

FLEET SURVEY TEAM: PROVIDING OPERATIONAL HYDROGRAPHY TO THE U.S. NAVY

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Abstract-Established in 2005, the U.S. Navy Fleet Survey Team (FST) is an organization that enables Theater combatant commanders worldwide with access in the littoral regions through operational hydrography. When forces are armed with detailed descriptions of the environmental conditions they could face, operations have a greater chance of being safely and efficiently executed. FST gathers the needed information via timely, self-contained hydrographic surveys in response to combatant commanders' requests. These requests frequently are for harbor, beach, or river areas where Navy operations will take place or where charting accuracy is uncertain. FST members (both civilian and military) quickly deploy to areas around the world outfitted with equipment to perform surveys from various boats of opportunity or from their own Rigid Hull Inflatable Boats (RHIBs) and personal water craft. Because of these unique capabilities, civilian and military members of FST have deployed to areas in the Middle East, Africa, and South America to perform near-shore surveys to collect data that aid in the safe navigation of U.S. forces and supplies traversing the area. FST members have also played significant roles in charting areas affected by natural disasters such as the 2004 south Asia tsunami and hurricanes Katrina, Rita, Gustav, and Ike in the Gulf of Mexico.

Comprised of approximately 65 military and civilian members, FST is collocated with the Naval Oceanographic Office and Commander, Naval Meteorology and Oceanography Command, at Stennis Space Center, Mississippi. Command personnel possess a unique blend of military and civilian knowledge and experience. Enlisted sailors routinely qualify as level-two military hydrographers, certifying their skills in addition to their Navy Meteorology and Oceanography (METOC) training. In addition to their strong backgrounds in math, science, and engineering, officers and civilians frequently obtain master's degrees in hydrographic science through an ongoing program with The University of Southern Mississippi, which offers an accredited course by the International Hydrographic Organization (IHO) for Category A hydrographers.

I. INTRODUCTION

As the United States Navy continues to operate around the world in coastal, littoral, and river areas, its needs to sufficiently characterize water depths for safety of navigation are ever growing. Too frequently, ships, submarines, and landing craft are restricted in operations, or worse, run aground due to inaccurate or incomplete nautical charts. Being able to measure and chart water depths, hazards, and aids to navigation in a tactical environment is a key enabler to success of maritime missions. Additionally, because of the universal core competency of maritime navigation to all coastal nations, hydrography and nautical charting are common scientific disciplines for building relationships among nations worldwide. This need for operational hydrography in the form of rapid response surveys and international engagement has set the stage for the successful establishment and development of the U.S. Navy Fleet Survey Team (FST) based at Stennis Space Center, Mississippi.

Hydrography, that branch of applied science that deals with the measurement and description of the physical features of the navigable portion of the earth's surface and adjoining coastal areas with special reference to their use for the purpose of navigation [1], has been an essential element of national safety, security, and commerce throughout history. Like maps over land, nautical charts not only provide mariners safe routes to navigate, but also depict a nation's ability to promote safe and efficient commerce, recreation, coastal management, and security within its waters. In the digital age, the importance of hydrography has increased with advances in technology due to the relative ease and openness of sharing information. However, data sharing comes with the financial and intellectual cost of collection, as well as the potential vulnerability of denied access to updated information. Hence, the need for a national capability to conduct hydrographic surveys is a key enabler to maritime safety and security.

II. HISTORY

The U.S. Navy has been in the hydrography business for many years. The Naval Oceanographic Office (NAVOCEANO) at Stennis Space Center, Mississippi, evolved originally from the Depot of Charts and Instruments, established during the mid-1800's to support the Navy's international operations. As the technology of hydrography also evolved from sextants and lead lines to acoustic echo sounders and satellite positioning, so too has NAVOCEANO advanced from hand-drawn charts to digital

databases from which a vast array of maritime geospatial information products can be produced. Whereas the Office of Coast Survey of the National Oceanic and Atmospheric Administration and the United States Army Corps of Engineers are responsible for surveying and charting U.S. coast and inland waters, respectively, it is the responsibility of the National Geospatial-Intelligence Agency (NGA) to provide worldwide nautical charts to the Department of Defense and other government agencies. Because NGA does not have its own capability to collect hydrographic information, NAVOCEANO is a primary provider of new charting data. In the past 50 years, NAVOCEANO's civilian and military personnel have conducted countless survey projects across all regions to update nautical charts for the Fleet. In places like Central and South America, the Balkans, the Far East, the Middle East, as well as the coasts and rivers of the Vietnam conflict, NAVOCEANO has mapped the seafloor to ensure U.S. and coalition ships have the most updated navigation information. Along the way, NAVOCEANO, with its principally civilian survey crews, has also built solid relationships and formal partnerships with more than 40 countries worldwide to collect hydrographic data within the territorial seas of the respective countries. This survey program, the Hydrographic Cooperation Program (HYCOOP), evolved to provide a persistent, international presence around the world, along with roughly one-half dozen NAVOCEANO survey ships conducting coastal surveying.

