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# EM61-MK2 Response of Three Munitions Surrogates

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<b>14. ABSTRACT</b>  Target response coefficients for three pipe nipples intended as surrogates for commonly encountered UXO items were calculated from measurements made using the recently developed NRL Time-domain Electromagnetic Induction array. These response coefficients were used to predict the signals expected from an EM61-MK2, the most commonly used geophysical survey instrument for UXO, for each of the three items as a function of orientation and distance of the center of the item below the bottom coil of the sensor. A series of EM61-MK2 survey measurements were made over the surrogates at the NRL Blossom Point Test site to confirm the predictions. The predicted EM61-MK2 signals are presented graphically as plots of the minimum signal expected at the second time gate as a function of distance from the sensor with the confirming survey measurements plotted on the same axes. The minimum signal at each of the four gates available from the EM61-MK2 is tabulated for depths corresponding to 3x, 5x, 7x, and 11x the object's diameter and all the results obtained are attached electronically as a spreadsheet.					
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## **EM61-MK2 RESPONSE OF THREE MUNITIONS SURROGATES**

### **INTRODUCTION**

The EM61-MK2 Electromagnetic Induction sensor (Geonics Limited, Mississauga, Ontario, Canada) is the most widely used geophysical sensor for unexploded ordnance (UXO) detection surveys. Like all time-domain electromagnetic induction sensors, it produces a pulsed magnetic field (primary field) that induces a secondary field in metallic objects in the vicinity of the sensor. The decay of this induced field is sensed by monitoring the current in a wire-loop receiver coil in four time gates after the turn-off of the primary field. In the EM61-MK2, the main receiver coil is co-located with the transmit coil.

In a typical UXO detection survey, the sensor, with attached wheels or mounted on a cart, is used to survey the field in a raster pattern with a line spacing on the order of the 1-m width of the sensor. Smaller line spacings can be used to increase the data density for more advanced analyses. After data collection, the raw data are typically leveled, background corrected, and mapped. Then, either line-by-line or from a data image, regions of anomalous response are selected and marked as potential metal targets. This initial list of anomalies is used as input to an analysis step that selects anomalies for digging based on features extracted during further analyses such as target size and shape. A target of interest that does not appear on this anomaly list constitutes a detection failure.

One important component of the management of a geophysical investigation is to devise a quality assurance approach that will lead to confidence that the percentage of missed detections is low. Often, this has involved the construction of a geophysical prove-out (GPO) area on the site in which a selection of the targets of interest are buried at a number of different depths and orientations. Each geophysical survey crew is qualified by surveying this area and reporting the number and locations of anomalies detected. Since the identities and locations of the emplaced items in the GPO are blind to the crews, this procedure can serve to validate the survey procedures and data analysis and anomaly detection methods to be used on the site.

This procedure can break down however. The survey crew, who know they are being tested, will always perform with maximum efficiency and care on the GPO but as the production survey proceeds and complacency sets in their performance may slip. If this occurs, the performance measured at the GPO may not be confidently expected in later parts of the survey. This possibility has led a number of site managers and regulators to propose replacing the extensive GPO with a smaller performance confirmation strip, used for a daily confirmation of the survey procedures, coupled with a blind seeding program in the production areas. This approach has the advantage of confirming survey performance as often as a seed is encountered by comparing the measured anomaly location and amplitude to the known values.

Blind seeding, as discussed above, on a large production site will require a large number of items for seeding. One approach is to use inert munitions, matching those expected to be encountered on the site. This is problematic for two reasons. It is often not possible to obtain a sufficient supply of inert munitions at a cost the project can afford. Even if the inert munitions can be found, use of munitions as

seeds requires an extensive inventory and tracking procedure to be implemented; an inert munition left on the site will quite likely trigger a 911 call in the future.

Another, more attractive, approach is to use munitions surrogates (items intended to produce a signature similar to the munitions targets of interest but that do not resemble munitions) as the seed items. If chosen carefully, these surrogates can be widely available and relatively inexpensive. Once the seed items are chosen, the response of the sensor to the items as a function of depth must be determined so that the expected anomaly amplitudes can be predicted.

In an earlier report, we used sensor performance models to predict the response of an EM61-MK2 to a number of common munitions as a function of depth [1]. To validate the results, we collected survey data over those same objects at varying depths and orientations, extracted the maximum signal observed, and compared the measurements to our predictions. In all cases, the model accurately predicts the measured anomaly amplitudes. In this report, we extend this method to three standard steel pipe nipples that we propose for use as surrogates. After a brief description of the model employed and the data collection methodology, we present the predicted and measured anomaly data in graphical and tabular form.

## DESCRIPTION OF THE MODEL

The response of a metallic object to an Electromagnetic Induction sensor is most simply modeled as an induced dipole moment represented by a magnetic polarizability matrix  $\mathbf{B}$  [2]. As a consequence of electromagnetic reciprocity, the matrix  $\mathbf{B}$  is symmetric. By a suitable rotation it can be transformed to diagonal form, so we can write

$$\mathbf{B} = \mathbf{U}\mathbf{B}_0\mathbf{U}^T \quad (1)$$

with

$$\mathbf{B}_0 = \begin{bmatrix} \beta_1 & 0 & 0 \\ 0 & \beta_2 & 0 \\ 0 & 0 & \beta_3 \end{bmatrix}. \quad (2)$$

In terms of yaw, pitch and roll Euler angles  $\phi$ ,  $\theta$  and  $\psi$  [3], the rotation matrix  $\mathbf{U}$  is given by

$$\mathbf{U} = \begin{bmatrix} \cos \theta \cos \phi & \cos \theta \sin \phi & -\sin \theta \\ \sin \psi \sin \theta \cos \phi - \cos \psi \sin \phi & \sin \psi \sin \theta \sin \phi + \cos \psi \cos \phi & \cos \theta \sin \psi \\ \cos \psi \sin \theta \cos \phi + \sin \psi \sin \phi & \cos \psi \sin \theta \sin \phi - \sin \psi \cos \phi & \cos \theta \cos \psi \end{bmatrix}. \quad (3)$$

The eigenvalues  $\beta_1$ ,  $\beta_2$ ,  $\beta_3$  correspond to responses induced by the sensor transmit field components aligned with each of the object's principal axes.  $\phi$ ,  $\theta$  and  $\psi$  together define the orientations of these principal axes relative to the X, Y and Z coordinate directions. Depending on sensor modality, the  $\beta$ s are functions either of time after the primary field cutoff or of the frequency of the primary field; the Euler angles are not.

In terms of  $\mathbf{B}$  above, the time-domain EMI sensor signal  $S$  is modeled as

$$S(t) = \mu_0 A I_0 \mathbf{C}_R \cdot \mathbf{C}_T \left\{ \frac{d}{dt} \int \hat{I}(t - \tau) \mathbf{B}(\tau) d\tau \right\} \equiv \mu_0 A I_0 \mathbf{C}_R \cdot \mathbf{C}_T \mathbf{B}_E(t) \quad (4)$$

In equation (4),  $\mu_0$  is the magnetic permeability of free space ( $4\pi \times 10^{-7}$  volt-sec/amp-m);  $A$  is a scaling factor that depends on the number of turns in the transmit and receive coils, the receiver gain, etc.;  $I_0$  is the peak amplitude of the transmit current pulse;  $\mathbf{C}_T$  and  $\mathbf{C}_R$  are coil sensitivity functions for the transmit and receive coils; and  $\mathbf{B}_E$  is the effective polarizability matrix, a quantity which encapsulates the influence of the normalized transmit pulse  $\hat{I}(t)$  on  $\mathbf{B}$ .  $\mathbf{C}_T$  and  $\mathbf{C}_R$  depend only on coil geometry and location relative to the object, while  $\mathbf{B}$  depends only on what the object is and how it's oriented, not where it is. The coil sensitivity functions are vectors that specify (a) the strength and direction of the primary field at the object ( $\mathbf{C}_T$ ) and (b) the sensitivity of the receive coil to the vector components of a magnetic dipole source at the object location ( $\mathbf{C}_R$ ). The vector  $\mathbf{C}_T \mathbf{B}_E$  describes the strength of the induced object response in the X, Y and Z coordinate directions. Taking the dot product with  $\mathbf{C}_R$  accounts for the relative sensitivity of the receive coil to each of these response components.

The strength and direction of  $\mathbf{C}_T$  and  $\mathbf{C}_R$  are sensitive functions of the location of the EMI sensor relative to the object.  $\mathbf{C}_T$  and  $\mathbf{C}_R$  are defined in terms of integrals around the coil involving the vector from the object to the coil:

$$\mathbf{C}_{T,R}(\mathbf{r}_0) = \frac{1}{4\pi} \oint_{T,R} \frac{d\mathbf{l} \times (\mathbf{r}_0 - \mathbf{r})}{|\mathbf{r}_0 - \mathbf{r}|^3} \quad (5)$$

where  $\mathbf{r}_0$  is the location of the object and  $\mathbf{r}$  is the location of a point on the coil.

The effective polarizability matrix  $\mathbf{B}_E$ , as expressed in (4), makes explicit reference to the filtering of  $\mathbf{B}$  via the transmit pulse. However, in general, the situation may further be complicated by the effects of the receiver electronics, which also filter the response. In practice, the latter is accounted for by lumping an object-dependent scale factor into  $\mathbf{B}_E$  and using standard test objects to calibrate the sensor by determining  $A$ . The eigenvalues (i.e.  $\beta_s$ ) of the effective polarizability matrix thus become the quantities which we work with.

In general, the aggregate magnitude of the  $\beta_s$  determines the size of the object, while differences among the  $\beta_s$  relates to the shape of the object. For axially symmetric shapes such as cylinders, prolate or oblate spheroids, and many UXO items, there is a basic longitudinal response along its length and two equal responses transverse to this.

Deriving the  $\beta_s$  from EMI data collected over an object is fairly straightforward. As the sensor moves relative to the object, the object is excited from different directions, while the sensitivity of the receiver to the different response components also varies – data from different locations above the object combine the elements of the polarizability matrix  $\mathbf{B}_E$  in different ways. As it turns out, if enough data are collected over an area whose dimensions are somewhat larger than the depth of the object, then all of the elements in  $\mathbf{B}_E$  contribute enough, and in enough different ways to the overall response that the data can be inverted to determine the  $\beta_s$ .

With data collected at  $N$  locations ( $\mathbf{r}_i, i=1,2,\dots,N$ ) over an unknown object, we have an overdetermined set of  $N$  simultaneous equations with nine unknown quantities (three  $\beta$ s, three Euler angles that define the object's orientation, and the xyz coordinates of the unknown target location  $\mathbf{r}_0$ ):

$$S_i = \mu_0 A I_0 \mathbf{C}_R(\mathbf{r}_0 - \mathbf{r}_i) \cdot \mathbf{C}_T(\mathbf{r}_0 - \mathbf{r}_i) \mathbf{B}_E, \quad i=1,2,\dots,N. \quad (6)$$

The equations are solved in a least-squares sense simultaneously for all values of time. This is accomplished by using a Levenberg-Marquardt gradient search technique to determine the target parameters that minimize the mean squared error between the dipole response model and the measured data.

A key assumption of the dipole response model outlined above is that the behavior with time of the induced currents within an object – from the early surface currents to the later volume currents – is fully embodied in  $\mathbf{B}$  (and hence the  $\beta$ s) defined *at a single point in space*. For the case of a simple compact object sufficiently far from the sensor, this is a very good approximation and can be represented by a unique set of  $\beta$ s. For the case of composite and/or extended objects sufficiently far from the sensor, the model can still give a reasonably good approximation but must now be represented by different sets of  $\beta$ s that depend on the object orientation relative to the sensor.

Note from (4) that for the special case where  $\hat{I}(t)$  is an ideal step function,  $\mathbf{B}_E \equiv \mathbf{B}$  for all time  $t$  after the transition from one to zero occurs. For this reason, we refer to the  $\beta$ s from  $\mathbf{B}$  as the *step response*  $\beta$ s and the  $\beta$ s from  $\mathbf{B}_E$  as the *effective*  $\beta$ s. Figure 1 below shows plots of the step response and effective  $\beta$ s for a 3" chrome steel and a 4" aluminum sphere. The underlying black curves in each panel represent the step response  $\beta$ s as obtained from theory. Since the sphere is perfectly symmetric,  $\beta_1=\beta_2=\beta_3$ . Overplotted in green are the theoretical effective  $\beta$ s for our time-domain electromagnetic sensor (TEM) array (described in the next section) computed solely by convolving the TEM transmit pulse with the step response  $\beta$ s followed by the time derivative, as prescribed by (4). The effective  $\beta$ s derived directly from data taken with the TEM array are shown in red. In this case, the  $\beta$ s (solid, dotted and dashed curves) are essentially identical, as expected. Note that for both the ferrous and nonferrous spheres, the derived effective  $\beta$ s from the TEM array data are an extremely good representation of the step response  $\beta$ s.

