References

[1] A. Pramanik, “Electromagnetism, Theory and Applications,” Prentice Hall Publishers, India,2004.

[2] William H. Hayt, Jr., “Engineering Electromagnetics,” Third Edition, , Mc Grow Hill Publishers, 2001.

[3] D. V. Reale, J. Mankowski, and J. Dickens, “Susceptability of Electro-Explosive Devices to High Pulsed Electric Fields,” ***IEEE** Transactions on electro Magnetic Compatibility*, pp. 211-214, 2012.

[4] K.R.Lee, J.E.Bennett, W.H. Pinkston and J.E. Bryant, “New method of assessing EED susceptability to electromagnetic radiation.” ***IEEE** Transactions on Electromagnetic Compatibility*, vol.33 no.4, pp. 328-333,1991.

[5] J. Parson, J. Dickens, J. Walter, and A. A. Neuber, “Pulsed magnetic field excitation sensitivity of match-type electric blasting caps,” Rev.Sci.Instrum., . ***IEEE** Transactions on Electromagnetic Compatibility*, vol.81, 105115, 2010.

[6] “Transmission line Reference Book,” Electrical Power Research Institute (EPRI) Publishers, 2005 & 1992.

[7] M.S.H. Salameh and M.A.S. Hossouna, “Arranging overhead power transmission line conductors using Swarm Intelligence technique to minimize electromagnetic fields,” *Progress in Electromagnetics Research* B, Vol.26, 213-236, 2010

[8] H. Verakis and D. Nicholas, “Electric Blasting systems- Requirements for shunting and circuit testing,” *Mine Safty and Health Administration, United States Department of Labour,* November, 2006.

[9] J. F. Rodrigues, R. C. Creppe, L. G. C. Porto, “To Estimate the Elecreic Field Near Electric Energy Transmission Systems by Use Simple Software,” *Departamento de Engenharia Electrica, Faculdade de Engenharia*, Bauru/UNESP, 2007.

[10] P. C Sligmann, “The design of circuits for electrical softfiring,” *Journal of the South African Institue of Mining and metallurgy*, October 1978.

[11] I.M.Nejdawi, O.A. Alani and M.S.H. Al Salameh, “Using Non-Linear Particle Optimisation (PSO) Algorithm to reduce the magnetic fields from overhead high voltage transmission lines.” *IJRRAS 4(1*).July 2010.

[12] S.Tupsie, A. Isaramongkolrak, P. Oao-la-or, "Analysis of Electromagnetic Field Effects Using FEM for Transmission Line Transposition," *World Economy of Science*, Engineering and Technology 29 2009.

[13] "Predicted EMF Levels for 132kV (9C6) & 330kV (9C5) Transmission Lines," *Tomago – Brandy Hill & Brandy Hill – Stroud*, TransGrid, Australia, 2011.

[14] R. D. Begamure, "Extra High Voltage AC Transmission Engineering." Second Edition, Wiley Eastern Limited, 1990.

[15] "Safety Guide for the Prevention of Radio Frequency Hazards in the Use of Commercial Electric Detonators," *Addendum to IME Safety Library Publication 20 (SLP-20),* Institute of Manufacturers of Explosives, July, 2001.

[16] R. F. Kerendian, S. Pazouki, A. Rajabloo, "Evaluation Methods of Limiting Switching Overvoltage during Line Energization," *International Journal of Science and Engineering Investigations*, vol. 2, issue 16, May 2013.

[17] S. Celozzi, R. Araneo, G. Lovat, "Electromagnetic Shielding," *Appendix B,* Copyright © john Wiley & Sons.Inc. 2008.

[18] C. Berry, "A Guide to Radio Frequency Hazards with Electric Detonators," *Occupational Safty and Health Program, IME Safety Library Publication N0. 20,* N.C. Department of Labour, Raleigh, September, 2009.

[19] H. Yildirim and O. Kalenderli, "Computation of electric field induced currents on biological bodies near High Voltage transmission lines." *XIIIth International Symposium on High Voltage Engineering,* Netherlands, Smit(ed) © 2003 Millpress, Rotterdam, 2003.

