

C.S.E.G. Geophysical Workstation SEG Y Standards

by Doug Bath

Following is a list of the SEG Y Standards Committee:

- Bruce Gawalko Sceptre Resources Ltd.
- Larry Adorjan Amoco Canada Ltd.
- Larry Walton Veritas Seismic Ltd.
- John Vermette Dyad Data Services Ltd.
- George Wirth Dyad Data Services Ltd.
- Tom Cox GeoQuest Systems Ltd.
- Ron Smaniotto Vector Archives Ltd.
- Ken Hedlin Husky Oil Operations Ltd.
- Dwight Landmark/ Mildenberger ITA Ltd.
- Dave Morgan Geo-X Systems Ltd.
- Allan Willis Geo-X Systems Ltd.
- Darrol Proskow Boyd Exploration Ltd.
- Dave Coldham Kernel Technology Ltd.
- John Townsley Geophysical Microcomputer Applications Ltd.
- David Jenkins Kerr McGee (Co-Chairman) Canada Ltd.
- Doug Bath ITS Interactive (Co-Chairman) Technical Services Ltd.

that it was far beyond our mandate to suggest a replacement for the SEG Y format. We also recognize that the thousands of SEG Y tapes now in existence will probably not be updated to the CSEG standard. It is the hope of this committee that the stan-

dards outlined will be followed for all new SEG Y data, but this can only happen if the consumers of this data (i.e., the oil companies) ask that their vendors adhere to the CSEG SEG Y standard.

SUGGESTED STANDARDS FOR SEG Y TAPES

2D and 3D data

1) 3200 byte EBCDIC header consisting of:

- Area name;
- Processing Center;
- Processing date;
- Datum elevation used for structure statics;
- Time to first sample;
- Processing history as detailed as possible;
- Survey datum (NAD 27, NAD 83);
- UTM Zone or central meridian;
- Header byte locations for critical items such as shotpoint, X Y coordinates.

2) 400 byte binary header containing at least:

| Byte Location | Format | Value |
|---------------|----------------|--|
| 17-18 | 16 bit integer | Sample rate of this data in microseconds |
| 21-22 | 16 bit integer | Number of samples for this data |
| 25-26 | 16 bit integer | Data Sample format code |
| | | 1 32 bit floating point |
| | | 2 32 bit integer |
| | | 3 16 bit integer |
| | | 4 32 bit integer with gain code |
| | | 5 36 bit floating point |
| | | 6 IEEE 32 bit floating point |
| | | 8 8 bit integer |
| 55-56 | 16 bit integer | Measurement system |
| | | 1 metres |
| | | 2 feet |
| 399-400 | 16 bit integer | Time to first sample in ms. |

3) 240 byte trace header

4) Sample values written in format indicated in (2) above. Record length and sample rate fixed for each line. Inter-record gap between tape blocks (Tape media only). One trace per block.

5) EOF.

Each line written to tape should follow the above sequence with one EOF between lines and 2 EOFs after the last line. Subsequent tapes in multi-tape volumes should have EBCDIC and binary headers at the start of each tape.

SUGGESTED STANDARDS FOR SEG Y TRACE HEADERS

The following should be the minimum information in each trace header for 2D stack data:

| Byte location | Format | Value |
|---------------|----------------|---|
| 1-4 | 32 bit integer | Trace number within line |
| 5-8 | 32 bit integer | Trace number within volume |
| 17-20 | 32 bit integer | Interpolated station number above this CDP multiplied by 1000 |
| 21-24 | 32 bit integer | CDP number |

With the proliferation of geophysical workstations in the industry it was felt by several members that the standards for SEG Y stack data should be re-examined and if necessary brought up-to-date. Accordingly a committee was formed to discuss standards for geophysical workstation SEG Y data formats. The following is a summary of the committee's recommendations. This committee actually followed in the footsteps of a previous committee formed in 1987 to examine the same issue. Their findings can be found in the October 1989 issue of the *Recorder*. While their recommendations are still valid today, (in fact they form the backbone of this committee's report), it is evident to anyone involved in workstation data loading that the standards recommended are not being rigorously adhered to. Although the limitations of the SEG Y format are well known, and are being addressed by the Petroleum Open Standards Consortium (P.O.S.C.), this committee felt

| Byte location | Format | Value |
|---------------|----------------|--|
| 29-30 | 16 bit integer | Trace ID code 1 Live trace 2 dead trace |
| 71-72 | 16 bit integer | Coordinate scalar. Positive for multiplier, negative for divisor |
| 73-76 | 32 bit integer | X coordinate of CDP |
| 77-80 | 32 bit integer | Y coordinate of CDP |
| 81-84 | 32 bit integer | X coordinate of CDP |
| 85-88 | 32 bit integer | Y coordinate of CDP |
| 89-90 | 16 bit integer | Coordinate units 1 Length. Metres or feet (UTM) 2 Seconds of arc (Lat- long) |
| 115-116 | 16 bit integer | Number of samples in trace |
| 117-118 | 16 bit integer | Sample interval in microseconds |

* All traces, even zero fold dead traces should be annotated.

