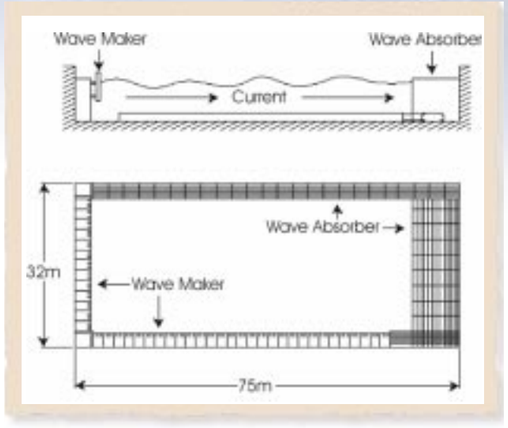
IMD Offshore Engineering Basin - Facility Specifications

Length	75m
Width	32m
Max. Water Depth	3.2m
Wave Making System (Power)	1800kW
Max. Wave Height (Regular Waves)	1m
Sig. Wave Height (Irregular Waves)	0.5m
Wave Lengths	0.5m to 20m
Wave Repeatability	High
Articulation of Waves (Modes)	Flapper
	Piston
	Combination
Wave Spectra	Regular
	Irregular
	Bi-modal
	Multi-directional
Current Speed	Water-depth Dependent (0.25m/sec at 2m depth)
Average Wind Velocity	11m/sec at 1m from Fan
	5m/sec at 5m from Fan
Turbulent Wind Spectrum Mean Speed	12m/sec
Wind Spectra	American Petroleum Institute Standard
	Norwegian Petroleum Directorate Standard
	Other Industry Standards
Optical Tracking System Accuracy	
Moored Models	±1mm
Free-running Models	±5mm



▲IMD Offshore Engineering Basin

Specification sheets are available for all major facilities, including:

- IMD Offshore Engineering Basin
- IMD 200 Meter Towing Tank
- OERC 58 Meter Towing Tank
- IMD 90 Meter Ice Tank
- IMD Cavitation Tunnel
- MI 22 Meter Flume Tank
- MI Centre for Marine Simulation

Specification sheets can be obtained from the Oceanic website or by contacting our main office.

Visit our NEW Website

www.oceaniccorp.com

Read about it on page 7 of this issue...

OCEANIC CONSULTING CORPORATION

95 Bonaventure Ave., Suite 401,
P.O. Box 28009, St. John's,
Newfoundland, Canada
A1B 4J8

Telephone: (709) 722-9060
Facsimile: (709) 722-9064
Email: oceanic@oceaniccorp.com
URL: http://www.oceaniccorp.com

OCEANIC CONSULTING CORPORATION

making waves

NEWSLETTER OF OCEANIC CONSULTING CORPORATION

SPRING/SUMMER 2001

ANNIVERSARY ISSUE

Charting the Course

▲Dan Walker, President, Oceanic Consulting Corporation

Welcome to the anniversary issue of *Making Waves*. We launched our first issue of this newsletter in the spring of 1999, in time for the Offshore Technology Conference (OTC). Since this issue is being produced in time for OTC this year, an offshore theme has again been adopted. However, Oceanic offers services in other sectors of the marine industry and we have made progress in each of those sectors over the past two years.

Oceanic began an aggressive marketing strategy two years ago to increase awareness of the track record of the Newfoundland ocean engineering research community. While our brand name, Oceanic Consulting Corporation, is less than three years old, our research efforts in Newfoundland are more than thirty with the start of the Ocean Engineering Research Center in the 1960s at Memorial University. Since that time, the development of Oceanic's participating organizations - National Research Council of Canada, Memorial University of Newfoundland and Marineering Limited - has been monumental. Over 200 researchers and professionals are at work in areas from sea trials of fishing technology to algorithm development of dynamic positioning systems.

Oceanic has been applying its expertise to a variety of marine projects worldwide. Currently, we are carrying out the hydrodynamic evaluation for the Swiss 2003 America's Cup challenge, conducting tests on an integrated tug and barge for transport of crude oil, and testing our sixth floating production storage and offloading vessel in the past two years. Since last year's OTC, Oceanic has completed tests on three designs of gravity base structures, and has performed a full-scale evaluation of ice abrasion on an oil transfer hose. Other areas of business have included towed systems for the geophysical industry and underwater vehicles.

Thank you for taking the opportunity to read our newsletter. If you are a client of our firm, or our community, I would also like to thank you for your business. If you are not, I hope we can be of service in the near future.

