H10943

NOAA FORM 76-35A

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

DESCRIPTIVE REPORT

Hydrographic /
Type of Survey Side Scan Sonar / Multibeam

Field No. W

Registry No. H10943

LOCALITY

State Texas

General Locality Gulf of Mexico

Locality 38 NM SE of Galveston

2000

CHIEF OF PARTY
Steven A. Lemke

NOAA FORM 77-28 (11-72)	U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NO. H10943
	HYDROGRAPHIC TITLE SHEET	
INSTRUCTIONS - The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.		FIELD NO. W

State TEXAS

General locality GULF OF MEXICO

Locality 38 MILES ~~SSW~~ SE OF GALVESTON

Scale 1:20,000 Date of survey 7 Dec 1999 – 26 Jan 2000

Instructions dated 23 October 1997 as amended Project No. OPR-K171-KR

Vessel R/V Neptune

Chief of party STEVEN A. LEMKE

Surveyed by S.Lemke, G.Ghiorse, A. Quintal, R. De Keyzer, D. Walker, J. Dietz, P. Donaldson, R. Nadeau ,

Soundings taken by (**echo sounder**,) hand lead, pole MULTIBEAM RESON SEABAT 8101

Graphic record scaled by survey personnel

Graphic record checked by survey personnel

Protracted by H.P. DESIGN JET 2500 (AHB) Automated plot by HP1055CM (FIELD)

Verification by ATLANTIC HYDROGRAPHIC BRANCH PERSONNEL

Soundings in fathoms (**feet,**) meters at MLW, (**MLLW**)

REMARKS: Contract # 50-DGNC-8-90025/SAIC
Contractor Name: Science Applications International Corp.
221 Third Street; Newport, RI 02840
HANDWRITTEN NOTES IN THE DESCRIPTIVE REPORT WERE MADE DURING OFFICE PROCESSING.

AWS/SURF 8/02 45

NOAA FORM 77-28 SUPERSEDES FORM C&GS-537.

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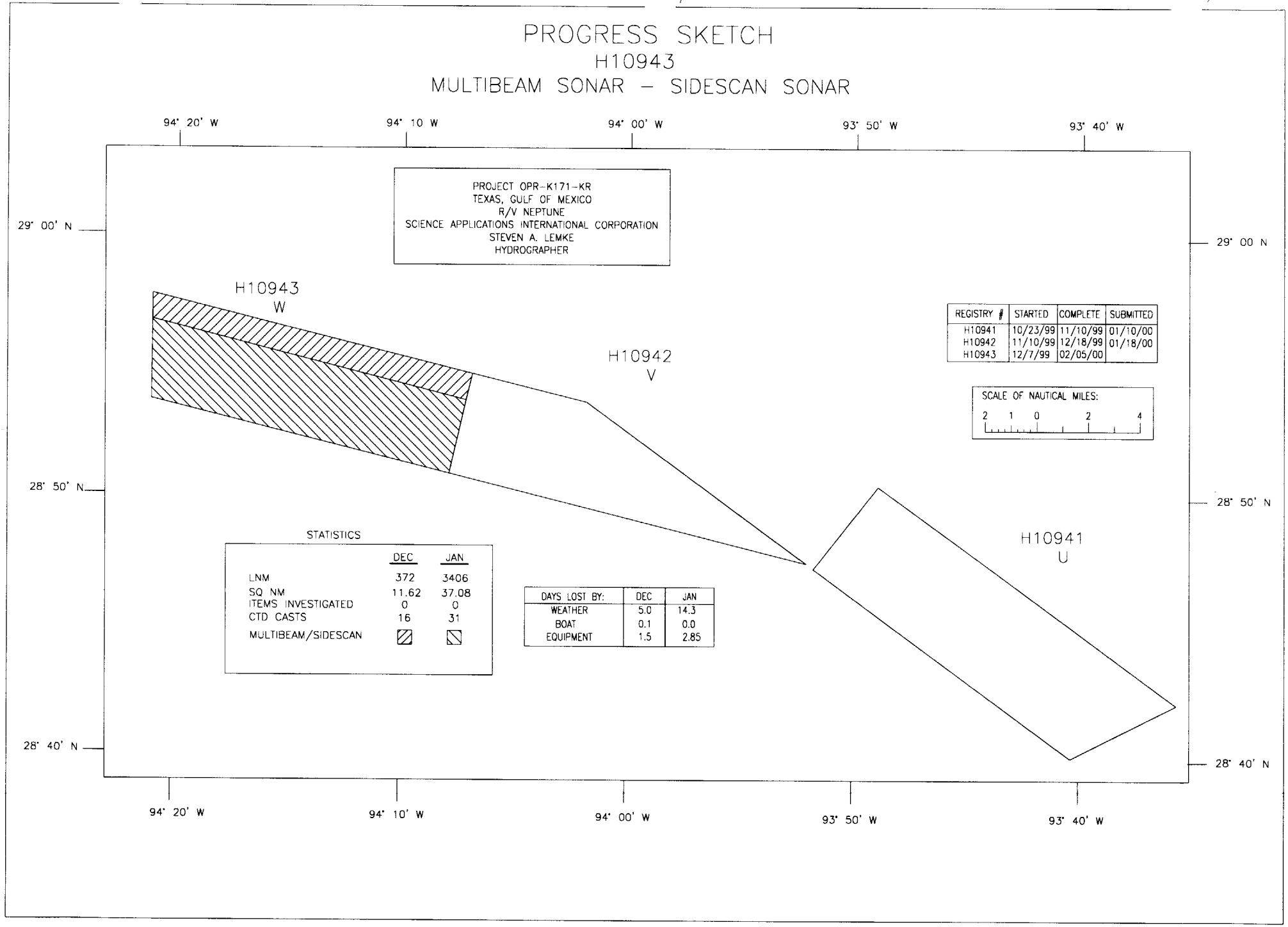
The Progress Sketch on the following page indicates:

1. Survey Outlines
2. Field Survey Letters and Survey Registry Numbers
3. Work Accomplished by Month

PROGRESS SKETCH
H10943
MULTIBEAM SONAR – SIDESCAN SONAR



* FILED WITH THE ORIGINAL FIELD DATA

* FILED WITH THE ORIGINAL FIELD DATA

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Descriptive Report to Accompany
Hydrographic Survey H10943
Scale 1:20,000 Surveyed 1999-2000
R/V NEPTUNE
Science Applications International Corporation (SAIC)
Steven A. Lemke, Hydrographer

A. PROJECT

Project Number: OPR-K171-KR

Dates of Instructions:	23 October 1997	**Original:** 50-DGNC-8-90025/SAIC
	5 January 1998	Modification #1:56-DGNC-8-24001/SAIC
	7 August 1998	Modification #2:56-DGNC-8-24002/SAIC
	9 November 1998	Modification #3:56-DGNC-9-24003/SAIC
	9 April 1999	Modification #4:56-DGNC-9-24004/SAIC
	12 July 1999	Modification #5:56-DGNC-9-24005/SAIC

Dates of Supplemental Instructions: 4 August 1998, 25 May 1999
Sheet Letter: W
Registry Number: H10943
Purpose: To provide NOAA with modern, accurate hydrographic survey data acquired using shallow water multibeam and side scan sonar technology with which to update the nautical charts of the assigned area.

B. AREA SURVEYED

Description:

The area surveyed was primarily the Shipping Safety Fairway at the Approach to Galveston, Texas. The following coordinates bound the survey approximately:

28 57 38.74320N	094 21 01.31040W
28 54 42.56280N	094 06 53.10720W
28 50 51.56520N	094 07 52.64040W
28 53 35.74320N	094 21 01.74240W

Dates of multibeam acquisition (UTC)

12/07/99 – 12/08/99	JD 341 – 342
12/11/99	JD 345
12/14/99 – 12/17/99	JD 348 – 351
12/19/99 – 12/20/99	JD 353 – 354
01/05/00 – 01/06/00	JD 005 – 006
01/09/00 – 01/14/00	JD 009 – 014
01/16/00 – 01/19/00	JD 016 – 019
01/25/00	JD 025
01/29/00	JD 029
02/05/00	JD 036

Dates of sidescan acquisition (UTC)

12/11/99	JD 345
12/14/99 – 12/17/99	JD 348 - 351
12/19/99 – 12/20/99	JD 353 - 354
11/09/00 – 11/14/00	JD 009 - 014
11/17/00 – 11/20/00	JD 017 - 020
01/25/00 – 01/26/00	JD 025 - 026

C. SURVEY VESSEL

The R/V Neptune was the platform for multibeam sonar, side scan sonar, and sound velocity data collection. Two CONEX containers were welded in place on the aft deck of the R/V Neptune. One container was used for multibeam and side scan data collection, the other for data processing. The POS/MV IMU was mounted on the vessel centerline just forward and above the RESON 8101 transducer, below the main deck. The multibeam sounder transducer was mounted on the keel. The side scan sonar tow position was located at the "A" frame aft center. A double-armored co-ax conductor cable on a SeaMac winch was used for towing the side scan. Table C-1 is a list of vessel characteristics for the R/V Neptune.

Table C-1. Survey Vessel Characteristics

Vessel Name	LOA (Ft)	Beam (Ft)	Draft (Ft)	Gross Tonnage	Power (Hp)	Registration Number
R/V Neptune	106.9	26	8	90	1200	D595478

The R/V Neptune sensor configuration is depicted in Figure C-1 and the vessel offsets are shown in Table C-2. Figure C-2 shows the R/V Neptune's draft calculations. All measurements are in meters. The Reference Point for the entire multibeam system is located at the top centerline of the POS/MV IMU. The transducer depth was recorded as 3.42 meters below the boat's main deck. The distance below the boat deck to the water surface was measured and subtracted from the transducer hull depth to determine the draft of the electronic center of the transducer. Lead line comparisons to the corresponding beam confirmed the 3.42 meters as the correct transducer depth below deck. Measurements were made on each side of the vessel before departure from port and upon return to port in order to prorate the daily draft for fuel and water consumption.

