



From Gases and Evaporators risk assessment towards an Integrated management of sea and land pollution incidents

MANIFESTS is a project co-funded by the European Union Civil Protection - DG-ECHO, developed in cooperation with RBINS, CETMAR, IMT Mines Alès, INTECMAR, IST, the UK Security Agency as associated partner and coordinated by CEDRE.



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D4.3 – Report on training activities at national and international levels

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D4.3 – Report on training activities at national and international levels

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General introduction

In the event of an accident or spill at sea, cooperation between local authorities is of paramount importance to manage the crisis. This is particularly true when transnational events occur and require cross-border cooperation. In this context, it is essential to provide joint training for leaders and agencies from both different countries or at a national level.

One of the objectives of the MANIFESTS *Genius* project is to transfer knowledge and decision-making tools that have been developed in the project and from previous EU and national projects, such as databases, guidance and tools to stakeholders and authorities involved in maritime pollution. These include fire services, maritime and Civil Protection agencies at local, regional and international levels, regional agreement Contracting parties (BONN, HELCOM and REMPEC) as well as the EMSA. In this regard, training materials have been developed and training courses were organised both at national and European levels to help instruct stakeholders in the use and application of the available tools.

The [MANIFESTS project's Decision Support System \(DSS\)](#) is designed to offer practical tools for organizing simulated exercises that train responders and decision-makers. These training programs effectively showcase the project's outputs and highlight their relevance in tackling pollution response challenges. Additionally, the trainings are tailored to meet the specific needs and interests of each target audience.



Training at national level

Such trainings were organised in four countries: UK, Spain, Belgium and France.

1. Training for UK Emergency Response Stakeholders

1.1. Introduction

UK Health Security Agency (UKHSA) completed a short programme of work to assess resilience amongst the UK maritime response community and identify potential emerging hazards. The work combined a survey of stakeholders involved in maritime emergency planning and response followed by a workshop to disseminate findings and test existing response approaches. Results were subsequently used to inform guidance produced by UKHSA around new maritime fuels. The work was supported by the UK Department of the Environment (DEFRA) as part of their Healthy Coast's initiative.

1.1.1. Stakeholder Survey

Approximately 80 stakeholders covering all of the UK were invited to respond to an online survey. Stakeholders included marine regulators, coast guard, fire service, health, environment and local authorities as well as industry bodies including shipping, ports and spill contractors. The survey ran for 4 weeks, after which results were collated and reviewed. Key questions used in the survey are presented in Table 1.

Table 1. List of questions used in the survey.

Please indicate the agency / body you represent and your job title / role.
Which coastal region(s) do you cover? (Multiple boxes can be ticked).
Briefly, what is your main role in responding to an incident affecting the marine environment / shoreline?
Have you been involved in any incidents affecting the marine environment / shoreline?
How would you rate your level of expertise regarding response to marine or shoreline incidents? (1 being little or none, 5 being expert)
Have any of the incidents been of an unknown source or origin? For example, a pollution incident or wildlife kill where the cause could not be established or was uncertain. Please provide brief details.
Do you have procedures for such incidents?
How are you most frequently notified / alerted to incidents in the marine environment / shoreline? (Please Rank).
Please provide any details regarding notification / alerting routes e.g., how are you initially notified.
Do you have a system for horizon scanning?
What future hazards do you think will be most relevant to your area?
Do you think there is a need for specific training and information regarding future hazards?

1.1.2. Survey Results

The survey returned a 30% response with a good mix of agencies and geographical coverage of the UK coastline (Figure 1).



Figure 1. Agencies roles and UK regions covered by the survey.

Key results suggested most responders had experience of maritime / coastal incidents and had procedures for response to such incidents. The survey further revealed that the public often played a role in alerting of coastal incidents. Regarding emerging concerns, roughly half of responders reported having horizon scanning procedures and suggested emerging areas of concern were around climate change / net zero impacts such as coastal erosion, extreme weather, offshore infrastructure and new maritime fuels (Figure 2).

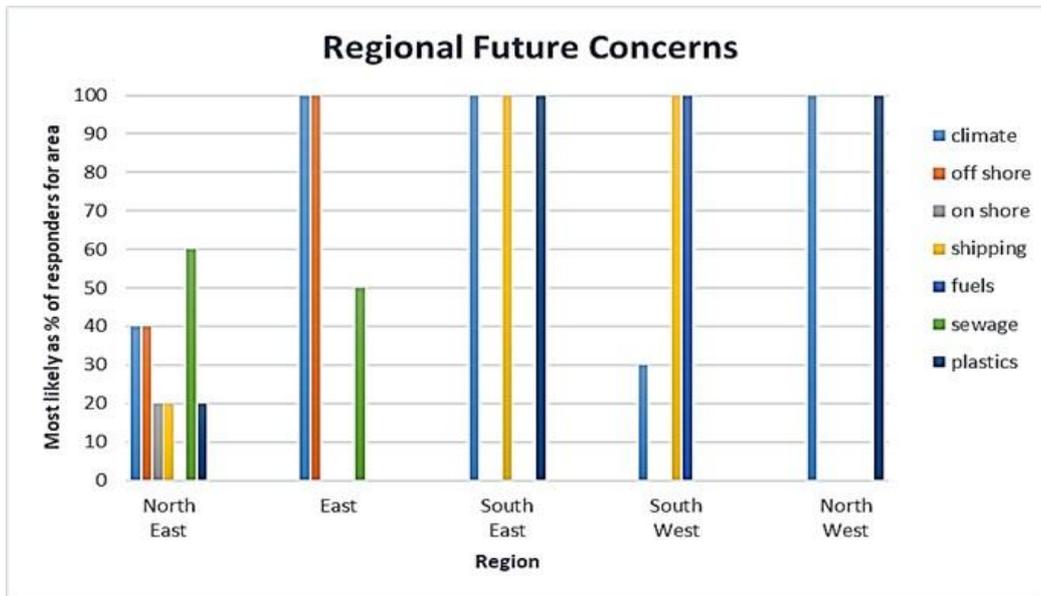


Figure 2. Emerging areas of concern by UK region. Approximately half of respondents stated that new areas of concern related to climate change, coastal erosion, extreme weather events, offshore infrastructure, and new marine fuels.

