HANDS-ON

The Newsletter of JMS Naval Architects & Salvage Engineers

2006 Volume 13.1

NTSB Forensic Engineering Analysis of *Ethan Allen*

JMS recently completed a rigorous examination into the cause of the Ethan Allen *tour boat tragedy for the NTSB. Above is a snap shot from the computer animation JMS developed for the public hearing.*

ENGINEERING & DESIGN

On October 2, 2005 the passenger vessel *Ethan Allen* capsized while touring Lake George with 47 passengers and one crewmember on board. After remaining inverted on the surface for a short period, the vessel subsequently sank. The master and 27 passengers survived. Twenty passengers died. According to numerous eyewitnesses on and near the vessel during the time of the accident, no obvious adverse weather, sea conditions, equipment failures or operator errors appeared to cause the capsize. Since the vessel operated only on Lake George, it was not required to be inspected by the U.S. Coast Guard. *Continued on page 2...*

A snap shot from the Infra-Red video captured by the USCG during a dramatic midnight rescue mission to save the crew of a sinking tug. See page 4, "Tug Tragedy Offers Lessons in Stability".

Letter from the President

Dear Readers,

This year's newsletter reflects the busy pace at JMS over the past year. Our naval architects have spent as much time inside the bilges of ships as they have in front of computers. The work has been diverse as is the increasing number customers who rely on us. The common thread through all of our projects is that we provide ship operators and builders with technical engineering solutions with a "hands-on" approach.

I hope our record demonstrates that we strive to provide the most reliable and highest quality service in the marine industry.

Although we are proud of our past results we realize that our success depends on our ability to back up our reputation with real results that bring value to our customers every day. Whether it is engineering, marine surveying, diving support, or marine science, we are committed to a process of continuous improvement in the services we provide.

Only a representative sample of projects is provided here. I hope you find them of interest and I encourage you to send me your comments. Contact me at jack@jmsnet.com or (860) 448-4850, ext. 12.

Regards,

Capt. Jack Ringelberg

Also inside...

ENGINEERING *continued...*

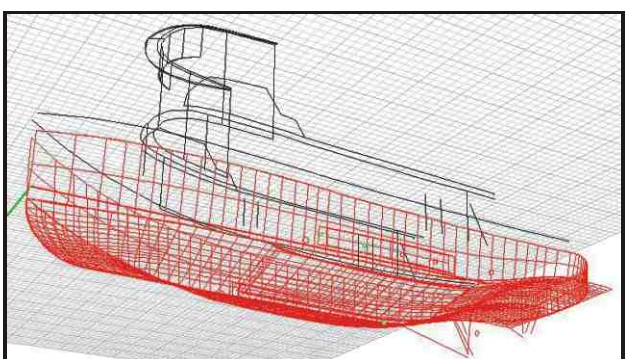
The National Transportation Safety Board selected JMS Naval Architects & Salvage Engineers to perform a detailed intact stability analysis on the design, configuration and passenger loading of the *Ethan Allen* to aid their investigation into the probable cause.

Ethan Allen is a Dyer 40 fiberglass mono-hull design built in 1964. The design has been in production since 1960 in a variety of configurations including tour boats similar to the *Ethan Allen*. JMS validated available engineering drawings, lines plans and previous stability calculations performed on the vessel. Many of those plans and calculations were discovered to be inconsistent, inaccurate and therefore unreliable. In order to develop an accurate hull form for the vessel, a detailed laser survey was completed to produce a three dimensional computer model of the hull to be used for the analysis.

During her 41 years of operation, the *Ethan Allen* was modified several times with protective canopies over the passenger area without any reassessment of its stability. JMS calculated the maximum allowable passenger loading for the each of the configurations and determined that the vessel would have been permitted to carry only 14 passengers based on U.S. Coast Guard stability criteria. A dynamic analysis was also conducted to study the effects of a passing wave and shifting passenger weight. This involved a roll sensitivity study to provide insight into the vessel's response characteristics under varying conditions.

Using the results of JMS' analysis, the NTSB determined that the probable cause of the capsizing was the vessel's insufficient stability to resist the combined forces of a passing wave or waves, a sharp turn, and the resulting involuntary movement of passengers. The study underscored inadequacies in the existing stability standards for small passenger vessels and inconsistencies in how these vessels are regulated when they are not under U.S. Coast Guard jurisdiction. As a result of this and other recent small passenger vessel incidents, the Coast Guard is reassessing the potential consequences of revising stability regulations for all domestic passenger vessels to account for increased passenger and vessel weight.

JMS also developed a computer animation recreating the accident event and to help explain the technical aspects of this accident. The animation is based on the technical results of the JMS report as well as survivor and eyewitness accounts. Images from the animations can be found here: www.jmsnet.com/ethan_allen.htm.



The tug Davis Sea *ready for inclining. The hydrostatic model is developed after laser measurement.*

Links to the NTSB final report, presentations and web cast from the public hearing on 25 July 2006 can be found here: www.ntsb.gov/Events/Boardmeeting.htm#.

JMS performed similar work for the NTSB in 1999 on the Arkansas DUKW Tour Boat *Miss Majestic* accident. More information can be found here: www.jmsnet.com/dukw.htm.

Inclining Tests and Laser Measurement

JMS has been active conducting stability tests for a wide variety of ship types. Stability tests have been conducted aboard tugs, sailing vessels, research vessels, and amphibious passenger vessels this past year. In many cases the vessels are older and undergoing major modification.