භූ විද්‍යා සමීක්ෂණ හා පතල් කාර්යාංශය
புவிச்சரிதவியல் அளவை, சுரங்கங்கள் பணியகம்
GEOLOGICAL SURVEY & MINES BUREAU

නො: 569, එපිටමුල්ල පාර,
පිටකෝට්ටේ, ශ්‍රී ලංකා.
இல.: 569, எப்பிட்டமுல்ல வீதி,
பிடகோட்டே, இலங்கை.
No.: 569, EPITAMULLA ROAD,
PITAKOTTE, SRI LANKA.

2013-03-12

My Ref. DDM/11/03/13-01

Eng.W.D. Anura S. Wijayapala,
Senior Lecturer,
University Of Moratuwa,
Moratuwa.

Reg. Post

Dear Sir,

Request for a study on effects of electromagnetic field due to high voltage transmission lines on sensitive detonator firing circuits

The mission of the **Geological Survey and Mines Bureau** (GSMB) is to provide Geo-Scientific Information, advice and services to the policy makers and the community and to promote and manage the mineral resources of the country for economic development while ensuring environmental sustainability. It regulates exploration, extraction, value addition, transportation and trading of minerals.

The GSMB also conducts awareness programmes to public officers of Divisional Secretariats, Grama Niladhari, Police Officer etc., and licence holders on the regulations gazetted under the Mines and Mineral Act and on environmental protection activities that should be followed with mining activities.

Also awareness programmes are conducted considering the importance of making the public, specially the school children and students of higher educational institutes aware on our mineral resources and geo-hazards.

One such hazard observed recently is the premature blasting of explosives by licence holders probably due to unintentional and unknown causes. Many such incidents have been recorded in mines in recent times and such incidents needs to be prevented to ensure safety of human lives and property while ensuring efficient mining activities such as explosive blasting.

One such common cause for occurrence of unintentional blasting is lightening which could be avoided if proper precautions are taken in advance. The other suspected cause that initiates premature firing of explosive is believed to be the extraneous electricity interfering from high voltage transmission lines with the detonator firing circuits.

දුරකථන / தொலைபேசி / Telephone	සභාපති / தலைவர் / Chairman	2886268	අධ්‍යක්ෂ ජනරාල් / பணிப்பாளர் நாயகம் / Director General	2886271	සාමාන්‍යාධිකාරී / பொது முகாமையாளர் / General Manager	2887826	පොදු / பொது / General	2886289, 2886290 2887820, 2887821 2887822, 2887823	ෆැක්ස් / தொலைநகல் இல. / Fax No.	94-011-2886273

E-mail : gsmb@slt.lk WEB SITE : http://www.gsmb.slt.lk

A detail study needs to be carried out for finding the effects of induced voltages on the electric detonator firing circuits from the high voltage transmission lines that runs in the vicinity of the mines carrying out explosions. I would be grateful if you could arrange a research level study to investigate into the impacts of extraneous electricity caused by nearby transmission lines and to develop a statement of safe distances of operation for sensitive detonator firing circuits to avoid inappropriate triggering. This would ensure safety of persons working in and around the mines and quarries avoid unexpected damages to property.

Further, the safety distances are different in different countries due to national restrictions and if such safe distances could be predicted accurately, we could educate the public, the licence holders and related officials to take appropriate measures accordingly and ensure safe explosive firing in the mines and quarries.

Your kind attention, in this regards, is much appreciated.

Thank You,

GEOLOGICAL SURVEY & MINES BUREAU
Director General

Eng. D. Sajjana de Silva.
Deputy Director (Mines)

