IEEE

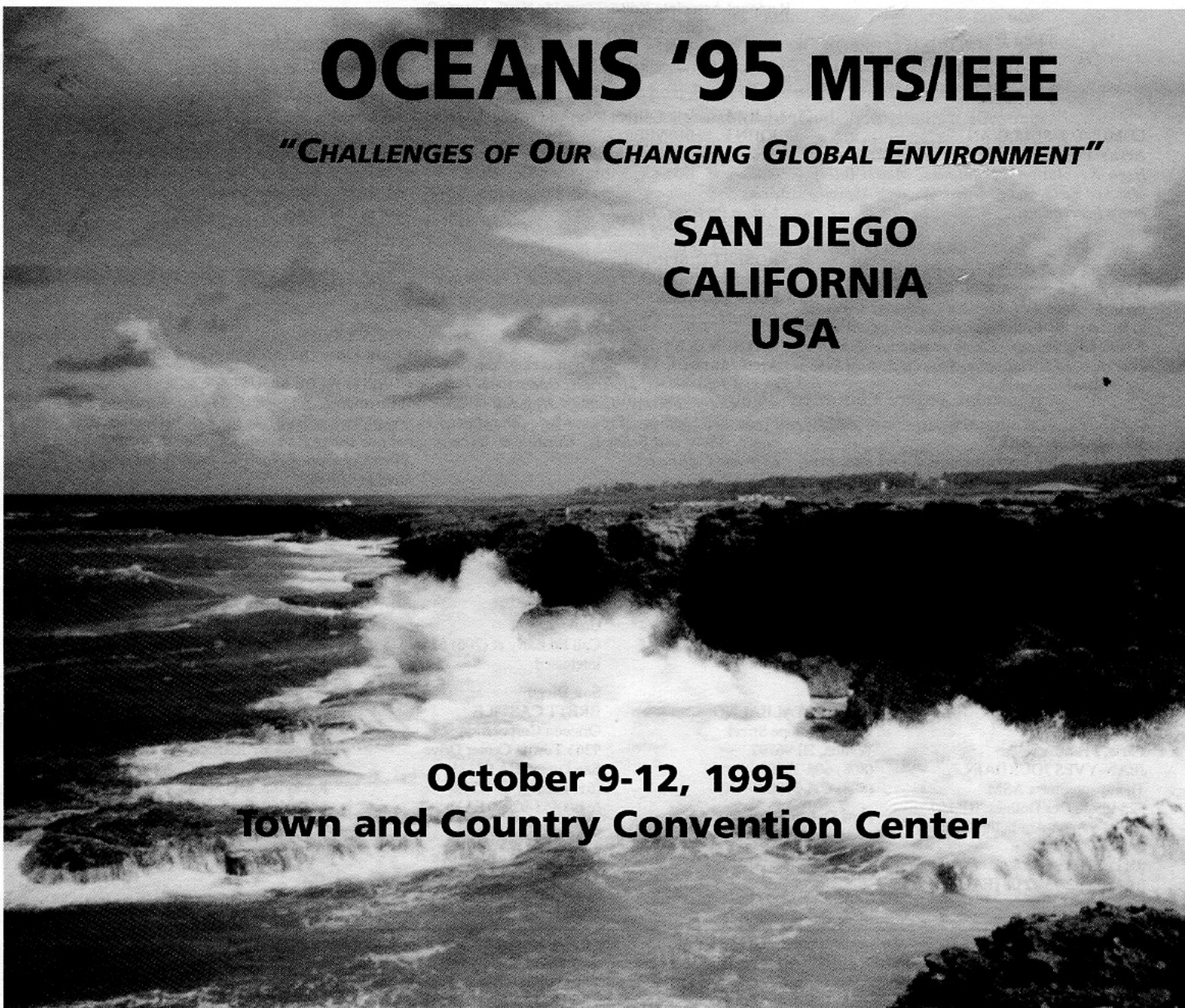
OCEANIC ENGINEERING SOCIETY

Newsletter

OES

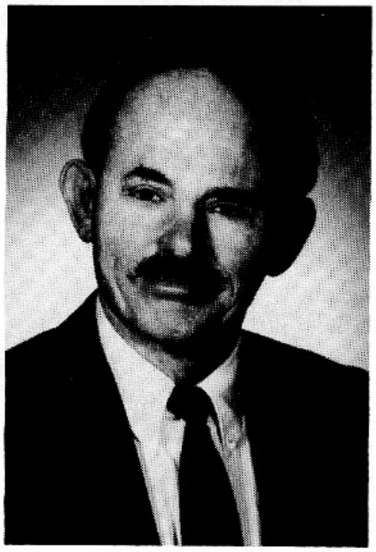
VOLUME XXX NUMBER 2

EDITOR: FREDERICK H. MALTZ SUMMER 1995 (USPS 420-910) ISSN 0746-7834



(Continued on back cover)

IEEE Oceanic Engineering Society Newsletter is published quarterly by the Oceanic Engineering Society of the Institute of Electrical and Electronics Engineers, Inc. Headquarters: 345 East 47th Street, NY 10017. $1.00 per member per year (included in Society fee) for each member of the Oceanic Engineering Society. Printed in U.S.A. Second-class postage paid at New York, NY and at additional mailing offices. Postmaster: Send address changes to IEEE OCEANIC ENGINEERING SOCIETY NEWSLETTER, IEEE, 445 Hoes Lane, Piscataway, NJ 08854



Fred Maltz

Editor's Comments

In the Winter 1994 issue of the newsletter, I published a reprint from the fall (1994 issue of the IEEE Instrumentation & Measurement Society on "The French Cable Station Museum" in Orleans (Cape Cod), Massachusetts. This was the first part of an article in collaboration between the OES and the I&MS covering the United States and French terminals. Through Tom Carver's (I&MS editor) and my correspondence with Jean Vicariot, who was in charge of local arrangements for the Oceans'94 Osates Conference in Brest, France, a contact was made between Tom Carver and René Salvador, whose article appearing in this issue of the OES newsletter, describes the French terminal in Deolen, outside of Brest. The article is being reprinted from the Spring 1995 issue of the I&MS newsletter. Also reprinted is the following letter from René Salvador of Paris:

"Your letter to Mr. Vicariot of Brest fell in my hands after a long and complicated course. But I think this is a good destination and I am ready to participate in a joint article about the telegraph cable between Cape Cod and Brest.

I worked forty years in submarine cables since 1948 and I am now retired. But I began repairing the Brest-Cape Cod cable to put it again in service after World War II and I retired just as TAT8 was ready for service (what progress in 40 years!!).

I remember well the French terminal station at Deolen near Brest which worked until the out of service date of the Brest-Cape Cod and Brest-Fayal-New York cables and I could find photographs to illustrate the article. Unfortunately, "French Cable et Radio" successor in France to the P.Q. Company sold the house and I don't know what happened after, but I can collect information about that.

The transmitting and receiving devices and accessories like artificial lines were dispersed and for the most part destroyed, but several important pieces were recovered and are in the French historic collection of telecommunication and in the Pleumeu Bodou International Telecommunication Museum.

Do you know that I remember very well the Orleans station too. In may 1949, with the cable ship "Pierre Picard" we changed the shore end section at Orleans and I think I have photos of that.

Sincerely,

René Salvador"

My thanks to Tom Carver for his idea of doing this joint article on the world's longest submarine cable and also thanks for his efforts and for allowing us to share it with the I&MS. The article begins on page 16.

Fred Maltz

James S. Collins

Let's Toot Our Horn

Oceanic engineers often look at colleagues in the space business with a bit of envy. This feeling is perhaps brought on not because space work is more interesting but because developments in space are more frequently held up for public inspection and perhaps as a consequence they are better funded (in spite of major cuts to the space station program). For example the Mir and and Columbia shuttle docking of late June received considerable media coverage which was perhaps a bit surprising since a similar docking had been done a number of years before with the Apollo and Soyuz spacecrafts.

Communication of accomplishments in the oceanic engineering business often has a handicap not encountered by manned space activity. When the oceanic work is underwater it becomes very difficult to convey its occurrence directly to the media in a timely fashion. What can be done to help this situation? Remotely Operated Vehicles (ROV's) have the capability of bringing up real time video, but what sort of activity would catch the public eye in a way to induce politicians to free up more funds for useful oceanic research- two arm wrestling ROV's won't do it (someone should talk to the World Wrestling Federation about running a demonstration competition).

Autonomous Underwater Vehicles (AUV's) offer some possibilites which might spur research and development in a more direct way. AUV's have very challenging communication,navigation, control and energy storage problems. Maybe a competition should be started to see which two countries could be the first to launch AUV's at their coastlines and have them rendezvous on an intervening abyssal plain. Perhaps a ROV could be stationed at the designated point and send back real-time video of the arrival of each AUV and the intricate details of the actual coupling in the same style as Mir and Columbia.

To spur some interest in pursuing this approach to media attraction I will schedule an informal workshop or discussion group on the topic for the OCEANS 95 Conference. There are obviously better ideas than those mentioned above. Either bring them to OCEANS with you or send them to the newsletter editor (and help him fill that blank page which he reserved for you in the Spring issue). The idea will be to further develop the best ideas at future conferences and in our newsletter. The ideas are not necessarily limited to AUV's so let's hear them. If you want to contact me directly my e-mail is j.s.collins@ieee.org.

James S. Collins
IEEE OES Vice-President
for Technial Activities

Norman D. Miller

Professional Activities and Student Poster Program at the OCEANS Conference

As Vice President of Professional Activities, I am involved with Chapters, Membership, USAB and EAB activities, Awards, and Students. The interface to the Chapters is ably handled by Ed Early, and Jim Barbara does an excellent job in membership development. Glen Williams is the Awards chair and actively seeks out distinguished members to recognize. I find myself attending USAB and PACE meetings as well as EAB workshops. While it is not practical for OES to develop PACE programs it is worthwhile for the Society to be represented at PACE meetings and to keep abreast of professional concerns that affect the members. At the recent Board of Directors meeting series in Washington, DC, the USAB hosted a reception and dinner for the IEEE officers and members in attendance. The Washington Office of USAB gave a very interesting presentation on their activities. This year has been a particular challenge because of the changes in Congress following the last election. The new congressional staffers regularly call the USAB office for information on technology matters and policy. I was proud that IEEE has a capable staff in Washington, DC to represent us and provide good technical information to our Congressional offices.