<u>K-SEA Transportation</u>
77ft tugboat *Davis Sea*
94ft tugboat *Houma*

<u>Great Lake Science Center</u>
65ft research vessel *Kaho*

<u>Yankee Sailing</u>
43ft sailing vessel *Yankee*

<u>Boston Duck Tours</u>
31ft amphibious DUKW tour boat

<u>Allied Transportation</u>
120ft tug *Falcon*

These older vessels often do not have vessel plans to work from. To create a computer model of the hull, JMS has been using laser measurement with much success. It is far more accurate and efficient than manually measuring complex hulls. The laser measures up to 50,000 data points and imports them into a 3D modeling and analysis program. A surface is fit through the points to create the shape of the hull.

Another technology JMS has been employing is the use of a clinometer instead of the traditional pendulum to measure heel angles during inclining tests. The clinometer measures roll and pitch angles relative to the vertical gravity vector more accurately than the traditional pendulum and batten arrangement. The sensing element is a glass vial half-filled with a conductive liquid. When the sensor is level, fluid covers five internal electrodes to equal depth. When the sensor tilts, the depth of fluid on each electrode changes, altering the electrical resistance between matched pairs of electrodes.

As accurate as it gets. The tour boat Ethan Allen *laser measured at Lake George, NY.*

Inclining Experiments; Time for an Upgrade?

Inclining experiments have long been used by Naval Architects and ship builders to accurately determine the light-ship vertical center of gravity for vessels. By moving an onboard weight a known transverse distance and precisely measuring the resulting angle of heel, the metacentric height (GM) and then the center of gravity (KG) of the vessel can be calculated. Knowing the KG is essential to determining a vessel's stability.

Adequate stability prevents capsizing. As a US Coast Guard safety requirement, stability must be determined for new vessels and re-established for vessels experiencing significant weight changes from major upgrades or modifications.

It has been generally accepted that a pendulum is the easiest and most accurate device to measure a resulting heel angle. By suspending a pendulum and measuring its horizontal (transverse) displacement, the heel angle of the ship can be obtained using simple trigonometry. While in theory this system seems simple and accurate, in reality there is room for improvement. Coast Guard guidelines require that pendulums have a displacement of at least 6 inches for accurate measurement. This coupled with the stipulation that heel angles not exceed four degrees, leads to a minimum pendulum length of 7'2". The guidelines recommend using a 10' pendulum. On smaller vessels this presents a problem locating a weather sheltered place to hang a pendulum of this length. Reading pendulums accurately becomes a problem because a ship is never fully at rest. The person reading the displacement is forced to "eyeball" the center of the oscillation as the true displacement. Wind can often bend or arc the pendulum line, creating more uncertainty in the reading.

JMS has found that the best solution to these problems is found in an electronic device known as a clinometer. Given the evolution of electronics, it seems rudimentary that inclining experiments are still being measured the same way they were 100 years ago. Digital clinometers now measure inclining heel angles with greater accuracy than reading traditional weighted pendulums. Uncontrollable environmental forces wind, current and waves, all cause the ship oscillations. These oscillations can be filtered out using the new electronic instrumentation. There are several other advantages beyond improved accuracy. Less man power is required to perform the inclining test, set up is quicker than pendulum set up, finding adequate space to set up is much easier, and a clinometer also measures the trim angle simultaneously.

These devices connect directly to a laptop and display angles about transverse and longitudinal axes. The user can choose an output data rate up to 10 readings per second. The program also displays graphs to help monitor ship oscillations. Taking data at an output rate of 10 per second over an interval of 5 to 10 seconds and then averaging, results in accurate measurements of the static heel angle. This also does a particularly good job at minimizing dynamic effects as the center of the oscillating sinusoidal wave is readily apparent.

Tug Launching

Mammoet Canada Eastern Ltd has contracted JMS to provide engineering support for a complex launching operation of an ATB tug being constructed for U.S. Shipping. The 12,000 HP tug is 150 feet long and weighs over 1,000 long tons.

JMS worked closely with Mammoet to develop a cradle design to be used with the heavy lift hydraulic transporters. The transporters that will be used for the operation presented unique challenges to the design of the cradle which is comprised of a series of individual saddles. These saddles are positioned along each side of the vessel and designed to tie together the principal structure of the tug with the structure of the transporters. The saddles will be cut free of the vessel once it is has been transported to the launching barge.

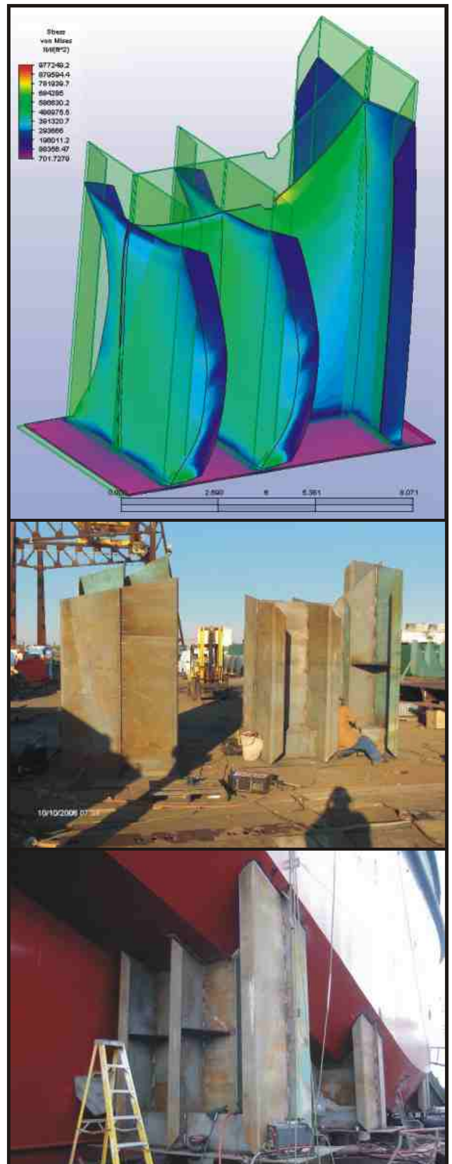
With the structural plans for the newly fabricated tug and the input provided by Mammoet regarding the anticipated loadout procedure, JMS developed a 3D model for each saddle. The models were then imported into a finite element analysis software package. Loads were derived based upon the information regarding the loadout schedule and a series of checks were performed. Further, these saddles are to be used for jacking points in the first and final phase of the loadout. This will result in higher loads for these eight saddles than the remaining eight saddles. The scantlings for these saddles were necessarily adjusted to reflect the increased stresses associated with the jacking operation.

