SPECIFICATION FOR PISCES II

PURPOSE

PISCES II is an incident response simulator designed for preparing and conducting command centre exercises and area drills. The application is developed to support exercises focusing on oil spill response. The PISCES product was designed to evaluate the preparedness to respond effectively to oil spills, in accordance with the requirements of the OPRC convention 1990. PISCES is developed specifically to support the Preparedness for Response Exercise Program (PREP) administered by the U.S. Coast Guard with the goal of providing an improved training environment for response managers.

The PISCES II provides the exercise participants with interactive information environment based on the mathematical modeling of an oil spill interacting with surroundings and combat facilities. The system also includes information-collecting facilities for the assessment of the participants' performance.

The method of using PISCES II implies that two groups of people participate in oil spill response exercises: instructors and trainees. There are three stages of an exercise: preparation, conduct and debriefing. The PISCES II operating modes corresponding to these stages (Preparation, Conduct and Debrief) are used for reproducing the "reality" of the exercise, automation of the instructor's activities and recording of the exercise key events.

BASIC CONFIGURATION

Ref. No.TR-S-PSC-SW01

Primary Instructor Workplace

The Instructor Workplace is a program providing the main human-machine interface of the PISCES II system and complete control over the preparation and conduct of exercises. The Instructor Workplace is a Windows application supporting operation with several cartographic windows, specialized data views, property pages of modeling objects and standard controls, such as main menu, toolbars and dialog boxes.

Exercise Server

The Exercise Server is the main task co-coordinating the operation of the PISCES II multi-user system in a local area network (LAN). In PISCES II configuration the Exercise Server is the only application requiring a software protection key (dongle). The Exercise Server supports up to four (4) users on separate Instructor Workplaces, all simultaneously developing a common scenario.

Main Modeling Server

The Modeling Server is a program in which the PISCES II oil spill mathematical model operates. The math model simulates development of an oil spill incident with human response. The Modeling Server calculates both the changes to the spill mass due to dynamically varying environmental parameters (e.g. currents, wind, sea state, etc.), and the deployment of spill to response resources, such as booms, skimmers and chemical dispersants.

Network Configuration Tools

The Configuration Editor allows the user to change the PISCES II network configuration before the exercise start. No re-installation is required. Up to four (4) Instructor Workplaces, four (4) Modeling Servers, and four (4) Communication Modules of each type (ALOHA, VTS and AIS) can be assigned to computers connected via LAN. All tasks can be assigned to a single computer or every task can operate on a separate computer.

Data Preparation Utilities

These utilities allow the user to create and edit data on icons, resource templates and models in internal PISCESII binary format.

The Icon Manager allows creating new icons for point type chart objects by using externally prepared black-and-white images. The icons may be named, annotated and organized in groups.

The Resource Model Editor allows the user to modify parameters of the equipment models delivered with PISCES II. These parameters are used by the program for the calculations of equipment-to-oil interaction.

The Template Editor handles response resource templates which are sets of particular values for every parameter of a given resource type. Templates are used to simplify the creation of modeled objects in PISCES II scenario. The Template Editor enables modification of default templates delivered with PISCES II and creation of create custom templates.

OPTIONS

Additional Instructor Workplace

Ref. No. TR-S-PSC-SW02

Up to three Additional Instructor Workplaces can run concurrently with the main Instructor Workplace. All workplaces are connected to one exercise, which is opened on the main Workplace. Within the opened exercise, the users can work independently with separate scenarios, or can collaborate to develop a single common scenario.

Observer Workplace

Ref. No. TR-S-PSC-SW09

The observer workplace provides the user with all information on the current scenario, but without capability of editing the model objects. The observer has the same means of viewing charts/data and that for report generation as the instructor has. The observer can work with the scenario only when he is connected to it by the instructor managing this scenario.

Visual Channel
Ref. No. TR-S-PSC-SW10

Visual channel provides 3-dimentional representation of incident area, oil spill and response resources using commercial-off-the-shelf visual areas and vessel models made by Transas.

PISCES II scenario may have a number of "viewpoints" specified. A viewpoint specifies the observer's geographical position and view direction.

User connects Visual Channel to one of the viewpoints to display modeling situation in 3D.

Illumination of visual scene depends on geographical position of observer, scenario time and time zone defined in scenario properties. In addition to view points, the user can switch visual channel to simplified course, pitch and speed control via keyboard.

