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SETS THE STANDARD

9th International Marine Environmental Modeling Seminar

Decision-Support Tools for Environmental Management

Transas *PISCES 2*

Potential Incident Simulation Control & Evaluation System

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What is *PISCES* ?

PISCES is an incident response exercise control tool, employing modeling and simulation

- Computes the trajectory and fate of an oil spill on the sea surface
- Simulates the interaction of the spill mass with complex coastlines and environmentally sensitive areas
- Simulates the interaction of spill response resource models with the spill mass in a training exercise
- Simulates the movement and deployment of resources, such as ships, aircraft, vessels, people, and equipment

Purpose & Objectives

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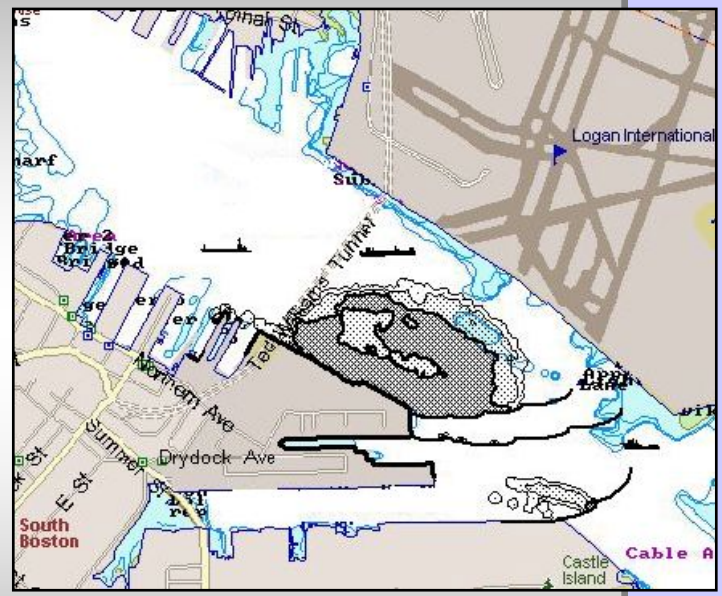
Purpose

- Utilize an oil spill model that calculates the trajectory and weathering of a surface release to train Spill Response Managers in key skills:
  - Development and use of containment and recovery strategies and tactics
  - Effective management of response assets in a rapidly developing spill scenario
  - Decision-making skills in a stressful situation
  - Effective gathering and dissemination of real-time information from the field
  - Use of spill forecasting tools for decision-support by non-scientific personnel



Objectives

- Present the results of the spill model in a manner that can be readily interpreted by non-scientific personnel involved in spill response management
- Ease of initialization in a fast-paced exercise environment
- Flexible model – accepts changes “on-the-fly” (weather, current, resources)

Floating Spill Model

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Challenges for the process modeler:

- Spill model solution not an unobstructed trajectory – must consider barriers and user-defined interactions
  - Coastline impact
  - Incursion into ESAs (Environmentally or Economically Sensitive Areas)
  - Boom configurations, fixed and moving (e.g., towed boom)
- Complex area geometries
  - Shape of the spill mass, including division into multiple masses, and reduction of oil due to recovery, dispersant application and burning operations
  - Coastline shape – islands, inlets, shoals, piers, and bridge abutments
- Wide range of spilled product quantities to be simulated
  - Tons to thousands of tons
- Resolution and scale of the operator display
  - Tens of meters (local response resource activity) to tens of kilometers (regional view of operations – the “big picture”)

Floating Spill Model

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More challenges:

- Dynamically changing scenario
  - Varying weather and sea conditions
  - Changing currents – tidal cycle, wind-influenced, user-defined and eddies
  - Real-time deployment and user control of response resources that interact with the spill
- Computational economy
  - Need for both real-time simulation and rapid fast-time forecasting
  - Requirement to operate on a PC platform
  - High volume of user functions requires intuitive and responsive user interface (GUI)
- Continually update and display model results in a highly realistic presentation format
  - Provide a complete picture of the state of the spill
  - Provide visualization of on-going response operations

