Halliburton-BHS SEGY

Revision 1.1

October 2010

HALLIBURTON

Table of Contents

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1 Introduction

This document describes the Halliburton Borehole Seismic (BHS) SEG-Y format as created by the Landmark SeisSpace process “SEG-Y Output”. This format is the standard customer data export and exchange file format for Halliburton Borehole Seismic processing services.

Differences between BHS SEG-Y and the SEG SEG-Y Standard Rev0 are noted as these are encountered in the format description. The format is in the main compatible with the SEG standard, with some extensions (highlighted in this document) for borehole seismic data types.

The BHS SEG-Y data format is intended primarily for disk devices.

2 Summary

For purposes of consistency and compatibility, all external SEG-Y file names use the 3-character extension “sgy”.

BHS SEG-Y follows disk SEG-Y Rev 1 conventions when creating files on disk or cd-rom media (not on streaming tape).

The BHS standard employs a fixed trace length, although it supports variable length traces as an option. Fixed length traces are recommended.

The SEG-Y standard is big-endian. Byte swapping is required on little-endian machines when encoding or decoding the SEG-Y format.

The SEG-Y standard is one file per tape (if used). Either 4mm or 8mm cassette tape is preferred. However, it is expected that most of our data will be exchanged as disk files, not as tape.

Although BHS and SeisSpace support 5 data formats on output (7 on input), BHS SEG-Y normally employs IBM (code 1), or IEEE (code 5) floating point formats to store trace data.

3 SEG-Y Overview

The SEG-Y Revision 0 tape format standard was developed by the Technical Standards Committee of the Society of Exploration Geophysicists in 1975. It was designed to meet current needs and provide flexibility for expansion as new technology and new ideas emerge. The detailed specifications of the SEG-Y standard are described in the booklet *Digital Tape Standards*, published by SEG.

There is a proposed revision of the 1975 standard known as SEG SEG-Y Rev1. Appendix A of that document outlines procedures for storing SEG-Y data as disk files (as opposed to tape).

In this section we will provide a brief overview of the SEG-Y format, highlighting those areas wherein BHS practice may deviate from the standard.

3.1 SEG-Y Data Components

SEG-Y data has two major components: the reel identification header and the trace data blocks. Data are stored as IBM 4-byte integers, IBM 4-byte floats, and IBM EBCDIC 1-byte characters. The SEG-Y standard is big-endian (IBM 370, Motorola), with the most significant byte written closest to the beginning of the file while the least significant byte is written closest to the end of the file. Byte swapping is required for little-endian (Intel) processors.

3.1.1 Reel Identification Header

The reel identification header contains information about the trace data blocks that follow. This header is divided into two blocks:

• The EBCDIC header consists of 3200 bytes of information stored in EBCDIC card image format. A total of 40 lines of 80 columns are provided to write information pertaining to data acquisition, data processing, etc.

• The binary header trails the EBCDIC header and consists of 400 bytes of binary information. The first 60 bytes are assigned to specific purposes; the other 340 bytes are provided for optional use. Some of the key byte assignments in the 400-byte binary header section are listed below:

Byte Numbers	Description

3205-3208	Line number
3217-3218	Sample interval in ms
3221-3222	# of samples per data trace
3225-3226	Data sample format code
3255-3256	Units. 1 meters 2 feet

3.1.2 Trace Data Blocks

The trace data blocks follow the 3600 bytes of reel identification header information. Each trace data block consists of a fixed 240-byte trace identification header and then the actual seismic trace data. Some of the key byte assignments in the 240-byte trace identification header are listed below:

Byte Numbers	Description
1-4	Trace sequence number
9-12	Original field file ID
21-24	CDP ensemble number
73-76	Source X coordinate
77-80	Source Y coordinate
81-84	Group X coordinate
85-88	Group Y coordinate

Trace data samples may be written in any of four standard SEG-Y data sample formats or in several nonstandard formats that have emerged over the years. Those formats supported by BHS SEG-Y output are highlighted:

Trace Sample Format	Code	Description
SEG-Y Standard Formats		
IBM Float	1	32-bit IBM floating point

Integer 4-Byte	2	32-bit fixed point
Integer 2-Byte	3	16-bit fixed point
Fixed Point with Gain	4	32-bit fixed point with gain (obsolete)
Non-Standard Formats		
IEEE Float	5	32-bit IEEE floating point
Float 2-Byte	7	16-bit floating point
Integer 1-Byte	6	8-bit fixed point

4 BHS SeisSpace SEG-Y Output

SEG-Y Output creates industry standard SEG-Y tapes and disk files and is also used to build the BHS custom SEG-Y. Table highlighting indicates custom fields. Not all fields are in active use or populated.

