, the mid-late time data agreed better than the Charters Towers Crone data collected with different coils.

It is stated that the reason for the supposed "slight" discrepancies inside the loop is not fully understood, but may be related to differences in how the sensors were read. One possibility suggested by Crone is that it may be due to the borehole cable being stretched out on the ground. If this is a possibility, then we are concerned as to how sensitive down hole readings are to the position of the cable. While having the borehole cable stretched along the surface may be an unusual configuration, how can Crone be sure that similar problems would not occur in a borehole, particularly with shallow readings?

b) XY Probe vs. Axial Coil

Data collected with the X and Y borehole coils agree reasonably well with each other, but do not agree with the axial or the surface data. According to Crone, the differences between the data collected by the XY coils and axial coil are due to the XY coils not being oriented vertically. The accelerometer data indicate that they were generally 25-30 degrees from the vertical.

This explanation is inconsistent with the data because:

1) This discrepancy between the axial and x coils is observed both for Loop 1 and Loop A. But for Loop 1, the horizontal component is insignificant in comparison to the vertical component even at late times.

2) Even for Loop A, for which the horizontal component is more significant, we calculate that a tilt of 45-55 degrees would be needed to obtain the response measured with the X coil. This is very significant tilt in the sensor and is greater than that of 25-30 degree tilt from the vertical indicated by the accelerometer data.

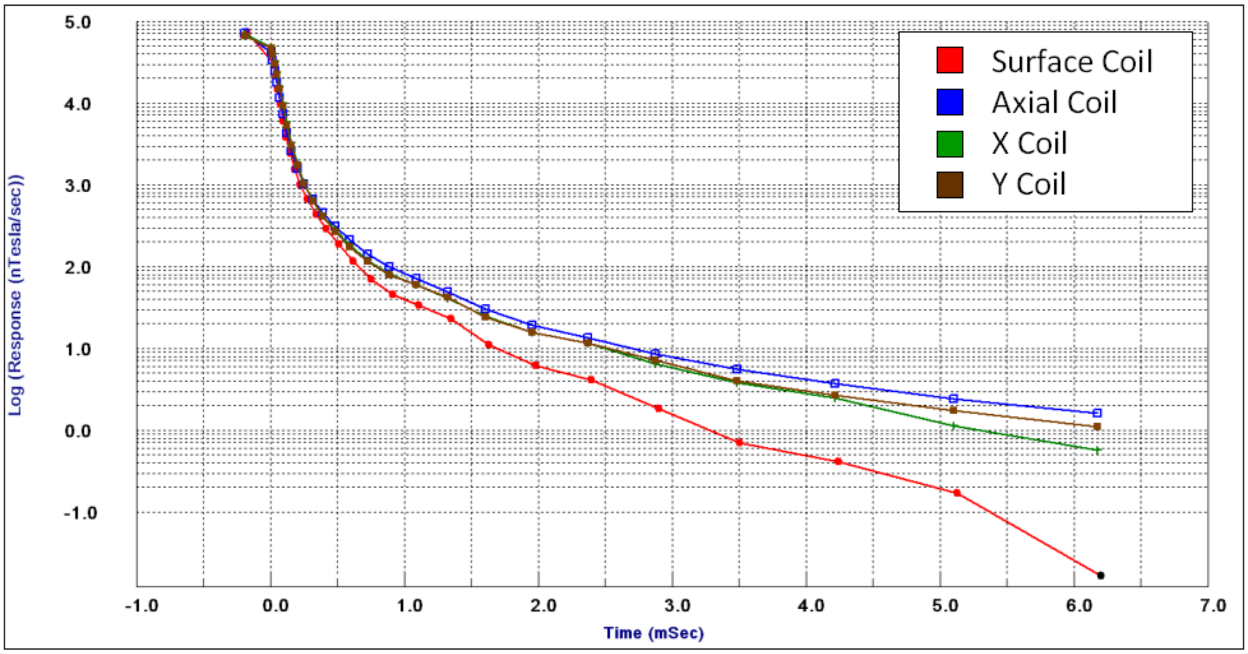

Figure 1: Comparison of data at 5000N on Line 5400E (Loop A) following timing correction and adjustment of axial coil amplitude by 25%. This is a modification of the figure on Page 2 of crone_data_issues_edit.pptx.

2) Timing Issues

Three issues timing-related issues were identified previously, and are addressed individually below.

Crone has provided explanations for these three issues. However, from these discussions it is clear that precise timing is not as important to Crone as it is to us. Nor does it appear to be as important to Crone as it is to other equipment manufacturers, based on our previous experience.

Through study of the APP and PP files that were collected on each day of surveying, we have examined the window timing and waveform. However, without careful study of these files, which we assume would not be performed by most geophysicists interpreting Crone data, we would have no understanding of these issues. It is clear that for this data, using the nominal channels and ramp length for both the surface and borehole data is not appropriate.

