SHIPBOARD DATA SYSTEM
(SDS III)

DATA ACQUISITION TEST PROJECT REPORT
SOLOMONS ISLAND, MARYLAND
JULY 15, 1985 - APRIL 1, 1986

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A. INTRODUCTION:

Two hydrographic surveys were planned in the area of Solomons Island, Maryland, to assist in the development and evaluation of the Shipboard Data System III (SDS III). These surveys, one at 1:5,000 scale and the other at 1:10,000 scale, were conducted by the National Ocean Service's Hydrographic Field Party #4 (HFP #4) between July 1985 and April 1986.

The purpose of this work was primarily to acquire "on-line" survey data which will be used to test and evaluate the software and hardware of the SDS III Data Acquisition System (DAS). It will also provide a basis for product comparisons between the current Hydroplot system and the new SDS III.

The survey data will be used to update nautical charts of the area and will be verified and evaluated at the Atlantic Marine Center.

B. TEST OBJECTIVES:

The following were SDS III project objectives for this test:

1. Provide SDS III with a library of recorded sensor input data as would be received by an operational SDS III Data Acquisition System (DAS) during a hydrographic survey for development and bench testing of applications software, algorithms, and sensor input software.

2. Provide two verified Hydroplot surveys for comparison of Hydroplot products with SDS III products.

3. Provide specific statistical data on Hydroplot surveys against which operating efficiency gains associated with SDS III can be measured.

4. Provide training in hydrography for SDS III development personnel, software vendors and other personnel.

5. Validate the sensor input data recording instruments for use aboard other vessels at other sites.

6. Provide a platform for other National Ocean Service, Office of Marine Operations (OMO) tests, the results of which are not reported here.

C. EQUIPMENT:

A Type I Jensen survey launch, #1020, was used for data collection on this project. With the exception of the Hydroplot data acquisition system, this launch was equipped with the types of sensor equipment that are anticipated to be used with the SDS III's DAS.

The Hydroplot data acquisition system on launch 1020 consisted of a PDP8/e computer, a Hydroplot Controller, high speed paper tape reader/punch unit, one teletype and a Complot plotter. The Raytheon DSF-6000N dual beam echo sounder was used in conjunction with this system.

The Motorola Falcon 484 Positioning system was the primary positioning control for both surveys. For Hydroplot data acquisition, this system was used with a maximum of two lines-of-positions (LOPs). To assist with the software development in the SDS III, which will have the capability of accepting more than two LOPs as well as information from more than one electronic positioning network, three Falcon LOPs were recorded on the sensor input data recorder.

In addition to the Falcon system, a Cubic Western ARGO DM-54 Positioning network consisting of three shore stations was used to provide positional control. This control was not used by the Hydroplot system, but data was collected on the magnetic tape of the sensor input data recorder for SDS III testing.

Speed and heading sensors, which currently are not part of the data acquisition system on the Type I launch, were installed to provide test data for the positional algorithms of the DAS. For speed information, the Caterpillar Engine Corp. electrical tachometer (part number 5N8176) was added to the launch on August 22, 1985. Heading data was provided by the DigiCourse Inc. magnetic digital compass, model 101C. To ensure that the compass was correct to within 3 degrees, it was adjusted by personnel from W.T. Brownley Company of Norfolk, Virginia, on September 6, 1985. Refer to Appendix C for an evaluation of these sensors.

Another digital magnetic compass, the Arc Industries, Inc., model DC-1291, was installed on the launch for evaluation purposes. It was originally planned to record this second set of heading data; however, too many problems were involved with the Arc compass so it was disconnected from the recorder system. Refer to section F, Problems Encountered, and Appendix C for additional information concerning this compass.

A Hewlett Packard Model 9825 programmable calculator provided the time reference input on the magnetic tape. A simple loop program was created to perform this function. This time reference data was used to correlate the recorded raw data with the Hydroplot processed data.

All the output data from the above sensors were recorded on Ampex wide-band magnetic tape via a Black Box Industries interface to a Thorn EMI SE3500 portable recorder/reproducer. This recorder is capable of recording data on 12 channels. However, for this test, only 8 channels were used. The channels were allocated as follows:

Channel 1 - Not used
Channel 2 - Not used
Channel 3 - Serial output from Hydroplot to DSF6000N to record event marks and position numbers
Channel 4 - DSF6000N serial output message
Channel 5 - Not used
Channel 6 - Falcon serial output message
Channel 7 - Not used
Channel 8 - Argo serial output message
Channel 9 - Caterpillar RPM sensor serial output message
Channel 10 - DigiCourse Compass serial output message
Channel 11 - HP 8925 serial output of time
Channel 12 - Falcon Pulse Time Tag

D. PERSONNEL:

David Enabnit	SDS III, Project Manager
Kathryn Andreen, LCDR	Solomons Test Task Manager (August, 1985 - February, 1986)
Donald Rice, LT	Solomons Test Task Manager (May-July, 1985)
Michael Rivers	Electronics Engineer, SDS III
Philip Libraro	Electronics Engineer, OMO
Richard Ribe	Electronics Engineer, OMO
Jason Maddox, LTJG	Officer-in-Charge (OIC), HFP #4
Ed Martin	Assistant OIC, HFP #4
Danny Bryant	Launch Engineer/Survey Technician, HFP #4
Reggie Adams	Survey Technician, HFP #4
Claude Dowty	Survey Technician, HFP #4 (November-December, 1985)
Frank Saunders	Rotating Cartographic Tech. AMC (August, 1985)
Regginal Keene	Rotating Cartographic Tech. AMC (October, 1985)

E. METHODS:

Methods used for this project are organized into four categories: Hydrographic Operations, Test Procedures, Statistics, and Miscellaneous Activities.

E.1 Hydrographic Operations:

This project consisted of two basic hydrographic surveys which were conducted under the standard requirements specified in the Hydrographic Manual, 4th Edition. The Officer-in-Charge (OIC) of the field party was responsible for the planning, execution and field processing of the survey in accordance with the SDS III Test Plan and the Project Instructions.

The acquisition of data was accomplished using the Hydroplot system or by manual methods. The Falcon system was the primary positioning system for these surveys. This system was operated with two LOPs in the range-range configuration and one LOP in the range-azimuth configuration in conjunction with a theodolite. Hewlett Packard Model 3810B Total System was the positioning system used in the manual model to provide precise distance and azimuth data for detached positions (DPs).

All data pertinent to the verification and evaluation of these surveys were submitted to the Atlantic Marine Center (AMC). Data needed for the SDS III test were either copied upon completion of the field work or will be made available after processing is completed at AMC.

For additional details concerning hydrographic field procedures, refer to the two Descriptive Reports, H-10193 (HFP-10-1-85, S-E211-HFP-85) and H-10195 (HFP-5-4-85, S-E211-HFP-85).

E.2. TEST PROCEDURES:

The following describes the test procedures.

E.2.1 General:

The Hydroplot system currently in use on all National Ocean Service vessels stores hydrographic data on punched paper tape. The data which are recorded at specific intervals does not represent the capability of real-time sensor data. In order to provide the DAS with all available test data, sensor inputs were recorded on wide-band magnetic tape.

Continuous input data from the DSF 6000N echo sounder, the serial output from the Hydroplot to the DSF 6000N, the Falcon and Argo systems, the Falcon pulse time tag, the engine speed indicator, the digital compass data, and serial output of time were recorded by the Thorn EMI SE3500 portable recorder/reproducer. All sensor data were recorded on 8 channels of a 12 channel, wide-band magnetic tape of the Thorn recorder using a Black Box Corporation interface.

To verify that the sensor data were being accurately recorded, the magnetic tape was checked at a minimum of four times a day. These checks were performed on-line by viewing the recorded data on a CRT. Using the read-after-write capability on the recorder and a switch box, which was developed to allow simple shifting from one channel to another, the data were reviewed on the CRT by the launch crew.

The sensor data were recorded at the following rates:

DSF 6000N	five per second
Hydroplot to DSF 6000N	on each event mark
Falcon (all codes)	once per second
Argo (all stations)	once per second
Falcon pulse time tag	once per second
engine speed (RPMs)	ten per second
DigiCourse heading	eight per second
Time	once per second

The above information was recorded simultaneously with the hydrographic data for the two surveys. Thus, in addition to the two Mini-Ranger LOPs required by the Hydroplot system, up to four other LOPS were established and recorded by the Thorn recorder as per the Test Plan. These extra LOPs were from ARGO stations and/or other Mini-Ranger transponders.

E.2.2 Reference System:

Since the SDS III system will be referencing all positional data to one particular point on the survey vessel, a coordinate system was established making this point equal to the launch's centroid. For these surveys, the centroid was defined as being the intersection of the horizontal plane of the water line at mean vessel loading, the vertical plane through the fore-aft centerline and a vertical plane which cuts in half the overall length of the launch. The lines defined by the intersection of any two of these planes represent the axes of the rectangular coordinates system: the "X" axis being the fore-aft line; the "Y" axis being the athwart ship line; and the "Z" axis being the vertical line. Positive values are to be assigned to "X" coordinates forward, "Y" coordinates to port and "Z" coordinates above the centroid in accordance with the right hand rule. Refer to section 2.21 of the Test Plan.

The centroid was not permanently marked on the launch since its location was in mid-air in the passageway between the stern and the cabin. However, the distances along the appropriate axes were measured to the center of the DSF 6000 transducer; to the wave guide on the Falcon Mini-Ranger Master antenna; to the top of the Argo antenna; and to the averaged location for center of the azimuth target used while performing range-azimuth hydrography, calibrations, and detached positions with the HP 3810B Total System. These distances were as follows:

Items	X-Axis	Y-Axis	Z-Axis
Transducer	0	-1' 8"	- 1' 6"
Falcon Antenna	-4' 11"	+3' 7"	+11' 3"
Argo Antenna	-13' 5"	0	+20' 3"
Azimuth Target	-4' 11"	+3' 7"	+ 7' 5"

E.2.3 Positional and Controlled Defects Experiments:

The following experiments were performed by the field unit to validate algorithms being developed for the SDS III system which will evaluate the various positioning inputs. Tests 1 through 11 were performed in areas where both Falcon and Argo coverage were available. Tests 12 through 18 used only the Mini-Ranger Falcon system. Test 19 was the only test involving the DSF 6000N echo sounder. The Argo system was used in both the hyperbolic and range-range modes.

It should be noted that the hours recorded on the magnetic tape from the HP 9825 were off five hours for the entire project. The correct hours are reflected in the data for the Mini-Ranger Falcon and Argo systems. In addition, the correct time was used and recorded on the hydrographic data printouts.

For detailed reports of the following tests, refer to Appendix D.

E.2.3.1 Static Positioning: This test involved securing the Jensen launch to a fixed object to provide the most stable position possible in the working grounds for a period of at least one hour. The location was picked so that it would be in a shelter from other vessels' wakes. The weather on the day chosen was relatively calm.

The test was performed on JD 292 (October 19, 1985) and JD 036 (January 5, 1986) along side the Tar Bay Entrance Light #1 located at latitude 38° 21'12" N., longitude 076°16' 26" W. The test was accomplished in the range-range mode on JD 292 and in the hyperbolic mode on JD 036.

The launch was secured to the light by three lines such that a maximum vertical motion of 2 feet and a maximum horizontal motion of 1 1/2 feet were observed during the test.

From this location, three Mini-Ranger transponders and all three Argo stations were received and recorded on the magnetic tape. (Refer to the Field Test Reports for the control stations used.)

On JD 292, the test was accomplished over a period of more than one and three-quarter hours. On one occasion during the test the computer crashed and had to be restarted. Also, 44 minutes after the test began, the Argo master station at Drum Point was taken off the air. These were noted on the raw data and in the Field Test Reports.

Data for this test can be found with the 1:10,000 survey data (H-10193) between the hydrographic position numbers 2096 to 2166 and "test data position numbers" 1563 to 1703. In addition, it is on magnetic tape #3 (688.7 to 1149.3 ft.) and tape #6 (837.0 to 1152.0 ft.)

E.2.3.2 Argo Smoothing Codes: Procedures for this test called for the collection of data in both directions along a sounding line whose length is at least 5 minutes of launch running time at a speed of 2400 RPMs. The sounding line was required to be re-run in both directions three times, first using a Argo smoothing code of 2, then increased to 6 and finally to a value of 9.

The test was performed on JD 015 (January 15, 1986) for the range-range mode and on JD 016 (January 16, 1986) for the hyperbolic mode. Control for the test included the three Argo stations along with two Mini-Ranger transponders. Information concerning which stations were used can be found in the Field Test Report.

There were no problems or abnormalities observed while obtaining the sounding lines with smoothing code 2. When this was changed to a value of 6, all stations had difficulties in tracking the launch. However, a partial tracking ability was maintained. Operations with a smoothing code of 9 was impossible if using only the Argo stations. There was absolutely no tracking from any station at this level.

Range-range data for this test is located with the 1:10,000 scale survey between "test data position numbers" 800 and 831 (magnetic tape #5 from 276.0 to 479.5 ft.). The hyperbolic data is between "test data position numbers" 1008 and 1044 (magnetic tape #5 from 1118.3 to 1320.4 ft.)

E.2.3.3 Line Jogs: The line jog test was accomplished on three different days: JD 288 (October 15, 1985) in the range-range mode, JD 290 (October 17, 1985) in the hyperbolic mode, and JD 022 (January 22, 1986) in the hyperbolic mode.

Procedures for this test were as follows: After the Argo and Falcon systems were calibrated and hydrography was being collected, the launch was deviated from the current sounding line for a short period of time as follows. When the vessel had steadied up on-line, the coxswain turned the launch 90 degrees, heading off in a perpendicular direction. At predetermined distances from the sounding line, the vessel would be quickly turned around and headed toward the base course where the coxswain tried to get back on-line as soon as possible. The distances at which this turn would occur were determined by using the Hydroplot system. The number of meters that were jogged on the first maneuver was doubled on the second. Approximately five times this distance was then used for the third jog. The entire test was required to be performed a total of three times.

In order to properly track the line jogs, position numbers were assigned to the beginning and end of each one. These numbers are listed in the Field

Test Reports in Appendix D and are also contained in the raw hydrographic field data for the 1:10,000 survey (H-10193).

Nine line jogs were accomplished on JD 288. The distances observed from the base course of the sounding lines while jogging off-line varied between 33 and 266 meters. Refer to position numbers 1888 and 1929 in the hydrographic data for additional information. The recorded magnetic tape data for this test can be found on Tape #2 between 1972.0 feet and the end of the tape.

The Argo system was used in a range-range mode for this first test using two stations. In addition to these, three Mini-Ranger transponders were recorded on the magnetic tape.

At the completion of the first test, it was found that one of the Argo stations had gained two lanes since the beginning calibration. Two lanes were added to station 2 just after the beginning calibration. This may have been an error but cannot definitely be determined. Thus, it is the hydrographer's opinion that the occurrence of the lane gains cannot be found.

The line jogs performed in the hyperbolic mode on JD 290 followed the same procedures as that used for the range-range data. During this segment of testing, all three Argo stations were utilized, in addition to three Mini-Ranger transponders. Only three jogs were accomplished at this time due to problems with the computer system. Data for JD 290 is located on magnetic tape # 3 between 262.5 and 370.0 feet and from position numbers 2043 and 2055 on the 1:10,000 survey (H-10193).

The comparison between the beginning and ending calibrations of the Argo system on JD 290 were excellent. No lane jumps were observed.

To complete the line jog test, the entire hyperbolic mode portion was repeated on JD 022 (1986). On this day, instead of three Mini-Ranger transponders, only two were used. Nine line jogs were performed with the distance from the base course varying from 42 to 420 meters.

The only problem encountered on JD 022 was the lost of signal from Point No Point during the last two jogs. Five lanes were lost during this time, but were easily identified on the strip chart. For data covering JD 022, refer to the 1:10,000 scale survey under "test data position numbers" 1377 through 1423. It is also on magnetic tape #6 from 111.6 to 358.1 ft.

E.2.3.4 U-Turns: The U-Turn test was performed in the hyperbolic mode on JD 290 (October 17, 1985) and in the range-range mode on JD 015 (January 15, 1986). Refer to the Field Test Reports (Appendix D) for information on which control stations and transponders were used for this test.

The U-turns were accomplished by operating the launch along a specific sounding line for at least 1 minute at a speed of 2400 RPM's then turning it about (i.e., 180 degrees) as quickly as possible. For the hyperbolic data, U-turns were made with the distances between the lines at the beginning and end of the turns (i.e., the line spacing) being 0, 10, 20 and 50 meters. The range-range portion had turning radii of 20, 40, and 100 meters. At least 1 minute of running time was completed before another turn was attempted. Except for the zero value turning radius, all turns were repeated three times.

Data for JD 290 is located on magnetic tape #3 (between 0 and 230.4 ft.) and from position number 1994 through 2040 in the 1:10,000 survey data (H-10193). The range-range data (JD 015) is from "test data position numbers" 863 to 934 and on magnetic tape #5 between 623.0 and 930.2 ft.

E.2.3.5 Cloverleafs: The cloverleaf test required the launch to perform "figure 8" maneuvers around a fixed pole (in this case, an oyster stake). An area on a starboard side cabin window was marked as a reference point for the computer operator. Whenever the stake passed that spot alongside the vessel, the operator would obtain a detached position and position number.

This test was performed on JD 015 (January 15, 1986) for the range-range portion with the hyperbolic data being accomplished on JD 016 (January 16, 1986). Positioning control included the three Argo stations and two Mini-Ranger transponders.

The location of the reference point on the launch was on the starboard side of the vessel's cabin. Refer to the Field Test Report in Appendix D for the SDS III reference system measurements to this point.

Using the "figure 8" maneuvers allowed the oyster stake to be approached from different headings while keeping the marked spot on the launch in relatively the same location in relation to the fixed object. The coxswain's steering meter on the launch was inoperative at the time this test was performed. This made it difficult to drive the "figure 8". Instead, 18 different magnetic courses were run past the oyster stake, making a figure more like a pinwheel. The ending result of the test should be a circle of position numbers with a 10 meter diameter.

No problems were encountered during the test. Data can be found with the 1:10,000-scale survey between "test data position numbers" 935 and 954. It is also on magnetic tape #5 from 931.2 through 1117.3 ft.