Dan Walker, Ph.D., P.Eng.
President

In This Issue...

Meet Us At:

OFFSHORE TECHNOLOGY CONFERENCE

Houston, Texas
April 30th - May 3rd
Booth 7545

OFFSHORE NEWFOUNDLAND PETROLEUM SHOW
JUNE 21-22, 2001
MILE ONE STADIUM, ST. JOHN'S NEWFOUNDLAND, CANADA

St. John's, Newfoundland
June 21st - 22nd
Booth 1008

An Ocean Technology Cluster

Oceanic Consulting Corporation has become widely known in the international marketplace as a supplier of marine performance evaluation services. Now, one of Oceanic's participating organizations, the National Research Council of Canada (NRC), is assisting in the development of an ocean technology cluster in St. John's. The initiative will link entrepreneurs, research institutions and technology firms in a network of alliances that will allow our community to secure a leading position in the global marketplace.

The effort will provide us with more expertise and resources in key areas related to offshore deepwater structures, sea ice and ice loads on ships, propulsion and thrusters, ocean environmental monitoring and engineering for sustainable fish production. NRC's proposed contribution to the development includes an expanded research mandate at the Institute for Marine Dynamics (IMD), development of an ocean engineering incubator facility in cooperation with Memorial University of Newfoundland (MUN), a young entrepreneur program, and facilitation of building alliances within the community. *(For more information, contact Derek Yetman, IMD)*

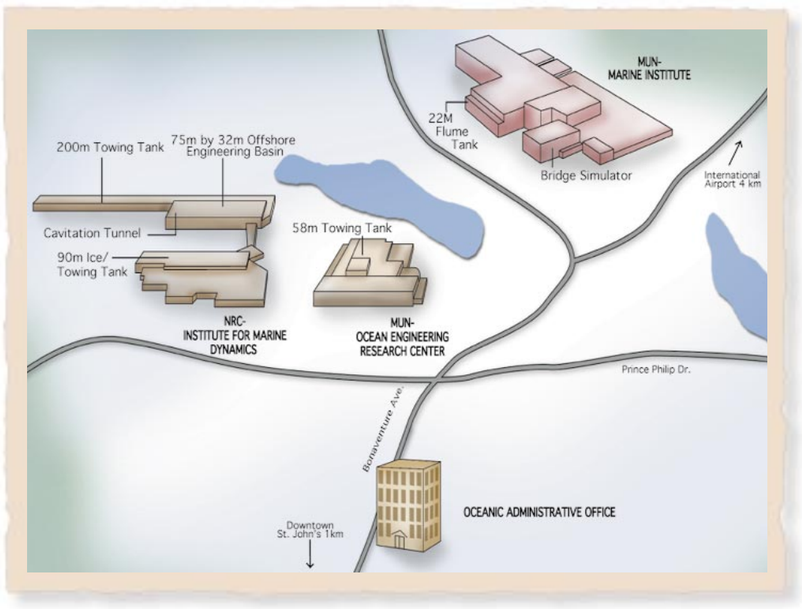
▲ National Research Council of Canada - Institute for Marine Dynamics

Areas of Research Within the Oceanic Alliance

NRC - Institute for Marine Dynamics
- Ship Dynamics
- Offshore Dynamics
- Hydrodynamic Technologies
- Propulsion System Technologies
- Wave Loads and Impacts
- Environment and Safety
- Ice Effects on Marine Systems
- Underwater Vehicle Technologies

MUN - Ocean Engineering Research Center
- Hydrodynamics
- Numercial Modeling
- Structural Analysis
- Risk Analysis
- Ice Engineering
- Controls
- Environmental Engineering

MUN - Marine Institute
- Ship Simulation
- Navigation and Blind Pilotage
- Dynamic Positioning Simulation
- Ballast and Cargo Operations
- Engine Room Simulation
- Fishing Technology



▲ Facilities - St. John's, NF

Clam Dredge Dynamics

To efficiently harvest clams from the seafloor, it is important to understand how the motions of a towed clam dredge are affected by the motions of the towing vessel. Grand Banks Seafoods recently contracted Oceanic to study the manner in which their novel clam dredge design responds to the motions of the towing vessel. While some preliminary full-scale assessments of clam dredge motions and fishing efficiency had been undertaken by the client, it was recognized that minimal knowledge exists relating to clam dredge performance.