1.2. Stakeholder Workshop

Using the findings from the survey, a one-day face to face workshop was organised, focussed on emerging new fuels and aimed at testing current resilience. The event was held in Birmingham on 19th March 2025 and comprised presentations outlining the MANIFESTS *Genius* Project and developments around new fuels, followed by a short desk top exercise.

The exercise involved a fictitious scenario of a subsea leak of ammonia resulting in a major fish kill and subsequent onshore impacts. This was further complicated by an incoming passenger ferry, with an electric vehicle fire on board. Delegates were placed into 3 groups, with a representative distribution of agencies and industry bodies in each group (Figure 3).

The exercise comprised time sequenced injects to assess alerting, source investigation, response and public engagement. The final 3 injects required decisions around the passenger ferry.

A facilitator from UKHSA was allocated to each table to observe and guide discussions. After each inject the groups were asked to provide feedback which was recorded for later review.



Figure 3. Pictures of the event held in Birmingham. The 28 delegates that attended the workshop were divided into three groups.

1.2.1. Workshop Feedback

A total 28 delegates attended on the day, again with a very similar mix of agencies and industry to those who completed the on-line survey. Feedback for the overall day was captured via an online questionnaire at the end, with generally positive results.

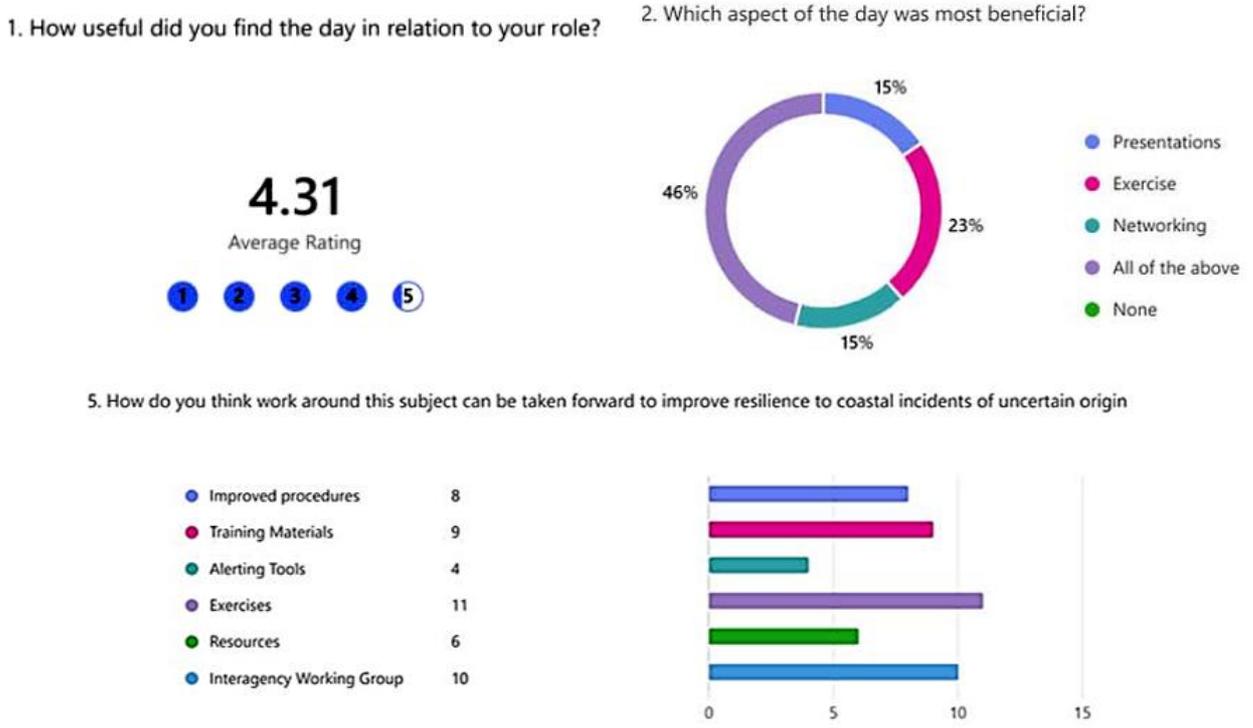


Figure 4. Online feedback from the 28 participants.

Overall, the workshop went well with all attendees fully engaged during the day. The exercise was seen as challenging but very useful. The only negative comments were for more time for the exercise and to include recovery phase injects (These were prepared but could not be completed in the time available). Specific feedback from the exercise was captured during the afternoon, with key learning points outlined below.

Initially this was seen as minor incident (probably a by-catch) requiring only a local follow up, raising potential resource issues if reported outside of normal working hours. Only as the exercise developed did consensus shift towards the need for wider multiagency response, initiation of formal response plans / structures and for more detailed monitoring and modelling including use of operator resources. Potential for wider impacts on shipping and commercial activities began to be considered at this time. Communications also became an important element. During discussions around the ferry, it became apparent that port and ship operators would have a lead role in decision making.

1.3. Overall Conclusions

Survey and workshop findings confirmed a good level of expertise amongst agencies and well-established response procedures. These appear however to be often targeted towards the classic hydrocarbon spill paradigm. Other types of incidents bring different challenges needing input from other specialist areas such as commercial operators and those with land-based expertise. The work raised awareness of the need to consider alternative net zero fuels in future maritime emergency resilience. Training and exercises were seen as very important around new and emerging risks, together with guidance and engagement with industry, particularly port and shipping operators.

Findings suggest a strong case for more investment in resources to respond to new and emerging hazards such as specialist monitoring, robust regulation and training for industry, emergency planners and responders. Multiagency / industry working groups will also be useful for future resilience.

As a result of these findings UKHSA have developed a series of response data cards for key new fuels soon available on the MANIFESTS Genius web site.