Figure C-1. Configuration of R/V Neptune during Survey Operations, measurements in meters

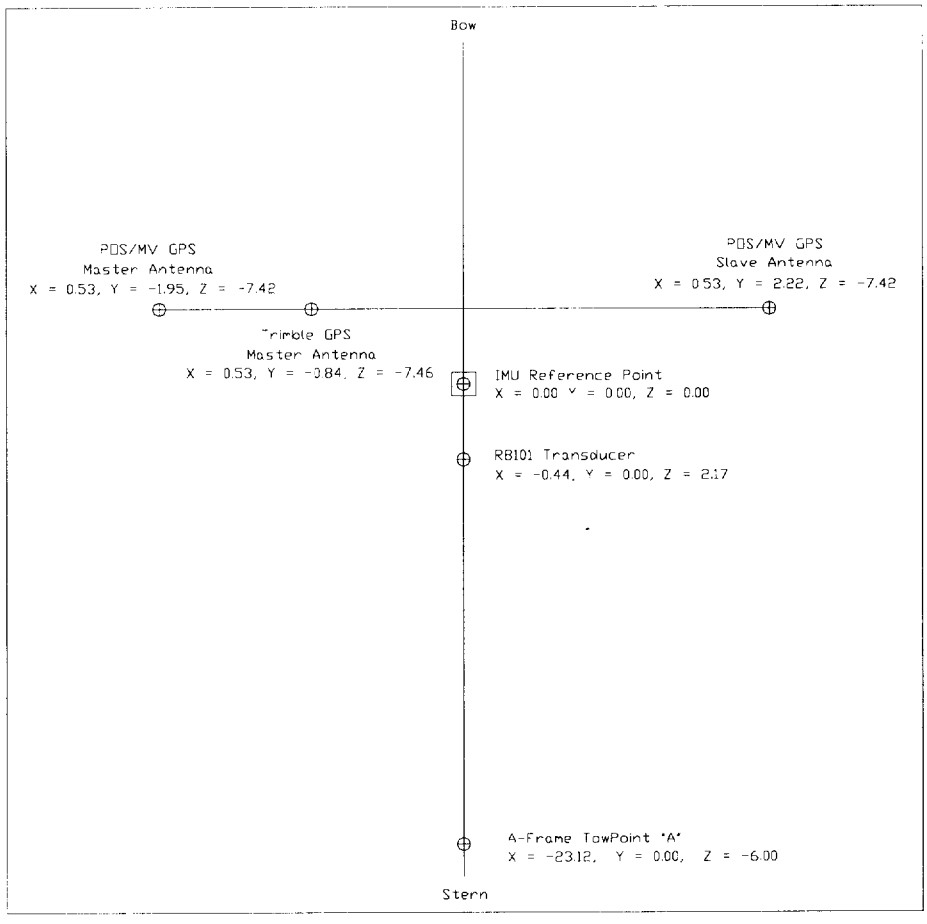
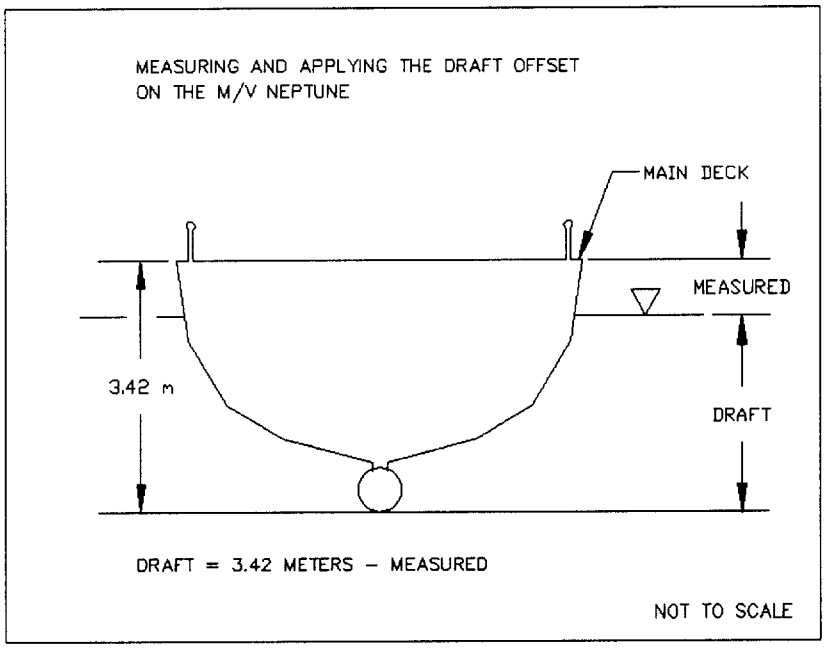


Table C-2. R/V Neptune Antenna and Transducer Locations Relative To the POS/MV IMU Vessel Reference Point, measurements in meters

Sensor	Offset in ISS2000		POS/MV IMU	
Multibeam Reson 8101 Transducer	X		X	-0.44
	Y		Y	0
	Z		Z	2.17
Trimble 7400 Antenna	X	0.53		
	Y	-0.84		
	Z	-7.46		
POS/MV GPS Master Antenna			X	0.53
			Y	-1.95
			Z	-7.42
Side Scan Tow Point "A" frame aft	X	-23.12		
	Y	0		
	Z	-6.00		

Figure C-2. R/V Neptune Draft Determination



The SAIC Integrated Survey System (**iss2000**) and the RESON 8101 multibeam system utilize different coordinate systems, and care must be taken when inputting correctors to the system. The **iss2000** considers "z" to be positive down, while both the RESON and POS/MV consider "z" positive up. Both the **iss2000** and POS/MV consider "x" positive forward, the RESON considers "x" as positive athwart ships to starboard. The SAIC **iss2000** considers "y" positive athwart ships to starboard, the POS/MV considers "y" positive athwart ships to port and the RESON considers "y" as positive forward.

D. AUTOMATED DATA ACQUISITION AND PROCESSING

SEE ALSO THE EVALUATION REPORT

Data acquisition was carried out using the SAIC **iss2000** system. Survey planning, real-time navigation, and data logging were controlled by the **iss2000** on a HP UNIX machine, with navigation and data time tagging running on an WIN/NT machine. The **iss2000** also provided navigation data to the Klein 5500 sonar system for merging with the side scan sonar data.

Navigation was recorded from both the POS/MV system and the Trimble 7400. Data from the POS/MV was used as the primary navigation merged with both multibeam and side scan data. Positioning confidence checks were performed alongside survey control stations in port. Daily positioning confidence checks for the R/V Neptune were done by comparing data recorded from the POS/MV to data recorded from the Trimble DGPS.

The RESON 8101 range scale was set to 50 or 75 meters. The data acquisition rate for the R8101 was set at 8 pings per second. This means that the specified on average 3.2 pings per 3 meters could be obtained at up to 14.5 knots with the 8 pings per second data rate. At an average speed of 8.5 knots and 8 per pings second, the average along track coverage was 4.37 pings per 3 meters. In all instances, the specified average of 3.2 pings per 3 meters was met.

The side scan sonar equipment used throughout the H10943 survey was the Klein 5500 System. The Transceiver/Processor Unit (TPU) was networked to a personal computer that logged data to hard disk. On a watch-by-watch basis, these raw Klein formatted data were transferred to a side scan sonar-processing computer where they were archived to 4mm tape. Both channels were set at a range scale of 75-meters throughout the survey. Vessel speed averaged 8 knots and never exceeded 10 knots. This ensured three or more side scan sonar pings per meter along track.

Once collected and archived to tape, the side scan data were converted to eXtended Triton Format (XTF). A side scan processor then reviewed the side scan data using Triton ISIS software. The processor would note data gaps due to weather, system problems, fish altitude out of range, data masking, or any other events that would cause the data to be rejected. With the assistance of the hydrographer, the processor would locate and verify contacts and create a contact list using ISIS. This contact list was later imported into the **iss2000** system for side scan contact to multibeam feature correlation.

Cleaning of the R8101 multibeam data began with an evaluation of the navigation track line. An automated filter was then applied for minimum and maximum depths of 4 and 30 or 35 meters, depending on the water depth. Interactive editing was then performed to remove noise, fish, etc. The editing process used the geoswath geo-referenced editor which allows for both plan and profile views with each beam in its true geographic position and depth. Tidal correctors were not applied in real-time. Observed tides were down loaded from the NOAA/CO-OPS web page. Preliminary and verified data from the Sabine Offshore Station (877-1081) were applied to the multibeam data using the zoning provided August 4, 1998. NOAA memorandum, "Final Water Level Data for Application to Hydrographic Survey OPR-K171-KR-1998", which is in Appendix F. All H10943 multibeam data were reprocessed using verified tide data from the Sabine Pass Offshore (877-1081) station as downloaded from the NOAA/CO-OPS web page.

Depth data were then gridded to 1-meter cells for quality evaluation and for comparing to side scan sonar contacts. When anomalies were seen in the 1-meter grids, the edited multibeam files were re-examined and re-edited as needed. When all multibeam files were determined to be satisfactory, the data were binned to a 10-meter cell size, populating the bin with the shoalest sounding in the bin and maintaining its true position and depth with tracking to the gsf data file.

Soundings were selected from the 10-meter binned layer using the **sel_sound** sounding selection software. This routine starts with the shoalest sounding in the survey, flags out soundings that would overlap it on the plot, proceeds to the shoalest remaining sounding and repeats the above process until all soundings in the 10-meter bin layer have been evaluated. The **set_sound** program was run to flag all selected soundings in the gsf multibeam file. The selected sounding file, the platform and navigation aids file, and the feature file were combined to produce the smooth sheet in **AutoCAD**.