Tug to be moved and then launched with JMS designed 'saddles'.

Ship Structures Committee

JMS has been tasked with revising the educational section of the Ship Structures Committee (SSC) website: www.shipstructure.org/case_studies.shtml.

The educational case studies section of the SSC website was developed by JMS in April 2000. The goal of the site is to increase appreciation of structural issues that are unique to the shipbuilding industry and provide a forum for the dissemination of information to universities and practicing naval architects. However, the



Top: Finite Element Analysis (FEA) model of tug support cradles designed by JMS for Mammoet.
Center: Saddles under construction.
Bottom: Saddles installed on the tug.

Other Engineering Projects

Naval architecture remains our core service and we have been involved in a variety of projects for an ever-increasing customer base this past year. In addition to those discussed in this newsletter, the following is a sampling of a few projects recently completed or currently underway.

Customer	Project
ABS Marine Casualty Response Center	• Non-tank vessel salvage engineering computer modeling
AGM Construction	• Crane barge load charts
Allied Transportation	• Tug *Falcon* inclining test
Bermuda Biological Station for Research	• Research vessel survey
Blount Boats, Inc.	• Passenger and vehicle ferry design and plan review
Boston Duck Tours	• DUKW stability analysis
Cetacean Marine	• *R/V Lake Guardian* repowering support
Chester Marine	• Push boat rudder modification
Crofton Industries	• Crane barge load charts
Connecticut DEP	• *R/V John Dempsey* bow thruster design and specification
Dominica Maritime Registry	• Admeasurement survey
Erie Petroleum	• Response plans
K-Sea Transportation	• Tug *Houma* inclining test and stability analysis
	• Tug *Davis Sea* Inclining test and stability analysis
Field Support Services	• Passenger vessel gear failure analysis
Great Lakes Towing	• AWO Responsible Carrier Program audit
	• Research vessel inclining test and stability analysis
Puerto Rico Towing	• Tug admeasurement survey
K-Sea Transportation	• Tug pilot house design
Mammoet	• 12,000 hp tug launching support
Maritrans	• Tank barge fleet computer loading program support
Mass Fabrication & Welding	• Barge design Edgewater
	• Salem pier h-14 barge design
	• Salem wharf h-17 barge design
	• Expert witness for barge design
	• Scallop vessel admeasurement survey
NOAA	• ME-70 multibeam sonar *FSV Bigelow*
	• Acceptance trials *FSV Bigelow*
NSF	• Fleet research vessel surveys
Osiris	• SWATH research vessel survey and shipyard specification
Poling & Cutler Marine Transportation	• Double hull tank barge concept design
	• Tank vessel stranding marine casualty response
	• AWO Responsible Carrier Program audit
	• Tank vessel structural analysis
Puerto Rico Towing	• AWO Responsible Carrier Program audit
Reinauer Transportation	• Tug inclining test and stability analysis
	• Benzene stability analysis
	• Tank vessel structural analysis
	• Tug structural repairs
	• Double hull tank barge feasibility
	• Tank barge generator room modifications
	• Tank barge fire damage repair plan
	• Tank barge fleet computer loading program support
	• Tank barge piping modifications
	• Tug mooring bitt design and modification
	• Tank barge deck house design
	• Tug propeller nozzle design and repair plan
	• Tank vessel structural analysis
Sandy Hook Pilots	• Pilot boat lifeboat davit design
Seapony	• Small passenger vessel stability analysis
SeaBoats	• Tank vessel structural analysis
University of Delaware	• Research vessel survey
USAA	• Damage claim survey
US Army Corps of Engineers	• Dredge stability review
US Geological Survey	• Research vessel repair oversight
	• Fleet safety management system review
	• Research vessel accident investigation and repair plan
WF Magann	• Crane barge design
Yankee Sailing	• Sailboat inclining test and stability analysis

website has not been updated in 5 years. Particular "failure" incidents are continuing, form a predictable pattern in some cases, and further, seem preventable in various ways. The following case studies are examples of the technical issues being pursued for inclusion in the educational case studies section of the SSC website:

MSC CARLA, a containership that was midbody lengthened, failed and broke in two in the modified area.

Examination of the oil tanker *Prestige* that failed and broke in two off the coast of Spain.

Structural failures of SWATH vessels

Double hulling of existing, older single hull tank barges. Some recurring stress fractures and structural weakening have been discovered and repaired repeatedly on some designs.

Patterns in bulker designs that are repeatedly leading to failures. Over one hundred bulkers have failed over the past decade resulting in over 300 lives lost.

If you are interested in being a contributor, please contact Susan Salancy: susan@jmsnet.com.