Additional Modeling Server
Ref. No. TR-S-PSC-SW03

It may be desirable to run additional scenarios concurrently with the primary scenario while an exercise is underway in the conduct mode; e.g. a fast forecast of the developing situation or evaluation of alternate response tactics. When multiple simultaneous scenarios are desired, each active scenario must have a separate Modeling Server assigned. The number of simultaneously running scenarios is equal to the number of Modeling Servers.

ALOHA COMMUNICATION PROTOCOL
Ref. No. TR-S-PSC-SW04

Freely distributed ALOHA software developed by NOAA provides forecasts of the downwind dispersion of toxic or hazardous vapours resulting from a chemical release. For the purposes of the ALOHA program, PISCES II plays the role of an atmospheric measurement station and sends to ALOHA data on air temperature, wind speed and direction. In return PISCES II receives from ALOHA the footprint of atmospheric plume area which is then displayed in the PISCES chart windows. The PISCES user has the freedom to establish the source of the chemical release at any location within the displayed exercise area.

TIDES AND CURRENTS DATABASE
Ref. No. TR-S-PSC-SW06

Calculations of tidal currents are made according to the British Admiralty Tidal Prediction Software (NP158). Averaged seasonal surface currents are imported from the database. This database is created after the processing of primary (observed) data of the National Oceanographic Data Centre (NODC and NOAA).

This database is made available to the PISCES II application through an import feature. PISCES II uses both types of currents as base vectors with time dependent variations of direction and velocity for calculation of the field of currents in oil modeling.

UAIS TRANSPONDER INTERFACE
Ref. No. TR-S-PSC-SW07

UAIS Server software provides communication with both TRANSAS UAIS T200/T210 and MDS MIII base station transponders. PISCES II can connect to the UAIS Server via TSP/IP protocol, to receive and display in text and graphic form data on real targets: coordinates, ship name, course, speed, etc.

Vessel Traffic System Interface
Ref. No. TR-S-PSC-SW08

PISCES II connects to the TRANSAS Navi-Harbour software via TCP/IP protocol. Navi-Harbour is a TRANSAS VTS product that displays Vessel Traffic Management information from radar and video inputs, and UAIS transponder data. Information on VTS-tracked targets, including their coordinates, identification, course and speed, can be transmitted to PISCES II and is displayed in text and graphic form on the PISCES operator display.

Automatic Control
Ref. No. TR-S-PSC-SW15

The software makes the record of user input like movements of vessels, equipment deployment and other response actions like dispersant and sorbent application. At the subsequent scenario run the program automatically plays back movements, deployments and other response actions. In result the instructor gains the ability to develop the scenario iteratively by adding new objects and actions to the existing record.

ICE Conditions
Ref. No. TR-S-PSC-SW16

The model is designed for training purposes and qualitative illustration of the main behavior peculiarities of an oil spill in ice conditions.

There are two kinds of ice in PISCES: pack and fast ice. Ice is presented as a set of polygons defined manually by the operator. It is assumed that the main source of information about ice conditions will be ice maps which are updated with the period from one to ten days.

The user can edit data on ice conditions in Forecast and Conduct modes at any moment of model time. When a scenario is running after a reset, all changes in ice conditions made at the previous run are being repeated automatically.

For the fast ice the user specifies the shape and location of ice regions, ice thickness and age. For the pack ice the user specifies ice concentration in addition to the same parameters as for the fast ice. Ice concentration is understood as the ratio of area covered by ice to the whole area of pack ice region.

Current oil spill model is supplemented with the following behavior peculiarities: oil adsorption by ice or freezing in, oil congelation due to low temperature and changes in oil transport, spreading and evaporation due to interaction with ice.

While the air temperature is decreasing from 20°C to the Pour Point value the oil viscosity gradually increases and spreading speed decreases. Oil spreading and weathering processes stop when air temperature reaches the Pour Point value.

Within pack ice area oil moves along currents and wind with the speed less than in open water. Spreading and evaporation is also less than in open sea. The decrease of movement, spreading and evaporation speeds depends on ice concentration.

Within fast ice area evaporation stops because oil is assumed to move under ice. The oil moves and spreads under fast ice with the speed lower than in open water. The decreasing of movement and spreading speed depend on ice thickness. The thicker is ice the less is the speed.

Oil thickness also affects spreading. The spreading stops when oil thickness reaches the critical value.