For comparison, the magenta curves show the theoretical effective  $\beta$ s for the EM61-MK2. These are computed again as prescribed by (4), but now the pulse being used is that of the EM61-MK2. Note that in this case, the derived effective  $\beta$ s are generally not a good representation of the step response  $\beta$ s. Coincidentally, however, in the regime of the EM61-MK2 time gates (shown as vertical dotted lines), the 3" chrome steel sphere  $\beta$ s are an approximate representation of the step response  $\beta$ s.

Since the EM61-MK2 signal vs depth curves in this report are generated via (4), and step response  $\beta$ s are given as derived from the TEM array data, it will be necessary to accurately convert these to effective  $\beta$ s for the EM61-MK2. A method which appears successful involves fitting each red curve with the sum of a weighted arbitrary number of loops using a procedure developed in SERDP project MM-1313 [4,5]. The cyan curves represent the result of convolving these fitted curves with the EM61-MK2 transmit pulse and taking the time derivative, as prescribed by (4).

Two examples of the predicted EM61-MK2 response in gate 2 are shown in Figure 2. The left panel plots the response expected from a 105mm projectile while the right panel plots the response expected from a 2.75" rocket warhead. For both cases, the predicted responses are plotted as a function of the distance of the items center below the bottom coil of the sensor. In normal operation, the EM61-MK2 is



deployed on wheels with the bottom coil 42 cm off the ground. For this case, the target depth below the ground will equal the abscissa reading minus 42 cm. Other deployment schemes have the EM61-MK2 sensors mounted on trays that are dragged across the ground. In those cases, a different offset would be applied.

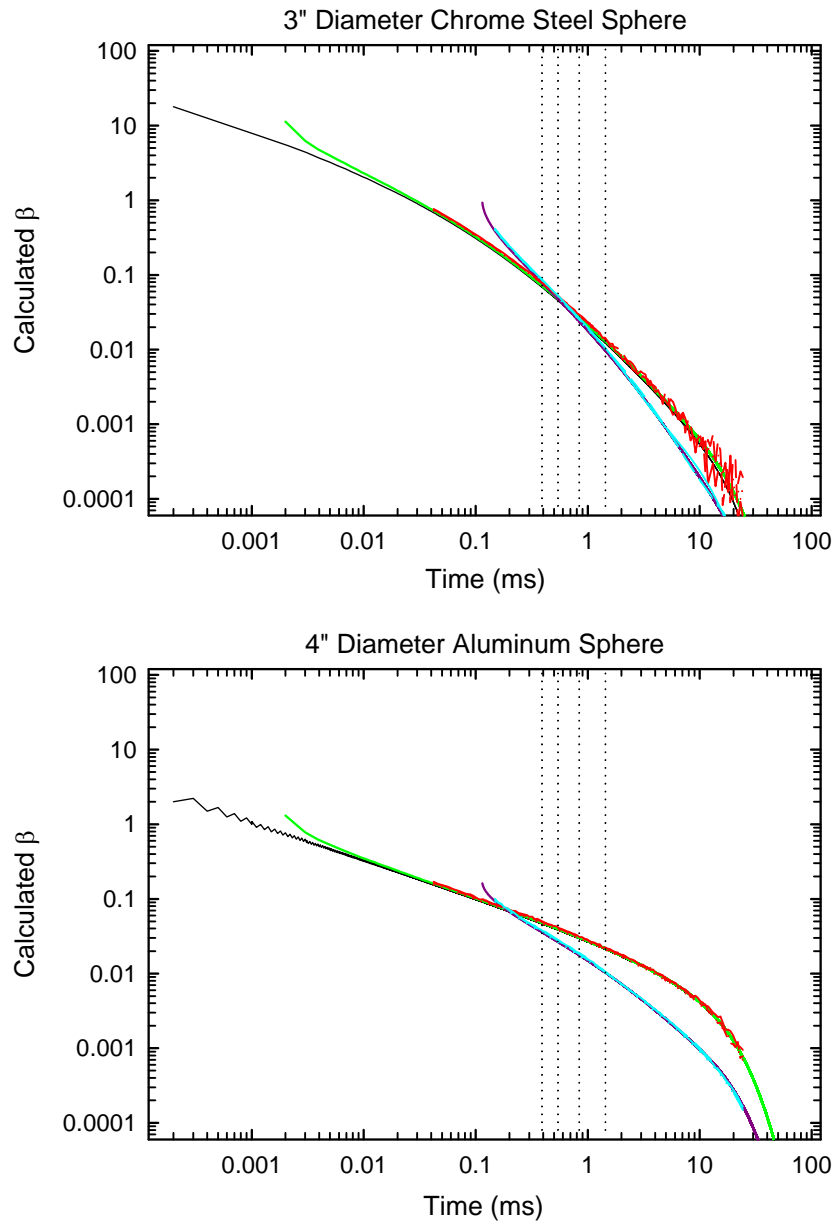


Figure 1 – Step response and effective  $\beta$ s for a 3" chrome steel and a 4" aluminum sphere. The underlying black curves represent the step response  $\beta$ s based on theory; the red curves represent the effective TEM array  $\beta$ s inverted from data; and the cyan curves represent the effective EM61-MK2  $\beta$ s computed using the effective TEM array  $\beta$ s. Please refer to the text for a full description of the method used. The vertical dotted lines represent the EM61-MK2 4-channel mode time gates.

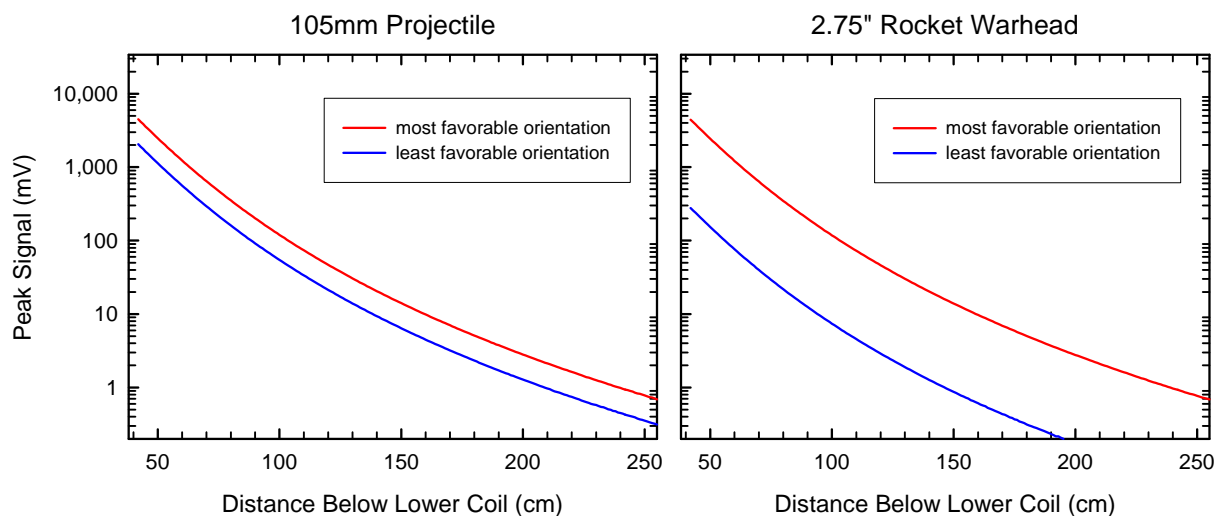


Figure 2 – Predicted EM61-MK2 signal at the second time gate as a function of depth for a 105-mm projectile (left) and a 2.75” rocket warhead (right). In both cases, the response to the object in its most favorable orientation is plotted as a red line and the least favorable orientation as a blue line.

For both items, the predicted response when the item is in its most favorable orientation (oriented vertically under the sensor) is plotted as a red line and that when the item is in its least favorable orientation (oriented horizontally under the sensor perpendicular to the sensor track) as a blue line. The length to diameter aspect ratio of the rocket warhead is substantially larger than that of the projectile accounting for the greater spread between the two responses in the right panel. The long axis of both targets is of similar size yielding similar responses in the most favorable orientation. Except in the most unfavorable conditions, site noise is typically 1 mV or below allowing both of these items to be detected at depths approaching 1 m under standard deployment conditions.

## MUNITIONS SURROGATES

In keeping with our goal of widely available and inexpensive surrogates, we have chosen to use pipe nipples. Each of the three surrogates employed is a black, welded steel, Schedule 40 straight pipe nipple, threaded on both ends. We obtained the samples for this study on-line from McMaster-Carr (<http://www.mcmaster.com/>) but they are widely available from a variety of sources. The details of the three surrogates are given in Table 1.

Table 1. Munitions Surrogates Used in this Work.

Item	Nominal Pipe Size	Outside Diameter	Length	Part Number
Small Surrogate	1"	1.315" (33.4 mm)	4"	44615K466
Medium Surrogate	2"	2.375" (60.3 mm)	8"	44615K529
Large Surrogate	4"	4.500" (114.3 mm)	12"	44615K137

## DATA COLLECTION PROCEDURES

Two data collections were carried out for each of the munitions items studied. Although the target response coefficients needed to predict the sensor signal as a function of depth can be determined from a series of EM61-MK2 measurements, it proved to be more efficient to determine the  $\beta$ s using our TEM array using the procedures outlined above. This instrument, developed with ESTCP support, comprises a five-by-five array of time-domain EM sensors each consisting of a 35-cm transmit coil and an inner 25-cm receive coil, Figure 3. With the munitions item to be investigated placed under the center sensor in the array, the transmit coils are energized sequentially and decay data are collected from all 25 receive coils; 625 individual decays in total, from 40  $\mu$ s to 25 ms after the primary is turned off.

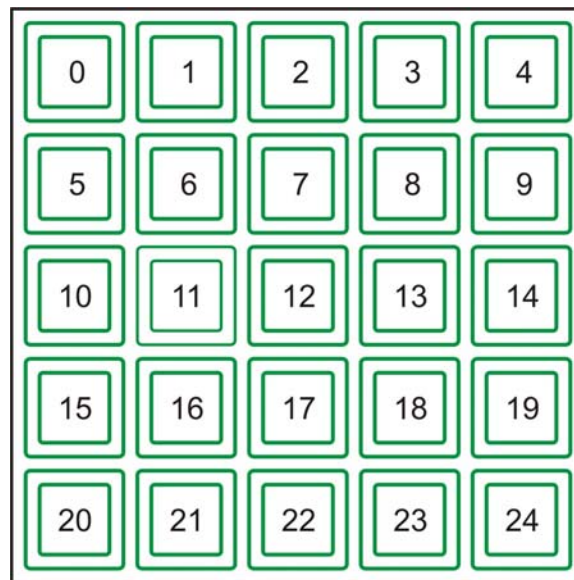


Figure 3 – Schematic of the 25-element TEM array used to determine the response coefficients of the test objects

A small subset of the data collected from a 2.75-in warhead oriented horizontally along track 35cm below the sensor array is shown in Figure 4. The nine decay curves shown are the response measured at the nine central receivers when the corresponding transmit coil is energized (monostatic response). Some of the shape information available from these sensors is evident in the plot. The decays measured using sensors 7 and 17, which primarily excite longitudinal modes of a prolate spheroidal target oriented along track, have distinct decay behavior from sensors 11 and 13, which primarily excite transverse modes.

TEM array data were collected from each of the three surrogates at different target orientations. These data were inverted for target response coefficients,  $\beta$ , as described above. Combined with the known transmit and receive properties of the EM61-MK2, these  $\beta$ s were used to predict the sensor response to the three items as a function of depth.

