DATA ACQUISITION AND PROCESSING REPORT

TO ACCOMPANY

UNITED NATIONS CONVENTION ON THE LAW OF THE SEA SURVEY
EASTERN GULF OF ALASKA

R/V KILO MOANA
Cruises KM0514-1 and KM0514-2

JUNE 24 – SEPTEMBER 1, 2005

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LT MARK VAN WAES, NOAA, LEAD HYDROGRAPHER

A. EQUIPMENT

All data for this project was acquired by the R/V KILO MOANA in the months of June, July, and August of 2005. Vessel description and offset measurements are included in Appendix A of this report.

Figure 1 – R/V KILO MOANA

A1. SOUNDING EQUIPMENT

Kongsberg Simrad EM 120 Multibeam Echo Sounder (MBES)

KILO MOANA is equipped with a hull-mounted Kongsberg Simrad EM 120 echo sounder. The EM120 is a 12-kHz, MBES system that transmits a 1° wide (fore-aft) acoustic pulse and then
generates 191 2° receive apertures (beams) over a 150° swath. The system is both pitch and yaw stabilized to compensate for vehicle motion during data acquisition. Refer to the Kongsberg Simrad EM 120 Product Description for full specifications and details on the system (Appendix F).

MBES data acquisition was monitored in real-time using the EM 120 operator station (Sun Solaris workstation) and Kongsberg Simrad’s Merlin software. Adjustable parameters used to control the EM 120 include beam angle, ping mode, spike filter strength, and beam spacing. Maximum port and starboard swath width angle was varied in order to achieve necessary across-track coverage while minimizing outer beam falloff. The system operated well within the HSSD-standard along-track coverage requirement of 3.3 pings per 10% of water depth. Ping mode was set to deep, as the depth of water in the survey area ranged from approximately 500 to over 4000 meters. Spike filter strength was set to medium. Beam spacing was typically set to equidistant to offer a uniform distribution of soundings, though on occasion was set to in-between.

**Knudsen Engineering 320B/R Deep Water Echo Sounder**

The Knudsen 320B/R is a dual-frequency (3.5 and 12kHz) digital-recording vertical beam echo sounder. The system is capable of resolving depths to an accuracy of 1m in >1000m of water. Data from the Knudsen was logged but not processed for this project. The system was secured much of the time due to it causing interference with the EM 120 multibeam echo sounder.

**A2. POSITIONING EQUIPMENT**

**Applanix POS/MV Position and Orientation System**

KILO MOANA is equipped with an Applanix POS/MV (Position and Orientation System for Marine Vessels) 320 Version 3 to provide primary positioning data to survey systems. The POS/MV, an aided strapdown inertial navigation system, provides a composite position solution derived from both an Inertial Measurement Unit (IMU) and two dual-frequency GPS receivers. The IMU and GPS receivers are complementary sensors; data from one are used to filter and constrain errors from the other resulting in high position accuracy.

Position accuracy and quality are monitored in real time during data acquisition using the POS/MV Controller software to ensure positioning accuracy requirements in the NOS Hydrographic Surveys Specifications and Deliverables are met. The POS/MV Controller software provides clear visual indications whenever accuracy thresholds are exceeded.

**DGPS Receiver**

KILO MOANA is equipped with a DGPS beacon receiver that is capable of being interfaced with the POS/MV to provide differential GPS corrections to the position solution. DGPS correctors were not, however, applied to the position solutions for this project.
P-Code

A P-Code GPS receiver is installed and connected to the POS/MV AUX 1 port. It can provide additional positioning information that the POS/MV can combine with its own data to improve positional accuracy. Prior to the beginning of the project, the receiver was updated with new codes. Following the update, it stopped sending correctors to the POS/MV. As a result, the P-Code receiver was not used during the project.

Thales Navigation ADU5

A Thales Navigation ADU5 positioning and attitude sensing system is installed. The attitude and orientation functions are not utilized, though the position data is fed to the multibeam echo sounder as a secondary positioning source. This data is logged with the multibeam data, and may be applied in post-processing in lieu of the default primary positioning data.

