8th Biennial International Conference
& Exposition on Petroleum Geophysics

"HYDERABAD 2010"

P-265

Design, Implementation & Integration of Fast Track Meta-Data Pre-Processing in Field Processing Units - An innovation in throughput & solution oriented approach

Guha Randeep*, Dharmaraj T, Pal J.S, Pandey U.S.D.
Regional Computer Center, ONGC ,Vadodara

Abstract:

The upstream E & P organisations are now a days equipped with the state-of-art hardware & software technology with advanced HPC computing / storage solutions in finding complex solution to geophysical problems. Inline with the modern day requirements of field QC and facilitation of enhanced data quality thru field data processing, almost all the acquisition crews are equipped with scaled down system hardware/software with graphic capabilities to ensure recommended field processing at on-site facility. On board processing in marine vessels or processing for QC-Stack in on land acquisition has now become a worldwide phenomenon, whereby we can QC the attributes before submitting the data to the processing centers.

The current practice of kilo channel recording requires seamless integration of navigation data with the field seismic trace data which necessitates consolidation of the metadata containing statics, elevation and location coordinates through the SPS files showing Shot, Receiver & relational data either manually or by real time up-dation in the recording instrument. This saves lot of time while final data preparation prior to processing in Field Processing Units or subsequently at Processing Centers.

Many constraints were observed, cumbersome methodologies were followed while adopting the available Conventional Processing Work-flow at Field Processing Units for auxiliary data management using Geolcuster S/W which uses default ASCII format (flat file).

To overcome this problem, an attempt was made to design and develop an integrated single-point solution, which was centered on Geocluster software from M/s CGG Veritas, and it's various supplementary formats for handling meta-data. In the improved flow, only navigation data is fed in international navigation standard SPS i.e Shell Processing Support format file and all the necessary processing inputs are generated in a single stroke compatible with the processing software.

The new methodology is very cost-effective, enables maximizing the utilization of QC checks with the scaled down processing systems available with field crews, value added outputs aimed at quality enhancement in data acquisition and substantial reduction in turn around time of total API cycle.

Introduction:

Field processing for facilitating online QC of physical/ geophysical attributes are managed through scaled down system hardware/software with graphic capabilities to ensure recommended field processing at on-site facility. In-field QC and facilitation of enhanced onsite data quality through Field Processing Unit (FPU) has become a common industry practise for most of the acquisition crews operating in both the onshore and offshore areas. The outline workflow, generally practised in the field crews commences with import of raw navigation data followed by QC followed by updating the same with supplementary attributes like Statics, Elevation, Coordinates etc in international navigation standard i.e SPS format with the software under use for survey

E-mail: randeep.guha@gmail.com

Design/Modelling/QC/Export like Geoland, Mesa Expert,Norsar etc.

Consequent to generation of the navigation data, the stage of field processing initiates, which includes reformatting of SPS files into concerned native formats, compatible with the processing software under use. Error free and consistent generation of such native files are immensely required to update the geometry with the corresponding seismic data. The conventional methodology as practised in the field as depicted in Fig 1 lacks the approach of doing rigorous QC primarily due to default non-database approach for auxiliary data management. Moreover, the methodology practised is very cumbersome due to running of multiple job sequences to attain the requisite auxiliary data and manual intervention at various stages.

To overcome such inherent limitations at FPUs, provisioning has been made to cater the field requirements of processing through introduction of an integrated solution, which facilitates generation of all requisite auxiliary data both is ASCII and database formats built in the software, thus enabling extensive graphical QCs of attributes. The solution has been designed as a simplified approach to attain the end-objective with all in-built features for effectively handling the interface in an error-free and intuitive manner. A comparative study of both the approaches (pros-and-cons) along with the functionalities provided in the solution are detailed in the subsequent figures/sections as in methodologies & implementations.

The new conceived flow provides value addition at the field facility through extensive QC options for various attributes like statics , elevation, spread definition etc subsequently followed by Merging/Binning and QC stacks before submitting the data to the processing centers.

Methodology:

The commencement of any Field Processing at on-site or camp facility basically requires the input navigation data i.e. SPS files for Shot,Receiver & Spread. There are various ways of consolidating these metadata either by manually preparing the data or output from recording instrument like UL 408/IO-Scorpion systems. The final data preparation prior to submission to RCC requires up-dation in statics, elevation and location coordinates.

