



P 140

## Analysing the onland seismic field data for parameter fixation: a new insight

*O.P.Singh\**, *Ram Kumar<sup>1</sup>* & *N.Roy<sup>1</sup>*

### Summary

Once the survey design is finalized, the crew goes to field for actual operation. Experimental work is carried out first to decide charge depth and charge size. The charge depth is decided based on the up-hole data integrating amplitude, pulse signature, lithology and check shots at the experimental location. Using this information as optimum depth (OD) at the location, charge optimization experiment is carried out where records are taken with different charge sizes.

The general practice is to analyze the monitor records in de-float mode for signal strength and frequency content. As in the de-float mode record is not compensated for spherical spreading losses, generally signal strength is weak at deeper level. Deciding the charge size in this mode may lead to finalization of higher charge size as with increase in charge deeper events are seen with better clarity and continuity but lowering of frequency in data.

A new method, examining the records in TAR mode, during charge optimization has been adopted. This procedure is found to be more useful. Also a new method of analysis of Up-hole data for OD finalization through interpreting the pulse amplitude multiplied by corresponding depth instead of just pulse amplitude has been found useful and implemented in practice.

**Keywords:** Analysis, Up-holes, Charge depth Optimization, Monitor records

### Introduction

Charge size and charge depth are important field parameters for acquiring good quality seismic data in a land seismic survey with explosive source. Once the geometry is fixed, the variables conveniently controllable are limited to charge size and depth of shooting. These parameters are decided in the field through experimental work and up-hole survey respectively.

Sharpe (1944) has demonstrated by analog field records that the large charge produces a higher ratio of reflected energy to very low frequency (10-20 Hz) surface wave (Ground Roll) interference than the small charge. Again the large charge produces a higher ratio of reflected energy to low frequency (20-50 Hz) random noise. Also the record with small charge is richer in frequency. Ziolkowski and Lerwill (1979) have studied the effect of charge size on the signal period and amplitude and concluded that as the charge size is reduced; the spectrum is shifted towards the

higher frequencies and reduced in level as  $M^{2/3}$  as shown in Figure 1. It follows that the processing signal bandwidth, in terms of octaves, remains the same, but because of the shift to higher frequencies, a higher resolution can be obtained. Thus the endeavor should be to use a charge whose spectrum is shifted in to most useful band.

The data of experimental records are analyzed for its continuity and frequency content. Examining the data in de-float mode may lead to selection of higher charge as amplitudes of deeper events are attenuated and one tries to see sufficient energy at deeper level, up to farthest receiver channel. Compensation for geometrical spreading losses is essentially done in data processing. Hence to some extent the charge used in order to see "sufficient energy" needs to be reduced. Thus a better approach of analysis of data for the optimization of charge size is required.

\*Western Offshore Basin, ONGC, Mumbai, <sup>1</sup>Cauvery Basin, ONGC, Chennai  
362, Priyadarshini, EE Highway, Sion, Mumbai-400 022, India;  
opsingh57@gmail.com

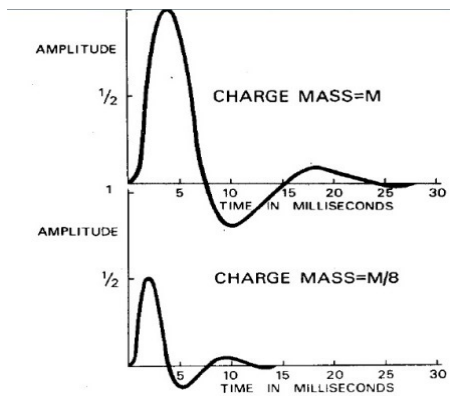


Figure 1: Charge mass and seismic amplitude relation (Ziolkowski et.al. 1979)

Analysis of up-hole data is an important step for deriving the information about the optimum shooting medium. Amplitude of the pulse recorded in a high velocity layer is a very good indicator for deciding optimum depth (OD) for charge placement. But this amplitude of the pulse is not the true amplitude. It is decaying with depth due to spherical spreading. So correction corresponding to the decay is required for getting the correct pulse amplitude. The recorded pulse amplitude as such is not very clear cut indicative of OD. Thus a sort of amplitude decay compensation is required to overcome this problem.