E.2.3.6 Beam Rolls: On JD 023 (January 23, 1986) with seas of 3 to 4 feet and wind 15 to 20 knots out of the northwest, sounding lines were collected while orienting the launch beam to the seas. Two 15-minute lines were accomplished in the range-range mode and then repeated in the hyperbolic mode. Beam rolls of the vessel during the test, varied between 3 and 30 degrees.

Positioning control for this test consisted of the three Argo stations and two Mini-Ranger stations. Information on the control stations used can be found in the Field Test Report. Refer to the 1:10,000 scale survey, "test data position numbers" 1471 through 1520 and magnetic tape #6 (359.5 - 637.4 ft.) for data concerning this test.

E.2.3.7 Water Current Effects: During a period of a 2 knot current, the launch was run in a straight line going with the current for a period of 5 minutes. The same line was then repeated in the opposite direction. At the mid-point of the second line, the vessel was turned 90 degrees to the left, which was across the current. This perpendicular sounding line was then run for a duration of 5 minutes before the vessel was turned around and run in the reciprocal direction. Each line was performed at a speed of 2400 RPMs. No adjustments to speed were made during the course of the test.

The test was conducted on JD 028 (January 28, 1986), first in the range-range mode and then the range-azimuth mode. Data for the test is located with the 1:10,000 survey between "test data position numbers" 1521 through 1562 and on magnetic tape #6 from 638.5 to 830.6 ft.

E.2.3.8 Range-azimuth: The range-azimuth test took place on JD 297 (October 24, 1985). The requirements for this test included that all Argo stations and at least two Mini-Ranger transponders be received while the launch ran sounding line arcs of 300 to 3000 meters from a range-azimuth station. The hydrographic data was to be collected in both directions while the Hydroplot system recorded the range-azimuth information. In order to fulfill these demands, the test area did not fall within the limits of either the 1:10,000 survey or the 1:5,000 survey.

Drum Point Light #2 was used as the range-azimuth station. The Argo equipment was first used in the range-range mode. Three Mini-Ranger transponders were available for recording; however, two ranges were lost at different times due to shadow zones. No problems were observed during the Argo range-range portion of the test. (Refer to "test data position numbers" 1 - 42.)

Upon completion of the range-range section, the Argo system was switched to the hyperbolic mode. The ranges were re-calibrated and the test was continued running the same range-azimuth arcs over ("test data position numbers" 43 - 87). The only problem encountered during this portion of the test was the occurrence of a lane jump.

The data for this test is contained on the magnetic tape #3 between 1156.2 and 1748.7 feet. As stated previously, the test area did not fall within the limits of a survey, thus these position numbers do not correlate actual survey information, just test data. Refer to the Field Test Report for information concerning the positioning control stations.

E.2.3.9 Simulated Lane Jumps (Argo): Lane jumps were simulated by changing the whole lane display of the patterns by one or two lanes while on-line. After the launch had obtained a couple of mainscheme sounding lines and was beginning another, one lane was added to one pattern through the Argo Control Processing Unit (CPU). Five minutes later another lane was added to the same pattern. During the next line, two lanes were subtracted from the original pattern over a period of 5 minutes. This procedure was repeated several times.

The test was performed over 4 days: JD 275 (October, 1985), JD 277 (October 4, 1985), JD 021 (January 21, 1986) and JD 022 (January 22, 1986). Refer to the 1:10,000 scale survey, hydrographic position numbers 1425-1483 and 1504-1556 for data in the range-range mode. The hyperbolic data is located between hydrographic position numbers 1557-1610, "test data position numbers" 1092 to 1198 and "test data position numbers" 1308 to 1376. The same data is contained on magnetic tapes #1 (1146.0 ft. - end of tape); #2 (0 - 494.0 ft.); #5 (1525.0 ft. - end of tape); and #6 (0 - 110.6 ft.)

The three Argo stations and two or three Mini-Ranger transponders were used to control the launch during the test. (Refer to the Field Test Reports in the appendices for the Mini-Rangers utilized each day.)

The following problems occurred during this test. The on-line computer program would suddenly crash due to unknown causes and program RK 561 could only calibrate two Argo patterns. The on-line program difficulty was solved by constantly re-loading it into the computer. As a result of RK 561 limitations on the first day, one of the three Argo patterns recorded on the magnetic tape was uncalibrated and has unreliable values (station number 3, Cove Point). This third range was not intended to be used for positioning control in the test. During the ending calibration, it was noted that station 2, Drum Point, had lost one lane while station 1 was good.

During the second day, the Argo CPU lost time slots 02 and 07 in the range-range mode. It is believed that this caused station 1 (Point No Point) to gain 3 lanes while station 3 (Cove Point) gained 22 lanes. The gaining of lanes was not noticed until performing the ending calibration of the day.

On the third testing day, the Cove Point Argo station kept going off the air. This was first caused by a loss of timing from the master station at Drum Point. The two other times appeared to be a problem with the station itself. Cove Point was a weak station where numerous difficulties trying to achieve proper grounding have occurred.

No problems were encountered during the fourth day while actual testing was accomplished.

<u>E.2.3.10 Systematic Detuning of the Argo Antenna</u>: The systematic detuning of the launch antenna was accomplished on JD 284 (October 11, 1985). The shore station portion of the test was performed on JD 015 (January 15, 1986). On JD 284, the test was accomplished with only two Argo stations whereas on JD 015, all three stations were used. The range-range mode was used for data collection on both days.

Test procedures began on the second main scheme sounding line of the day. After data acquisition had resumed, the Argo Receiver Processing Unit (RPU) was turned one step toward maximum capacitance. This detuning continued with one step being turned every few seconds until edit or high VSWR lights showed. Upon reaching such a state, the system was left in the degraded mode for at least 60 seconds then brought back to a good AGC level.

While performing the launch antenna detuning during the first attempt, the RPU was switched to the wrong mode (set on Antenna Check). As a result, the high VSWR lights were not achieved as the RPU was stepped through the entire cycle from minimum to maximum capacitence. A degraded level was acquired; however, it was not noticed since the VSWR lights were not displayed. This was corrected and the test repeated. No problems with the Argo system were observed while performing the test.

The shore station antenna detuning was performed at Drum Point. The test procedures were repeated three times with no problem encountered. Once again, the Argo system appeared to recover well from the detuning action.

Refer to hydrographic position numbers 1821 to 1859 and the "test data position numbers" 834 through 862 in the 1:10,000 survey data (H-10193) for test information. This data is also on magnetic tape #2 (1702.9 to 1970.5 ft) and tape #5 (480.5 to 622.0 ft.).

E.2.3.11 Ground Plane Effects (Argo): This test was performed on JD 280 (October 7, 1985). After the launch had acquired several sounding lines, a truck was driven onto the ground plane at one of the Argo stations. As hydro operations continued, the vehicle was slowly moved across the ground plane to within a few feet of the antenna and then back out of the area. This movement occurred at 2 to 3 foot increments. Also, whenever the vehicle was moved, radio transmissions were produced within the ground plane.

These actions would have produced tremendous interference with a Raydist station, however, the Argo manual claims no such effects. Apparently, this is the case as nothing was observed during the test.

After conducting the test, a calibration was completed using RK 561 giving the appearance that the other Argo station (which was not part of the test) had lost 3 lanes. This was later found to be incorrect when performing a second calibration.

Refer to hydrographic position numbers 1707 to 1757 which is contained in the 1:10,000 survey data (H-10193) and magnetic tape #2 (between 495.1 and 1702.1 ft) for this information.

E.2.3.12 Shadow Zones (Falcon): This test was performed on JD 347 (December 13, 1985) using three Mini-Ranger transponders. Range-azimuth control was used to position the launch.

Test procedures required that one of the transponders be positioned such that a shadow zone was created in the surveying area. Then sounding lines which ran into and out of the zone were to be collected. For this test, a point of land was used to produce the shadow zone for code 2 on Kingston Creek. It was observed that as soon as the vessel lost line of sight with code 2, the signal strength dropped to zero and the range value lost.

Refer to the 1:5,000 scale survey data, "test data position numbers" 1 through 42 and magnetic tape #4 between 0 and 344.0 ft. for information covering this test.

E.2.3.13 Minimum Operating Range (Falcon): This test called for hydrographic sounding lines to be collected using Mini-Ranger positioning control, where they approach closer to the transponder than the minimum recommended operating range.

The test was performed on JD 347 (December 13, 1985) within the limits of the 1:5,000 scale survey. The sounding lines for the test started at a distance of 400 meters from the transponder at Light #8 and gradually got nearer until the closest point of approach was approximately 15 meters. The minimum range value that was produced by code 2 on Light #8 was 48 meters.

Data for this test are located with the 1:5,000 scale survey between "test data position numbers" 43 through 86 and on magnetic tape #4 from 345.0 to 418.3 ft.

E.2.3.14 Antenna Section (Falcon): The object of the test was to obtain sounding lines that traversed the normal operating sector of a Mini-Ranger antenna. This test was accomplished on JD 351 (December 17, 1986) using range-azimuth and Mini-Ranger control.

While performing the test, it was noticed that as the launch moved out of the operating sector, the signal strength of the transponder would drop and erroneous ranges would be received.

Refer to the 1:5,000 scale survey, "test data position numbers" 272 to 322 and magnetic tape #4 from 1238.5 to 1500.0 ft. for data covering this test.

E.2.3.15 Variable Attenuator (Falcon): On JD 009 (January 9, 1986) hydrographic data was obtained using range-azimuth and Mini-Ranger control while the attenuation of one transponder was changed. The attenuation of transponder was increased from a minimum setting at the beginning of hydro through the 40 db level, at which time the signal was lost.

Since this transponder did not control the launch positioning, nothing except what would normally be seen during a baseline calibration was observed.

Data for this test are located with the 1:5,000 scale survey from "test data position numbers" 261 through 346 and on magnetic tape #4 between 1689.0 and 2171.4 ft.

E.2.3.16 Reflected Signal (Falcon): This test was performed on JD 351 (December 17, 1985) using range-azimuth positioning as the primary control for hydrography while obtaining reflected signals from a supplemental Mini-Ranger transponder.

To produce the reflected signals, a 60-foot vessel (NOAA Launch LAIDLY) was placed in close proximity of a transponder. The sounding lines were then accomplished within the limits of the 1:5,000 scale survey. Due to a 12 volt power supply being out of adjustment, the test was repeated. It was later discovered that both sets of data were good. Refer to the Field Test Reports in Appendix D.

Refer to "test data position numbers" 200 through 271 and 323 through 360 with the 1:5,000 scale survey. Also, this information is on magnetic tape #4 from 900.0 to 1226.9 ft. and 1501.9 to 1688.0 ft.

E.2.3.17 Frequency Interference (Falcon): The object of this test was to operate the survey vessel in an area where two Mini-Ranger transponders were set to the same frequency. This test was performed on JD 009 (January 9, 1986) with range-azimuth control along with two code 1 transponders. (A different code was used with the range-azimuth positioning.)

This test showed that with the signal strengths being equal, the range from the closest transponder would be the the one accepted by the Falcon system. When the vessel approached the mid-point between the two code 1 transponders, the Falcon Control Display Unit (CDU) would alternate between the two units, then hold onto the transponder which would soon become the nearest one.

Data for this test is contained with the 1:5,000 scale survey between "test data position numbers" 347 and 418. In addition, it is located on magnetic tapes #4 (2171.5 ft. to the end of the tape) and #5 (0 - 275.0 ft.).

E.2.3.18 Null Zones (Falcon): The object of this test was to obtain sounding lines through an area known as a null zone or range hole of a Mini-Ranger transponder. Using the range hole location formula in the Solomons Island Test Plan, null zone areas were found for a transponder which was not controlling the position of the launch.

At the primary test location, the Mini-Ranger transponder in which the null zones were predicted had 30 to 40 meter jumps in the observed ranges. Also, the signal strength dropped to zero when going through the center of the hole.

Refer to the 1:5,000 scale survey, "test data position numbers" 1725 through 1745 and magnetic tape #6 from 1259.3 to 1388.5 ft. for data covering this test.

E.2.3.19 DSF 6000N Low Frequency Operation: The purpose of this test was to acquire low frequency echo sounder data over various bottom types. This was accomplished on JD 036 (February 5, 1986) where sounding lines were conducted within the limits of the 1:10,000 scale survey. Hydrographic positioning was not specified for this test; however, it was obtained during part of the operations.

While operating the launch at either 2400 or 1000 RPMs, low frequency data was collected over sand, rip-rap (rocks), mud and sparse grass. Areas with thick grass and silt could not be found.

For the information covering this test, refer to the 1:10,000 scale survey, "test data position number" 1704 through 1724 and magnetic tape #6 from 1153.0 to 1258.3 ft.

E.2.4 Statistics: While conducting the two hydrographic surveys, field party personnel along with SDS III observers maintained daily written logs on both field and support operations. The statistical data included the type of work performed, the time consumed by failures and problems, the amount of time spent for each activity, and the number of miles of hydrography. This information was reported in four different logs in addition to the normal survey records: Launch Operations Log, Daily Staff Hour Summary, Processing Log, and Observer Records.

E.2.4.1 Launch Operations Log: This was a bound notebook (a sounding volume) in which the field party recorded events of each day when obtaining or attempting to obtain hydrography. This log contains the date (calendar and Julian day); time of departure from and return to the pier; beginning and ending times of calibrations, bar checks, personnel breaks, equipment breakdowns plus type of equipment failure and cause if known; visual or electronic stations used (signal number and Mini-Ranger or Argo code); time of arrival and departure from the work area; type of position experiments performed along with position numbers; lineal nautical miles of hydrography obtained; and any descriptive comments that were beneficial to understand the day's operations. Since this log is part of the raw hydrographic field records, a xerox copy was provided to N/CG211 on a monthly basis.

E.2.4.2 Daily Staff Hour Summary: These forms were instrumental in monitoring the type and amount of man-hours required to complete the project. Each field party employee recorded their time spent performing tasks in the following five categories. These forms were submitted directly to N/CG211. They were only required for the SDS III Test Plan and are not part of hydrographic records.

1. Administration and nonsurvey work: Time spent accomplishing administrative tasks such as payroll activities or personnel actions as well as time spent with nontechnical duties like travel or maintenance of equipment.

2. Technical Support: Technical activities which are required in support of hydrography but which do not involve hydrographic data gathering or processing. This included drawing up boat sheets, geodetic survey operations, setting up electronic stations and installing tide gages.

3. Hydrography: Any hydrographic data gathering activity including settlement and squat measurement, bar checks, obtaining actual sounding data and processing the data.

4. Lost Productivity due to Hydroplot: Time lost due to Hydroplot failures. Besides time lost due to hardware failures, this included time used to correct a Hydroplot-caused problem such as re-typing the master tape after a punch jam or entering manually recorded data collected when the on-line system was down.

5. Lost Productivity due to all other causes: Time lost due to weather, mechanical and electrical breakdowns other than the Hydroplot system. This includes the time lost prior to switching to other activities.

E.2.4.3 Processing Log: This log was established to determine the amount of effort involved in field processing each survey. Information such as date, daily beginning and ending times of processing, name of the processor, day number of the data being processed, and the type of action performed was recorded in this log.

The types of processing activities were broken into four categories:

R = Rough Plot Processing: This is the folding and scanning of records; making corrector tapes; and first off-line plot. In other words, all the efforts necessary to generate the first off-line plot.

I = Intermediate Processing: All activities between the first plot and the final field plot. Included with this are any secondary or enlarged plots, and corrections to soundings or positions.

S = Smooth Field Plot: The final field plotting of the survey plus any subsequent processing or activity to generate the final field sheet.

D = Support Documents: This is the report writing; checking and correcting support documents or records; and working on calibration abstracts.

E.2.4.4 Observer Records: SDS III staff personnel were assigned as observers to the field party to record specific times and activities which the field party performed. Being routine activities which the field unit did not track, this data included the following:

(1) The names and numbers of each program used.

(2) Amount of time necessary to select and load a program to the stage where the operator is able to use it. Also, the number of times to re-start the program due to operator errors.

(3) The type and cause of any Hydroplot failure and/or malfunction plus the amount of time necessary to correct the failure and the number of occurrences.

(4) Any manual activities and computations such as recording and averaging calibrations, along with the time used and the number of times the activities were performed.

(5) The beginning and ending times of position experiments, the type of experiment and any pertinent remarks.

(6) Miscellaneous activities and comments involving daily launch operations.

E.2.5 Miscellaneous Activities: It is not often that logistics are satisfactory such that a platform for testing equipment, procedures, and training is available. Due to the SDS III Test Plan requiring a field unit at Solomons Island, Maryland, this opportunity was made available. As a result, while conducting operations on this project, there were additional tasks assigned that were not part of the hydrographic survey or SDS III test activities.

One supplemental assignment was conducting two hydrographic orientation classes for SDS III development personnel, software vendors and Office of Marine Operations (OMO) personnel. The first class was 4 days in duration, providing 3 days of classroom instruction plus 1 day in the field. Due to the size of the class, the field portion consumed the total support of the field unit for 3 days. The second class was condensed into 1 day of classroom instruction and 1 day in the field. In addition to the SDS III software vendors, this second class included two people from the Department of Commerce, Inspector General's Office.

As an additional activity, the Tektronix model 4107 graphics terminal that is part of the DAS was taken down to the launch to determine how easily it could be seen by operators under ambient lighting conditions. The day this occurred was partly cloudy providing both overcast and sunny lighting conditions. Placing the terminal in an anticipated orientation in the cabin directly facing the interior of the launch, constantly in shade, all the main colors (red, orange, green, blue, purple) and most of the available tints could easily be seen. When set in direct sunlight, only the major colors were easily distinguishable while the tints were washed together. It is recommended that tints not be used to differentiate between adjacent features. All tinting abilities should be at the discretion of the Officer-in-Charge (OIC) of the launch.

All other supplemental activities during this project were under OMO and either required support equipment or part time assistance from the field party on a "not to interfere" basis. These activities included the positional accuracy testing of the Global Positioning System (GPS) and the space diversity/range hole testing of the Falcon system. For additional information on these activities, contact Lt. Tim Rulon, Operational Systems Engineering Branch, OMO, Rockville, Maryland.

F. PROBLEMS ENCOUNTERED:

A few problems were encountered while performing this project. The majority of these consisted of hardware difficulties with the electronic equipment installed on the Jensen launch 1020.

Productivity was lost on several occasions due to the computer and hydroplot controller. This antiquated system had daily failures, some of which could be easily resolved while others required lengthy troubleshooting and/or delays waiting for spare parts. Examples of these difficulties are computer and Hydroplot controller card failures, the computer inability to achieve "nav up" on initial loading, computer program crashes, plotter failures and a reader/punch unit failure.