In order to validate these predictions, EM61-MK2 surveys were conducted over each of the surrogates positioned at a variety of depths and orientations in our test pit at Blossom Point. These surveys consisted of a single pass of the sensor at normal survey speed over the object starting ten meters in front of the pit and continuing ten meters past the pit. Before and after each series of measurements, data were collected over the empty pit to ensure that the sensor background was at reasonable levels. The

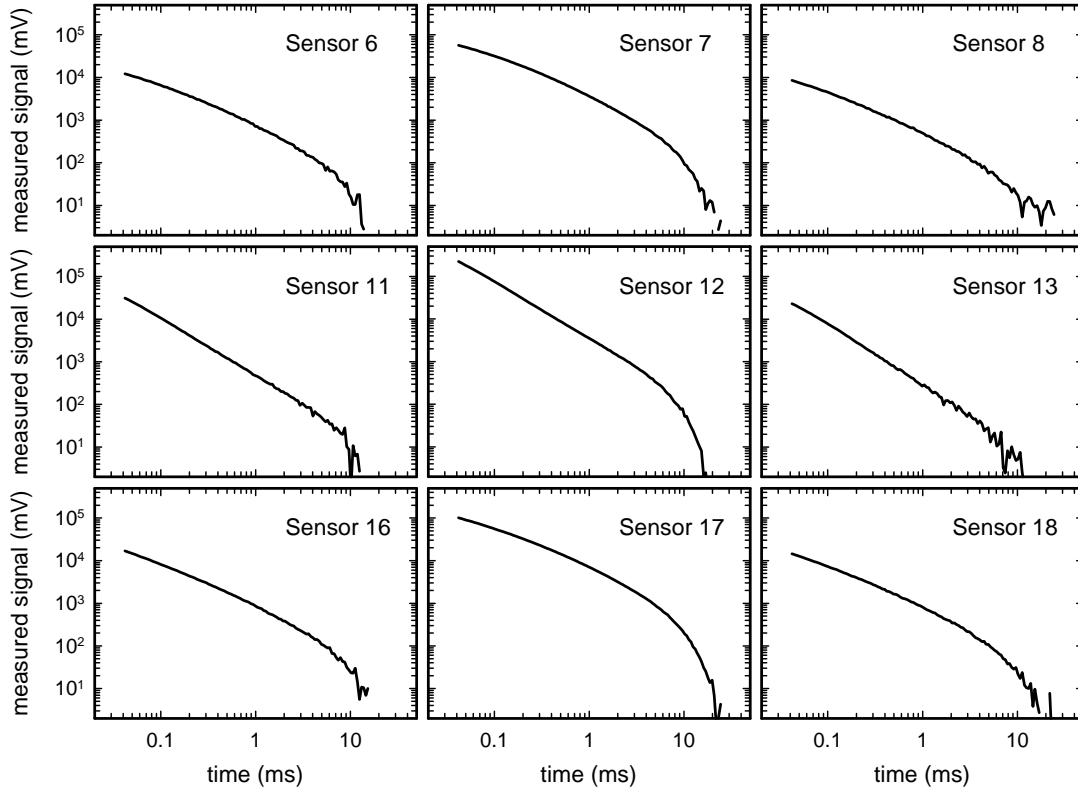


Figure 4 – Measured response of a 2.75-in warhead oriented horizontally along track 35 cm below the TEM array. The nine decays shown represent the response of the nine central receivers (see Figure 1) when the corresponding transmitter is energized.

survey data were background corrected using data collected before and after the test pit and the largest amplitude signal for each of the four time gates selected. In many cases this is not the measurement directly above the object; for a cylinder placed flat and oriented along the survey track, the peak signals are observed before and after the object. Each object was measured at nine to twelve unique position/orientation combinations.

For all EM61-MK2 data reported in this report, the sensor was operated in 4-channel or “4” mode with four sampling gates devoted to the lower, primary receive coil. The nominal delay time from the initial turn-off of current to the coil for each of the four gates is listed in Table 2. A standard EM61-MK2 was used for this work; the instrument manual lists delays from complete turn-off of current.

Table 2. Nominal delay time and receive coil used for each of the EM61-MK2 gates in “4 channel” mode

Gate	Receive Coil	Nominal Delay
1	Lower	216 $\mu$ s
2	Lower	366 $\mu$ s
3	Lower	660 $\mu$ s
4	Lower	1266 $\mu$ s

## RESULTS

The results of this investigation are shown in Figures 5 through 7. For each of the figures, the top panel is a photograph of the actual item measured and the bottom panel shows the predicted and measured EM61-MK2 response at the second time gate. The predicted response when the item is in its least favorable orientation is plotted as a solid blue line. Measured responses are plotted as crosses. In all cases, the measured responses are described well by the calculated curve. The system noise, which limits the ultimate depth of detection of the item under investigation, determined at the site is plotted as a dash-dot line. The RMS noise at this site was 0.5 mV for gate 2 but this is a strong function of the roughness of the terrain and may be higher at other sites. The observed static and moving RMS noise amplitudes for all gates are given in Table 3.

Table 3. Measured RMS noise for each of the four gates in static and survey mode.

Gate	Static (mV)	Survey (mV)
1	0.5	0.8
2	0.1	0.5
3	0.2	0.4
4	0.3	0.3

The minimum signals predicted for all three surrogates investigated for all four gates for depths corresponding to 3x, 5x, 7x, and 11x the items diameter are tabulated in Table 4. All predicted sensor responses are tabulated in a spreadsheet which is attached electronically as Appendix A.

The results presented here are for data collected when the test object passes directly under the middle of the sensor. Depending on the objectives of a particular survey (detection vs. classification, large deep items vs. small shallow items) the survey lane spacing chosen may result in some potential targets passing off-center under the sensor. Figure 8 plots the measured signals from a test sphere and the small surrogate as a function of distance from the center of the sensor. In each case, the items were positioned with their center 50 cm below the lower coil of the EM61-MK2.

The upper panel of Figure 8 shows the response from a standard 4-in aluminum sphere. As expected, the response is relatively constant near the center of the coil and then begins to fall off as the sphere approaches and then passes outside the edge of the coil which is indicated with a dotted line. The lower panel plots the response of the small surrogate oriented along- and across-track with the scaled response of the sphere for reference. The surrogate oriented along track results in fall-off behavior that matches the sphere data. As the across-track surrogate is moved toward the edge of the transmit coil, more of the long-axis response of the pipe is excited and the signal rises dramatically before beginning to fall as the surrogate moves outside the sensor coil.

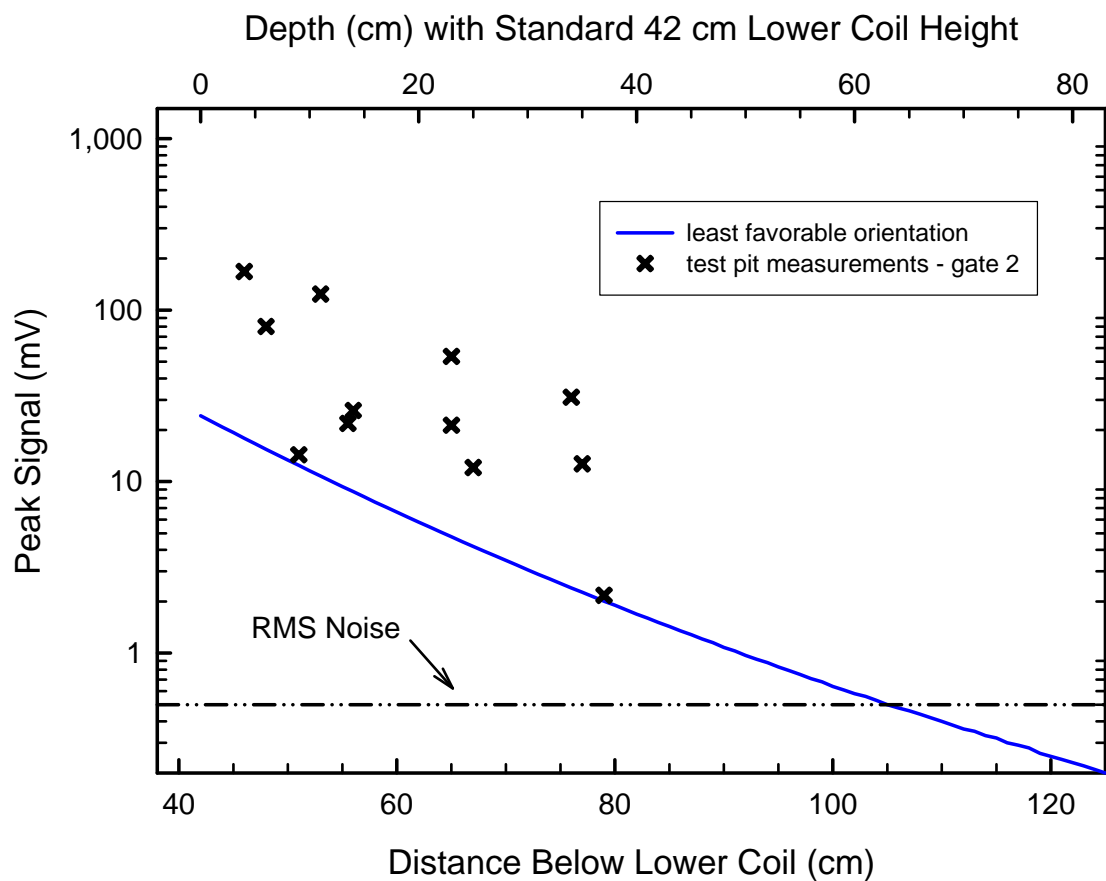


Figure 5 – EM61-MK2 signal at the second time gate as a function of the distance of the center of a small munitions surrogate below the sensor's bottom coil. The predicted response to the object in its least favorable orientation is shown as a solid line, test pit measurements are plotted as crosses, and the site noise is shown as a dot-dash line.

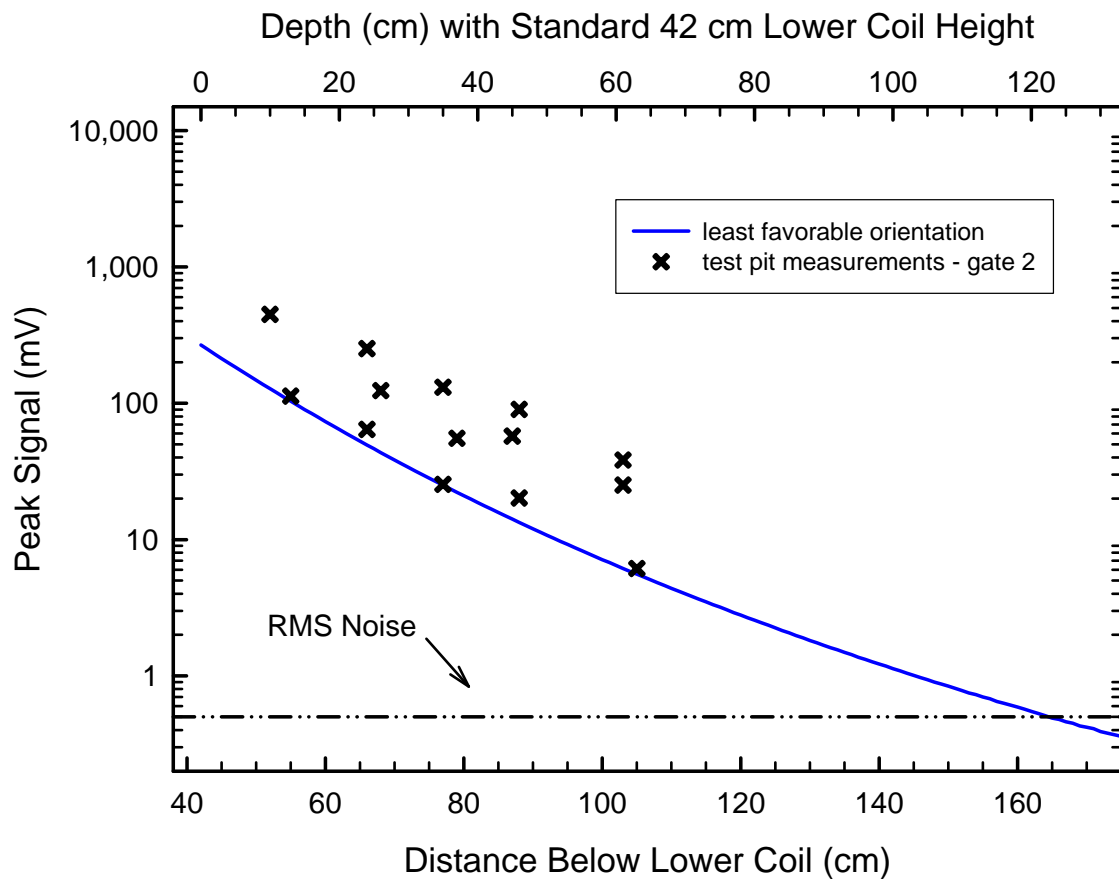


Figure 6 – EM61-MK2 signal at the second time gate as a function of the distance of the center of a medium-sized munitions surrogate below the sensor’s bottom coil. The predicted response to the object in its least favorable orientation is shown as a solid line, test pit measurements are plotted as crosses, and the site noise is shown as a dot-dash line.