### Methodology adopted for analysis of data

#### Analysis of Up-hole data:

The normal method adopted for the analysis and interpretation of up-hole data is given in Figure 2. Here the pulse amplitudes are plotted with respect to depth as shown in the figure, and seen for sharper and high amplitude pulse in the high velocity layer. The amplitude curve gives usually a gradually amplitude decaying shape and in such a case it is not very much indicative of highest amplitude (best pulse) in sub-weathering layer.

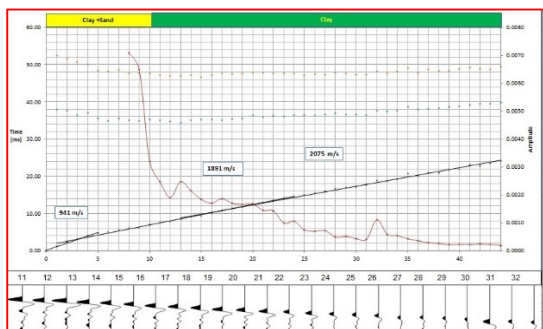


Figure 2: Up-hole 715 pulse amplitude plot (Normal method of interpretation)

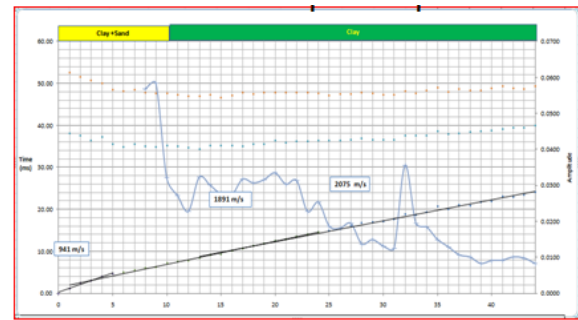


Figure 3: Up-hole 715 pulse amplitude x depth plot (New method suggested)

Instead, if we plot the amplitude of the pulse multiplied by corresponding depth of the shot, as shown in Figure 3, the amplitude curve is better indicative of OD, in this case 21 m. This is towards the compensating the amplitude for decay due to spherical spreading (TAR). Next high amplitude point at 32 m is discarded as it is very narrow layer and may not be practically suitable. The amplitude curve without consideration of depth (Figure 2) indicated that OD can be 13 m which has not been the case after study of check shots and new curve in Fig. 3. Lithology encountered at this up hole is clay and sand up to 10 m and clay beyond that depth as depicted on the plots. Similar work has been done for 03 more up-holes of the area and all indicate that amplitude multiplied by depth curve is better depiction of pulse amplitude information than just amplitude (Figure 4-6). All the up-holes in the area indicate that OD can be 21 m in this area.

Plotting of up-hole pulse signatures at different depths with TAR coupled with modified amplitude curve as above would further fine tune the optimum depth selection based on up-hole data.