Throughout this descriptive report wherever software is mentioned, it is inferred that the most current version of the software available was used. A complete list of all software versions and dates is provided in Appendix K. FILED WITH THE ORIGINAL FIELD RECORDS

Processing of side scan sonar data is discussed in Section E.

The real time multibeam acquisition system used for the H10943 survey included:

One UNIX workstation – Used for system control, survey operations, real-time quality control.
One personal computer – Used for running POS/MV and Trimble software, for downloading and conversion of sound velocity data from CTD's.

One personal computer – Used for navigation and time syncing on the WIN/NT operating system.
A custom computer from RESON was used to operate the 8101 system.
A custom computer from RESON was used to operate the R6042 system.

Uninterrupted power supplies (UPS) protected the entire system.

Multibeam Data Processing

Multibeam data processing was performed in two stages. Initial data cleaning and validation was done shortly after the data were collected, usually by the same watchstander who had collected the data. To maintain a high degree of continuity between data collection and data processing it was convenient to split a watchstander's work into two phases, one to collect data and the next to process that same data.

On a watch by watch basis, tracklines were created, verified, and corrected to ensure data coverage and to also check for navigation errors. Next, outer beams of the multibeam data, exceeding the accuracy standards calculated by the Hydrographer, were flagged as invalid using the **iss2000** software. Multibeam data were manually edited and the preliminary multibeam coverage grid was then updated. Each watchstander would perform a backup of all data on the processing system at the end of each processing watch. After the watchstander had completed the initial data cleaning, a data manager or the hydrographer verified the data. Any questionable possible obstructions were noted and later evaluated by the hydrographer. Later, a data manager on the survey vessel corrected the data for draft and tides, made updated coverage grids, tracklines, sounding grids, selected sounding plots and preliminary data products. The data manager's duties also included routine system backups on all computers and quality control on all data.

In the processing lab in Newport, RI, further quality assurance reviews were done, and corrections were made to all data. Contact analysis was performed correlating side scan contacts with multibeam features. Multibeam coverage and sounding grids were updated following changes found during the contact analysis. The **iss2000** system used proprietary algorithms to create the grids and selected soundings. Final plots were produced exporting data to a dxf format using the **iss2000** software. These data were then imported into **AutoCAD** for final map production.

E. SIDE SCAN SONAR

The following side scan sonar equipment was used for the H10943 survey:

Klein 5500 Side scan Sonar System towfish
    Serial Number 250
    Vertical beam width 40°, 0° depression, 455kHz.
    K-Wing-II Depressor, serial number 435
Transceiver/Processing Unit (TPU), serial number 109
Display/Control/Data logging computer

1. Side Scan Sonar Data Acquisition Procedure

The watchstander would always have the assistance of the previous watchstander who was located close by processing data. This assistance was necessary for conducting CTD casts as well as towfish deployment and retrieval. A minimum of four people were used during towfish deployment and retrieval.

Side scan operations were conducted in water depths ranging from 42 to 81 feet. The side scan towfish altitude off the bottom was maintained between six and fifteen meters. The MacArtney Sheave was equipped with a cable counter with a read out in meters. The cable out data was broadcast from the cable counter to the **iss2000** system where layback and fish positions were calculated. The cable length was manually adjusted to maintain the proper fish altitude using a remote controller for the SeaMac winch. The watchstander appended to a side scan annotation file when changes were made to the cable out length. These annotation files were later merged with the XTF data using proprietary software.

Maintaining towfish height above the bottom was relatively easy using the remote controller for the winch. A proprietary software program, which graphically displays the towfish and water depths, aids in monitoring the towfish altitude.

The use of a hydrodynamic depressor allowed the amount of cable out to be kept less than the water depth. Thus permitting turns to be tighter and faster than surveys previously conducted without the use of a depressor. This also removed all concern about the towfish hitting the seafloor while conducting CTD casts. In addition, the depressor kept the towfish below the propwash even at higher survey speeds of 9 knots.

Survey line spacing was 65-meters. Survey lines were run at an azimuth of 103° and 283°. Navigation file names were manually changed after each survey line was completed. Because the high data rates of the Klein 5500 side scan, the Klein data logging software automatically changes the file name every ten minutes. The side scan range scale was set to 75-meters.

Watchstanders used proprietary software to create digital annotation files that were later merged with XTF side scan data.

Daily confidence checks were conducted using trawl marks, anchor scours, and any other geologic features (sand waves) that ran through both channels while on line.

2. Problems Encountered During Side Scan Sonar Survey Acquisition

The Klein 5500 locks on to the strongest signal. In water depths less than 60 feet, this often meant the water surface if Sargasso or wind waves were present. Weather had a significant negative impact on the quality of the side scan data. When operating in 3 to 4 foot seas, it was frequently impossible to avoid surface wave noise and the subsequent large number of data gaps. Numerous data gaps were caused by thermoclines distorting the side scan imagery.

3. Side Scan Sonar Processing

After being archived to 4mm tape, digital side scan data from the Klein 5500 system were converted from the Klein proprietary format to eXtended Triton Format (XTF) using a SAIC proprietary program called xtf_io. These XTF files were copied to 4mm tape in tar format and are the deliverables to be used with CARIS SIPS. The XTF data also allowed data review and target analysis in Triton Isis.

A side scan processor looked at each record using Triton ISIS to review the data. A spreadsheet was used to log times where data gaps were caused by seaweed interference, biota in the water column, or other reasons. The time, survey line, corresponding multibeam file, start/end of line, side scan file name, watch id number, line azimuth, and data gaps information were all logged in the spreadsheet.

This information was used to set the bad data off line so that they were ignored in processing and in coverage analysis.

On June 16, 1999 a slave IRIG-B card was installed in the TPU to provide accurate time stamping of the ping data in synchronization with the **iss2000** and UTC from the GPS signal. After the IRIG-B card was installed, numerous erroneous dates, times and positions were found in the raw Klein data. The duration of the problem was typically 2 to 3 seconds and could be as large as 6 seconds. The xtf_io program was customized to do an interpolation over these gaps to resolve the problem.

Annotation files logged in real-time by the watchstanders were later corrected for errors and additional annotations were added. Additional annotations include contacts, confidence checks, and comments on the records. The corrected annotations were merged into the XTF data using the xtf_io program. Trackline data were extracted from the XTF files for each Julian day.

A time window file, which lists the times of all valid data, was created for each 100% of coverage in order to create both trackline and mosaics in the **iss2000** system. By viewing the mosaics in the **iss2000** survey-planning tool, a user can easily plan survey lines to fill in any data gaps.

Side Scan Contact Analysis

ISIS and Contact Post Processing Software (Triton/Elics Inc.) were used to select and process contact information from the XTF sonar files. Contact information includes the following:

1. Year and Julian Day contact was acquired.
2. Time contact was acquired.
3. Contact position - Latitude and Longitude.
4. Contact identifier.
5. Slant range to contact (Note: Negative number if contact was detected on port side).
6. Fish altitude when contact was acquired.
7. Shadow length of contact.
8. Contact height, based on length of shadow and geometric calculation using steps 5, 6, and 7.

Contact information was stored in .CON files that were converted into a .CTV file using a SAIC proprietary program called isis2ctv. During the conversion, a postscript image file was made of each contact. This .CTV file can be directly loaded into **iss2000** as a separate data layer. Once in the **iss2000** system, contacts were correlated by position and height with the one-meter grid of the multibeam data displayed with side scan contacts overlaid. Bathymetric features in the multibeam data were then compared with the side scan contact data.

F. SOUNDING EQUIPMENT

The following components were used for acquisition of multibeam sounding data using the RESON SeaBat 8101 multibeam system:

- Transducer, Serial Number 099707
- 8101 Processor, Serial Number 13819
- R6042 Controller and Processing Unit, Serial Number 590 P0 794-387

A lead line made of Kevlar line with an 8 pound mushroom anchor as a weight was used for checking the multibeam echo sounder. The line was marked in feet and was calibrated against a steel tape. Lead line comparisons are summarized in Appendix G, Table App. G-1. Daily comparisons of R8101

nadir soundings to ODOM EchoTrak 200 kHz vertical echo sounder are also summarized in Appendix G, Table App. G-2. FILED WITH THE ORIGINAL FIELD RECORDS

G. CORRECTIONS TO SOUNDINGS

1. Speed of Sound

The following systems were used to determine sound velocity profiles for corrections to multibeam sonar soundings.

- "A" - Sea-Bird Electronics, Inc., Model 19 CTD, Serial Number 193607-0565, Calibration Date 14 September 1999.
- "B" - Sea-Bird Electronics, Inc., Model 19 CTD, Serial Number 2710, Calibration Date 14 September 1999.

The primary unit was SBE19 #0565. Daily confidence checks were obtained using simultaneous casts with the primary CTD and the secondary CTD. After downloading CTD casts, both were converted to the proper format and compared to each other and to the previously applied cast. All profiles were computed using **SBE Term19** and converted using the **SBE DatCnv** software. Computed profiles were copied to the **iss2000** for comparison on the screen. A selected profile was applied to the system, recorded, and sent to the RESON 6042, where a refraction lookup table was computed for application of speed of sound and ray tracing correctors to the multibeam sounding data. If sounding depths exceeded the cast depth, the 6042 used the bottom of the table to extend correctors below the table.

Factors considered in determining how often a CTD cast was needed included: shape and proximity of the coastline, sources and proximity of freshwater, seasonal changes, wind, sea state, cloud cover, thermoclines seen in the side scan data, and changes from the previous profile. A cast was taken at least once during each 6-hour watch.