Specification for Supreme Short Delay Detonators

Description	**CEFAP Specifications**
Construction	Aluminium shell filled with ASA and PETN as primary and secondary charge. These detonators should have delay numbers ranging from 0 to 9,with a nominal time interval of 25 milliseconds for 7 and 8 and 75 milliseconds for 9
shell	Aluminium with a conical depression at the bottom, length varying for different delay numbers.
Strength	No.6 or 8
Leg(Lead) Wire colour	Should specify
Shell Diameter	6.5 ± 0.05 mm
Leg (Lead) Wire Diameter	24 SWG iron wire
Lead Wire Resistance	0.1 - 0.3ohms/m
Leg(Lead)wire length	4 and 9 m
Fuse Head resistance	1.6 to 2.0 ohms
Firing Energy	2.5 to 3.0 mJ/ohm
Firing Current per series	1 to 1.2 Amps
No firing (No Initiation) Current	50 mAmps
Year of manufacture	Current
Shelf Life	Min. of 05 Years
Packing	Each case should contain detonators of the same delay number only. Five detonators are held in bunch and five such bunches are banded to make a bundle of 25 detonators. Two bundles of 25 detonators each are wrapped in kraft paper and make into a packet, and suitable labelled. 20 to 50 such packets are placed in a wooden case, inside of which is lined with water proof paper. The case is fastened with plastic straps or wires. Entire consignment is desired in 20 foot containers.

MATLAB Script for electric field around 220kV TX Line

```
%===================================================================================
===================================================================================
%  220kV Configuration
%===================================================================================
===================================================================================
clc
clear all
close all

e_r=1;                                      %relative permitivity of air
S=[200 200 200 200 200 200 200 200];        %sub conductor spacing - diameter in mm
N=[  2    2    2    1    2    2    2    1];  %number of sub conductors per line
d=[ 28.6   28.6   28.6   18   28.6   28.6   28.6   18];   %sub conductor diameter in mm
h=[ 7   12.8   18.5   27   7   12.8   18.5   27];   %Height above ground in m
x=[ -6.5   -6.5   -6.5 -6 6.5     6.5    6.5   6];
Vp_p  =[220 220 220    0 220 220 220 0];     %Phase to Phase value of conductor
voltage
phase =[   0 120 240    0    0 120 240 0];     %Phase angle of the conductor voltages

e_0= 8.854187817e-12;
e_m=e_r*e_0;
D=S./sin(pi./N);
d_eq=(N.*d.*(D).^(N-1)).^(1./N);            %equivalent diameter in bundle conductor

n=size(S,2);                                %number of lines
P=zeros(n,n);                               %Maxwell potential matrix

for j=1:n
    for i=1:n
        if(i==j)
            P(i,j)=(1/(2*pi*e_m))*log(4*h(1,i)*1000/d_eq(1,i));
        else
            den=(x(1,i)-x(1,j))^2+(h(1,i)-h(1,j))^2;
            num=(x(1,i)-x(1,j))^2+(h(1,i)+h(1,j))^2;
            num=4*h(1,i)*h(1,j)+den;
            P(i,j)=(1/(2*pi*e_m))*log(sqrt(num/den));
        end
    end
end
```

```
P_inv=inv(P);
V_r=Vp_p.*cosd(phase)/sqrt(3);%
V_i=Vp_p.*sind(phase)/sqrt(3);%
Q_r=V_r*P_inv;%
Q_i=V_i*P_inv;%

x_N=[-20:0.1:20];
% y_N=[20:0.1:20];
y_N=1*ones(1,100);

x_points=size(x_N,2);
y_points=size(y_N,2);
Ex=zeros(x_points,y_points);
Ey=zeros(x_points,y_points);
V=zeros(x_points,y_points);

j_com=sqrt(-1);
for j=1:size(y_N,2)
    for i=1:size(x_N,2)
        for k=1:n
            C0=(x_N(1,i)-x(1,k))/((x(1,k)-x_N(1,i))^2+(h(1,k)-y_N(1,j))^2);
            C1=(x_N(1,i)-x(1,k))/((x(1,k)-x_N(1,i))^2+(h(1,k)+y_N(1,j))^2);
            C2=C0-C1;
            C3=C2/(2*pi*e_m);
            C4=(Q_r(1,k)+j_com*Q_i(1,k));
            Ex(i,j)=Ex(i,j)+C4*C3;



        end
    end
end



for j=1:size(y_N,2)
    for i=1:size(x_N,2)
        for k=1:n
            C0=(y_N(1,j)-h(1,k))/((x(1,k)-x_N(1,i))^2+(h(1,k)-y_N(1,j))^2);
```

```
            C1=(y_N(1,j)+h(1,k))/((x(1,k)-x_N(1,i))^2+(h(1,k)+y_N(1,j))^2);
            C2=C0-C1;
            C3=C2/(2*pi*e_m);
            C4=(Q_r(1,k)+j_com*Q_i(1,k));
            Ey(i,j)=Ey(i,j)+C4*C3;
        end
    end
end

E_real_2=real(Ex).^2+real(Ey).^2;
E_imag_2=imag(Ex).^2+imag(Ey).^2;

E=sqrt(E_real_2+E_imag_2);    % Intensity in kV/m



% -------------------- 3D plot for Electric Field-------------------
[plot_X plot_Y]=meshgrid(x_N,y_N);
surf(plot_X,plot_Y,E')
title('Electric Field (1m above ground)');
xlabel('Horizontal axis- X');
ylabel('Verticall axis- Y');
zlabel('Electric Field (kV/m)');
%----------------------------------------------


 for j=1:size(y_N,2)
    for i=1:size(x_N,2)
         for k=1:n
            C0=sqrt(((x(1,k)-x_N(1,i))^2+(h(1,k)-y_N(1,j))^2));
            C1=log(C0/h(1,k));
            C2=sqrt(((x(1,k)-x_N(1,i))^2+(h(1,k)+y_N(1,j))^2));
            C3=log(C2/h(1,k));
            C4=(C1-C3)/(2*pi*e_m);
            V(i,j)=V(i,j)+ (Q_r(1,k)+j_com*Q_i(1,k))*C4;
         end
     end
 end
```

```
V_abs=sqrt(real(V).^2+imag(V).^2); %Potential in kV



%-----------------------------------------------------
figure
%-----------------------------------------------------



%------------------- 3D plot for Potential-------------------
[plot_X plot_Y]=meshgrid(x_N,y_N);
surf(plot_X,plot_Y,V_abs')
title('Potential for 245kV Double CCT Line');
xlabel('Horizontal axis- X');
ylabel('Verticall axis- Y');
zlabel('Potential(kV)');
----------------------------------------------
```