Using recorded motions for vessels presently operating in the harvesting fleet, Oceanic undertook a test program in which the effects of these motions were imposed on a clam dredge model so that the dredge's performance could be appraised. To our knowledge, this program was the first attempt to evaluate this technology at model scale. The clam dredge system was modeled at a 1:15 scale and was tested in the 22 Meter Flume Tank at the Marine Institute. The effects of vessel motion, hawser loads, tow cable tension and dredge loading were measured so that subsequent analysis of the test data identified the operational parameters for the dredge. Ultimately, this work will assist Grand Banks Seafoods in fine-tuning their design such that they will be able to deliver a superior fisheries product to market.

▲Model of Clam Dredge

www.oceaniccorp.com - *A New Site is Launched*

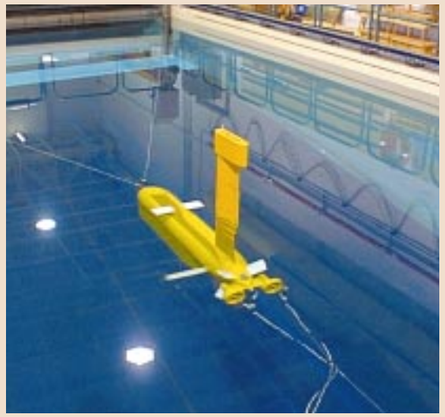
Oceanic is pleased to announce that it has launched its new website. Designed to be informative and user-friendly, the website provides information for each sector of the marine industry that we serve. Information is also provided on our recent developments, initiatives, job opportunities and tradeshow appearances. Visitors can download and print Oceanic publications, and in the near future, our clients will be able to securely access up-to-date information on their particular projects. And, to measure client satisfaction, there is an on-line form under the section *Services*. We would very much appreciate your feedback through this, or any other means.

Oceanic aims to provide current and future clients with information that they require to make informed decisions about choosing service providers. Furthermore, we are dedicated to continuously improving our services, both technically and commercially, and we need your advice to make the most improvement possible. *Please visit us at www.oceaniccorp.com*

▲ Oceanic Serving the Marine Industry Worldwide

A Break from Tradition in Subsea Intervention

With the increasing development of offshore oil and gas fields in deepwater locations, new technological challenges are faced in subsea intervention. To ensure that the development and operation of these fields is economically viable, and to more aggressively pursue new oil and gas reserves, continued investments in technology are required to ensure that equipment reliability is high and that subsea maintenance and repair costs are minimized.



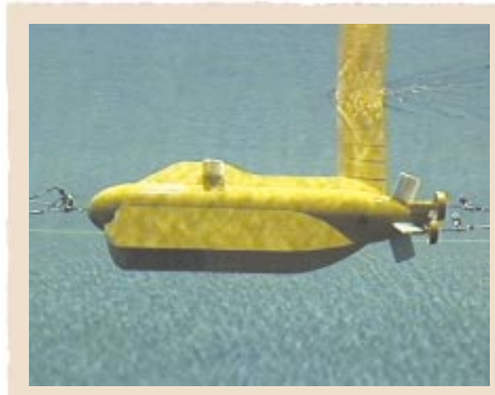
▲ Above-water View of Model Test of AUV

One innovative approach to subsea intervention is the use of a hybrid Autonomous Underwater Vehicle - Remote Operating Vehicle (AUV-ROV) rather than a conventional ROV tethered to a surface support vessel. An AUV can work independently from its base while it completes its mission, which can include anything from environmental monitoring and fault detection to pipeline surveillance and repair.

Testing of this concept was the subject of recent work undertaken by Oceanic. An evaluation of a proposed AUV/ROV hybrid design was completed using both numerical and physical modeling to address hydrodynamic characteristics of the design and to explore the likely performance envelope in current and waves. Preliminary motion predictions were made using Oceanic's seakeeping software MOTSIM. This provided the opportunity to determine if there were any hullform sensitivities over the anticipated range of operating conditions.

Subsequent physical experiments were conducted using a 1:10 scale multi-segmented model. To allow for test configurations in both transit and ROV-deployed conditions, the mass properties of the primary vessel components (i.e. the AUV and the ROV) were modeled individually. Drag data for various vehicle orientations was obtained using the 22 Meter Flume Tank at the Marine Institute. Tests in waves were completed in the IMD 200 Meter Towing Tank where the ROV was deployed from the AUV. A variety of headings and operating depths was examined for wave conditions ranging from the expected normal operating conditions through to a near survival condition. Final data products included wave elevation, drag loads, rigid body motions, mooring loads and ROV tether loads.