Moreover, value addition is also done at the field facility through extensive QC of various attributes like statics , elevation , spread definition etc subsequently followed by Merging/Binning and QC stacks.

Consequent upon the updated metadata received from the field, such data need to be reformatted into the native formats of the software i.e Geocluster in our case through usage of modules depicted in the workflow of conventional processing (Fig 1).

The recommended QC's at Field facility includes:

- Surface positioning errors pertaining to Shots/Receivers especially in case of shot recoveries. (Must be thru Graphical QC for error detection/correction)
- Statics & Elevation anomaly pertaining to Shots/Receivers and also Statics/Elevation correspondence map (Must be thru Graphical QC for error detection/correction)
- Matching between Shot & Receiver field header locations and post-merging internal header locations
- Matching between Shot Positioning thru LMO method with travel time estimation/correction

The problems generally faced by the field geoscientists in order to achieve above mentioned QCs (some with the auxiliary data and some post geometry merging with seismic data) is to deal with some cumbersome procedures which are enumerated as follows:

Spread file (GEOCOL format) consisting of record, Shot & Receiver Information for 3D Header updation

Coordinates (NAVP1/NAVP2 format) consisting of Source /Receiver surface positioning.

Statics (LIBRI format) consisting of Source /Receiver total statics.

Elevation (LIBRI format) consisting of Source /Receiver Z coordinate Data

Valid File Information consistent with records in relation file for NTBC removal.

GRID information for Binning i.e. information regarding Inlines/Xlines

The nature of repetitive job execution and manual intervention from time-to-time leads to erroneous and inconsistent outputs, which consumes lot of man-hours to debug & troubleshoot. Moreover, the requisite outputs lack extensive graphical QC, which is imperative as recommended field QC before delivery of data to clients.

Conventional Processing Work-flow at Field Processing Units

The methodology for Conventional Processing Work-flow at Field Processing Units suffers from constraints/limitations like:

- running cumbersome job sequences for preparing compatible data format for subsequent data processing.

- it also expects a detailed knowledge of concerned formats (columnar) and know-how to debug/troubleshoot the error messages. Although the auxiliary data management can be done either thru flat file format (LIBRI) or database (E**X**tended **P**rocessing **S**upport - **XPS**) , yet the workflow generates necessary auxiliary data only in flat files (LIBRI format) to be used in the further processing sequence.

- moreover, most serious drawback with this conventional methodology is the lack of default database approach for auxiliary data management (XPS), which enables extensive Graphical QC, and subsequent alteration of data in spreadsheet mode.

Besides above, there are also limitations in handling complex geometries like intermix of receivers i.e Geophone, Marshy geophone, Hydrophone and SVSM (Vectorseis) in a typical shooting spread. Modern acquisition systems, which have digital sensors, equipped specially for multi-component surveys and working in difficult logistics have option of recoding / deploying such receivers. During the field processing wherever channel increment is equal to receiver increment or uniform, geometry merging is simple, but if this case doesn't exist like SVSM appears in increment of 3 whereas Hydrophone / Marshy Geophone has increment of 1, preparation of navigation data for geometry merging and binning doesn't work.
As in most of the cases, it is normally recommended to use the SPS data generated from acquisition systems, it has become a major challenge to circumvent this problem of channel, receiver mismatch to produce valued added QC attribute analysis and QC stack generation. The conventional process flow is depicted pictorially in Fig 1.

Subsequently the need was felt to devise a methodology/workflow, which is devoid of hassle free translation of navigation data into useful information required in field processing. An effort was made to overcome all the constraints faced in the conventional methodology enabling fast track decision-making, quality enhancements and drastic reduction in turn- around time at the Field location itself.