In 1999 and 2000, as the U.S. Navy strategy shifted more to littoral, expeditionary focus, the leadership in the Naval Oceanography community recognized the need for a rapid-response, self-contained, deployable teams to collect data and provide navigation-quality, on-scene hydrographic products in a shallow water environment. A cadre of military officers and HYCOOP civilians were enrolled in the newly formed University of Southern Mississippi (USM) Hydrographic Master of Science program to educate them in the science and latest technology of hydrography, geodesy, and geospatial information systems providing International Hydrographic Organization's (IHO) Category A Hydrographer academic certification. By 2005, FST was commissioned as a subordinate command of NAVOCEANO and was manned with Navy officers and enlisted and civilian personnel with the mission to conduct hydrographic surveys in support of Navy and Marine Corps global operations.

III. MANNING

Building on the foundations and surveying lessons learned from the Naval Oceanographic Office and the Hydrographic Cooperation Program, FST manned, trained, and equipped itself to fulfill its mission. Before being commissioned as a command, FST manning was first comprised of junior officers at the Lieutenant Commander level and below, plus enlisted quartermaster and supply specialists. The HYCOOP civil service physical scientists, most of whom are educated in geography, math, geology, chemistry, and engineering disciplines, merged with the military members to provide long-term expertise and continuity to the team. To provide the command with survey technicians and boat coxswains, enlisted personnel were also added to the command. Additionally, NAVOCEANO supplied civilian specialized electronics technicians who are familiar with the complex hydrographic equipment. Today, 65 personnel comprise FST, with only five non-survey positions for command sustainment; the remaining billets routinely deploy 30-60 days at a time, two to three times per year, for port and harbor navigation surveys. For beach or river surveys that are smaller in scope, teams deploy two to three weeks at a time with as little as 96 hours lead time before departure.

IV. TRAINING

Training for FST personnel is based on IHO standards and Navy professional development. The FST officers and enlisted personnel are Navy Oceanographers and Aerographers Mates as part of the Naval Meteorology and Oceanography Command organization. This composition is advantageous for controlling billets and managing training, but because enlisted rate training is largely based on weather and oceanographic functions such as weather and ocean forecasting, hydrographic training has been locally developed and administered at additional overhead to the organization. Along with the USM Master's in Hydrographic Science program, NAVOCEANO and FST conduct a nine-week apprentice hydrographer course. The FST also conducts the International Hydrographic Management and Engineering Program (IHMEP), which is a six-month, IHO-accredited apprentice course designed for junior officers from both the U.S. and international navies. For the junior enlisted personnel, weekly on-the-job training is conducted based on the apprentice hydrographer curriculum that leads toward survey technician and boat coxswain qualifications. Written exams and oral boards are held within the command to qualify personnel for various positions.

V. EQUIPMENT

The equipment used in hydrography is cutting edge and always evolving. The rapid-response, worldwide nature of its mission requires FST to stay current with the latest commercial hydrographic equipment because the U.S. Navy does not maintain any government-developed hydrographic gear. In the past 8-10 years, with the advent of highly accuracy Differential Global Satellite Positioning (DGPS), compact multibeam echo sounders, highly capable motion compensation units, and small, lightweight digital side scan systems, navigation-grade surveys using bolt-on gear on faster, smaller boats have been possible. This equipment has been key to FST's operational mission success. The decimeter accuracy of real-time satellite-provided differential corrections, called Real Time Gypsy, has alleviated the need for long dwell time at geodetic base stations and complicated radio transmitters.

Moreover, the small size of the NAVCOM receivers and antennas (Fig. 1) has enabled FST to build “fly-away” kits that can be easily transported by surveyors as baggage on commercial airline flights to reduce the response time for contingency requirements such as disaster relief after hurricanes/typhoons or short-fuse port visits. Recent commercial advances in dual-frequency digital processing has reduced the size and weight of side scan tow bodies so that they are also easily man-portable and transported as baggage on commercial passenger flights (Fig. 2).

To meet the needs of amphibious and special warfare customers, FST partnered with the Naval Research Laboratory, Stennis Space Center, Mississippi, to develop a very shallow water survey capability using personal water craft. The FST currently has four of these craft, formally called Expeditionary Survey Vehicles (ESV), rigged with commercial fishing-based single beam echo sounder and side scan sonar. The ESVs are used to conduct surf zone hydrographic surveys for Fleet landing craft such as LCUs, Mike boats, etc. (Fig. 3). The shallow draft and maneuverability of personal water craft make them well suited for this application, although the sounding accuracy is highly susceptible to the craft’s motion in surf or to air bubbles and particulates in the water column. Using developed techniques such as collecting data only on the inbound survey lines, surveying during minimal sea state periods, and utilizing high-frequency GPS observations (25 Hz), FST is able to minimize the noise in sounding and side scan data, resulting in suitable non-charting-level products that are of great value to beach master units for planning and executing safe ship to shore movement. The FST has conducted expeditionary surveys using ESVs on both U.S. coasts for exercises, as well as in Central America for the Navy’s Operation Continuing Promise 2008, at which landing craft were used to bring doctors, dentists, and engineers and their material ashore to assist countries such as El Salvador, Guatemala, and Peru. The ESVs represent FST’s aggressive implementation of cutting-edge commercial technology for military applications.