Oil Spill in Ice-Covered Waters

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Presence of ice has considerable effect on transport, spreading, and weathering processes:

- Containment and recovery operations are limited
- *Transport* and *spreading* depend on ice thickness and oil thickness
- Reduced *Weathering* related to evaporation – oil contact with air is minimal as it travels under the ice
- *Solidification* occurs and weathering and spreading are reduced with decreasing temperatures
- *Encapsulation* – absorption into the ice
- Ice is represented in the *PISCES* model as:
  - Pack Ice – drifting floes defined by thickness, age, and concentration or percent area coverage
  - Fast Ice – solid ice attached to shore, defined by thickness and age with total coverage of the sea surface

Object Models Interact with Process Model

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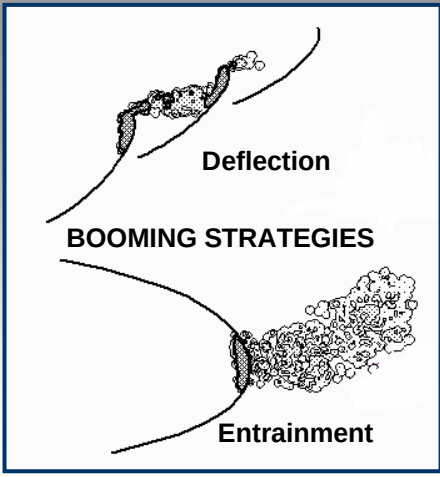
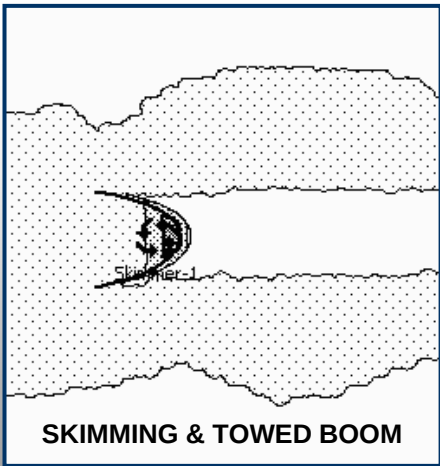
The spill model supports interactions that simulate real-world operations

- Booms deployed for containment, deflection, protection, recovery, and absorption
- Effects such as entrainment, reduced efficiency and boom failure can be demonstrated
- Application of dispersant chemicals applied from aircraft or vessels
- Varying effectiveness and window of opportunity for dispersant use can be demonstrated
- Recovery operations – skimming efficiencies tied to skimming methods, product characteristics, weathering and sea state
- Shoreline cleanup can be simulated for exercise purposes, at rates controlled by the user





PISCES is Unique

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Exercise Design, Conduct, and Control features

- Innovative simulation models
- Intuitive, Windows©-based graphical user interface (GUI)
- 2-D visualization of an incident in a geographic area
- 3-D visualization representing “out-the-window” view
- Worldwide scenario generation – >10,000 nautical charts
- Internal Tide & Current database – extensive dataset
- Layers of information - overlay terrain and street maps, satellite images and shape files
- GIS database – detailed information linked to objects displayed on charts and maps
- Exercise Log accessible from any network workstation
- Automated resource activation and scenario scripting
- Configuration flexibility - distributed tasks and displays over networked workstations

Modeling Processes & Objects

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Internal models

- Floating oil spill model
- Biota mortality model
- Smoke plume model
- Response resource models
- Vehicle, equipment, and personnel models
- Shoreline restoration models

External models

- *ALOHA* chemical release model

Process Models

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Process model characteristics and data input