2. Workshop in Spain

2.1. Introduction

On June 4th, 2025, the CETMAR Foundation (Vigo, Spain) hosted the “Workshop on risk assessment of gases and volatile substances and the integrated management of marine and terrestrial pollution incidents”, framed in the MANIFESTS Genius project, co-funded by DG ECHO.

Building on the outcomes of the MANIFESTS project (2021-2023), MANIFESTS Genius aims to strengthen preparedness and response capacities for the integrated management of accidental pollution. The project primarily focuses on developing accessible knowledge and tools for end users, facilitating their preparedness and response to the release of hazardous and noxious substances (HNS), including alternative fuels such as ammonia, methanol, and liquefied natural gas (LNG), which in the event of an accident could form toxic gas clouds with explosion risks and/or drift toward the coast, impacting local communities.

The Workshop aimed to present MANIFESTS and MANIFESTS Genius tools by using practical cases, assess the different potential application of the tools during crisis management and promote their use by the organizations attending the event. Scenarios were provided for illustrative purposes.

The event also counted with the collaboration of the Technological Platform for Coastal and Marine Environment Protection (PROTECMA), coordinated by CETMAR. This platform brings together numerous potential end users of the project’s results, including authorities responsible for responding to accidental pollution, coast guards, port authorities, and technology providers.

2.2. Target audience and participants

The Workshop featured the participation of the MANIFEST Genius partners together with experts and professionals from the maritime sector including representatives from Regional and National Coastguard Services (Gardacostas de Galicia, Salvamento Marítimo), Port Authorities (Port of Coruña, Port of Vigo), Maritime Competent Authorities (Ministerio de Transportes, Dirección General de la Marina Mercante, Capitanías Marítimas), Research Institutes (IEO) and Environmental Companies (EuroFins-IPROMA).

Throughout the sessions, speakers could share their knowledge and experiences with 58 attendees, who were able to follow the event either in person or online (Figure 5).

2.3. Key topics addressed

The event opened with welcoming remarks by Marisa Fernández (CETMAR), Stéphane Le Floch (CEDRE) and Laura Cotte (CEDRE), who introduced the objectives of the workshop and the topics that will be presented.

The workshop was organised in three sections focused on: 1) chemical knowledge and risk assessment, 2) public health risk and response and 3) training, in which the project partners showcased the project outputs and provided interactive demonstrations of the tools developed on practical scenarios.



Figure 5. Opening of the workshop by Marisa Fernandez (CETMAR) and Stephane Le Floch (CEDRE).

2.3.1. Introduction

A first presentation by Stéphane Le Floch (CEDRE), project coordinator, opened the event providing an overview of the MANIFESTS & MANIFESTS Genius projects, objectives and

background, and making emphasis in the vocation of the project to deliver tools that can be transferable and applicable by those in charge of HNS spill preparedness and response.

A keynote lecture presented by Sergio Alda (EMSA) followed on the “Challenges from alternative fuels”, that provided a wide overview of the regulatory transition of the international maritime transport to meet the goal of decarbonisation by the European Union and by the International Maritime Organisation (IMO). These policies have accelerated the adoption of alternative fuels such as ammonia, methanol, hydrogen, and LNG. While these fuels reduce carbon emissions, they introduce new risks associated with toxicity, volatility and combustion, which will eventually require new response procedures, modelling and training efforts of responders and administrations in charge of contingency plans.



Figure 6. Sergio Alda (EMSA).

2.3.2. Part I: From chemical knowledge to risk assessment

The first session dedicated to the project was presented by Ludovic Lepers (RBINS) and Laurent Aprin (IMT Mines Alès) and focused on the key modelling components of the MANIFESTS DSS (Decision Support System). A practical scenario involving an accident of a vessel transporting ammonia in the Port of Le Havre was presented to show the audience how the project tools can be used in the event of a crisis or for training purposes.

Ludovic started showing how to obtain information about the chemical properties of ammonia by entering the HNS database, that in addition to deliver physicochemical parameters, includes ecotoxicological values, fire and explosion parameters and experimental data obtained by CEDRE at different temperatures and salinities.

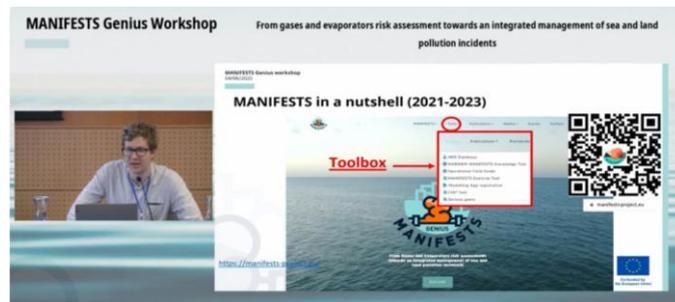


Figure 7. Presentation from Ludovic Lepers (RBINS).

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A second part most focused on the risk assessment followed in which Laurent explained how to use the MANIFESTS fire and explosion models in the event of an ignition leading to a gas explosion in the scenario proposed. The models show concentric ellipses that provide translated information to inform about potential consequences in structures and risk for human health.

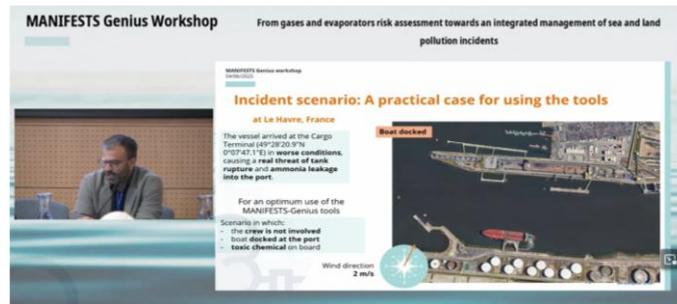


Figure 8. Presentation from Laurent Aprin (IMT Mines Alès)

Two more models were presented by Ludovic that allow users to predict the drift and fate of a chemical spilled in the open sea (OSERIT model), and to model the rise of gas bubbles in the water column in the event of a gas leakage from a wreck or a pipeline.