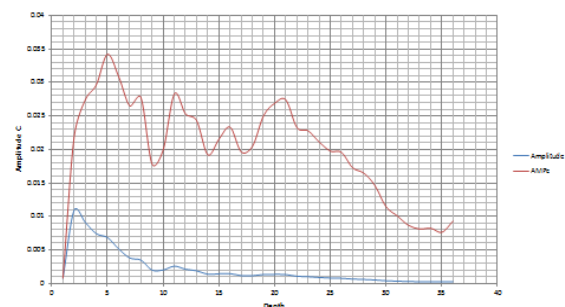


Figure 4: Up-hole 731 pulse amp. & amp X depth plots

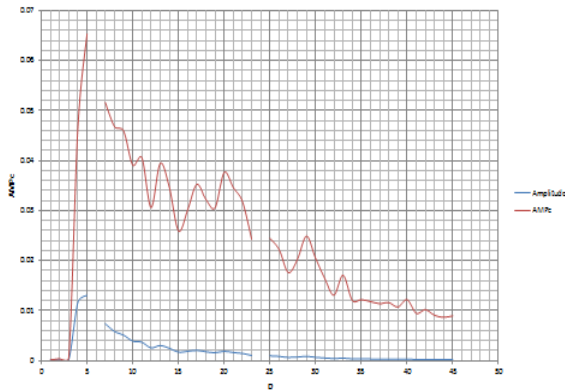


Figure 5: Up-hole 693 pulse amp. & amp X depth plots

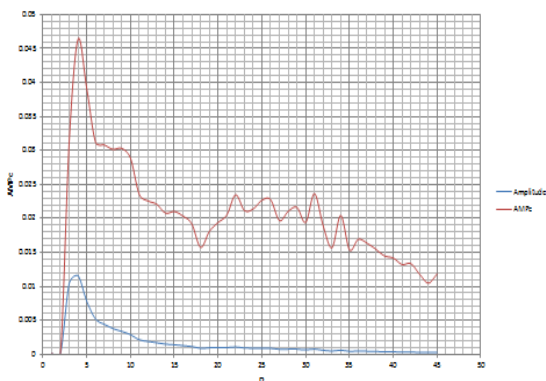


Figure 6: Up-hole 694 pulse amp. & amp X depth plots

### Charge Size analysis

#### Area A:

Charge size experimental survey was done in this area of Cauvery Basin where OD was 23 m. Shots were taken with 2.5 kg, 3.5 kg, 4 kg and 5 kg. at this depth. Records with de-float and TAR are shown in Figure7-10. Frequency content is given in Table1.

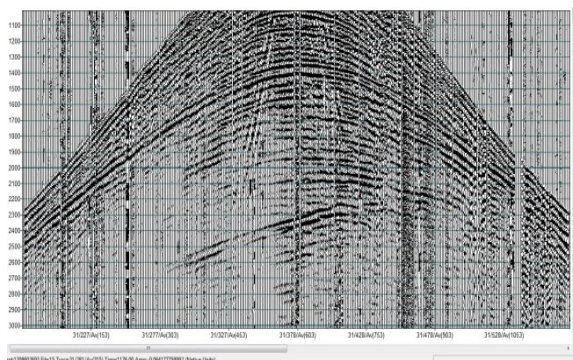


Figure 7: Test Record with 4kg in De-float mode

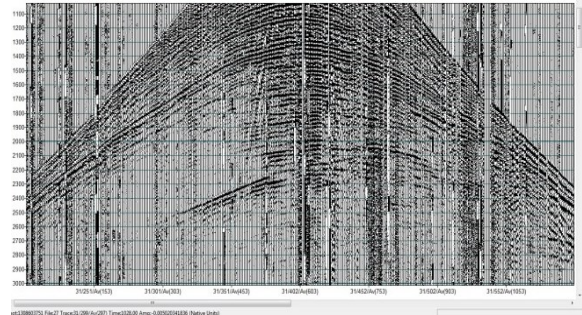


Figure 8: Test Record with 5kg in De-float mode

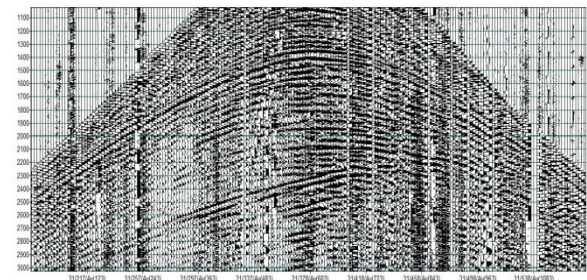


Figure 9: Test Record with 4kg in TAR mode

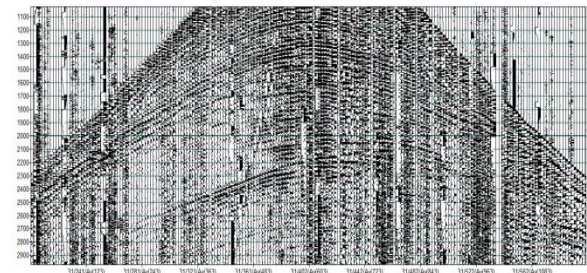


Figure 10: Test Record with 5kg in TAR mode

Charge (Kg)	Depth (M)	Freq. Band (Hz) at -12 db
5.0	22.0	10-59
4.0	23.6	09-62
3.5	23.6	09-62
2.5	23.0	09-63
4.0	30.3	08-43
3.5	31.6	09-41
2.5	29.0	09-48