- Internal model – floating oil spill model (complex)
  - Product parameters – API gravity, viscosity, surface tension, distillation curve, pour and flash points, emulsification constant
  - Dispersion, evaporation, spreading, emulsification, solubility
  - Stranding – shoreline composition – mud, sand, rock, gravel, wetland
  - Spill performance in water-ice mixture – ice thickness, age, area coverage
- Spill model responds to dynamically changing conditions
  - Sea and air temperatures
  - Wind speed and direction
  - Sea state
  - Salinity
- Trajectory and fate simulation time is user-controlled
  - Real-time simulation (1:1) for exercises
  - Fast-time simulation forecasting (1:2, 1:5, 1:10, 1:30, 1:60, 1:300...)
  - Multiple trajectory track overlays displayed to compare scenarios
  - Recorded scenario playback in real-time/fast-time, forward/backward

Process Models

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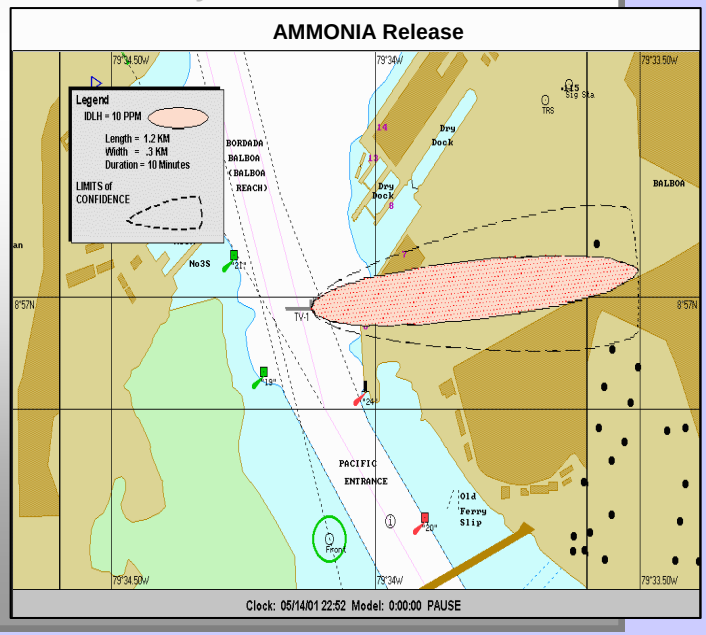
Types of Oil Spills simulated – 2D surface release

- Instantaneous Point Source release
- Leak Source, variable rate of release
  - Stationary Source
  - Moving Source, e.g. leaking vessel following a trackline
- Area Source – discovered spill slick of undetermined origin

Process Models

Process model characteristics

- Biota mortality model for populations affected by a spill
  - Birds, shellfish, fish, amphibians, mammals, zooplankton populations
  - Computes reduction of organism population from exposure time and lethal concentration values
- Simple smoke plume model – burning oil
  - Direction of smoke plume based on scenario wind velocity
- Connection to external models – *ALOHA* chemical plume
  - *ALOHA* chemicals database
  - Initialization of the chemical release
  - Wind velocity data from *PISCES*
  - *ALOHA* generates airborne chemical plume "footprint"
  - Location of chemical release source specified in *PISCES*
  - "Footprint" sent to *PISCES* for geographically-referenced display



Object Models

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Resource models and simulation of spill response

- Response resource models – interact with the spill model
  - Booms, containment and absorbent
  - Skimmers and vacuum systems
  - Absorbent pads
  - Dispersant chemicals and dispersant spraying systems
- Vehicle, equipment, and personnel models – time-based movement and state-change simulation
  - Activity – activation, movement, routing, deployment, operation, retrieval
  - State – on-scene, operating, in-transit, delayed, out-of-service, unavailable, deploying, retrieving
- Shoreline cleanup models – simulate restoration of oiled coastline employing user-defined productivity parameters
  - Equipment, e.g. payloaders, steam-cleaning gear
  - Personnel - individuals and cleanup teams

What is *PISCES* for ?