MARINE CASUALTY RESPONSE

Tug Tragedy Offers Lessons in Stability

Incident

At 2am on 18 January 2006 JMS received an emergency call from one of their ERnet member companies requesting salvage engineering response assistance for their 135,000 barrel double hull tank barge. The fully loaded barge was being towed by a 6,000 HP tug in heavy seas off the coast of North Carolina. Just a few hours earlier, the tug crew had radioed the Coast Guard that their tug was listing heavily and urgently needed help and possibly rescue. The USCG dispatched a search & rescue helicopter and an airplane equipped with Infra-red camera. Another tug was local and responded to assist the USCG rescue efforts. By the time JMS was notified, the tug crew had set the barge adrift and was 12 miles from its tug heading towards shallow water at 0.8 knots. JMS employees responded immediately and arrived at the JMS offices to begin preparations for salvage engineering response.

Using JMS' HECSALV computer model for the barge JMS began preparing for engineering responses to various potential grounding scenarios.

At approximately 3am the Coast Guard reported that the tug had sunk and that some of its crew members had not survived.

The tug that was assisting the Coast Guard rescue efforts was no longer required at the scene and was immediately redeployed to retrieve the drifting barge. A Coast Guard helicopter was also sent and placed 3 of their personnel on board the barge to attempt a connection of the barge's dragging tow wire to the tug. After numerous tries and a close pass by a lighthouse, the connection was finally made and the barge safely under tow by 2pm. Remarkably, the fully loaded barge had suffered no damage.

Aftermath

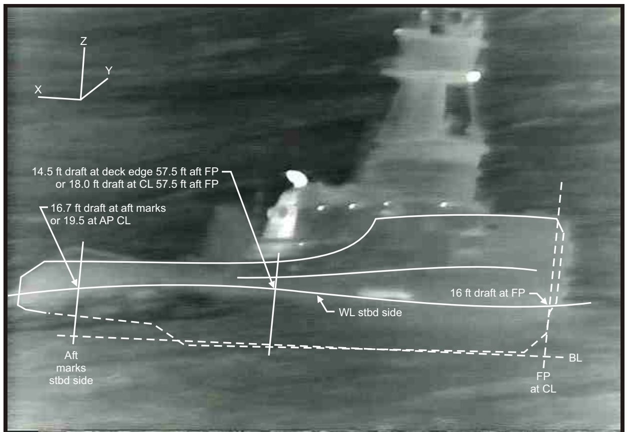
JMS has assisted the vessel owner with an exhaustive investigation into the cause of the casualty. JMS was asked to conduct a complete engineering analysis of the tug design, vessel equipment, and operational procedures.

The vessel owner's leadership and management should be applauded for their completely unselfish and extraordinary efforts. “Not only did we owe this to the surviving crew members, and to the families of those who didn't survive, we owe it to every crew member of every boat we have out there working today” said the vessel operator. “We want to make sure we aren't doing something wrong operationally and don't know it…or if we have a tug design that may be unsafe in some way.”

JMS began their work by building a detailed and accurate computer model of the tug in HECSALV, a computer program built specifically for salvage engineering response. The tug model was built using as-built vessel drawings and data gathered during two ship visits to the vessel operator's facility. A thorough survey of a sister vessel was conducted and JMS participated in interviews conducted by the vessel operator with the surviving vessel master and crew. During the on-site visits JMS studied crew procedures, maintenance and vessel operating procedures, equipment and piping system arrangements for ballast, fuel and fresh water.

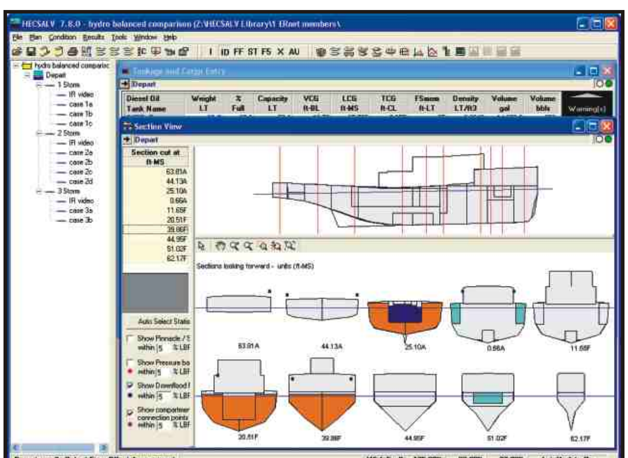
Once an accurate HECSALV computer model was developed it was used to calculate the stability characteristics of the tug before and during the incident. JMS began the stability analysis by recreating the departure load condition and burn-off condition just prior to when the master noticed the vessel beginning to heel. The HECSALV model seemed to perform well compared to the actual tug as reported by the crew under these loading scenarios. With this reliable baseline established JMS began to examine various intact loading and damage flooding scenarios.

The crew reports could not offer a complete picture of the event or an accurate assessment of the condition of the tug. There were still a number of critical pieces of information missing. The HECSALV model would need to be used to examine nearly all possible combinations of ballast and damage flooding scenarios in order to recreate the vessel's condition during the incident.



Measurements taken to determine degrees of heel and trim from Coast Guard IR video of tug casualty.

Fortunately, the Coast Guard recorded an Infra-Red video of the final 40 minutes of the incident. The video was invaluable in validating testimony regarding the attitude of the vessel and the degree of vessel heel and trim. But even the IR video proved a challenge to measure. The often blurry video was recorded at night, from a circling plane, of a pitching and rolling vessel, during a storm, with heavy seas and no visible horizon. The degree of accuracy for measurements of heel taken from the video was very coarse.



HECSALV model of tug undergoing salvage engineering analysis.

The video did provide clues to the naked eye of where the center of rotation generally was located and the drafts of the vessel could be measured with a reasonable degree of accuracy. With these external measurements, JMS could begin to create 'what-if' loading conditions with various fuel, fresh water and ballast distributions and various flooded compartment conditions.

After creating and examining hundreds intact and damaged conditions, JMS narrowed the list to a handful of likely scenarios that produce results similar to the vessel's performance during the sinking sequence.

