Gdynia Maritime University - GMU

Case Study 2
SEA SURGE AND EXTREME WINDS AT BALTIC SEA AREA
Scenario 2
Chemical Spill Due to Extreme Sea Surges

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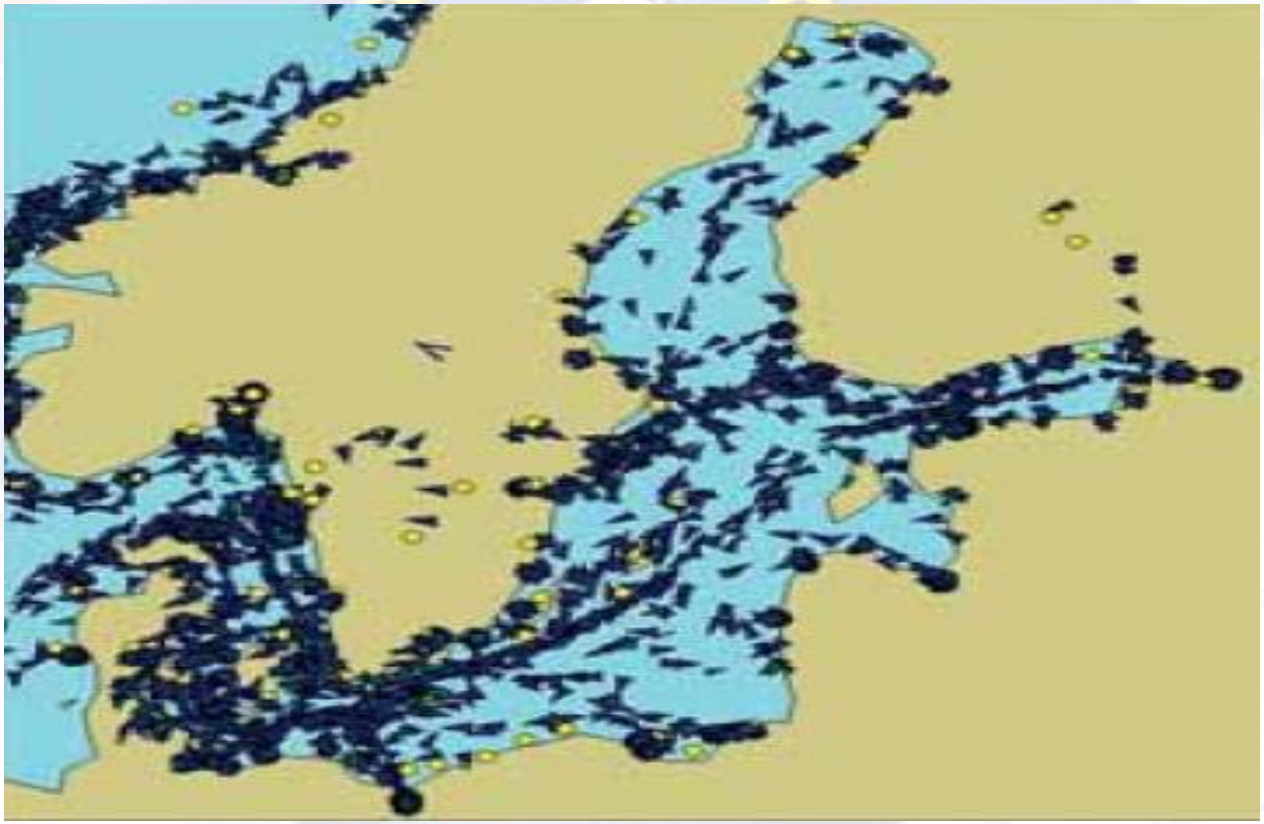
Scenario 2: Chemical Spill Due to Extreme Sea Surges - Location

Figure 1. Baltic Sea Shipping



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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Location

Figure 2. The Port of Gdynia

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Location

Figure 3. The Port of Karlskrone

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Location

Figure 4. Maritime Ferry Route Between Gdynia and Karlskrone

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Location

Figure 5. The Maritime Ferry Stena Baltica

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Description

The sea transport of dangerous chemicals is pretty safe at normal environmental conditions.

However, the transported goods may be swept overboard as a result of bad weather and hard sea conditions.

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Description

The released chemicals may create the threat for the crew and the ship as well as pollute the seawater and the coast.

The Baltic Sea and nearby ecosystems are vulnerable to pollution and contamination as a result of sea accident during the dangerous goods transportation.

Today, one major accident at the Baltic Sea happens every year approximately.

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Description

There are more than 50,000 ships entering and leaving the Baltic Sea every year and about 2,000 vessels are at the Baltic Sea at any given moment.