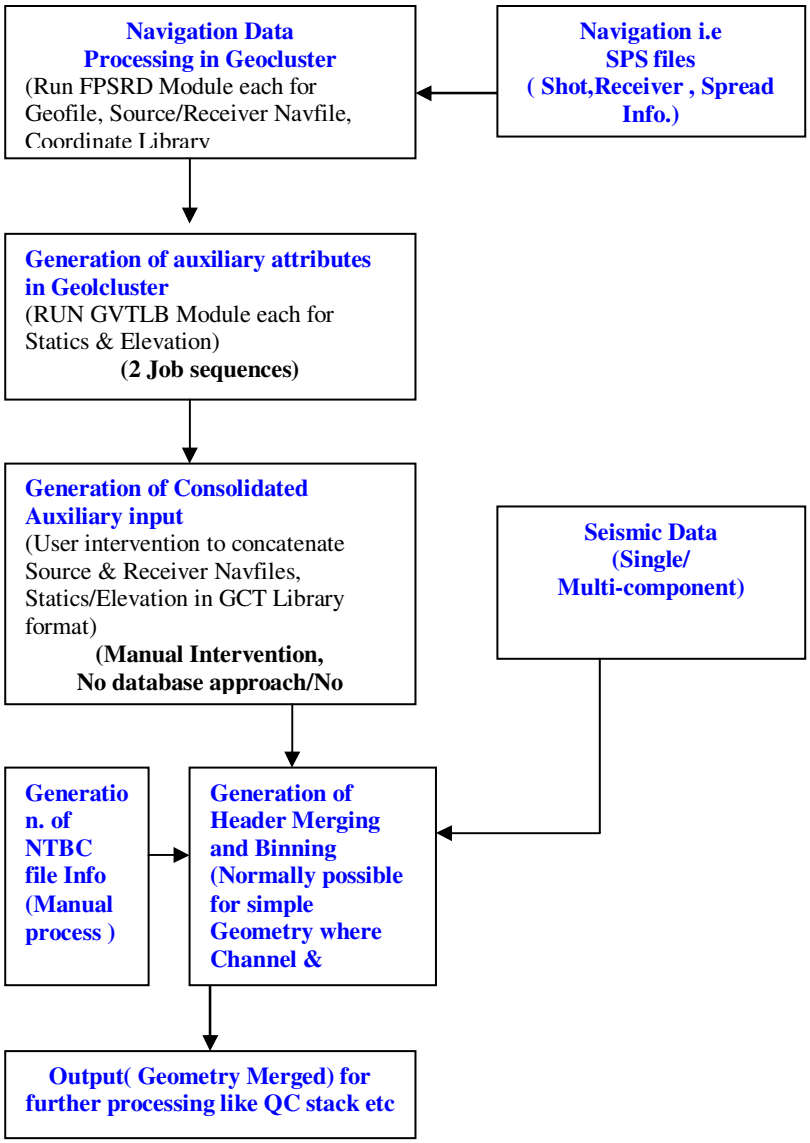


Fig 1 Flow diagram – Conventional Processing Workflow

Alternatively "**Fast Track Meta-Data Pre-Processing for FPU**" was conceptualized which highlights on the following aspects

- All desired inputs required for field processing clubbed in single-package concept through single-entry-exit point/input i.e. SPS files.(Simplified approach)
- Outputs generated are geofile, coordinates for source & receiver and generation of statics & elevation library thru a single-mouse click

- Customised validation of inputs like correct SPS Type and mandatory parameters in-built in the interface (User-friendly intuitive interface)
- All the outputs generated are both in specific LIBRI formats + XPS formats without any user intervention.
- All the outputs generated are both in specific LIBRI formats + XPS formats without any user intervention.
- Mapping of all necessary header words recorded in field by SN388/UL 408 & IO-Scorpion including multi-component relevant headers thru suitable customization.
- Incorporation of Utility programs in the package like NTBC files recognition