When oil interacts with fast ice the model calculates oil mass loss due to oil absorption by ice. The amount of "frozen in" oil is displayed in oil spill statistics.

External Weather

Ref. No. TR-S-PSC-SW17

External Meteo Data (EMD) Source is any type of automatic system providing actual weather data for a given geographical location. Meteo buoy is an example of such source. EMD Source monitors weather parameters like air and water temperatures, speed of current and others. EMD Source periodically updates current values and provides historical data for these parameters.

For each new type of EMD Source Transas develops a custom utility called “Meteo Server”. By default PISCES is delivered with Meteo Server acquiring data from text files in format specified by Ljubljana University. This utility directly accesses EMD Source data, converts the data and sends it via TCP/IP based protocol to PISCES Meteo Data Communicator.

A PISCES configuration may include only one Meteo Data Communicator which can be linked to several Meteo Servers. The user configures Meteo Data communicator manually via filling in the list of Meteo Servers. For each adapter name, IP address and port shall be set.

A Meteo Server linked to PISCES appears in scenario as an object in Meteo Data category in Data Browser and is represented with a point object in Chart Window. The user can associate any of weather parameters with the data coming from Meteo Server. Different weather parameters can be associated with different sources. For example: wind speed and direction can be taken from Buoy1 while water temperature from Buoy2.

EMD Sources providing currents data can be used in PISCES scenario as base current vectors for calculation of the field of currents.

Joint Exercise

Ref. No. TR-S-PSC-SW18

Up to 4 local PISCES configurations can be connected to each other via the Internet by using the TCP/IP protocol. Users of one local configuration can expose their scenarios, so the users of other configurations can joint to the exposed scenario. Users joined to the external scenario have read-only access to the scenario resources by default. The scenario owner can assign a subset of scenario resources to be controlled by external users.

Backtracking

Ref. No. TR-S-PSC-SW19

Calculation of Diagrams of Probable Spill Location (PSL) for the specified time interval in the past. Display of PSL diagrams together with ships positions for the detection of likely spill source. The model takes into account current location of oil spill, variable wind and field of currents and accuracy of input data. “Similarity to spill source” rating is automatically calculated for each vessel in the scenario basing on the analysis of vessel movements and PSL diagrams.

Forecast Mode

Ref. No. TR-S-PSC-SW21

“Forecast” mode is designed for fast calculations of oil spill fate with minimum simulation of response actions like stationary booms. In “Forecast” mode modelling speed is much higher than in “Preparation” mode due to increased model time step. E.g. it takes about 2 hours to calculate a 2 days scenario in Preparation and about 5 minutes in Forecast mode.

FEATURES

Exercise Management

Exercise and Scenario Archiving

PISCES II exercise may contain several scenarios. Instructors can work with different scenarios within one opened exercise. PISCES II provides the Instructor with a complete set of file operations with exercises and scenarios: “create”, “save”, “copy”, “rename” and “delete”. It is possible to make a copy of a running scenario.

Three operational modes for running an exercise scenario are supported:

- Preparation – used for scenario design, and to run predictions during the conduct of an exercise for tactical planning purposes;
- Conduct – the mode in which an exercise is finally run with all participants in play; all actions are recorded to enable documenting and debriefing the final exercise outcome;
- Debrief – this mode enables efficient post-exercise analysis by providing tools to rapidly pinpoint different time periods in the recorded exercise, and to replay the action in fast-time, both forward and in reverse.

Scenario Control

An exercise scenario is controlled via the following functions: Run, Set Speed (from 1:1, Real-Time to 1:600, Fast-Time), Pause, Create a save-point, Restore from a save-point. The scenario record can be played back in Debrief mode in forward and backward directions.

User Interface

PISCES II user interface uses standard elements and ordinary operation method of a Windows application. A PC-user qualification is sufficient to control PISCES II and no special computer skills are required.

Main informational load is carried by two types of PISCES II child windows: Chart and Data Views. Chart View provides geographical presentation of the incident area over the background of professionally looking nautical charts. Data Views provide comprehensive structured access to all modeling objects and their properties in text-based form.

The user may expand properties of modeling objects with links indicating files stored on main PISCES II node. From within PISCES II it is possible to open applications associated in the operational system with the linked file.