Ludovic explained that information about all models is accessible from the website, and that for gaining access it is necessary to contact RBINS. All models can be used worldwide except for the OSERIT model that it is available only for the North Sea and the English Channel. The rising gas model will only be available at the end of the project. The rising gas bubbles model will only be available at the end of the project.

2.3.3. Part II: Public health risk and response

The second part addressed “Public health risk and response” presenting relevant response tools such as the operational field guide on sheltering or evacuation (UKHSA), the MARINER-MANIFESTS Knowledge tool (CETMAR) and the Common Operational Picture Tool (INTECMAR). Paul Harold (UKHSA) presented the operational field guide developed within MANIFESTS, designed to support emergency managers in deciding between shelter-in-place or evacuation. Although ‘shut doors and windows’ is often the immediate protective action, the guide emphasizes that key factors—population vulnerability, building integrity, meteorological conditions, infrastructure accessibility—must be considered in determining the adequacy of sheltering.

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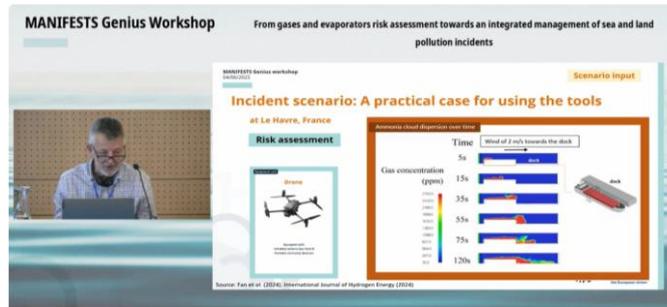


Figure 9. Presentation of the operational field guide by Paul Harold (UKHSA).

Marisa Fernández and Rula Domínguez (CETMAR) showed the upgraded MARINER–MANIFESTS Knowledge Tool (KT), which consolidates resources dealing with HNS developed by European and national I+D projects and by international organisations working in the field. At the moment the DB integrates information more than 800 resource including reports, databases, books, multimedia, videos, etc. into a unique repository. This DB is continuously updated with new entries and new functionalities are being implemented.



Figure 10. Presentation of the update KT by Marisa Fernandez (CETMAR).

Pedro Montero from INTECMAR followed with a presentation of the Common Operational Picture (COP) Tool, which coordinates situational awareness during emergencies. The system integrates a series of layers that range from satellite imagery, model outputs, drift buoy data, POLREPs, risk maps, protected-areas information, and real data gathered during the emergency into an interactive GIS-based interface.



Figure 11. Presentation of the COP tool by Pedro Montero (INTECMAR).

The main strength of the COP Tool is its capability to deliver the specific information to each type of users. Different users – ranging from unified command to advisory boards, field teams,

modellers, and the general public – require different types of data and levels of confidentiality. The tool enables customized COPs tailored to each type of user. The COP Tool was used in an exercise in the Port of Coruña to test it and to allow for coordination between different actors.

Within MANIFESTS Genius, protocols for sharing information with other agencies are being improved. CEDRE has a tool called ARGEPOL to manage pollution crisis and now efforts are being done to facilitate the exchange of information between both tools.

Work is also ongoing to transform model outputs into formats that are easy to use and that effectively support decision-making. To do that, a survey has been created for users to provide inputs on the types of information needed during an emergency. Participants were invited to send their feedback through this survey (link available through a QR code).

2.3.4. Part III: Training

The workshop continued in the early afternoon with a session dedicated to present training tools such as the online Exercise tool (CETMAR) to facilitate the preparation, development and evaluation of exercises and the Niovelius Serious game (IMT Mines Alès) created to raise awareness and prepare crisis managers to deal with accidental marine pollution by HNS.

Regarding the Exercise Tool, Marisa Fernández (CETMAR) reviewed the different sections of the tool and explained that its main objective is to help organizations to prepare exercises and to provide the capability to standardize documentation and replicate exercises.

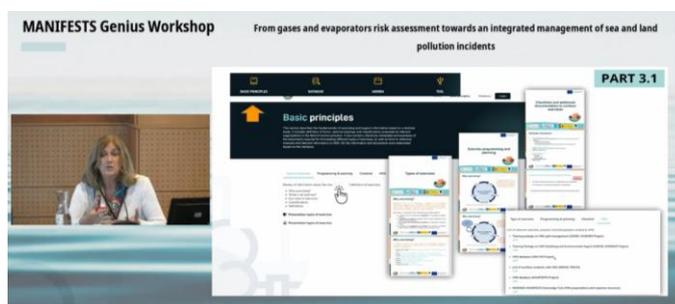


Figure 12. Presentation of the Exercise Tool by Marisa Fernandez (CETMAR).

Rula Domínguez (CETMAR) followed presenting the exercise tool component of the website, explaining its functionalities, the different ways to access it, the available templates and forms, and the outputs it generates.

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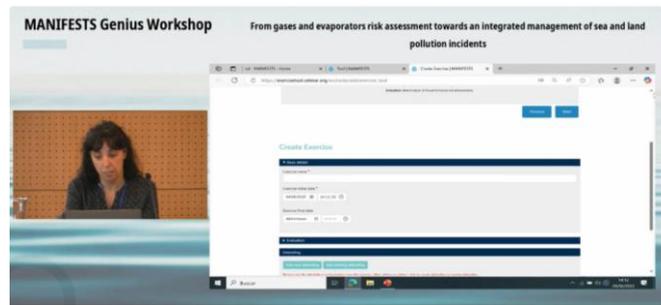


Figure 13. Presentation of the Exercise Tool by Rula Dominguez (CETMAR).

Marisa Fernández (CETMAR) also explained that, within the MANIFESTS Genius project, a decision was made to simplify the exercise reporting process and to do so a lite version of the tool is being created in collaboration with INTECMAR. This simplified tool will be accessible through the same website and focuses on preparation and evaluation. It also allows collaboration among multiple organizations and sharing of information.