MATLAB Script for Magnetic Field around 220kV TX Line

```
%===============================================================================
===============================================================================
%  220kV Double Circuit Configuration
%===============================================================================
===============================================================================

clc
clear all
close all

u_r_air =1;                          %Relative permeability of air
u_r_soil=1;                         %Relative permeability of soil
e_r_soil=1;                        %Relative permittivity of earth
sigma    =0.001;                      %Conductivity of earth
f        =50;                        %Frequency in Hz
h=       [ 7  12.8  18.5  27  7  12.8  18.5  27 ];  %Height above ground in m
x=       [ -6.5  -6.5  -6.5 -6 6.5    6.5   6.5  6 ];  %Horizontal placement in m
I_amp=  [1200 1200 1200 0 1470 1470 1470 0 ];  %Amplitude of Conductor phase
                                                current in A
I_phase=[ 0 120 240 0 0 120 240 0 ];   %Current phase angle in degrees

n=size(h,2);                                                %number of lines
u_air   =u_r_air*4*pi*10e-7;
u_soil  =u_r_soil*4*pi*10e-7;
e_soil  =e_r_soil*8.8541878176e-12;
j_comp  =sqrt(-1);
I_phasor=I_amp.*(cosd(I_phase)+j_comp*sind(I_phase));

x_N=[-20:0.1:20];%  [0 70 100 700 1000 -1000];;
% y_N=.01*ones(1,100);
y_N=[1:0.1:6.0];  %[0];
x_points=size(x_N,2);
y_points=size(y_N,2);

%--------------------------Effect of Conductor Current ----------------------------
 H_line_x=zeros(x_points,y_points);
H_line_y=zeros(x_points,y_points);
```

```
%Conductor effect - x axis
for j=1:y_points
    for i=1:x_points
        for k=1:n
            r=sqrt((x_N(1,i)-x(1,k))^2+(y_N(1,j)-h(1,k))^2);
            H_line_x(i,j)=H_line_x(i,j)+(I_phasor(1,k)./(2*pi*r))*(h(1,k)-
y_N(1,j))/r;
        end
    end
end

%Conductor effect - y axis
for j=1:y_points
    for i=1:x_points
        for k=1:n
            r=sqrt((x_N(1,i)-x(1,k))^2+(y_N(1,j)-h(1,k))^2);
            H_line_y(i,j)=H_line_y(i,j)-(I_phasor(1,k)./(2*pi*r))*(x(1,k)-
x_N(1,i))/r;
        end
    end
end
```



```
H_real_2=real(H_line_x).^2+real(H_line_y).^2;
H_imag_2=imag(H_line_x).^2+imag(H_line_y).^2;


H=5.3*sqrt(H_real_2+H_imag_2);

%------------------------Effect of Earth's Current---------------------------------

H_e_line_x=zeros(x_points,y_points);
H_e_line_y=zeros(x_points,y_points);

 % Earth's effect -x axis
for j=1:y_points
    for i=1:x_points
        for k=1:n
```

```
            Y=sqrt(j_comp*2*pi*f*u_soil*(sigma+j_comp*2*pi*f*e_soil));
            r=sqrt((x_N(1,i)-x(1,k))^2+(y_N(1,j)+h(1,k)+ 2/Y)^2);
            phi_x=-((h(1,k)+y_N(1,j)+2/Y)/r);
            H_e_line_x(i,j)=H_e_line_x(i,j)-
(I_phasor(1,k)./(2*pi*r))*(1+(1/3)*(2/(Y*r))^4)*phi_x;
        end
    end
end

%Earth's effect -y axis
for j=1:y_points
    for i=1:x_points
        for k=1:n
            Y=sqrt(j_comp*2*pi*f*u_soil*(sigma+j_comp*2*pi*f*e_soil));
            r=sqrt((x_N(1,i)-x(1,k))^2+(y_N(1,j)+h(1,k)+ 2/Y)^2);
            phi_y=(x_N(1,i)-x(1,k))/r;
            H_e_line_y(i,j)=H_e_line_y(i,j)-
(I_phasor(1,k)./(2*pi*r))*(1+(1/3)*(2/(Y*r))^4)*phi_y;
        end
    end
end



H_e_real_2=real(H_e_line_x).^2+real(H_e_line_y).^2;
H_e_imag_2=imag(H_e_line_x).^2+imag(H_e_line_y).^2;



H_e=sqrt(H_e_real_2+H_e_imag_2);

 %--------------------- Total Magnetic Field---------------------

H_total=sqrt(H_real_2+H_imag_2+H_e_real_2+H_e_imag_2); %Total magnetic field in A/m


%--------------------- Total Magnetic Flux Density --------------
```

```
B_total=u_air*H+u_soil*H_e; %Total magnetic flux density in Wb/m2

[plot_X plot_Y]=meshgrid(x_N,y_N);

%==================================================================================
%       Plot Component of H due to conductor current alone
%==================================================================================
surf(plot_X,plot_Y,H')
title('Magnetic Field -Component of H due to conductor current alone ');
xlabel('Horizontal axis- X (m)');
ylabel('Verticall axis- Y');
zlabel('Magnetic Field (A/m)');

figure

%==================================================================================
%       Plot Component of H due to earth current
%==================================================================================
surf(plot_X,plot_Y,H_e')
title('Magnetic Field -Component of H due to earth current');
xlabel('Horizontal axis- X(m) ');
ylabel('Verticall axis- Y');
zlabel('Magnetic Field (A/m)');

 figure

%==================================================================================
%       Plot Resultant H due to conductor and earth current
%==================================================================================
surf(plot_X,plot_Y,H_total')
title('Magnetic Field -Total');
xlabel('Horizontal axis- X(m)');
ylabel('Verticall axis- Y');
zlabel('Magnetic Field (A/m)');

figure
```

```
%=================================================================================
%       Plot Resultant B due to conductor and earth current
%=================================================================================
surf(plot_X,plot_Y,B_total')
title('Magnetic Flux Density -Total');
xlabel('Horizontal axis- X(m)');
ylabel('Verticall axis- Y');
zlabel('Magnetic Flux Density (Wb/m^2) or (T)');
```