One of the areas that I enjoy and am proud of is the work that OES does with students. Since OCEANS '89, the OCEANIC Engineering Society has sponsored a Student Poster Program at the OCEANS conference. Students are invited to submit a "Poster Abstract" for consideration. The abstracts are reviewed and students submitting the best abstracts are invited to come to the conference and present their posters. The OES provides travel and lodging expense and the Conference provides a complimentary registration. In addition their poster papers are published in the Conference Proceedings. When the program began in 1989 we worked through the Sea Grant schools to solicit student poster abstracts. We now work through the IEEE student chapters and "Potentials" to announce the program. We have also developed a selected list of schools that have supplied students in the past and we continue to get abstracts from these sources. In 1994 we went international and had fourteen posters from students in France, Italy, Portugal, UK, and Russia. We also invited eight students from the USA and Canada to present posters. This year we have invited eleven students to present posters. Once again we have an international representation with students from the USA, UK, Scotland, France, and Russia invited to present their posters. With the advent of the Internet and e-mail, the communications problems have been materially eased. All of the students have access to the internet and all can write in English. We hope that next year we can use a Home Page on the WWW to announce the "Call for Posters" and gain a broad range of abstracts for review. When you come to OCEANS '95, please be sure and browse through the student posters. They will be set up in the lobby area and will be available for viewing all three days of the Conference. Students will be available at their posters each day as posted in the Conference Program. A judging of the poster presentations will be made and the winners will be announced and recognized at the Awards Luncheon. Its going to be a great poster display. Don't Miss It!

Norman D. Miller, P.E.
Vice President
Professional Activities

Membership in the Oceanic Engineering Society (OES)

The first question one must ask is "Why should I join the Oceanic Engineering Society?" Some of the reasons can be found in the following paragraphs, as well as background information on the society.

In addition to the benefits associated with the parent IEEE, the OES offers interested professionals a technical forum for all technologies related to ocean engineering. Specifically, the society has the following technical committees:

- Autonomous Unmanned Underwater Vehicle Technology
- Current Measurement Technology
- Marine Communications and Navigation Technology
- Modeling, Simulation, and Database Technology
- Neural Networks for Ocean Engineering Technology
- Nonacoustic Image Processing Technology
- Oceanic Instrumentation Technology
- Polar Instrumentation Technology
- Remote Sensor Technology
- Sonar Signal Processing Technology
- Underwater Acoustic Technology

Members can stay technologically current by networking with each other, (approximately 2165 members throughout the world.),through attendance at local chapter meetings, OCEANS XX, participation on a technology committee, submitting technical articles, and other ways.

The OES publishes and distributes to its members both a journal, with peer reviewed articles, and this newsletter that contains items of interest to the ocean community. The journal is published on a quarterly basis and the newsletter is published quarterly as well. The OES originated the "OCEANS" conference and continues to sponsor the meetings each year in the fall. This year the Marine Technology Society has agreed to cosponsor the meetings for the foreseeable future affording the marine community one well grounded meeting which includes a broad range of topics spanning the full spectrum, from theory to governmental and industrial practice.

The OES presents two awards each year, The Distinguished Technical Achievement Award, and The Distinguished Service Award, at the OCEANS Conference. The former is to recognize superior contributions to ocean engineering technology, and the latter is presented to individuals who have demonstrated outstanding dedication and leadership of the society.

Present membership of the society totals 2165 members in all regions of the IEEE. As a reminder, the IEEE is divided into ten regions to service every country. Regions 1-6 are totally contained in the United States, Region 7 services Canada, Region 8 services Europe, Region 9 is South America, and Region 10 is Asia.

Region	OES Members	Percent of Total
1	374	17.2
2	302	13.8
3	161	7.3
4	81	4.6
5	132	6.1
6	421	19.4
7	136	6.2
8	298	13.6
9	47	2.2
10	213	9.7

As far as the composition by grade, as one would imagine, the largest category is Member with 1335 followed by Senior Member with 204. The life category, that includes Fellows, Senior Members and Members. numbers 199. There are 86 Fellows and 198 Affiliates.

If you are currently an IEEE member or student member you may join the society simply by noting the society on your annual renewal and paying the required fee ($10 annually). If you are not an IEEE member, you will have to complete an application to join.

As a new member of the AdCom suggested to me, "Remember that MEmbership begins with ME". You will only find the society beneficial if you participate. We find it very hard to turn down a volunteer. There are many functions to be performed to make the society a strong and viable force in the engineering community and to help it grow and continue to support the professional needs of its members.

James T. Barbera, Sr.
Membership Development

Join us!

1995 IEEE MEMBERSHIP APPLICATION

IEEE

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(New applicants complete entire application areas 1 through 12.)
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Institution ______

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5. **IEEE Endorser's Name** ______ Member, Senior Member or Fellow (Print) ______ Membership No.

Endorser's Signature ______ Date ______
I verify that the applicant's information is accurate

I hereby make application for IEEE membership and, if elected, will be governed by IEEE's Constitution, Bylaws, Statements of Policies and Procedures and Code of Ethics.

6. ______
Full signature of applicant ______ **Date**

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Use the numbers to identify your plant activity and your own work.
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WORK AND PLANT (Enter codes) Plant ______ **Your own work** ______

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9. Software engineer
10. Basic research
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9. Design engineer
10. Engineer / Scientist (incl. software)
11. Other Professional/Technical (explain)

______

EVENT CODE							
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E	Z	1	9	4		
68	69	70	71	72	73	74

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Entry into Force of the 1982 United Nations Convention on the Law of the Sea
M. Walker, U.S. Department of State, DC

Results of Six Years of Operations with Deep Manned Submersibles "MIR-1" and "MIR-2" on the Nuclear Submarine "KOMSOMOLETS" Wreck
A.M. Sagalevitch, P.P. Shirshov Institute of Oceanography, Russia

Status of Acoustic Thermometry of Ocean Climate (ATOC) Program
W. Munk, UCSD Scripps Institute of Oceanography, CA

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(Reprinted from AUV '94)

Remote Environmental Measuring Units

Christopher von Alt, Ben Allen, Thomas Austin, Roger Stokey
Woods Hole Oceanographic Institution

***Abstract*—There are civilian and military justifications for the development and commercialization of free swimming survey platforms; which may be carried and operated by one person. To be effective, these platforms must be capable of characterizing the spatial and vertical variability of the physical environment beneath the surface of the water. There is therefore a need to develop low Asks affordable, underwater vehicles which are easily reproduced and which provide effective solutions, but whose loss is not an economic catastrophe. Research aimed at quantifying cause and effect relationships and predicting long term trends in coastal, inland and global marine processes will benefit from such systems. One important aspect of such research is the development of coastal ocean modeling and data assimilation computer programs which permit hind-casting and forecasting of circulation patterns in coastal regions. An affordable system of vehicles, which will permit ground truthing of remotely sensed data and the rapid measurement of vertical distributions beneath the surface, will support the use of these computer programs in characterizing remote coastal regions with a minimum investment. Once operational, these models may be used in support of both military and civilian objectives.**

A system of Remote Environmental Measuring Unit(s) (REMUS) is intended to provide such a capability. The REMUS concept includes a number of small, low cost, free swimming vehicles which may be operated jointly or independently. They offer an appropriate technology for gathering data in the coastal and open ocean. Operations in the open ocean may be conducted from large or small ships of opportunity as well as from long term seafloor observatories such as Rutgers' LEO-15, which operates at the end of an electro-optic cable buried in the seafloor. [1] Coastal and inland operations may be conducted from a shore station or a pier slide location, as well as from a small boat. Since the vehicle weight will not normally exceed 40 kilograms, it is envisioned that the vehicle system may be transported to the site of interest in a compact car and set up and operated by one person.

I INTRODUCTION

The Remote Environmental Measuring Unit(s) (REMUS) vehicles are intended to provide researchers with a simple, low cost, rapid response capability which facilitates the collection of pertinent environmental data necessary to further our understanding of stability and change in marine ecosystems. By remaining simple to operate and low in cost, the system strives to provide researchers with the ability to maintain a commitment to make frequent observations of a broad class of marine processes. In addition, because the system is small and mobile, it will provide scientists with the ability to respond quickly when an episodic event is detected. It is felt that a rapid response to these events is needed in order to better understand their causes and how they evolve.

This work was supported in part by Rutgers, The State University of New Jersey under Grant No. NA16RU0370-01 from DOC-NOAA.

The REMUS vehicle may be operated and controlled from a short base line acoustic tracking system, or pre-programmed to follow a path laid out by a number of bottom moored acoustic transponders The vehicles will be capable of operating in two modes using the same hardware: *man-in-the-loop* and *autonomous*. Man-in-the-loop mode is suitable for harbor and estuary environmental characterization, or operation off of a boat or ship. In this mode, the vehicle is piloted manually by an operator, who follows the vehicle using a broadband acoustic tracking system such as ATS which has been developed at Woods Hole [2]. In this mode, multiple vehicles may be operated at one time. The second mode, autonomous, is suitable for unattended operation: the vehicle may be launched from the shore, a boat, a subsea platform, or seafloor observatory such as the LEO-15 (see III Applications). On command from the control station, the vehicle will automatically navigate a pre-programmed round trip course. The vehicle's trajectory will be guided by homing on a series of bottom moored transponders The vehicle will then return to the launch site, dock, download its data set over the optical link to shore, and begin to recharge its batteries in preparation for another trip.

An internal data logger which is synchronized before launch with the tracking/communication system retains data collected during a deployment In this manner, data collected during a mission may be correlated with positions from the tracking system.