During the course of the project, approximately 3 weeks of vessel operating time was lost due to the malfunctioning of the Hydroplot Controller. At first, failures caused by this unit were intermittent and appeared to be produced by other equipment. As the Controller deteriorated, 95 percent of the work day was lost attempting to keep the Hydroplot system functioning properly. After many futile man-hours spent troubleshooting the equipment without success, the Hydroplot Controller was replaced, which eliminated 90 percent of the observed problems.

Other problems involved the procurement, testing, and installation of the Thorn EMI SE 3500 recorder/reproducer system in launch 1020. This system consisted of the recorder, the Black Box interface unit, a separate power regulator, a CRT, a switch box and the connecting cables.

Several delays were experienced in procuring the recorder. Submitting paperwork near the end of the fiscal year, an extremely active period for the Procurement Division, caused a lag in the delivery time. Many components were sole-source items with limited stock. Time was lost when manufacturers had to assemble these to meet requested amounts.

During the testing of the system, approximately half of the Black Box generator boards were found to be defective and had to be replaced. These boards are very sensitive, having a tendency to drift in frequency. They required substantial adjustments otherwise they would have produced faulty data on the magnetic tape. Also, three of the PCM modules for the Thorn recorder were of the wrong revision level and had to be replaced.

Difficulties with the launch's electrical power and grounding were encountered while installing the recorder system. A voltage regulator with noise suppression was placed on the vessel when it was discovered that the output of the Onan generator had too much electrical noise/interference for recording the data. This unit failed before the system installation was completed and had to be replaced. The replacement unit worked well until just prior to the end of the project when it also failed. On January 23, 1986, the recorder system was switched back to just Onan power in order to complete the last few positional tests. The earlier problems of electrical noise were not observed by launch personnel at this time.

In addition, the single point grounding on the launch had deteriorated and was not providing an adequate contact. Several sensors were also not sufficiently grounded which, coupled with the above problems, provided electrical noise interference to the recorder system. Several connecting cables had to be replaced with special double shielded computer cables.

Both the Arc Industries compass and the VHF radio were not sufficiently shielded, thus providing other sources of noise. The radio only disturbed the CRT leaving the recorded data clean, whereas the Arc compass had to be removed from the entire system and could not be tested.

Another item that was noted while setting up this system, which might re-occur in future uses with other systems, was the operational status of the serial outputs for the Argo and Falcon units. These extra output ports are normally not used by the east coast field units and may or may not be used by the west coast. For the instruments on launch 1020, it was discovered that the serial PC board in the Argo CDU was inoperable. In order to record data from the Falcon, the factory preset of 9600 baud output had to be changed to 2400 on the output driver board.

The speed and heading sensors were connected to a triple output DC power supply which also produced a few difficulties. Besides one complete failure of the power supply at the beginning of the project, it was easy for launch personnel to accidentally knock the power supply out of adjustment. When this happened, speed and heading data would not be recorded on the magnetic tape. Some of the positional tests had to be repeated as a result of this.

A couple of the Argo units at both the shore stations and on the launch had to be replaced due to minor failures. Also, two of the three Argo stations were damaged after a severe storm occurred at the beginning of November. Two power supplies and one Antenna Loading Unit were ruined beyond repair when the station sites were flooded. At that time, there were no spares available at the Atlantic Marine Center (AMC). Field party operations had to be switched over to other activities (i.e., survey work and tests on the 1:5,000 scale survey) while they waited for one of the NOAA ships to return to AMC with other Argo equipment. A few delays in the completion of the project resulted as weather conditions deteriorated during this one and a half month waiting period.

Other minor inconveniencies included a failure with a DSF 6000N echo sounder and a Mini-Ranger transponder being stolen.

G. DEVIATION FROM PLAN:

The only deviations from the Test Plan were very minor and did not affect the overall objectives. These were as follows:

The range/azimuth test data was obtained outside the survey limits defined in the Project Instructions. There were no adequate locations for performing this test which would meet the requirements stated in the Test Plan in this area.

While performing Variable Attenuator Test, the attenuation of the transponder was increased up to a maximum value, but was not brought back down as specified in the Test Plan.

Digitized data for the DSF-6000N low frequency beam were not recorded on the magnetic tape for a grass covered area. At the time this test was accomplished, grass was not present in or near the working area.

H. ANALYSIS AND EVALUATION: The primary objective of this test project was to obtain a library of taped sensor input data for the development and bench-testing of the DAS. Six magnetic tapes containing the data and information specified in the Solomons Test Plan were obtained.

H.1 Analysis: The primary data analysis of this project concerns the statistical data which will provide a historical basis for later comparisons between Hydroplot and SDS III. Operating efficiency factors and current reliability information on a Hydroplot system were also obtained. The examination of this data has provided a means for determining areas of hydrography where SDS III has the most potential for improving efficiency.

The statistical data as described in E.2.4 Statistics, have been expressed in staff(man)-hours and miles of hydrography per hour. Table I, Project Staff-Hours, breaks down the total amount of time spent on different activities into hours per 100 miles of hydrography for both surveys. The "Hydro" times listed in this table include the times listed in Tables II, III and IV. However, it should be noted that Tables II and III express time in launch operating hours not staff-hours. Launch operations involved two to four field party crew members, thus, one launch hour may be equal to four staff-hours.

Table I
Project Staff-Hours

	1:10,000 Total	H-10193 Per 100 Mi	1:5,000 Total	H-10195 Per 100 Mi
Admin-NS	747.5	221.2	712.8	737.9
Sur-Supp	458.8	135.7	326.4	337.9
Hydro	1115.0	329.9	1300.5	1346.3
LProd-HP	195.5	57.8	33.5	34.7
LProd-Oth	156.9	46.4	76.0	78.7
Total	2673.7	791.0	2449.2	2535.4

Test (Total time for both surveys): 742.3

Admin-NS = Administrative & non-survey support times
Sur-Supp = Survey support time for basic hydrography
Hydro = Data acquisition & processing times of hydrography
(Tables II, III, & IV)
LProd-HP = Lost production time due to Hydroplot system
LProd-Oth = Lost production time due to other causes
Test = All times in support of SDS III test only (not included under any other category)

Tables II and III, Data Acquisition Times, tabulate times for specific data acquisition operations in terms of launch operating hours. Table IV, Processing Times, lists the amount of time spent on the initial, intermediate and final manipulation of data plus preparation of support documentation in staff-hours and staff-hours per 100 miles of hydrography.

Table V, System Initialization Times, tabulates the amount of time it took the hydrographers to bring the Hydroplot system up to a working status. These times were obtained from the non-field party observers. It should be noted that the days in which observers were present were picked randomly, thus, there were some days in which hydrography was not obtained due to equipment problems. Also, observations were made while field party operations covered both the 1:10,000 scale survey and the 1:5,000 survey. As a result, usage requirements of programs, procedures and equipment varied during the 10 observing days. Hence, the number of attempts that the activities listed in Table V occurred, greatly differ.

Table II
Data Acquisition Times - 1:10,000 H-10193

Vessel Operating Hours

	Total Time	Percentage for Project	Hours Per Mile
Calibration	4.5	3	0.013
Hydro (Basic)	45.3	31	0.134
Down Time - HP	23.9	16	0.071
Down Time - OTH	14.2	10	0.042
Travel - T&F	51.1	35	0.151
Bar Checks	6.6	5	0.020
Total	145.6	100	0.431

HP = Hydroplot System
OTH = Anything other than the Hydroplot system
T&F = Times to and from the work area

Table III

Data Acquisition Times - 1:5,000 H-10195

Vessel Operating Hours

	Total Time	Percentage for Project	Hours Per Mile
Calibration	2.5	3	0.026
Hydro (Basic)	62.3	66	0.645
Down Time - HP	3.6	4	0.037
Down Time - OTH	1.1	1	0.011
Travel - T&F	22.2	23	0.230
Bar Checks	3.0	3	0.031
Total	94.7	100	0.980

HP = Hydroplot System
OTH = Anything other than the Hydroplot system
T&F = Times to and from the work area

Table IV

Processing Times

Man-Hours

	1:10,000 H 10193		1:5,000 H 10195	
Processing Activity	Total Hours	Hours Per 100 Miles	Total Hours	Hours Per 100 Miles
Rough	174.3	51.6	184.1	190.6
Intermediate	78.5	23.2	170.6	176.6
Smooth	223.6	69.1	259.6	268.7
Documentation	164.9	48.8	170.5	176.5
Total	651.3	192.7	784.8	812.4

Table V

System Initialization Times

Activity	Number of Attempts	Total Time (Hrs)	Hrs. Per Occur.	Occur. Per Day
Setting M/R	6	0.33	0.06	1
Tuning Argo	9	4.65	0.52	2.25
Loading RK 112	9	0.43	0.05	1.8
Re-start RK 112	58	4.27	0.07	11.6
Loading RK 116	5	0.25	0.05	1.25
Re-start RK 116	7	0.42	0.06	1.75
Loading RK 300	5	0.23	0.05	1.67
Re-start RK 300	6	0.17	0.03	6.0
Loading RK 561	3	0.18	0.06	1.5
Re-start RK 561	2	0.33	0.17	1.0
Header Tapes	8	0.40	0.05	1.14

The 1:10,000-scale (H-10193) basic survey contained 338.0 lineal nautical miles of hydrography which were gathered in 33 actual launch days with 145.6 hours of vessel use. Thirty one percent of the total launch hours (45.3 hrs.) was used for actual on-line data acquisition. Using these figures, an average of 2.32 nautical miles of hydrography per hour, 7.46 nautical miles of hydrography per data acquisition hour, and 4.41 hours of launch time per day, were achieved. The total number of man-hours involved with this survey was 2673.7 hours. (Total man-hours includes field and office support, repair times, data acquisition, data processing, weather days, etc.)

The 1:5,000-scale (H-10195) basic survey was made up of 96.6 lineal nautical miles over 28 launch days involving 94.7 hours of vessel use. Sixty six percent of the total launch hours (62.3 hrs.) was used for actual on-line data acquisition. Included in these totals, this survey contains 35.2 launch hours (147.6 man-hours) of manual data acquisition required for the AWOIS item investigations. The manual work was accomplished over a period of 11 days comprising a total of 3.2 hours of launch operating time per day. An average of 1.02 nautical miles of hydrography per hour, 1.55 nautical miles per data acquisition hour, and 2.23 hours of launch operating time per day, were achieved. The total man-hours making up this survey were 2449.2.

H.2 Evaluation: Survey procedures, the area of operation, equipment, weather, and personnel, determine the quantity and quality of hydrographic surveying. Since each hydrographic survey is unique, it is necessary to identify the major factors that influenced the values given in the above statistical tables.

H.2.1 NonInfluencing Factors: Some of these factors will be affected by the implementation of SDS III, whereas others will experience little or not change. Those which will not be influenced by the new data acquisition system are as follows:

H.2.1.1 Weather: Each survey area is subjected to weather days when it is too rough or hazardous to perform field operations. This varies greatly with location and time of year. A survey in Bristol Bay, Alaska during the summer months cannot be compared to one in the same area at a different time nor to one at another location. This must be considered when attempting to match two surveys and determine efficiency values.

During the course of this project, and in particular while performing the 1:10,000-scale survey, production was limited several times due to weather conditions. Not only were there the few nonproductive periods due to normal storm systems (i.e., weather days), but the field party had to contend with a day of tornado watches, two hurricanes, and flooding conditions. These surveys could have been considered "typical" where weather was involved except for the hurricanes.

H.2.1.2 Travel Time: The actual operating area was a factor in the amount of production accomplished on both surveys. For the 1:10,000-scale survey, the time getting to and returning from the working area was greater than the amount of time spent on obtaining hydrographic data. The quantity of time spent traveling to and from the working grounds obviously varies with each survey and can limit the number of sounding miles acquired. The travel time on the 1:5,000-scale survey was considerably lower since the vessel was moored within the limits of the survey. As an influence in efficiency ratings, this should be considered when comparing surveys.

H.2.1.3 SDS III Recorder: It should be noted that setting up the recording system in the launch for SDS III occupied approximately 3 weeks of launch time. During this period, the vessel was not available for survey operations which directly affected the overall efficiency statistics of the project and caused a delay in its completion. Most of the time, productivity was not lost as a result of this inconvenience. The OIC was able to substitute nonautomated tasks involving both data acquisition and processing. However, some of these items may not have been required if the launch was operational and the surveys were completed at an earlier time.

H.2.1.4 ARGO Equipment: As mentioned previously in this report under "Problems Encountered," the loss of the Argo shore stations for one and a half months affected the production statistics for the 1:10,000-scale survey and delayed the completion of the project. Even through changes of operating areas or tasks to reduce the amount of down time due to equipment failures, production times will still suffer from lack of spare parts. The implementation of SDS III will not alter this; however, statistical analysis using the SDS III equipment inventory ability may allow better forecasting of possible future failures and indicate what additional spare parts maybe needed.

H.2.1.5 Miscellaneous Factors: Lost production due to other causes included: failures with the Argo system, Mini-Ranger system, and the Raytheon DSF 6000N echo sounder; launch mechanical difficulties; transportation of instruments between the field party and AMC; and miscellaneous activities such as assisting in SDS III's Hydrographic Orientation Classes and OMO's tests. Of these, only the Argo system had several failures which delayed the performance of several SDS III positioning tests and caused a loss in launch data acquisition time. These problems were not in excess of what is normally experienced during a project.

H.2.2 Influencing Factors: The following are factors affecting the statistical data on this project which will be influenced by SDS III:

H.2.2.1 Hydroplot System: The major factor influencing these surveys, which will be the one most affected by the introduction of SDS III, is the Hydroplot data acquisition and processing equipment currently in use on the vessels. This antiquated system, the work horse of hydrographic program, is now ready for pasture. Reviewing the data obtained by nonfield party observers reveals that the main difficulties while performing the surveys were starting up and keeping the Hydroplot system on line. The problems with the equipment were not always detrimental such that a lot of time was lost while repairing and waiting for spare parts. A large portion of the time was concentrated on numerous attempts to load or restart programs while working in the survey area. Using the observers' data for a typical day prior to the replacement of the Hydroplot Controller in November, RK 112 was restarted an average of 11 to 12 times at a rate of 4.2 minutes each time. Other programs varied in both attempts and duration; refer to Table V.

Since the crew of the field party was well acquainted with the Hydroplot system and its eccentricities, they were proficient in minor troubleshooting procedures. If the desired result was not achieved in an expected amount of time, personnel would immediately take action. This will not be the case when the test surveys are redone with the developmental DAS in the future and should be accounted for when comparing the performance between the two systems.

Since field operations began on the 1:10,000-scale survey (H-10193), the Hydroplot difficulties had a tremendous affect on the productivity of this survey. By the time operations concentrated on the 1:5,000-scale survey (H-10195), these problems were solved. This allowed more efficient use of launch operation time, thus giving the 1:5,000-scale survey (H-10195) a higher percentage of data acquisition time.

H.2.2.2 Positioning System Calibrations: One area that was expected to demonstrate a decrease in the survey efficiency was the calibration of positioning systems. There are several methods applicable for calibration procedures which require various time durations. This project was fortunate to have the easiest and most efficient methods available, the static point and an azimuth-distance (using the HP 3810B Total System).

Any fixed point such as daybeacons, piling, etc., can be located to Third Order horizontal control standards, thus allowing the launch to pull up to it and either compare ranges to calculated values or set the correct lane values. Using the HP Total System, a range-azimuth observer would take a set of three angles and distances to the launch which were averaged and then was used to compute the positional system's correctors. These methods typically took 5 minutes to perform. Manual computations of corrector values for the calibration were determined in approximately 1 to 5 minutes. The static point calibration is not typically performed during a survey since such a point is not easily found. Also, not all field units have the HP Total System nor do the launches normally work in adequate conditions to use one (close proximity and calm waters). Hence, the calibration times for these surveys are biased and do not reflect that seen in normal operations.

The "typical" (if one exists) survey is either on the open coast or with a rugged shoreline where calibrations are performed by three-point sextant fixes, theodolite intersection of two azimuths, using a range and angle; or two ranges. (This range is not a positioning system value but the coincidence of two objects.) These methods require a greater amount of time to perform than static point method. Depending on the proficiency of the personnel, the three-point sextant fixes and the theodolite intersection routine can take between 20 and 60 minutes. The range methods are usually faster requiring 10-25 minutes to perform, but are difficult to set up. The computations for the corrector values using these methods would then take an additional 10 to 30 minutes.

In addition to the "critical" calibration methods mentioned above, less accurate procedures which verify that the positioning system is working correctly (known as "non-critical" system checks) are required on a daily basis. These include baseline crossing, launch-to-launch comparisons, three range fix comparisons, and when using the Falcon, least squares methods.

Except for the least squares, the data for such system checks are obtained quickly (within 5 - 10 minutes), but it is the off-line computations for correctors that are lengthy to accomplish (25 - 60 minutes). None of these were performed on the Solomons Island surveys. The Falcon least squares method is accomplished in approximately 1 minute with no off-line computations. It was the only type used during this project.

It is in the time and effort involved in the software manipulation of the calibration procedures where SDS III will improve efficiency. Using the Hydroplot system, the calibration programs are not the same as that used to acquire hydrographic data nor can they be stored in the computer at the same time. It is necessary to jump between the computer programs while constantly re-entering the initializing data (i.e., survey parameters, station locations, signal numbers, etc). At times, more than one program is needed to compute the calibration corrector values. If a mistake is made when entering data for the first part and not noticed until the operator is using the second program, the sequence must be repeated.

SDS III should eliminate the necessity of re-entering initializing data along with the switching between calibration and hydrographic acquisition programs. In addition, SDS III will assign a quality factor to the positioning information which allows the hydrographer to determine the value of the calibration. A high reliability of system checks and calibrations will be achieved; thus fewer calibrations will be required. The time saved for these procedures is estimated by the author to be on an average of 25 minutes per calibration.

H.2.2.3 Location and Positioning Methods: Other influences that affected the statistical data involved the type of positioning mode used and the physical operating area. The 1:10,000-scale survey was primarily an open water survey with a small amount of shoreline, few dangers to navigation and little vessel traffic. The launch "mowed the lawn," obtaining one sounding line after another without reducing speed, using the easiest and most direct method of positioning: Mini-Ranger Falcon in the range-range mode. This type of control network requires minimal operator assistance, minor maintenance and is the fastest technique for obtaining hydrography.