We disappointed by Crone's lack of concern about window timing and the lack of information provided on how we should address these issues.

a) Discrepancy in timing between borehole and surface coils

On average, the borehole data are 20 µs later than the surface data. We determined this by comparing the primary pulse files for the different coils. According to Crone, this is due to different timing methods being used: a synchronization cable was used for the borehole data and a crystal clock for the surface coil data. While the data collected using different timing methods should not be in disagreement, timing differences of this magnitude have also been observed in equipment made by another manufacturer for these two different modes.

b) Length of Ramp

According to the data files, the ramp is 1 ms long but the APP files indicate that it is shorter: 0.92 ms for the Khumsup data. While not addressed in Crone's report, we understand from a previous conversation that a variation in the ramp time from the nominal ramp is possible and the ramp should be consistent for a given piece of equipment. Indeed, this is what we observed: the ramp in the ORE data was consistently 0.97 ms, and the ramp in the Khumsup data was consistently 0.92 ms. But without the APP files that we specifically requested, we would have had no knowledge of the proper ramp time. Accurate knowledge of the ramp length is important because it affects the amplitude of the response.

c) Location of the time channels with respect to the times given in the data file

Through study of the PP files, we found that for both the borehole data and the surface data, time zero was not at the end of the ramp. Thus, the nominal time channels needed to be shifted such they were referenced to the end of the ramp. While not addressed in the report, Crone addressed this issue in our meeting. Our understanding is that the operator enters the delay in the data file. Apparently an incorrect delay was entered, in this case requiring us to shift the channels earlier by 20 µs for the surface coil data and 40 µs for the borehole data. These are significant differences in timing and we are concerned that the delays are not well-known or that the operators are not being given sufficient information to determine the appropriate delay.

3) Amplitude of Axial Coil Data

The axial data were 23% larger than the XY probe and surface coil data in the on-time. This discrepancy in amplitude was observed both in the data files and in the APP and PP files. According to Crone, the correct effective areas were not used when converting the data to nT/s for the borehole coils. The correct effective area of Khumsup's axial coil is 8287 m^2, whereas the effective area in the data files is 6500 m^2. Therefore, if the data were processed with the correct effective area, the response would be decreased by 27% (8287/6500=1.27) and the amplitude of the axial data would differ only a few percent from the other data. Thus, the use of the incorrect effective area apparently accounts for the majority of the on-time amplitude discrepancy in the axial coil.

However, the effective area of the XY coils was apparently incorrect in the data files as well. The correct effective area is 3137 m^2, whereas the raw data files indicate an effective area of 2800 m^2. 3137/2800=1.12. But the amplitude of the XY coil data and surface coil data agree without making a correction for the effective area of the coil. If the XY data were adjusted for the correct effective area, then its amplitude would be about 12% smaller than that of the surface coil data and the corrected axial coil data. Therefore, there is apparently an error in the amplitude of the XY probe data or in the effective area of these coils.

Thus, the information provided on the effective area of the coils solves the discrepancy between the axial and surface coil data amplitude, but indicates that there is a problem with the XY probe data.

Amplitude Issues in Previous Borehole Data

In 2008 and 2009, before we became involved in the project, data were collected by ORE in seven boreholes. We do not have PP files, but have examined the data to determine if the XY and axial data are consistent in amplitude based on how a background model fits the on-time channel for the different components. As all of these holes are in-loop, the on-time response is essentially freespace.

For one of the seven holes, there appears to be slight errors in geometry, or a significant effect from structure at the on-time channel. For three of the other six holes, the current needed to be adjusted slightly for the model to fit the axial data. Once this adjustment was made for each hole, the response of the model was compared to the total response measured by the XY probe. (i.e., the amplitude of the azimuthal and horizontal components) The total response measured by the XY coils was studied rather than the individual components in case there were derotation errors.

By comparing the response of the model to the data, we were able to determine whether the amplitude of the data from the XY probe was consistent with the data collected with the axial probe. In all of these holes, the amplitude of the azimuthal and horizontal data was found to be inconsistent with the amplitude of the axial data. In all but one case, the response of the model was too large by 8-12%. i.e., the amplitude of the data collected with the XY probe was too small by about 10% in comparison with the axial data.

Thus, it is not just the 2011 Khumsup data that contains amplitude discrepancies in the XY vs. axial probe data. Note that we would have to confirm that the 2008 and 2009 data were processed with the correct effective areas to be confident of this. However, the pem files do not contain the nominal values for effective areas (which we understand are 6500 m^2 and 2800 m^2 for the axial coil and XY coils respectively). Thus, we expect that the effective coil areas are correct in the data files. Note that the ORE data indicate a similar discrepancy in amplitude as the Khumsup data following the correction for effective area: the amplitude of the XY data is about 10% too small.

While we have borehole data from 2010 as well, these holes are all outside of the loop, and the on-time channel is somewhat sensitive to the subsurface in all but one of the holes. Thus, it is more difficult to determine whether the axial and XY amplitudes are in agreement. For the one hole in which the on-time response was essentially freespace, there appear to be slight geometry problems with the hole, but the amplitude of the XY data is about 8% lower than expected based on the amplitude of the axial data.

4) <u>Late-Time Anomaly in Loop 4 Data</u>

Both Khumsup and ORE collected surface data off Loop 4, but the datasets are not in agreement. The Khumsup data have a late-time anomaly, centered at the northing of the loop, which is not observed in the ORE data.

Apparently in the Khumsup survey, access problems at the corner of the loop necessitated that wires be run to the transmitter, and these were run across a fence. It is thought that this is the cause of the strong late-time response in the Khumsup data.

What is curious about this explanation is:

1) There are no fences anywhere near Loop 4.

2) Loop 4 is entirely on the client's property, and the loop is nowhere near the property boundary. Thus, we are unclear as to how there were access problems.

3) ORE did not have problems with this loop a mere 2 months earlier.

Thus, Khumsup's statements are completely inconsistent with our knowledge of the site. Furthermore, we are concerned that other errors in survey procedures may have resulted in some of the other problems we are seeing in the data.