A3. Heading and Attitude Equipment

Applanix POS/MV Position and Orientation System

KILO MOANA is equipped with a POS/MV Model 320 Version 3 for vessel heading and attitude determination. The POS/MV is an aided strap down inertial navigation system (INS), consisting of an Inertial Measurement Unit (IMU) and two GPS receivers. The IMU senses linear acceleration and angular motion along the three major axes of the vessel. The POS/MV’s two GPS receivers determine vessel heading using carrier-phase differential position measurements.

POS/MV Heading Computation

The POS Computer System (PCS) blends data from both the IMU and the two GPS receivers to compute highly accurate vessel heading. The IMU determines accurate heading during aggressive maneuvers and is not subject to short-period noise. However, IMU accuracy characteristically diminishes over time. The GPS receivers compute a vector between two fixed antennas and provide azimuth data using the GPS Azimuth Measurement Subsystem (GAMS). GPS heading data is accurate over time, but is affected by short-period noise. The POS/MV combines both heading measurement systems into a blended solution with accuracies greater than either system could achieve alone. The POS/MV is used for MBES heading.

POS/MV Heave, Pitch, and Roll Computation

Heave is computed in the POS/MV by performing a double integration of the IMU-sensed vertical accelerations. The POS/MV v3 controller heave filter is used for all data aboard KILO MOANA. A heave bandwidth of 20 seconds and heave damping ratio of 0.707 are used. The system is outfitted with TrueHeave, though it was not applied to the data.
Both roll and pitch measurements are computed by the IMU after sensor alignment and leveling. The IMU mathematically simulates a gimballed gyro platform and applies the sensed angular accelerations to this model to determine roll and pitch. The POS/MV is used for MBES heave, pitch, and roll.

**A4. SOFTWARE**

**Acquisition**

MBES data is acquired using Sun Solaris workstation running Kongsberg Simrad’s *Merlin* acquisition software. System offsets are entered directly into the multibeam system, as are sound velocity profiles, and applied at time of acquisition.

**Processing**

MBES data is converted and processed with *Caris HIPS and SIPS 5.4*. System offsets and sound velocity profiles are not applied in the Caris software.

IVS 3D’s *Fledermaus* software is used for visualization of exported data.

Acoustic backscatter mosaics are created and reviewed with *SwathEd*, developed by the Ocean Mapping Group at the University of New Brunswick.

**Planning**

Line planning during the first leg of the cruise was accomplished using the Kongsberg Simrad acquisition software to estimate required line spacing. SAIC’s *ISS-2000* software package was used for line planning and real-time bathymetry display during the second leg of the cruise, greatly improving the line planning process.

**Sound Velocity**

Sippican expendable bathythermograph (XBT) temperature measurements are processed with Sippican’s *WinMK21* software to produce sound velocity profiles. Sound velocity profiles are also developed using data from a SeaBird Electronics CTD, processed using SeaBird *SeaSoft* software. Profile data from the Brooke Ocean Technology Moving Vessel Profiler (MVP) is generated using the *MVP Controller* software.

These profiles are converted to a Kongsberg Simrad compatible format for use with the multibeam system using scripts written in-house by Hawaii Mapping Research Group (HMRG).
A5. HARDWARE

Acquisition takes place on a Sun Ultra 10 workstation running the Solaris operating system. Data processing is accomplished on a variety of Dell Latitude and Precision laptops running Windows XP Pro, Windows 2000, and/or Fedora Core Linux. Other processing and data management tasks take place on various Windows and Linux machines.
B. DATA PROCESSING AND QUALITY CONTROL

B1. CONVERSION AND PRE-CLEANING

Raw Kongsberg Simrad data files are converted to HDCS format using the Caris HIPS and SIPS 5.4 Conversion Wizard. Conversion parameters specifying the sources of the attitude and navigation data are stored in the LogFile located in each of HDCS processed line folders.

![Conversion Parameters](image1)

**Figure 2** – Conversion Parameters

After conversion, zero tide is applied, and the data merged. A BASE surface is then created using swath angle for a weighting method. Total Propagated Error (TPE) is not calculated at this point, so an uncertainty-weighted BASE cannot be generated. A BASE surface generated by swath-angle weighting is simply a weighted grid of depths.

![BASE surface creation](image2)

**Figure 3** – BASE surface creation
B2. SWATH EDITING AND DATA CLEANING

After conversion and pre-cleaning steps, the data is edited in the Caris HIPS and SIPS 5.4 Swath Editor. Data fliers and obvious noise are removed by a combination of manual editing and filtering.