In contrast to the 1:10,000-scale survey, the 1:5,000-scale survey contained a substantial amount of shoreline, many dangers to navigation, and was performed using the range-azimuth mode of positioning. The area made it necessary to operate the vessel at reduced speeds while 1 performing normal sounding operations, 2 approaching the shoreline, and 3 avoiding hazards such as pilings or piers.

There was over a 50-fold increase in the number of Automated Wreck and Obstruction Information System (AWOIS) items or hazards to navigation on the 1:5,000-scale survey from that on the 1:10,000-scale survey. The time involved in verifying or disproving these items resulted in a large decrease in the number of nautical miles of hydrography per acquisition hour.

The efficiency of the survey was also influenced by the range-azimuth method of positioning. This is a much slower mode of data acquisition and requires additional personnel along with an increase in the processing time.

SDS III will not produce an increase in efficiency where physical limitations of the survey area are concerned, but should help with the data acquisition and processing of the AWOIS items and the range-azimuth hydrography.

With the availability of multiple LOPs that can be used by SDS III, much of the range-azimuth hydrography may be deemed unnecessary. A confidence factor will be assigned to each position obtained which could be used to determine which type of positioning method is needed.

H.2.2.4 Processing Data: Under the current Hydroplot system, all processing procedures are very time consuming. The editing of punched data tapes requires entirely new tapes to be produced to accomplish the changes. In addition, the plotting routines are complicated and slow. To perform the simplest plot with uncorrected depths due to tide, etc., requires a minimum of two tapes. The field party's final plot with depths corrected for velocity of sound and tidal effects, requires four tapes. It is anticipated that a considerable amount of time will be saved in this area alone by the implementation of SDS III. Storing all this data on disks will allow both ease in editing data, pooling of correction values to be applied simultaneously, and the elimination of reproducing data tapes. Also, it will be easy to perform comparisons between current survey information and prior data (Composite Source File), thus reducing the number of conflicting soundings and unresolved features.

H.2.2.5 Administrative Duties: Reviewing the statistical information, it was noted that a large amount of man-hours was spent on administrative, nonsurvey support duties. This was the second largest value of staff-hours used on the project. SDS III will have little impact on this area. However, it is apparent that improvements can be made on this front, too. The field party which performed the Solomons test was not furnished with any modern office equipment until the end of the project. At that time, they were given an IBM Personal Computer; however, no training and only a few programs were available. All reports and forms had to be handwriten. The DPS will have word processing and editor capabilities which would eliminate many hours involved in handwriting and/or recopying reports alone. Additionally, many of the required abstracts and forms will be produced by the DPS, thus eliminating the required manual labor.

H.2.2.6 Equipment Inventory: Many of the correctors applied to the hydrographic data are equipment specific such as Mini-Ranger baseline correctors which vary with each unit. The tedious task of tracking equipment serial numbers is required to ensure the appropriate corrector is used. Under present conditions, this logging of data is performed manually by launch personnel. It is not uncommon that this information is omitted from the daily records or the numbers are incorrectly submitted. Through its equipment inventory ability, SDS III will eliminate this task and such errors.

H.2.3 Factors not Experienced: Other conditions that will affect survey productivity which were not experienced on this project but will be influenced by SDS III are as follows:

H.2.3.1 Sea Conditions: The location of these two surveys is another influencing factor on hydrographic operations. The 1:10,000-scale survey is in the Chesapeake Bay at the mouth of the Patuxent River. The 1:5,000-scale survey falls entirely within the Patuxent River. Unlike working on the open ocean, this area is well protected; large ground swells and sea states were not experienced. Conditions which exceeded preferred surveying conditions (i.e., 4 to 6 feet. waves) were encountered during the 1:10,000-scale survey; however, these are small compared to other working areas such as off the Hawaiian Islands.

When such unfavorable conditions exist, observed sounding depths must be adjusted to express the actual depth. Currently, this is performed by visually inspecting the echo sounder's analog trace, averaging the wave action, and manually correcting each depth. The sounding selection algorithms used in SDS III should eliminate a large portion of this labor.

H.2.3.2 Surveying Depths: Depths on the two test surveys were relatively representative of east coast in-shore launch hydrography (except for Maine and the Caribbean areas) with a range from 0 to 140 feet. The bottom topography was comparatively gentle with some steep slopes. Surveys along the coast of Maine, the Caribbean and the west coast are quite different with extreme depths (up to 700 fathoms) and very steep slopes (as seen in the Alaskan fiordlands). These conditions can cause difficulties when acquiring depth information. With the shallow depths, this was not a problem on the test project; however, adequate testing of the SDS III software may not be accomplished because the full range of expected sounding conditions were not met.

As with sea conditions, the selective sounding algorithms in the new system should reduce depth value errors.

H.2.3.3 Tidal Variation: Another condition that was not seen during the Solomons surveys was a large tidal variation. Tides in this area have a maximum range of 3 feet. Errors in tidal zoning and predicted values with such a small magnitude of actual tide are difficult to find. This may not be sufficient when performing a test on the tidal package expected with SDS III.

H.2.4 SDS III Influences: The above observations and statistics identify the following areas where improvements will be achieved with the implementation of SDS III:

1. On-line data acquisition - time involved and quality of data.

2. Reduction in the number of unresolved discrepancies between prior survey data and current data due to the readily accessible digital prior survey data.

3. Elimination of many grueling manual tasks such as adjusting depths for wave action, keeping track of statistics like serial numbers of equipment, etc.

4. More efficient processing abilities - especially in areas of editing, plotting, and comparing data.

5. Reduction in calibration and system check times.

6. Report writing - reduction of administrative, non-survey, and technical support hours.

7. Reduced requirements for range-azimuth positioning systems.

8. Identifying the amount of time involved in equipment usage, thus predicting possible failures and needed spare parts.

I. MARINE CENTER PROCESSING STATISTICS:

To obtain a complete statistical baseline of the Solomons test surveys, it is necessary to include the time and effort involved with verification and quality control of the surveys. After the field work for each survey is finished, the data will be sent to the Atlantic Marine Center (AMC), in Norfolk, Virginia, for verification and evaluation. During this phase, the following categories of statistical data will be requested from the Hydrographic Surveys Branch, AMC.

1. Number of man-hours checking soundings: inserted times, peak and deep values, digitized and corrected depths.

2. Number of man-hours checking and correcting positional accuracy and junctions.

3. Number of man-hours performing prior survey and chart comparisons.

4. Number of man-hours checking data on AWOIS items.

5. Number of man-hours checking calibrations, velocity corrections, bar check values, etc.

6. Number of man-hours performing the Preprocessing Review.

7. Number of man-hours spent on hand lettering and corrections.

8. Number of man-hours spent on spooling data.

9. Number and types of problems/errors with data tapes when spooling the data and plotting the data.

10. Number and types of plots produced, plus man-hours involved.

11. Number of man-hours comparing AMC plots to final field sheets.

12. Number and type of items/problems unresolved, unable to adequately process and/or requires further field work, including reasons for such decisions.

13. Number of man-hours performing quality control (Q.C.) review.

14. Number and type of problems discovered during Q.C. review.

15. Number, type and reason data is returned to reviewing cartographic technician.

16. Number of man-hours spent on other duties not mentioned but involved in the survey: administrative, report writing, etc.

This information will provide a means for comparison between the Hydroplot system and SDS III. In addition, it is a method for determining areas in which SDS III will be able to improve efficiency, whether it be increasing the quality of incoming data and verification procedures, or eliminating current difficulties.

Since verification and quality control are performed over several months, this statistical information will not be included with this report. It is recommended that this phase be monitored by an SDS III task manager and be included with a report covering the Solomons testing of the DAS performing the same surveys.

Kathryn A. Andreen
Lieutenant Commander, NOAA
Solomons Island Task Manager

APPENDIX A

Hydrographic Field Party #4 - Officer-in-Charge
Project Report
by
Officer-In-Charge, Hydrographic Field Party #4

OIC PROJECT REPORT

Upon the arrival of Project Instructions S-E211-HFP-85, it was clear that the Shipboard Data System III (SDS III) test plan was more important to complete than the survey itself. The movement of party personnel and equipment to Solomons, Maryland, was quick and easy, since most of the large items were left in Gulf Breeze, Florida. This was so the party could move back to Gulf Breeze after the month of October (the estimated completion date of the project). However, the launch was not at Solomons when the party arrived and the recorder system had not been installed to record any part of the testing.

The party set up shop and proceeded with all preliminary survey support for the project as scheduled. Within the second week at Solomons Hydrographic Field Party #4 (HFP-4) began hydrography on the 1:10,000-scale survey to meet production requirements from the Hydrographic Field Parties Section (HFPS) office. As the survey continued, delays from SDS III to install the recorder system grew. The test plan became least important as the weeks went by. From the standpoint of HFPS, it wasn't the matter of getting the recorder system installed but the old phrase "miles make smiles."

By mid-August, SDS III personnel were ready to install the recorder system in the launch. By this time, the 1:10,000-scale survey was 85 percent complete. The launch laid tied up to the pier for 3 weeks for this installation. However, "production" didn't stop. The party got a Zodiac from AMC and conducted item investigations on the 1:5,000-scale survey. By September, the launch was functional with the recorder system. Now the launch was ready for the important testing, but this opened a new ball of wax as far as the operation, execution, and processing applies. This project became a tug of war for the OIC between the two people he had to satisfy. At first this wasn't a problem, but as time passed (by the month of October), pressure started to build in the office of HFPS. It was evident that HFP-4 was going to move, but how soon wasn't clear. A push to get the surveys finished was translated to the OIC from HFPS but also to continue to the test plan. A second push was being conveyed by SDS III, where finish the test plan and then worry about the survey, was suggested.

A shower of equipment failures followed. The first major problem occurred when the Hydroplot controller completely broke down. This was a problem that started early in the survey. Although the problem was easy to overcome at first, but it soon became so wacky that it had to be changed out. This took up a full week of lost production.

The next major problem encountered was the arrival of Juan, a down-graded hurricane that swept the eastern seaboard in a fashion that cost over $100,000 in ARGO equipment. The lack of replacements delayed ARGO testing for 2 months.

Other problems and delays were the loss of a Mini-Ranger remote station, coordinating the use of an ARGO station with the GPS party, and 4 days of in-house hydrographic orientation for Sperry and NOAA personnel.

However, although ARGO was out of commission, the party continued production and testing on the 1:5000-scale survey. Each test was performed as close to the test plan as instructed. Upon the request of the SDS III coordinator, a narrative of each test was written explaining how the test was performed and in-field observations during the test. These narratives proved to be quite helpful but required an extra amount of time for the OIC. Many weekends and nights were spent for the write-up of these reports. Other required documents that are not associated with an actual survey are the staff hour reports, processing logs other than the statistic log kept in any survey, and two control abstracts, where a regular survey would have only one set of positioning devices.

Once the ARGO equipment was replaced and installed, the party moved back onto the 1:10,000-scale survey. Testing continued with redoing most of the previous tests. Again each test was performed as close to the test plan as instructed. And each test was followed up on a narrative.

As the testing came to a close, so did the surveys. The 1:10,000-scale survey was processed and turned over to AMC. The 1:5,000-scale survey is complete and will soon be turned in to AMC. It is believed that both offices HFPS, and SDS III were satisfied together and at the same time.

General improvements of this project and of the DAS system are as follows:

1) Have the vessel fully equipped and functional before having a unit arrive to test it.

2) A more complete installation of equipment is needed and a look at the launch overall power supply and grounding.

3) Get rid of the ArcCompass: it is no good!

4) A communication line with HFPS so there are no contradictions.

5) Have a full time ET from SDS III here.

Jason H. Maddox,
Lieutenant (junior grade), NOAA
Officer-in-Charge, HFP-4

APPENDIX B

Field Test Reports

The time from the HP 9825 calculator recorded on the magnetic tapes for the following tests is in error. Throughout the entire project, this time was off by a positive five hours. The time data associated with the Mini-Ranger Falcon and Argo systems are correct.

ARGO CALIBRATION

The following is an abstract of ARGO calibration correctors that have been calculated using the partials recorded during fixed point (circle) calibrations on Patuxent River Light "4" signal number 013. Day 275,288, and 036 utilized RK351 and two Mini-Ranger ranges for ARGO calibrations.

When the survey began, it was unknown what the Argo frequency was. The signal tape was made containing a frequency taken from the Hydrographic Manual and was then used throughout the survey. This frequency was 1618.65 Hz. Using RK3000 calculate the patterns for the ARGO lanes, the lane count for ARGO stations 1, 2, and 3 was 237.31, 18.31, and 100.49. the lanes were set in to the ARGO CDU (disregarding partials) as the launch passed by the calibration point. These same lane counts were used for both Range-Range and Hyperbolic modes.

It was not until a later time that the actual ARGO frequency was found. This frequency was found. This frequency was 1649.70 Hz and it was used to recalculate the correctors for the following control abstract. The lane count changed as follows: ARGO station 1 = 241.42; ARGO station 2 = 19.16; ARGO station 3 = 102.23. The resultant correctors were obtained by this manner: The observed partials and lanes were subtracted from the true lane and partial of the fixed point. With all lane counts set to the old calculated lanes, and with a good closing calibration, all correctors should contain a lane and partial corrector. For example:

The launch is at Light "4", the old calculated pattern for station 1 is 237.31. On the pass, the whole lane count is manually set on the ARGO CDU (237). The launch then passes the light five more time, recording the observed partials .44, .48, .43, .52, and .40. These observed partials are then averaged. The above average is 0.45. the averaged partial is then added to the set lane giving 237.45. Now the new true lane count is compared to this observed:

241.42	true lane count
237.45	observed lane count
+3.97	corrector to be applied

This is the reason why the correctors are high, but as stated before, in having a good closing calibration, these correctors are consistent for all days data.

On Julian days 290 and 297, ARGO was run in Hyperbolic mode using the calculated Range-Range patterns. The rates for Hyperbolic patterns were recalculated using RK300 and the actual ARGO frequency. The resultant patterns were ARGO station 1 = 7.66 and for ARGO station 3 = 2.98 Again this explains why the correctors are so large for these days. This was corrected on the next day ARGO was run in Hyperbolic mode.

SDS III BASELINE SURVEY
ARGO CONTROL ABSTRACT

J.D.	CONFIGURATION	PT. NO PT. SIG. #1	DRUM PT SIG. #2	COVE PT. SIG. #3
274	R/R	+3.52	+0.84	+2.18
275	R/R	+3.50	+1.19	DOWN
277	R/R	+3.54	+0.89	+1.31
280	R/R	DOWN	+0.84	+1.26
284	R/R	+3.50	+0.68	+2.06
288	R/R	+2.82	+0.82	DOWN
290	HYPER	-230.08	MASTER	-97.04
291	N/A	R	R	R
292	R/R	+2.65	+1.08	+2.11
297	R/R	+4.30	+0.74	+1.31
297	HYPER	-229.92	MASTER	-97.29
297				-1 LANE FX. 65-87
***	ARGO REPLACEMENT ***			
015	R/R	+3.74	+0.60	+1.98
015		ADD 15 LANES TO 3 FX. 904-934		
016	HYPER	+0.54	MASTER	-0.14
021	HYPER	+0.69	MASTER	-0.16
022	HYPER	+0.66	MASTER	-0.12
023	R/R	+3.74	+0.55	+2.08
023	HYPER	+0.64	MASTER	-0.19
028	R/R	+3.68	+0.76	+2.04
028	HYPER	+0.69	MASTER	-0.17
036	HYPER	+0.70	MASTER	-0.31

JD 274 Range-Range Hydrography - No Testing

On JD 274, hydrography was accomplished with Argo and Mini-Ranger positioning control for the first time to compile data for SDS III. The Argo stations used on this day consisted of Drum Point (station #2) as the master with Point No Point (station #1) and Cove Point (station #3) as slaves. The Mini-Ranger transponders were located at Cove Point Lighthouse (code 1 - signal #18), Patuxent River Light #2 (code 6 - signal #12), and Hooper Island Light (code 2 - signal #19). The Argo system was set in the range-range mode using time slots 02 and 07 with a smoothing code of 2.

The Argo system was calibrated by the fixed point method at Patuxent River Light #4 (signal #13) whereas the Mini-Rangers were checked by a static non-critical method at buoy #57. These were accomplished by making five passes as near as possible to the light or buoy with the launch and comparing observed readings to computed values for these locations. The averaged range rates were used to obtain applied corrector values.

The hydrographic data for the day was comprised of 50-meter-spaced sounding lines in an area at the northeast corner of the 1:10,000-scale survey. Sea conditions were 2 to 4 feet, that which was considered the limit for acquiring adequate data.

A few problems were encountered during the day involving the SDS III recorder and the Hydroplot system. The recorder stopped several times while on-line, thus requiring continuous attention so that as much data as possible would not be lost. However, this may have caused several areas to be missing some data. The only problem with the computer system was that it died once before the beginning of hydro which may be reflected on the magnetic tape.

Ending calibrations for the Argo had good agreement with the beginning values. Refer to the 1:10,000-scale survey data (H-10193) from hydrographic position numbers 1306 to 1345 and magnetic tape #1 (612.0 - 1143.0 ft.).

ARGO SYSTEM TESTS

JD 275 Simulated Lane Jump Test - Range-Range Mode (Part 1)

The positioning control for this test was the same as for JD 274. The Argo system was utilized in the range-range mode (time slots 02 and 07, smoothing code 2). Calibration of the Mini-Ranger transponders used buoy #57 for obtaining a non-critical check. Argo calibration was performed using the computer program RK561 and two Mini-Ranger ranges.

East-west sounding lines were obtained for this test on the 1:10,000-scale survey, but only after several difficulties. At the beginning of the day, the positioning systems were calibrated by fixed point methods and acquisition of hydrography was started; however, the Hydroplot system kept failing. After three attempts at obtaining data and having the computer die each time, operations were aborted and the launch proceeded onto other duties (tide gauge inspection). When returning back to the hydrographic working area, the Hydroplot system began functioning again. The Argo system was re-calibrated using RK561 and the lane jump test performed.

This test was accomplished by first obtaining two mainscheme sounding lines without any simulated lane jumps. On the third line, a lane jump was simulated by adding one lane to the observed Argo ranges through the Control Processing Unit (CPU) on the launch. This lane gain was produced on the second fix number of the line to station 1, Point No Point. This action was annotated on the strip chart. Erratic lines were observed on the strip chart record for this station. These may have been caused by the recorder itself.