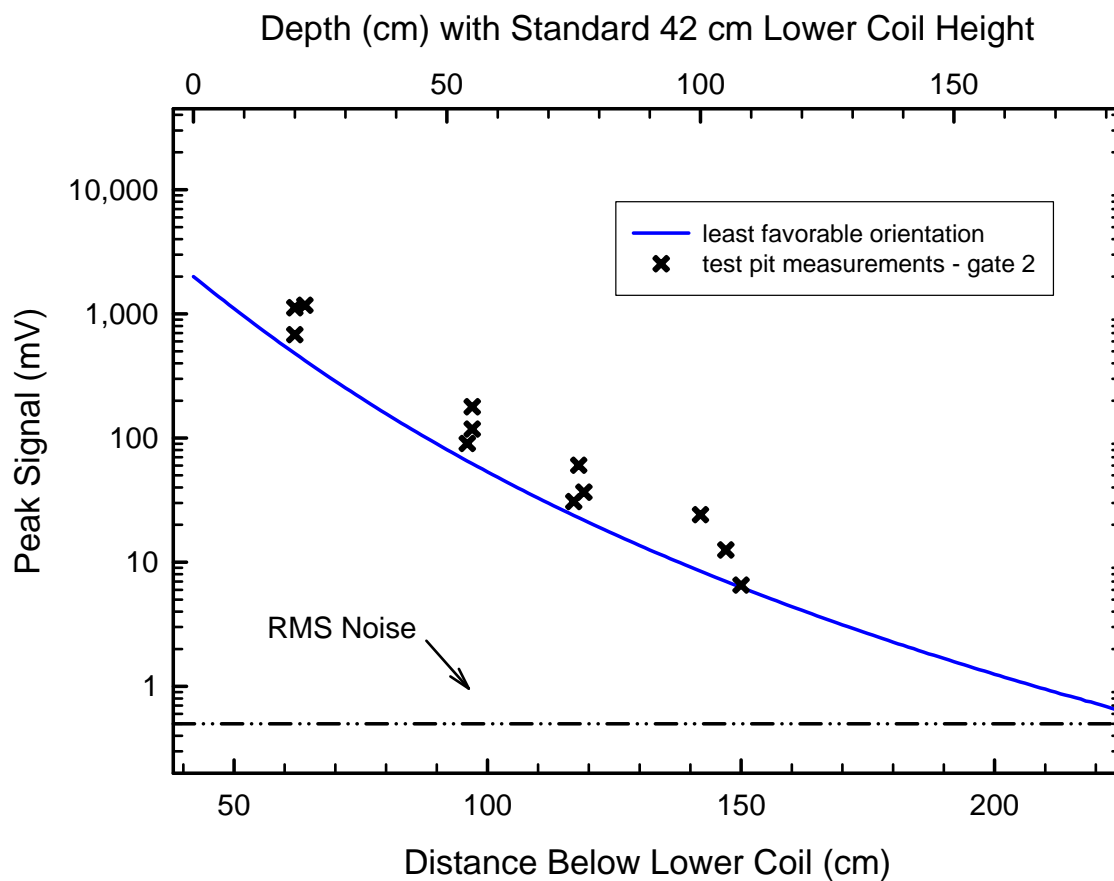


Figure 7 – EM61-MK2 signal at the second time gate as a function of the distance of the center of a large munition surrogate below the sensor's bottom coil. The predicted response to the object in its least favorable orientation is shown as a solid line, test pit measurements are plotted as crosses, and the site noise is shown as a dot-dash line.



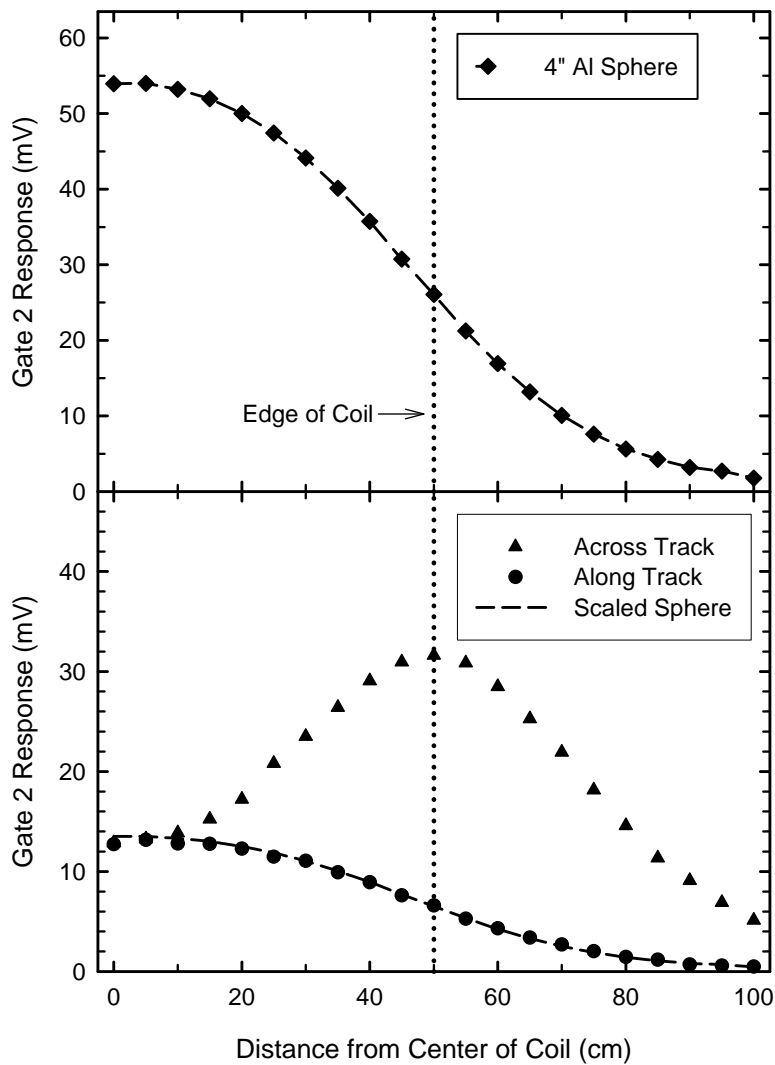


Figure 8 – Test item response as a function of cross-track distance from the center of an EM61-MK2 oriented with the 1-m axis perpendicular to the survey direction. The top panel shows the response of a 4-in aluminum sphere located 50 cm below the lower coil. The bottom panel shows the response of the small surrogate oriented both along the direction of survey and across the direction of survey. The scaled response of the sphere is shown for reference. In both panels, the edge of the sensor coil is indicated by a dotted line.

Table 4. Predicted minimum EM61-MK2 signal for the three munitions surrogates at a depth corresponding to 3x, 5x, 7x, and 11x their respective diameter. The sensor is assumed to be deployed on its standard wheels which correspond to the bottom coil 42 cm above the ground.

Item	Depth (cm)	Gate 1 (mV)	Gate 2 (mV)	Gate 3 (mV)	Gate 4 (mV)
<b>3x Depth</b>					
Small Surrogate	10	20.9	11.6	5.2	1.8
Medium Surrogate	18	131	73.4	33.2	12.7
Large Surrogate	34	324	199	98.8	40.2
<b>5x Depth</b>					
Small Surrogate	17	12.8	7.1	3.2	1.1
Medium Surrogate	30	60.4	33.9	15.3	5.8
Large Surrogate	57	91.6	56.1	27.9	11.3
<b>7x Depth</b>					
Small Surrogate	23	8.6	4.8	2.1	0.8
Medium Surrogate	42	29.8	16.7	7.6	2.9
Large Surrogate	80	31.2	19.1	9.5	3.9
<b>11x Depth</b>					
Small Surrogate	37	3.6	2.0	0.9	0.3
Medium Surrogate	66	8.6	4.8	2.2	0.8
Large Surrogate	128	5.1	3.1	1.6	0.6

## SUMMARY

We have used the NRL TEM Array to characterize three standard pipe nipples intended to serve as surrogates for munitions items commonly found on Military Munitions Response Sites. Using these data we have determined EM response coefficients for each object. These response coefficients have been used to calculate the expected signal from an EM61-MK2 over each surrogate as a function of depth and orientation. These results have been presented graphically and the minimum signal expected at a depth corresponding to 3x, 5x, 7x, and 11x the objects diameter has been tabulated.

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**Predicted EM61-MK2 Response to a Small Munitions Surrogate**

Distance of Target Center Below Lower Coil (cm)	Target Depth Assuming Deployment on Standard Wheels (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 (mV)	
		Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
42	0	378.3	43.6	263.3	24.2	155.1	10.8	72.9	3.8
43	1	350.7	40.4	244.1	22.4	143.8	10.0	67.6	3.5
44	2	325.2	37.5	226.3	20.8	133.3	9.3	62.7	3.3
45	3	301.8	34.8	210.0	19.3	123.7	8.6	58.2	3.0
46	4	280.1	32.3	194.9	17.9	114.8	8.0	54.0	2.8
47	5	260.1	30.0	181.0	16.6	106.7	7.4	50.1	2.6
48	6	241.7	27.9	168.2	15.4	99.1	6.9	46.6	2.4
49	7	224.7	25.9	156.4	14.4	92.1	6.4	43.3	2.3
50	8	208.9	24.1	145.4	13.4	85.7	6.0	40.3	2.1
51	9	194.4	22.4	135.3	12.4	79.7	5.5	37.5	2.0
52	10	181.0	20.9	126.0	11.6	74.2	5.2	34.9	1.8
53	11	168.6	19.4	117.3	10.8	69.1	4.8	32.5	1.7
54	12	157.1	18.1	109.3	10.0	64.4	4.5	30.3	1.6
55	13	146.4	16.9	101.9	9.4	60.0	4.2	28.2	1.5
56	14	136.6	15.8	95.1	8.7	56.0	3.9	26.3	1.4
57	15	127.5	14.7	88.7	8.1	52.3	3.6	24.6	1.3
58	16	119.0	13.7	82.8	7.6	48.8	3.4	22.9	1.2
59	17	111.2	12.8	77.4	7.1	45.6	3.2	21.4	1.1
60	18	103.9	12.0	72.3	6.6	42.6	3.0	20.0	1.0
61	19	97.2	11.2	67.6	6.2	39.8	2.8	18.7	1.0
62	20	90.9	10.5	63.3	5.8	37.3	2.6	17.5	0.9
63	21	85.1	9.8	59.2	5.4	34.9	2.4	16.4	0.9
64	22	79.7	9.2	55.5	5.1	32.7	2.3	15.4	0.8
65	23	74.7	8.6	52.0	4.8	30.6	2.1	14.4	0.8
66	24	70.0	8.1	48.7	4.5	28.7	2.0	13.5	0.7
67	25	65.6	7.6	45.7	4.2	26.9	1.9	12.7	0.7
68	26	61.6	7.1	42.9	3.9	25.2	1.8	11.9	0.6
69	27	57.8	6.7	40.2	3.7	23.7	1.6	11.1	0.6
70	28	54.3	6.3	37.8	3.5	22.3	1.5	10.5	0.6
71	29	51.0	5.9	35.5	3.3	20.9	1.5	9.8	0.5
72	30	47.9	5.5	33.4	3.1	19.7	1.4	9.2	0.5
73	31	45.1	5.2	31.4	2.9	18.5	1.3	8.7	0.5
74	32	42.4	4.9	29.5	2.7	17.4	1.2	8.2	0.4
75	33	39.9	4.6	27.8	2.6	16.4	1.1	7.7	0.4
76	34	37.6	4.3	26.2	2.4	15.4	1.1	7.3	0.4
77	35	35.4	4.1	24.7	2.3	14.5	1.0	6.8	0.4
78	36	33.4	3.9	23.2	2.1	13.7	1.0	6.4	0.3
79	37	31.5	3.6	21.9	2.0	12.9	0.9	6.1	0.3
80	38	29.7	3.4	20.7	1.9	12.2	0.9	5.7	0.3
81	39	28.0	3.2	19.5	1.8	11.5	0.8	5.4	0.3
82	40	26.5	3.1	18.4	1.7	10.9	0.8	5.1	0.3
83	41	25.0	2.9	17.4	1.6	10.3	0.7	4.8	0.3
84	42	23.6	2.7	16.5	1.5	9.7	0.7	4.6	0.2
85	43	22.4	2.6	15.6	1.4	9.2	0.6	4.3	0.2
86	44	21.1	2.4	14.7	1.4	8.7	0.6	4.1	0.2
87	45	20.0	2.3	13.9	1.3	8.2	0.6	3.9	0.2
88	46	18.9	2.2	13.2	1.2	7.8	0.5	3.7	0.2
89	47	17.9	2.1	12.5	1.2	7.4	0.5	3.5	0.2
90	48	17.0	2.0	11.8	1.1	7.0	0.5	3.3	0.2
91	49	16.1	1.9	11.2	1.0	6.6	0.5	3.1	0.2
92	50	15.3	1.8	10.6	1.0	6.3	0.4	2.9	0.2
93	51	14.5	1.7	10.1	0.9	5.9	0.4	2.8	0.2
94	52	13.7	1.6	9.6	0.9	5.6	0.4	2.7	0.1
95	53	13.0	1.5	9.1	0.8	5.3	0.4	2.5	0.1
96	54	12.4	1.4	8.6	0.8	5.1	0.4	2.4	0.1