Figure 4 – Swath editing. Gray data is rejected, manually or by across-track filtering

B3. SUBSET EDITING AND DATA REVIEW

All data is reviewed in subset mode to find data fliers that were missed in swath editing, and to examine continuity of data from line to line. The BASE surface is recomputed.

B4. FINALIZATION OF BASE SURFACES

BASE surfaces are not finalized during the processing of the data.
C. CORRECTIONS TO ECHO SOUNDINGS

C1. SOUND VELOCITY

Sound velocity profiles are acquired using the systems listed below, and applied at time of acquisition. SVP is not applied during processing in Caris HIPS and SIPS. The profile(s) applied to the soundings are converted with the raw multibeam data and stored in the Caris line file folder.

Sippican T-7 Expendable Bathythermograph (XBT)

The primary source of sound velocity profile information is the deployment of Sippican T-7 Expendable Bathythermographs. Deployments occur every six hours (or more frequently). Temperature profile data is logged using the MK21 USB system, and sound speed profiles are generated using the WinMK21 software. To generate the profile, the software requires a salinity value. The value is determined by adjusting it to make the sound speed in the profile at a depth of 8 meters match the sound speed measured at the transducer face.

The T-7 XBT has a maximum depth of 760 meters, and can be deployed at a speed of up to 15 knots. See the datasheet for more information (Appendix F). After the profile is generated by the WinMK21 software, it is converted to the Kongsberg Simrad SSP format (using and in-house script written by HMRG), extended to a depth of 12km, and applied directly to the data as it is acquired. The entire process occurs without interruption of acquisition.

SeaBird SBE 911+ Conductivity, Temperature, and Depth (CTD) Profiler

KILO MOANA has the capability of conducting deep profiles using the SBE 911+ CTD system. Full-depth profiling can take up to three hours per cast; therefore CTD casts are only taken when there is reason to believe the XBT is generating an erroneous profile.

CTD data is logged in real time using the SeaSoft software provided by SeaBird. The profile data is then converted to Kongsberg Simrad SSP format (using an in-house script written by HMRG), extended to a depth of 12km, and applied directly to the data as it is acquired.

The calibration reports for the SBE 911+ CTD profiler are included in Appendix F to this report.

Brooke Ocean Technology Moving Vessel Profiler

A Brooke Ocean Technology MVP-300 is installed for constant water column profiling while underway. The system is used to obtain profiles of the upper 300 meters of water every half hour. Profiles generated from the system’s CTD sensor are converted into the Kongsberg Simrad SSP format (using an in-house script written by HMRG), extended to a depth of 12km, and applied directly to the data as it is acquired.

The MVP was used for the first few days of Leg 1 of the cruise, until the temperature probe failed. No spare was available; the MVP was not used for the remainder of the project.
Kongsberg Simrad Surface Sound Velocity System

KILO MOANA is equipped with a Kongsberg Simrad Surface Sound Velocity System (SSVS). The SSVS uses an Applied Microsystems Limited Sound Velocity and Temperature Smart Sensor to measure sound velocity and temperature at the depth of the Simrad EM 120 transducer. Mounted in a void near the transducers, the smart sensor samples water pumped through insulated stainless steel pipes passing through the void. This unit calculates and outputs temperature and sound velocity ten times per second to the EM 120 Sun operator workstation for real-time beam-steering at the transducer head. These values are averaged by Simrad before application by 3 seconds. This averaging mitigates the effects of erroneous measurements.

C2. VESSEL OFFSETS AND DYNAMIC DRAFT CORRECTORS

One HIPS Vessel File (HVF) was created and used for the KILO MOANA (KILO_MOANA_EM120.hvf). System offsets are applied in the multibeam system, not by the HVF in Caris.

**Note:** A number of the offsets entered into the multibeam system for the project were incorrect. Refer to the Report on Vessel Offsets for R/V KILO MOANA, (LT Mark Van Waes, NOAA; dated 22 August 2005, and included with this documentation) for a complete discussion of the errors. The HVF contains values to correct for the horizontal errors in the values. Angular offset errors were not compensated for in the HVF.

A summary of vessel offsets and the calculated correction offsets can be found in Appendix A.