Table 1 Freq. analysis results of charge size experiment in Area A

On comparison of Figure 7 and Figure 8 in a conventional way of deciding charge size, Figure 8 shows more energy at deeper level seen up to farther channels and one could optimize charge size as 5 kg. The same data was analyzed in TAR mode where along with a fixed gain an absorption

gain of 3db/sec was applied as shown in Figure9 & Figure10. These records show that a charge size of 4 kg is optimum which gives equally good amplitude continuity in comparison with 5 kg charge. The record with 4.0 kg charge appears with lower frequency on visual inspection than 5.0kg record. The same was observed while analyzing these test records but frequencies are comparable when seen at -12dB down. However, it is clear that more information is available on the records when we see in TAR mode than de-float mode. Up hole plot and pulse amplitude at the experimental location are given in Figure 10a and Figure 10b. The layer at 31 m was also tested and shows lowering of frequency than the layer at 23 m as shown in table 1.

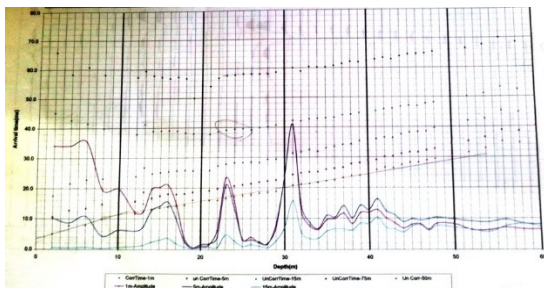


Figure 10a: Up hole plot at experimental location

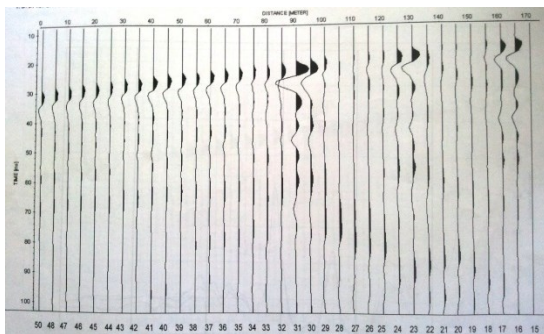


Figure 10b: Pulse amplitude plot at experimental location

**Area B:**

Charge size experiment was carried out in this area of Cauvery Basin where OD was 24 m. Shots were taken with 1.0 kg, 1.5 kg, 2.0 kg, 2.5 kg, 3.0 kg, 3.5 kg & 4.0 kg charge size at this depth. Records for 2.5 kg, 3.0 kg and 3.5 kg are shown in Figure 11-16 in de-float and TAR mode. Frequency analysis results are given in Table 2. Analyzing the records in de-float mode, optimum charge size appears to be as 3.5 kg whereas TAR mode display shows that optimum charge size can as well be 2.5kg/3.0kg with a focus on gain of 6 Hz in the high frequency end.