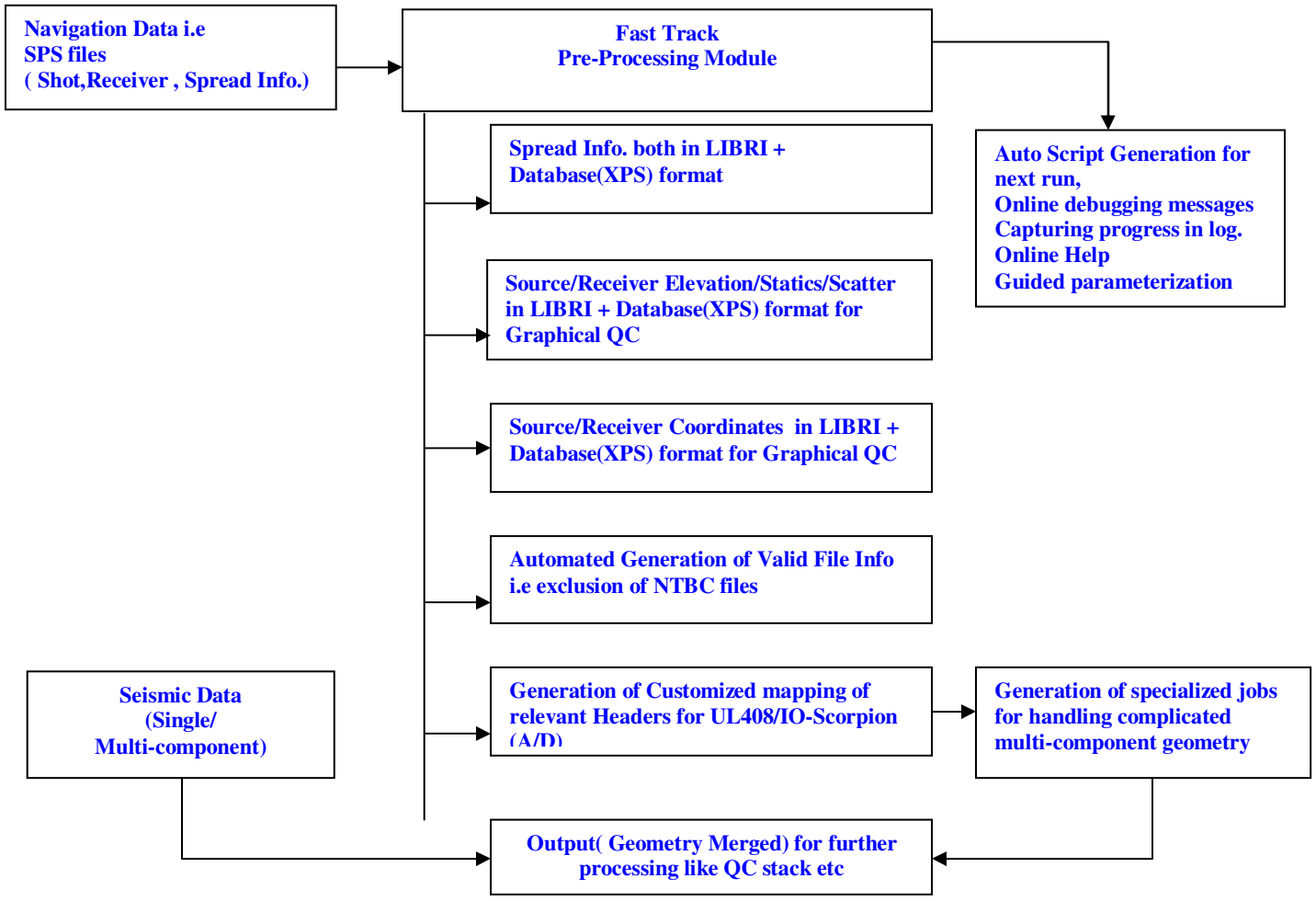


Fig 2 Flow diagram – Fast Track Meta-Data Pre-Processing Workflow

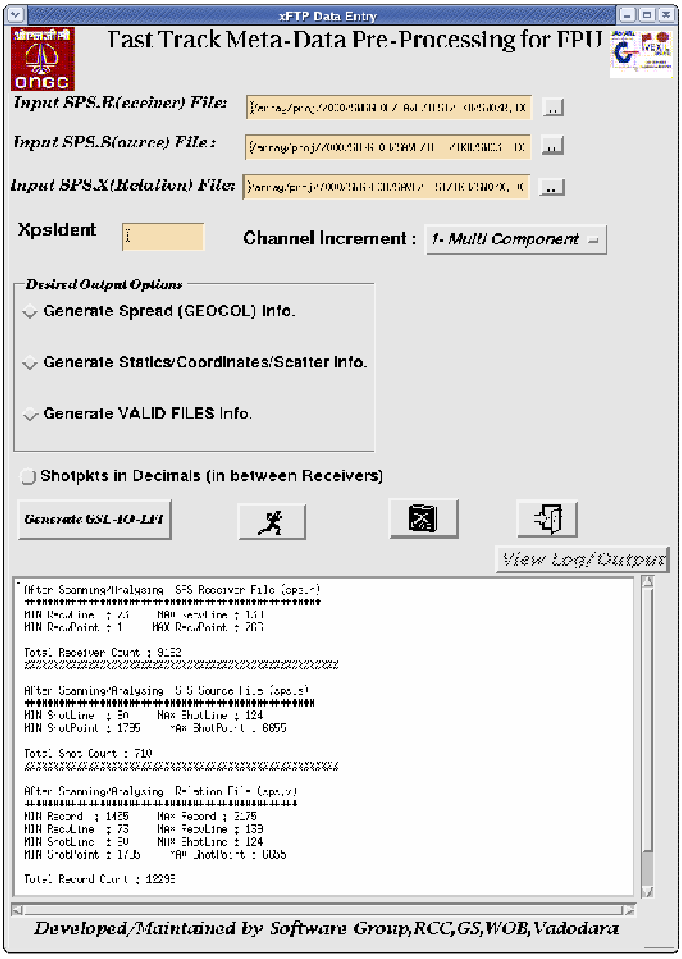
Fast Track Meta-data Pre-Processing Methodology-Implementations