Decision-makers are trained to respond to major incidents using *PISCES* displays, models and simulation

- *PISCES* maintains exercise "Ground Truth" – actual vs. perceived
  - Exercise controllers can conduct complex emergency response scenarios in real-time – training involves comparison between the incident response team's perspective of the situation and the *actual* scenario conditions (Ground Truth)
- Spill Trajectory and Fate – forecasting and current status
  - The sophisticated model shows current state of the oil spill, its interaction with the shore, and intrusion into sensitive areas
  - Run fast-time forecasts, offline, in the early stages of the exercise
- Response simulation – user-controlled assets
  - Resource management - track the location and status of hundreds of resources deployed for the response
  - Observe operations and their effectiveness – realistic visualization of booming, skimming, "in situ burning", and dispersant use
- Beached oil and simulation of shoreline cleanup
  - Apply beach cleaning tactics and personnel/equipment resources – simulates cleanup by interacting with the stranded oil to restore the shoreline

What does *PISCES* do ?

PISCES Exercise Management System

- Provides real-time spill development scenarios and fast-time forecasts
- Tracks the location, movement and status of each and every resource that exercise participants put in play
- Includes both automated and manual exercise event logging, and a user-defined event scripting capability
- Can be deployed over a network for entry, reports, and status displays
- Expandable and highly flexible in co
- Maintains a history of all exercise ac
- Replay the recorded scenario for po
- Simulation control – real-time, fast-ti
- Features an unsurpassed means of
  - 2-dimensional (geographic reference – charts, maps, aerial imagery)
  - 3-dimensional ("out-the-window" view, airborne surveillance)

How is *PISCES* used ?

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Routine training develops teamwork, tests response plans, and improves decision-making skills

Tabletop Exercises

- Enables Incident Response Teams to visualize an emergency scenario
- Facilitates problem-solving and planning
- Tests notification procedures and assembly of the team

Functional Exercises

- Enables simulation of complex emergency scenarios
- Provides the ability to compress time to cover the maximum possible objectives
- Relieves Exercise Facilitators of mundane tasks

How is *PISCES* used ?

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Full-Scale Exercises

- Maintains real-time “ground truth”
- Enables decision-makers to monitor the status of a response over a large area
- Tracks large numbers of resources, including equipment and personnel
- Computes realistic time intervals for resource movements, activations and deployments
- Records the exercise to provide an effective debrief and documents the training activities

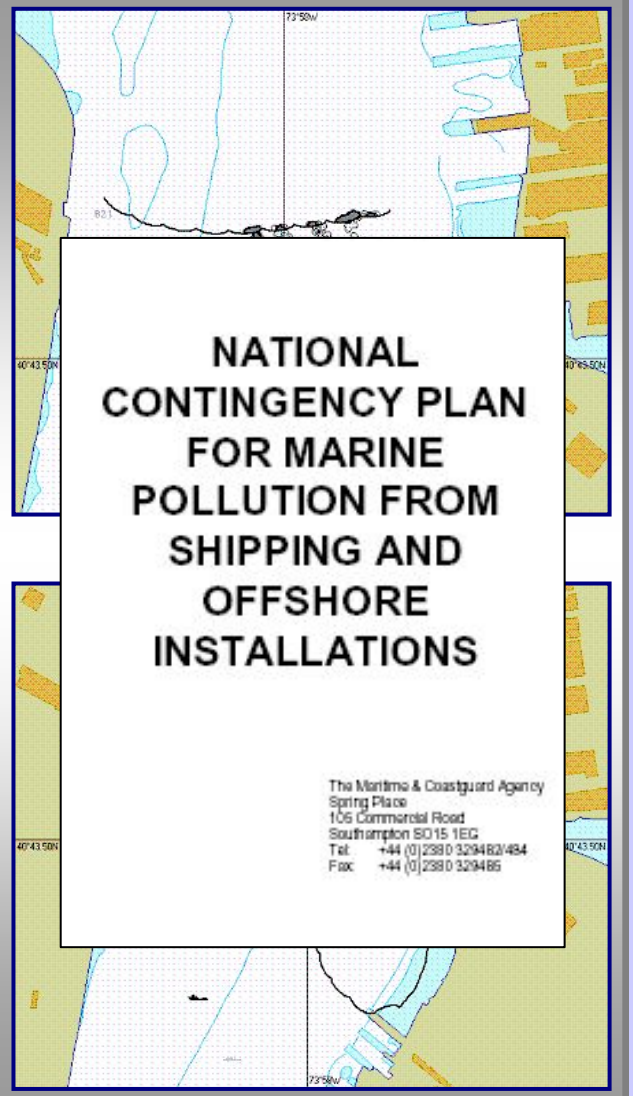
Spill Scenario Duration – generally 12-72 hours; longer exercises supported