Static draft was not directly measured. An assumed vessel draft of 7.01m (correlating to the ship’s stationary draft at level trim, according to the pilot information sheet) was used. Dynamic draft was also not measured. A Small Waterplane Area Twin Hull (SWATH) design, KILO MOANA is equipped with four canards, two fixed on the stern and two adjustable at the bow. The forward canards are angled in such a way as to maintain the vessel’s level trim at varying speeds. As such the draft value used is generally correct, to within less than a meter. In the waters surveyed for this project, the error is a fraction of a percent of water depth.

C3. ROLL, PITCH, AND HEADING, INCLUDING BIASES AND NAVIGATION TIMING ERRORS

Two patch tests were conducted during this project, one at the beginning of each leg, prior to commencing data acquisition for that leg. Roll, Pitch, and Heading biases and Navigation Time Latency error for the EM 120 system were generated using the Kongsberg Simrad Calibration Utility. The biases were entered into the acquisition software and applied at time of data acquisition. No biases were entered into the Caris HVF. Patch test reports can be found in Appendix C.
C4. WATER LEVEL CORRECTORS

Sounding data is not corrected for tide levels. A zero tide file is applied to the data when merged in Caris HIPS and SIPS 5.4.
D. APPROVAL

As Lead Hydrographer, I have ensured that standard field surveying and processing procedures were adhered to during this project in accordance with the NOS Hydrographic Surveys Specifications and Deliverables, as updated for March, 2003. Any necessary deviations have been documented.

All of the information contained in this report is complete and accurate to the best of my knowledge.

Submitted:

LT Mark Van Waes, NOAA
Lead Hydrographer
APPENDIX A – VESSEL REPORT, OFFSETS, AND DIAGRAMS

BACKGROUND

The R/V KILO MOANA (AGOR 26) is a small waterplane area, twin hull (SWATH) design oceanographic research ship designed to perform general purpose oceanographic research in coastal and deep ocean areas. The SWATH hull form is designed to provide a comfortable, stable platform in high sea conditions. The ship was built in 2001 at Atlantic Marine Shipyard in Jacksonville, Florida.

KILO MOANA Characteristics

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>185’ 7”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length Overall:</td>
<td>(56.56m)</td>
</tr>
<tr>
<td>Strut Length:</td>
<td>172’</td>
</tr>
<tr>
<td></td>
<td>(52.43m)</td>
</tr>
<tr>
<td>Lower Hull Length:</td>
<td>171’</td>
</tr>
<tr>
<td></td>
<td>(52.12m)</td>
</tr>
<tr>
<td>Beam:</td>
<td>88’</td>
</tr>
<tr>
<td></td>
<td>(26.82m)</td>
</tr>
<tr>
<td>Depth to 01 Level:</td>
<td>47’ 6”</td>
</tr>
<tr>
<td></td>
<td>(14.48m)</td>
</tr>
<tr>
<td>Draft at Deepest Load Line:</td>
<td>25’</td>
</tr>
<tr>
<td></td>
<td>(7.62m)</td>
</tr>
</tbody>
</table>

R/V KILO MOANA

Table 1 – R/V KILO MOANA Characteristics

<table>
<thead>
<tr>
<th>Performance</th>
<th>15 KTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed (designed sustained):</td>
<td>12 KTS</td>
</tr>
<tr>
<td>Survey Speed:</td>
<td></td>
</tr>
<tr>
<td>Operability:</td>
<td>Sea state 6</td>
</tr>
<tr>
<td>Range:</td>
<td>10,000 NM at 11KTS</td>
</tr>
<tr>
<td>Endurance:</td>
<td>50 Days</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Displacement</th>
<th>2542 LT</th>
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<tbody>
<tr>
<td>Full Load:</td>
<td></td>
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<tr>
<td>Lightship:</td>
<td>1996 LT</td>
</tr>
</tbody>
</table>

VESSEL SURVEY

At the time of construction and outfitting, all equipment was installed and positioned. The resultant offsets are what have been entered into the systems and used for data acquisition.

In February-March of 2005, KILO MOANA went into dry dock in Brisbane, Australia. While there, Blom Maritime conducted a full resurvey of all vessel offsets. For complete details of the survey, refer to the Report of Dimensional Survey and enclosures, dated 10 February 2005.