The intent of the examination ultimately was to prevent a similar occurrence from happening again. Although no definitive conclusions several lessons learned have already been identified. It is critical that vessel masters maintain an accurate accounting of all liquid loads and significant deadweight items on board at all times. Tank level indicators should be installed on all tanks to allow real-time reading of actual tank quantities. Accurate draft recording should also be made as well as checking for load line submergence prior to departure. If a vessel is already fully loaded before having listing problems, don't add more ballast to attempt to correct the list. Both masters and crew should have a certain level of understanding of vessel stability.

Situational awareness is also critical. If the vessel is not acting normally, report it to the master immediately, who in turn should report it to their shoreside naval architects. Detailed and accurate HECSALV models should be built and tested before something happens. These tests may reveal sensitive stability characteristics in a vessel design or under certain loading or operational situations. And of course, a HECSALV model may be needed in the middle of the night when there is no time to build one from scratch.

VESSEL OPERATIONS SUPPORT AND MARINE SURVEYS

Research Vessel Support

JMS has successfully completed a variety of research vessel projects this year. JMS has unique qualifications related to research vessels for surveying, naval architecture, and marine engineering projects. JMS understands the importance of defining science mission requirements of the vessel and balancing them with the operational, regulatory, and budget requirements. JMS also recognizes that the sea going scientist is the end customer and the ship systems must ensure that the vessel can serve the science mission effectively and safely. Our ability to relate to vessel crews as well as the sea-going scientists is an important aspect of providing the most comprehensive service.

R/V Atlantic Explorer *inspection.*


Japanese built SWATH research vessel survey.

National Science Foundation

This past year, JMS was awarded a contract to conduct vessel inspections of the UNOLS research fleet on behalf of the National Science Foundation. JMS has conducted over 70 of these inspections during the past 10 years and has successfully recompeted the contract on two occasions. UNOLS is a consortium of 64 academic institutions with significant marine science research programs that either operate or use the U.S. academic research fleet. The research vessels in the UNOLS fleet stand as the largest fleet of oceanographic research vessels in the world. JMS reviews the safety procedures for vessel operations and science evolutions including weight handling, laboratory arrangement, data acquisition, sensor deployment, and shipboard engineering systems. In addition to an assessment of the ships' ability to conduct science missions, the inspection encompasses hull, mechanical and electrical systems, safety equipment, oceanographic mission support systems, and deck machinery systems. The vessels were surveyed underway in an operational environment observing performance of the vessel's deck machinery, and navigational equipment, and testing propulsion power machinery. Emergency drills are also conducted during the underway phase.

In addition to several vessel inspections for NSF, JMS also conducted vessel safety assessments for the Bermuda Biological Station for Research (*R/V Atlantic Explorer*) and the University of Delaware (*R/V Hugh Sharp*) this past year. The 168 foot *R/V Atlantic Explorer* replaces BBSR's older vessel the *R/V Weatherbird II*. Its research efforts will take place primarily off the coast of Bermuda and range throughout the Atlantic Ocean and into the Caribbean. The 146 foot, diesel-electric, *R/V Sharp* is a general purpose Oceanographic Research vessel designed to have a low radiated noise signature meeting standards based on the hearing ability of fish so that the ship itself does not influence the behavior of the fish being studied.

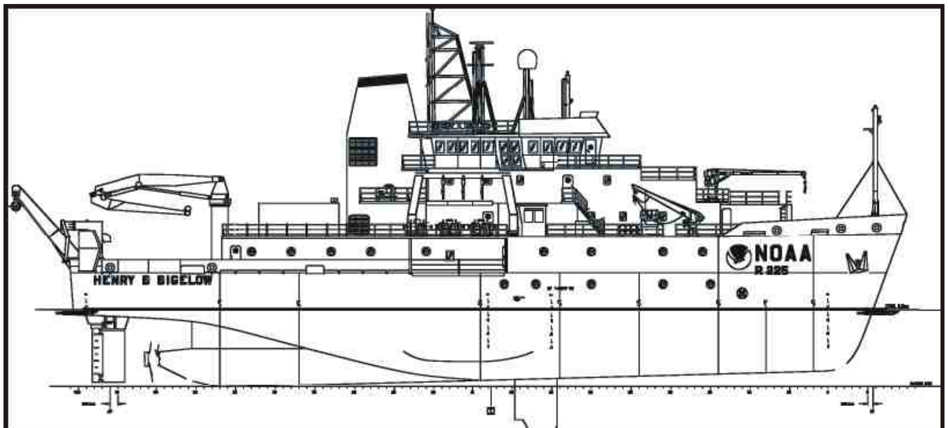
U.S. Geological Survey

This past year, the U.S. Geological Survey (Department of the Interior) contracted JMS to conduct a safety management review of their research vessel operations. JMS previously performed a comprehensive assessment of the research vessel fleet and provided documented condition reports to be used to evaluate the state of each vessel and its funding needs in order to maintain an advanced state of readiness for meeting the scientific research objectives of USGS. As a result of the assessments, JMS recommended the development of USGS policy to address the management and utilization of its research vessel fleet to better ensure safety at sea, prevent the occurrence of human injury or loss of life, and avoid environmental and property damage.

Other research vessel projects JMS has been involved with this past year include:

- Design laboratory modifications and provide engineering support for repowering the 180 foot *R/V Lake Guardian*.
- Survey of Small Waterplane Area Twin Hull [SWATH] Japanese research vessel.
- Provide project management, engineering, and shipyard support for NOAA's fisheries vessel, *FSV Bigelow*.
- Conduct inclining tests and stability assessments of the research vessels *R/V Grayling* and *R/V Kaho* on the Great Lakes.
- Design a bow thruster for the Connecticut Department of Environmental Protection research vessel *R/V John Dempsey*.