Quality control tools, including real-time displays and a multibeam swath editor, were used to monitor how the sound velocity was affecting the multibeam data. Severe effects due to improper sound velocity could easily be seen by viewing multibeam data in an along track direction.

A table including all CTD casts, dates of each cast, the location of the cast, and the maximum depth of each cast is located in Appendix J. FILED WITH ORIGINAL FIELD RECORDS

2. Instrument Corrections

No instrument corrections were necessary after the initial installation and calibration was complete.

3. Corrections Determined from Vertical Casts

Lead line comparisons to multibeam soundings were made at least every two weeks to verify the transducer draft and echo sounder instrument correctors. For each comparison, a CTD cast was taken and the sound velocity profile loaded into the **iss2000** and the RESON 6042. Twenty lead line readings, ten from the port side and ten from starboard, were recorded along with the UTC time of observation while the **iss2000** recorded the multibeam readings. **Exammb** was used to determine the appropriate port and starboard beam depth readings for the time and position of each lead line reading.

The results of these readings were entered into a spreadsheet along with the draft readings and any settlement correctors that may have been entered into the **iss2000**. The spreadsheet applied a calibration corrector to the lead line readings and converted the readings from feet to meters. It also applied correctors for any settlement inadvertently left in the **iss2000** to the port and starboard multibeam readings.

Each corrected lead line cast depth was compared to the simultaneous multibeam data. The ten comparisons were averaged and the standard deviations were computed. The lead line cumulative results are included in Appendix G. *

4. Static draft

Depth of the transducer below the deck was determined from measurements made while the boat was on the marine railway in 1998, and was verified by lead line comparisons. The static draft was observed by measuring from the main deck to the waterline before getting underway from Galveston and subtracting that measurement from the transducer distance below the deck. If the static draft value changed from the previously noted value, the new value was entered into the RESON system. The static draft was again determined upon return to port and the change in draft was prorated on a daily basis. The measured and prorated draft results are reported in Appendix G,* Table App. G-5.

5. Settlement and Squat

Measurements of settlement were conducted near 29° 11 42N 094° 28 48W on day 138, May 19, 1999, in fifteen meters of water. The following procedures were used to determine the settlement correctors:

- Selected an area of flat bottom at a depth similar to the survey area.
- Planned a survey line across the flat bottom.
  1. Considered the current and wind in planning the line.
  2. Used Sabine Offshore (877-1081) station for the water level during the test.
  3. Calibrated the echo sounder, and applied sound velocity profile for the test area. (Timing latency and pitch, roll and heading biases had been determined and applied.)
  4. Approached the line at a slow to moderate speed, brought the RPM's to zero and drifted down the line while recording soundings over the flat bottom.
  5. Ran the line at each of the predetermined RPM settings while recording soundings over the flat bottom.
  6. Applied water level correctors to the soundings.
  7. Subtracted the depth determined from each of the RPM passes from the depth determined on the drifting, zero RPM pass. These differences are the settlement and squat correctors to be applied when operating at the corresponding RPM.
  8. Constructed a lookup table of RPM and settlement and squat correctors in the configuration file so that the computer could interpolate a corrector based upon the RPM entered into the system

Geoswath was used to measure the depth for each pass. The results were compiled into a lookup table of vessel's engine RPM vs. settlement and squat. When on survey line, the engine's RPM was entered into the **iss2000** system by the real-time system operator. The computer applied settlement and squat correctors interpolated from the lookup table, and recorded them in the "Depth Corrector" field of the GSF data file for each ping. All results are reported in Appendix G,* Table App. G-6.

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6. Roll, Pitch and Heading Biases

The following sensor was used for acquisition of Heave, Roll, Pitch and Heading data:

- TSS POS/MV Inertial Navigation System, Serial Number 024

The accuracy of the sensor was five percent of one meter or five centimeters for heave ± 0.10° dynamic accuracy for roll and pitch, and ± 0.05° static accuracy for roll and pitch. The dynamic heading accuracy of the unit is better than 0.05°.

Heading, roll, and pitch biases were determined in a series of tests performed in the survey area prior to the start of the survey. Prior to conducting any of the tests, a CTD cast was taken to determine the sound velocity profile and entered into the RESON system. Initially, the roll, pitch, and heading bias were set to 0° in the RESON system.

The roll bias test was run first in an area with relatively flat bottom. The range scale of the RESON was set to 75-meters. One line was run in opposite directions at the same speed. The width of the swath was measured and entered in a spreadsheet along with paired port and starboard depth measurements. An equal number of pairs were measured from swaths in opposite directions. This was to eliminate any influence from true slope in the bottom. The spreadsheet computed the apparent roll bias from each pair, and the mean and standard deviation of all the computed biases. The spreadsheet allows for entry of the roll bias that was in the **iss2000** system during the test, and outputs the new bias to be entered in the **iss2000.** Roll bias results are shown in Appendix G,* Table App. G-4.

After the roll biases were calculated and applied to the data, a pitch bias test was conducted using the same lines and measuring the change in position of a small obstruction covered by the roll lines. During the test, ship speed was maintained at as constant a rate as possible. Pitch biases were computed by comparing runs in opposite directions. There was no discernable pitch bias as a result of these tests, and a bias of 0.0° was kept in the system for the survey. Pitch bias results are shown in Appendix G,* Table App. G-3.

Table App. G-6 contains the results of the Accuracy test conducted on JD 295
Roll, pitch, and heading biases applied in H10943 are shown in Table G-1.

Table G-1. Roll, Pitch, and Heading Bias for the R/V Neptune

Julian Days	296 –036
Roll	0.13
Pitch	0.00
Heading	0.00

H. CONTROL STATIONS

SEE ALSO THE EVALUATION REPORT

The horizontal datum used for the survey was the North American Datum (NAD) 1983.

Horizontal control stations CG-20 1974 and CG-21 1974 were used for independent checks of the positioning system on the survey vessel. Data for these stations were downloaded from the NOAA/NGS web page.

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I. HYDROGRAPHIC POSITION CONTROL

The following equipment was used for positioning on the R/V Neptune:

- TSS POS/MV, Serial Number 024
- Trimble 7400 GPS Receiver, Serial Number 3713A18839
- Trimble Differential Beacon Receiver
- 41R Differential Beacon Receiver, Serial Number 3508-102-18550

The primary hydrographic positioning equipment was the POS/MV, which used correctors from the USCG differential station at Galveston, TX. The **iss2000** monitored HDOP, number of satellites, elevation of satellites, and age of correctors to ensure the resulting hydrographic positioning errors did not exceed ten meters at the 95% confidence level.

When in port, the R/V Neptune tied up to Pier 15 where measurements were made to calculate the offset between the hydrographic navigation position and horizontal control stations CG-20, 1974, or CG-21, 1974. While measurements were being made, navigation data were being logged. Comparison of the navigation center position computed from the control station and the average position based on navigation resulted in confidence checks that were well within specifications, with no more than 3 meters inverse distance from the check position. Daily position confidence checks were established using a Trimble DGPS with correctors from the U.S. Coast Guard station at Port Aransas, TX. A real-time monitor raised an alarm when the two DGPS positions differed by more than 10 meters horizontally. Positioning confidence checks were well within the allowable inverse distance of less than 15 meters.

All antenna, transducer, towpoint, and towfish offsets were measured relative to the POS/MV's IMU. Two separate teams of two people measured and calculated all offsets using a measuring tape. The final offsets from both teams were compared and were found to agree.

The **iss2000** software calculates the towfish position using an automatic cable out value and the towpoint configuration or offsets previously measured.

J. SHORELINE

Not applicable.

K. CROSSLINES

There were 155 linear nautical miles of crosslines surveyed and 2,585 linear nautical miles of mainscheme lines surveyed resulting in 6.0 percent coverage by crosslines. Actual total linear nautical mileage of mainscheme lines collected is 3,623. Gap fill and rerun lines as well as lines run in order to achieve 100% coverage in the shoal areas located in the northern corner of the survey area comprised 1,038 linear nautical miles.

Comparisons of all crossing data show that more than 99.95 percent of comparisons are within 30 centimeters and 100.00 percent of comparisons are within 40 centimeters. The skew in distribution indicates that the main scheme was shoaler than the cross lines.

Table K-1. Junction Analysis Main Scheme vs. Cross Lines

Depth Difference Range			All Difference		Positive Difference		Negative Difference		Zero Difference
From		To	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count
00.1cm	->	10.0cm	4902077	71.45	1602404	79.54	3012951	66.08	286722
10.1cm	->	20.0cm	1718188	96.49	376052	98.20	1342136	95.52	
20.1cm	->	30.0cm	237243	99.95	35058	99.94	202185	99.95	
30.1cm	->	40.0cm	3423	100.00	1171	100.00	2252	100.00	
40.1cm	->	50.0cm	22	100.00	10	100.00	12	100.00	
sub-totals ->			6860953		2014695		4559536		286722
			100.00%		29.36%		66.46%		4.18%
H10943 Main Scheme Sounding Minus Cross Line Sounding Junction Analysis									

L. JUNCTIONS

SEE ALSO THE EVALUATION REPORT

This survey junctions with H10876 on the west and H10942 on the east. See Table L-1 for the listing of the Junction Analysis, H10943, Sheet W vs. H10876, Sheet X. Of the 381,582 comparisons, 99.50% were within 30 centimeters, and more than 99.96% were within 40 centimeters. The 10 differences exceeding 50 centimeters were attributed to navigational difference along a slope located at 28 54 53.5N 094 21 03.6W. This same slope accounts for 110 of the 151 differences in the 40-50cm range. The distribution of comparisons indicates that H10943 soundings were shoaler than those of H10876.