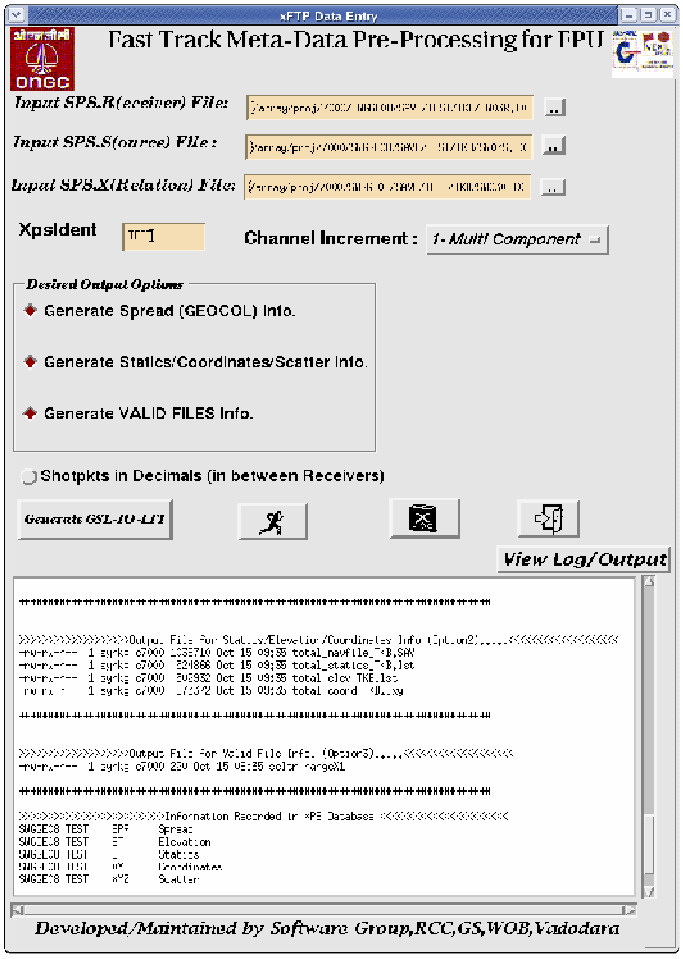
Consequent upon the conceiving the minimal input required to facilitate the generation of auxiliary processing inputs, an C/Motif interface was developed with back-end scripts/programs in C/Fortran enabling embedding all functionalities like min-max display of navigation data, reporting of wrong input file, filling of mandatory parameters, guided parameterisation, online help, logging debugging information, flexibility in selecting options, handling shot points in decimals etc.
Fig 2 depicts the Fast Track Meta-Data Processing workflow in which the manual job sequences (mandatory in the conventional workflow) were eliminated, enabling a simplistic outlook to throughput and solution oriented approach which facilitates a single entry-exit interface to achieve the end result for generation of requisite auxiliary inputs for further processing sequence.

Moreover, the workflow also handles some complicated receiver deployment through incorporation of hydrophones, marshy geophones especially in multi-sensor acquisition surveys. Special care has been taken to attend any 2D/3D SPS navigation data inclusive of case in which shot (depicted as decimal) is in between receivers.