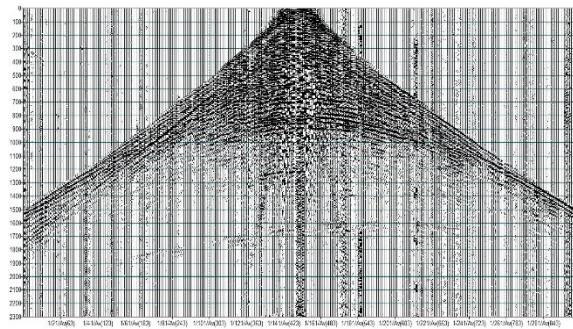


Figure 11: Monitor Record with 2.5 kg charge - De-float mode

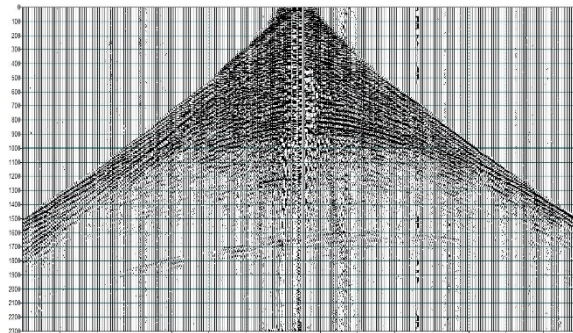


Figure 12: Monitor Record with 3.0 kg charge - De-float mode

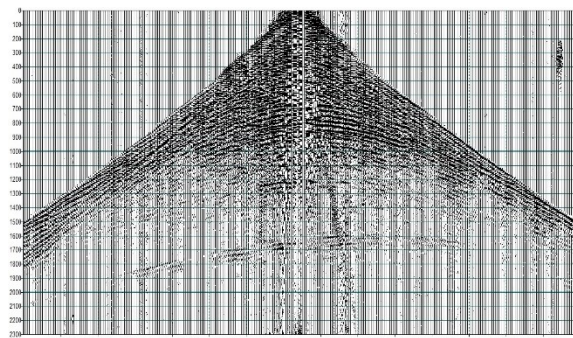


Figure 13: Monitor Record with 3.5 kg charge - De-float mode

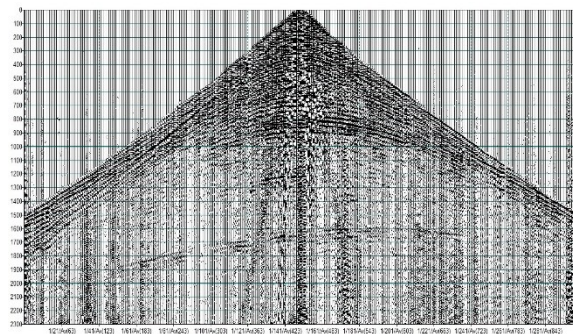


Figure 14: Monitor Record with 2.5 kg charge - TAR mode

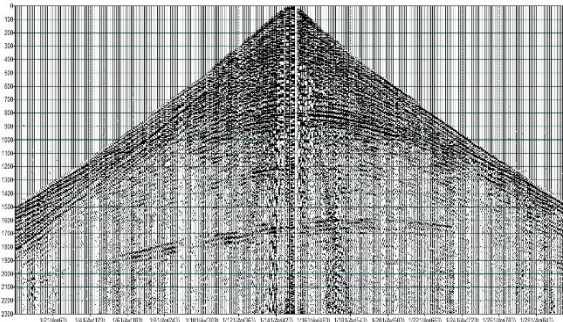


Figure 15: Monitor Record with 3.0 kg charge - TAR mode

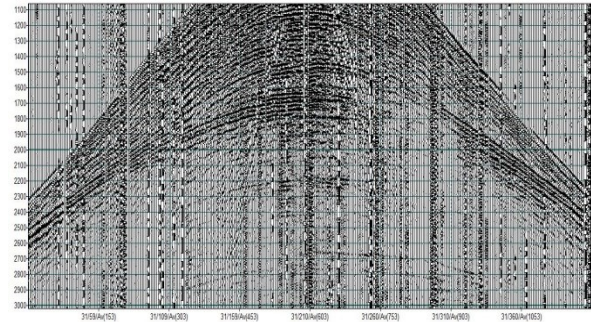


Figure 17a: Monitor record in De-float mode

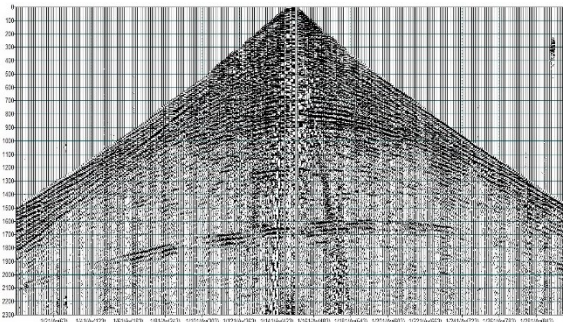


Figure 16: Monitor Record with 3.5 kg charge - TAR mode

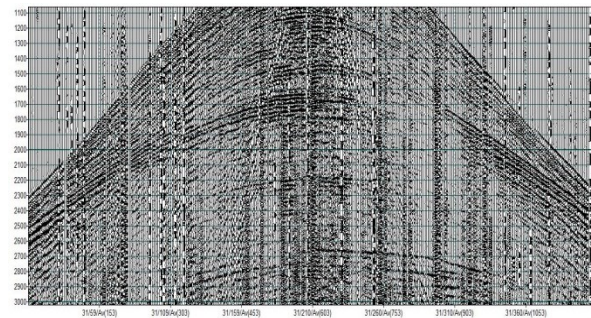


Figure 17b: Monitor record in TAR mode

Charge (Kg)	Depth (m)	Freq. (Hz) at -12 Db	Band
1.0	24.0	08-84	
1.5	24.7	08-82	
2.0	24.5	08-80	
2.5	24.6	08-76	
<b>3.0</b>	25.4	<b>08-76</b>	
<b>3.5</b>	24.0	<b>10-70</b>	
4.0	26.0	12-64	

Table 2 Freq. analysis results of charge size experiment in Area B

### Monitor records

Monitor records can be better displayed in TAR, if provision exists in recording system, instead of de-float mode as TAR mode provides realistic display of deeper events. Even shallow events become cleaner and major reflector hodographs are seen clearly as shown in Figure 17a & Figure 17b. The data can be viewed in AGC mode (Figure 17c) also where weak and deeper events will be seen but here relative amplitudes are not honored and this display becomes noisy and may not be preferable. Moreover, the TAR record is close to what is going to be realized in processing.