II RELATED TECHNOLOGIES

A. Existing Small Vehicle Technology:

Two existing commercial products have been identified that closely matched the desired capabilities of a REMUS vehicle Sippican's small AUV based on their military MK 39 EMATT, and BENTHOS's MICROROVER (a tethered pipeline inspection vehicle). A non-commercial product, the SEA SHUTTLE was also identified [3,4]. The SEA SHUTTLE was developed during the late 1980s when the Applied Physics

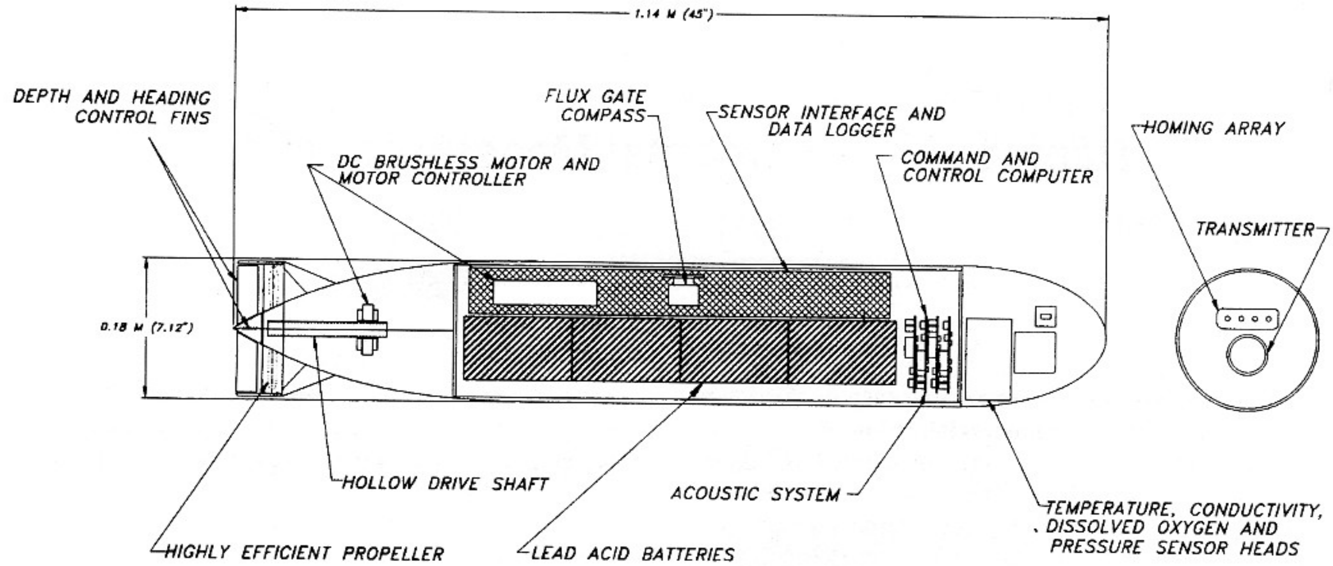

Figure 1. A REMUS vehicle configured for autonomous operations.

Laboratory at the University of Washington modified an old MK 38 vehicle, developed at APL-UW in the 1970s for the Navy, and installed new control electronics and a Sea Bird CTD. The EMATT system is a MARK 39 system, the next generation after the MARK 38. All of these small systems have been shown to have meaningful endurances in the field and confirmed that the REMUS vehicle system is a viable concept.

Our analysis indicated that altering any of these designs to a form that could be used to support the REMUS concept would increase both development and production costs when compared to starting with a new design based on 1994 commercial technology. One of the benefits of our new design approach addresses the main technical problem with the MARK 38 derivatives, their hull diameter. The original systems are 8.9 cm in diameter, a requirement forced on them by the Navy for sonatube deployment. For REMUS, this approach was unacceptable in view of our low cost objective and the need to recharge the system at sea A small diameter hull drives up the cost of the system by limiting the use of commercial off the shelf hardware and conventional lead acid batteries.

B. Ship Board Techniques

Current techniques for acquiring conductivity, temperature, and other data versus depth and position involve towed systems and as well as individual casts from ships or boats. Shiptime and personnel costs are extremely high, and it is difficult to get anything but the sparsest record. The detection and tracking of sharp transitions in ocean frontal systems are difficult using casts from a surface vessel, and day to day mapping is nearly impossible. Furthermore, the approach is highly weather dependent. Rapid response to changing conditions is often impractical. These facts provide a primary justification for the development of REMUS.

C. Autonomous Moorings

The REMUS approach may have distinct advantages over a group of autonomous moorings with sensors, batteries, and acoustic telemetry. Namely, it might be less expensive from a system view point. Technically, acoustic telemetry over long ranges in shallow water is much more difficult than simple acoustic ranging, and consequently the hardware is more complex and expensive. A fifteen mile acoustic link is especially challenging, and simply not available commercially. One must also consider the initial cost of the mooring, as well as maintenance costs, since battery turnarounds and sensor cleaning and calibrations may be required at 6 month intervals.

When a REMUS vehicle is operated in the autonomous mode, the acoustic navigation/tracking system design will use proven transmitter/receiver technology similar to that used by many manufacturers of acoustic releases and transponders Tests performed with standard transponders have demonstrated ranging capability in excess of 7 km in Nantucket Sound, a shallow water environment We are estimating that the typical transponder spacing will be 5 km The cost of buoyant, expendable transponders in a 17" glass housing is approximately $3k, including a 4 year battery pack. These transponders have no external metal parts, are simple to deploy, and typically last longer than 4 years.

III APPLICATIONS

A. LEO-15

An innovative sea floor observatory will go on line in June of 1995 in 15 meters of water off the coast of New Jersey Under the sponsorship of NSF and NOAA, the engineering staff of the Oceanographic System Laboratory (OSL) at WHOI is collaborating with the staff of the Institute of Marine and Coastal Science at Rutgers and over thirty scientists throughout the United States to develop and deploy the Long Term Eco-system Observatory (LEO-15). Eventually, a network of LEO's will extend into the deep ocean.

The connection of LEO-15 to the Internet via an electro-optic cable buried in the seafloor will permit scientists to log on from anywhere in the world and obtain real time-data from their experiments The two-way data link will permit scientists to redirect the course of the experiments based on data they have obtained. The traditional electrical power, data bandwidth, and wait-and-see limitations which have plagued ocean science will be essentially eliminated.

REMUS vehicles are an integral part of the LEO-I 5 design They will be used to exploit the real time deployed presence that the seafloor observatory offers by making measurements of episodic events which take place in locations which are remote from the cable. On command from a control station, perhaps via the Internet, one or more of the vehicles garaged in the seafloor observatory will be launched and will then automatically negotiate a pre-programmed round trip course. The vehicle's trajectory will be guided by homing on a series of bottom moored transponders. Upon returning to the launch site, the vehicles will dock, download recorded data, and begin to recharge their batteries in preparation for another trip. The recorded data will be sent over the optical link to shore and beyond via the Internet.

Students and scientists will have access to tethered and autonomous REMUS vehicles both of which will be continuously deployed at the observatory. These systems will be used to observe and manipulate biological experiments as well as to track the location of ocean frontal systems and to learn more about episodic events as they occur. A vertical profiler will be used to calibrate ocean color satellites for use in coastal waters and to study the water column as it moves past the observatory Other systems will permit scientists to study sediment transport and bottom boundary layer growth and decay During its expected twenty year life span, the observatory will also provide insight into how ocean storms affect processes under study.

B. Long Tenn Coastal Surveys

When operated in conjunction with moored seafloor transponders, a REMUS vehicle will offer an affordable means of performing repeated environmental surveys of fairly large scale areas. Figure 2 above depicts the Atlantic Ocean at the entrance to New York Harbor. Each black dot represents the location of a bottom moored acoustic transponder. The transponders are spaced at 5 km intervals, and each transponder is identified by a different broad band coded ping. The transponders are surveyed into position using a small boat equipped with a GPS receiver. The transponders should have a life expectancy of four years. They represent an initial investment of approximately $20,000.

A typical survey would begin by launching a vehicle from the shore. One person may accomplish this task. The vehicle will be preprogrammed by the operator to follow the dotted track line in Figure 2. As the vehicle navigates the path, it records sensor data which is correlated with its position and time. Upon completion, the vehicle returns to the shore and is recovered by the operator. The data is then available for analysis. The REMUS vehicle may then be recharged, reconfigured with different sensors if desired, and deployed on another survey as early as the next day. Surveys of this nature may be conducted throughout the world with a minimum amount of investment.

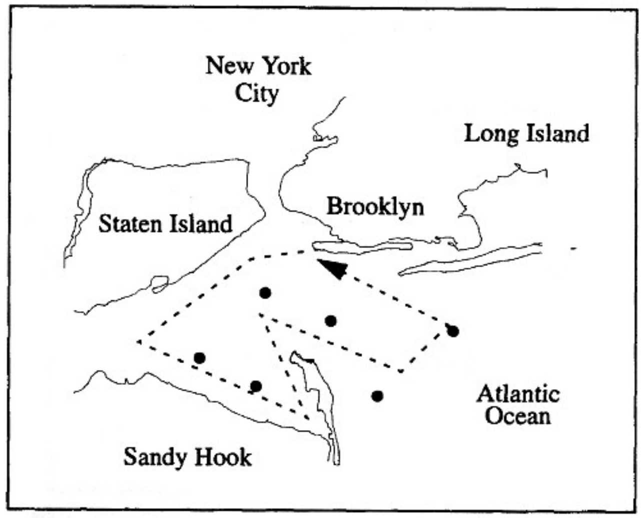

Figure 2. REMUS autonomous survey in New York Harbor

IV SYSTEM DESIGN

To gain acceptance, autonomous vehicles must be easily understood, they must not adversely affect the environment, they must be safe, easily transported and deployed, they must not cause an economic catastrophe if lost and they must be flexible so that they may perform a number of diverse missions of societal importance. In addition, people with reasonable training must be able to maintain them. The REMUS concept involves a vehicle which can be easily handled by one person. The vehicle must therefore weigh comfortably less than 40 kg.