Garbiñe Ayensa (INTECMAR) showed the Exercise Tool Lite, noting that its design was based on the experience organizing and participating in exercises within the regional contingency plan, and at the national level. She guided users through the different phases involving the creation of exercises and highlighted that the tool is particularly useful for replicating exercises that have already been conducted. She also presented the exercise evaluation component, which can be useful for developing debriefing report and assessing the exercise performance.

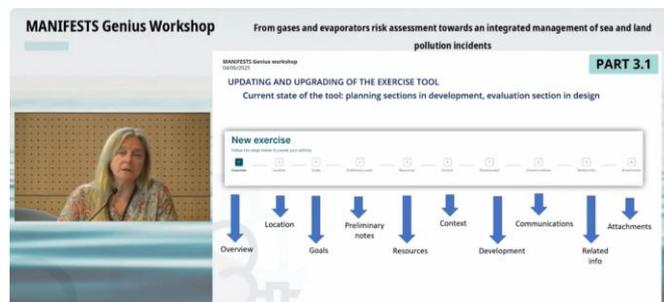


Figure 14. Presentation of the Exercise Tool Lite by Garbiñe Ayensa (INTECMAR).

Regarding the Niovelius Serious Game, Laurent Aprin (IMT Mines Alès) explained that this game was developed in the framework of the former MANIFESTS project and it is similar to a reverse escape game. The objective of the game is to prepare responders and crisis managers to deal with accidental marine pollution caused by HNS as part of their training program.



Figure 15. Presentation of the serious game by Laurent Aprin (IMT Mines Alès).

The game is based on puzzle games inspiration following a reverse escape game and it has a linear structure: each puzzle must be solved to move on to the next. It is presented in hybrid format including paper support documents and an app. It is played in teams of 4 players and 1 facilitator, and the total playing time reaches about 3 hours. It is a very useful material for supporting training activities and for preparing responders and managers to deal with chemical pollution crisis.

2.4. Feedback from participants

The Workshop included an open debate after each session where participants could pose their doubts and confirmed the interest generated by the project and associated tools and their willingness to further explore their applicability.

Regarding presentations during **part I** of the workshop, participants highlighted gaps and needs to improve the knowledge and response to crisis involving the new alternative fuels and HNS accidents in the marine environment. One of the concerns was focused on the lack of practical and accessible information on hazardous substances. While chemical data exist, responders often lack expert guidance on how substances behave in the marine environment (e.g. whether they sink, evaporate or dissolve). Participants recommended enriching databases and safety data sheets with clearer, more practical and translated information focused on real response needs.

With regards to presentations given in **part II**, participants highlighted several key points in their feedback. Andrés Guerra (Port of A Coruña) noted that the Port of A Coruña is undergoing a long transition in fuel operations, moving toward new types of fuels for which current preparedness is still limited. This will require revising the internal maritime emergency plan and linking it with industrial self-protection plans, extending beyond the strictly maritime scope.

Representatives from the Galician Coastguards expressed their appreciation as users of the COP Tool, emphasizing their high level of satisfaction with both the tool and the quality of information it provides. Garbiñe Ayensa (INTECMAR) commented that although incidents involving volatile substances evolve very quickly and require an immediate response, the COP tool will be very useful for preparedness and training of responders.



Figure 16. Discussion with participants.

Participants from Salvamento Marítimo suggested assessing how the COP Tool could be integrated with existing emergency management systems at the regional level such as Civil protection's systems. Pedro Montero added that discussions are already underway with Civil Protection to integrate data layers.

In the discussion of **part III**, Sebastian Legrand (RBINS) shared his testimony about the use of the Niovelius game, noting that it is engaging, enjoyable, and highly educational. He highlighted that the game helps users better understand concepts such as the European classification of chemical substances and the interpretation of HNS database information and strongly recommended its use.

Stéphane Le Floch underlined that CEDRE has a dedicated training department, reinforcing the importance of training and capacity building alongside the use of these tools. The serious game presented was also seen as a valuable way to strengthen responder capacities.

Additional comments from the people following the event remotely strengthened the need for strong response plans and for the development of exercises that involve all relevant stakeholders. Participants were also informed that presentations and recordings will be available online in the project website. Finally, Stéphane Le Floch emphasized the importance of ensuring interoperability and communication between different emergency management tools.

2.5. Conclusions

The workshop concluded encouraging attendees to explore and use the MANIFESTS tools, to disseminate them within their institutions and to provide feedback to continue improving the tools to better meet the needs of crisis managers and responders.

The value of the project outputs was underlined, particularly for preparedness and training purposes. The project partners stressed that the tools and scenarios developed can help responders to better understand the range of situations they may face during an emergency.

2.6. Recordings and presentations

The event recordings and power point presentations are accessible via the following links:

- Video in Spanish:
https://youtu.be/oiM5HjD2j_Y
- Video in English:
<https://youtu.be/EsFBbRtouJQ>
- Presentations:
 - [Sergio ALDA - EMSA](#)
 - [MANIFESTS presentations](#)

3. Training courses in Belgium

The Royal Belgian Institute of Natural Sciences is both a partner of the project and the institution responsible to run simulations on an operational framework in Belgium. During the MANIFESTS *Genius* project, the institute of Natural Sciences did several presentations and exercise using the new capabilities and model that have been developed during the MANIFESTS and MANIFESTS *Genius* projects.

On the 31st of May 2024, the new capabilities of OSERIT HNS along with the fire and explosion model have been presented in Bruges at a Overlegorgaan with all the Belgian coastguards linked institutions. This allowed all the Belgian responders and stakeholders to be aware of the existence of these new tools and be ready when then are used.

In September 2024, the modelling app (OSERIT HNS and the explosion model) was used in a real emergency situation, as an incident occurred with the vessel MV RUBY. This vessel was carrying ammonium nitrate and had issue with his engine. Simulations have been performed to assess the impact in case of an explosion of this cargo, mainly providing safety distance to keep from the vessel for the responders. These simulations where very useful to disseminate the model capacity with a concrete example use case. They were shown at OTSOPA, to most of European responders.