**Predicted EM61-MK2 Response to a Small Munitions Surrogate**

Distance of Target Center Below Lower Coil (cm)	Target Depth Assuming Deployment on Standard Wheels (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 (mV)	
		Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
97	55	11.8	1.4	8.2	0.8	4.8	0.3	2.3	0.1
98	56	11.2	1.3	7.8	0.7	4.6	0.3	2.2	0.1
99	57	10.6	1.2	7.4	0.7	4.4	0.3	2.1	0.1
100	58	10.1	1.2	7.0	0.6	4.1	0.3	2.0	0.1
101	59	9.6	1.1	6.7	0.6	3.9	0.3	1.9	0.1
102	60	9.1	1.1	6.4	0.6	3.8	0.3	1.8	0.1
103	61	8.7	1.0	6.1	0.6	3.6	0.3	1.7	0.1
104	62	8.3	1.0	5.8	0.5	3.4	0.2	1.6	0.1
105	63	7.9	0.9	5.5	0.5	3.2	0.2	1.5	0.1
106	64	7.5	0.9	5.2	0.5	3.1	0.2	1.5	0.1
107	65	7.2	0.8	5.0	0.5	2.9	0.2	1.4	0.1
108	66	6.8	0.8	4.8	0.4	2.8	0.2	1.3	0.1
109	67	6.5	0.8	4.5	0.4	2.7	0.2	1.3	0.1
110	68	6.2	0.7	4.3	0.4	2.6	0.2	1.2	0.1
111	69	5.9	0.7	4.1	0.4	2.4	0.2	1.1	0.1
112	70	5.7	0.7	3.9	0.4	2.3	0.2	1.1	0.1
113	71	5.4	0.6	3.8	0.4	2.2	0.2	1.0	0.1
114	72	5.2	0.6	3.6	0.3	2.1	0.2	1.0	0.1
115	73	4.9	0.6	3.4	0.3	2.0	0.1	1.0	0.1
116	74	4.7	0.5	3.3	0.3	1.9	0.1	0.9	0.1
117	75	4.5	0.5	3.1	0.3	1.9	0.1	0.9	0.1
118	76	4.3	0.5	3.0	0.3	1.8	0.1	0.8	0.0
119	77	4.1	0.5	2.9	0.3	1.7	0.1	0.8	0.0
120	78	4.0	0.5	2.8	0.3	1.6	0.1	0.8	0.0
121	79	3.8	0.4	2.6	0.2	1.6	0.1	0.7	0.0
122	80	3.6	0.4	2.5	0.2	1.5	0.1	0.7	0.0
123	81	3.5	0.4	2.4	0.2	1.4	0.1	0.7	0.0
124	82	3.3	0.4	2.3	0.2	1.4	0.1	0.6	0.0
125	83	3.2	0.4	2.2	0.2	1.3	0.1	0.6	0.0
126	84	3.1	0.4	2.1	0.2	1.3	0.1	0.6	0.0
127	85	2.9	0.3	2.0	0.2	1.2	0.1	0.6	0.0
128	86	2.8	0.3	2.0	0.2	1.2	0.1	0.5	0.0
129	87	2.7	0.3	1.9	0.2	1.1	0.1	0.5	0.0
130	88	2.6	0.3	1.8	0.2	1.1	0.1	0.5	0.0
131	89	2.5	0.3	1.7	0.2	1.0	0.1	0.5	0.0
132	90	2.4	0.3	1.7	0.2	1.0	0.1	0.5	0.0
133	91	2.3	0.3	1.6	0.2	0.9	0.1	0.4	0.0
134	92	2.2	0.3	1.5	0.1	0.9	0.1	0.4	0.0
135	93	2.1	0.2	1.5	0.1	0.9	0.1	0.4	0.0
136	94	2.0	0.2	1.4	0.1	0.8	0.1	0.4	0.0
137	95	2.0	0.2	1.4	0.1	0.8	0.1	0.4	0.0
138	96	1.9	0.2	1.3	0.1	0.8	0.1	0.4	0.0
139	97	1.8	0.2	1.3	0.1	0.7	0.1	0.4	0.0
140	98	1.7	0.2	1.2	0.1	0.7	0.1	0.3	0.0
141	99	1.7	0.2	1.2	0.1	0.7	0.1	0.3	0.0
142	100	1.6	0.2	1.1	0.1	0.7	0.1	0.3	0.0

**Predicted EM61-MK2 Response to a Large Munitions Surrogate**

Distance of Target Center Below Lower Coil (cm)	Target Depth Assuming Deployment on Standard Wheels (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 (mV)	
		Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
42	0	6766.7	3262.6	4929.8	1998.6	3137.3	993.4	1699.0	404.1
43	1	6272.8	3024.5	4570.0	1852.7	2908.3	920.9	1575.0	374.6
44	2	5817.5	2805.0	4238.3	1718.3	2697.2	854.1	1460.7	347.4
45	3	5397.7	2602.5	3932.4	1594.3	2502.6	792.4	1355.3	322.3
46	4	5010.4	2415.8	3650.3	1479.9	2323.0	735.6	1258.1	299.2
47	5	4653.1	2243.5	3390.0	1374.3	2157.3	683.1	1168.3	277.9
48	6	4323.3	2084.5	3149.7	1276.9	2004.4	634.7	1085.5	258.2
49	7	4018.7	1937.7	2927.8	1187.0	1863.2	590.0	1009.1	240.0
50	8	3737.5	1802.1	2722.9	1103.9	1732.8	548.7	938.4	223.2
51	9	3477.6	1676.7	2533.6	1027.1	1612.3	510.5	873.2	207.7
52	10	3237.3	1560.9	2358.5	956.2	1500.9	475.3	812.9	193.3
53	11	3015.2	1453.8	2196.7	890.6	1397.9	442.7	757.1	180.1
54	12	2809.6	1354.7	2046.9	829.9	1302.7	412.5	705.5	167.8
55	13	2619.4	1263.0	1908.4	773.7	1214.5	384.6	657.7	156.4
56	14	2443.3	1178.1	1780.0	721.7	1132.8	358.7	613.5	145.9
57	15	2280.1	1099.4	1661.2	673.5	1057.2	334.7	572.5	136.2
58	16	2128.9	1026.5	1551.0	628.8	987.0	312.5	534.6	127.1
59	17	1988.7	958.9	1448.9	587.4	922.1	292.0	499.4	118.8
60	18	1858.7	896.2	1354.1	549.0	861.8	272.9	466.7	111.0
61	19	1738.0	838.0	1266.2	513.3	805.8	255.2	436.4	103.8
62	20	1626.0	784.0	1184.6	480.3	753.9	238.7	408.3	97.1
63	21	1521.9	733.8	1108.8	449.5	705.6	223.4	382.1	90.9
64	22	1425.2	687.2	1038.3	421.0	660.8	209.2	357.9	85.1
65	23	1335.3	643.8	972.8	394.4	619.1	196.0	335.3	79.7
66	24	1251.6	603.5	911.9	369.7	580.3	183.8	314.3	74.8
67	25	1173.8	566.0	855.2	346.7	544.2	172.3	294.7	70.1
68	26	1101.3	531.0	802.4	325.3	510.6	161.7	276.5	65.8
69	27	1033.8	498.5	753.2	305.4	479.3	151.8	259.6	61.7
70	28	970.9	468.1	707.4	286.8	450.2	142.5	243.8	58.0
71	29	912.3	439.9	664.6	269.5	423.0	133.9	229.1	54.5
72	30	857.6	413.5	624.8	253.3	397.6	125.9	215.3	51.2
73	31	806.5	388.9	587.6	238.2	373.9	118.4	202.5	48.2
74	32	758.9	365.9	552.9	224.1	351.8	111.4	190.5	45.3
75	33	714.3	344.4	520.4	211.0	331.2	104.9	179.4	42.7
76	34	672.7	324.4	490.1	198.7	311.9	98.8	168.9	40.2
77	35	633.8	305.6	461.8	187.2	293.9	93.1	159.1	37.9
78	36	597.4	288.1	435.3	176.5	277.0	87.7	150.0	35.7
79	37	563.4	271.6	410.5	166.4	261.2	82.7	141.5	33.6
80	38	531.5	256.3	387.2	157.0	246.4	78.0	133.5	31.7
81	39	501.7	241.9	365.5	148.2	232.6	73.7	126.0	30.0
82	40	473.7	228.4	345.1	139.9	219.6	69.5	118.9	28.3
83	41	447.5	215.7	326.0	132.2	207.5	65.7	112.4	26.7
84	42	422.9	203.9	308.1	124.9	196.1	62.1	106.2	25.3
85	43	399.8	192.8	291.3	118.1	185.4	58.7	100.4	23.9
86	44	378.1	182.3	275.5	111.7	175.3	55.5	94.9	22.6
87	45	357.8	172.5	260.7	105.7	165.9	52.5	89.8	21.4
88	46	338.7	163.3	246.7	100.0	157.0	49.7	85.0	20.2
89	47	320.7	154.6	233.6	94.7	148.7	47.1	80.5	19.2
90	48	303.8	146.5	221.3	89.7	140.9	44.6	76.3	18.1
91	49	287.9	138.8	209.8	85.0	133.5	42.3	72.3	17.2
92	50	273.0	131.6	198.9	80.6	126.6	40.1	68.5	16.3
93	51	258.9	124.8	188.6	76.5	120.0	38.0	65.0	15.5
94	52	245.6	118.4	179.0	72.6	113.9	36.1	61.7	14.7
95	53	233.1	112.4	169.9	68.9	108.1	34.2	58.5	13.9
96	54	221.4	106.7	161.3	65.4	102.6	32.5	55.6	13.2