Table L-1. Junction Analysis H10943, Sheet W vs. H10876, Sheet X

Depth Difference Range			All Difference		Positive Difference		Negative Difference		Zero Difference
From		To	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count
00.1cm	->	10.0cm	255220	66.88	86707	68.48	152268	63.78	16245
10.1cm	->	20.0cm	101089	93.38	30003	92.18	71086	93.56	
20.1cm	->	30.0cm	23373	99.50	8540	98.92	14833	99.78	
30.1cm	->	40.0cm	1739	99.96	1209	99.88	530	100.00	
40.1cm	->	50.0cm	151	100.00	147	99.99	4	100.00	
50.1cm	->	60.0cm	10	100.00	10	100.00	0	100.00	
sub-totals ->			381582		126616		238721		16245
			100.00%		33.18%		62.56%		4.26%
H10943 Sounding Minus H10876 Sounding Junction Analysis									

See Table L-2 for the listing of the Junction Analysis, H10943, Sheet W to H10942, Sheet V. Of the 618,203 comparisons, 99.49% were within 30 centimeters, and 100% were within 50 centimeters. The distribution of comparisons indicates that H10943 soundings were shoaler than those of H10942.

Table L-2. Junction Analysis H10943, Sheet W vs. H10942, Sheet V

Depth Difference Range			All Difference		Positive Difference		Negative Difference		Zero Difference
From		To	Count	Cumulative Percent	Count	Cumulative Percent	Count	Cumulative Percent	Count
00.1cm	->	10.0cm	429958	69.55	194719	77.99	208668	61.02	26571
10.1cm	->	20.0cm	149656	93.76	52783	99.13	96873	89.35	
20.1cm	->	30.0cm	35451	99.49	2176	100.0	33275	99.08	
30.1cm	->	40.0cm	3130	100.0	5	100.0	3125	100.0	
40.1cm	->	50.0cm	8	100.0	0	100.0	8	100.0	
sub-totals ->			618203		249683		341949		26571
			100.00%		40.39%		55.31%		4.30%
H10943 Sounding Minus H10942 Sounding Junction Analysis									

M. COMPARISON WITH PRIOR SURVEYS

SEE ALSO THE EVALUATION REPORT

Comparison with prior surveys was not required under this contract. See Section N for comparison to the nautical chart.

N. COMPARISON WITH THE CHART

SEE ALSO THE EVALUATION REPORT

H10943 was compared to Chart 11323, 57th edition, 27 March 1999, at a scale 1:80,000 and Chart 11330, 12th edition, 8 August 1998 at a scale 1:250,000. All Figures in this Section depict selected soundings from this survey in blue.

Figure N-1 depicts an uncharted wreck located at 28° 55 32.046N, 094° 18 42.846W. Recommend that a 65-foot sounding be charted at this position with the appropriate symbol. CONCUR, WITH CLARIFICATION SEE ALSO THE EVALUATION REPORT.

Figures N-2 depicts the area of three, 61-foot charted soundings in the area of this survey. The charted soundings are shoaler than this survey's soundings by 6 to 7 feet. All other surveyed soundings are within one to two feet of the charted soundings. Recommend that charted soundings be replaced by soundings from this survey, and that additional soundings be charted to more fairly represent the bottom in the area covered by this survey. CONCUR.

In the shaded relief area depicted by Figure N-3, 100% multibeam coverage was collected to further develop a number of 42-foot soundings near a charted 43. The western boundary of H10943 was developed as part of H10876, Sheet X, and is included with that data set.

Because of the limitations of plotting at 1:20,000 scale feature #1, 64 feet, was not plotted. A 63-foot sounding overlapped the 64-foot sounding and was selected to represent the shoalest point at the scale of survey. All other features are plotted on the smooth sheet and are identified with the appropriate label.