Debriefing Tools

PISCES II provides software functions to support output of the operator screen to a large screen display, such as an LCD projector (for wall projection) or to an additional oversize monitor. The large screen display is attached to the second video channel of the Instructor Workplace. Large screen images may consist of a chart view, textual or tabular view, or a combination of both. The large screen image is controlled via a specialized window within the PISCES II Instructor Workplace. This control window supports all chart and data navigation tools and allows adjustment of the large screen layout.

Chart Operations

Basic Chart Operations

The complete set of basic chart functions common to TRANSAS chart viewing products (e.g. ECDIS, VTS, etc.) is supported: Centre, Scale, Pan, Zoom, Distance and Bearing measurement and Load/Unload Charts. Overlay management functions permit the complete customisation of individual chart window views, by controlling standard TX97 and PISCES-specific data layers, as well as the display of chart borders, the coordinate grid, and range rings.

The display of aids to navigation and other info from TX-97 chart is provided. Descriptions of buoys, lighthouses, dangers and other objects located in the close vicinity of the location indicated by the user are shown in a dedicated "Chart Info" window.

Export to/Import from Raster Images

The chart window image can be saved as a file in Windows.bmp format for use in documents or to transmit via internet/intranet. The ability to save chart window images automatically at pre-defined time intervals while a scenario is running is supported.

A raster image can be imported from any 256-colour Windows.bmp file and overlaid on a displayed chart. Transparent colours can be indicated immediately on the image in chart window. Alignment of a raster image (such as an aerial photograph) can be geographically referenced and scaled to the underlying chart: the size and position of the image is controlled by defining two reference points with both graphical and numerical input of coordinates.

Add Info

Additional information in the form of icons, polygons and text boxes can be drawn over the displayed nautical chart, and these modifications can be saved with the chart view for subsequent recall and display. The Add Info objects do not modify original charts in any way, but are saved within the current scenario.

Environmental Data

Impact Area

During the initialisation of a scenario the user is required to define a polygonal Impact Area in which response activities will take place. Oil spill interacts with the shoreline within the Impact Area only. This feature helps to reduce computational overhead and results in faster simulations when operating in fast-time modes.

Coastline

The coastline can be imported from multiple TX97 chart(s) in a form of a complex multi-connected polygon. The user can assign to a coastline segment a type attribute: rock, sand, mud, coral, etc. These attributes will determine the manner in which the spill math model computes oil beaching parameters.

Coastline polygons can be edited via moving, adding, and deleting of vertices. The user can create additional coastline polygons (islands).

A subset of coastline polygons can be assigned as a "parcel" and named. Overall parcel length and amount of stranded oil is displayed for each parcel in data windows. The user can easily select the parcel by its local name and obtain spill statistics for that beach.

Weather Conditions

Wind speed and direction, water and air temperature, wave height, and water salinity each have a single value applied over the entire modeled area. The alteration of these parameters is defined via tabular functions. Interim values between user-specified data points are interpolated. The weather parameters can be modified by the user at any time during the simulation, and the new values will continuously update the math model.

Field of Currents

The field of currents is determined from a set of "base vector" stations with the given time-dependent velocity variations that were entered by the scenario designer or imported from the Tides and Currents database. The velocity of the surface current at any inter-station point within the Impact Area is computed by interpolation of nearby "base vector" values and taking into account the "non-penetrate" condition on the coastline.

The user can add and edit base vectors manually. The resulting field of currents can be displayed as read-only vectors arranged on a regular grid.

Alternate way to determine field of currents is to import "map of currents". Map of currents is a table with a big number of current vectors defined on a regular grid. Currents in the map do not depend on time. The user imports maps of currents from XML files. It is possible to make superposition of base vectors and map of currents.

Field of Wind

The field of wind is defined in the similar way as the field of currents. The user creates one of more base wind vectors. Each vector has time table for strength and direction. The field of wind data can be exported to and imported from text files.

Spatial variability of the wind becomes important for big modelling regions with dimensions of 100 km and bigger.

Environmentally Sensitive Areas

Environmentally Sensitive Areas are presented in chart windows as polygons. User can define ESA's prior to scenario start. ESA objects detect oil impact and automatically generate alert messages and log entries at the time of impact.

The user can specify a list of dweller groups for the Environmentally Sensitive Areas (ESA). The number of dwellers, lethal concentration of LC50 toxic substances and the corresponding $T_{LC}50$ time period are specified for each group.

At the user's request, the model computes the share of toxic substances getting to water from the oil slick for each ecologically sensitive area and calculated the share of the died bions in each group.