**Predicted EM61-MK2 Response to a Large Munitions Surrogate**

Distance of Target Center Below Lower Coil (cm)	Target Depth Assuming Deployment on Standard Wheels (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 (mV)	
		Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
97	55	210.3	101.4	153.2	62.1	97.5	30.9	52.8	12.6
98	56	199.8	96.3	145.6	59.0	92.6	29.3	50.2	11.9
99	57	189.9	91.6	138.4	56.1	88.1	27.9	47.7	11.3
100	58	180.6	87.1	131.6	53.3	83.7	26.5	45.3	10.8
101	59	171.8	82.8	125.1	50.7	79.6	25.2	43.1	10.3
102	60	163.4	78.8	119.1	48.3	75.8	24.0	41.0	9.8
103	61	155.6	75.0	113.3	46.0	72.1	22.8	39.1	9.3
104	62	148.1	71.4	107.9	43.8	68.7	21.8	37.2	8.9
105	63	141.1	68.0	102.8	41.7	65.4	20.7	35.4	8.4
106	64	134.5	64.8	98.0	39.7	62.3	19.7	33.8	8.0
107	65	128.2	61.8	93.4	37.9	59.4	18.8	32.2	7.7
108	66	122.2	58.9	89.0	36.1	56.7	17.9	30.7	7.3
109	67	116.5	56.2	84.9	34.4	54.0	17.1	29.3	7.0
110	68	111.2	53.6	81.0	32.8	51.6	16.3	27.9	6.6
111	69	106.1	51.2	77.3	31.3	49.2	15.6	26.6	6.3
112	70	101.3	48.8	73.8	29.9	47.0	14.9	25.4	6.1
113	71	96.7	46.6	70.5	28.6	44.9	14.2	24.3	5.8
114	72	92.4	44.6	67.3	27.3	42.8	13.6	23.2	5.5
115	73	88.3	42.6	64.3	26.1	40.9	13.0	22.2	5.3
116	74	84.4	40.7	61.5	24.9	39.1	12.4	21.2	5.0
117	75	80.7	38.9	58.8	23.8	37.4	11.9	20.3	4.8
118	76	77.2	37.2	56.2	22.8	35.8	11.3	19.4	4.6
119	77	73.8	35.6	53.8	21.8	34.2	10.8	18.5	4.4
120	78	70.7	34.1	51.5	20.9	32.8	10.4	17.7	4.2
121	79	67.6	32.6	49.3	20.0	31.4	9.9	17.0	4.0
122	80	64.8	31.2	47.2	19.1	30.0	9.5	16.3	3.9
123	81	62.0	29.9	45.2	18.3	28.8	9.1	15.6	3.7
124	82	59.4	28.6	43.3	17.6	27.5	8.7	14.9	3.6
125	83	56.9	27.5	41.5	16.8	26.4	8.4	14.3	3.4
126	84	54.6	26.3	39.8	16.1	25.3	8.0	13.7	3.3
127	85	52.3	25.2	38.1	15.5	24.3	7.7	13.1	3.1
128	86	50.2	24.2	36.6	14.8	23.3	7.4	12.6	3.0
129	87	48.1	23.2	35.1	14.2	22.3	7.1	12.1	2.9
130	88	46.2	22.3	33.7	13.6	21.4	6.8	11.6	2.8
131	89	44.3	21.4	32.3	13.1	20.6	6.5	11.1	2.7
132	90	42.6	20.5	31.0	12.6	19.7	6.3	10.7	2.5
133	91	40.9	19.7	29.8	12.1	18.9	6.0	10.3	2.4
134	92	39.2	18.9	28.6	11.6	18.2	5.8	9.9	2.3
135	93	37.7	18.2	27.5	11.1	17.5	5.5	9.5	2.3
136	94	36.2	17.5	26.4	10.7	16.8	5.3	9.1	2.2
137	95	34.8	16.8	25.4	10.3	16.1	5.1	8.7	2.1
138	96	33.5	16.1	24.4	9.9	15.5	4.9	8.4	2.0
139	97	32.2	15.5	23.5	9.5	14.9	4.7	8.1	1.9
140	98	31.0	14.9	22.6	9.2	14.4	4.6	7.8	1.9
141	99	29.8	14.4	21.7	8.8	13.8	4.4	7.5	1.8
142	100	28.7	13.8	20.9	8.5	13.3	4.2	7.2	1.7
143	101	27.6	13.3	20.1	8.2	12.8	4.1	6.9	1.7
144	102	26.6	12.8	19.4	7.8	12.3	3.9	6.7	1.6
145	103	25.6	12.3	18.6	7.6	11.9	3.8	6.4	1.5
146	104	24.6	11.9	18.0	7.3	11.4	3.6	6.2	1.5
147	105	23.7	11.4	17.3	7.0	11.0	3.5	6.0	1.4
148	106	22.9	11.0	16.7	6.8	10.6	3.4	5.7	1.4
149	107	22.0	10.6	16.1	6.5	10.2	3.2	5.5	1.3
150	108	21.2	10.2	15.5	6.3	9.9	3.1	5.3	1.3
151	109	20.5	9.9	14.9	6.1	9.5	3.0	5.1	1.2

**Predicted EM61-MK2 Response to a Large Munitions Surrogate**

Distance of Target Center Below Lower Coil (cm)	Target Depth Assuming Deployment on Standard Wheels (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 (mV)	
		Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
152	110	19.8	9.5	14.4	5.8	9.2	2.9	5.0	1.2
153	111	19.1	9.2	13.9	5.6	8.8	2.8	4.8	1.1
154	112	18.4	8.9	13.4	5.4	8.5	2.7	4.6	1.1
155	113	17.7	8.6	12.9	5.2	8.2	2.6	4.5	1.1
156	114	17.1	8.3	12.5	5.1	7.9	2.5	4.3	1.0
157	115	16.5	8.0	12.0	4.9	7.7	2.4	4.2	1.0
158	116	16.0	7.7	11.6	4.7	7.4	2.3	4.0	1.0
159	117	15.4	7.4	11.2	4.6	7.1	2.3	3.9	0.9
160	118	14.9	7.2	10.8	4.4	6.9	2.2	3.7	0.9
161	119	14.4	6.9	10.5	4.2	6.7	2.1	3.6	0.9
162	120	13.9	6.7	10.1	4.1	6.4	2.0	3.5	0.8
163	121	13.4	6.5	9.8	4.0	6.2	2.0	3.4	0.8
164	122	13.0	6.3	9.5	3.8	6.0	1.9	3.3	0.8
165	123	12.5	6.0	9.1	3.7	5.8	1.8	3.2	0.8
166	124	12.1	5.8	8.8	3.6	5.6	1.8	3.0	0.7
167	125	11.7	5.7	8.5	3.5	5.4	1.7	2.9	0.7
168	126	11.3	5.5	8.3	3.4	5.3	1.7	2.9	0.7
169	127	11.0	5.3	8.0	3.2	5.1	1.6	2.8	0.7
170	128	10.6	5.1	7.7	3.1	4.9	1.6	2.7	0.6
171	129	10.3	5.0	7.5	3.0	4.8	1.5	2.6	0.6
172	130	9.9	4.8	7.2	2.9	4.6	1.5	2.5	0.6
173	131	9.6	4.6	7.0	2.8	4.5	1.4	2.4	0.6
174	132	9.3	4.5	6.8	2.8	4.3	1.4	2.3	0.6
175	133	9.0	4.4	6.6	2.7	4.2	1.3	2.3	0.5
176	134	8.7	4.2	6.4	2.6	4.1	1.3	2.2	0.5
177	135	8.5	4.1	6.2	2.5	3.9	1.2	2.1	0.5
178	136	8.2	4.0	6.0	2.4	3.8	1.2	2.1	0.5
179	137	7.9	3.8	5.8	2.4	3.7	1.2	2.0	0.5
180	138	7.7	3.7	5.6	2.3	3.6	1.1	1.9	0.5
181	139	7.5	3.6	5.4	2.2	3.5	1.1	1.9	0.5
182	140	7.2	3.5	5.3	2.1	3.4	1.1	1.8	0.4
183	141	7.0	3.4	5.1	2.1	3.3	1.0	1.8	0.4
184	142	6.8	3.3	5.0	2.0	3.2	1.0	1.7	0.4
185	143	6.6	3.2	4.8	2.0	3.1	1.0	1.7	0.4
186	144	6.4	3.1	4.7	1.9	3.0	0.9	1.6	0.4
187	145	6.2	3.0	4.5	1.8	2.9	0.9	1.6	0.4
188	146	6.0	2.9	4.4	1.8	2.8	0.9	1.5	0.4
189	147	5.8	2.8	4.3	1.7	2.7	0.9	1.5	0.4
190	148	5.7	2.7	4.1	1.7	2.6	0.8	1.4	0.3
191	149	5.5	2.7	4.0	1.6	2.6	0.8	1.4	0.3
192	150	5.4	2.6	3.9	1.6	2.5	0.8	1.3	0.3
193	151	5.2	2.5	3.8	1.5	2.4	0.8	1.3	0.3
194	152	5.0	2.4	3.7	1.5	2.3	0.7	1.3	0.3
195	153	4.9	2.4	3.6	1.5	2.3	0.7	1.2	0.3
196	154	4.8	2.3	3.5	1.4	2.2	0.7	1.2	0.3
197	155	4.6	2.2	3.4	1.4	2.1	0.7	1.2	0.3
198	156	4.5	2.2	3.3	1.3	2.1	0.7	1.1	0.3
199	157	4.4	2.1	3.2	1.3	2.0	0.6	1.1	0.3
200	158	4.2	2.0	3.1	1.3	2.0	0.6	1.1	0.3
201	159	4.1	2.0	3.0	1.2	1.9	0.6	1.0	0.3
202	160	4.0	1.9	2.9	1.2	1.9	0.6	1.0	0.2
203	161	3.9	1.9	2.8	1.2	1.8	0.6	1.0	0.2
204	162	3.8	1.8	2.8	1.1	1.8	0.6	1.0	0.2
205	163	3.7	1.8	2.7	1.1	1.7	0.5	0.9	0.2
206	164	3.6	1.7	2.6	1.1	1.7	0.5	0.9	0.2



Predicted EM61-MK2 Response to a Large Munitions Surrogate

Distance of Target Center Below Lower Coil (cm)	Target Depth Assuming Deployment on Standard Wheels (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 (mV)	
		Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
207	165	3.5	1.7	2.5	1.0	1.6	0.5	0.9	0.2
208	166	3.4	1.6	2.5	1.0	1.6	0.5	0.9	0.2
209	167	3.3	1.6	2.4	1.0	1.5	0.5	0.8	0.2
210	168	3.2	1.6	2.3	1.0	1.5	0.5	0.8	0.2
211	169	3.1	1.5	2.3	0.9	1.5	0.5	0.8	0.2
212	170	3.0	1.5	2.2	0.9	1.4	0.5	0.8	0.2
213	171	3.0	1.4	2.2	0.9	1.4	0.4	0.7	0.2
214	172	2.9	1.4	2.1	0.9	1.3	0.4	0.7	0.2
215	173	2.8	1.4	2.0	0.8	1.3	0.4	0.7	0.2
216	174	2.7	1.3	2.0	0.8	1.3	0.4	0.7	0.2
217	175	2.7	1.3	1.9	0.8	1.2	0.4	0.7	0.2
218	176	2.6	1.3	1.9	0.8	1.2	0.4	0.7	0.2
219	177	2.5	1.2	1.8	0.8	1.2	0.4	0.6	0.2
220	178	2.5	1.2	1.8	0.7	1.1	0.4	0.6	0.2
221	179	2.4	1.2	1.7	0.7	1.1	0.4	0.6	0.1
222	180	2.3	1.1	1.7	0.7	1.1	0.3	0.6	0.1
223	181	2.3	1.1	1.7	0.7	1.1	0.3	0.6	0.1
224	182	2.2	1.1	1.6	0.7	1.0	0.3	0.6	0.1
225	183	2.2	1.0	1.6	0.6	1.0	0.3	0.5	0.1
226	184	2.1	1.0	1.5	0.6	1.0	0.3	0.5	0.1
227	185	2.1	1.0	1.5	0.6	1.0	0.3	0.5	0.1
228	186	2.0	1.0	1.5	0.6	0.9	0.3	0.5	0.1
229	187	2.0	0.9	1.4	0.6	0.9	0.3	0.5	0.1
230	188	1.9	0.9	1.4	0.6	0.9	0.3	0.5	0.1
231	189	1.9	0.9	1.4	0.6	0.9	0.3	0.5	0.1
232	190	1.8	0.9	1.3	0.5	0.8	0.3	0.5	0.1
233	191	1.8	0.9	1.3	0.5	0.8	0.3	0.4	0.1
234	192	1.7	0.8	1.3	0.5	0.8	0.3	0.4	0.1
235	193	1.7	0.8	1.2	0.5	0.8	0.3	0.4	0.1
236	194	1.6	0.8	1.2	0.5	0.8	0.2	0.4	0.1
237	195	1.6	0.8	1.2	0.5	0.7	0.2	0.4	0.1
238	196	1.6	0.8	1.1	0.5	0.7	0.2	0.4	0.1
239	197	1.5	0.7	1.1	0.5	0.7	0.2	0.4	0.1
240	198	1.5	0.7	1.1	0.4	0.7	0.2	0.4	0.1
241	199	1.5	0.7	1.1	0.4	0.7	0.2	0.4	0.1
242	200	1.4	0.7	1.0	0.4	0.7	0.2	0.4	0.1
243	201	1.4	0.7	1.0	0.4	0.6	0.2	0.4	0.1
244	202	1.4	0.7	1.0	0.4	0.6	0.2	0.3	0.1
245	203	1.3	0.6	1.0	0.4	0.6	0.2	0.3	0.1
246	204	1.3	0.6	0.9	0.4	0.6	0.2	0.3	0.1
247	205	1.3	0.6	0.9	0.4	0.6	0.2	0.3	0.1
248	206	1.2	0.6	0.9	0.4	0.6	0.2	0.3	0.1
249	207	1.2	0.6	0.9	0.4	0.6	0.2	0.3	0.1
250	208	1.2	0.6	0.9	0.4	0.5	0.2	0.3	0.1
251	209	1.2	0.6	0.8	0.3	0.5	0.2	0.3	0.1
252	210	1.1	0.5	0.8	0.3	0.5	0.2	0.3	0.1
253	211	1.1	0.5	0.8	0.3	0.5	0.2	0.3	0.1
254	212	1.1	0.5	0.8	0.3	0.5	0.2	0.3	0.1
255	213	1.1	0.5	0.8	0.3	0.5	0.2	0.3	0.1
256	214	1.0	0.5	0.8	0.3	0.5	0.2	0.3	0.1
257	215	1.0	0.5	0.7	0.3	0.5	0.2	0.3	0.1
258	216	1.0	0.5	0.7	0.3	0.5	0.1	0.3	0.1
259	217	1.0	0.5	0.7	0.3	0.4	0.1	0.2	0.1
260	218	0.9	0.5	0.7	0.3	0.4	0.1	0.2	0.1
261	219	0.9	0.4	0.7	0.3	0.4	0.1	0.2	0.1