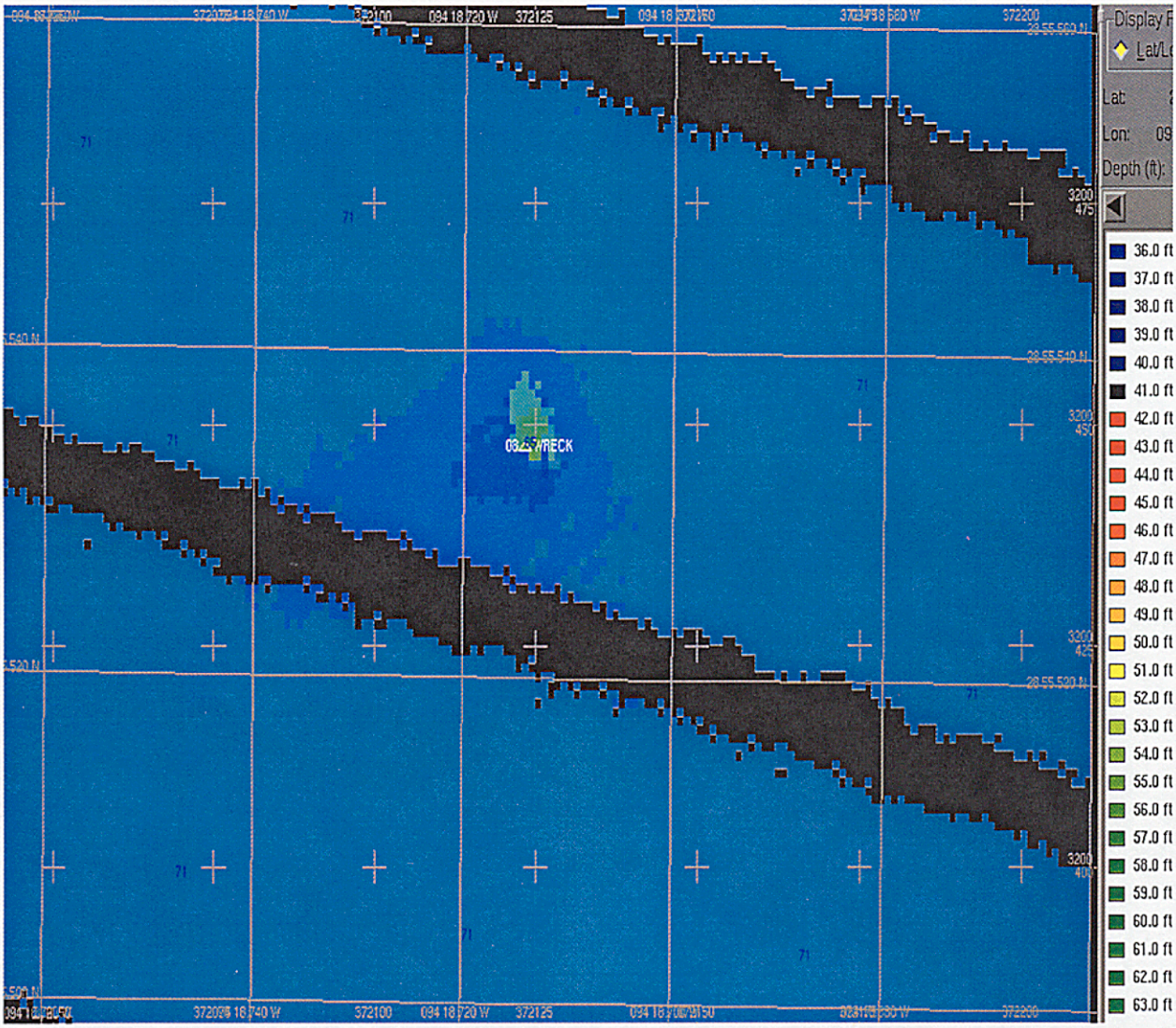


Figure N-1. Uncharted Wreck

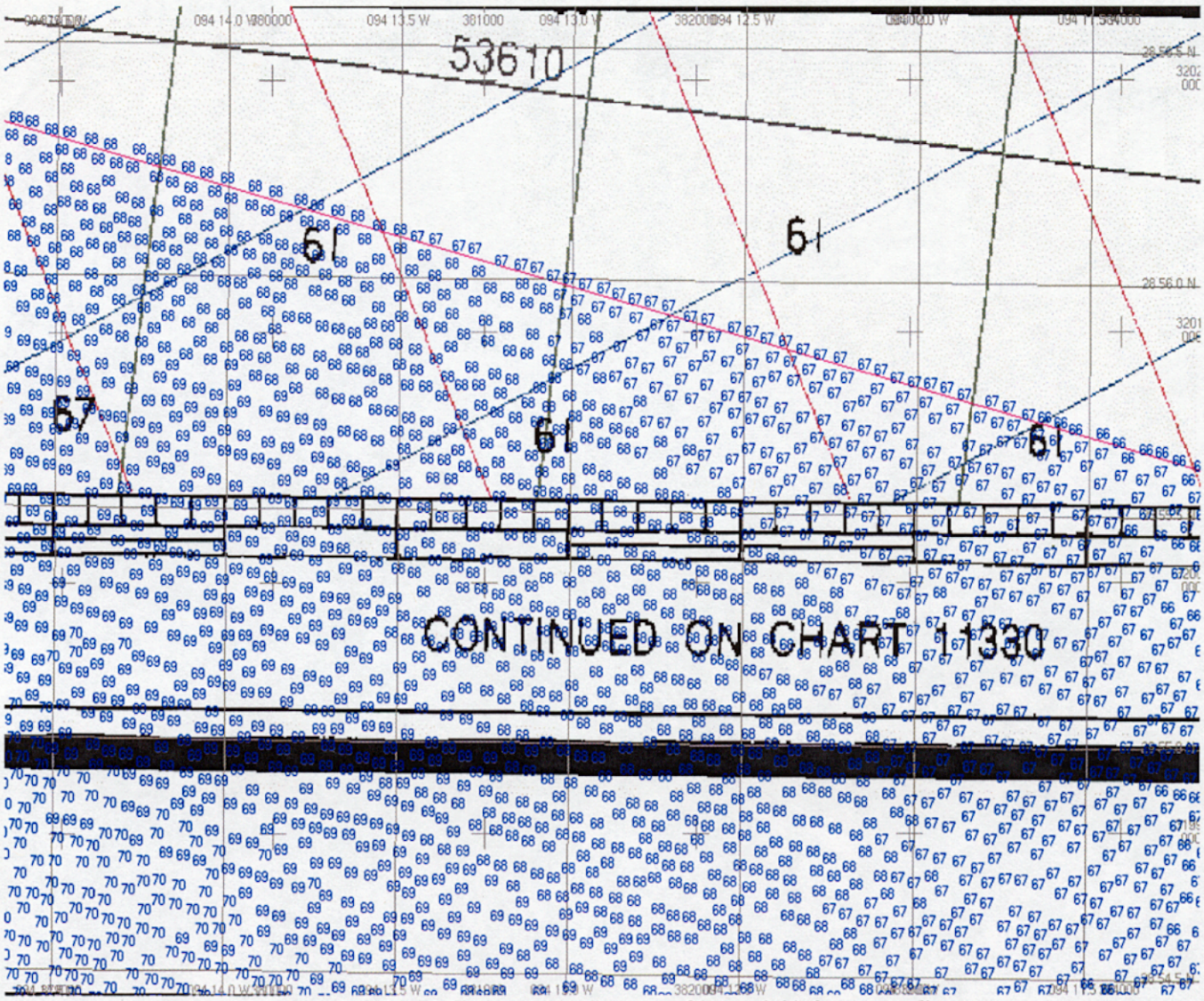


Figure N-2. 67 and 68-foot soundings vs. Charted 61-foot soundings

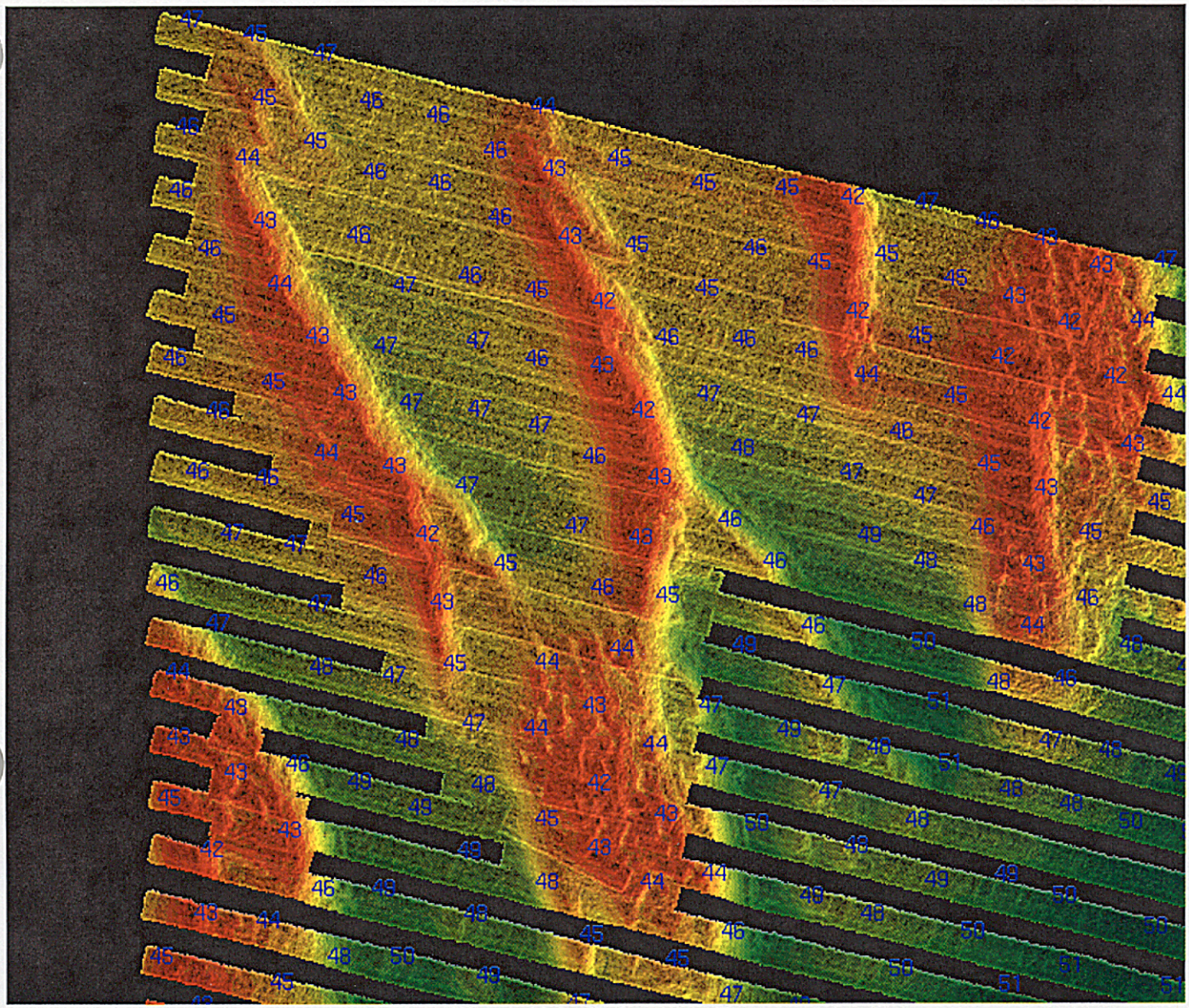


Figure N-3. 42-foot soundings

O. NOT USED BY CONTRACTOR

P. AIDS TO NAVIGATION

There were no charted pipelines within this survey, and no new pipelines were detected. There are no aids to navigation in this survey.

Q. STATISTICS

Survey statistics are as follows:

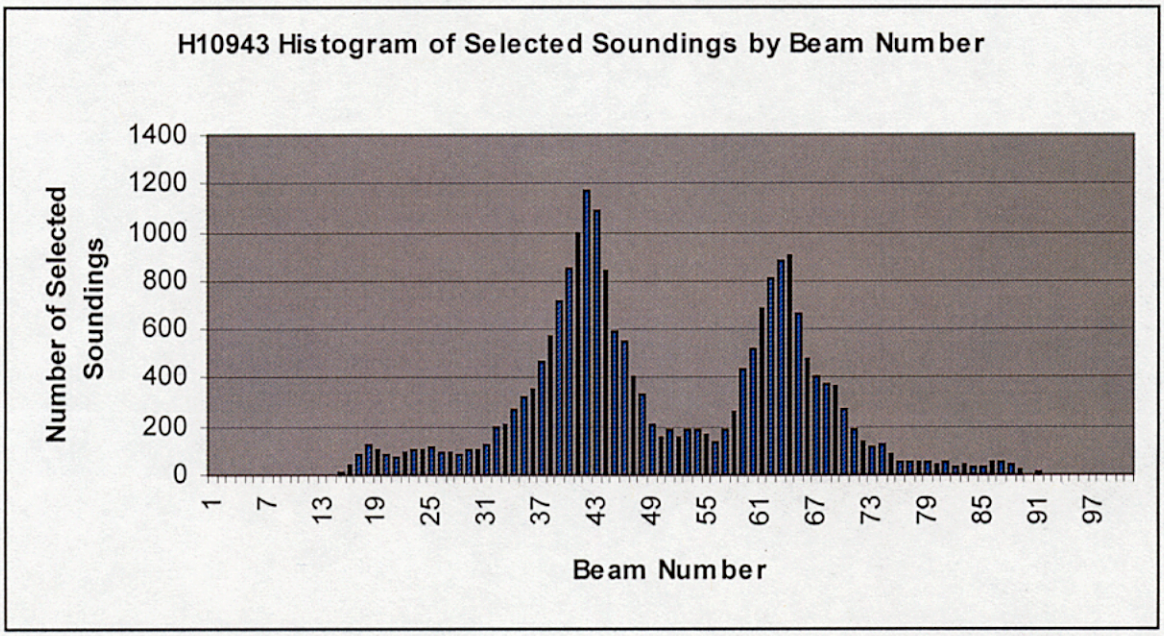
3778 nm	Linear nautical miles of sounding lines (multibeam and side scan)
48.7 nm^2	Square nautical miles of multibeam and side scan
47	Number of sound velocity casts
2	Number of items investigated

R. MISCELLANEOUS

SEE ALSO THE EVALUATION REPORT

Figure R-1 shows the distribution by beam number of the 21,337 soundings selected for the smooth sheet. The majority of soundings appear to be in the area where the bottom detection algorithm changes from phase to amplitude. All of the soundings selected meet the position and depth accuracy specifications (position error not to exceed 10 meters at 95% confidence, depth error not to exceed 0.3 meter at 90% confidence).

Figure R-1. Histogram of Selected Soundings by Beam Number



S. RECOMMENDATIONS See Also the Evaluation Report

Recommend the entire common area of charts 11323, 11330, and 11300 be reconstructed with data from this survey.

There are no additional recommendations for further investigation.

T. REFERRAL TO REPORTS

None.

February 23, 2000

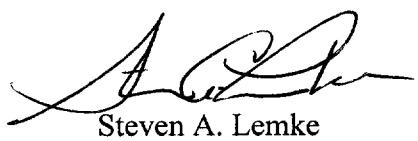
LETTER OF APPROVAL

REGISTRY NUMBER H10943

This report and the accompanying smooth sheet are respectfully submitted.

Field operations contributing to the accomplishment of survey H10943 were conducted under my direct supervision with frequent personal checks of progress and adequacy. This report and smooth sheet have been closely reviewed and are considered complete and adequate as per the Statement of Work.