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1 The survey was completed in week 9 of 2005, which is 28 February to 6 March. The February date of the report appears to be erroneous, and likely should be 10 March 2005.
Blom document number 0404143-05000261. The new values for offsets were not entered into the systems prior to or during the KM0514 cruises.

**Vessel Offsets**

A rigorous examination of the vessel offsets was undertaken during the KM0514-2 cruise. Several notable errors in the applied offsets were discovered, including an approximately 4.5m position offset for all sounding data, a result of an error in the POS/MV antenna offset and the Kongsberg Simrad EM 120 transducer offset. Complete documentation of the offset examination can be found in the *Report on Vessel Offsets for R/V KILO MOANA* (LT Mark Van Waes, NOAA; dated 22 August 2005, and included with this documentation).

In the tables that follow, the “New” columns are offsets as they should be entered following the recent vessel survey. The “Current” columns are the offsets as entered into the system for the project. The “Difference” columns indicate the difference between the New and Current values.

**POS/MV**

<table>
<thead>
<tr>
<th><strong>RP to IMU</strong></th>
<th><strong>IMU Frame wrt Reference Frame (deg)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New</strong></td>
<td><strong>Current</strong></td>
</tr>
<tr>
<td>X</td>
<td>1.059</td>
</tr>
<tr>
<td>Y</td>
<td>-1.218</td>
</tr>
<tr>
<td>Z</td>
<td>-0.431</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>RP to Primary GPS</strong></th>
<th><strong>RP to Heave</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New</strong></td>
<td><strong>Current</strong></td>
</tr>
<tr>
<td>X</td>
<td>6.437</td>
</tr>
<tr>
<td>Y</td>
<td>6.536</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>RP to Vessel</strong></th>
<th><strong>RP to AUX 1 GPS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New</strong></td>
<td><strong>Current</strong></td>
</tr>
<tr>
<td>X</td>
<td>-9.050</td>
</tr>
<tr>
<td>Y</td>
<td>8.500</td>
</tr>
<tr>
<td>Z</td>
<td>8.153</td>
</tr>
</tbody>
</table>

* Note that this change is due to correcting the primary antenna offset. The current value is for the starboard antenna, though the port antenna is actually the primary.

<table>
<thead>
<tr>
<th><strong>RP to AUX 2 GPS</strong></th>
<th><strong>Sensor 1 Frame wrt Ref. Frame (deg)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New</strong></td>
<td><strong>Current</strong></td>
</tr>
<tr>
<td>X</td>
<td>0.000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>RP to Sensor 1</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New</strong></td>
<td><strong>Current</strong></td>
</tr>
<tr>
<td>X</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 2 – POS/MV Lever Arms & Mounting Angles
Kongsberg Simrad EM 120

### Sensor Location

<table>
<thead>
<tr>
<th>Sensor Location</th>
<th>New</th>
<th>Current</th>
<th>Difference</th>
<th>New</th>
<th>Current</th>
<th>Difference</th>
<th>New</th>
<th>Current</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pos., Port 1</td>
<td>-9.050</td>
<td>-7.220</td>
<td>-1.830</td>
<td>8.500</td>
<td>8.500</td>
<td>0.000</td>
<td>-8.153</td>
<td>-8.153</td>
<td>0.000</td>
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<tr>
<td>Pos., Port 3</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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<tr>
<td>Pos., Port 4</td>
<td>3.742</td>
<td>3.800</td>
<td>-0.058</td>
<td>3.958</td>
<td>3.980</td>
<td>-0.022</td>
<td>-23.343</td>
<td>-23.800</td>
<td>0.457</td>
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<tr>
<td>Pos., Ethernet</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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<tr>
<td>Tx Transducer</td>
<td>-3.270</td>
<td>-3.290</td>
<td>0.020</td>
<td>-0.053</td>
<td>-0.040</td>
<td>-0.013</td>
<td>0.803</td>
<td>0.790</td>
<td>0.013</td>
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<tr>
<td>Rx Transducer</td>
<td>1.159</td>
<td>1.120</td>
<td>0.039</td>
<td>-1.225</td>
<td>-1.210</td>
<td>-0.015</td>
<td>0.804</td>
<td>0.770</td>
<td>0.034</td>
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<tr>
<td>Motion Sensor</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
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<tr>
<td>Waterline</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>-6.210</td>
<td>-6.240</td>
<td>0.030</td>
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</table>