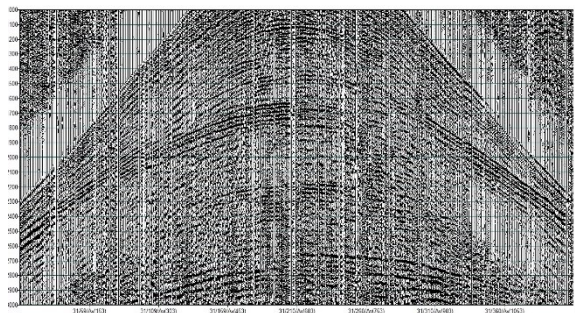


Figure 17c: Monitor record in AGC mode

### Conclusions

- While analyzing the Up-hole data, the plot of pulse amplitude multiplied by depth can be a better option instead of just pulse amplitude plot.
- Field data is to be analyzed with TAR option i.e. after compensation of decay of amplitude due to spherical spreading for better charge size optimization.



- Plotting of monitor records with TAR application is a better option than in de-float mode which is the usual practice.

### **Acknowledgements**

With a deep sense of gratitude, authors wish to thank Shri P K Bhowmick, ED-COED, Basin Manager-Western Offshore Basin and Shri Mahendra Pratap, GGM-Block Manager-MO Block, WOB for encouraging and allowing to write this paper.

The authors express their gratitude to Dr. B.S. Josyulu, ED-Basin Manager, Cauvery Basin, for giving the opportunity to work on this project and constant encouragement to strive towards attainment of best result.

The efforts made by party personnel of GP-28 & GP-29 in acquiring data are duly acknowledged.

Authors thankfully acknowledge Shri N K Verma, D (E), ONGC, for permitting the presentation and publication of this paper.

The views expressed in the paper are of the authors only, and not of the organization.

### **References**

Sharpe J.A.1944, The effect of charge size on monitor records; Geophysics, 09,131-142.

Ziolkowski A. and Lerwill W.E., 1979, A simple approach to high resolution seismic profiling for coal; Geophysical Prospecting, 27, 360-393.