A. Hull Shaping

Since the volume available for propulsion and energy systems in any vehicle with a cylindrical cross section is proportional to the cube of its diameter, and the propulsive and energy requirements are influenced mainly by the wetted surface area, which is proportional to the square of its diameter, there is a beneficial geometric effect in increasing a vehicle's volume. However, transportation, launch and recovery methodologies, weight, and overall system costs bound a range of acceptable vehicle volumes. As the vehicle volume becomes small, manufacturing, energy, and component costs begin to climb due to unrealistic performance to volume ratios. As vehicle volume increases, the same trends exist due to unrealistic performance requirements. The REMUS vehicle design seeks to optimize performance for a class of missions which may be accomplished within the performance to weight ratio established by a vehicle which may be handled by one person.

The design of the REMUS vehicle body shape is therefore a constant volume problem where vehicle diameter is not limited. The maximum weight constraint affords a displaced volume of approximately 0.03 m^3 (1 $ft.^3$) in seawater. A desire to minimize the drag of the vehicle suggests the use of body shape with a length to diameter ratio on the order of 6.5 [5]. The final body shape will therefore have an average diameter of 0.18 m (7.12 in) and a length of 1.14 m (45 in). The vehicle with this fineness ratio will operate at Reynolds numbers between $2x10^6$ and $4x10^6$. The fully appended vehicle should

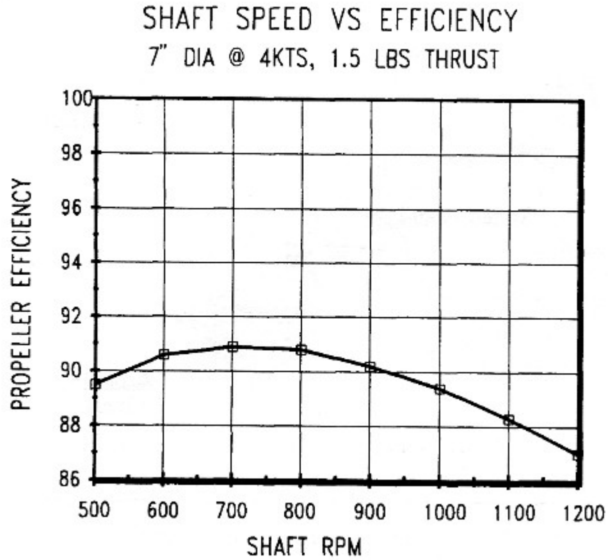

Figure 3. REMUS propeller efficiency

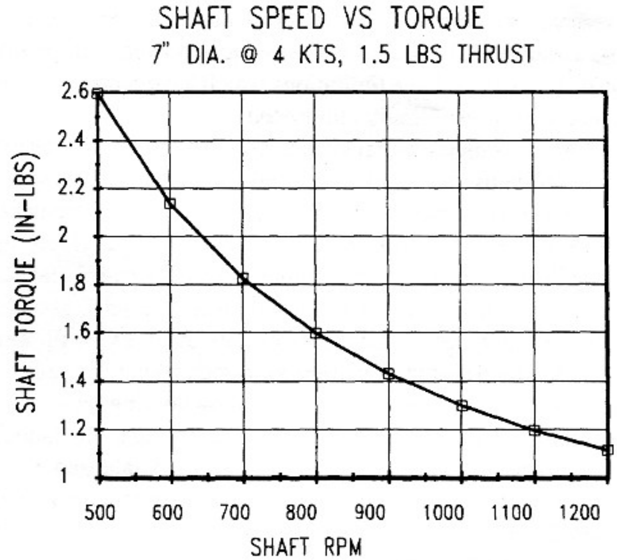

Figure 4. REMUS propeller torque

have a coefficient of drag on volume near 0.03. Fluid flow in the boundary layer over the vehicle is assumed to be fully turbulent, but attached. Transition to turbulent flow in the boundary layer is assumed to occur at the nose due to vehicle maneuvering, hull roughness, and ambient turbulence levels in the ocean. Figure I on page 2 depicts a potential hull shape design for the vehicle. It is based on a study conducted by D.F Myring [6]. Other shapes are being considered.

B. Energy and Propulsion

The REMUS vehicle hull shape will be propelled through the water by a shrouded propeller which is directly driven by a brushless DC motor The propulsor will be optimized for operations at 2 1 m/s (4 knots). The vehicle will be capable of operating between 0 and 3 m/s (0-6 knots) An overall average propulsive efficiency of 80% is assumed (output electrical power from the batteries to the output power from the propeller). A frameless torque motor has been selected to permit the use of a hollow shaft. The hollow shaft is needed to permit the actuation of the heading and depth fins which are located aft of the ducted propeller.

1) Propeller Selection

The REMUS vehicle is a free swimming low-drag shape which requires low propulsive force, and can use a propeller diameter equal to the diameter of the vehicle. These two factors make the selection of a large diameter unducted propeller appropriate because of the high propulsive efficiencies achievable.

A lifting line based propeller design program was used to analyze the effects of diameter, load and RPM on the propulsive efficiency [7]. The thrust values were derived from appended vehicle drag coefficients A high propeller RPM is desirable as it requires a smaller reaction torque from the vehicle over its full range of performance than a lower RPM. Figure 3 shows the effects of RPM on propulsive efficiency. The corresponding torque is shown in Figure 4 for a series of 0.178 m (7 in) diameter propellers at different pitch ratios all generating 6.67 N (1.5 lbf) of thrust at 2 06 m/s (4 knots).

The peak efficiency of 90 8 occurs for a design turning at 800 RPM; however, the efficiency curve is very flat and a wide selection of shaft speeds and torques are available within the 500 to 1200 RPM range, all with propeller efficiencies above 86%

Parameters	Case 1	Case 2	Case 3	Case 4
Vehicle Speed m/ s (knts)	1.54 (3.0)	2.06 (4.0)	2.57 (5.0)	3.09 (6.0)
Vehicle Drag N (lbf)	3.29 (0.74)	5.87 (1.32)	9.16 (2.06)	13.2 (2.97)
Propulsive Efficiency%	65	65	65	65
Electrical Power watts	7.82	18.6	36.3	62.8
Vehicle Hotel Load watts	8	8	8	8
Vehicle Endurance hrs.	25.9	15.4	9.25	5.78
Range (No Current) km (nm)	144 (77.6)	114 (61.5)	85.6 (46.2)	64.3 (34.7)
Total Energy watt-hrs	430	430	430	430

Figure 5. Predicted vehicle performance

2) Vehicle Performance and Cost Estimate

Figure 5 presents the predicted performance of a REMUS vehicle over a range of operational speeds under no ambient current conditions. The propulsive efficiency includes all losses associated with the propeller, the DC brushless motor, and the motor controller. The thrust values used for the propeller analysis are conservatively higher than the drag values calculated at the 2.06 m/s (4 knot) speed. The electrical hotel load includes provision for the use of digital signal processing chips required for broad band signal processing. The total cost for all components in the system should not exceed $18,000 including sensors.

C. Heading, Depth and Roll ControL

Vehicle pitch and heading will be maintained with four controllable fins which will be located behind the propeller assembly as shown in Figure 1. The two vertically oriented fins will be activated by a single actuator as will the two horizontally oriented fins The fin actuators will be located forward of the D.C. brushless motor for the propeller. Control rods inside the hollow propeller shaft will connect the actuators to the fins Passive roll control will be provided via a low center of gravity that generates a restoring moment.

D. Acoustic Tracking and Remote Control

REMUS vehicles will be operated and controlled from a short base line acoustic tracking system, or pre-programmed to follow a trajectory laid out by a number of bottom moored acoustic transponders depending on the application.

1) Man-in-the-loop operation

The Acoustic Tracking System (ATS) developed at the Oceanographic Systems Laboratory at Woods Hole Oceanographic Institution will be used to track and control the vehicles during man-in-the-loop operations. [2]

ATS is a short baseline navigation system which is capable of tracking either tethered or free swimming vehicles at ranges on the order of a few kilometers in shallow water When used with untethered vehicles, the vehicle emits a coded wide bandwidth ping in response to a broadband ping from the tracking system. The tracking system then measures both the round trip arrival time and the phase difference at a sparse array of 4 hydrophones. This information is then used to compute a range and bearing to the vehicle relative to the tracking array.

The design of the acoustic transmitter/receiver board housed in the REMUS vehicle also facilitates the transfer of low bandwidth information from the vehicle to the operator while the vehicle's location is being tracked. Existing hardware will permit the transmission of four different preprogrammed broad-band codes. One of the codes is used to initialize the tracking cycle; the remaining three are used to communicate the current state of the vehicle. This is accomplished by relating the time delay between the initial tracking ping and the arrival time of the next coded ping The code relates a predetermined state (depth) and the delay relates the value (15 m). The next code relates new information such as compass heading. Within each tracking cycle, which is on the order of one second, the four codes may be reused to transfer additional information about the vehicle once the multipath levels of the code have diminished to acceptable levels. Information is passed to the vehicle from the tracking array in a similar manner. This information includes a new desired heading or depth. By varying the vehicles' heading and depth, the operator may maneuver the vehicle over its desired trajectory Figure 6 below is the ATS display. Other approaches may be used in the future.

Normally, short base line tracking systems use a very short narrow band ping because multipath signals quickly corrupt the desired signal. This limits the total energy available for detection, and consequently requires a fairly high amplitude source for adequate resolution. By spreading the signal bandwidth, the multipaths, which arrive at the receiver, are uncorrelated with the direct path, and may therefore be filtered out The transmitted signal duration is no longer limited by multipath delays improved SNR may be obtained by increasing the

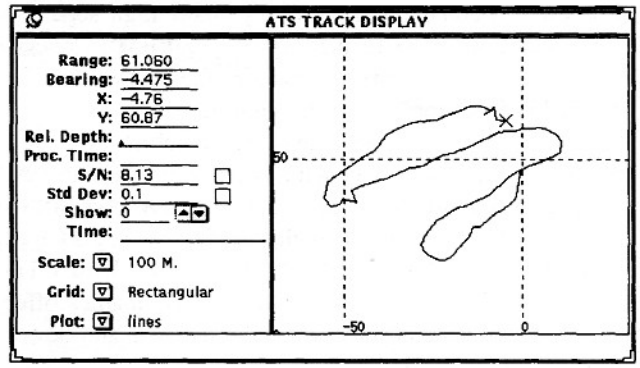

Figure 6. ATS tracking display

signal duration rather than signal power. This effect permits the development of low probability of intercept signalling schemes.