The following should be the minimum information in each trace header for 3D stack data:

| Byte | Format | Value |
|---------|----------------|--|
| 17-20 | 32 bit integer | Row number (Crossline, east-west line, etc.) |
| 21-24 | 32 bit integer | Column number (inline, north-south line, etc.) |
| 29-30 | 16 bit integer | Trace ID code 1 Live trace 2 dead trace |
| 71-72 | 16 bit integer | Coordinate scalar. Positive for multiplier, negative for divisor |
| 73-76 | 32 bit integer | X coordinate of bin centre |
| 77-80 | 32 bit integer | Y coordinate of bin centre |
| 81-84 | 32 bit integer | X coordinate of bin centre |
| 85-88 | 32 bit integer | Y coordinate of bin centre |
| 89-90 | 16 bit integer | Coordinate units 1 length. Metres or feet (UTM) 2 Seconds of arc (Lat- long) |
| 115-116 | 16 bit integer | Number of samples in trace |
| 117-118 | 16 bit integer | Sample interval in microseconds |

The outside label of a SEG Y tape can be an important source of information about the tape or extremely vague and misleading. The following standards are offered as a guide to the minimum information that should be found on a tape label.

The following should be the minimum information on the outside label of a 2D stack tape:

- 1) Area name
- 2) Company name
- 3) Line name(s)
- 4) Processor
- 5) Processing date
- 6) Type of processing (At least stack or pre-stack, as extensive as space permits)
- 7) Tape density (Important for 8 mm tapes as well as 9 track)
- 8) Record length in ms
- 9) Sample rate in ms
- 10) Format (Floating point, Integer)

- 11) Shotpoint range (From first trace to last, not just field shot range)
- 12) Shotpoint scalar (1000)
- 13) Trace number within line
- 14) Tape number in multi-tape sequence.

The following should be the minimum information on the outside label of a 3D stack tape:

- 1) Area name
- 2) Company name
- 3) Prospect name (If different from area name)
- 4) Processor
- 5) Processing date
- 6) Type of processing (At least stack or pre-stack, as extensive as space permits)
- 7) Tape density (Important for 8 mm tapes as well as 9 track)
- 8) Record length in ms
- 9) Sample rate in ms
- 10) Format (Floating point, Integer)

- 12) Line range (May be referred to as columns, inlines, north-south lines, etc.)
- 13) Trace range within line (May be referred to as rows, crosslines, east-west lines, etc.)
- 14) Orientation of this data set (north-south or east-west)
- 15) Azimuth angle of this data set (Use at least 5 decimal places)
- 16) Bin size in both directions
- 17) X Y coordinates for all four corners
- 18) Tape number in multi-tape sequence
- 19) Indicate if dead traces dropped.

The following items are desirable but not essential. Applies to 2D and 3D labels:

- 1) Header byte locations for critical items such as shotpoint, X Y coordinates, row column
- 2) Survey datum (NAD 27, NAD 83)
- 3) UTM Zone or central meridian
- 4) Time to first sample.

If SEG Y volumes consist of multiple versions of lines the version of the line that is most likely to be loaded onto a workstation (e.g., filtered migration) should be the first file on tape followed by the other versions in descending order of loading probability (e.g., filtered structure stack, unfiltered migration, unfiltered structure). With multiple lines all the lines of each processing type should be grouped together to facilitate data loading (i.e., all the filtered migrations followed by all the filtered structures, etc.).

The aim of the committee was to publish a reasonable standard that could be adhered to by all parties without making major software changes. Accordingly we have avoided changes to the existing standard. The only item in the above standard that is new is the additional option for the flag in the binary header to denote IEEE floating point. Most if not all seismic processing and tape copy centres are capable of writing SEG Y data to this standard now. It is up to the industry to encourage them to do so.

The committee wishes to thank the C.S.E.G. Executive for encouraging our work and also gives thanks to the members of the previous committee for their efforts. We thank all the people in the industry who offered their views and advice.