Pollution

Spill Sources

More than one spill source can be defined in a scenario. For each spill source the following properties can be set: oil product, amount spilled, start time of the spill and other parameters depending on spill source type:

- Point Source – position of the centre of the spill;
- Area source – initial shape of the spill;
- Leak source – trajectory of movement and spill rate depending on time.

Spill Statistics

The following data is displayed for a spill as whole: amount of spilled, floated, evaporated, dispersed, stranded, burned, sunk and recovered oil product. Also the amount of floating and recovered oil emulsion (water/oil mixture), maximum thickness, and the total area of oil slick are displayed.

For a user-defined local area the following statistics are displayed: maximum thickness, area of oil slick, amount of floating and stranded oil.

Changes taken place in the oil spill statistics during scenario modelling are saved and displayed in “Statistics/History” page in Data Browser window. The period of statistics data saving is adjustable with the discretion of 5 minutes. Statistics history can be exported to MS Office for further processing.

Graphical Presentation of a Spill

Floating oil product is presented in the form of a complex multi-connected polygon. Up to three (3) contour lines may be displayed, depicting the perimeter of the spill mass, and internal areas of different thickness. The user can modify thickness values for the inner contour lines.

The trajectory of oil shapes in the first 24 hours of a spill scenario is presented in Chart Views as a set of points reflecting the movement of geometrical centre of spill, and time-labelled tags. The tags display data on the amount of floating oil, average speed, slick area and maximum thickness.

Oil/Chemical Database

Changes may be made to the product parameters of a particular oil type to suit the requirements of a scenario; however the changes are only saved in the scenario in which they were made. The Oil Specification Editor only permits the oil products database to be edited before the PISCES exercise is run. During the conduct of a PISCES exercise, the user can obtain data from the product database in “read-only” mode.

The oil product is characterised by a common product name, type (e.g. crude or refined), specific gravity, surface tension, viscosity, distillation curve, and emulsification constants.

Air Pollution Forecast

PISCES II supports import of a hazardous airborne pollution forecast from the ALOHA model. The airborne chemical plume footprint is presented as a static polygonal area in the chart window, and represents a calculation of the immediate downwind dispersion and extent from the initial chemical release.

Model of Air Pollution

PISCES II simulates air pollution resulted from oil burning. Sources of smoke are free or compulsory burning areas. The model takes into account properties of oil product, burning intensity and duration, wind and atmosphere stability.

Polluted area and areas where PM-10 exceeds maximum permissible concentration are displayed over geographical map. The program continuously updates the shape and position of polluted area.

Response Simulation

Response Resources

PISCES II supports various types of response resources. All resources simulate en-route movement and state switching between three categories of states: organizational, locating and operational. Different types of resources have the following specific behavior features:

- Platforms can carry other resources, such as for transport to the spill site;
- Generic Equipment simulates deployment and retrieval operations;
- Booms, skimmers, dispersants and dispersant delivery systems interact with floating oil. These interactive resources also exhibit deployment and retrieval characteristics. The efficiency of booms and skimmers is automatically calculated based on environmental conditions and oil properties. Individual versions of booms, skimmers, dispersants, and dispersant delivery systems can be created by the user to exhibit a variety of performance characteristics. The user may create skimmers with vastly different recovery rates, or booms designated as “protected water” or “open water” and exhibiting different performance in various sea state or wind and current conditions.

Organizational states are split into two groups: one for free resources and the other for resources “in use”, which are considered to be under the control of the command centre. States of in-use resources are compatible with ICS. Assignment list is corrected automatically when the user switches a resource between in-use states.

For in-use resources the cost of operation is calculated automatically. The cost of operation may be specified separately for organizational states: “Available”, “Assigned” and “Out of service”. The total cost with subdivisions according to resource structure is continuously updated.

The user can edit hierarchical organizational structure and make resource assignments according to the structure to reflect the response organization in place.

Response resources can be exported to and imported from tab-delimited text files. The development of an exercise can use realistic equipment inventories by importing data from a response contractor’s database. The ability to import external resource data is facilitated by enabling the measurement units and the list of data fields for export and import to be set by the operator prior to data transfer.

Response Actions

Booms are simulated as flexible permeable barriers with the ability to move. The permeability or efficiency of booms is calculated with regard to the boom type, wave height and relative water velocity. Automatic boom shape calculations take into account wind and currents. The user can manually adjust boom efficiency. The efficiency of a boom can be set to zero, simulating a complete failure of the boom.