The ATS control program allows different processing options to be selected, displays the track history of the vehicle, and allows the operator to view selected waveforms for algorithm analysis.

2) Autonomous Operation

Using the same acoustic tracking hardware discussed above, the vehicle will be programmed to interrogate a trail of seafloor transponders, approaching each transponder by minimizing range. When the range is below a programmed threshold, the vehicle will then listen for the next transponder and approach it using the same technique. In the event that REMUS cannot establish communication with a particular transponder, it will reverse course and follow the transponder trail back.

This technique of transponder ranging is the simplest and lowest cost method of following a track for an autonomous vehicle. Low cost, reliable, long life transponders are commercially available. By setting the transponders once using GPS, a known trackline may be followed on mission after mission Navigation software will be developed to allow the vehicle to follow any arbitrary track within a network of transponders.

E. Sensors

Sensor installation has been divided over the two year development program. During the first year, depth and temperature sensors will be installed. The depth and temperature sensor combination represents a minimum level of support needed in our year one test program Our objective is for the REMUS program to generate important scientific results during the first year of the program.

The more complex sensors (conductivity and dissolved oxygen) will be selected and integrated in year two REMUS will be configured to operate in conjunction with the LEO-15 in year two as well. The engineering study required to finalize the selection of the year two sensors for REMUS will be completed in conjunction with this effort. One direction currently under-consideration involves the use of lower cost, less accurate, but fast response sensors on REMUS These sensors will be used in conjunction with very stable high accuracy sensors located on LEO-15 platform. Since REMUS operations are short (i.e. 10 hours or less) pre- and post-calibration of the REMUS sensors, using the high accuracy sensors on LEO-15 as a reference, is possible when the vehicle is docked at the LEO-15 site. This concept may permit further reduction in sensor cost beyond that which is currently envisioned.

Alternatively, commercial, high quality sensor packages such as the Ocean Science OS200 and the Sea Bird CTD products are being considered. Both these companies offer commercial components which fit within the size and power constraints of the REMUS system.

V CONCLUSION

REMUS vehicles have the potential to provide an important data-set that cannot be efficiently obtained by standard shipboard techniques due to weather and logistical constraints The ability to remotely direct survey operations will benefit research in:

- rapid characterization of upwelling events;
- fish recruitment processes;
- control of surf clam recruitment;
- carbon dioxide fluxes;
- variability and sources of trace metals and pollutants;
- benthic boundary layer dynamics;
- characterization of suspended and dissolved materials

Free swimming underwater vehicles may be used to provide a simple, low cost, rapid response capability which facilitates the collection of pertinent environmental data necessary to characterize and model the open ocean, coastal ocean, and/or harbors and estuaries. Historically however, Autonomous Underwater Vehicles (AUVs) have had mixed successes. Their large size and high cost often makes the operational risks associated with using them unacceptable, consequently they spend much of their time ashore; little actual data is collected. By trying to design vehicles which are capable of doing everything, they end up doing nothing.

Because of this trend, there is a need to develop low risk, low cost, mission specific, vehicles which are easily fabricated and which provide effective solutions, but whose loss is not an economic catastrophe.

ACKNOWLEDGMENTS

The authors would like to acknowledge the contributions of the engineering staff of the Oceanographic Systems Laboratory at Woods Hole Oceanographic Institution, and Scott Glen and the faculty and staff of the Institute of Marine and Coastal Science at Rutgers, The State University of New Jersey. A major portion of the design work presented in this paper was accomplished with support from grants awarded to Rutgers University by NOAA's National Undersea Research Program. The WHOI contribution number is 8692.

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Announcing: The Lost Instrument Network

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As we all know, ocean research entails a certain amount of risk. Moorings, instrumentation, etc. are designed to withstand our best guess as to the worst mother nature can throw at us. Yet we still find ourselves searching for that lost instrument. Most people label their gear, but even that precaution is not foolproof. We, like all ocean research organizations, receive the occasional phone call from a fisherman or the Coast Guard, 'We dragged up this contraption, it looks like ——, is it yours? Do you know anyone it belongs to?' Generally, the equipment is not ours and more often as not we don't have a clue as to whom it might belong. Until now, word of mouth has been the only way to identify the owner. With the arrival of E-mail and mailing list servers, we can provide an information clearing-house and broadcast notification of found equipment to a world-wide audience.

The Lost Instrument Network is intended as a clearing house for information regarding oceanographic instrumentation lost at sea by researchers that has been found by others. In a nutshell, there are three ways to participate:

1. Subscribe to the lost-instruments mailing list. As a subscriber, you will receive notices via e-mail when oceanographic instrumentation has been found and the owner cannot be readily identified.

2. Search the Lost Instrument List to identify the owner of something found. The mailing list's information file contains a list of instruments or equipment that have been reported to the network as lost, with information detailing where and when an item was lost and who to contact.

3. Be aware of this service and report 'found' instrumentation to it. An e-mail message sent to the list with information concerning the equipment is the most direct method to do this.

If you do not have access to e-mail, the information can be passed along by calling the voice mail telephone service (508) 457-2324. This is a recording only. Please leave detailed information and a point of contact should more information be needed.

There are many people who work in the ocean sciences who do not have access to e-mail. The success of this idea depends upon getting everyone who is involved with oceanographic instrumentation to participate. Of particular concern is to inform those who do not have access to the Internet that this service is available. Many of these people are just the eyes and ears we would want to be plugged into the network. We feel strongly that anyone who subscribes to this list consider themselves a local point of contact for unconnected people and organizations such as the Coast Guard or local police. These organizations are most like to be contacted by a member of the public who has found something odd washed up on the beach. If you decide to participate, please make your involvement with this service known to others who do not have e-mail access to the Internet, so that they would know who to contact to get the word out if they should find an instrument. It is for this reason that we decided to go with a mailing list for this service. E-mail is perhaps the simplest and often the first contact people have with the Internet. E-mail is a service offered by most providers such as America On Line, Compuserve, etc.

The mailing list, lost-instruments@nobska.er.usgs.gov, is the cornerstone of the Lost Instrument Network. Subscribe to the list if you are interested in being contacted when an unidentifiable instrument is discovered by a member of this network. This is a moderated list, meaning that all incoming messages to the list are screened by a human (the moderator), and are not automatically forwarded to list subscribers. A message will be distributed to subscribers only when a message is received by the moderator with a request to report that an instrument (or other significant object, such as a buoy) is found and the owner could not be otherwise identified.

This service involves two lists (as part of the lost-instruments mailing list): 'Lost Instruments' and 'Found Instruments'. Reports of lost instruments received by the moderator will be added to the Lost Instrument List. It can be accessed from the list-server at any time by anyone, but will not be sent automatically to the subscribers. The archive for the lost-instruments mailing list will serve as the 'Found Instrument List'. The archives can also be accessed by anyone, at any time. If an instrument has been reported to the list as lost and is subsequently returned to the owner, a message should be sent to the lost-instruments mailing list so that the 'Lost Instrument List' can be updated by the moderator. The success of this service depends on subscribers forwarding any information they receive concerning reported sightings.

To obtain more detailed information and the current Lost Instrument List send a message to
listproc@nobska.er.usgs.gov
with the following line as the only line in the body of the message: info lost-instruments

To subscribe to the list, send an E-mail message to:
listproc@nobska.er.usgs.gov
with the following line as the only line in the body of the message: subscribe lost-instruments YOUR_NAME_HERE

We welcome and encourage you to participate in any way.

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Reprinted from Instrumentation and Measurement Society Newsletter, Spring 1995 issue.

A Short History of French Trans-Atlantic Telegraph Cables from the French Viewpoint

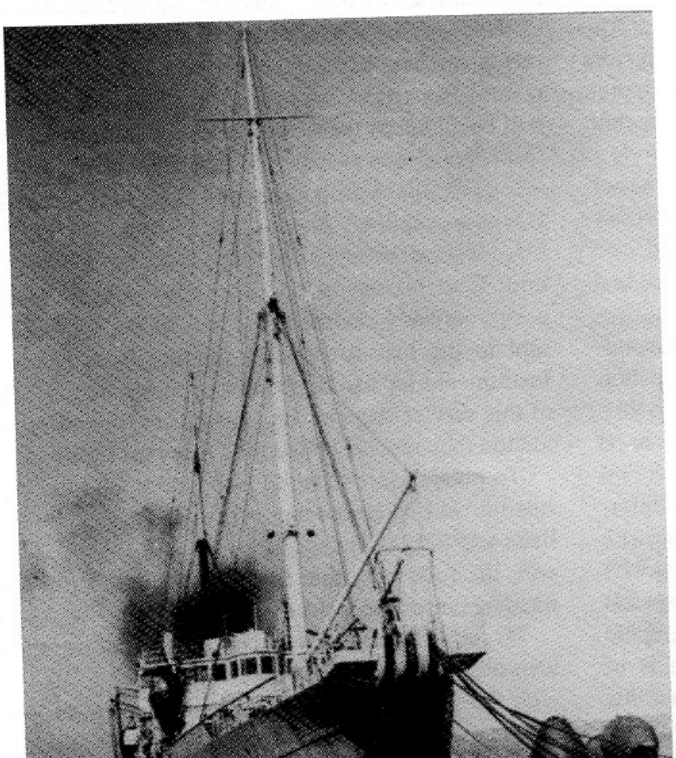
by René Salvador

In the Fall 1994 issue of *Instrumentation and Measurement Society Newsletter*, O.T. Carver published an article on the French Cable Station Museum at Orleans, Massachusetts. He felt it would be interesting to supplement this with a short history of French transatlantic telegraph cables as seen from the other side of the Atlantic. He asked me if I could help and I accepted with pleasure. Starting in 1948, I spent 40 years with France Telecom's submarine cables department. When I began as a young engineer, the old telegraph cables were still in service.

The early history of French trans-Atlantic telegraph cables was complicated by alternating periods of cooperation and head-on competition between French cable companies on the one hand and British and American companies on the other.