This huge traffic across the Baltic Sea will be observed.

On the basis of the statistical data coming from reports on chemical accidents at sea, the risk of dangerous chemicals accidents at sea and their dangerous consequences will be modelled, identified and predicted.

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Description

Further, under the assumption of the stress of weather influence on the operation conditions in the form of maritime storm and/or other hard sea conditions existence, the risk of chemical spills at sea will be examined and the results will be compared with the previous results.

The risk of chemical spills at sea the environment degradation optimization will be performed and practical suggestions and procedures decreasing the risk of the environment degradation will be worked out.

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

The examination of the climate-weather change influence on the maritime ferry safety and on shipping critical infrastructure accident consequences will be performed within the following presented below conditions.

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

1. Experiment area dimension and time of execution

1a. Desired spatial dimension:

Maritime ferry safety examination:
The area in the neighbourhood of the maritime ferry route.

The approximate length of the maritime ferry sea water route is equal to 250 km.

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

1a. <u>Desired spatial dimension</u>: :

Critical infrastructure accident consequences examination:

The area around the maritime ferry sea water route (narrow scale experiment), the Baltic Sea area (wide scale experiment).

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1b. <u>case study execution time</u>

Date: January 2018.

1st day, in the afternoon: Training Course (Scenario 2).

2nd day, in the afternoon: Going by a maritime ferry from Gdynia to Karlskrone and coming back to Gdynia. Details of the performed Case Study 2 Scenario 2 will be illustrated by power-point presentation at the board of the maritime ferry during this cruise.

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

2. Ferry operation process data

2a. <u>ferry operation process data parameters</u>:

– the ferry operating at port area

1. ferry operation states
2. realizations of ferry operation process

– the ferry operating at sea area

1. ferry operation states
2. realizations of ferry operation process

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

2b. ferry operation process type of data

– the ferry operating at port area

1. number of ferry operation states and their definitions
2. number of realizations of ferry operation process, empirical numbers of transitions between the ferry operation states, empirical lengths of ferry operation process conditional sojourn times at the particular operation states

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

2c. source and availability of ferry operation process data

- source of data

Gdynia Maritime University (GMU), Maritime Search and Rescue Service in Gdynia (MSRSG), Maritime Office in Gdynia (MOG)

- availability of data

complete data available

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

3. Ferry operating area climate-weather change process data

3a. <u>climate-weather data parameters</u>:

– the ferry operating at port area

1. sea water
2. wind

– the ferry operating at sea area

1. sea water
2. wind

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

3b. climate-weather type of data

– the ferry operating at port area

1. sea water level
2. wind speed

– the ferry operating at sea area

1. sea water wave height
2. wind speed
3. wind direction (eventually in final examination, if necessary)

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

3c. source and availability of climate-weather data

- source of data

Institute of Meteorology and Water Management in Gdynia (IMWMG)

- availability of data

complete data available

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

4. Ferry safety states changing process data

4a. <u>ferry safety states changing process data parameters</u>:

1. ferry technical system safety structure
2. ferry technical system and its components safety states
3. realizations of ferry technical system components safety changing processes

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

4b. <u>ferry safety states changing process type of data</u>

1. ferry technical system safety structure and its parameters identification

2. number of ferry technical system and its components safety states and their definitions

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

4b. <u>ferry safety states changing process type of data</u>

3. numbers of realizations of pipin ferry technical system components safety states changing processes at the particular ferry operation states , empirical numbers of ferry technical system components leaving the safety state subsets at the particular ferry operation states, empirical lengths of ferry technical system components conditional lifetimes in the safety state subsets at the particular ferry operation states

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

4c. <u>source and availability of ferry safety states changing process</u>

- source of data

Ferry safety examination:

Gdynia Maritime University (GMU), Maritime Search and Rescue Service in Gdynia (MSRSG), Maritime Office in Gdynia (MOG)

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

- source of data

Critical infrastructure accident consequences examination:

Global Integrated Shipping Information System (GISIS) of the International Maritime Organization (IMO), United States Coast Guard National Response Centre and Centre of Documentation, Research and Experimentation on Accidental Water Pollution (Cedre)

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

4c. source and availability of ferry safety states changing process data

- availability of data

Ferry safety examination:

1. ferry technical system safety structure and its parameters identification - complete data available
2. number of ferry technical system and its components safety states and their definitions - complete data available

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

Ferry safety examination:

3. numbers of realizations of ferry technical system components safety states changing processes at the particular ferry operation states, empirical numbers of ferry technical system components leaving the safety state subsets at the particular ferry operation states, empirical lengths of ferry technical system components conditional lifetimes in the safety state subsets at the particular ferry operation states - complete data not available, application of approximate data coming from expert opinions

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Scenario 2: Chemical Spill Due to Extreme Sea Surges - Design

Critical infrastructure accident consequences examination:

1. realizations of three interacting and interdependent processes, the process of initiating events, the process of environment threats and the process of environment degradation - complete data not available, application of approximate data coming from data bases and expert opinions

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Scenario 2: Chemical Spill Due to Extreme Sea Surges – Data Collection and Processing

The considered maritime ferry is a passenger Ro-Ro ship operating at the Baltic Sea between Gdynia and Karlskrona ports on regular everyday line.