- Compressed time (fast-time simulation) used for longer scenarios

How is *PISCES* used ?

Planning – Contingency Plan Development and Validation

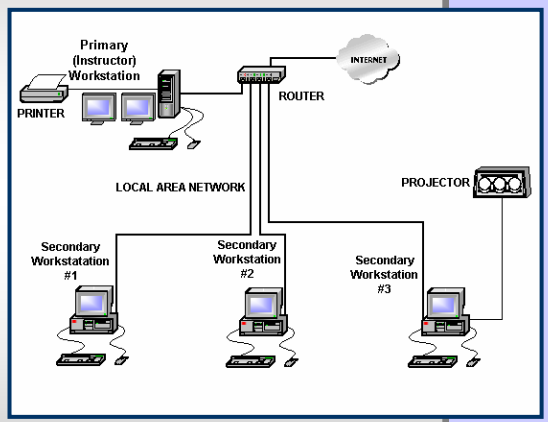
- Test worst case and most likely to occur scenarios: spills, fires, major civic events, transportation accidents, natural disasters, terrorist incidents, and population evacuations
- Develop and test protection strategies that would be specified in a Contingency Plan
- Test assumptions regarding resource staging depots and time to deploy
- Examine impact on sensitive areas for spills occurring under various seasonal, tidal or weather conditions



What is the Significance of *PISCES 2* ?

