Integrating Field Processing Unit (FPU) with Seismic Data Acquisition System (SN388) for Facilitating Real Time QC of Field Data

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Summary

Quality in all the E&P activities of ONGC is re-emphasized and continuous improvement in terms of quality of all the activities has become the order of the day. In this direction to have real time quality checks of seismic data at the acquisition stage itself, Field processing units (FPU) were introduced, by the Geophysical Services of ONGC. This has improved the quality of seismic data acquired and reduced the time delay in getting the feedback on the quality of data acquired. The incompatibility of cartridge drives used in the FPU and SN388 data acquisition system was delaying the real time QC in the field itself. At Geophysical Services, Jorhat this issue was addressed and an optimum solution in terms of time & cost was arrived at. The different options explored and an acceptable solution arrived at are discussed in this paper.

Introduction

The acquisition of seismic data in a complex area is a highly challenging job for a Geoscientist. In such a difficult terrain, recording of good quality data meeting the objectives of exploration needs, a rigorous online quality check of seismic data is mandatory. Lot of efforts are being put in by Geophysical Services, to improve the quality of acquired seismic data, by adhering to high work standards. To adopt the state of art technology in industry, in January 2004, seventeen numbers of Field Processing Units (FPU) were inducted in the seismic field data acquisition parties. This is a step forward to meet the requirement of real time quality control of seismic data at the acquisition stage in the field itself.

The FPUs have the facilities to monitor the quality of acquired seismic data in the field itself. The FPUs are equipped with Geocluster© software of M/s CGG for 2D/ 3D seismic data processing, which is similar to that of the processing s/w available with the Regional Computer Centre (RCC)s of Chennai, Baroda & Jorhat. Each FPU is configured with an IBM-3590 cartridge (capacity 10 GB) drive for input of the seismic data in SEG-D format for processing.

The Existing fifteen numbers of SN388 seismic telemetry data acquisition systems, record the field data in SEG-D format in an IBM 3490E cartridge (each cartridge is of capacity 800 MB). The FPUs of those field parties where SN388 units are used, for recording the seismic data, cannot read the data from 3490E cartridge directly. Whenever the data is required to be used in FPU, the 3490E data cartridges were brought to RCC and the data was copied into a 3590 cartridge. The copied 3590 cartridge was taken back to the field for input of data in FPU for processing and quality checks. This procedure delays the process of quality Control (QC) in the field at the data acquisition stage.

In order to make the acquired seismic data available to the FPU in a shorter period for real time QC, four options that were explored at Geophysical Services, ONGC, Jorhat are discussed below.

Limitations in the existing procedure for QC

The recording and storage medium for the data acquisition system (Sercel-make SN388 system) and input medium for processing system (CGG-make FPU) in the seismic field parties are different i.e. 3490E & 3590 respectively, as such FPUs could not read the data from 3490E cartridge directly. This necessitated the field party personnel to bring the 3490E cartridges at a regular time interval, to RCC and then the data was copied into a 3590 cartridge. The copied 3590 cartridges were taken back to the field for QC purpose using FPU. This procedure is depicted in Figure-1 and had the following limitations.

- Delayed QC: - It was time-consuming for the remotely-located field parties to send the recorded cartridges (in 3490E) to RCC and get back the converted cartridges (in 3590) which resulted in the delayed quality control at field using FPU.
- Recurring cost: - The hand carried original and copied cartridges had a recurring transportation cost involved.

Fig. 1: Procedure followed earlier

- Risk involved: - Frequent movement of recorded original data cartridges for copying purpose at RCC involved certain risks.

To overcome these constraints, the following options were explored at GPS,ONGC, Jorhat.

Option-I: (OEM solution)

The OEM , M/s Sercel was contacted for a solution to achieve the desired goal of real time QC using FPU & SN388 instrument in the field. It was suggested to replace the existing 3490E cartridge drive by a new 3590 drive in the SN388 instrument system. Then, the recording in SN 388 system will be done in a 3590 cartridge. Hence no copying/ conversion is needed and the seismic data recorded 3590 cartridge can be used directly in the FPU, facilitating the real time QC.

However, for replacement, it was indicated a basic cost of USD 16,500 as a license fee per system for interfacing SN388 system with 3590 drive. Considering the cost of a new 3590 drive as US$16,500, the total replacement cost worked out to be approximately $33,000/- per unit of SN388 system.

In view of the very high cost involved and to meet the requirement of online quality control of seismic data at the acquisition stage in the field, the authors developed and tested three alternative methods, which are, described hereunder-.