Another lane (1) was added to station 1 on the following 5th fix number, allowing 5 minutes before the addition. The line ended and a lane (1) was subtracted on the second fix of the fourth mainscheme line. Five minutes later, another lane (1) was subtracted on the following 5th fix number.

The station was then back to original status. Though the strip chart was showing erratic lines, the whole lane count seemed to be good. At this point, the computer failed. It was restarted and the launch continued back on-line at the position where the last fix was recorded. Once on-line and obtaining data, the simulated lane jumps were performed on station 2, Drum Point (master), and the procedure followed the same method.

On the second fix of this re-started line, a lane (1) was added but the line was almost completed. On the next mainscheme line while waiting for the five minute duration between simulated lane jumps, the computer died again. After reloading and restarting the computer, the system was back up and the test continued. It was not until 6 minutes into this line that a lane (1) was added. Five minutes later, a lane (1) was subtracted which was the end of the line. On the 5th fix number into the next line, another lane (1) was subtracted from station 2, bringing it back to original status. The lanes looked very good from this station with fewer erratic lines on the strip chart.

When the next line began, testing resumed again on station 1, Point No Point. One lane was added on the second fix of the line but soon after the magnetic tape ran out. Before the end of that line, a lane (1) was subtracted from station 1 to bring it back to an equal number of lane additions and subtractions. At this point, testing ended for the day.

On the closing calibration of the Argo system using RK 561, station 1, Point No Point, had good agreement with beginning values. However, station 2, Drum Point, had lost one lane. This loss was unobserved on the strip chart. Noting the traces of the Argo stations on the strip chart recorder, station 1 not 2 appeared to be more susceptible to the lane loss but none occurred. A partial corrector of +0.47 should be applied for the entire day to station 2 (Drum Point) to account for the lane loss.

The data for this day is on magnetic tape #1 from 1146.0 feet to the end of the tape. Also, refer to the hydrographic data on the 1:10,000 scale survey from position numbers 1425 to 1482. A summary of fix numbers to lane change is as follows:

Fix	Lanes	Station
1425	+1	1
1430	+1	1
1438	-1	1
1443	-1	1
1448	+1	2
1459	+1	2
1464	-1	2
1470	-1	2
1479	+1	1

JD 277 Simulated Lane Jump Test - Range-Range & Hyperbolic Modes (Part 2)

Test procedures, Argo stations and Mini-Ranger location for this day were identical to those used on JD 275. Calibration for the Argo system was accomplished using the fixed point method at Light #4 with that for the Mini-Ranger transponders at buoy #57.

The Argo system was first set in the range-range mode using time slots 02 and 07 with smoothing code 2. However, problems developed on the second mainscheme sounding line when the Argo Control Processing Unit (CPU) lost time slots 02 and 07. These were reset by a toggle switch behind the console unit and the testing continued.

During the third mainscheme line and on the second fix, a lane (1) was added to station 3, Cove Point. On the following 5th fix, 21 lanes were added by mistake. These lanes were subtracted immediately on the 5th sounding before the next fix number. However, it was later observed that the first lane added was never subtracted. At the end of the line, the Argo system was changed to the hyperbolic mode with time slots 01 and 06. (In this phase, the master no longer keeps a position count, only a timing pulse for the subordinate stations.)

On the 5th fix of the next mainscheme line as the test continued, a lane (1) was added to station 3, Cove Point. Five minutes later, another lane (1) was added to station 3. After another 5 minutes, one lane (1) was subtracted from station 3. The line ended and another lane (1) was subtracted on the second fix of the next mainscheme line. Five minutes later the test shifted over to station 1, Point No Point, and a lane (1) was added. After 5 more minutes another lane (1) was added and the line was completed.

On the next mainscheme line, one lane (1) was subtracted from station 1, Point No Point. Five minutes later, 2 lanes were subtracted from this station. Now with a deficit of 1 lane, one lane was then added after another 5 minute period. No more changes were made after this point.

At the end of the test, station 1 (Point No Point) should have been on lane count; station 2 (Drum Point, master) should have been off since it was shifted to the hyperbolic mode as the master station); and station 3 (Cove Point) should have had a plus one lane (the very first lane of the test which was never subtracted).

At the closing calibration, the system was switched back to the range-range mode. It was observed that station 1 had gained 3 lanes, and station 3 gained 22 lanes. It could be a possibility that when the CPU froze and lost the time slots, the lane gains occurred. Or, by switching to the hyperbolic mode, all stations lane counts were thrown off. It seemed unusual that 22 lanes were gained on station 3, almost as if the 21 lanes added by mistake were not taken out as implied on the strip chart.

The run down on fix number, simulated lane jumps and stations which were effected for this test are as follows:

Fix	Lane	Station
1540	+1	3
1545	+21	3
1545+5	-21	3
	Switched to hyperbolic mode	
1561	+1	3
1566	+1	3
1571	-1	3
1576	-1	3
1580	+1	1
1584	+1	1
1594	-1	1
1599	-2	1
1604	+1	1

Refer to the 1:10,000 scale survey data for information concerning this test. It is located between hydrographic position numbers 1539 and 1610. The same data is on magnetic tape #2 from 0 to 494.0 ft.

JD 280 Ground Plane Effects Test - Range-Range Mode

Positioning control for the Ground Plane Effects test included two Argo stations, Drum Point and Cove Point, along with the Mini-Ranger locations of Patuxent River Light #2 (code 6 - signal #12), Cove Point Lighthouse (code 1 - signal #18) and Hooper Island Light (code 2 - signal #19). The Argo station of Point No Point was not used due to a failure of the Range Processing Unit (RPU) while the launch was underway to the working grounds. The fixed point calibration method at Light #4 was used for the Argo system while the same method was employed at buoy #57 for the Mini-Ranger transponders. The Argo system was set for the range-range mode with time slots 02 and 07 using a smoothing code 2.

Before the test began, several 50 meter-spaced sounding lines were accomplished at the northeast corner of the 1:10,000 scale sheet which were recorded on the magnetic tape. For the test, hydrographic operations were shifted to the southern portion of the survey area with the test beginning on the second sounding line.

Procedures for the Ground Plane Effects test at a shore station were as follows: As a sounding line started a government truck was brought up to the edge of the ground plane and during the operation of hydro, the truck was moved a few feet closer to the antenna every few minutes, ending as close as possible to the antenna. The movement of the vehicle was accomplished at the same time that fix numbers occurred. These are identified on the raw data.

During this test, nothing was observed. The vehicle was located at station 3, Cove Point, and was moved up to approximately 1 foot from the antenna. Additional hydro was ran on this day, but no further testing occurred.

During the day station 2, Drum Point (master), showed continual edit lights. As a result, it was calibrated with RK561 using two Mini-Ranger ranges. It appeared that three lanes were lost on station 2, thus they were added to bring the lane count to a zero correction. At the ending calibration using a static point procedure, it was found that the three lanes had not actually been lost. (Since three lanes were added prior to the ending calibration, there was a -3 lane corrector obtained at the completion of the day.) Closing calibration values on station 3, Cove Point, was excellent.

Data for this test is located with the 1:10,000 scale survey, position numbers 1707 through 1757, and on magnetic tape #2 between 495.0 and 1702.1 ft.

JD 284 Systematic Detuning of the Argo Launch Antenna - Range-Range Mode

The Argo network (Point No Point, Drum Point and Cove Point) and the three Mini-Ranger transponders [Patuxent River Light #2 (code 6 - signal #12), Cove Point Lighthouse (code 1 - signal #18) and Hooper Island Light (code 2 - signal #19)] were used as the positioning control for this test. Calibration of the Argo was accomplished at Light #4 whereas the Mini-Rangers were system checked at buoy #57. The test was run with the Argo system in the range-range mode using time slots 02 and 07, smoothing code 2.

After a difficult start where the Argo system went down following an initial calibration in the hyperbolic mode, calibration procedures were repeated (changing the system to range-range) and hydrography accomplished in the northeast corner of the 1:10,000-scale survey. Sounding lines were performed in the east-west direction.

Systematic detuning of the launch Argo antenna began on the second mainscheme line. On the second fix of this line, the Receiver Processing Unit (RPU) was turned one step towards maximum capacitance. Every few seconds following, another step up in capacitance was obtained.

Realizing that normally there are only 22 steps from minimum to maximum, during the first attempt the entire range of steps were observed with no edit lights or high VSWR lights showing. No degraded tuning was observed due to an operator error. It was noticed that the selection switch on the RPU was in the Automatic Gain Control (AGC) Select position not the Antenna Tune position.

Finally, close to the end of the next line while continuing to step down the capacitance (to step 33) and before the selection switch was changed, high VSWR lights were achieved and the system was left in the degraded mode for 60 seconds. Station 1, Point No Point, exhibited an erratic lane recording on the strip chart. The tune was then brought back to good AGC.

At this time, the selection switch was set to the Antenna Tune position and the testing continued. On the next line at the tenth step towards maximum capacitance, high VSWR lights were achieved. Again, this was left in the degraded tune for 60 seconds then brought back to good AGC. Nothing was observed on the strip chart.

Where edit marks appear on the strip chart during the first test for both stations 1 and 3, nothing was observed on the second test. After the end of the second detuning, operations ended and calibration followed. The closing calibration revealed good partial correctors for both stations, no lane jumps were observed.

Refer to the 1:10,000-scale survey data, hydrographic position numbers 1822 through 1857 and the magnetic tape #2 (1702.9 - 1970.5 ft.) for information covering this test.

JD 288 Line Jog Test - Range-Range Mode (Part 1)

Positioning control for this day consisted of two Argo stations, Point No point (station #1) and Drum Point (station #2) along with three Mini-Ranger stations, Patuxent River Light #2 (code 6 - signal #12), Cove Point Lighthouse (code 1 - signal #18), and Hooper Island Light (code 2 - signal #19). The Argo station at Cove Point was down for the entire day, thus it was not used. The Argo system was set in the range-range mode using time slots 02 and 07 with a smoothing code of 2. Calibration for the Mini-Ranger transponders was performed at buoy #57 (non-critical static point method). The Argo system was calibrated using RK561 and ranges from the Mini-Ranger transponders.

Sounding lines for this test were performed in the southern half of the 1:10,000-scale survey. After the completion of several mainscheme lines (which were also recorded on the magnetic tape), the test proceeded as follows:

Once the survey vessel steadied up on a sounding line in an east-west direction, it was quickly turned 90 degrees from the main heading and then swung back around to drive, once again, along the same line. During this maneuver, the Hydroplot system would keep track of the distance the launch jogged off the line. The jog was then repeated two more times with the distance from the base course first doubling and then quintupling the original jog length. Each of the jogs were identified with position numbers at the beginning and ending of the maneuver. This set of three jogs was repeated two more times to complete the test.

At the completion of the last jog, the Argo was again calibrated with RK561. Unfortunately, the station 2, Drum Point (master), had gained two lanes. Observing the strip chart a strange glitch occurs on station 2 between fix 1899 and 1900 which is the middle of one of the jogs. Because this glitch is located on a turn, it is difficult to declare it as the spot the lanes were gained. Thus, the test was performed again on a later date.

A summary of the jogs and distances is as follows:

Starting Fix	Distance	Ending Fix
1890	44 m	1891
1893	116 m	1894
1898	266 m	1901
1903	33 m	1904
1906	108 m	1907
1910	277 m	1912
1915	38 m	1916
1921	129 m	1922
1926	232 m	1928

Data for this test is located with the 1:10,000-scale survey between position numbers 1890 and 1929. Also, refer to magnetic tape #2 from 1972.0 ft. through the end of the tape.

JD 290 U-Turns - Hyperbolic Mode (Part 1)

All three Argo stations (Point No Point, Drum Point, and Cove Point) and Mini-Ranger stations [Patuxent River Light #2 (code 6 - signal #12), Cove Point Lighthouse (code 1 - signal #18), and Hooper Island Light (code 2 - signal #19)] were used to control this test. The Argo system was set in the hyperbolic mode with time slots 01 and 06 (smoothing code 2) and calibrated by the fixed point method at Light #4. The Mini-Ranger transponders were system checked at buoy #57.

This test was accomplished while obtaining sounding lines in the east-west direction within the limits of the 1:10,000-scale survey. Once the launch was steadied up on a line for at least one minute at a cruising speed of 2400 RPMs, it would be turned 180 degrees around to head in the opposite direction. The radius of the first turn was zero meters, requiring the launch to turn as "hard over" as possible to come back on the same line. This maneuver was repeated three more times with the radii being 10, 20 and 50 meters, respectively. The test was completed with two more sets of three turns each. Position numbers were used to identify the start and finish of each turn. The following is a summary of fix numbers correlating the U-turns:

Fix Numbers	U-Turns (radius)
1997 (LTLA)-1998 (LR)	0 m*
2001 (LTLA)-2002 (LR)	10 m
2007 (LTRA)-2008 (LR)	20 m
2011 (LTLA)-2012 (LR)	50 m
2016 (LTRA)-2017 (LR)	10 m
2020 (LTRA)-2021 (LR)	20 m
2025 (LTLA)-2026 (LR)	50 m
2030 (LTLA)-2031 (LR)	10 m
2035 (LTLA)-2036 (LR)	20 m
2037 (LTLA)-2038 (LR)	50 m

* Same sounding line was resumed, only heading opposite direction.

LTLA = Line Turns Left About
LTRA = Line Turns Right About
LR = Line Resumes m = Meters

Ending calibration of the Argo system had excellent agreement with beginning values. For data covering this test, refer to the 1:10,000 scale survey from position numbers 1994 to 2042 and magnetic tape #3 between 0 and 230.4 ft.

JD 290 Line Jog Test - Hyperbolic Mode (Part 2)

This test was performed on the same day as the U-turns. All Argo stations, Mini-Ranger transponders, calibration procedures and positioning mode (hyperbolic) were the same. The method of testing was the same as described on JD 288.

On this day, only two line jogs were completed before the Hydroplot system started crashing at a continual rate. Because of this difficulty, operations were suspended and the test continued another day.

The following is a summary of position numbers identifying where line jogs occurred.

Starting Fix	Distance	Ending Fix
2045	73 m	2046
2048	146 m	computer crashed
2051	151 m	2052

m = Meter

Data for this test is located with the 1:10,000-scale survey under position numbers 2043 through 2055 and on magnetic tape #3 between 262.5 and 370.0 ft. (The information on the magnetic tape between 370.1 and 686.0 ft should be rejected because it covers the time traveling to and from the working grounds.)

JD 292 Static Positioning Test - Range-Range Mode

Positioning control for this test included the three Argo stations (Point No Point, Drum Point, and Cove Point) along with three Mini-Ranger stations [Patuxent River Light #2 (code 6 - signal #12), Cove Point Lighthouse (code 1 - signal #18), and Hooper Island Light (code 2 - signal #19)]. The test occurred at the Tar Bay Entrance Light #1 (latitude 38/21/12 N, longitude 076/16/26 W). Light #4 was used as the fixed point calibration spot for the Argo system with buoy #57 used for the Mini-Ranger transponders.

The Argo system was set in the range-range mode using time slots 02 and 07 with a smoothing code of 2. The weather on this day was clear with seas one to two feet from the northeast and wind 10 to 15 knots out of the east.

After the launch was tied to the fixed aid by three lines, the maximum vertical movement was 2 feet and the maximum horizontal movement was 1 1/2 feet. The test began on 135442 Universal Coordinated Time (UTC) with data being recorded every 30 seconds. At the beginning of the test, fix numbers were produced every 3 minutes with 5 in-between soundings at the 30 second intervals.

At 142400 UTC, the computer crashed requiring the program to be reloaded. The system was brought back on-line at 142700 UTC at which time the fix interval was changed to 30 seconds with one in-between sounding 15 second after the fix.

At 143818 UTC (fix number 2045), the Argo master station, Drum Point was taken off the air due to a test being performed by personnel from the Office of Marine Operations, Rockville. (This was the GPS test by LT Tim Rulon.) This data showed up on the magnetic tape as asterisks next to that particular Argo range.

For any slave stations, this would mean a fast degrading of signal since timing by the master was lost. The launch configuration was quickly switched from a mobile slave to a mobile master. In this mode, the launch unit should be in the original master timing sequence and by switching it from slave to master changes it from a mobile slave to a mobile master.

After the switch, station 3 (Cove Point), was observed to lose its signal strength. The degrading AGC should also be observed on the magnetic tape, again with asterisks and decreasing signal strength that is shown to the right of each rate. The poor AGC lasted only a few minutes and the station soon regained a steady AGC.

The test continued for 1 hour after the dismantle of the master shore station. The closing calibration on the other two Argo stations (1 and 3) showed excellent agreement with the beginning calibrations for both the whole lanes and partial correctors. No closing calibration was performed on station 2 but it is believed that the data obtained from this station was good.

Data for this test can be found with the 1:10,000-scale survey from position numbers 2096 through 2166 and on magnetic tape #3 between 688.7 and 1149.3 feet.

JD 297 Range-Azimuth Test - Range-Range and Hyperbolic Modes

Operations for the Range-Azimuth test utilized the three Argo stations (Point No Point, Drum Point and Cove Point) along with the following three Mini-Ranger transponders: code 6 on Drum Point Lt. #2 (signal #12), code 1 at Cove Point Lighthouse (signal #18) and code 2 at Hooper Island Light (signal #19). The Argo system was calibrated at Light #4 using the fixed point method, with the least squares system check method used for the Mini-Ranger transponders. For the first portion of the test, the Argo system was set in the range-range mode with time slots 02 and 07 using a smoothing code of 2.

The range-azimuth observer was set up on Drum Point Light #2 (signal #12) with a T-2 theodolite and a Mini-Ranger transponder. Light #4 (signal #13) was the initial target with an angle of zero degrees.

In order to perform this test where the launch could get within 300 meters of the range-azimuth observer, the area in which the test was accomplished had to be located outside the limits of both the 1:10,000 or 1:5,000 scale surveys.

For this test, sounding lines were obtained along the 300, 500, 1000, 2000, and 3000 meter arcs, first in one direction and then the other. The magnetic tape was not turned on until part way through the first 300 meter arc. As a result, this arc was repeated. The launch was run at a speed of 2400 RPMs during the entire test.

At least two Mini-Ranger rates were recorded during this portion of testing. Codes 1 and 2 would be exchanged during areas of shadow zones or land paths. The test only required one addition rate be recorded and this was achieved. After the 3000 meter arc, the launch proceeded to perform the closing calibration for the Argo system in the range-range mode. All lanes and partials had excellent agreement with beginning values.