Its route is illustrated in Figure 4.

In this figure, there are marked 7 experimental points in which the realizations of the climate-weather change process for the maritime ferry operating area will be collected.

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Scenario 2: Chemical Spill Due to Extreme Sea Surges – Data Collection and Processing

In the experimental points 1 and 7 (Figure 4), to define the climate-weather states in this area, there will be distinguished 2 parameters that mainly decide about the climate-weather change process influence on the safety of the maritime ferry operating at Gdynia and Karlskrone ports, i.e. the sea water level measured in centimeters and the wind speed measured in meters per second.

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Scenario 2: Chemical Spill Due to Extreme Sea Surges – Data Collection and Processing

In the experimental points 2-6 (Figure 4), to define the climate-weather states in this area, there will be distinguished 2 (eventually 3) parameters that mainly decide about the climate-weather change process influence on the safety of the maritime ferry operating at restricted and open sea areas, i.e. the sea water height measured in meters and the wind speed measured in meters per second (eventually plus the wind direction measured in azimuth degrees).

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Scenario 2: Chemical Spill Due to Extreme Sea Surges – Data Collection and Processing

The climate-weather change process data are in disposal and will be guaranteed by Institute of Meteorology and Water Management in Gdynia (IMWMG).

The ferry operation process data are in disposal and will be guaranteed by Gdynia Maritime University (GMU).

The ferry safety states changing process data are in disposal and will be guaranteed by Gdynia Maritime University (GMU).

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Scenario 2: Chemical Spill Due to Extreme Sea Surges – Data Collection and Processing

Data processing will be based on the results of the following GMU reports:

[EU-CIRCLE Report D2.3-GMU1, Identification methods and procedures of Critical Infrastructure Operation Process (CIOP) including Operating Environment Threats (OET), 2016],

[EU-CIRCLE Report D2.3-GMU2, Identification methods and procedures of Climate-Weather Change Process (C-WCP) including Extreme Weather Hazards (EWH), 2016],

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Scenario 2: Chemical Spill Due to Extreme Sea Surges – Data Collection and Processing

[EU-CIRCLE Report D2.3-GMU3, Identification methods and procedures of unknown parameters of Critical Infrastructure Operation Process General Model (CIOPGM) related to Operating Environment Threats (OET) and Extreme Weather Hazards (EWH), 2016],

[EU-CIRCLE Report D2.3-GMU5. Evaluation of unknown parameters of a maritime ferry transportation system operation process related to Operating Environment Threats (OET) and Extreme Weather Hazards (EWH) at the Baltic Sea area, 2016],

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[EU-CIRCLE Report D3.3-GMU4, Identification of unknown parameters of critical infrastructure safety integrated model, 2016],

[EU-CIRCLE Report D3.3-GMU8, Maritime ferry safety modelling, identification and prediction (without climate-weather change influence), 2016],

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Scenario 2: Chemical Spill Due to Extreme Sea Surges – Data Collection and Processing

[EU-CIRCLE Report D3.3-GMU15, Application of the General Integrated Model of Critical Infrastructure Safety (GIMCIS) to maritime ferry safety modelling, identification and prediction (with climate-weather change influence), 2017],

[EU-CIRCLE Report D3.3-GMU22, Identification of unknown parameters of the General Model of Critical Infrastructure Accident Consequences (GMCIAC), 2017],

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Scenario 2: Chemical Spill Due to Extreme Sea Surges – Data Collection and Processing

[EU-CIRCLE Report D3.3-GMU24, Practical application of the General Model of Critical Infrastructure Accident Consequences (GMCIAC) to the chemical spill consequences generated by the accident of one of the ships of the shipping critical infrastructure network operating at the Baltic Sea waters, 2017].

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Scenario 2: Chemical Spill Due to Extreme Sea Surges – Next Steps

Preparatory Data for Case Study 2 – Scenario 2

Preparatory Approach to Case Study 2 Modelling, Identification, Prediction and Optimization – Scenario 2

Final Approach to Case Study 2 Modelling, Identification, Prediction and Optimization – Scenario 2

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Thanks!

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