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION



Steven A. Lemke
Hydrographer
February 23, 2000

NOAA FORM 76-155
(11-72)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

SURVEY NUMBER

H-10943

GEOGRAPHIC NAMES

Name on Survey	A ON CHART NO. 1323, 1330	B ON PREVIOUS SURVEY NO.	C ON U.S. QUADRANGLE MAPS	D FROM LOCAL INFORMATION	E ON LOCAL MAPS	F P.O. GUIDE OR MAP	G RAND MCNALLY ATLAS	H U.S. LIGHT LIST	K	
GALVESTON (title)	X		X							1
GULF OF MEXICO	X		X							2
TEXAS (title)	X		X							3
										4
										5
										6
										7
										8
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										25

Dennis J. Romberg

AUG 15

NOAA FORM 76-155 SUPERSEDES C&GS 197

11/02/2000

HYDROGRAPHIC SURVEY STATISTICS
REGISTRY NUMBER: H10943

NUMBER OF CONTROL STATIONS	2
NUMBER OF POSITIONS	21338
NUMBER OF SOUNDINGS	21338

	TIME-HOURS	DATE COMPLETED
PREPROCESSING EXAMINATION	16.0	03/14/2000
VERIFICATION OF FIELD DATA	58.0	08/18/2000
QUALITY CONTROL CHECKS	0.0	
EVALUATION AND ANALYSIS	29.0	
FINAL INSPECTION	18.0	09/29/2000
COMPILATION	35.0	10/25/2000
TOTAL TIME	156.0	

ATLANTIC HYDROGRAPHIC BRANCH APPROVAL 08/22/2000

NOAA FORM 61-29
(12-71)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

REFERENCE NO.
N/CS33-75-00

LETTER TRANSMITTING DATA

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Chief, Data Control Group
N/CS3x1, Station 6813. SSMC3
1315 East-West Highway
Silver Spring, MD 20910

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11-2-0

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H10943
Texas, Gulf of Mexico, 38NM SE of Galveston

One Box containing:
1 Original Descriptive Report for survey ~~H10843~~ H10943 RW

1 Tube containing:
1 Original smooth sheet for H10943
1 Paper composite plot of survey H10943 for chart 11323
1 Paper composite plot of survey H10943 for chart 11330
1 Mylar H-Drawing of H10943 for chart 11323
1 Mylar H-Drawing of H10943 for chart 11330
1 Contractor field smooth sheet for H10943
7 Additional contractor field sheets for survey H10943

FROM: *(Signature)* R. H. Whitfield
Richard H. Whitfield

RECEIVED THE ABOVE
(Name, Division, Date)

Return receipted copy to:

Atlantic Hydrographic Branch, N/CS33
439 West York Street
Norfolk, Virginia 23510-1114

NOAA FORM 61-29 SUPERSEDES FORM C & GS 413 WHICH MAY BE USED.

This form was electronically produced by Elite Federal Forms, Inc.

ATLANTIC HYDROGRAPHIC BRANCH
EVALUATION REPORT FOR H10943 (1999-2000)

This Evaluation Report has been written to supplement and/or clarify the original Descriptive Report. Sections in this report refer to the corresponding sections of the Descriptive Report.

D. AUTOMATED DATA ACQUISITION AND PROCESSING

The following software was used to process data at the Atlantic Hydrographic Branch:

Hydrographic Processing System
NADCON, version 2.10
AutoCad, Release 12
MicroStation 95, version 5.05
I/RAS B, version 5.01
CARIS HIPS/SIPS

The smooth sheet was plotted using a Hewlett Packard DesignJet 2500CP plotter.

H. CONTROL STATIONS

Horizontal control used for this survey during data acquisition is based upon the North American Datum of 1983 (NAD 83). Office processing of this survey is based on these values. The smooth sheet has been annotated with ticks showing the computed mean shift between the NAD 83 and the North American Datum of 1927 (NAD 27).

To place this survey on the NAD 27, move the projection lines 0.890 seconds (27.391 meters or 1.37 mm at the scale of the survey) north in latitude, and 0.643 seconds (17.428 meters or 0.87 mm at the scale of the survey) west in longitude.

L. JUNCTIONS

H10876 (1999) to the west
H10942 (1999) to the east

A standard junction was effected between the present survey and H10876 (1999) and H10942 (1999). There are no junctional surveys to the north and south. Present survey depths are in harmony with the charted hydrography to the north and south.

M. COMPARISON WITH PRIOR SURVEYS

A comparison with prior surveys was not done during office processing in accordance with section 4. of the memorandum titled *Changes to Hydrographic Survey Processing*, dated May 24, 1995.

N. COMPARISON WITH CHARTS 11323 (58th Edition, Jun 24/00) 11330 (12th Edition, Aug 08/98)

Hydrography

The charted hydrography originates with the prior surveys and requires no further consideration. The hydrographer makes adequate chart comparisons in section N. of the Descriptive Report. Attention is directed to the following:

1. During office processing a Danger to Navigation Report containing three items was submitted to Eighth Coast Guard District Hale Boggs Federal Building 501 Magazine Street, New Orleans, LA for inclusion to the Local Notice to Mariners. A copy of the report is appended to this report. These items are currently shown on the latest edition of chart 11323 listed above. No change in charting is recommended. It is recommended that these items be charted on additional charts should the scale of the chart allow.

2. The following uncharted obstructions were located by the hydrographer and are shown on the present survey. These obstructions are not recommended for charting because of equal or shoaler depths in the respective areas.

Obstruction	ft/m	Latitude(N)	Longitude (W)
Obstr	61/18[6]	28°56'07.22"	94°19'34.02"
Obstr	64/19[5]	28°56'09.16"	94°19'24.73"
Obstr	67/20[4]	28°56'18.07"	94°19'06.59"
Obstr	68/20[7]	28°56'10.68"	94°19'28.37"
Obstr	65/19[8]	28°56'17.84"	94°19'15.20"
Obstr	63/19[2]	28°55'53.12"	94°20'02.52"
Obstr	68/20[7]	28°53'52.08"	94°12'27.61"
Obstr	76/23[1]	28°53'55.89"	94°07'53.66"

Except as noted above, the present survey is adequate to supersede the charted hydrography within the common area.

R. MISCELLANEOUS

Chart compilation was done by Atlantic Hydrographic Branch personnel, in Norfolk, Virginia. Compilation data will be forwarded to Marine Chart Division, Silver Spring, Maryland. The following NOS Charts were used for compilation of the present survey:

11323 (58th Edition, Jun. 24/00)
11330 (12th Edition, Aug. 8/98)

S. ADEQUACY OF SURVEY

This is an adequate hydrographic/side scan sonar/multibeam survey. No additional field work is recommended.

Robert Snow

Robert Snow
Cartographic Technician
Verification of Field Data
Evaluation and Analysis

APPROVAL SHEET
H10943

Initial Approvals:

The completed survey has been inspected with regard to survey coverage, delineation of depth curves, development of critical depths, cartographic symbolization, and verification or disproval of charted data. The digital data have been completed and all revisions and additions made to the smooth sheet during survey processing have been entered in the digital data for this survey. The survey records and digital data comply with NOS requirements except where noted in the Evaluation Report.

Robert G. Roberson Date: 22 AUGUST 2000

Robert G. Roberson
Cartographer
Atlantic Hydrographic Branch

I have reviewed the smooth sheet, accompanying data, and reports. This survey and accompanying digital data meet or exceed NOS requirements and standards for products in support of nautical charting except where noted in the Evaluation Report.

Andrew L. Beaver Date: 22 AUG 00

Andrew L. Beaver
Lieutenant Commander, NOAA
Chief, Atlantic Hydrographic Branch

****

Final Approval:

Approved: Samuel P. DeBow, Jr. Date: December 20, 2000

Samuel P. DeBow, Jr.
Captain, NOAA
Chief, Hydrographic Surveys Division

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE, Office of Coast Survey
Atlantic Hydrographic Branch
439 W. York Street
Norfolk, VA 23510-1114

March 13, 2000

Commander (oan)
Eighth Coast Guard District
Hale Boggs Federal Building
501 Magazine Street
New Orleans LA 70130-3396

Dear Sir,

During office processing of hydrographic survey operations, 38 NM SE of Galveston, Texas (Project OPR-K171-KR, 1999/200 Registry H10943) by Science Applications International Corporation (SAIC), three items have been identified as hazards to navigation. I recommend these items be included in the next Local Notice to Mariners. These items were located using Differential GPS and are based on NAD83 datum. The soundings have been reduced to Mean Lower Low Water (MLLW). All depth data is preliminary pending final office verification.