R/V John Dempsey *bow thruster design.*



FSV Henry Bigelow

FSV Henry Bigelow PSA Contract

The US National Oceanographic and Atmospheric Administration, NOAA, has contracted JMS to perform all Post Shakedown Availability work on board the new NOAA Fisheries Survey Vessel *Henry Bigelow*. The *Henry Bigelow* is 208 feet long with diesel-electric drive that is designed to eliminate virtually all radiated noise. The purpose is to be able to closely monitor and sample populations of fish without disturbing them in their natural habitat. The *Henry Bigelow* will be home ported in the northeast after final delivery.

JMS will provide engineering, shipyard management, and vessel repair services for the vessel. The *Henry Bigelow* will be docked alongside the Norfolk VA NOAA Marine Operations Center after delivery from VT Halter Marine in Pascagoula MS where she was built. JMS will subcontract and oversee the various work items to commercial marine repair outfits primarily in the Norfolk area. Some of the more involved work items include modification of the vessel's anti-roll tank, reconfiguring portions of the sophisticated fish handling system, and adding to the installation of the scientific computer system that involves considerable additional internal cable. The challenge will be to complete all work items in a timely fashion to allow the ship to commence scientific missions at the end of February 07.

DIVING SUPPORT

DIT Grows, Makes Campus Improvements

Divers Institute of Technology (DIT) has seen enrollment and job placement on the steady rise again this past year. DIT, located in Seattle, WA, is a subsidiary of JMS and provides a fully accredited program of commercial dive training.

DIT recently completed a grueling re-accreditation review by the Accrediting Commission of Career Schools and Colleges of Technology (ACCSCT). DIT staff from all departments prepared for months for this thorough 'inspection'. DIT was honored to have received the maximum 5 year certification from the US Department of Education approved accreditation agency.

DIT is also proud of recent campus improvements made this past year. Brand new, larger, waterfront classroom buildings have replaced the older ones and a new state-of-the-art underwater video system was recently added to the Underwater Television, Video and ROV program. The metal shop buildings have been completely refurbished allowing the cutting & welding instruction to now be conducted inside and year-round.

DIT's commercial diving program is 30 weeks long with seven classes going at a time. An average of 175 students are training and diving on-site at the waterfront school at one time. Students receive deep diving training to 165 feet off the diving vessel Response. The Response is fully equipped with air, mixed gas and oxygen (students are taught surface decompression chamber operations, using oxygen). DIT is the only U.S. diving school offering real-to-life, at-sea operations. This capability combined with shoreside technical training in welding, NDT, HazMat, hydraulic tools, photography/videography, salvage, and commercial SCUBA modules makes DIT the leader in commercial diving training. Since training is done exclusively in open water DIT graduates are the best prepared in the commercial diving industry.

Graduates also receive certification indicating that they have successfully completed a training program recognized by the Divers Certification Board of Canada. This aggressive deep dive program and certification, available only at DIT, further increases a DIT grad's employability by allowing him or her to work internationally. No other dive school in the U.S. offers this type of certification.

Diving Operations at Bath Iron Works

Since 1992 JMS has maintained a steady presence at Bath Iron Works Corporation in

FSV Bigelow Principal Characteristics

Machinery Plant	• Integrated Diesel Electric, 24-Pulse DC SCR Drive System
	• Two 1,150kW(1,542 hp) Propulsion Motors on a Common Shaft
	• One 720 kW (966 hp) AC Induction Azimuthing Bow Thruster
	• Two 1,360 kW Diesel Generators
	• Two 910 kW Diesel Generators
	• One 4.3 m (14.1 ft) Diameter Fixed Pitch Propeller
Accommodations	• 39 persons, including 19 scientists
Length Overall	• 63.6 m (208.6 ft)
Breadth	• 15.0 m (49.2 ft)
Depth to Main Deck	• 8.65 m (28.4 ft)
Draft	• 5.90 m (19.4 ft) (Centerboard Retracted)
	• 9.05 m (29.7 ft) (Centerboard Extended)
Full Load Displacement	• 2479 mt
Light Ship Displacement	• 1840 mt
Speed, Sustained	• 14.0 kts
Speed, Hydroacoustic Survey	• 0 to 11.0 kts
Endurance	• 40 days/12,000 nm @ 12 kts

BIW dive team

Bath Maine. JMS initially exported a DIT commercial diving course which trained a core group of surface supplied capable divers. Along with the qualified divers came the need for an outside nonunion representative to oversee the safe and efficient day to day operation of the diving services conducted at the yard. Through the years due to attrition the dive team dwindled in numbers and the requirement again came to provide additional training for commercial qualified divers. JMS again provided that service with an exported course conducted in early 1997. It has been almost 10 years since that time and 14 years since the inception of the original diving team. 3 members of the original dive team still remain along with an additional 6 members who were trained during second exported DIT course. Diving is only a part time vocation at the shipyard since the production of new Arleigh Burke destroyers is the primary emphasis. New ships only require minimal diving support and are limited to mostly inspections of hull appendages with occasional emergent repairs occurring infrequently.

As in the past couple of years the majority of the diving conducted at Bath Iron Works is in support of the shipyard infrastructure. The shipyard has 4 piers with all the associated pilings, floats and fendering systems. A 15 acre Land Level Transfer Facility (LLTF) that incorporates over 700 concrete pilings, 25 cylindrical metal cells most of which are 62 feet in diameter, 10 each sacrificial galvanic anodes, and numerous other concrete and metal structures that support this facility. Two different pump houses, one on each end of the yard, a 750 foot long, 180 foot wide, 28,000 ton floating dry-dock, 3 sets of submerged grid-works that the dry-dock berths on and numerous chains and anchoring systems in support of the dry-dock.