Predicted EM61-MK2 Response to a Large Munitions Surrogate

Distance of Target Center Below Lower Coil (cm)	Target Depth Assuming Deployment on Standard Wheels (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 (mV)	
		Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
262	220	0.9	0.4	0.7	0.3	0.4	0.1	0.2	0.1
263	221	0.9	0.4	0.6	0.3	0.4	0.1	0.2	0.1
264	222	0.9	0.4	0.6	0.3	0.4	0.1	0.2	0.1
265	223	0.8	0.4	0.6	0.3	0.4	0.1	0.2	0.1
266	224	0.8	0.4	0.6	0.2	0.4	0.1	0.2	0.1
267	225	0.8	0.4	0.6	0.2	0.4	0.1	0.2	0.1
268	226	0.8	0.4	0.6	0.2	0.4	0.1	0.2	0.1
269	227	0.8	0.4	0.6	0.2	0.4	0.1	0.2	0.1
270	228	0.8	0.4	0.6	0.2	0.4	0.1	0.2	0.0
271	229	0.7	0.4	0.5	0.2	0.3	0.1	0.2	0.0
272	230	0.7	0.4	0.5	0.2	0.3	0.1	0.2	0.0
273	231	0.7	0.3	0.5	0.2	0.3	0.1	0.2	0.0
274	232	0.7	0.3	0.5	0.2	0.3	0.1	0.2	0.0
275	233	0.7	0.3	0.5	0.2	0.3	0.1	0.2	0.0
276	234	0.7	0.3	0.5	0.2	0.3	0.1	0.2	0.0
277	235	0.7	0.3	0.5	0.2	0.3	0.1	0.2	0.0
278	236	0.6	0.3	0.5	0.2	0.3	0.1	0.2	0.0
279	237	0.6	0.3	0.5	0.2	0.3	0.1	0.2	0.0
280	238	0.6	0.3	0.4	0.2	0.3	0.1	0.2	0.0
281	239	0.6	0.3	0.4	0.2	0.3	0.1	0.2	0.0
282	240	0.6	0.3	0.4	0.2	0.3	0.1	0.2	0.0
283	241	0.6	0.3	0.4	0.2	0.3	0.1	0.1	0.0
284	242	0.6	0.3	0.4	0.2	0.3	0.1	0.1	0.0
285	243	0.6	0.3	0.4	0.2	0.3	0.1	0.1	0.0
286	244	0.5	0.3	0.4	0.2	0.3	0.1	0.1	0.0
287	245	0.5	0.3	0.4	0.2	0.2	0.1	0.1	0.0
288	246	0.5	0.3	0.4	0.2	0.2	0.1	0.1	0.0
289	247	0.5	0.2	0.4	0.2	0.2	0.1	0.1	0.0
290	248	0.5	0.2	0.4	0.2	0.2	0.1	0.1	0.0
291	249	0.5	0.2	0.4	0.1	0.2	0.1	0.1	0.0
292	250	0.5	0.2	0.4	0.1	0.2	0.1	0.1	0.0
293	251	0.5	0.2	0.3	0.1	0.2	0.1	0.1	0.0
294	252	0.5	0.2	0.3	0.1	0.2	0.1	0.1	0.0
295	253	0.5	0.2	0.3	0.1	0.2	0.1	0.1	0.0
296	254	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
297	255	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
298	256	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
299	257	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
300	258	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
301	259	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
302	260	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
303	261	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
304	262	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
305	263	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
306	264	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
307	265	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
308	266	0.4	0.2	0.3	0.1	0.2	0.1	0.1	0.0
309	267	0.3	0.2	0.3	0.1	0.2	0.1	0.1	0.0
310	268	0.3	0.2	0.2	0.1	0.2	0.1	0.1	0.0
311	269	0.3	0.2	0.2	0.1	0.2	0.1	0.1	0.0
312	270	0.3	0.2	0.2	0.1	0.2	0.1	0.1	0.0
313	271	0.3	0.2	0.2	0.1	0.2	0.1	0.1	0.0
314	272	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.0
315	273	0.3	0.2	0.2	0.1	0.1	0.0	0.1	0.0
316	274	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0

**Predicted EM61-MK2 Response to a Large Munitions Surrogate**

Distance of Target Center Below Lower Coil (cm)	Target Depth Assuming Deployment on Standard Wheels (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 (mV)	
		Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
317	275	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0
318	276	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0
319	277	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0
320	278	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0
321	279	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0
322	280	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0
323	281	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0
324	282	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0
325	283	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0
326	284	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0
327	285	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.0
328	286	0.2	0.1	0.2	0.1	0.1	0.0	0.1	0.0
329	287	0.2	0.1	0.2	0.1	0.1	0.0	0.1	0.0
330	288	0.2	0.1	0.2	0.1	0.1	0.0	0.1	0.0
331	289	0.2	0.1	0.2	0.1	0.1	0.0	0.1	0.0
332	290	0.2	0.1	0.2	0.1	0.1	0.0	0.1	0.0
333	291	0.2	0.1	0.2	0.1	0.1	0.0	0.1	0.0
334	292	0.2	0.1	0.2	0.1	0.1	0.0	0.1	0.0
335	293	0.2	0.1	0.2	0.1	0.1	0.0	0.1	0.0
336	294	0.2	0.1	0.2	0.1	0.1	0.0	0.1	0.0
337	295	0.2	0.1	0.2	0.1	0.1	0.0	0.1	0.0
338	296	0.2	0.1	0.2	0.1	0.1	0.0	0.1	0.0
339	297	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.0
340	298	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.0
341	299	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.0
342	300	0.2	0.1	0.1	0.1	0.1	0.0	0.1	0.0

**Predicted EM61-MK2 Response to a Medium Munitions Surrogate**

Distance of Target Center Below Lower Coil (cm)	Target Depth Assuming Deployment on Standard Wheels (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 (mV)	
		Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
42	0	2110.2	476.5	1510.7	267.1	929.4	120.9	478.5	46.1
43	1	1956.2	441.7	1400.4	247.6	861.6	112.1	443.6	42.7
44	2	1814.2	409.6	1298.8	229.7	799.0	104.0	411.4	39.6
45	3	1683.3	380.1	1205.0	213.1	741.4	96.5	381.7	36.7
46	4	1562.5	352.8	1118.6	197.8	688.2	89.5	354.3	34.1
47	5	1451.1	327.6	1038.8	183.7	639.1	83.2	329.0	31.7
48	6	1348.2	304.4	965.2	170.7	593.8	77.3	305.7	29.4
49	7	1253.3	283.0	897.2	158.7	552.0	71.8	284.2	27.4
50	8	1165.6	263.2	834.4	147.5	513.3	66.8	264.3	25.4
51	9	1084.5	244.9	776.4	137.3	477.7	62.1	245.9	23.7
52	10	1009.6	228.0	722.7	127.8	444.7	57.9	228.9	22.0
53	11	940.3	212.3	673.1	119.0	414.1	53.9	213.2	20.5
54	12	876.2	197.8	627.3	110.9	385.9	50.2	198.7	19.1
55	13	816.9	184.4	584.8	103.4	359.8	46.8	185.2	17.8
56	14	762.0	172.0	545.5	96.5	335.6	43.7	172.8	16.6
57	15	711.1	160.6	509.0	90.0	313.2	40.8	161.2	15.5
58	16	663.9	149.9	475.3	84.0	292.4	38.0	150.5	14.5
59	17	620.2	140.0	444.0	78.5	273.2	35.5	140.6	13.5
60	18	579.7	130.9	415.0	73.4	255.3	33.2	131.4	12.7
61	19	542.0	122.4	388.0	68.6	238.7	31.1	122.9	11.8
62	20	507.1	114.5	363.0	64.2	223.3	29.1	115.0	11.1
63	21	474.6	107.2	339.8	60.1	209.0	27.2	107.6	10.4
64	22	444.5	100.4	318.2	56.3	195.8	25.5	100.8	9.7
65	23	416.4	94.0	298.1	52.7	183.4	23.9	94.4	9.1
66	24	390.3	88.1	279.4	49.4	171.9	22.4	88.5	8.5
67	25	366.1	82.7	262.1	46.3	161.2	21.0	83.0	8.0
68	26	343.5	77.6	245.9	43.5	151.3	19.7	77.9	7.5
69	27	322.4	72.8	230.8	40.8	142.0	18.5	73.1	7.0
70	28	302.8	68.4	216.8	38.3	133.4	17.4	68.7	6.6
71	29	284.5	64.2	203.7	36.0	125.3	16.3	64.5	6.2
72	30	267.4	60.4	191.5	33.9	117.8	15.3	60.6	5.8
73	31	251.5	56.8	180.1	31.8	110.8	14.4	57.0	5.5
74	32	236.7	53.4	169.4	30.0	104.2	13.6	53.7	5.2
75	33	222.8	50.3	159.5	28.2	98.1	12.8	50.5	4.9
76	34	209.8	47.4	150.2	26.6	92.4	12.0	47.6	4.6
77	35	197.7	44.6	141.5	25.0	87.1	11.3	44.8	4.3
78	36	186.3	42.1	133.4	23.6	82.1	10.7	42.3	4.1
79	37	175.7	39.7	125.8	22.2	77.4	10.1	39.8	3.8
80	38	165.8	37.4	118.7	21.0	73.0	9.5	37.6	3.6
81	39	156.4	35.3	112.0	19.8	68.9	9.0	35.5	3.4
82	40	147.7	33.4	105.8	18.7	65.1	8.5	33.5	3.2
83	41	139.5	31.5	99.9	17.7	61.5	8.0	31.6	3.1
84	42	131.9	29.8	94.4	16.7	58.1	7.6	29.9	2.9
85	43	124.7	28.2	89.3	15.8	54.9	7.1	28.3	2.7
86	44	117.9	26.6	84.4	14.9	51.9	6.8	26.7	2.6
87	45	111.6	25.2	79.9	14.1	49.1	6.4	25.3	2.4
88	46	105.6	23.9	75.6	13.4	46.5	6.1	24.0	2.3
89	47	100.0	22.6	71.6	12.7	44.1	5.7	22.7	2.2
90	48	94.7	21.4	67.8	12.0	41.7	5.4	21.5	2.1
91	49	89.8	20.3	64.3	11.4	39.5	5.1	20.4	2.0
92	50	85.1	19.2	60.9	10.8	37.5	4.9	19.3	1.9
93	51	80.7	18.2	57.8	10.2	35.6	4.6	18.3	1.8
94	52	76.6	17.3	54.8	9.7	33.7	4.4	17.4	1.7
95	53	72.7	16.4	52.1	9.2	32.0	4.2	16.5	1.6
96	54	69.0	15.6	49.4	8.7	30.4	4.0	15.7	1.5