The first submarine cable linking Brest, Saint-Pierre and Cape Cod was commissioned by the *Societe du cable transatlantique francais* in 1869. The cable was manufactured by the Telegraph Construction and Maintenance Company and laid by the *Great Eastern* assisted by a number of auxiliary vessels. France's first submarine cable operator was, however, taken over by the Anglo-American Telegraph Company in 1873.

In 1879, Mr. Pouyer-Quertier founded a new firm, *Compagnie Francaise du Telegraphe de Paris a New York*, and commissioned a new cable linking Brest to Saint-Pierre with extensions to both Cape Cod, Massachusetts, and Cape Breton, Newfoundland. The firm soon became known as "PQ", after the founder's initials. The nickname was so popular that for many years, the British and continental Europeans referred to all French companies operating trans-Atlantic cables as PQ.

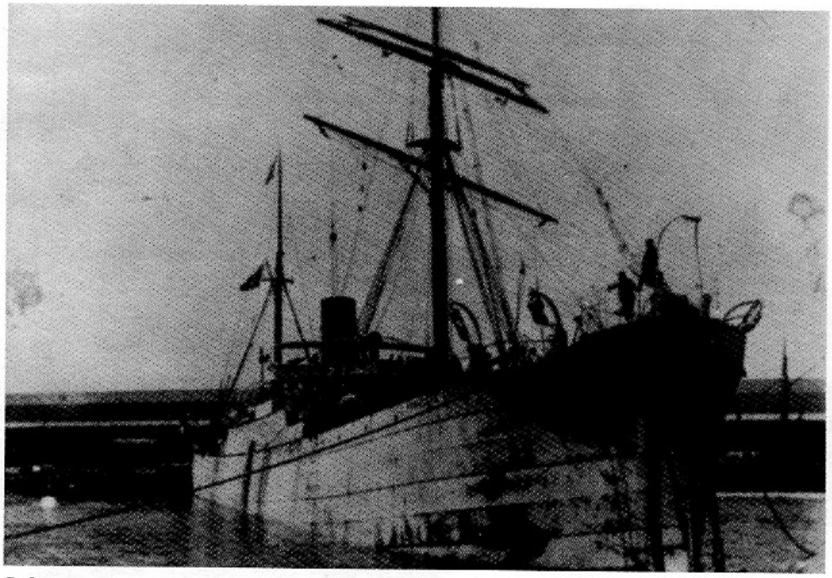


French submarine cable laying ship Pierre Picard.

In 1880, the company added an extension from Brest to Porthcurnow in Cornwall to pick up traffic from London. A little later, to avoid head-on competition, PQ signed a revenue-sharing agreement with the Anglo-American group.

In 1895, at Pouyer-Quertier's instigation, *Compagnie Francaise du Telegraph de Paris a New York* merged with *Societe Francaise des Cables Telegraphiques*, which retained the nickname PQ in France and became totally independent of the British and American companies. On the American side, the company was known as the French Telegraph Cable Company, or FTCC.

One of the first things the new company did was to lay a new cable from Brest to Cape Cod. Manufactured in Calais, France, by *Societie Industrielle des Telephones* (SIT), it took four expeditions by the French cableship *Francois Arago* during 1897-98 to lay. At 3173 nautical miles, it was the longest telegraph cable ever laid. The cable core weighed 300/180 kg/NM (i.e., 300 kg, of copper conductor and 180 kg of gutta-percha insulation per nautical mile). For deepwater sections, the core was pro-



Submarine cable ship Francois Arago, which laid the "Direct" in 1897-98.

tected by steel armor comprising 24 wires each 2 mil in diameter. The cable was particularly subject to twisting and kinking, making it difficult to handle and lay.

The first cable linking Brest to Saint Pierre and Cape Cod, which landed ate Duxbury, Massachusetts, was abandoned in 1893. In 1899, an extension was laid from Cape Cod to Coney Island, New York.

The PQ network comprised:

- the Brest-Saint-Pierre-Cape Cod cable laid in 1879,
- the Brest-Cape Cod cable laid in 1898 and known as the *Le Direct*,
- the Brest-Porthcurnow extension laid in 1880,
- the Cape Cod-New York extension laid in 1899.

In 1891, the US terminals were grouped together at the cable station at Orleans Cove, now the French Cable Station Museum.

On the French side, the first cable (laid in 1869) came ashore on a beach below the lighthouse at Le Minou on the north side of the entrance to the narrows leading from the open sea to Brest harbor. Starting in 1879, efforts were made to find a landing point further away from Brest. A small inlet at Deolen, 17 km west of Brest, proved ideal. Since then, all French trans-Atlantic cables have landed at Deolen. To avoid the long detour around Ouessant island, extensions to Porthcurnow landed at Brignogan to the north.

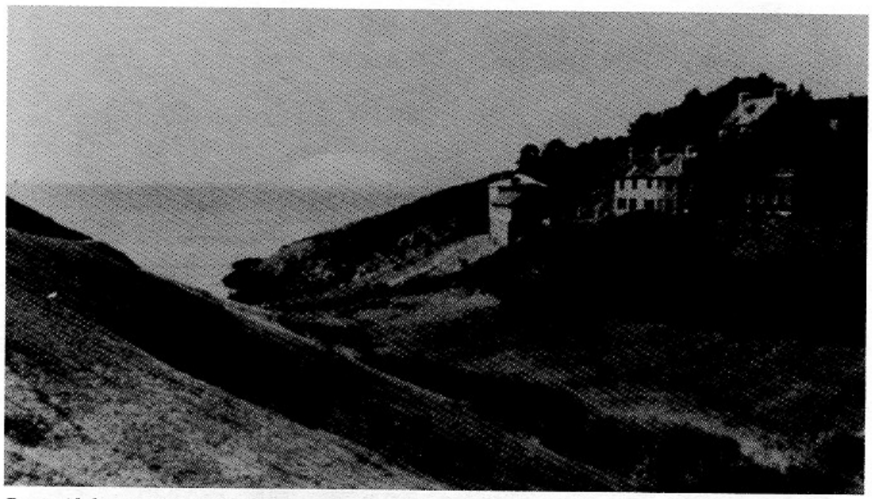
At the end of the first world war, the German cable linking Emden, Fayal (in the Azores) and New York was assigned to France. This was rerouted to Deolen in 1920 and its operation entrusted to PQ. To give London access to three trans-Atlantic cables, a second extension was laid between Porthcurnow and Brignogan in 1918.

In 1929, the Brest-Saint Pierre-Cape Cod cable was damaged by a submarine earthquake south of the Newfoundland Grand Banks and had to be abandoned.

Until 1925, there was no terminal station as such at Deolen, just a small building some 200 meters above the landing point. Here the Submarine cables were joined to a buried landline running 17 km to the main post office in Brest. The building also contained measuring equipment to monitor the submarine cables and locate faults on the sea end. The cables from Porthcurnow to Brignogan ran to a similar building then by buried landline to the Brest post office.

In Brest, messages were transferred manually from the trans-Atlantic cables to the lines to London and Paris. The receiver was a device known as an ink siphon recorder. The operator read the tape produced by the siphon recorder and copied it on a typewriter. The typewritten message was then passed to the telegraph operator connected to Paris via the French telegraph network operated by Baudot or to London via Porthcurnow. At first, transmission over the submarine cables was by operators using handkey senders. Later punched tape and automatic senders offered a more uniform transmission rate.

In 1922, PQ decided to centralize submarine cable operations at Deolen. The new station, built on the site of the former cable hut, was commissioned in 1925. It was superbly situated. The superintendent's house was on higher ground offering magnificent views over the Iroise sea, the local name for the approaches to the narrows leading to Brest harbor.



Beautiful site of the French terminal of the 3,173 nautical mile cable between Orleans, Massachusetts and Deolen, France. In the center of the photo is the terminal station building which housed the send/receive and regenerating equipment. The cable came ashore to the left and below the terminal station. Other buildings behind the terminal are the manager's house and auxiliary buildings. The terminal station no longer exists.

The new station featured more modern equipment and direct connections between the submarine cables and the telegraph networks linking Deolen to PQ's Paris office via the Deolen-Brest landline and the French telegraph network and to London via the Deolen-Brignogan landline and Porthcurnow. By this time, the latest receiving equipment at each end of the trans-Atlantic cables was the Heurtley magnifier (a type of hot-wire amplifier). This produced a signal strong enough to drive a regenerator which, as the name implies, accurately regenerated each dot, dash or space in the correct sequence.

Incoming signals from London or Paris for transmission over the trans-Atlantic cables went directly to a regenerator which acted as an automatic sender transmitting at a steady 450 center holes per minute for *Le Direct*. Given the cable's length (*and the fact that transmission speed is inversely proportional to square of the cable's length*) this was a remarkable achievement. It compared very favorably indeed with the Brest-Fayal cable which was only half as long, yet operated at just 660 center holes per minute.

The new equipment at Deolen also made it possible to upgrade *Le Direct* from simplex to duplex operation (i.e., simultaneous transmission in both direction). *The received signals being very weak, duplex operation required a bridge arrangement which, in turn, called for an "artificial cable" to balance the actual submarine cable. The cable's RLC characteristics were duplicated using "Muirhead boxes."* A 1450-F cable required an artificial cable comprising 60 to 70 Muirhead boxes. The new equipment was installed in a very large room in the station's basement. Mr. Bernard, the superintendent, became very adept at quickly readjusting the artificial cable each time repairs were made at sea.

In June 1940, the German army occupied Brest. The Brest-Cape Cod, Brest-Fayal and Brest-Porthcurnow cables immediately ceased operation. The German forces did not, however, damage any of the submarine cables in the Brest area. Further out to sea, the British cut them and attempted to divert them to the British Isles for their own use. Throughout the German occupation of France, the German army exercised strict control to ensure that none of the cable equipment was used for clandestine activities. On the other hand, nothing, was destroyed or removed. The Brest cable plant was placed under the control of a highly skilled German officer with specialist knowledge of submarine cables.