TX Line: Kotugoda - Katunayaka				**Date : 23.05.2014**			
Transmission line Voltage & configuration : 132kV double circuit twin zebra **Line Currents : 780A, 860A** **Line Conductor height (Lowest Phase): 7.7m**							
Distance from centre (m)	Right			Distance from centre (m)	Left		
	Electric field (V/m)	Distance (m)	Electric field (V/m)		Electric field (V/m)	Distance (m)	Electric field (V/m)
0	3380	13.0	501	0	3380	-13.0	420
0.5	3400	13.5	401	-0.5	3370	-13.5	370
1.0	3400	14.0	301	-1.0	3390	-14.0	342
1.5	3410	14.5	280	-1.5	3410	-14.5	305
2.0	3450	15.0	220	-2.0	3440	-15.0	290
2.5	3490	15.5	180	-2.5	3480	-15.5	250
3.0	3480	16.0	140	-3.0	3480	-16.0	230
3.5	3450	16.5	120	-3.5	3450	-16.5	175
4.0	3390	17.0	115	-4.0	3350	-17.0	155
4.5	3295	17.5	105	-4.5	3275	-17.5	140
5.0	3150	18.0	100	-5.0	3050	-18.0	125
5.5	2950	18.5	95	-5.5	2950	-18.5	110
6.0	2575	19.0	95	-6.0	2701	-19.0	100
6.5	2450	19.5	90	-6.5	2501	-19.5	95
7.0	2200	20	85	-7.0	2291	-20.0	90
7.5	2010			-7.5	2050		
8.0	1670			-8.0	1800		
8.5	1482			-8.5	1650		
9.0	1390			-9.0	1401		
9.5	1200			-9.5	1280		
10	1100			-10	1100		
10.5	900			-10.5	920		
11.0	830			-11.0	801		
11.5	732			-11.5	702		
12.0	685			-12.0	594		
12.5	605			-12.5	505		