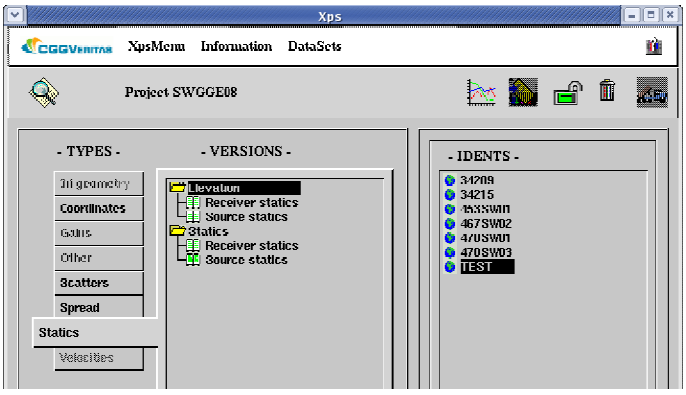
The methodology was mainly aimed to address the processing problems at FPUs, installed at field facility faced with I/O Scorpion acquisition systems, which is essentially multi-sensor in nature, which the conventional field processing methodology fails to attend. Eventually the same has been extended into an approach, which holds good for any type of acquisitions .It has been validated in almost all the field crews deployed at Geophysical services, Western Onshore Basin. It has been thoroughly tested with various SIGs, which were essentially multi-sensor acquisition and shooting were done with varied type of sensors leading to complicated SPS data. This methodology would in fact, enable readiness to handle the field processing of forthcoming proposed 3D-3C surveys effectively. Time-to-Time feedback was obtained from end-users to facilitate the field processing requirements along with the deployment strategy to install this integrated solution.

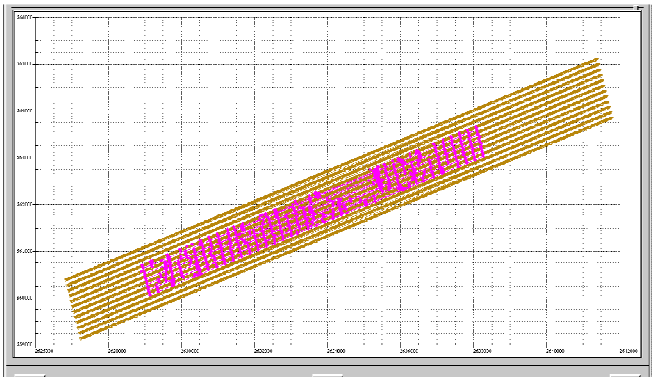
Following are some of the pictorial representations of the integrated interface along with the functionalities:





xFTP Interface showing analysis (MIN-MAX)of navigation data(SPS) along with various options for auxiliary data generation / Indication of Mandatory parameters / Progress indicated in Output Area

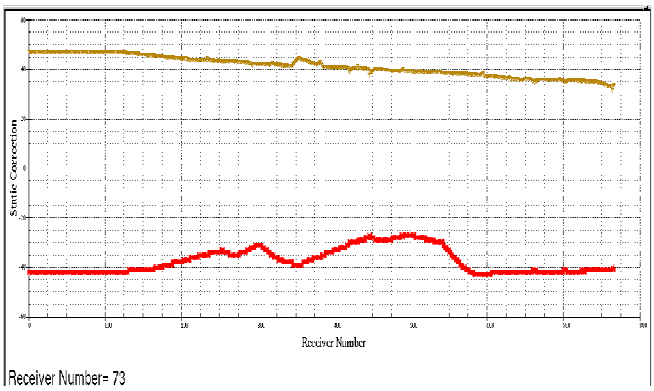




Simultaneous generation of auxiliary data like coordinates, Representing Source/Receiver coordinates as Scatters,Spread, Statics in flat-file as well in database format as part of graphical QC from database post xFTP