On the 4th of April 2025, the Belgian maritime police was trained on OSERIT model.

In June 2025, an exercise at sea took place in Belgium with Belgian, French and UK pollution responders. Simulations results were shown to the responders along modeler interpretation. This allows to test and improve the communication between the coastguard institutions and to familiarize the responders with the models outputs.

Apart from these national meeting, the MANIFESTS web interface, the models, and the HNS database have been presented to the group UKSpill, on the 3rd of July 2025. This group composed of many stakeholders from various organization including ship owners, ports, responders, spill modeling companies... Stakeholders from modeling and responders groups attended the meeting, with the objective to gain knowledge on the tools developed during both MANIFESTS project.

4. Training in France

A 2 hours training was held at CEDRE, in Brest, during the “Chemical spill response at sea” course on November 6th, 2025. A number of 13 participants attended the training. The structure of the workshop followed the same format as the international workshops conducted by CEDRE, as described on page 30 (Workshop typical structure).

4.1.Scenario

For this training, the incident scenario involved a LNG spill at the terminal of Nynäshamn, Sweden, caused by a collision between two vessels. The full scenario can be found in Appendix A.2. Accident Scenario. The document depicts the course of the incident, starting with a description of the events along with descriptive schemes (Figure 17). The coordinates of the location where the vessel is docked have to be provided for future use in the second part of the exercise. Time slots were added to the scenario.



Figure 17. Part of exercise scenario at Nynäshamn, Sweden.

The exercise started when the vessel was docked at the port. The crew had been evacuated from the boat so the crisis management only focuses on the chemical risk at stake. The Arctic Pearl vessel is in poor conditions, but no leak happened at this stage.

4.2. Course of the exercise

The 13 participants present at the training were split into 4 different groups of 2 to 4 people. There were no roles defined, all participants were working on the response management by sharing their own expertise.

Before starting the exercise, each group received a folder containing the following documents:

- Methane safety datasheet from Air Liquide;
- Response form (see A.1. Exercise response form);
- Scenario (see A.2. Accident Scenario);
- Supplementary Information (A.3. Supplementary information; A.4. Supplementary information – LNG Leak Scenario);

- One set of MANIFESTS Tool Cards (B.1. Tool cards).

The exercise was set to last 1 hour and 20 min, with the following time allocated for each part:

- 1st part: Chemical expertise (HNS database): 20 min;
- 2nd part: Risk assessment (Modelling App): 30 min;
- 3rd part: Public Health risk (response algorithm of the Operational Field guide): 15 min;
- 4th part: Response (knowledge tool): 15 min.

4.2.1. 1st part: Chemical expertise (HNS database)

The aim of this part was for the participants to learn more about LNG and methane thanks to the HNS database. Cards n°1 (HNS database) and n°6 (MAR-ICE) are expected to be played. By playing the HNS database card, participants could use the HNS database available online to look for Methane (Figure 18). When the MAR-ICE card was played, a printed Ericard datasheet on methane (Figure 19) was provided to the participants as the MAR-Cis datasheet is not available for methane. A synthetic report from MAR-ICE on the risk of an LNG spill was also presented one hour later.

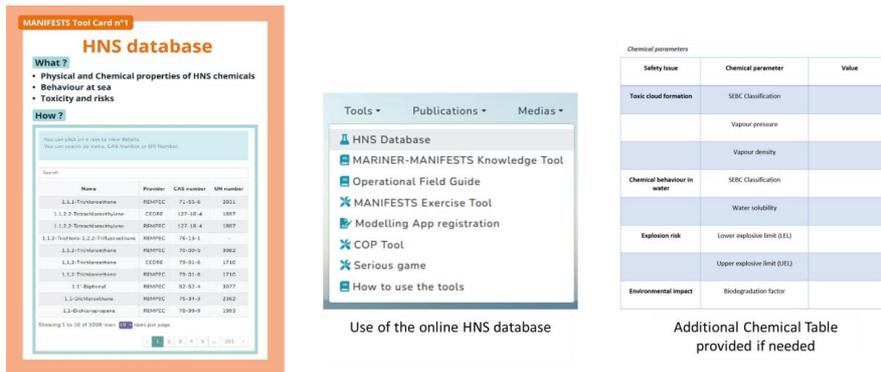


Figure 18. Cards no. 1 (HNS Database) is expected to be used during the first part of the exercise. Card no. 1 provides access to the online database and, if necessary, to the printed Chemical Table.

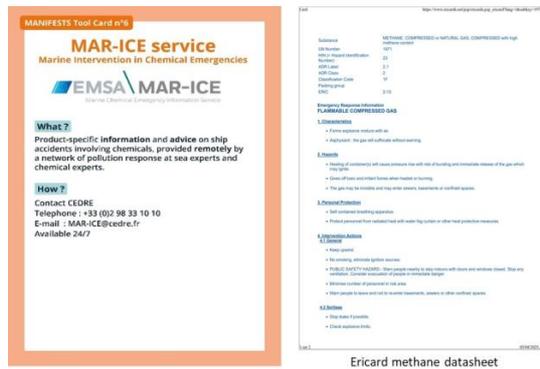


Figure 19. The card no. 6 (MAR-ICE Service) is expected to be used during the first part of the exercise. It grants access to the Ericard datasheet for methane, as well as a synthetic report from MAR-Ice delivered one hour later.

4.2.2.2nd part: Risk assessment (Modelling App)

During the second part, a fictive call was played adding some inputs to the scenario. An intervention team provided information on the state of the ship by sending a drone equipped with an infrared camera and a methane explosimeter, giving the volume of methane and its concentration in the air (30 m³ and 60,000 ppm).