The configuration of the Argo system was then changed to the hyperbolic mode using time slots 01 and 06 with a smoothing code of 2. The launch made a new opening calibration and proceeded to repeat the five sets of sounding line arcs. The same procedures used with the range-range data were followed.

When the launch began the 2000 meter arc, an unusual "S" shaped trace was observed on the strip chart record for station 3. This had occurred after the beginning of the second portion of the arc. Further investigation showed a difference between the number of lane changes from station 1 to station 3. On the first 2000 meter arc, there were six lane changes on station 1 to five lane changes on station 3. During the second arc, there were six lane changes on station 1 to six lane changes on station 3. One lane was gained on station 3 at the location of the "S" curve indicted on the strip chart. This was verified by the closing calibrations.

The testing continued through the remaining arcs. At the closing calibration on the Argo, it was found that station 3, Cove Point, did actually gain one lane while station 1, Point No Point, had good closing values.

The data for this test is on magnetic tape #3 between 1156.2 and 1748.7 feet. In addition, it can be found with the 1:10,000-scale survey data between "test data position numbers" 1 and 87.

The following is a summary of the fix numbers to the hydrography obtained.

Argo Range-Range Data

Fix Numbers	Sounding Line Arc & Heading
1 - 3	300 meter S-N (rejected)
4 - 5	300 meter N-S
6 - 7	300 meter S-N
8 - 10	500 meter S-N
11 - 13	500 meter N-S
14 - 17	1000 meter S-N
18 - 21	1000 meter N-S
22 - 26	2000 meter S-N
27 - 31	2000 meter N-S
32 - 37	3000 meter S-N
38 - 42	3000 meter N-S

Argo Hyperbolic Data

43 - 49	3000 meter S-N
50 - 56	3000 meter N-S
57 - 60	2000 meter S-N
61 - 65	2000 meter N-S*
66 - 69	1000 meter S-N*
70 - 73	1000 meter N-S*
74 - 75	500 meter S-N*
76 - 78	500 meter N-S*
79 - 81	300 meter S-N* (rejected)
82 - 84	300 meter N-S*
85 - 87	300 meter S-N*

* Subtract 1 lane on station 3.

Mini-Ranger System Tests

JD 347 Shadow Zone Test

Range-azimuth positioning control was used for this test with an observer using a T-2 theodolite and Mini-Ranger transponder code 6 at station Tell (signal #4). The T-2 was initialized on Light #8 (station #15) with an angle of 180/00/00 degrees.

Two other Mini-Ranger transponders were set up for use with the Hydroplot system and for recording on the magnetic tape for SDS III. These transponders were located at Solomon Island (Code 1 - signal #5) and Kingston Creek (Code 2 - signal #8). Calibration for the Mini-Ranger transponders was accomplished by the least squares method. The calibration values verified the observed baseline correctors.

Test activities included running sounding lines in the north-south direction within the 1:5,000 scale survey limits. Using the point of land, Town Point, a shadow zone was produced in the working area for Code 2 on station Kingston Creek. The magnetic tape recorder was turned on just prior to the beginning of obtaining sounding line data.

After four lines were accomplished, it was discovered that the time being recorded on the magnetic tape was off by 4 minutes from the Hydroplot system. This problem was immediately resolved by synchronizing the Hydroplot to the Hewlett Packard programmable calculator (whole hours were still 5 hours off). Four more sounding lines were then obtained, completing the test. While performing the test, it was noted that as soon as the launch lost line of sight with Code 2 on Kingston Creek, the signal strength dropped to zero and the range value lost.

Data for this test can be found with the 1:5,000-scale survey, between "test data position numbers" 1 and 42. It is also located on magnetic tape #4 between 0 and 344.0 ft.

JD 347 Minimum Operating Range

This test was performed on the same day as the Shadow Zone test but using different control stations. Range-azimuth control was the major positioning method used for this test. An observer with a T-2 theodolite along with the Mini-Ranger transponder Code 2 was set up on station Kingston Creek (signal #8). Light #8 (signal #15) was used as the initial station with an angle of 180/00/00 degrees.

Two other Mini-Ranger transponders were set up and recorded on the magnetic tape. Code 6 was located at station Tell (signal #4) and code 1 was on Light #8 (signal #15). The calibration used for the Shadow Zone test was also used for this test, verifying Mini-Ranger baseline correctors.

Procedures for this test included running 50 meter-spaced east-west sounding lines from the center of the Patuxent River continuing past Light #8. The closest point at which the launch approached the light ranged from 400 meters on the first line to 15 meters on the last line. It was observed that 48 meters was the minimum range value the Mini-Ranger transponder from Light #8 produced.

For information concerning this test, refer to the 1:5,000-scale survey, hydrographic printouts for "test data position numbers" 43 through 86 and between 345.0 and 418.3 ft on magnetic tape #4.

JD 350 Range-Azimuth Hydrographic Data - NO TESTS

This is just a day of range-azimuth hydrography void of any testing. The azimuth observer was set up with the T-2 theodolite and Mini-Ranger transponder, code 6, at station Tell (signal #4). Light #8 (signal #15) was used as the initial station with an angle of 180/00/00 degrees.

In addition to code 6, two other Mini-Ranger transponders were set up and recorded on the magnetic tape. Code 1 was on station Solomons Is. (signal #5) and code 2 on station Lewis (signal #7). The least squares system check was used to verify Mini-Ranger baseline correctors.

Sounding lines for this day were run in the east-west direction on sheet B of the 1:5,000-scale survey. Refer to the hydrographic printouts for positions 5850 through 5942** and between 419.3 and 893.8 ft on magnetic tape #4 for this data. (** In order to keep from having duplicated hydrographic position numbers for the survey data, these position numbers were changed on the printouts to 5923 through 6012. However, these changes were not performed on the magnetic tape data.)

JD 351 Reflected Signal Test

The primary control for this test was the range-azimuth method with an observer using a T-2 theodolite set up on station Chuckhold Creek (signal #11) with the Mini-Ranger transponder, code 2. An initial angle of 180/00/00 was set on Patuxent River Light #8 (signal #15).

Two other Mini-Ranger transponders were set up at the following locations: Code 6 at Kingston Creek (signal #8) and code 1 on top of Light #8 pointed south. The calibration method for this day was a critical system check using the HP 3810B Total System set up at Chuckhold Creek. (For the calibration, the initial was zero degrees on Light #8.)

During operations, sounding lines were run in an east-west direction at 1000 RPMs within the 1:5,000-scale survey limits. To obtain reflected signals from a Mini-Ranger transponder, the NOAA Launch LAIDLY was placed inside the Kingston Creek breakwater. This provided a large metal obstruction in which a reflected signal from code 6 could be produced. Weather for this day was clear with seas 0 to 1 foot and wind from the northeast at 10 to 15 knots.

This test was accomplished twice due to what appeared to be problems with the 12 volt power supply used on the magnetic tape recorder system. At the end of the first test, it was discovered that this power supply was out of adjustment. As a result, it appeared that the heading and speed information were not being recorded on the magnetic tape. The data would not be displayed on the CRT when the tape was played back. The power supply was re-set and the test repeated. Later when the magnetic tape was re-checked with the power supply adjusted correctly, it was noted that all data had been recorded normally.

The first set of data is between "test data position numbers" 200 and 271. It is located on magnetic tape #4 from 900.0 to 1226.9 ft. This information is considered good, just being duplicate data.

The repeated test data is located between "test data position numbers" 323 and 360. The magnetic tape portion of this information is on tape # 4 between 1501.9 and 1688.0 ft.

JD 351 Antenna Section Test

This test was performed on the same day as the Reflected Signal test. The type of control, Mini-Ranger stations, range-azimuth observer station, and calibration procedures were all the same.

The test involved obtaining sounding lines running in and out of the 180 degree operating sector of Mini-Ranger transponder, code 1, located on Light #8. Seven hydro lines were run in the north-south direction at 1000 RPMs within the limits of the 1:5,000-scale survey.

It was after completion of the first sounding line that the problem with the 12 volt power supply was discovered. (Refer to the text on the Reflected Signal Test.) The power supply was immediately re-set and the first sounding line repeated.

Refer to the hydrographic data and printouts for SDS III tests for this information. This material is located between "test data position numbers" 272 and 322. ("Test data position numbers" 272 through 277 contains the first sounding line data when the heading and speed information appeared not to be recorded.) This information can be found on magnetic tape #4 between 1238.5 and 1500.0 ft.

JD 009 (1986) Variable Attenuation Test

Control for this test was range-azimuth positioning. The observer was set up on station Kingston Creek (signal #8) with the theodolite and Mini-Ranger code 6. The initial angle was 180/00/00 degrees on Patuxent River

Light #8 (signal #15). Two other transponders were set up at the following locations: code 1 on station Tell (signal #4) and code 2 with the variable attenuator on Little Kingston (signal #9). Calibration of the positioning system was performed by using the fixed point method at Light #8.

The test was accomplished by obtaining east-west sounding lines on the 1:5,000-scale survey while changes were made in the attenuation of code 2. Due to limited personnel on the field party, the range-azimuth observer was required not only to obtain fix angles but run approximately a quarter of a mile to code 2 at Little Kingston to change the attenuation. As a result, observers were changed a couple of times during the test.

The attenuation on code 2 started at the minimum setting and ended at the 40 db level with the loss of the range signal. Fix marks were used to identify when increases in attenuation level occurred:

Fix Number	db Level
266	Minimum
270	2
274	4
278	8
283	10
287	12
291	14
295	16
300	18
301	20
305	22
310	25
314	27
319	29
325	31
328	33
332	35
337	37
341	39
346	40 - no signal

Refer to "test data position numbers" 261 through 346 on the 1:5,000-scale survey (H-10195) and magnetic tape #4 between 1689.0 and 2171.4 ft. for information concerning this test.

JD 009 (1986) Frequency Interference Test

This test was performed on the same day as the attenuation test. The type of control, range-azimuth observer station and calibration procedures were the same. The only difference was that the Mini-Ranger code 2 at station Little Kingston was changed to a code 1 to produce interference on that frequency. This provided two code 1 transponders: one on station Tell (signal #4) and one on Little Kingston (signal #9).

The Mini-Ranger Falcon Control Display Unit (CDU) would not accept range values from two transponders set at the same code. Thus, only two ranges could be recorded during this test. At the beginning of the test, only code 1 at station Tell and code 6 at Kingston Creek were turned on.

After two lines (at position number 361), the code 1 at Little Kingston was also put on the air. With the two identical frequencies, it was observed that the range from the closest transponder would be accepted by the Falcon CDU. Near the mid-point between the stations, the CDU would alternate between the two transponders, then hold onto the unit that became closer as the launch continued on the sounding line. The signal strength of the two code 1 transponders were nearly identical. From the observed results, it is anticipated that if one unit had a stronger signal strength than the other, it would be the dominant transponder.

Data for this test can be found with the 1:5,000-scale survey between "test data position numbers" 347 and 418. Also, it is on magnetic tapes #4 (2172.5 ft. - end of the tape) and #5 (0 - 275.0 ft.). The magnetic tapes were changed at position number 371.

Argo System Tests

JD 015 (1986) Smoothing Code Test - Range-Range Mode (Part 1)

Control for this test consisted of using two Mini-Ranger transponders and three Argo stations. The transponders were set up on Patuxent River Light #2 (code 6 - signal #12), and Cove Point Lighthouse (code 1 - signal #18). The Argo stations were at Cove Point (station #3), Drum Point (station #2) and Point No Point (station #1). It should be noted that the Drum Point Argo station contained a new Antenna Loading Unit (ALU), Range Processing Unit (RPU) and a power supply. The Cove Point site had a new power supply. These changes in equipment were due to the failures of these units during the flooding in November. The Argo system was set up in the range-range mode using time slots 02 and 07 with a smoothing code of 2.

Argo was calibrated at the Patuxent River Light #4 (signal #13) by the fixed point method. The Mini-Ranger transponders were calibrated using the HP 3810B Total System critical check.

The procedures for this test called for the launch to obtain sounding lines while the Argo smoothing codes were changed. During the test, the coxswain's steering needle on-board the launch did not work. To compensate for this difficulty, X-Y coordinates (figured from program RK300) were entered into the Falcon CDU. With these values, the CDU processor computed a grid overlay while displaying X-Y values on the unit. Using the displayed values, the coxswain was able to steer the sounding lines.

Six sounding lines were obtained for this test. These were run in southwest-northeast directions within the limits of the 1:10,000-scale survey. A set of two identical sounding lines were performed for each of the following smoothing codes: 2, 6, and 9.

No problems were encountered during the first three lines. At the end of the third line (middle of the set for smoothing code 6), station Cove Point continued tracking as if the launch was still on line. Midpoint on the turn between lines three and four, edit lights on the Argo Control Processing Unit (CPU) lit up for all stations. However, the stations continued to partially track. The test continued onto smoothing code 9 for the last two lines. Observations of the Argo stations at this point showed no tracking at all.

Refer to the 1:10,000-scale survey data, "test data position numbers" 800 through 831 along with magnetic tape #5 between 276.0 and 479.5 for data covering this test.

JD 015 (1986) Shore Station Antenna Detuning Test - Range-Range Mode

This test was performed on the same day as the Smoothing Code test. The Mini-Ranger stations, Argo stations, and calibration procedures were identical. The Argo was set in the range-range mode using time slot 02 and 07 with a smoothing code of 2. After the completion of the Smoothing Code test, the Argo system was re-calibrated at Patuxent River Light #4 (signal #13).

The test procedures followed the same methods used during the Launch Antenna Detuning test. One minute after the launch began the sounding line, the antenna at the Drum Point. station was detuned by decreasing the capacitance, one increment every 20 seconds on the Control and Display Unit (CDU). This continued until the high VSWR light was observed for that station. The system was left at this degraded mode for 1 minute, then the process reversed until the original setting was obtained. These procedures were repeated three times with no observable changes in the system performance on the launch. At the end of the test, the closing calibration values had excellent agreement with beginning values.

Data for this test is contained with the 1:10,000-scale survey between "test data position numbers" 834 and 862. It is also located on magnetic tape #5 from 480.5 through 622.0 ft.

JD 015 (1986) U-turn Test - Range-Range Mode (Part 2)

The range-range mode of the U-turn test occurred on the same day as the Smoothing Code and Shore Antenna Detuning tests. The Argo and Mini-Ranger stations along with calibration procedures were identical to those described under those tests. The Argo system was set in the range-range mode using time slots 02 and 07 with a smoothing code of 2.

The procedures used on this day were the same as those on JD 290 when performing the hyperbolic section of this test. For the range-range data, the turns were accomplished at line spacings (radii) of 20, 40 and 100 meters. Three sets of turns were achieved for these distances. The first set was completed without any problems. On the second 20 meter turn (end of line #5), Argo station Cove Point went down exhibiting edit lights. This station stayed off the air through the sixth line and part of the seventh line, then it came back on with a good Automatic Gain Control (AGC) value. No other difficulties were encountered as the testing continued with another full sequence of 20, 40, and 100 meter U-turns.

The ending calibration for stations Point No Point (signal #1) and Drum Point (signal #2) were excellent. Cove Point (signal #3), however, had lost 15 lanes. Data from station Cove Point between position numbers 893 and 904 should be rejected. 15 lanes should be added to the data from Cove Point obtained after position number 904. The cause for the Cove Point station going off the air is unknown. It had also gone off and on just prior to the beginning calibration.

Refer to the 1:10,000-scale survey data, "test data position numbers" 863 to 934 and magnetic tape #5 between 623.0 and 930.2 ft. for this test data.

JD 015 (1986) Cloverleaf Test - Range-Range Mode (Part 1)

This test was also performed on the same day as the Smoothing Code test. All positioning control stations, Argo system and calibrations were configured as described under that test.

As required by this test, a reference point was marked on the starboard side of the vessel's cabin. Using the SDS III reference system, this point was located at X = +2 ft. 6 in.; Y = -18 ft. 7 in.; and Z = +6 ft. 0 in. The particular spot which the launch used to maneuver around was an oyster stake north of the limits of the 1:10,000-scale survey. This location is at latitude 38/20/36.4 N, longitude 076/22/50.6 W.

This test was accomplish by the launch running a series of several magnetic courses, such that the oyster stake would be passed on the starboard side at a distance of 5 meters. The launch assumed a steady course for 30-40 seconds before passing the oyster stake. When the stake was alongside the launch a detached position was obtained. The ending result should be a circle of fix positions 10 meters in diameter with the stake in the middle.

The following is a summary of the courses which the launch was steering when the detached positions were taken:

Position Number	Heading	Position Number	Heading
935	160	936	310
937	143	939	355
941	188	942	028
943	200	944	050
945	238	946	090
947	275	948	128
949	270	950	120
951	325	952	165
953	020	954	210

The closing calibration for the Argo ranges were in excellent agreement with beginning values. Data for this test is located with the 1:10,000-scale survey, between "test data position numbers" 935 and 954. SDS III recorded data is on magnetic tape #5 from 931.2 and 1117.3 ft.

JD 016 (1986) Smoothing Code Test - Hyperbolic Mode (Part 2)

The procedures and configuration for this test were the same as those described under Smoothing Code Test - Range-Range Mode on JD 015. The Argo system was set for hyperbolic mode with time slots 01 and 06 using a smoothing code of 2. Calibration of the Argo system was performed by the fixed point method at the Patuxent River Light #4 while the Mini-Ranger was system checked at bouy #57. Weather for this day was clear skies with 1-2 ft. seas from the north and wind out of the north at 5-10 knots.

As per the test plan, the same sounding line was repeated, twice each time the smoothing code was changed. As with the range-range data, smoothing codes of 2, 6 and 9 were used and the same results were observed. When using code 2, Argo tracking was complete. When changed to a value of 6, tracking continued but was hampered. Under a code of 9, signals from the stations would not track.

For data covering this test, refer to the 1:10,000-scale survey, "test data position numbers" 1008 through 1044 and magnetic tape #5 between 1118.3 and 1320.4 ft.

JD 016 (1986) Cloverleaf Test - Hyperbolic Mode (Part 2)

This test was performed in the same fashion as the Cloverleaf Test - Range-Range Mode on JD 015. The same Argo and Mini-Ranger stations were used. The Argo system was set in the hyperbolic mode using time slots 01 and 06 with a smoothing code of 2. This test followed the Smoothing Code test on JD 016 with a re-calibration of the Argo system at Light #4. The calibration of the Mini-Ranger equipment was still adequate and was not repeated. For the procedures, location of the launch reference point, and the site of the test (the oyster stake) refer to the test description on JD 015.