For sorbing boons, the amount of oil they can absorb per a length of unit is specified. The oil collected by the Sorbing boons is added to the general statistics category of “collected” oil.

A skimmer removes floating oil in the immediate vicinity of where it is deployed. The recovery rate depends on the skimmer model and defined productivity, oil viscosity, and sea state. The efficiency of a particular skimmer instance can be manipulated by the user during an exercise to further impact its productivity. This feature can be used to degrade a skimmer's performance or cause it to fail to operate completely.

A dispersant application scenario can be simulated by two methods:

- Via assigning a route to a dispersant delivery system loaded with a particular dispersant. The DDS moves along the route and at each model step applies dispersant on a small area. The area size and the applied portion of the dispersant depend on spray width and application rate of the delivery system;
- For other training purposes, a simplified dispersant application scenario can be used. Instant dispersant application models a situation where the duration of application can be neglected. The user defines a rectangular area in the exercise area, selects the amount of dispersant to be applied, and sets the time of application. When the scenario reaches application time, the dispersant is applied evenly within the application area.

The oil model calculates the effect of dispersant application taking into account the mass of the dispersant and its properties.

Sorbent application within a given area is simulated by instantly removing part of floating oil and increasing the value in "amount of recovered oil" statistic category. No sorbent properties are utilized in the model. Before setting properties of the sorbent application area, the user should determine the maximum amount of oil which can be adsorbed. The user specifies a polygonal sorbent application area in Chart View, the amount of oil to be adsorbed and the time of application.

In-situ burning is modeled in two ways: "free" and "compulsory":

- For the free burning method the user defines the initial burning area on the chart and the ignition time. At the ignition time the oil within the area is set on the fire and the model calculates the burning process taking into account water temperature, oil properties, thickness of the floating product, and percentage of water in oil;
- For the compulsory burning, the user defines burning area on the chart and duration of burning operation. The program removes oil mass within the specified area at the burn rate specified by the user.

A simple shore cleaning model simulated collection of stranded oil. The special type model object "Cleaner" is "assigned" to a coastline parcel. The rate of cleaning depends on the Cleaner's capacity. Capacity is taken to mean the share of oil collected by the Cleaner vis-a-vis the total amount of stranded oil at the parcel.

Together with oil, the Cleaner traps some soil. The share of the taken soil is accounted for using the Soil/Oil Ratio parameter.

The cleaning process is simulated successively for each coastline parcel included in the shore part to be cleaned. The cleaner sign is displayed in the center of the current parcel.

Oil "collected" by the Cleaner is added to the "Recovered" statistics category. The following information on cleaning efficiency and cost is accumulated for each coastline parcel and for all parcels in total:

- Amount of collected material (soil + oil);
- Amount of collected oil;
- Amount of left oil.

Calculation of Resource Use Const

Cost of each "mobilized" resource is determined for the statuses "Ordered", "Available", "Assigned", and "Out of service", taking into account the time period, when the resource was in the each of these statuses. At the user's request, the program generates a MS Excel format report including the resource cost summaries for:

- Current date;
- Specified period;
- Owner organizations;
- Organization divisions;
- Individual kinds of resources.

Tracked Objects

PISCES II displays targets acquired from VTS and AIS data sources. Response resources can be linked to the targets. Linked resources change their positions according to the data received from targets, and their positions on the chart are updated accordingly by the PISCES application.

AIS and VTS targets can be linked to link platforms automatically. All platforms have the following identification fields:

1. IMO number (Lloyd's number).
2. MMSI.
3. Call sign.
4. Ship name.

On the user request the program compares these fields for each pair platform – target (in the mentioned sequence). If any of these fields of a platform coincidences with the corresponding field of a target, the program automatically turns the platform to "GPS tracked" state and links it to the target.

Oil Spill Modeling

The PISCES II mathematical model simulates processes in an oil spill on the water surface: transport by currents and wind, spreading, evaporation, dispersion, emulsification, viscosity variation, burning, and interaction with booms, skimmers, and the coastline (stranding or beaching).

The following factors are taken into consideration in the math model:

- Environmental parameters: coastline, field of currents, weather, wave height and water density;
- Physical properties of spilled oil: specific gravity, surface tension, viscosity, distillation curve and emulsification characteristics;
- Properties of spill sources;
- Human response actions: booming, on-water recovery, application of chemical dispersants.