### Installation Angles

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<tr>
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<tbody>
<tr>
<td>Tx Transducer</td>
<td>-0.064</td>
<td>0.01</td>
<td>0.074</td>
<td>0.024</td>
<td>0</td>
<td>-0.024</td>
<td>0.026</td>
<td>-0.024</td>
<td>-0.006</td>
</tr>
<tr>
<td>Rx Transducer</td>
<td>-0.092</td>
<td>0.15</td>
<td>0.242</td>
<td>0.044</td>
<td>0.06</td>
<td>0.016</td>
<td>0.046</td>
<td>0.016</td>
<td>0.254</td>
</tr>
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</table>

### Caris HIPS Vessel File (HVF)

The following summarizes the correction values entered into the HVF in order to correct for the horizontal offset errors in positioning of the POS/MV primary antenna (Table 2 – RP to Primary GPS) and the EM 120 positioning system value (Table 4 – EM 120 Sensor Location).

### HVF Offset Corrections (Navigation sensor)

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3.992</td>
<td>-1.830</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Refer to Appendix D for the complete HVF file contents.
OFFSET DIAGRAMS

Position Diagram - Plan View
(Blom survey coordinate system)

Axis units: meters

Position Diagram - Profile View
(Blom survey coordinate system)

Axis units: meters
APPENDIX B – HARDWARE AND SOFTWARE INVENTORY

HARDWARE

The following hardware installed on KILO MOANA was used for survey operations for this project.

**Multibeam**
- Kongsberg Simrad EM 120

**Singlebeam**
- Knudsen Engineering 320B/R

**Positioning and Attitude Sensor**
- Applanix POS/MV 320 V3
- Thales Navigation ADU5 (positioning only)

SOFTWARE

The following software was used during acquisition and processing of survey data for this project.

**Acquisition**
- Kongsberg Simrad Merlin

**Survey Planning**
- SAIC ISS-2000

**Multibeam Processing**
- Caris HIPS and SIPS 5.4 and 6.1
- OMG/UNB SwathEd

**XBT Processing**
- Sippican WinMK21

**CTD Processing**
- SeaBird SeaSoft

**MVP Processing**
- Brook Ocean Technology MVP Controller

**Data Visualization**
- IVS 3D Fledermaus
APPENDIX C – PATCH TEST REPORTS

BACKGROUND

Prior to any survey operations, a calibration, or patch test, must be conducted to determine the calibration errors for the sonar system. These errors include timing, pitch, roll, and heading errors.

For the KM0514 project, one patch test was conducted prior to data collection on each leg of the project. The Kongsberg Simrad Calibration Utility and Caris Calibration Tool were used independently to verify the errors already entered in the system, and correct them if necessary.

Note: It is standard procedure on KILO MOANA to enter offsets and calibration values directly into the Kongsberg Simrad acquisition software, therefore the Caris HIPS Vessel File (HVF) is zeroed for these values (with the exception of horizontal positioning offsets as discussed in this DAPR).

LEG 1 PATCH TEST – JULY 2, 2005 (DN 183)

The patch test for Leg 1 of the project was conducted upon arrival near the project area, just to the west of Hodgkins Seamounts.

Figure 1 – Patch test location for first leg
The first patch test line was run up the southern flank of a seamount at 12 knots. It was followed by a line run down the southern flank at 6 knots. These two lines were used for timing and pitch calibration. The first line, running to the northeast, did not run over the seamount. The second line was therefore offset 10km to the southeast and run to the southwest to find a steep slope. It was run at 6 knots due to the fact that the bridge had taken one engine offline. The results of the timing and pitch test showed that no static offsets were necessary.

Heading bias was examined next. Two parallel lines were run over a channel in the seafloor. The test showed that there was no static heading bias.

Finally, a roll bias test was run over a flat area of the seafloor, with reciprocal lines run at the same speed. A 0.05° roll bias was found, but did not appear to affect the data when applied. As a result, the value was left at 0.00°.

**LEG 2 PATCH TEST – AUGUST 3, 2005 (DN 215)**

The patch test for Leg 2 of the project was conducted upon arrival near the project area, approximately 100nm north of the Surveyor Seamount.