The diving can be quite challenging due to extreme tidal changes, the current of the Kennebec River, large ice flows, and the sometimes extreme cold environment in the winter. Hot water suits are the preferred method for diving in the extremes but are not always possible during dry-docking operations in the middle of the Kennebec River when scuba in dry-suits with through the water communications must be employed. Whenever the requirement exits for the inspection of the submerged grid-works which are over 100 foot long and 8 foot wide and there are 6 of these in each set of grid-works, scuba is also employed.

The diver's at BIW are part of over 5000 personnel working in the shipyard and are employed primarily in their respective trades when not diving. Communication within the shipyard environment is essential and understanding of union rules and regulations is necessary to fairly and equitably remobilize the dive team and keep from incurring additional grievances and costs. At the same time the successful completion of the diving task in a safe and efficient manner has continued to be part of JMS's on site 24/7 availability over the last 14 years.

MARINE SCIENCE & TECHNOLOGY

Marine Archeology and Education in Southern Portugal

JMS has supported 6 expeditions to Portugal with the Ocean Technology Foundation (OTF), along with institutions from the U.S. and Portugal since 2000. The most recent expedition took place in southern Portugal this past summer to investigate the remains of a 17th Century fort. Because of attacks from Vikings, Muslims, and the United Kingdom between the 8th and 16th Centuries, residents and armies of Portugal built a series of fortresses along the southern coast to protect important harbor ways and cities. Fort de Sao Lourenco was built in 1653 in order to protect the entrance to Olhao's harbor and the city it supported. The fort was destroyed during a major storm event in 1824, with archaeological remains that exist today. They lie underwater in 0.5 to 2.5 meter depth, approximately 3 kilometers from the mainland.

For 10 days in June 2006, eleven ambitious students from the University of Connecticut joined our team of Portuguese and American researchers in Olhao, Portugal. During the expedition students and researchers worked collectively to explore aspects of Portugal's Archaeological heritage, and to learn essential archaeological surveying skills such as mapping, compass navigation, and plotting structures to scale at the site. The team used a large vacuum-like device to excavate specific locations at the site. Pieces of ancient pottery and charred wood below the sandy bottom were found, all clues to previous human life in the fort. Three cannons and a 2.5 meter diameter, circular stone structure are prominent features at the site. A highlight of the expedition was the hands-on learning experience and cultural exchange opportunity for the students.

North Cape Lobster Restoration Program Completed

The restoration plan realized its goal on June 23, 2006 by placing a V-notch in the tail flipper for the last of 1.248 million lobsters. A celebratory event was held in Providence, RI on Aug. 10, 2006 with Rhode Island Governor Donald L. Carcieri, Senator Jack Reed, federal officials from NOAA's National Marine Fisheries Service and the U. S. Fish & Wildlife Service, representatives from the commercial fishing and oil shipping industries, as well as Rhode Island's Department of Environmental Management to acknowledge the success of the program. The effort lasted more than six years in order to restore Rhode Island's lobster

A female lobster notched by an OTF observer.

population due to significant impact from an oil spill.

The *North Cape*, a 340-foot oil barge, ran aground off Moonstone Beach, RI in 1996 after its tug received damage from a severe winter storm and ensuing fire. More than 800,000 gallons of home heating oil spilled into the waters resulting in death to an estimated 9 million lobsters, and other marine life and birds. Following the oil spill, a Board of Trustees developed a restoration plan for those lobsters lost, and OTF was hired to carry out that plan. With facilitation from JMS and Jamestown Marine Offshore, OTF hired and trained 91 observers and worked with over 150 fishermen in RI and MA to complete the project. In a prepared press release statement, Governor Carcieri said, “this partnership between Rhode Island's fishermen and marine biologists has been a tremendous success. It has helped to restore our lobster population, and it has ensured that this important piece of our economy will continue.” President of the Rhode Island Lobstermen's Association, Lanny Dellinger, noted, “…this project is a perfect example of industry working together with state and federal agencies to accomplish a positive outcome for the resource.”

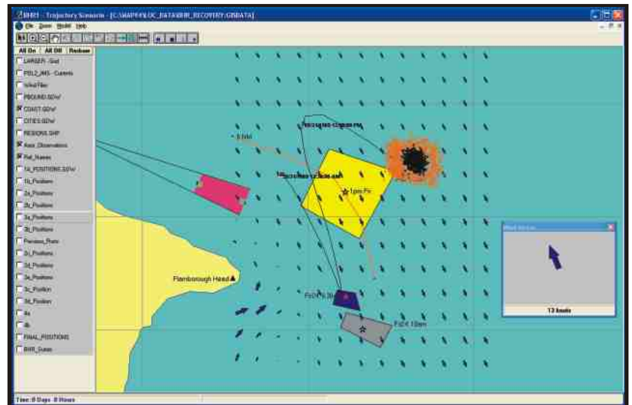
OTF Completes 2006 Expedition to Find *Bonhomme Richard*

JMS is providing engineering and technical support to the Ocean Technology Foundation's (OTF) to locate the remains of this historic naval warship *Bonhomme Richard* including the development of the team's search area based on computer drift simulations. The first expedition to find the remains of John Paul Jones' famous vessel was completed this summer. The expedition took place 20 miles off the coast of England in the North Sea from 17 July though 19 August.

The *Bonhomme Richard* was captained by John Paul Jones during the most important single ship naval battle of the American Revolution. John Paul Jones is perhaps best known during this battle for making his infamous cry, “I have not yet begun to fight!” Finding the remains of this national treasure has been compared in historical significance to the discovery of the wreck of the *Titanic*.