**Predicted EM61-MK2 Response to a Medium Munitions Surrogate**

Distance of Target Center Below Lower Coil (cm)	Target Depth Assuming Deployment on Standard Wheels (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 (mV)	
		Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
97	55	65.6	14.8	46.9	8.3	28.9	3.8	14.9	1.4
98	56	62.3	14.1	44.6	7.9	27.4	3.6	14.1	1.4
99	57	59.2	13.4	42.4	7.5	26.1	3.4	13.4	1.3
100	58	56.3	12.7	40.3	7.1	24.8	3.2	12.8	1.2
101	59	53.6	12.1	38.4	6.8	23.6	3.1	12.2	1.2
102	60	51.0	11.5	36.5	6.5	22.5	2.9	11.6	1.1
103	61	48.5	11.0	34.7	6.1	21.4	2.8	11.0	1.1
104	62	46.2	10.4	33.1	5.9	20.4	2.7	10.5	1.0
105	63	44.0	9.9	31.5	5.6	19.4	2.5	10.0	1.0
106	64	41.9	9.5	30.0	5.3	18.5	2.4	9.5	0.9
107	65	40.0	9.0	28.6	5.1	17.6	2.3	9.1	0.9
108	66	38.1	8.6	27.3	4.8	16.8	2.2	8.6	0.8
109	67	36.3	8.2	26.0	4.6	16.0	2.1	8.2	0.8
110	68	34.7	7.8	24.8	4.4	15.3	2.0	7.9	0.8
111	69	33.1	7.5	23.7	4.2	14.6	1.9	7.5	0.7
112	70	31.6	7.1	22.6	4.0	13.9	1.8	7.2	0.7
113	71	30.2	6.8	21.6	3.8	13.3	1.7	6.8	0.7
114	72	28.8	6.5	20.6	3.7	12.7	1.7	6.5	0.6
115	73	27.5	6.2	19.7	3.5	12.1	1.6	6.2	0.6
116	74	26.3	5.9	18.8	3.3	11.6	1.5	6.0	0.6
117	75	25.2	5.7	18.0	3.2	11.1	1.4	5.7	0.6
118	76	24.1	5.4	17.2	3.1	10.6	1.4	5.5	0.5
119	77	23.0	5.2	16.5	2.9	10.1	1.3	5.2	0.5
120	78	22.0	5.0	15.8	2.8	9.7	1.3	5.0	0.5
121	79	21.1	4.8	15.1	2.7	9.3	1.2	4.8	0.5
122	80	20.2	4.6	14.5	2.6	8.9	1.2	4.6	0.4
123	81	19.3	4.4	13.8	2.5	8.5	1.1	4.4	0.4
124	82	18.5	4.2	13.3	2.4	8.2	1.1	4.2	0.4
125	83	17.8	4.0	12.7	2.3	7.8	1.0	4.0	0.4
126	84	17.0	3.8	12.2	2.2	7.5	1.0	3.9	0.4
127	85	16.3	3.7	11.7	2.1	7.2	0.9	3.7	0.4
128	86	15.7	3.5	11.2	2.0	6.9	0.9	3.6	0.3
129	87	15.0	3.4	10.7	1.9	6.6	0.9	3.4	0.3
130	88	14.4	3.3	10.3	1.8	6.3	0.8	3.3	0.3
131	89	13.8	3.1	9.9	1.8	6.1	0.8	3.1	0.3
132	90	13.3	3.0	9.5	1.7	5.8	0.8	3.0	0.3
133	91	12.7	2.9	9.1	1.6	5.6	0.7	2.9	0.3
134	92	12.2	2.8	8.8	1.6	5.4	0.7	2.8	0.3
135	93	11.8	2.7	8.4	1.5	5.2	0.7	2.7	0.3
136	94	11.3	2.6	8.1	1.4	5.0	0.7	2.6	0.3
137	95	10.9	2.5	7.8	1.4	4.8	0.6	2.5	0.2
138	96	10.4	2.4	7.5	1.3	4.6	0.6	2.4	0.2
139	97	10.0	2.3	7.2	1.3	4.4	0.6	2.3	0.2
140	98	9.7	2.2	6.9	1.2	4.3	0.6	2.2	0.2
141	99	9.3	2.1	6.7	1.2	4.1	0.5	2.1	0.2
142	100	8.9	2.0	6.4	1.1	3.9	0.5	2.0	0.2
143	101	8.6	1.9	6.2	1.1	3.8	0.5	2.0	0.2
144	102	8.3	1.9	5.9	1.1	3.7	0.5	1.9	0.2
145	103	8.0	1.8	5.7	1.0	3.5	0.5	1.8	0.2
146	104	7.7	1.7	5.5	1.0	3.4	0.4	1.7	0.2
147	105	7.4	1.7	5.3	0.9	3.3	0.4	1.7	0.2
148	106	7.1	1.6	5.1	0.9	3.1	0.4	1.6	0.2
149	107	6.9	1.6	4.9	0.9	3.0	0.4	1.6	0.2
150	108	6.6	1.5	4.7	0.8	2.9	0.4	1.5	0.1
151	109	6.4	1.4	4.6	0.8	2.8	0.4	1.5	0.1

Predicted EM61-MK2 Response to a Medium Munitions Surrogate

Distance of Target Center Below Lower Coil (cm)	Target Depth Assuming Deployment on Standard Wheels (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 (mV)	
		Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
152	110	6.2	1.4	4.4	0.8	2.7	0.4	1.4	0.1
153	111	5.9	1.3	4.3	0.8	2.6	0.3	1.4	0.1
154	112	5.7	1.3	4.1	0.7	2.5	0.3	1.3	0.1
155	113	5.5	1.3	4.0	0.7	2.4	0.3	1.3	0.1
156	114	5.3	1.2	3.8	0.7	2.4	0.3	1.2	0.1
157	115	5.2	1.2	3.7	0.7	2.3	0.3	1.2	0.1
158	116	5.0	1.1	3.6	0.6	2.2	0.3	1.1	0.1
159	117	4.8	1.1	3.4	0.6	2.1	0.3	1.1	0.1
160	118	4.6	1.1	3.3	0.6	2.0	0.3	1.1	0.1
161	119	4.5	1.0	3.2	0.6	2.0	0.3	1.0	0.1
162	120	4.3	1.0	3.1	0.6	1.9	0.3	1.0	0.1
163	121	4.2	0.9	3.0	0.5	1.8	0.2	1.0	0.1
164	122	4.0	0.9	2.9	0.5	1.8	0.2	0.9	0.1
165	123	3.9	0.9	2.8	0.5	1.7	0.2	0.9	0.1
166	124	3.8	0.9	2.7	0.5	1.7	0.2	0.9	0.1
167	125	3.7	0.8	2.6	0.5	1.6	0.2	0.8	0.1
168	126	3.5	0.8	2.5	0.5	1.6	0.2	0.8	0.1
169	127	3.4	0.8	2.5	0.4	1.5	0.2	0.8	0.1
170	128	3.3	0.8	2.4	0.4	1.5	0.2	0.8	0.1
171	129	3.2	0.7	2.3	0.4	1.4	0.2	0.7	0.1
172	130	3.1	0.7	2.2	0.4	1.4	0.2	0.7	0.1
173	131	3.0	0.7	2.2	0.4	1.3	0.2	0.7	0.1
174	132	2.9	0.7	2.1	0.4	1.3	0.2	0.7	0.1
175	133	2.8	0.6	2.0	0.4	1.2	0.2	0.6	0.1
176	134	2.7	0.6	2.0	0.3	1.2	0.2	0.6	0.1
177	135	2.6	0.6	1.9	0.3	1.2	0.2	0.6	0.1
178	136	2.6	0.6	1.8	0.3	1.1	0.2	0.6	0.1
179	137	2.5	0.6	1.8	0.3	1.1	0.1	0.6	0.1
180	138	2.4	0.5	1.7	0.3	1.1	0.1	0.5	0.1
181	139	2.3	0.5	1.7	0.3	1.0	0.1	0.5	0.1
182	140	2.3	0.5	1.6	0.3	1.0	0.1	0.5	0.1
183	141	2.2	0.5	1.6	0.3	1.0	0.1	0.5	0.1
184	142	2.1	0.5	1.5	0.3	0.9	0.1	0.5	0.1
185	143	2.1	0.5	1.5	0.3	0.9	0.1	0.5	0.0
186	144	2.0	0.5	1.4	0.3	0.9	0.1	0.5	0.0
187	145	1.9	0.4	1.4	0.3	0.9	0.1	0.4	0.0
188	146	1.9	0.4	1.3	0.2	0.8	0.1	0.4	0.0
189	147	1.8	0.4	1.3	0.2	0.8	0.1	0.4	0.0
190	148	1.8	0.4	1.3	0.2	0.8	0.1	0.4	0.0
191	149	1.7	0.4	1.2	0.2	0.8	0.1	0.4	0.0
192	150	1.7	0.4	1.2	0.2	0.7	0.1	0.4	0.0
193	151	1.6	0.4	1.2	0.2	0.7	0.1	0.4	0.0
194	152	1.6	0.4	1.1	0.2	0.7	0.1	0.4	0.0
195	153	1.5	0.3	1.1	0.2	0.7	0.1	0.4	0.0
196	154	1.5	0.3	1.1	0.2	0.7	0.1	0.3	0.0
197	155	1.4	0.3	1.0	0.2	0.6	0.1	0.3	0.0
198	156	1.4	0.3	1.0	0.2	0.6	0.1	0.3	0.0
199	157	1.4	0.3	1.0	0.2	0.6	0.1	0.3	0.0
200	158	1.3	0.3	1.0	0.2	0.6	0.1	0.3	0.0
201	159	1.3	0.3	0.9	0.2	0.6	0.1	0.3	0.0
202	160	1.3	0.3	0.9	0.2	0.6	0.1	0.3	0.0
203	161	1.2	0.3	0.9	0.2	0.5	0.1	0.3	0.0
204	162	1.2	0.3	0.9	0.2	0.5	0.1	0.3	0.0
205	163	1.2	0.3	0.8	0.2	0.5	0.1	0.3	0.0
206	164	1.1	0.3	0.8	0.1	0.5	0.1	0.3	0.0

**Predicted EM61-MK2 Response to a Medium Munitions Surrogate**

Distance of Target Center Below Lower Coil (cm)	Target Depth Assuming Deployment on Standard Wheels (cm)	Gate 1 (mV)		Gate 2 (mV)		Gate 3 (mV)		Gate 4 (mV)	
		Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation	Most Favorable Orientation	Least Favorable Orientation
207	165	1.1	0.3	0.8	0.1	0.5	0.1	0.3	0.0
208	166	1.1	0.2	0.8	0.1	0.5	0.1	0.2	0.0
209	167	1.0	0.2	0.7	0.1	0.5	0.1	0.2	0.0
210	168	1.0	0.2	0.7	0.1	0.4	0.1	0.2	0.0
211	169	1.0	0.2	0.7	0.1	0.4	0.1	0.2	0.0
212	170	1.0	0.2	0.7	0.1	0.4	0.1	0.2	0.0
213	171	0.9	0.2	0.7	0.1	0.4	0.1	0.2	0.0
214	172	0.9	0.2	0.6	0.1	0.4	0.1	0.2	0.0
215	173	0.9	0.2	0.6	0.1	0.4	0.1	0.2	0.0
216	174	0.9	0.2	0.6	0.1	0.4	0.1	0.2	0.0
217	175	0.8	0.2	0.6	0.1	0.4	0.1	0.2	0.0
218	176	0.8	0.2	0.6	0.1	0.4	0.1	0.2	0.0
219	177	0.8	0.2	0.6	0.1	0.4	0.1	0.2	0.0
220	178	0.8	0.2	0.6	0.1	0.3	0.0	0.2	0.0
221	179	0.8	0.2	0.5	0.1	0.3	0.0	0.2	0.0
222	180	0.7	0.2	0.5	0.1	0.3	0.0	0.2	0.0
223	181	0.7	0.2	0.5	0.1	0.3	0.0	0.2	0.0
224	182	0.7	0.2	0.5	0.1	0.3	0.0	0.2	0.0
225	183	0.7	0.2	0.5	0.1	0.3	0.0	0.2	0.0
226	184	0.7	0.2	0.5	0.1	0.3	0.0	0.2	0.0
227	185	0.6	0.1	0.5	0.1	0.3	0.0	0.2	0.0
228	186	0.6	0.1	0.5	0.1	0.3	0.0	0.1	0.0
229	187	0.6	0.1	0.4	0.1	0.3	0.0	0.1	0.0
230	188	0.6	0.1	0.4	0.1	0.3	0.0	0.1	0.0
231	189	0.6	0.1	0.4	0.1	0.3	0.0	0.1	0.0
232	190	0.6	0.1	0.4	0.1	0.3	0.0	0.1	0.0
233	191	0.6	0.1	0.4	0.1	0.2	0.0	0.1	0.0
234	192	0.5	0.1	0.4	0.1	0.2	0.0	0.1	0.0
235	193	0.5	0.1	0.4	0.1	0.2	0.0	0.1	0.0
236	194	0.5	0.1	0.4	0.1	0.2	0.0	0.1	0.0
237	195	0.5	0.1	0.4	0.1	0.2	0.0	0.1	0.0
238	196	0.5	0.1	0.4	0.1	0.2	0.0	0.1	0.0
239	197	0.5	0.1	0.3	0.1	0.2	0.0	0.1	0.0
240	198	0.5	0.1	0.3	0.1	0.2	0.0	0.1	0.0
241	199	0.5	0.1	0.3	0.1	0.2	0.0	0.1	0.0
242	200	0.4	0.1	0.3	0.1	0.2	0.0	0.1	0.0