Objects Addressed:

Feature	Latitude	Longitude
65-ft Wreck	28°55'32.05"N	94°18'42.85"W
56-ft Obstn	28°56'17.41"N	94°19'29.27"W
60-ft Obstn	28°56'05.02"N	94°19'32.29"W

Affected Nautical Charts:

Chart	Edition No.	Date
11323	57th	Mar 27/99
11330	12TH	Aug 08/98

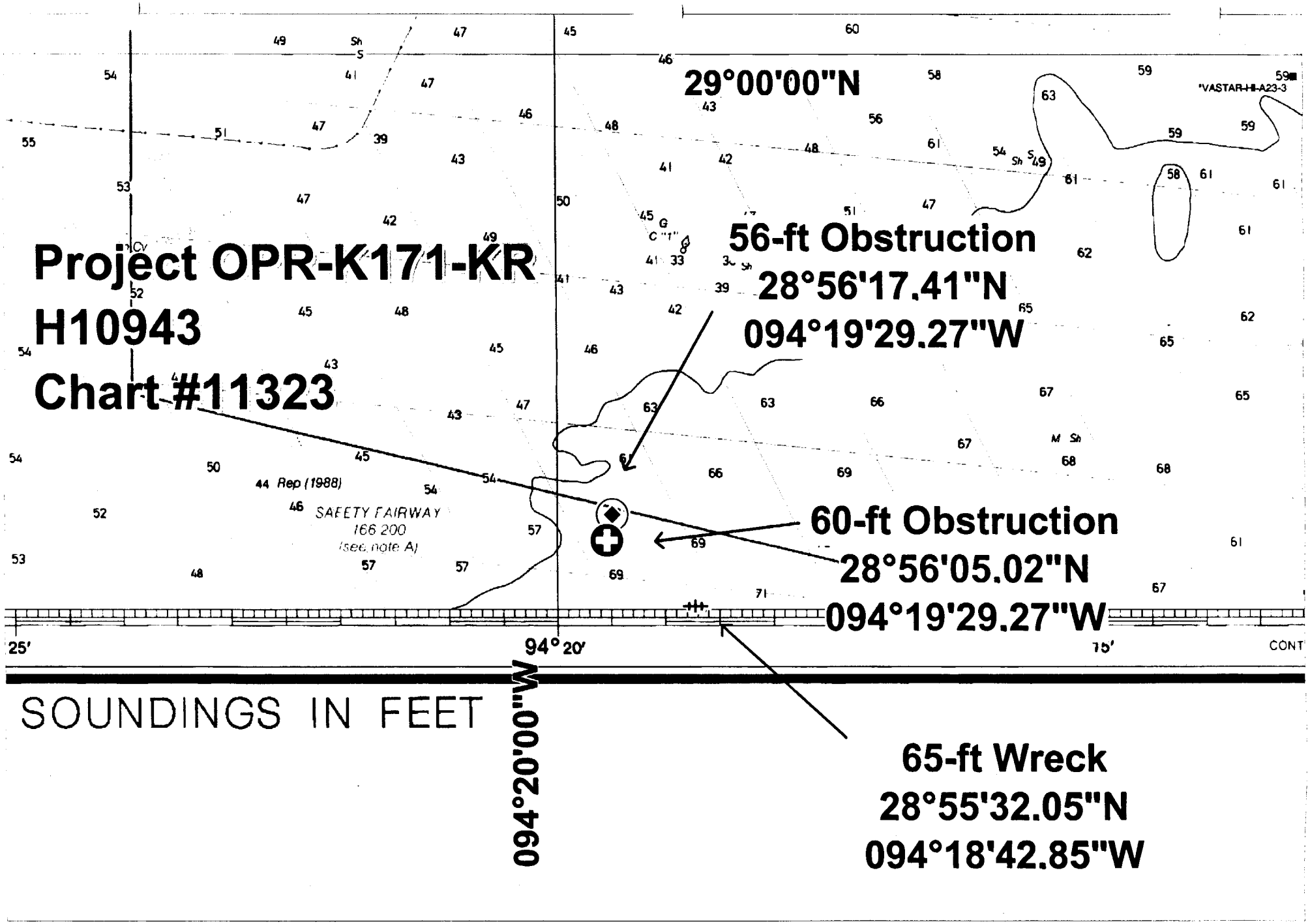
Questions concerning this report should be directed to the Atlantic Hydrographic Branch, by calling (757) 441-6746.

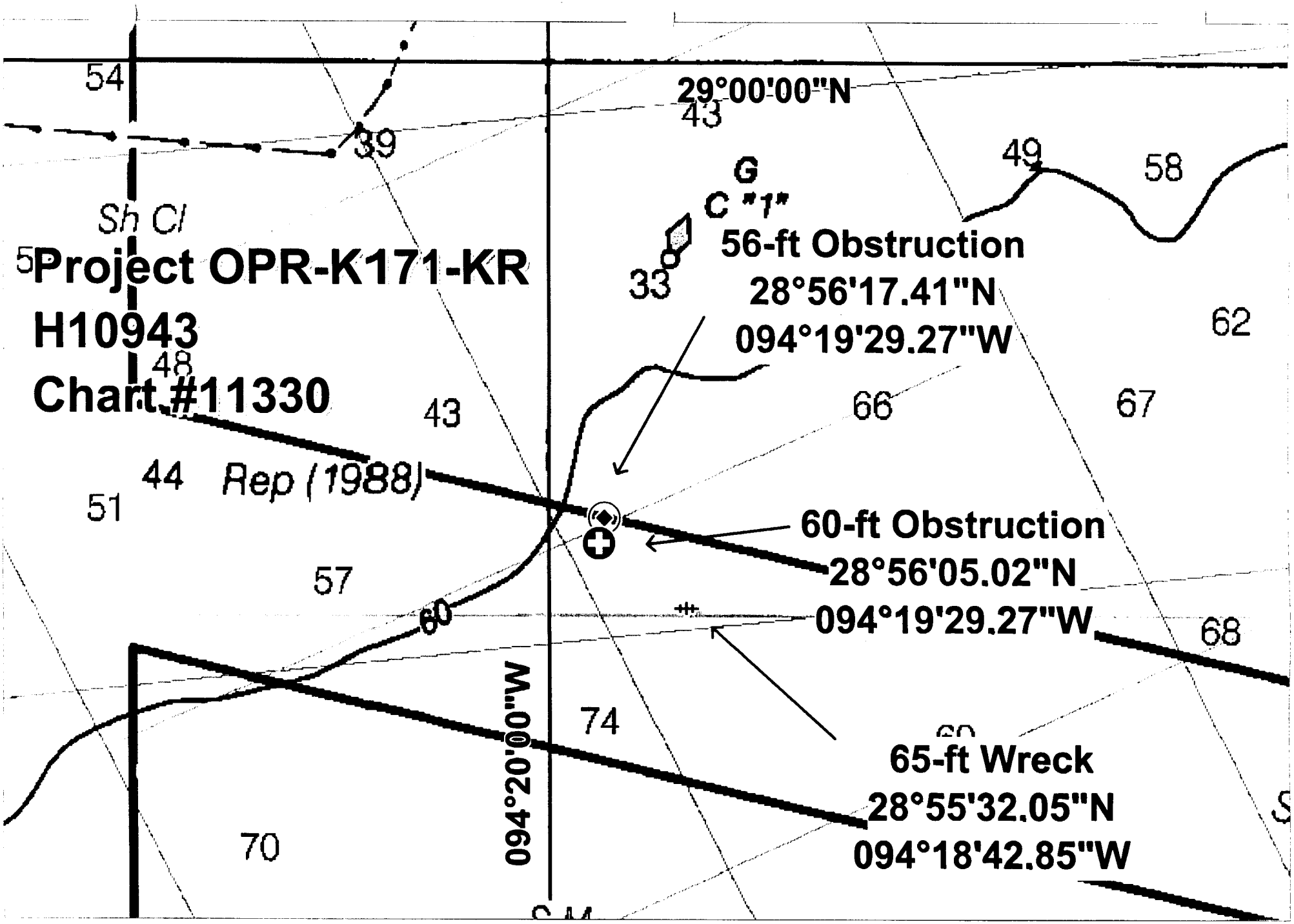
Sincerely,

Andrew L. Beaver, LCDR, NOAA
Chief, Atlantic Hydrographic Branch

Attachment

cc: NIMA-NIS
N/CS26
N/CS31


29°00'00"N
Project OPR-K171-KR
H10943
Chart #11323
56-ft Obstruction
28°56'17.41"N
094°19'29.27"W
60-ft Obstruction
28°56'05.02"N
094°19'29.27"W
65-ft Wreck
28°55'32.05"N
094°18'42.85"W
SAFETY FAIRWAY
166 200
(see note A)
44 Rep (1988)
25'
94° 20'
094°20'00"W
SOUNDINGS IN FEET


Project OPR-K171-KR
H10943
Chart #11330
29°00'00"N
56-ft Obstruction
28°56'17.41"N
094°19'29.27"W
60-ft Obstruction
28°56'05.02"N
094°19'29.27"W
65-ft Wreck
28°55'32.05"N
094°18'42.85"W
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NOAA FORM 61-29
(12-71)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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H10943
Texas, Gulf of Mexico, 38NM SE of Galveston

One Box containing:
1 Original Descriptive Report for survey ~~H108843~~ H10943 RW

1 Tube containing:
1 Original smooth sheet for H10943
1 Paper composite plot of survey H10943 for chart 11323
1 Paper composite plot of survey H10943 for chart 11330
1 Mylar H-Drawing of H10943 for chart 11323
1 Mylar H-Drawing of H10943 for chart 11330
1 Contractor field smooth sheet for H10943
7 Additional contractor field sheets for survey H10943

FROM: *(Signature)* R. H. Whitfield
Richard H. Whitfield

RECEIVED THE ABOVE
(Name, Division, Date)

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Norfolk, Virginia 23510-1114

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NOAA FORM 75-96
(10-83)

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

MARINE CHART BRANCH

RECORD OF APPLICATION TO CHARTS

FILE WITH DESCRIPTIVE REPORT OF SURVEY NO. H-10943

INSTRUCTIONS

A basic hydrographic or topographic survey supersedes all information of like nature on the uncorrected chart.
1. Letter all information.
2. In "Remarks" column cross out words that do not apply.
3. Give reasons for deviations, if any, from recommendations made under "Comparison with Charts" in the Review.

CHART	DATE	CARTOGRAPHER	REMARKS
11323	10/19/00	[signature]	Full ~~Part~~ ~~Before~~ After Marine Center Approval Signed Via
			Drawing No.
11330	10/24/00	[signature]	Full Part Before After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
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			Full Part Before After Marine Center Approval Signed Via
			Drawing No.
			Full Part Before After Marine Center Approval Signed Via
			Drawing No.

SUPERSEDES C&GS FORM 8352 WHICH MAY BE USED