Application of the hybrid AUV-ROV technology is intended to revolutionize the way designers and operators of subsea facilities, and others requiring subsea inspection and intervention, plan and conduct their operations. It is expected that the construction and production segments of the offshore industry will turn to some form of AUV/ROV to meet the challenge of economically developing deep-water fields. *(For more information, contact Carl Harris)*



▲ Underwater View of Model Test of AUV

Removing Risks of Offshore Offloading Tasks

In last year's newsletter (Winter 2000), we told you about a dynamic positioning (DP) system developed by the Institute for Marine Dynamics (IMD) for use in model test programs. IMD's DP system has been used with great success in commercial testing of a moored Floating Production Storage and Offloading (FPSO) vessel and a free-floating semi-submersible. The system has also been used in research work of the type described here.

▲ Tandem Study of FPSO and Shuttle Tanker

Current FPSO and shuttle tanker control technology utilizes an uncoordinated approach in which the shuttle tanker is "slaved" at the stern of the FPSO. In actual operations around the world, problems with this situation have included excessive surfing, fishtailing and yawing motions by the trailing shuttle tanker. Since the shuttle follows the FPSO, the excursions that the shuttle must take are amplified by the resulting large yawing radius of the system. Vessels maneuvers are often coordinated manually by the operators. For example, if the shuttle tanker captain has difficulty maintaining station due to changed environmental conditions, he has to request a heading change by the FPSO. Such operations are fraught with hazards due to limited level of communication between the ships and the shipboard systems.

It is our belief that by coordinating the two vessels using a supervisory control scheme, some of the risks may be removed from the FPSO-shuttle tanker's offloading task. This summer, model tests will be conducted in IMD's Offshore Engineering Basin to evaluate the effectiveness of such a controller towards improved performance and freedom from collision. *(For more information, contact Jim Millan, IMD)*

Simulating Damage to Moorings

Mode-scale evaluation of a catenary mooring often requires examining the response of the system to the loss of one or more mooring lines under storm conditions. The Instrumentation Group at IMD has developed a device that allows Oceanic to include this type of instantaneous damage simulation within a normal 'intact' test matrix. When the required damage scenario has been established with the designer, usually identifying the most heavily loaded line(s), the test is repeated with the small lightweight fused-release element replacing the load cell on the desired leg. With the same overall dimensions and connection details as the load cell, this substitution can be made quickly, and without affecting the line pre-tension or load-excursion characteristics of the mooring. Initiating the damage is as simple as pressing a button, and at the clients' discretion the release can be timed to occur at some arbitrary point within a wind/wave spectrum, or to coincide with a particular wave grouping. *(For more information, contact Bruce Paterson or Ed Kennedy, IMD)*

▲ Fused-release Element Replacing Load Cell

Meeting Changing Demand: R&D Trends in Offshore Operations

As the oil industry pushes the envelope of technology to tap reserves at sea, external support is often required to assess the feasibility of new and existing concepts. To meet this demand, one of the principal areas of Oceanic's business is the assessment of offshore structures and equipment. Supported by a broad base of researchers, Oceanic has the expertise to provide the oil industry with accurate and timely performance evaluation services. The diversity of projects that have been undertaken is illustrated here with some examples.

Side-by-side Vessel Mooring Configuration

A side-by-side vessel mooring configuration tested by Oceanic included a Catenary Anchor Leg Mooring (CALM) buoy, Floating Storage and Offloading (FSO) vessel and shuttle tanker. Modeled at a scale of 1:60, the system was tested for component interaction, hawser and mooring line loads, and motions in wind, waves and current. The primary environmental combinations were collinear wind, waves and current and collinear wind and waves with a current at a ninety-degree relative angle. Three-hour storms were simulated and tests were conducted at fully loaded and ballasted conditions to represent the likely extreme differences in vessel draft due to cargo transfer. For selected combinations of environment and vessel loading, tests were repeated with the most heavily loaded CALM buoy mooring leg disconnected once the system achieved a state of equilibrium. *(For more information, contact Ron Drodge)*

