Probe Array Measurements

eLB001-003
24th February 2006

Background: Third test using scale models.

Aim:

To determine the behaviour of different probe array configurations using stainless steel putty knives.

Equipment:

- DVM and stainless steel putty knives (4 off)
- 9V battery
- Plastic rectangular wash dish (approximately 35cm by 28cm and 12cm in depth)

Method:

- Fill plastic wash dish to ¾ with ordinary tap water (suggest avoiding rain water because of lack of impurities)
- Apply 9V between a pair of putty knives spaced at 2.3cm apart
- Measure induced e.m.f. between a second pair of putty knives approx. 30cm away
- Compare received potential for broadside (goal posts) configuration to in-line configuration

Results:

1. Two sets of measurements were made for the broadside configuration – each with a measurement for each polarity of the 9V battery potential. This was needed as there was a residual potential difference even with the 9V battery **not** connected. See Figure 1.

Broadside	Residual (mV)	+ Polarity (mV)	- Polarity (mV)	Result (mV)
Meas 1	24.6	55.1	-7.2	31.15
Meas 2	7.2	34.3	-24.2	29.25

2. One set of measurements was made for the in-line configuration with a measurement for each polarity of the 9V battery potential. Only one set of measurements were taken as it was considered at that time that further measurements would be of little use (see discussion following).

In-line	Residual (mV)	+ Polarity (mV)	- Polarity (mV)	Result (mV)
Meas 1	5.2	6.3	4.3	1

Discussion:

Result 1 (Broadside). Comparing the results of measurement 1 and measurement 2 for the broadside configuration show a consistent result with 8.9V applied across one pair of putty knives resulting in a measurement of ~ 30mV across the second pair of putty knives at a distance of 30cm. The distance to spacing ratio of 30/2.3 = ~ 13 gives a path loss attenuation of 49.5dB.

Result 2 (In-line). The results of measurement 1 for the in-line configuration show a result that with 8.9V applied across one pair of putty knives a measurement of ~ 1mV is obtained across the second pair of putty knives at a distance of 29cm. The distance to spacing ratio of 29/2.3 = ~ 13 here gives a path loss attenuation of 79.0dB.

Conclusion:

The wash dish simulation of array configurations shows a result inconsistent with expected results with the in-line configuration displaying ~30dB more attenuation than the broadside configuration. It is considered that the constraining effect of the plastic insulating wash basin distorts the lines of current in such a fashion as to render comparison between the two array configurations (broadside and in-line) invalid. This because the in-line array configuration relies on current passing through one probe and then the other in a direction which is blocked by the insulating wash basin wall.

In contrast the broadside configuration relies on current passing parallel to the walls – the insulating walls have the effect of concentrating current in this direction. Therefore the 30dB deficit measured for the in-line configuration should be classed as invalid.

A quick check between the two configurations with both probe pairs in close proximity showed a closer agreeance in results. However, because at this distance small differences in position made large differences in measurements no results were recorded as they would have been poor data.

A second quick check in a stainless steel kitchen sink also showed little difference between the two arrays even when the probe pairs were close to the sink walls. This was taken to be because this environment more closely simulated the infinite extent of real earth. However, because the readings now were so low (effect of short-circuiting the induced potentials?) that once again comparisions would have been invalid.

At this point the tests were terminated as it is considered that valid tests could only be done where the test tank was large in comparision with probe spacing and the distance between probe pairs.

Further testing will be done in the field with real earth.

As it is known from the literature that large and slowly-varying potentials are found to be developed across earth probes (and also known from quick backyard tests) it is considered that further tests will be carried out using AC drive signals coupled with

receiving systems that block DC (or the slowly-varying DC interfering potentials) and only respond to signal frequencies above approximately 10Hz.

Figure 1 - Broadside Configuration (Goal Posts) Measurement