2ème partie : Évaluation des risques 30 min ⌚

Maintenant que les paramètres chimiques de la substance impliquée sont déterminés, une première équipe d'évaluation est envoyée pour évaluer l'état du bateau. Le rapport suivant est reçu :

"Rapport pilote de drone A1. Heure locale 00h10. Premier passage du drone terminé. Pas de brèches majeures dans les réservoirs de GNL. Plusieurs joints d'étanchéité endommagés sur le dessus d'un réservoir. Fuite de méthane sur le pont du navire constatée, observation via la caméra IR. Volume de gaz estimé : **trente mètres cubes**. Gaz accumulé dans un espace confiné à bord du navire. Concentration mesurée dans cet espace : **60 000 ppm**. Images thermiques et données en cours de transmission. Terminé."

Figure 20. Highlighted inputs from the fictive call.

The concentration of 60,000 ppm is within the explosive range for methane (53,000 to 140,000 ppm, [MANIFESTS - HNS Details](#)), meaning that the card n°5 of prediction models had to be used in this part to assess the damages of a potential explosion. The gas volume of 30 m³ was chosen based on the modelling by Nubli et al.¹ This value was also chosen because an explosion of this size could reach the populated area of Nynäshamn, creating a realistic and controlled scenario for discussing sheltering or evacuation in the next part of the exercise. As the participants have access to the model, they can also decide to model the explosion of the whole capacity of the ship (6 000 cubic meters). This would impact wider areas and modify the risk assessment. Printed results of a modelling were given as the soon as the card n°5 “prediction models” is played, and a temporary login was provided to enable the use of the model on the platform (Figure 21).

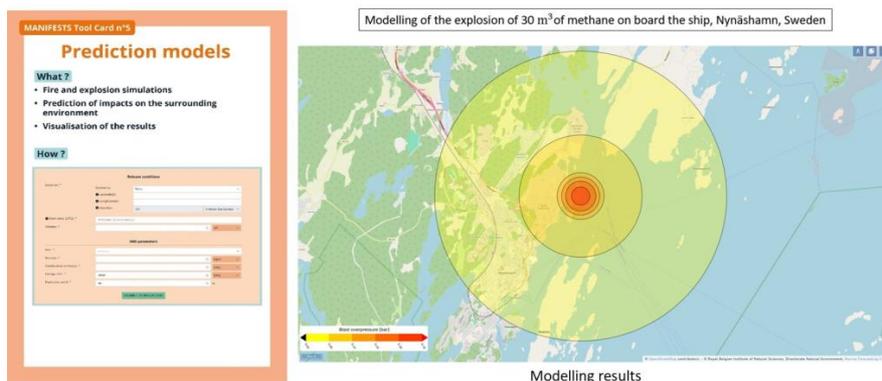


Figure 21. The card n°5 (Prediction models) is expected to be played during the second part of the exercise. The results of the modelling of a 30 m³ methane explosion are provided to the participants.

¹ Haris Nubli, Jung-Min Sohn, and Dongho Jung, 'Consequence Analysis of Accidental LNG Release on the Collided Structure of 500 Cbm LNG Bunkering Ship', *Journal of Marine Science and Engineering*, 10.10 (2022), p. 1378, doi:10.3390/jmse10101378.

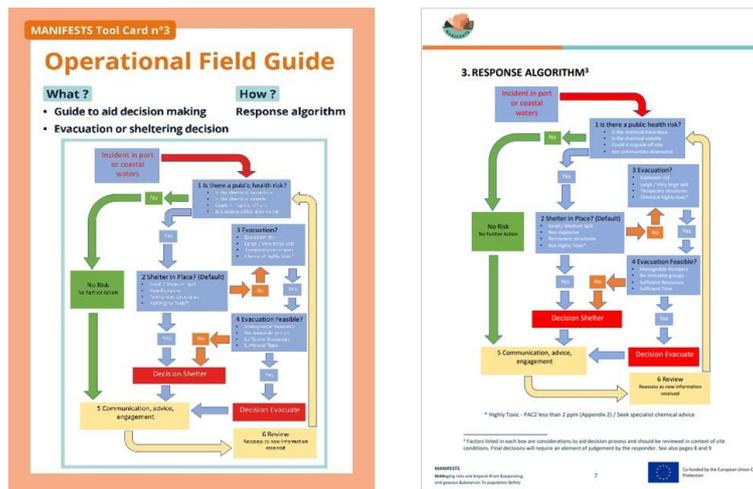
D4.3 – Report on training activities at national and international levels

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Additional explanations and schemes regarding the formation of the explosive atmosphere were provided in order to make the scenario more realistic (see A.4. Supplementary information – LNG Leak Scenario). It was assumed that the collision energy impacted the seals on top of the LNG tank, causing boil-off methane vapours to migrate towards the ship's deck and to escape through a damaged valve seal. As the cold gas is escaping from the refrigerated tank, the low temperature caused crackles on the surroundings, worsening the state of the boat. On the ship's deck, the gas was trapped near the ground at high concentration before rising up when warming up in contact with the atmosphere. Assuming this scenario, methane vapours were stuck on the main's deck, and settled in an area in which a concentration of 60 000 ppm was recorded.

4.2.3.3rd part: Public Health risk (Operational Field guide)

Based on the information gathered in the last part, participants were expected to play card n°3 “Operational Field Guide” to decide whether to shelter or evacuate the population in the area. Once the card was played, the plasticized response algorithm was given to the participants so that they could mark the path that led them to their final decision.



Playing the Card no. 3 gives access to the plasticized response algorithm where the path towards final decision (shelter or evacuation) can be hand-written.

All groups came to the same conclusion to evacuate the port area, but shelter the inhabitants in their houses in the populated area located further away from the port. Then, the MAR-ICE report was presented, the leak was assumed to be contained and the scenario was concluded.

4.2.4.4th part: Response (Knowledge and Exercise tools)

In this part, the participants were expected to play the cards n°2 and n°4, respectively the Knowledge Tool card and the Exercise tool card. Participants could access these tools and browse their contents online. They got to know the resources available, such as a record of past projects related to incident management or materials for organizing their own training session.