Brest and Deolen were liberated on 3 September 1944 after a 40-day siege, including heavy shelling and bombing. But the cable station was intact and, thanks largely to the courage and efficiency of superintendent Bernard, the Germans left without destroying this important resource. As a result, the station itself was ready to operate almost at once.

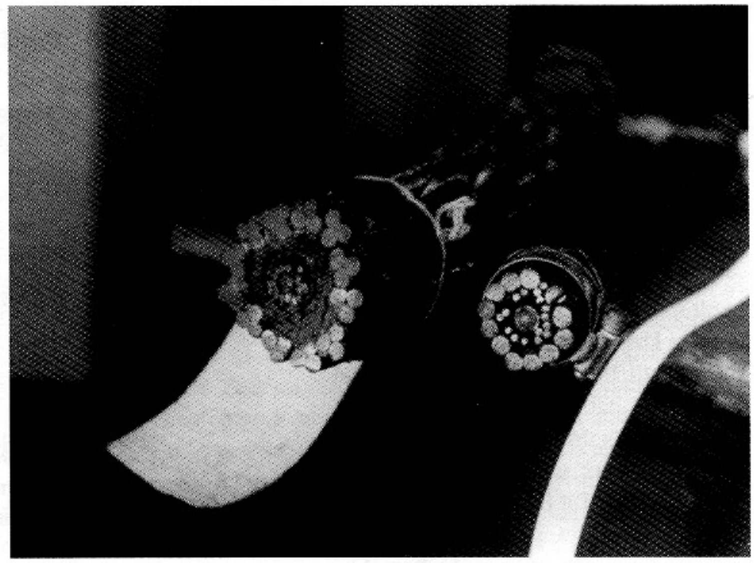
By 1945, the Brest-Fayal-New York link had resumed service after having been repaired by British cableships. To improve the connection with London, one of the Brignogan-Porthcurnow cables was rerouted to Deolen via a submarine extension in 1947.

It took much longer to repair *Le Direct* as it was broken and damaged in many places including at least three at depths between 4,000 and 5,000 meters. Repair work was undertaken by the *Pierre Picard. Built in France in 1913* and operated by PQ as the *Edouard Jeramec*, she had been sold to All America Cables in 1929. In 1946 she was repurchased by the French PTT administration and renamed the *Pierre Picard*. Work began on the western side of the Atlantic. The *Pierre Picard* left Le Havre in January 1949 and began repairing the shallow-water section (down to 200 m) on the continental shelf off Cape Cod and out to about 200 nautical miles.

Photo taken in 1949 during replacement of the shore end at Orleans, Cape Cod. Note the cable being loaded on the barge from the Pierre Picard.

Photo was taken at the wharf in Halifax, Nova Scotia in 1949. Shows the staff of the Pierre Picard. On the right is Captain Thibaudeau. Next to the Captain is the author: Rene Salvador. The ships in the background are the cable ships John W. McVay on left and Pierre Picard.

Rene Salvador: French Telecom submarine cable engineer; Director of submarine cable Department from 1973-1984



Two pieces of submarine cable are shown: a shore-end section on the left and the deep water section on the right. The shore-end section is more heavily protected because of the likelihood of accidental damage. Photo taken at Orleans French Cable Museum — OTC)

Ten or more breaks were repaired in this section including one very close to the Orleans Cove shore-end. In May 1949, a new shore-end was laid.

The first deepwater break, south of Halifax, Nova Scotia, was not due to natural causes. In 1941, the British had decided to use the Brest-Cape Cod cable to provide an additional link between Halifax and Porthcurnow. The western derivation was installed, but work on the eastern derivation had to be abandoned due to the threat posed by German U-boats. When the *Pierre Picard* arrived on the scene in 1949, neither the PQ management nor the French PTT administration were aware of what had happened. During a stopover in Halifax, the officers of the *Pierre Picard* had the immense good fortune to meet those of the *Cyrius Field.* Just before they were scheduled to set sail, the officers of the *Pierre Picard* learned what they needed to know, making their task considerably easier than it would otherwise have been.

The *Pierre Picard* returned to Brest in September 1949 after completing all necessary repairs between Cape Cod and a point in the mid-Atlantic north of the Azores. Much work remained, however. The author remembers this eight-month expedition particularly well. Up to 35 days were spent at sea between ports. As a young engineer, I assisted Mr. Mangon who had been a senior cable engineer with PQ before the war. It took two more summer expeditions to finish the job. Given the cable's susceptibility to twisting and kinking and the weather in the North Atlantic, summer was the only season deepsea repairs could be undertaken with a fair chance of success. Only in 1962 did *Le Direct* return to service.

In 1945, the *Compagnie Francaise des Cables Telegraphiques* closed down. The French government asked the country's other cable operator, *Compagnie des Cables Sud-Americains,* popularly known as "Sudam" to take over PQ's trans-Atlantic cables. The company continued to be known as FTCC in the United States, and as PQ in France and Britain. Customers in both European capitals had long been accustomed to writing "via PQ" on their telegrams to America.

The French PTT administration operated two other cables from Brest; one to Casablanca, Morocco, the other to Dakar, Senegal. Both came ashore at the lighthouse at Le Minou, the landing point for the first Brest-Saint Pierre cable laid in 1869. Before the war, both were connected to buried landlines running to the terminal equipment at Brest's central post office. With the post office destroyed during the siege of 1944 and the new one unable to accommodate the cable terminals, they were transferred to Deolen. For a time, the PTT administration and Sudam shared the Deolen station, the former occupying the first floor, Sudam the second. In 1952, the PTT transferred the operation of its African cables to Sudam and the Deolen station was once again under the management of a single organization.

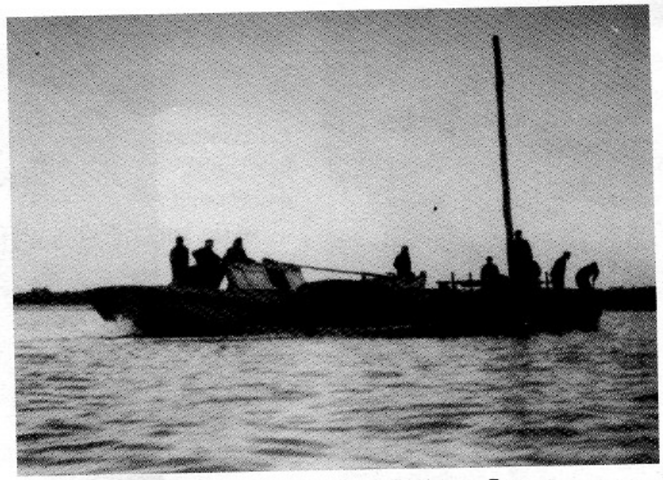
In engineering and operational terms, the basic principles were the same as they had been before the war. Regeneration and direct retransmission, element by element, to London and Paris and direct transmission of signals over the submarine cables after regeneration. The main improvement in the immediate post-war period was a device to relay the recorded signal to a normal harmonic telegraph channel on the landline network.

Leg Direct was abandoned in 1959. In France,1959 proved a big year for submarine cable in central. Two major events marked the end of an era and the beginning of a new one. First, *Compagnie des Cables Sud-Americains* became *Compagnie Francaise de Cables sous-marins et de Radio*, or FCR. Second, the

TAT 2 trans-Atlantic telephone cable was commissioned to take over from the TAT I cable laid in 1956. FCR obtained rights to operate telegraph circuits using the TAT 2 cable enabling it to expand its activities as a "record carrier". FCR also went on to become a driving force behind French participation in the development of modern submarine telephone cables.

The Deolen station remained operational until 1962 when the Brest-Fayal-New York cable was abandoned, after which FCR sold the land and building. The equipment was removed and dispersed, most of it being destroyed. Fortunately, a few items were saved, including two Heurtley magnifiers. One of these is to be seen at the Pleumeur-Bodou telecommunications museum in Brittany, the other is part of the historic telecommunications collection in Paris. Other surviving items are displayed by various organizations and at FCR's head office in central Paris.

It is a pity that Deolen in Brittany was not made into a museum similar to that at Orleans, Massachusetts. On the other hand, thanks to the efforts of everyone associated with the French Cable Station Museum project, the world now has access to the heritage of some 60 years of service provided by *Leg Direct* and FTCC, or, as we say in France, PQ. During those 60 years, the Orleans station was an important link in the saga of submarine telecommunications that began with the first cable between England and France in 1851 and today includes a world-encircling network of fiber-optic cables. Since the introduction of fiber optics, submarine cables are again one of the most efficient ways of moving information between continents.



The barge in this photo is moored in Orleans Cove, very near the present Orleans French Cable Station Museum on Cape Cod, Massachusetts.

René Salvador, Ingenieur General des Telecommunications, retired (translated and adapted from the French by Steve Dyson).

Congress Salutes Our Profession During National Engineers Week 1995

U.S. senators and representatives paid tribute to the engineering profession during National Engineers Week, held Feb. 19-25. Some of the lawmakers' remarks, published in the *Congressional Record*, are excerpted below:

Rep. John N. Hostettler, R-Ind., noted that "National Engineers Week is celebrated around George Washington's birthday for a reason. Washington had the educational background of an engineer and land surveyor and is considered the nation's first engineer. I have been a registered professional engineer for only three years, but I have seen this country's technology and quality of life advance tremendously, largely due to its 1.8 million engineers."

Also a registered engineer, **Rep. Jay Kim, R-Calif.,** noted that "Engineers are hardworking, honest and professional, but most are low-key, shy and don't seek credit for their accomplishments. I can say this because I am an engineer. During National Engineers Week, engineers go public to increase recognition of the contributions that engineering makes to the quality of our lives."

Rep. Robert S. Walker, R-Pa., chair of the House Science Committee on Commerce, stated, "From building microchips to constructing skyscrapers, engineers contribute a great deal to the United States' productivity, and it is only fitting that we designate this week in their honor."

Sen. Larry Pressler, R-S.D., chair of the Senate Committee on Commerce, Science, and Transportation, urged his colleagues to "try to imagine what our lives would be like without engineering achievements . . . From clothes to communications, medicines to microwave ovens, television to transportation, potato chips to microchips, the work of engineers touches every aspect of our lives."