Option-II : (Data copied into a CD)

During the Field Season 2003-04, a copy of the recorded seismic data (5Sec.RL, 579 channels, 6 line swath) was made in a CD, after recording it paralelly in SUN5 w/s of SN388 system and using a PC, a cross cable & Leech FTP protocol (Figure-2). The aim to generate this CD was to have a redundancy of data and for processing on FPU for QC.

Attempts were made to read this SEG-D data written in a CD, using the FPU software but were unsuccessful. Similar efforts were made to read and use it in the processing s/w available in RCCs (Chennai & Jorhat) but the desired output could not be achieved. Number of traces that could be retrieved was less than the recorded and non-uniform trace shifting were noticed.

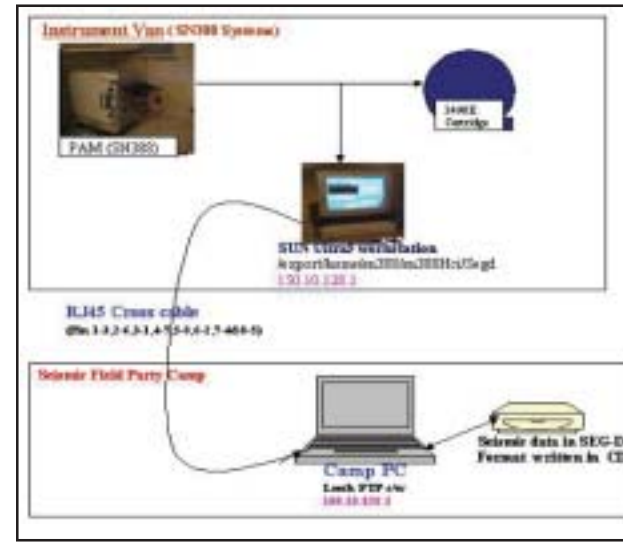

Fig. 2: Transfer of SEG-D seismic data into a CD

Option-III:(Instruments configuration)

One SN-388 instrument with 3490 E cartridge Drive and 3590 drive of FPU were configured on the SN388 system by installing one single ended SCSI card and a Differential SCSI card in the SUN Ultra5 system of SN388. After this configuration, both the drives 3490E and 3590 were now available on the SN388 system for direct cartridge-to-cartridge copy and the data conversion from 3490E medium to 3590 medium could be achieved at the equipment level itself.

The picture of the interfaces between SN388 and FPU using this option is shown in Figure-3.

Data from two field recorded 3490E cartridges were copied on the 3590 cartridges using this configuration. The results were plotted and matched to test the validity of the entire process The plots of the same file taken from the source and copied cartridge are shown at Figure-4. This shows the preservation of data and no distortion is found.

Fig. 3: Instruments configuration

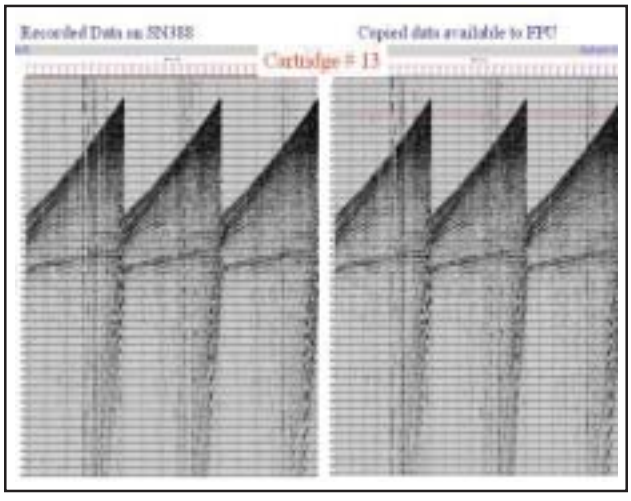

Fig. 4: Plot of original & copied shot data

Individual trace amplitudes both from input and output cartridges, in terms of numerals, were also checked in random and found tallying. The randomly picked traces and their amplitude values from the input (3490E cartridge) & the same traces from the output media (3590 cartridge) are shown at Figure-5. It was observed that the integrity of the data has been maintained. There was no change in the amplitude values.

Time reduction

This approach had eliminated the limitations to a certain extent in terms of time & cost. This is illustrated as following.