Survey lines were run to confirm the values already entered into the Kongsberg system. Data were acquired and then processed independently with Caris and Kongsberg software.

Two reciprocal lines were run over a locally flat area of seafloor to determine roll bias. A roll bias of 0.10° was found with the Kongsberg software (0.07° with Caris). As a result, the -0.30° bias already entered into the Kongsberg system was adjusted to -0.20°.

Timing and pitch lines were then run across a channel, reciprocal lines at the same speed (10 knots) and on final line at 5 knots. Processing the data through both software packages revealed no change to the entered system values.
APPENDIX D – HIPS VESSEL FILE

Vessel Name: KILO_MOANA_EM120.hvf
Vessel created: August 26, 2005

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2005-121 00:00

Transducer #1:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Unknown
Model: Unknown
Serial Number:

Navigation Sensor:

Time Stamp: 2005-121 00:00

Comments Correction for error in (X) GPS offset and (Y) transducer offset entered in acquisition system.
Latency 0.000
DeltaX: -3.992
DeltaY: -1.830
DeltaZ: 0.000

Manufacturer: (null)
Model: (null)
Serial Number: (null)

Gyro Sensor:

Time Stamp: 2005-121 00:00

Comments (null)
Latency 0.000

Heave Sensor:

Time Stamp: 2005-121 00:00

Comments (null)
Apply No
Latency 0.000
DeltaX:  0.000
DeltaY:  0.000
DeltaZ:  0.000

Manufacturer:  (null)
Model:   (null)
Serial Number:  (null)

Pitch Sensor:

Time Stamp:  2005-121 00:00

Comments (null)
Apply No
Latency 0.000
Pitch offset: 0.000

Manufacturer:  (null)
Model:   (null)
Serial Number:  (null)

Roll Sensor:

Time Stamp:  2005-121 00:00

Comments (null)
Apply No
Latency 0.000
Roll offset: 0.000

Manufacturer:  (null)
Model:   (null)
Serial Number:  (null)

TPE

Time Stamp:  2005-121 00:00

Comments
Offsets

Motion sensing unit to the transducer 1
X Head 1 -0.007
Y Head 1 0.100
Z Head 1 1.235

Motion sensing unit to the transducer 2
X Head 2 0.100
Y Head 2 -7.761
Z Head 2 28.973

Navigation antenna to the transducer 1
X Head 1 -7.761
Y Head 1 -5.278
Z Head 1 28.973
Navigation antenna to the transducer 2
  X Head 2 0.000
  Y Head 2 0.000
  Z Head 2 0.000

Roll offset of transducer number 1 0.000
Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.
Measurement errors: 0.002
Motion sensing unit alignment errors
Gyro:0.050  Pitch:0.050  Roll:0.050
Gyro measurement error: 0.010
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 4.000
Transducer timing error: 0.001
Navigation timing error: 0.001
Gyro timing error: 0.001
Heave timing error: 0.001
PitchTimingStdDev: 0.001
Roll timing error: 0.001
Sound Velocity speed measurement error: 0.500
Surface sound speed measurement error: 0.050
Tide measurement error: 0.010
Tide zoning error: 0.200
Speed over ground measurement error: 0.030
Dynamic loading measurement error: 0.030
Static draft measurement error: 0.050
Delta draft measurement error: 0.010
APPENDIX E – DEVICEMODEL.XML

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  <Operating_Frequency_1 value="12.0"/>
  <Operating_Frequency_2 value="0.0"/>
  <Max_Angle value="75.0"/>
  <Beam_Width_Across value="1.0"/>
  <Beam_Width_Along value="2.0"/>
  <Steering_Angle value="0.0"/>
  <Range_Sampling_Frequency value="400.0"/>
  <Range_Sampling_Distance value="3.750"/>
  <Min_Pulse_Length value="0.015"/>
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    <Attitude value="200"/>
    <Imagery value="10"/>
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  <Density>
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    <Attitude value="100"/>
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    <Steered value="Yes"/>
    <Splithead value="No"/>
    <Bathymetric value="Yes"/>
    <Imagery value="Yes"/>
    <Attitude value="Yes"/>
  </DeviceProperties>
</SonarModel>
APPENDIX F – EQUIPMENT SPECIFICATIONS AND CALIBRATIONS

Please see the Separates folder included with the digital data for this survey.