A former Presidential candidate and long-time Member of Congress, **Sen. Paul Simon, D-Ill.,** commended engineers for "their technological breakthroughs that have enabled people around the world to live healthier, more efficient and more fulfilling lives."

Reprinted from IEEE USA Legislative Report, May 10, 1995

Congress Acts on Tort Reform

Angry debate, charges, claims and counter arguments echoed in the Capitol when Congress returned from the Easter recess on April 24. The Senate that day began consideration of a bill to limit the liability of manufacturers of faulty products, a process expected to tale about two weeks. S. 565 sets national standards on law suits over faulty products and limits punitive damages to $250,000—or three times a victim's economic damages.

During early March the House passed three bills that affect product liability. The most far-reaching (HR 965) was approved March 10 by a vote of 265-161. Its main provisions are as follows:

- Preempts state laws and sets a national standard for lawsuits;
- Limits punitive damages to the greater of $250,000 or three times the economic damages;
- Requires "clear and convincing evidence" that a manufacturer either intended to cause harm or acted with conscious, flagrant indifference for punitive damages;
- Bars damages if the plaintiff was intoxicated or under the influence of drugs;
- Makes retailers liable only if they engaged in intentional wrongdoing, negligence, or if the product failed to comply with an express warranty made by the retailer; and
- Prohibits filing suit against the maker or seller of a product if that item was manufactured or sold more than 15 years in the past, a provision called a statute of repose.

Separate legislation requires the loser of any lawsuit to pay the winner's legal costs if the loser rejects a settlement offer.

When the House considered HR 967 (on March 8), it became difficult to decide whether the members were addressing the same bill. Advocates of reform—Rep. Henry Hyde (R. Ill.), for instance—said lawsuit abuse "harms American industry and American workers" and discourages employers from making better and more innovative products." The annual cost of the tort system, he said, is $117 billion, "the most costly system in the world." He quoted the Commerce Department's estimate that only 40 cents of each dollar spent in product liability lawsuits reaches the injured victim.

Democrats who oppose the bill called it "a frontal assault on consumers" and charged that corporate pressure was behind the Republican efforts to change the law. These charges—by Rep. John Conyers (D, Mich.) were echoed by Rep. Pat Schroeder (D, Colo.), who said that unnamed "fat cats" were getting their reward with this bill. They are "going to get their tax cuts and a huge liability shield." Rep. Barney Frank (D, Mass.) charged the Republicans with inconsistency in "federalizing tort law" at a time when they argue for the devolution of many Federal functions to the states.

Rep. Thomas Bliley (R. Va.) offered his set of statistics, to-wit: between 1973 and 1988 product liability suits in Federal courts increased 1000 percent. In state courts the increase was between 300-500 percent. One estimate of the total cost of these suits is $132 billion a year, "a sum equal to the combined profit of the nation's 200 largest corporations."

For the past several years, IEEE-USA has joined organizations promoting industrial competitiveness in a campaign to reform product liability laws. Working through the American Association of Engineering Societies (AAES), IEEE-USA argues that Federal legislation is needed to supplement the current patchwork of state liability laws. In a statement sent April 26 to key senators, AAES said that costs and uncertainties under the present system frustrate innovation. Although the shift varies by industry, "potentially valuable technologies and innovations are abandoned because of the fear of unjustified risk imposed by the current tort system."

Noting that "as practitioners of innovation, engineers are particularly susceptible to the system's unpredictability," AAES also called for amendments to apply reforms "to both products and services, particularly in fundamental areas such as joint and several liability and punitive damages."

Upcoming Conferences

THE THIRD THEMATIC CONFERENCE ON REMOTE SENSING FOR MARINE AND COASTAL ENVIRONMENTS

Seattle, Washington 18-20 September 1995
Contact: Erim Conferences, (313) 994-1200, ext. 3234,
Fax: (313) 994-5123

OCEANS 95 MTS/IEEE

San Diego, California 9-12 October 1995
Contact: Bob Wernli, (619) 553-1948, Fax: (619) 553-1915,
wernli@nosc.mil

OCEAN CITIES

Monaco 20-23 November 1995
Contact: Ocean Cities '95 General Secretariat, SEE*48, rue de Procession, F-75724 PARIS Cedex 15, FRANCE

OFFSHORE TECHNOLOGY CONFERENCE

Houston, Texas 6-9 May 1996
Contact: OTC, (214) 952-9494, Fax: (214) 952-9435

AUV '96

Monterey, California 3-6 June 1996
Contact: Don Brutzman, (408) 656-2149,
Fax: (408) 656-3679, brutzman@nps.navy.mil

PACON '96

Honolulu, HI June 16-20, 1996
Contact: Pacon International
P.O. Box 11568, Honolulu, HI 96828

AUV '96 MONTEREY CA.

CALL FOR PAPERS

SYMPOSIUM ON AUTONOMOUS UNDERWATER VEHICLE TECHNOLOGY

June 3-6 1996, Monterey California

The *IEEE Oceanic Engineering Society* is sponsoring a symposium on Autonomous Underwater Vehicle Technology to be held in Monterey, CA. at the Hyatt Regency Hotel on June 3-6, 1996. The objective of the Symposium is to disseminate knowledge of recent technological advances in the field, to be a focus for the current state of the art including identification of technology shortfalls and to provide a forum for discussion of new relevant ideas.

TOPICS

The Symposium will focus on topics that are related to the AUTONOMOUS OPERATION OF UNDERWATER VEHICLES. These include but are not limited to :

- Sensors and Multi-Sensor Fusion
- Navigation, Redezvous and Docking
- Modeling and Simulation Methods
- Energy Systems
- Vehicle Design and Control
- Biological Models
- Multiple Cooperating Vehicles
- Communications and Telemetry
- Imaging Techniques and Systems
- Mission Control and Software Architectures
- Autonomous Manipulation
- New Concept Vehicles for Mine Countermeasures
- Oceanographic Sampling Networks
- Mission Scenarios

The Symposium will include Tutorials on June 3, a **VIDEO PROCEEDINGS**, visits to area technical attractions including the Naval Postgraduate School AUV Test Facility and Virtual Reality Laboratory and the Monterey Bay Aquarium Research Institute Laboratories at Moss Landing. Other area attractions include Stanford University and NASA AMES Research Center. Tourist attractions include the Monterey Aquarium, Carmel and the Big Sur Coastline.

ABSTRACTS

Prospective authors are invited to submit proposed abstracts (300-500 words) by electronic mail. Providing hardcopy backup is optional. Include a paragraph containing title author names, addresses with one author named as the point of contact including phone and fax numbers. Acceptance is by committee review of abstracts. Faxed abstracts will not be considered. Authors must describe the problem addressed, solutions obtained and importance of the contribution to AUVs. Questions are alsways welcome Send abstracts to:

Don Brutzman, Ph.D., Technical Program Chair, brutzman@nps.navy.mil
Undersea Warfare Academic Group, UW/Br
Naval Postgraduate School
Monterey, CA 93943 Ph. 408-656-2149 Fax: (408)-656-3679
AUV '96 Home Page: http: //www.cs.nps.navy.mil/research/auv/auv_96.html

DEADLINES

The following deadlines have been established and it is essential that authors and contributors meet these dates. Thanks

Abstracts (Electronic Copy) Due:	**October 15, 1995**
Notice of Acceptance and Authors Kits Distributed	**December 15, 1995**
Full Paper Manuscript (Camera Ready)	**February 1, 1996**
Video Submissions Due	**March 1, 1996**

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS
OCEANIC ENGINEERING SOCIETY

***** **CALL FOR VIDEOS** *****

IEEE Oceanic Engineering Society

Symposium on Autonomous Underwater Vehicle Technology

AUV 96

June 3-6, 1996 * Hyatt Regency Hotel * Monterey, California, USA

The IEEE Oceanic Engineering Society is sponsoring the next Symposium on Autonomous Underwater Vehicle Technology (AUV 96) on June 3-6, 1996. The Symposium will be held at the Hyatt Regency Hotel in Monterey California USA.

The Symposium will focus on topics that are related to the

AUTONOMOUS OPERATION OF UNDERWATER VEHICLES

These include but are not limited to:

- Sensors and Multi-Sensor Fusion
- Navigation, Rendezvous and Docking
- Modeling and Simulation Methods
- Energy Systems
- Vehicle Design and Control
- Biological Models
- Multiple Cooperating Vehicles
- Communications and Telemetry
- Imaging Techniques and Systems
- Mission Control and Software Architectures
- Autonomous Manipulation
- New Concept Vehicles for Mine Countermeasures
- Oceanographic Sampling Networks
- Mission Scenarios

Current and archival footage of events significant to the development of autonomous underwater vehicle technology and applications are welcome. Video segments demonstrating results described in the conference proceedings are particularly appropriate.

Video clips from one to five minutes length are suggested. Early electronic submission of an abstract describing the video is most strongly encouraged and will directly impact inclusion of the clip if space becomes an issue. Written abstracts describing the video should accompany each clip. Abstracts should not exceed 100 words, and should also include title, author names, organizational affiliation, address and phone/fax/e-mail as appropriate. If email is not possible, inclusion of an additional abstract copy in electronic form (ASCII or WordPerfect diskette) with the film clip is appreciated.

Clarity and technical content of the video submissions are essential. Narration and audio are critical components. Entries must be edited to provide a high quality, quickly-paced presentation of general interest to symposium attendees.We can accommodate standard play (SP) VHS, Super VHS and 8mm camcorder tape. Extended play (EP/LP) format VHS is unacceptable due to poor video quality. Please label your videotape mailer "Magnetic Media Enclosed."

All selected videos will be professionally compiled without individual clip editing onto a single master, duplicated, and provided to conference attendees with the printed proceedings at no extra charge.

Call for Videos:	September 1, 1995
Video Submission Deadline:	March 1, 1996
Notification of Video Acceptance:	May 1, 1996
Final Production:	May 15, 1996

Mail tapes and abstracts to:

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(408) 656-2056 work, (408) 656-3679 fax

Visit the AUV 96 World-Wide Web page at **http://www.nps.navy.mil/research/auv/auv_96.html**