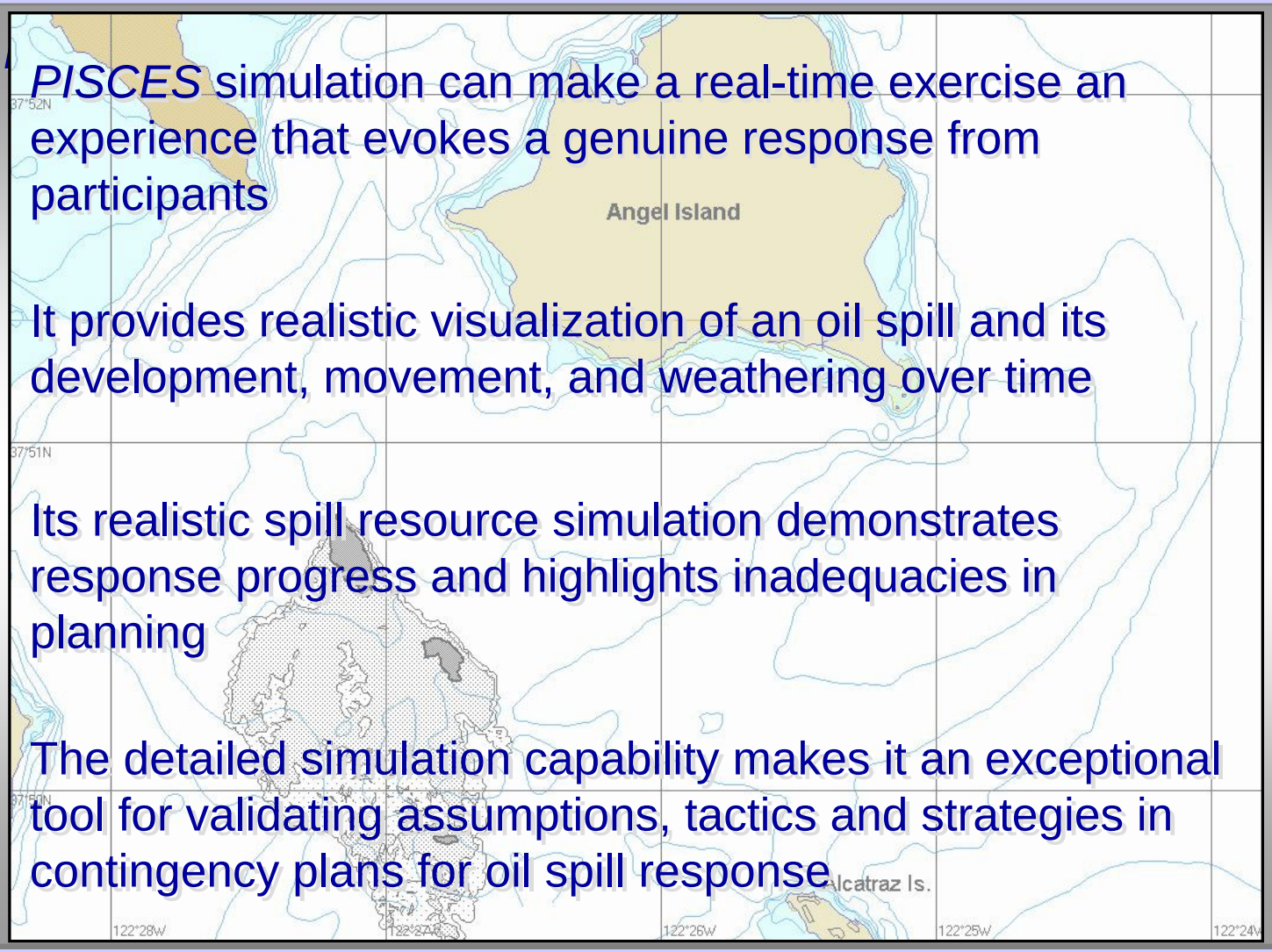
When delivered to the U.S. COAST GUARD in 1998 *PISCES* was specifically designed to create and conduct *oil spill response exercises* from a single PC workstation.

PISCES 2 is the second generation of this application, greatly enhanced from the original product:



- Now multi-incident capable
  - Not limited to spill scenarios
  - Real-time simulation of any incident in which large numbers of resources are activated / tracked
- Network deployable – hard-wire or wireless network connections and over the Internet
- Auto-load tidal current or surface current data from an extensive internal database for the scenario date and time
- Input weather and water current data to an active scenario from Met-Ocean buoys offshore

Summary



PISCES simulation can make a real-time exercise an experience that evokes a genuine response from participants

It provides realistic visualization of an oil spill and its development, movement, and weathering over time

Its realistic spill resource simulation demonstrates response progress and highlights inadequacies in planning

The detailed simulation capability makes it an exceptional tool for validating assumptions, tactics and strategies in contingency plans for oil spill response

WATERWAYS SIMULATION CENTRE

Technology for qualification

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www.aquaviarios.com.br

PISCES is an important component of the simulators at the Waterways Simulation Centre, a partner in training with Universidade Federal do Rio de Janeiro – UFRJ

For more information email: contato@aquaviarios.com.br

A Bit About Transas

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Transas Ltd. includes a worldwide group of companies including technology development, agents and dealers.

Specialties include:

- Digital cartographic technology
- Electronic chart and information systems
- Modeling and simulation – ship hydrodynamic models, oil spill models, liquid and liquified gas cargo system models, marine propulsion plant models, and 3-dimensional geographic imagery models
- Training simulators – maritime, aircraft, crisis management
- Vessel Traffic Management Systems
- Digital communications and long-range tracking systems

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Questions ?

THANK YOU FOR YOUR ATTENTION!