TX Line: Bolawatta - Nattandiya				**Date : 23.05.2014**			
Transmission line Voltage & configuration : 33kV double circuit single racoon **Line Currents : 180A, 165A** **Line Conductor height (Lowest Phase): 5.4m**							
Distance from centre (m)	Right			Distance from centre (m)	Left		
	Electric field (V/m)	Distance (m)	Electric field (V/m)		Electric field (V/m)	Distance (m)	Electric field (V/m)
0	384	13.0	95	0	384	-13.0	100
0.5	388	13.5	93	-0.5	390	-13.5	98
1.0	404	14.0	88	-1.0	400	-14.0	88
1.5	426	14.5	80	-1.5	424	-14.5	80
2.0	445	15.0	78	-2.0	440	-15.0	80
2.5	458	15.5	70	-2.5	460	-15.5	70
3.0	464	16.0	65	-3.0	464	-16.0	65
3.5	450	16.5	65	-3.5	455	-16.5	65
4.0	438	17.0	60	-4.0	439	-17.0	60
4.5	420	17.5	60	-4.5	430	-17.5	60
5.0	390	18.0	55	-5.0	400	-18.0	55
5.5	370	18.5	55	-5.5	340	-18.5	55
6.0	347	19.0	55	-6.0	340	-19.0	55
6.5	300	19.5	50	-6.5	320	-19.5	50
7.0	288	20	50	-7.0	280	-20.0	50
7.5	270			-7.5	258		
8.0	240			-8.0	240		
8.5	220			-8.5	210		
9.0	180			-9.0	200		
9.5	177			-9.5	180		
10	170			-10	170		
10.5	140			-10.5	160		
11.0	145			-11.0	150		
11.5	130			-11.5	140		
12.0	120			-12.0	120		
12.5	110			-12.5	110		