As with the data collected in the previous test, no problems were encountered and the same results were observed. Excellent agreement was obtained between the beginning and ending calibrations for this test.

The following is a summary of the courses steered at the time the detached positions were taken.

Position Number	Heading	Position Number	Heading
1045	060	1046	250
1047	095	1048	290
1049	130	1050	340
1051	160	1052	010
1053	210	1054	065
1055	275	1056	130
1057	320	1058	155
1059	010	1060	215
1061	070	1062	270

Data covering the hyperbolic test is contained in the 1:10,000-scale survey from "test data position number" 1045 through 1062 and on magnetic tape #5 between 1321.4 and 1511.4 ft.

JD 021 (1986) Simulated Lane Jump Test - Hyperbolic Mode (Part 3)

Control for this test used the three Argo stations (Point No Point, Drum Point, and Cove Point) and the two Mini-Ranger stations (Drum Point Light #2, code 6 - signal #12; and Cove Point Lighthouse, code #1 - signal #18). Argo calibration was performed at the Patuxent River Light #4 while the Mini-Ranger system check was accomplished at bouy #57. The Argo system was set up in the hyperbolic mode using time slots 01 and 06 with a smoothing code of 2.

The steering needle for directing the launch on-line failed on JD 015, thus X-Y coordinates from the Mini-Ranger Falcon Control Display Unit (CDU) were used. Sounding lines were run in a southwest to northeast direct400 RPMs.

As before when this test was performed, once the launch had completed a few minutes of hydrography, a lane jump was simulated. This was accomplished by either adding or subtracting one lane to the observed ranges through the Argo Control Processing Unit (CPU) on the launch. Two minutes after the test had begun, the station at Cove Point went off the air, when the timing was lost from the master at Drum Point. This occurred on the second sounding line, following the addition of one lane to station Point No Point. Operations were halted at position number 1097, in order to tune station Drum Point (master). This brought Cove Point back on the air. The Argo was re-calibrated at Light #4.

During the second attempt, two more lines were accomplished with simulated lane jumps occurring on station Point No Point (station #1). Just after the test shifted to station Cove Point on the third line, this station once again went off the air.

The test continued with three more sounding lines after another calibration was completed. Simulated lane jumps were tested on both the Point No Point and Cove Point stations during these lines. Again on the third line, Cove Point died. This occurred between position numbers 1192 and 1197.

As a result of the difficulties with the Cove Point equipment, it is the opinion of the hydrographer that only the first two lines and the last three lines prior to position 1192 contain good data and should not be rejected. The following is a summary of the positions at which lanes changes were made and/or position when stations dropped off the air.

Position Number	Event
1072	LBDB @ 2400 RPM's
1089	LT
1090	LR
1092	+1 lane - Point No Point
1097	LBKS - Cove Point Down
	re-calibration
1098	LR @ 2400 RPM's
1100	+1 lane - Point No Point
1105	+1 lane - Point No Point
1110	-1 lane - Point No Point
1113	LT
1114	LR @ 2400 RPM's
1116	-2 lane - Point No Point
1121	+1 lane - Point No Point
1130	LT
1131	LR @ 2400 RPM's
1132	+1 lane - Cove Point
1137	+1 lane - Cove Point
1142	-1 lane - Cove Point

1143	Cove Point Down
1145	LBKS - re-calibration
1146	LR @ 2400 RPM's
1147	+1 lane - Cove Point
1152	+1 lane - Cove Point
1157	-1 lane - Cove Point
1163	LT
1164	LR @ 2400 RPM's
1165	-2 lane - Cove Point
1170	+1 lane - Cove Point
1174+5	+1 lane - Point No Point
1180	LT
1181	LR @ 2400 RPM's
1182	+1 lane - Point No Point
1187	-1 lane - Point No Point
1192	-2 lane - Point No Point
	Cove Point station down
1197	+1 lane - Point No Point
1198	LEDE

Refer to the hydrographic data on the 1:10,000-scale survey, "test data position numbers" 1092 through 1198 and magnetic tape #5 between 1525.0 and 2143.3 ft. for information covering this test.

JD 022 (1986) Simulated Lane Jumps Test - Hyperbolic Mode (Part 4)

This was a continuation of the testing from JD 021. The Argo stations, Mini-Ranger stations, area of operation, and test procedures were the same. The coxswain's steering meter was still inoperative during this test, so X-Y coordinates from the Falcon's CDU were used to guide the launch. The Argo system was set up in the hyperbolic mode using time slots 01 and 06 with smoothing code 2. Initial Argo calibration was performed at Patuxent River Light #4 while the Mini-Ranger system check was conducted at bouy #57.

Since the Cove Point Argo station had not been functioning too well during the last few days, whole lanes and partial values were transferred to bouy #57's location to be used for Argo calibrations. This new calibration spot was utilized several times during the day's operations.

Four sounding lines with testing were completed on this day. Except for the Cove Point Argo station going off the air twice before testing began, there were no problems encountered with this data The ending Argo calibration had excellent agreement with the beginning values.

The following is a summary of positions where lane jumps were simulated:

Position Number	Event
1308	LBDB @ 2400 RPM's
1311	+1 lane - Point No Point
1316	+1 lane - Point No Point
1321	-1 lane - Point No Point
1324	LT

1325	LR @ 2400 RPM's
1326	-2 lanes - Point No Point
1331	+1 lane - Point No Point
1336	+1 lane - Cove Point
1341	+1 lane - Cove Point
1343	LT
1344	LR @ 2400 RPM's
1348	LBKS - change magnetic tapes
1349	LR @ 2400 RPM's
1350	-1 lane - Cove Point
1352	Recorder turned on - new mag tape
1355	-2 lanes - Cove Point
1359	LT
1360	LR @ 2400 RPM's
1361	+1 lane - Cove Point
1366	-2 lanes - Point No Point
1371	+2 lanes - Point No Point
1376	LBKS - end of test

Data for this test is located with the 1:10,000-scale survey, between "test data position numbers" 1308 and 1376. SDS III recorded data is on magnetic tapes #5 (2144.3 ft. - end of tape) and #6 (0 - 110.6 ft.).

JD 022 (1986) Line Jog Test - Hyperbolic Mode (Part 3)

After the Simulated Lane Jump Test, operations continued on JD 022 with the hyperbolic portion of the Line Jog Test. The same Argo stations, Mini-Ranger stations and calibration procedures were used, as described under the Simulated Lane Jump Test done earlier this day. The Argo system was kept in the hyperbolic mode using time slots 01 and 06, smoothing code 2. Also, the launch still had to be steered using the X-Y coordinates off the Falcon CDU.

Three sets of line jogs were accomplished during this test. The jogs were conducted at three minute intervals within a line and/or three minutes after the beginning of the line. As in previous Line Jog Tests, the first jog was a quick turn off and back onto the sounding line. The distance that the launch drifted from the line on the first jog was then used to determine lengths of the other jogs. The second jog occurred for a length twice the distance of the first jog and the last jog was for five times the distance. Position numbers were used to mark the beginning and ending location of the jogs.

During the third set of line jogs, Argo station Point No Point (station #1) stopped tracking twice while the launch turned back on-line. These problems took place during the second and third jogs.

Ending Argo calibration showed a loss of five lanes on the Point No Point station. The loss was easily seen on the strip chart located at the point where the two jogs occurred and the station stopped tracking. The Cove Point station was confirmed to have the right lane and partial count.

The following is a summary of where the line jogs occurred.

Position Numbers	Event
1377	LB @ 2400 RPM's
1379	LBKS - traffic
1380	LR @ 2400 RPM's
1383	Line jog begins
1384	Line jog ends - 81 meters
1387	Line jog begins
1388	Line jog ends - 179 meters
1391	Line jog begins
1394	Line jog ends - 420 meters
1395	LT
1396	LR @ 2400 RPM's
1399	Line jog begins
1400	Line jog ends - 42 meters
1403	Line jog begins
1404	Line jog ends - 153 meters
1407	Line jog begins
1409	Line jog ends - 216 meters
1412	Line jog begins
1413	Line jog ends - 51 meters
1416	Line jog begins (Point No Point not tracking)
1417	Line jog ends - 112 meters
1420	Line jog begins (Point No Point not tracking)
1422	Line jog ends - 242 meters
1423	LEDE

Data for this test is located with the 1:10,000-scale survey, "test data position numbers" 1377 through 1423 and on magnetic tape #6 from 111.6 ft. to 358.1 ft.

JD 023 (1986) Beam Rolls Test - Range-Range and Hyperbolic Modes

Positioning control for this test was conducted using the three Argo stations (Point No Point, Drum Point and Cove Point) and two Mini-Ranger stations (code 6, Drum Point Light #2 - signal #12, and code 1, Cove Point Lighthouse - signal #18). Calibration of the Argo was performed at Light #4 (signal #13). A system check was at bouy #57 for the Mini-Ranger transponders. Testing on this day was performed using Argo, first, in the range-range mode (time slots 02 and 07, smoothing code 2) and then in the hyperbolic mode (time slots 01 and 06, smoothing code 2). Re-calibration of the system was accomplished between the two modes of operation.

The requirements of this test were to obtain 15 minute-long sounding lines that were run purposefully beam to the seas. To achieve some decent rolling motion, operations were conducted with 3-4 ft. seas out of the north. Wind conditions were 15-20 knots from the northwest.

The first sounding line was run in an east direction with the seas hitting the vessel on the port side. The second line was a reverse of the first, running in the west direction with seas on the starboard side. The Argo strip chart and computer printout were annotated with the averaged beam roll on each fix. Druing the test, beam rolls varied between 3 and 30 degrees.

At the completion of the second line, the Argo system was re-calibrated and set in the hyperbolic mode. The two same sounding lines were then repeated. Both ending calibrations for the range-range data and the hyperbolic data had excellent agreement with the whole lane and partial values of the beginning calibrations.

Refer to the 1:10,000-scale survey data, "test data position numbers" 1471 through 1520 along with magnetic tape #6 between 359.5 and 637.4 ft. for information covering this test.

JD 028 Current Effects - Range-Range & Hyperbolic Modes

The positioning control for this test was the three Argo stations (Point No Point, Drum Point and Cove Point) along with two Mini-Ranger transponders set up at Patuxent River Light #2 (code 6 - signal #12) and at Cove Point Lighthouse (code 1 - signal #18). Calibration for the Argo was performed by the fixed point method at Light #4. A critical system check utilizing the HP 3810B Total Station was employed for the Mini-Ranger calibration. The Argo system was first set in the range-range mode using time slots 02 and 07 with a smoothing code of 2.

On this day, the weather was clear with waves 2 to 3 feet high. The wind was strong out of the northwest which helped to push the water out of the Patuxent River. This action enhanced a 2 knot ebbing current in the working area. This 2 knot current was in a 050 degree direction.

Test procedures required that the launch acquire sounding lines where they were with, against, and across the current. At 2400 RPMs, the survey vessel first obtained a 5 minute sounding line going with the current. The same line was then repeated, but in the opposite direction and for only half the distance. At the end of the second line, the launch performed a 90 degree turn to the left, running a 5 minute sounding line across the current. During this third line, the current was on the starboard side of the vessel. Then a fourth line was accomplished in the opposite direction of the third line, leaving the current on the port side. Throughout the test, the cruising speed of the launch was not changed.

At the completion of the test, the Argo system was re-calibrated at Light #4. Ending values were in excellent agreement with beginning values.

The configuration of the Argo system was then changed to hyperbolic mode using time slots 01 and 06 with a smoothing code of 2. The stations were calibrated again and the entire test repeated. As with the range-range data, the closing calibration values for the hyperbolic portion agreed with beginning figures.

The following is a summary of position numbers and events occurring during this test.

Position Number	Event
Range-Range Data:	
1521	LBDB - running with current
1526	LTBA
1527	LR - against current
1529	LTL - current on starboard
1534	LTBA
1535	LR - current on port
1540	LBKS
Hyperbolic Data:	
1541	LR - running with current
1546	LTBA
1547	LR - against current
1550	LTL - current on starboard
1556	LTBA
1557	LR - current on port
1562	LEDE

LBDB - Line begins, day begins
LTBA - Line turns back around (same line)
LR - Line resumes
LTL - Line turns left
LBKS - Line breaks
LEDE - Line ends, day ends.

Refer to the 1:10,000-scale survey data, "test data position number" 1521 through 1562 and magnetic tape #6 between 638.5 and 830.6 ft. for information covering this test.

JD 036 Static Positioning Test - hyperbolic Mode (Part 2)

This was a continuation of the Static Positioning test performed on JD 292. The same Argo stations utilized on JD 292 were used for control along with three Mini-Ranger transponders (Cove Point Lighthouse, code 1 - signal #18; Patuxent River Light #2, code 6 - signal #12; and Hooper Island Lighthouse, code 2 - signal #19). The Argo system was set in the hyperbolic mode using time slots 01 and 07 with a smoothing code of 2. It was calibrated via the fixed point method at Light #4. The Mini-Ranger transponders were calibrated by a critical system check using the HP 3810B Total Station.

As before, the launch was tied up to Tar Bay Entrance Light #1. This time it was secured with lines to the light and an anchor off the stern. The maximum movement observed during the test in either the horizontal or vertical direction was 1 ft.

At the beginning of the day during the transit to Tar Bay Entrance Light #1, the Argo station at Cove Point went down. The system was then re-calibrated using the computer program RK 561 and two Mini-Ranger ranges. The same thing occurred for a short period of time at the completion of the test on the way back to perform the ending calibration. The closing calibration revealed that the Cove Point Argo station had lost one lane. It is the hydrographer's opinion that this occurred during the transit period and that the test data is good.

Data for this test is located with the 1:10,000-scale survey between "test data position numbers" 1563 and 1703. It is also on magnetic tape #6 from 837.0 through 1152.0 ft.

JD 036 Echo Sounder Test

After the completion of the Static Positioning Test on this day, operations switched to the Echo Sounder Test. Using the same Argo and Mini-Ranger stations for control, sounding lines were performed over various bottom textures. The data was collected using the low frequency acquisition mode.

The area in which the test was performed is located on the 1:10,000-scale survey near Cedar Point. The first line was run over a sandy bottom with the launch speed of 2400 RPMs. The second sounding line was on the north side of Cedar Point across a large portion of "rip-rap" that extended out into 10 ft. of water. On this line, the launch ran at 1000 RPMs.

Operations then moved out into the middle of the 1:10,000-scale survey where bottom samples revealed a mud bottom. At a speed of 2400 RPMs, a line was started. Unfortunately, dense fog had developed which lowered the Mini-Ranger signal rate until no ranges could be received. Since positioning requirements were not required for this test, this data was kept. The Argo system was running during this time, however, a closing calibration was not performed. It is hydrographer's opinion that the Argo was good and could be used if positioning is needed.

The last area which was covered by the DSF 6000N echo sounder test was south of Cedar Point near Goose Creek marsh. This site contained sparse grass and was the only location in the area that could be used for testing in grass.

Sounding lines were not accomplished over an area with silt. Such a location could not be found.

The following is a summary of position numbers and the types of bottom the encompass.

Position Number	Bottom Characteristic
1704 - 1710	Sand
1711 - 1715	Rip-Rap
1716 - 1719	Mud
1720 - 1724	Grass

Refer to the 1:10,000-scale survey, "test data position numbers" 1704 through 1724 and magnetic tape #6 between 1153.0 and 1258.3 ft. for data concerning this test.

Mini-Ranger System Test

JD 041 Null Zone Test

Positioning control for this test included a range-azimuth observer using a T-2 theodolite and Mini-Ranger transponder code 2, at station Lewis (signal #7); Mini-Ranger transponder code 6, on station Solomons Is. (signal #5); and Mini-Ranger transponder code 2, at station Tell (signal #4).

The theodolite was initialled on Patuxent River Light #6 (signal #14) with an angle of 180/00/00 degrees. Calibration of the Mini-Ranger system was a noncritical system check using the least squares method.

Weather conditions for the day were partly cloudy skies with 10- to 15-knot winds from the north and seas 1 to 2 feet.

Range holes (null zones) were calculated by using the equation $R_N = (h_1 \times h_2 \times 2)/N \times 0.054$. For this test, h_1 = 2.72 meters (shore station) and h_2 = 3.39 meters (launch unit). The calculated range holes were at R_1 = 242 meters, R_2 = 171 meters, and R_3 = 114 meters. The test was conducted using code 2 at station Tell as the range hole source.

As the launch approached station Tell, a slight drop of signal strength in code 2 was observed at 240 meters (R1), but not enough to conduct the test. However, when the launch approached the R2 distance (170 meters), the ranges from code 2 jumped 30-40 meters and a signal strength of zero was observed. The R3 distance was not checked for a range hole since it was in too shallow of water for the launch.

Four sounding lines were conducted through the 170 meter range hole area. Using an X coordinate of 10380 meters, lines were run in the east-west direction at a speed of 600 RPMs. A full minute of good signal strength on all Mini-Rangers were obtained before and after running through the null zone.

Data for this test is located with the 1:5,000-scale survey between "test data position numbers" 1725 and 1745. Also, it is located on magnetic tape #6 from 1259.3 to 1388.5 ft.