4.1 Theory

This process offers the option of writing a SEG-Y disk image file in IEEE format. The disk format allows the retention of some of the header information for later use, while writing out a SEG-Y format disk file.

Note: The location coordinates: SOU_X, SOU_Y, REC_X, REC_Y are stored as 4 byte integers in SEG-Y trace headers. Due to the storage type, values less than or equal to 7 digits are stored precisely. Values greater than 7 digits will be rounded. If coordinates have greater than 7 digits BHS SEG-Y will use the SEG-Y Output remap feature and save the coordinates as double precision floats in the extended trace header. If this is necessary, the circumstances and location will be annotated separately.

4.2 BHS SEG-Y Trace Header Byte Definitions

Bytes	Use
1-4	trace sequence number within line
5-8	trace sequence number within reel
9-12	original field record number
13-16	trace number within the original field record (channel)
17-20	energy source point number
21-24	CDP ensemble number
25-28	trace number within CDP ensemble
29-30	trace identification code 9=reference 11=hydrophone 12=vertical 13=crossline horizontal (HX, H1) 14=inline horizontal (HY, H2)
31-32	number of vertically summed traces
33-34	number of horizontally stacked traces (fold)
35-36	data use: production or test
37-40	distance from source to receiver
41-44	receiver group elevation
45-48	surface elevation at source
49-52	source depth below surface
53-56	datum elevation at receiver
57-60	Final seismic reference datum elevation x 10000 (integer)
61-64	water depth at source
65-68	water depth at receiver
69-70	scalar for bytes 41-68
71-72	scalar for bytes 73-88
73-76	source X coordinate
77-80	source Y coordinate
81-84	receiver X coordinate

85-88	receiver Y coordinate
89-90	coordinates units – to database
91-92	weathering velocity
93-94	sub-weathering velocity
95-96	uphole time at source
97-98	uphole time at receiver
99-100	source static correction
101-102	receiver static correction
103-104	total static applied
105-106	lag time A
107-108	lag time B
109-110	delay recording time
111-112	mute time start
113-114	mute time end
115-116	number of samples in this trace
117-118	sample interval in this trace
119-120	gain type of instruments
121-122	instrument gain constant
123-124	instrument early gain
125-126	correlated flag
127-128	sweep start frequency
129-130	sweep end frequency
131-132	sweep length
133-134	sweep type
135-136	sweep start taper length
137-138	sweep end taper length
139-140	sweep taper type
141-142	alias filter freq
143-144	alias filter slope
145-146	notch filter freq

147-148	notch filter slope
149-150	low cut freq
151-152	high cut freq
153-154	low cut slope
155-156	high cut slope
157-158	year recorded
159-160	day of year recorded
161-162	hour of day recorded
163-164	minute of hour recorded
165-166	second of minute recorded
167-168	time basis code
169-170	trace weighting factor used in 32, 16, and 8 bit integer formats
171-172	geophone group number of roll switch pos. 1
173-176	Measured Depth below well reference elevation, MD x 10000 (integer)
177-178	Source ID
179-180	Geophone no.
181-184	True Vertical Depth below well reference elevation, TVD x 10000 (integer)
185-188	Well reference elevation (KB etc) x 10000 (integer)
189-192	Source reference elevation x 10000
193-196	Source depth below source reference elevation x 10000
197-208	Not used
209-212	First break pick time, msec x 1000 (integer)
213-216	Reference pick time (Tref), msec x 10000 (integer)
217-224	Not used
225-228	Time correction from source to datum, msec x 1000 (integer)
229-232	Secondary pick time, msec x 1000 (integer)
233-240	optional use