Distance from centre (m)	Right			Distance from centre (m)	Left		
TX Line: Kotugoda - Katunayaka				**Date : 23.05.2014**			
Transmission line Voltage & configuration : 132kV double circuit twin zebra **Line Currents : 780A, 860A** **Line Conductor height (Lowest Phase): 7.7m**							
	Mag. Field (μT)	Distance (m)	Mag. Field (μT)		Mag. Field (μT)	Distance (m)	Mag. Field (μT)
0	16.0	13.0	11.2	0	16.0	-13.0	11.3
0.5	16.5	13.5	10.8	-0.5	16.5	-13.5	11.1
1.0	16.8	14.0	10.4	-1.0	16.8	-14.0	10.5
1.5	17.9	14.5	10.1	-1.5	17.0	-14.5	10.0
2.0	18.7	15.0	9.6	-2.0	17.5	-15.0	9.5
2.5	19.5	15.5	9.1	-2.5	18.2	-15.5	9.1
3.0	19.6	16.0	8.5	-3.0	18.8	-16.0	8.5
3.5	19.9	16.5	8.1	-3.5	19.2	-16.5	7.8
4.0	20.6	17.0	7.9	-4.0	19.5	-17.0	7.29
4.5	20.9	17.5	7.6	-4.5	19.7	-17.5	7.1
5.0	20.9	18.0	7.0	-5.0	19.8	-18.0	7.0
5.5	20.8	18.5	6.6	-5.5	19.6	-18.5	6.9
6.0	20.4	19.0	6.5	-6.0	19.3	-19.0	6.8
6.5	20.0	19.5	6.01	-6.5	18.9	-19.5	6.5
7.0	19.5	20	5.8	-7.0	18.2	-20.0	6.5
7.5	18.2	20.5	5.4	-7.5	17.5	-20.5	6.3
8.0	17.86	21.0	5.8	-8.0	16.93	-21.0	5.99
8.5	17.0	21.5	5.6	-8.5	16.0	-21.5	5.85
9.0	16.0	22.0	5.42	-9.0	15.5	-22.0	5.76
9.5	15.5	22.5	52.2	-9.5	15.0	-22.5	5.56
10	14.0	23.0	5.02	-10	14.1	-23.0	5.23
10.5	13.8	23.5	4.82	-10.5	13.5	-23.5	5.12
11.0	13.37	24.0	4.73	-11.0	13.0	-24.0	4.99
11.5	12.8	24.5	4.5	-11.5	12.45	-24.5	4.8
12.0	12.2	25.0	4.45	-12.0	11.9	-25.0	4.5
12.5	11.7			-12.5	11.4		

Annex 8

TX Line: Bolawatta - Nattandiya				Date : 25.05.2014			
Transmission line Voltage & configuration : 33kV double circuit single raccoon **Line Currents : 180A, 165A Line Conductor height (Lowest Phase): 5.4m**							
Distance from centre (m)	Right			Distance from centre (m)	Left		
	Mag. Field (μT)	Distance (m)	Mag. Field (μT)		Mag. Field (μT)	Distance (m)	Mag. Field (μT)
0	6.8	13.0	2.2	0	6.8	-13.0	2.2
0.5	6.82	13.5	2.0	-0.5	6.85	-14.0	2.1
1.0	6.83	14.0	2.0	-1.0	6.91	-13.5	2.0
1.5	6.84	14.5	1.8.5	-1.5	7.0	-14.0	1.85
2.0	6.86	15.0	1.8	-2.0	7.05	-15.0	1.8
2.5	6.8	15.5	1.7	-2.5	6.98	-15.5	1.7
3.0	6.77	16.0	1.6	-3.0	7.02	-16.0	1.65
3.5	6.6	16.5	1.5	-3.5	6.91	-16.5	1.6
4.0	6.5	17.0	1.5	-4.0	6.75	-17.0	1.5
4.5	6.3	17.5	1.4	-4.5	6.55	-17.5	1.4
5.0	6.01	18.0	1.3	-5.0	6.3	-18.0	1.35
5.5	5.72	18.5	1.3	-5.5	6.0	-18.5	1.3
6.0	5.45	19.0	1.2	-6.0	5.65	-19.0	1.2
6.5	5.12	19.5	1.2	-6.5	5.35	-19.5	1.2
7.0	48.4	20.0	1.1	-7.0	5.05	-20.0	1.1
7.5	4.54	20.5		-7.5	4.7	-20.5	
8.0	4.22	21.0		-8.0	4.4	-21.0	
8.5	4.0	21.5		-8.5	4.1	-21.5	
9.0	3.7	22.0		-9.0	3.8	-22.0	
9.5	3.5	22.5		-9.5	3.6	-22.5	
10	3.2	23.0		-10	3.3	-23.0	
10.5	3.0	23.5		-10.5	3.1	-23.5	
11.0	2.88	24.0		-11.0	2.9	-24.0	
11.5	2.62	24.5		-11.5	2.7	-24.5	
12.0	2.5	25.0		-12.0	2.6	-25.0	
12.5	2.35			-12.5	2.4		

.