The test data had a sampling Interval of 2 ms., Recording Length of 5 Secs., and number of channels were 363. The time taken in copying the data from one 3490E cartridge into a 3590 cartridge using this configuration was 30 minutes

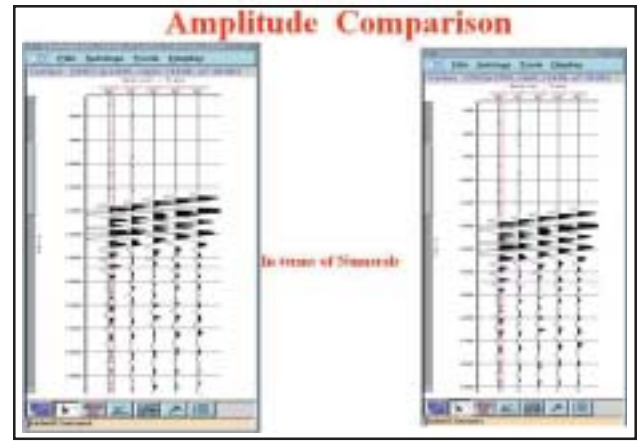

Fig. 5: Trace amplitude comparison from input & output cartridges

Cost involved in field implementation

The additional hardware required for this solution are one Differential SCSI card, one Single Ended PCI SCSI card and a SCSI cable. The Cost of which is approximately Rs.90,000/- per unit. With the existing 3590 drives of FPUs a lengthy signal cable is available. In the camp, whenever the copies are required to be made, the SN-388 Instrument van can be brought near the hut of FPU. The cables are to be connected to the SN-388 system and the drives could be made ready for cartridge-to-cartridge copy of data in either way. This solution can be implemented at a total cost of Rs.90,000/- which is very economical in comparison to replacement of units offered by OEM.

Option-IV (Improvement over Option-III)

In this method, instead of Sun Ultra-5 workstation of SN388 system, emphasis is given on the existing SCSI port of HP workstation of FPU. The SN388 instrument has to be brought near the FPU Hut, without dismantling any module. Then 3490E drive inside the Instrument Van could be connected at the second SCSI port of HP XW 8000 W/S of FPU using 12+2 mt. cable already provided.

Now the data can be transferred to FPU for processing, and storing in 3590 cartridge subsequently. The block diagram of this method is shown at Figure-6.

Components Used

The workstation of FPU- HP XW8000 contains: -

- Two Adaptec-make SCSI Ports 29160 Ultra160 LVD and 2944 UW HVD &

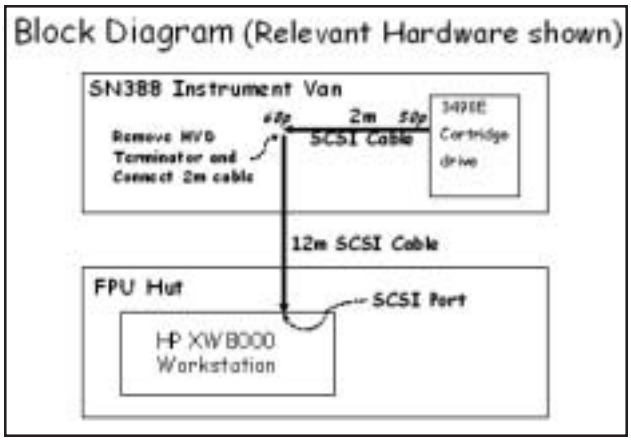

Fig. 6: Block diagram for Option-IV

- 12-meter differential SCSI Cable (supplied for connecting 3590 drive).

SN388 System contains HD68 to HD50 SCSI Cable, which have both side high-density male connectors SUN Part no. 5302115-1.2m/5302228-2m (supplied for connecting CD-ROM drive with RDI Sun laptop, originally provided with the SN388). Hence, in this option, no extra Hardware/ Software cost will incur. (However, in case HD68-HD50 Cable is not available, its approximate cost is Rs. 5000/-)

Time factors

The actual testing of this set-up was carried out with the FPU. The 3490E data cartridge, containing 104 files of seismic line (SR - 2 ms, RL - 6 sec, 296 Channels, split spread), were downloaded in FPU by creating a SEGIN job and was viewed in Geocluster© environment after applying suitable gain and outputs were acceptable. The time taken to download these 104 files of 6 Sec-Record length, 2ms SI, 296 channel data of line TR 42-05 in Geocluster© environment was 5 minutes.

Conclusions

The benefits of the four options explored at GPS, ONGC, Jorhat for making the data available for Real time QC when SN388 and FPU are available in a single field party are:

1. Data is not required to be sent to RCC for cartridge conversion, thereby resulting in saving of cost and time.

2. Field parties working in the field can carry out QC activities independently.

3. Real time availability of data is ensured for carrying out QC checks.

4. Copies of the recorded data cartridges can be made at field itself. This means the recorded media is verified in the field and data is duplicated in another type of media, which is an added advantage of data protection.

5. The solutions can be implemented immediately on SN-388 systems integrated with FPUs.

6. Option-4 is the most cost effective and was successfully implemented in field crews working with SN-388

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