Equipment Used for the Solomons Project

Argo Equipment:

Cove Point Station -

Receiver Processing Unit (RPU)	- s/n R047843
Power Supply (July-Nov. 1985)	- s/n V0379124
Power Supply (Jan.Feb. 1986)	- s/n V0478100
Antenna Loading Unit (ALU)	- s/n A0379127

Drum Point Station -

RPU (July-Nov. 1985)	- s/n R0379117
RPU (Jan.-Feb. 1986)	- s/n R1083665
Power Supply (July-Nov. 1985)	- s/n V0478108
Power Supply (Jan.-Feb. 1986)	- s/n V0478106
ALU (July-Nov. 1985)	- s/n A0783640
ALU (Jan.-Feb. 1986)	- s/n A0379109

Point No Point Station -

RPU (July-Sept. 25, 1985)	- s/n R1083667
RPU (Sept. 25-Nov. 1985)	- s/n R0379115
RPU (Jan.-Feb. 1986)	- s/n R1083667

Power Supply (July-Sept.25, 1985	- s/n V0478100
Power Supply (Sept.25-Nov. 1985)	- s/n V0379116
Power Supply (Jan.-Feb. 1986)	- s/n V0383132
ALU (July-Feb. 1986)	- s/n A047849

Launch 1020 -

RPU (July-Nov. 1985)	- s/n R1083667
RPU (Jan.-Feb. 1986)	- s/n R047843
Control Processing Unit (CPU)	- s/n C047821
ALU	- s/n A0379123
Strip Chart Recorder	- s/n 60384199

Mini-Ranger Equipment:

Launch 1020 -

Receiver Processing Unit (RPU)	- s/n E0141
Control Display Unit (CDU)	- s/n E0002
Receiver/Transmitter Unit (R/T)	- s/n E2919

Shore Station Transponders -

Code 1	- s/n E2890
Code 2	- s/n E2900
Code 6	- s/n E2922

APPENDIX C

Speed and Heading Sensor Evaluation Report

Speed & Heading Sensor Report

This report describes the OIC's observations and impressions of the Caterpillar Engine Corporation digital tachometer and the DigiCourse magnetic digital compass, model 101C and the Arc industries, Inc., model DC1291, Worldguide Digital Compass.

The Caterpillar Engine Corporation digital tachometer is not a true speed sensor, but rather an indicator of engine speed which can be related to the speed of the vessel over the ground. We usually use the tachometer to indicate speed so there is no change in policy. The tachometer worked pretty well except that no speed at all was indicated when the engine went in reverse. When in forward up to 1000 rotations per minute (RPM) the digital tach was very reliable in that it and the console-mounted gage agreed. Between 1000 and 2000 RPM, the digital tach registered 100 RPM slower. Above 2000 RPM, the digital tach showed 150 to 200 RPM slower. The digital tach was responsive to speed changes. I don't have any preference between the digital and analog tachometers, but the two should agree.

The DigiCourse magnetic compass worked very well. The compass was adjusted after mounting in the launch to be accurate within 3 degrees by W.T. Brownley Company of Norfolk, Virginia. Swinging the launch took about 1 hour. The compass didn't seem to be grossly affected by the normal vibrations of the launch. The digital compass would be good for a helmsman display, since it responded quickly and had an accurate display.

An Arc Industries "Worldguide" compass sensor and master display digital readout model DC1293RC, was used as an aid in steering test and survey sounding lines. The steering compass was installed by the Office of Marine Operations personnel in July of 1986 as per project requirements.

Before operations began the compass was adjusted and a deviation card was determined by W.T. Brownley Company of Norfolk, Virginia. At that time the previous compass was removed and the Worldguide was installed to the left of the instrument console.

Compass quality depends on ease of adjustment, movement dampening and the rate of card "swing". The Worldguide in the beginning of the project appeared to fulfill these requirements very well. The card was appropriately stable in a seaway and the card would swing quickly enough following the launches heading until a course was obtained then "steadying up" rapidly.

As winter approached and the weather turned colder it was noticed that the compass card movement was getting progressively slower. The card would only complete its movement after the launch was turned and on a different heading. As the party had experienced helmsmen, the compass simply was not used as a guide in steering lines. It was noticed on January 14 and 15 the compass card would barely move.

In conclusion it appears that this type of compass is not compatible with severe weather as experienced on this project.

APPENDIX D

Total Cost Analysis

Cost Analysis - Solomons Island Project

Field Party Costs: (7/15/85 - 4/1/86)

Salaries	$60,700.41
Per Diem	21,375.00
Fuel & Gas	5,404.04
Operating Costs	5,480.82
Total	$92,960.27

Support Personnel: (6/1/85 - 4/1/86)

Rockville ETs Salaries	$20,912.08
Per Diem	1,637.60
AMC ETs Salaries	1,338.48
Per Diem	600.00
AMC Hydrographic Field Parties Section Salaries	$2,420.71
Total	$26,908.87

SDS III: (5/27/85-5/1/86)

Task Managers Salaries	$27,675.36
Per Diem	1,231.80
Observers Salaries	804.40
Per Diem	375.20
Others Salaries (Armstrong)	328.77
Per Diem	0.00
Equipment & Supplies	32,989.15
Total	$63,404.68

Project Total: $183,273,82

Equipment & Supplies:

Thorn Recorder	$19,723.20
Tachometer	267.57
DigiCourse Compass	1,655.33
Arc Compass	1,559.48
Voltmeter & Bustle	1,731.44
Black Box Interface	3,399.58
Ampex Magnetic Tapes	252.55
Miscellaneous Connectors	200.00
FM Modules for Recorder	4,200.00
Total:	$32,989.15

APPENDIX E

Solomons Island Project's Hydrographic Sensor Recorder System

HYDROGRAPHIC SENSOR DATA ACQUISITION SYSTEM FOR SHIPBOARD DATA SYSTEM III

INTRODUCTION:

The following is a description of the hydrographic sensor data acquisition system developed to record and directly plan back actual on-line sensor data to the Shipboard Data System III (SDS III). The following sensors are being recorded as ASCII code compatible with EIA RS-232C standard:

a. Cubic Western Argo DM-54
b. Motorola Falcon 484
c. Raytheon DSF-6000N Echo Sounder
d. DigiCourse Model 261A Heading Sensor
e. ARC Industries Model 200 Heading Sensor
f. Launch RPM output
g. System Time Clock/Calendar
h. Hydroplot output to DSF-6000N
i. Motorola Falcon 484 Data Timing Pulse

The system operates in a parallel, non interfering mode with the standard HYDROPLOT system. The system records and reproduces data in a real time parallel sensor, serial digital data output mode. The system is capable of recording 8-12 hours of data on one reel depending on tape length.

In the present configuration all sensors are set to output data to the recording system at 2400 baud, but can be switched to output at 300 to 9600 baud. One feature of this type of recording is that by switching the speed of operation of the system on playback the data baud rate appears to double for each doubling of speed; the 2400 baud transmissions can be made to look like they were recorded at any speed form 1200 baud to 19200 baud and beyond.

OPERATING INSTRUCTIONS:

After the system has been properly installed, the procedure for operating the system is as follows:

1) Make sure the system power bus strip is OFF and the system components are all turned ON.

2) Provide power to the Stabiline Transient Suppressor/Voltage Regulator.

3) Switch the system power from the buss strip ON. Several automatic functions will occur at this time, such as the system clock program loading.

4) Check to see that a adequate supply of tape is loaded on the Thorn/EMI recorder and has been properly threaded (as according to the diagram on the recorder) and has been properly tensioned by rotating the take-up reel until there is no slack along the tape path.

5) Push the RECORD and forward ( ) buttons on the recorder simultaneously to start the recording process. If the tape does not move or the record indicator light does not come on repeat the previous line. If after several attempts there is still no tape movement re-check step 4.

6) Using the switch box step through the occupied channels and observe the data streams on the system monitor CRT. There is a delay of approximately 3-4 seconds between the writing of data and its playback on the monitor. Often the first line of data after switching to a new channel will appear to be in error; disregard this. It is caused by the terminal receiving an incomplete data stream.

7) If any of the occupied channels do not display data, check the sensor for power, proper mode of operation, and connection to the recording system. If no discrepancies can be found notify the qualified service technician.

8) If the system is operating properly there is no need for further operator attention. Periodic checks of the data on all channels can be made or the system can be left to monitor any of the sensor data streams. Recording will continue until stopped or the supply reel runs out of tape.

9) The proper shutdown sequence for the recording system is as follows:

a) Push the STOP button on the recorder if still running. If there is to be no further recording, push the rewind bottom and allow the tape to fully return to the supply reel. Remove the reel and check that it is properly labeled.

b) Shut OFF the recording system power at the system bus strip.

The system is now powered down and is protected from launch power changeovers. It is unnecessary to unplug the Stabiline unit, but it must be unloaded (bus strip OFF) before power is applied.

THEORY OF OPERATION:

Although the system records and reproduces digital data streams, it is an instrumentation or analog recorder as opposed to a digital recorder such as a 9-Track parallel bit computer data recorder (e.g. Kennedy 9000 series. The recording method approximates that used in audio tape recording with some notable exceptions. A brief explanation of the operating mode follows:

a) All of the sensor inputs (with the exception of the Falcon 484 timing pulse) are converted to RS232 signals if they are not yet compatible. Engine RPM, for instance, is derived from the speedometer cable engine takeoff and converted to an AC voltage by means of tachometer. This output is in turn fed to digital panel meter and scaled to output BCD digits reading directly in RPM's. The BCD digits are then converted to a serial data stream at 2400 baud by a device called an ASCII Transmitter Bustle. Both compasses used a similar Bustle to convert their BCD output to an RS-232C serial stream.

b) All serial data streams are fed into individual Clock Generator Boards. These boards generate a continuously clocking pulse in synchronization with the sensor input data stream. This signal is necessary for the recording process.

c) Each serial data stream and its associated clocking pulse train is input to a PCM (pulse code modulation) module on the Thorn/EMI recorder. The PCM data module comprises a complete PCM recording and playback channel excluding bias and mixer for recording and initial amplification for playback. The PCM module can be used at any of the tape speeds selected on the control panel. The module is configured to record NRZ encoded data with its clock waveform in delay modulation (DM) format. Although the module is manufactured to handle CCITT European Standard of data transmission it is also suitable for recording of the RS-232C standard data.

d) The function of the playback circuitry is to provide phase/frequency and amplitude correction on PCM recorded signals received from the preceding head amplifier on playback. Appropriate equalization is selected automatically according to tape speed. DM mode signals are received as a balanced input from the associated head amplifier. After equalization, DM recorded data is output limited and squared and the outputs are selected to be CCITT/RS-232C compatible. This output is available either while recording (read-after-write with a 3-4 second delay) or off line playback.

e) All RS-232C signals are available simultaneously on playback. In order to monitor the various outputs a simple switching box has been constructed to select the channel to be observed. The output of the switching box is connected to a CRT terminal for near real time monitoring of the recorded signals. When playing back into the prototype SDS III system all channels will be input in parallel.

INSTALLATION GUIDE:

The following is a listing of the major problems encountered in the assembly and installation of the SDS III field data recorder system aboard Launch 1020. It is presented for information purposes in the hope that it will help avoid similar problems in future installations.

1) Tachometer/compass installation: Due to the lack of clearance on the engine the installation of the mechanical pickoff for the tachometer electrical output required more effort than originally envisioned. The installation of the two compasses was complicated by the difficulty in the calibration of both units, which required an expert to be brought in to perform the actual calibration.

2) ARC Compass noise radiation: In addition to the above, it was discovered that the ARC compass radiated a considerable amount of electrical noise that interfered with other system components. This problem was circumvented by locating the unit outside the cabin and keeping all internal wiring lengths to a minimum.

3) Launch Power and Grounding: Several problems related to Launch 1020 available power were discovered. First, the output of the ONAN generator on-board was found to be unsuitable for the recording system and a voltage regulator with noise suppression was installed to power the system and related equipment. There was a failure of this power regulator due to unknown reasons and the unit had to be replaced. The output voltage and frequency of the ONAN also had a tendency to drift to the low side and had to be adjusted.

The grounding on the launch also caused considerable noise problems. When originally measured there was found to be a 300-400 ohm resistance difference between the ground bus in the power box and the hull. Investigation revealed that although the launch uses a one point grounding of all power returns to the hull there should be no resistance difference; this problem was corrected.

The grounding of the individual sensor units on the launch also is a question. Originally all major sensors such as the DSF-6000N, Argo and Miniranger had no grounding straps; in the case of the DSF-6000N it is known that this causes noise on the analog traces and can cause problems in the automatic operation of the system.

All signal cables had to be replaced using special double shielded computer cable in place of standard cable. Ground straps were added to all major sensors. Similar installations on other launches may have similar problems.

4) Argo interfacing: The Argo system is equipped with a RS-232C/ current loop port which is not used with Hydroplot on the east coast. Documentation was secured to find the proper internal switch settings for RS-232C selection and 2400 baud rate. The appropriate jumper and switch locations can be found on Figure 4-38 Schematic Diagram - CDU Serial Interface Circuit Board on page 4-43 of the ARGO DM-54 Maintenance Manual.

5) Mini-ranger interfacing: There was a similar unused RS-232C output port on the Mini-ranger. When checked it was discovered that this port is factory preset for 9600 baud; to be reset for 2400 baud a jumper must be unsoldered and moved on the output driver board. The documentation in the manual is not very clear; fortunately there is a diagram on the inside of the RPU which shows how this change may be made.

6) The Black Box Clock Generator boards have a tendency to drift in frequency with temperature and cause sporadic record/reproduce errors on the tape. A blower fan was installed below the Black Box card cage and this effect was significantly reduced, but some errors are still recorded. If the system is repackaged for portable operation it is suggested that serious consideration be given to replacing the Black Box PC boards with a custom circuit PC board. A preliminary version of the custom board was designed before the Black Box boards were procured, but the lead time to availability of components conflicted with scheduling.

MAINTENANCE GUIDE:

The individual manuals for the various sensors have sections for maintenance and repair of the individual units. The Maintenance guide for the Thorn-EMI recorder is with the recorder. For information concerning the remaining units consult the appropriate manuals. A wiring scheme for the DigiCourse/Arc Industries Heading Sensor interface and a block diagram of the data sensors follows.

DigiCourse Model 261A / ARC Industries HEADING SENSORS Interface

	DigiCourse WIRE COLOR	DigiCourse PIN #	BUSTLE	ARC PIN#	ARC WIRE COLOR
OUT MSB Q9	WHITE	5	7	J2-4	GRAY
Q8	BLACK	24	8	J2-6	YELLOW
Q7	BROWN	11	14	J2-13	WHITE/GRAY
Q6	RED	30	13	J2-14	WHITE
Q5	ORANGE	12	11	J2-15	WHITE/VIOLET
Q4	YELLOW	31	12	J2-7	ORANGE
Q3	WHITE	10	18	J2-9	WHITE/BLACK
Q2	GRAY	28	17	J2-12	BROWN
Q1	BLACK	29	15	J2-11	VIOLET
LSD Q0	VIOLET	9	16	J2-10	WHITE/RED
BUSY	RED	2			
INP B TERM	VIOLET	4	PS GND	J2-3	BLACK
G TERM	YELLOW	21	+12 VDC		
W TERM	GREEN	13			

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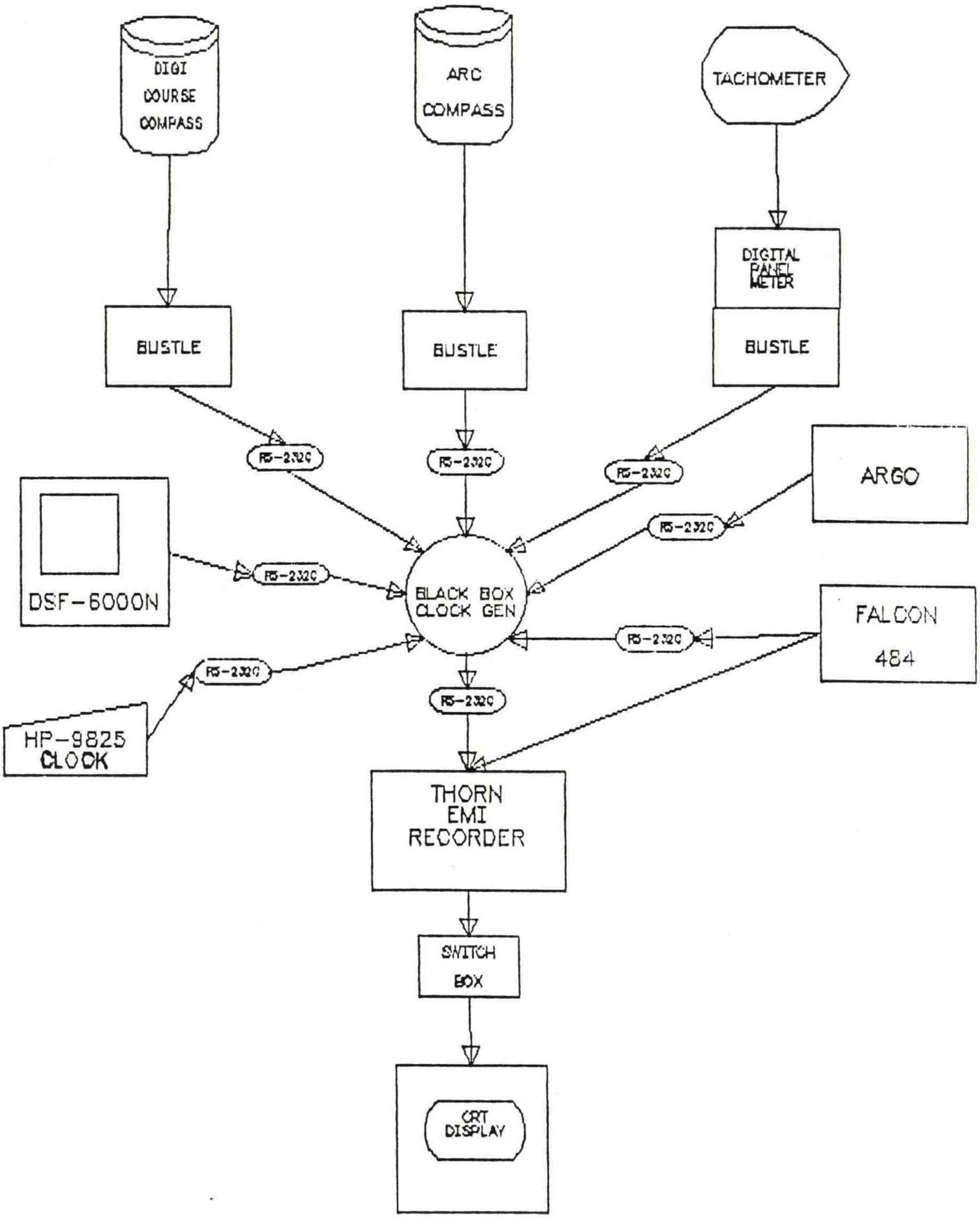
DIGI COURSE COMPASS
ARC COMPASS
TACHOMETER
DIGITAL PANEL METER
BUSTLE
BUSTLE
BUSTLE
ARGO
RS-232C
DSF-6000N
BLACK BOX CLOCK GEN
FALCON 484
HP-9825 CLOCK
THORN EMI RECORDER
SWITCH BOX
CRT DISPLAY

N/CG214 - Lucas
WSC-1 Rm. 509