For traditional port and harbor surveys, FST utilizes commercial Rigid Hull Inflatable Boat (RHIB) vessels that are configured with survey grade DGPS, single-beam and multi-beam echo sounders, and side scan sonar (Fig. 4). The FST currently has three of these vessels, which are usually transported worldwide by U.S. Navy C-130 cargo aircraft. The boats are configured to fit inside military aircraft and can be easily assembled by the four to six personnel that accompany the boats on missions. These RHIBs can complete a typical port survey within 30-45 days and operate to 12 nautical miles from shore and in maximum 50-200 meters depth, depending on side scan or multi-beam sonar use. The FST has been using RHIBs for more than five years and has perfected the placement of sonar and motion compensation systems to enable IHO Order 1 or even Special Order data collection. The FST and NAVOCEANO electronics technicians rig, operate, and maintain the vessels with occasional higher order maintenance performed by local marine service stations.

VI. PRODUCTS AND SERVICES

The products provided by FST vary and are tailored to customer needs. The principal product is a Smooth Sheet, a hydrographic industry-standard large-format paper media that displays soundings, shoreline, and aids and hazards to navigation that were collected or verified during a survey. It is not designed to be a navigation product. Although the evolution of digital products has lessened the use of Smooth Sheets, many of the underdeveloped countries expect hard-copy products when FST conducts surveys in their waters. Another product that FST can provide is a Field Chart. The Field Chart has the look and feel of a standard nautical chart, but it is designed to be used only as an interim navigation chart by U.S. Fleet ships and craft for a specific exercise or operation. It is not supported by Notice to Mariners updates, so its distribution is limited to specific customers only. For beach and river areas, FST produces graphics with soundings overlaid on overhead imagery provided by NAVOCEANO that depict water and land features valuable for landing craft planning. Other products include beach survey reports, photography, and tide tables. One of the newest formats adapted by NAVOCEANO for product delivery is the georectified PDF, which utilizes the widely available commercial Adobe Acrobat reader to display geographically accurate maps



Fig. 1 NAVCOM DGPS receiver and antenna.



Fig. 2 EdgeTech 4125 side scan sonar.



Fig. 3 Expeditionary Survey Vehicle.



Fig. 4. Rigid Hull Inflatable Boat.

and imagery overlaid with survey data. The improved functionality over text or slide show graphics (e.g., Microsoft PowerPoint) and widespread access to PDF files have been invaluable to Fleet customers.

The services provided by FST through operational hydrography directly contribute to international engagement. Partnerships through hydrographic surveys are directly related to U.S. Theater Combatant Commanders and their respective Naval Components Theater Security Cooperation (TSC) initiatives. By identifying emerging countries with which to foster partnerships that develop maritime geospatial information (e.g., charting) capabilities in a country, the United States can effectively shape and influence the international maritime safety and security environment, as well as assist countries with their own navigation needs. The FST's ongoing hydrographic surveys in West Africa, including Ghana, Congo, Sao Tome and Principe, Cameroon, Nigeria, Angola, and Gabon, have directly supported Africa Command's TSC objectives and emerging maritime security partnerships.

In addition to hydrographic surveys, FST's presence encourages growth of hydrographic capacity through mobile training teams and coordination of formal education opportunities for nations to build their organic capability. Through the NAVOCEANO and FST hydrography Mobile Training Teams (MTT), the University of Southern Mississippi Master's in Hydrographic Science program, and the Hydrographic Science and the International Hydrographic Management and Engineering Program, a partner nation can increase its knowledge for safe navigation. Once a hydrographic capability has matured in a country, data exchange agreements and subject matter expert exchanges ensure continued sharing of navigation information. The end result is a global maritime partner that collects accurate data and networks information for safe navigation, as well as greater maritime security for both the U.S. and partner nation.

VII. CONCLUSION

The Fleet Survey Team is an organization that directly supports safe navigation of U.S. and partner nation ships, submarines, and landing craft through hydrographic surveys to update nautical charts. The universal need by maritime nations to provide accurate and up-to-date nautical charts makes the science of hydrography important to all maritime nations and forms a common basis for cooperation. The FST is uniquely manned, trained, and equipped to conduct navigation and expeditionary surveys around the world—providing operational hydrography to minimize the risk to the warfighter.

REFERENCES

- [1] International Hydrographic Organization, "Hydrographic Dictionary," Special Publication No. 32, Part I, Volume I, Fifth Edition, Monaco, 1994.