The expedition team was able to survey for 21 days. Only 10 days of bad weather prohibited magnetometer and side scan sonar operations. The team announced that nearly 70% of its planned search area was covered during this season's expedition. The team was thrilled that the weather was favorable enough to allow so much delicate work in such an unforgiving part world.

The team was also excited to report that they located four wrecks sites that look promising. They intend to return next year with a remotely operated vehicle (ROV) for a more detailed survey. The four wrecks were located within the 50 square mile search area that was developed by JMS using computer simulation. Hundreds of eyewitness accounts recorded during the 1779 battle were used to reconstruct a complex timeline of events surrounding the vessel's final hours afloat. The *Bonhomme Richard* drifted for 36 hours after the battle before it sank somewhere off the Yorkshire coast of England. Using the timeline of eyewitness accounts and dozens of drift simulations of a computer generated drifting *Bonhomme Richard* they developed the team's final search area. JMS's method for finding the final resting place of the vessel has never been employed before - and never to locate a ship that was lost over 225 years ago.



A hybrid computer program was custom built to perform dozens of drift simulations of the Bonhomme Richard.

Returning next year with an ROV will enable the team to get a better view of the target sites, and to take video and still images for further analysis. Processing of the magnetometer and sidescan data gathered this summer will take place over the next couple of months to make a mosaic of some of the wreck sites and to get a better idea of how the debris fields are laid out. They also expect that when all of this year's data is analyzed, there will be additional sites that warrant further exploration. The toughest challenge will be securing funding for next year's expedition.

The following expedition objectives were met:

- Produced a comprehensive Geographic Information Systems (GIS) map and database of potentially significant cultural resources, and surface geologic features in the project area where the *Bonhomme Richard* is believed to have sunk.
- Systematically mapped the seafloor in the project area using magnetometry and high-resolution acoustic data that can be used for a variety of base maps, GIS coverage, and scientific visualization methods.
- Began the interpretation and prioritization of individual magnetic anomalies, anomaly complexes, and acoustic targets according to potential cultural significance and association to *Bonhomme Richard*.
- Promoted awareness and appreciation in students, educators and the public of Captain John Paul Jones, the Battle of Flamborough Head, and the historical significance of the battle.

The project's outreach and education efforts met with great success. Nine presentations were made to school groups in Bridlington (England)

The remains of the Bonhomme Richard*? One of the wrecks scanned during this summer's expedition in the North Sea.*

and the surrounding towns. More than 300 students from ages 9 -17 attended these presentations. A website delivered weekly expedition updates and photos. Three presentations for the public were conducted and expedition team members also spoke at various local meetings. A press conference was held during the expedition, and members of the media were also invited to join the expedition for a day. Press coverage was substantial via television, radio, and newspapers, both in the U.K. and the U.S. The History Channel filmed portions of the expedition for a future documentary.

For more information about the expedition and for ways that you can help, please visit www.bonhommerichard.org.

OTHER NEWS...

New Hires

Bill Foster joined JMS in June of 2006 as a naval architect. He recently graduated from Memorial University of Newfoundland and Labrador in May 2006 with a Bachelor of Engineering in Ocean and Naval Architectural Engineering. Prior to University as well as while studying he spent several summers sailing aboard tall ships, gaining sea time and hands on experience in the maintenance and operation of aging wooden and steel sailing vessels. As part of his engineering program he interned with a number of marine industry related firms, gaining experience in various segments of the industry. As an intern for the Ocean Technology Centre in St. John's NFL he assisted in the development of a new concept design for a multi-species fishing vessel for the Newfoundland fishery. The concept design used the latest technology in the harvesting and handling processes to ensure a high level of productivity while guaranteeing the best possible end product. During his time with Aker Marine in Vancouver, he performed the structural design for a new ROV support vessel for the offshore oil and gas industry in the Gulf of Mexico, under the guidance of the lead engineer. Bill spent an internship with the National Research Council of Canada, at the Maritime Technology Centre located in St.John's Newfoundland. During his time there he participated in tow tank tests in the ice tow tank and preliminary analysis on a Podded Propulsor design. The tests were conducted in order to assess the loadings a Podded Populsor may encounter when operating in ice, in both a tractor mode and pusher mode. Bill spent two internships with Canadian Sailing Expeditions (CSE) as a naval architect. He participated in the conversion of the 245' motor vessel *Caledonia* into a three-masted sailing barquentine to be operated by CSE along the eastern seaboard. He also participated in the design of the interior arrangement and associated systems design for the refit of the sailing vessel *True North*. Bill is currently involved in a variety projects with JMS, and is expanding his knowledge with software programs such as Algor FEA, Rhinoceros 3D, HECSALV and AUTOCAD.

Bill Foster

Sikder "Habib" Rahman joined JMS this past February. He earned his Bachelors and Masters of Science degrees in Naval Architecture and Marine Engineering from Bangladesh University of Engineering & Technology (BUET). His Masters thesis was a study of "Free Fall Lifeboats in Regular Waves". He has over 4 years experience in shipbuilding construction and repair and some salvage related experience from when he began his engineering career in Bangladesh. During his previous employment with the May Ship Repair Company in Staten Island, NY, he supervised the construction of a 1,000 LT barge and a 150'x80'x6' dry dock. Mr. Rahman is currently involved in a number of projects utilizing HECSALV for salvage engineering model development and other engineering support roles.

Sikder "Habib" Rahman

JMS
NAVAL ARCHITECTS
SALVAGE ENGINEERS
1084 Shennecossett Road
Groton, Connecticut 06340
http://www.jmsnet.com
860.448.4850 voice
860.448.4857 fax
jms@jmsnet.com