	Source Number	Line Number	X Abscissa	Y Ordinate	Elevation	Static Correction	Source Depth	Point Number	Point Index	Uphole Time	Source Code
690	12442151	124	2633706.75	561547.31	40.50	-11.00	24.60	4215	1	0.0	11
691	12443351	124	2633470.50	561473.19	40.20	-11.00	24.70	4335	1	0.0	11
692	12444951	124	2633174.25	561374.19	40.10	13.00	22.00	4495	1	0.0	11
693	12445951	124	2632992.00	561324.87	40.00	-13.00	23.00	4595	1	0.0	11
694	12446951	124	2632793.75	561250.62	39.90	-12.00	24.00	4695	1	0.0	11
695	12448151	124	2632565.50	561176.50	39.80	11.00	24.10	4815	1	0.0	11
696	12449052	124	2632397.25	561108.31	39.70	-10.00	23.00	4905	2	0.0	11
697	12450551	124	2632109.00	561028.19	39.70	-9.00	25.70	5055	1	0.0	11
698	12451751	124	2631900.75	560954.00	39.10	-9.00	24.50	5175	1	0.0	11
699	12452951	124	2631652.50	560879.81	38.90	9.00	25.30	5295	1	0.0	11
700	12454151	124	2631424.25	560805.69	38.60	-9.00	24.00	5415	1	0.0	11
701	12455351	124	2631196.00	560731.50	38.40	-10.00	24.30	5535	1	0.0	11
702	12456551	124	2630967.75	560657.38	34.20	12.00	22.00	5655	1	0.0	11
703	12457751	124	2630549.25	560521.30	37.60	-10.00	25.00	5875	1	0.0	11
704	12458951	124	2630511.25	560509.00	37.60	-10.00	25.30	5895	1	0.0	11
705	12459951	124	2630435.25	560484.31	37.60	-9.00	25.50	5995	1	0.0	11
706	12459751	124	2630359.00	560459.62	37.40	-8.00	26.40	5975	1	0.0	11
707	12462751	124	2629788.50	560274.19	37.60	8.00	26.10	6275	1	0.0	11
708	12463951	124	2629561.50	560201.87	37.50	-8.00	26.00	6395	1	0.0	11
709	12464951	124	2629370.00	560138.19	36.50	8.00	24.00	6495	1	0.0	11
710	12466152	124	2629141.75	560064.12	36.10	-9.00	23.00	6615	2	0.0	11

Display of various attributes in columnar spreadsheet form



Statics/Elevation correspondence map across a RL

The advantages derived out of the conceived model would immensely help the field geoscientists to produce QC-Stacks at the field site facility and run through a set of graphical QCs of attributes either during the on-going field operations or before delivering the final data to respective processing data centers. Following are the imperative benefits perceived in this fast track processing methodology

- Avoidance of running cumbersome/repetitive FPSRD sequences for generation of auxiliary files for merging/gridding.
- Hassle free generation of inputs for processing in FPU without bothering about internal formats.
- In-built generation of requisite inputs in both LIBRI + XPS formats. Graphical QC's enforced thru XPS
- Independent of Geoland & multiple job sequences for producing inputs for merging/gridding.
- Utilizing merging module to work with complex SPS file format especially 3-component geometry (Channel Assignments) including Hydrophones & Marshy Geophones
- Incorporation of standard header up-dation & extensive use of XPS database in the workflow for QC purpose.

Conclusion & Future Scope

With the advent of state-of-the-art acquisition systems equipped at the fields crews with volumetric recording capabilities in terms of channels and quality of acquired data has become the major concern, such consolidated package with all in-built helps/checks would generate the requisite auxiliary inputs for field processing within no-time and without extensive knowledge about the internal data formats.

Moreover, it would drastically reduce the turn around time for recommended field quality checks ensuring minimization of human intervention, cost and time effectiveness, customer satisfaction and last, but not the least significant reduction in **API cycle time**.

Some other auxiliary information like charge size, near surface velocity, uphole information can also be incorporated in the same interface so that similar graphical QCs can be enforced.

Acknowledgements

The authors express gratitude to ONGC for providing resources, support to carry out this work.

Authors are grateful to Shri P.B.Pandey , Basin Manager ,Western Onshore Basin ONGC, Vadodara for his keen interest and permission for presentation/publication of this paper in SPG Conference and Exposition 2010.

Authors are thankful to Dr. S.Viswanathan, Head Geophysical Services, ONGC, Vadodara for his encouragement, inspiration & guidance.

The authors also express their gratitude to personnel from Geophysical Field Parties and Regional Electronics Laboratory ONGC Vadodara for providing input, support & suggestions.

The authors are also thankful to the end-users for extending their critical review and feedback from time to time for further improvement.

The views expressed in the paper are solely of the authors and do not necessarily reflect the views of the organization which they belong to.