▲Model Test of Side-by-side Configuration

Disconnectable Buoy Turret Mooring System

The ability to quickly disconnect from an oil well and move a production vessel off-site provides operators with the flexibility to avoid severe weather, icebergs, or heavy sea-ice. Oceanic explored this concept by evaluating a disconnectable system that included a Floating Production Storage and Offloading (FPSO) vessel, turret and buoy. Also modeled at a scale of 1:60, the system was evaluated for different environmental conditions, including wind, wave and current loads. During simulated three-hour storms, the fully loaded FPSO was tested with the system connected. The significant motions and accelerations of the buoy and the FPSO as well as mooring line tensions were measured. Disconnects during a storm were also modeled with additional tests undertaken to study the response of the disconnected buoy. The results demonstrated that disconnects were achieved without interference between the buoy and FPSO hull, risers and mooring lines. These tests allowed the owners to define the system's operational parameters to safely maximize oil production without endangering the production vessel or the environment. (*For more information, contact Ron Drodge)*

▲Model Test of Disconnectable Buoy Turret Mooring System

Gravity Based Structure (GBS), Single Anchor Leg Mooring (SALM) Buoy and Floating Storage and Offloading (FSO) Vessel

Using the expertise of Oceanic on a series of projects, Sakhalin Energy Investment Company Ltd. recognized the value of model testing to their operations in three oil fields offshore Sakhalin Island, Russia. In addition to withstanding sea loads, a particular challenge of operating in the Sakhalin Island area is dealing with the moving pack ice from late Fall to early Spring. With a history in modeling severe seas and evaluating ice loads, Oceanic could accurately test aspects of the Sakhalin Island operations and suggest improvements to increase productivity.

In the first oil field, Piltun-Astokhskoye I, the Sakhalin facility consists of a GBS (Molikpaq) production platform, SALM and a FSO. Oceanic was initially contracted to investigate the effects of green water loading on the topside of the Molikpaq GBS. At a scale of 1:40, the model included a number of wave deflector concepts that were tested to determine which performed best in a given set of conditions. Based on the results, the height of several of the deflectors around the structure was increased.

Later, Oceanic was contracted to evaluate ice loading on the SALM/FSO system. Conducted in the IMD 90 Meter Ice Tank, the test examined loading on the SALM unijoint and hawser and included various options to protect the SALM from ice damage. The effect of side loading and astern loading of ice on the FSO-offloading tanker was also evaluated.

▲GBS Model Ready for Testing in IMD Offshore Engineering Basin

After testing the structures, Oceanic investigated the effect of ice on the hose transferring oil from the FSO to an offloading tanker. The test program demonstrated that as the hose was pushed close to the offloading tanker, it would form a vertically oriented loop that could be hooked by passing ice floes, and it was shown that wind-loading forced additional ice onto the hose. It was determined that the ice induced loading on the transfer hose could be reduced to an acceptable range through the use of ice management.

However, possible long-term ice abrasion of the transfer hose prompted further study. To explore this possibility, it was recommended that the hose be tested at full scale in the IMD 90 Meter Ice Tank. A 1.5 meter section of marine hose was fabricated and subjected to two types of experiments in ice of full-scale strength and thickness. The first experiment moved the hose along a rough ice edge using a pressurized plate, and the second attempted to puncture the hose using an ice indenter. A 2-D version of the discrete element code DECICE was also used to provide estimates of ice loading on the hose. The computer code simulated ice thickness, pack ice concentration and various floe sizes. Throughout these tests, no abrasion and no failure of the hose was evident.

Using Oceanic's test results, various aspects of the Piltun-Astokhskoye I oil field operation were fine-tuned enabling the operators to extend the production season. Work is continuing offshore Sakhalin island with two additional fields considered for development - Piltun-Astokhskoye II and Lunskoye. For these fields, new gravity based structures were proposed and Oceanic was contracted to evaluate four basic platform configurations involving one, three and four leg concepts. The test program was designed to determine global wave loading on the base and local pressures on the legs and deck. Basic design parameter variation included base size and height, number of legs, leg size and shape, and the height of the deck. *(For more information, contact Don Spencer)*

▲Test of Ice Abrasion on Marine Hose

Applying the Experience

A current project of Oceanic involves an external turret moored FSO, permanently moored to the seabed off the coast of Africa. The primary objectives of the model tests are to: confirm the most critical combinations of FSO loading condition and design environmental condition; check FSO loads, motions, and fatigue; ensure that motion behavior and shipping in green water are acceptable; and determine the mooring over-running condition to ensure that the clearance between the tanker bow and the anchor legs is adequate.

Oceanic's expert knowledge of the requirements for different types of offshore structures, combined with superb test facilities, allows us to assist designers in defining the structural stability of various systems from complex mooring arrangements to innovative GBS concepts. With its current project, Oceanic continues its development of model testing methods and expertise for the offshore sector.