4.3. Feedback and improvements

4.3.1. Feedback

A feedback form (Appendix F. Participant feedback form) was shared after the exercise to the participants. A total of 13 forms were collected at the end of the exercise. Results of the survey are presented in Figure 22.

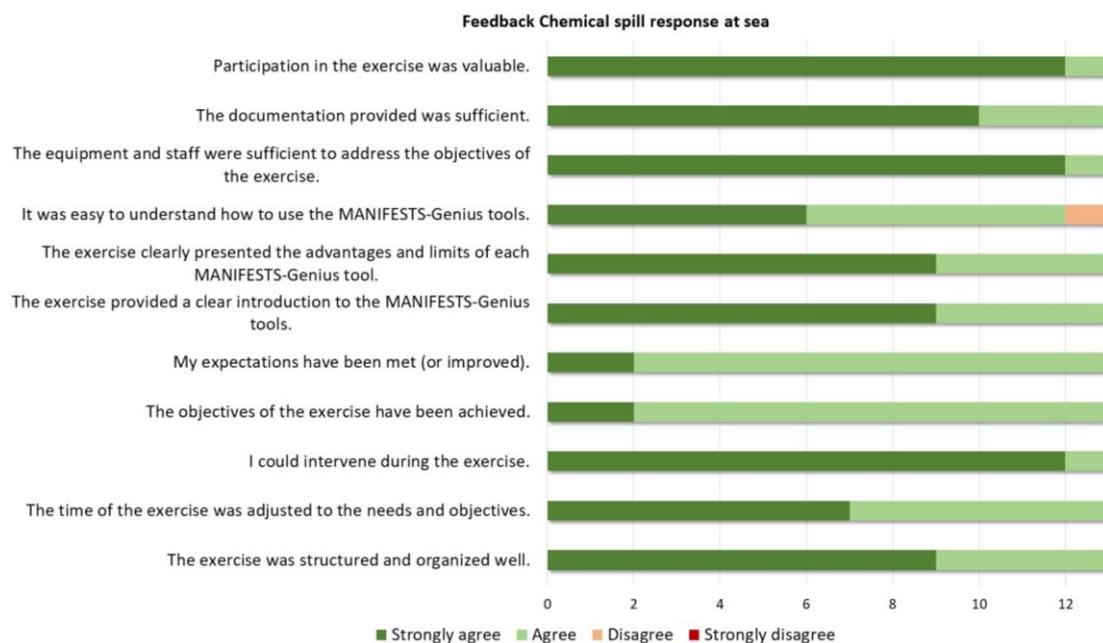


Figure 22. Feedback from the Chemical spill response at sea participants of 13 forms were collected, with an overall response being really positive.

All points received a majority of “Strongly agree” or “Agree”, and only one “Disagree” was observed for the statement “It was easy to understand how to use the MANIFESTS *Genius* tools.” Indeed, comments were made by the participants to make the tools more user-friendly and easier to understand. A need for allocating more time to the exercise was also pointed out.

4.3.2. Subsequent improvements

The main areas for improvement suggested in the comments related to the lack of time and clear details to fully understand the tools. After closely reviewing the feedback from the participants, the following improvements were carried out:

- Run simulations before the exercise begins in order to familiarise the participants with the prediction model tool;
- Specify the coordinate format while filling the simulation on the prediction model to avoid wasting time;
- Provide some data on the port city concerned (number of inhabitants, maritime traffic, type of housing, proximity to other urban areas) to enable better analysis of the situation.

Training at international level

General introduction

In order to improve awareness on decision-making tools available for crisis management, trainings were organised in the form of tabletop exercises. The objectives of the tabletop exercise were as follows:

- Presentation and use of the MANIFESTS *Genius* tools;
- Assess the different potential uses of the tools during crisis management;
- Convince participants to promote MANIFESTS *Genius* tools to their chemical experts.

Three international training sessions were initially planned, coupled to Regional Agreement meetings: Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC), Bonn Agreement and Baltic Marine Environment Protection Commission (HELCOM).

REMPEC covers the Mediterranean Sea under the Barcelona Convention. Its mission is to assist Mediterranean coastal states in preventing and responding to pollution from ships by building their national capabilities, facilitating cooperation in emergencies, supporting enforcement of maritime conventions, and promoting information exchange and training.

The Bonn Agreement focuses on the North Sea and the English Channel, aiming to improve cooperation among coastal states to combat pollution from ships and offshore installations, enhancing preparedness and joint responses to pollution incidents.

HELCOM governs the Baltic Sea region under the Helsinki Convention. Its mission includes protecting and restoring the Baltic marine environment by controlling pollution from ships, land, and air, and promoting sustainable maritime activities through regional cooperation.

Each of these organizations holds training sessions and regional meetings to strengthen collective maritime pollution prevention and emergency response.

The first training session was held at REMPEC on 15 May 2025, with the participation of 16 Contracting Parties to the Barcelona Convention, while the second took place on 22 May 2025 during the OTSOPA meeting, involving 11 Contracting Parties to the Bonn Agreement. Unfortunately, the training session originally planned with HELCOM contracting Parties could not be held due to scheduling constraints, as no suitable dates were available before the end of the project's eligibility period on 31 March 2026. However, an additional training session, not initially planned, was organised in October 2025 for the new beneficiaries of the MAR-ICE service, alongside an HNS-EMSA training hosted at CEDRE (8 states involved).

The typical structure of the workshop organised by CEDRE is outlined in the following section, page 25. For the three international events, the scenario design, the course of the exercise, and the subsequent feedback and improvements are presented and discussed (see sections 2, 3 and 4).

1. Workshop typical structure

The workshop typical structure begins with a presentation of the MANIFESTS *Genius* project, followed by an introduction to the MANIFESTS Decision-Support System (DSS) tools included into the tabletop exercise. Based on a specific incident scenario, the exercise is then conducted to allow participants to engage in the practical use of these tools. The remaining tools of the MANIFESTS DSS that are not addressed during the exercise are subsequently presented at its conclusion.

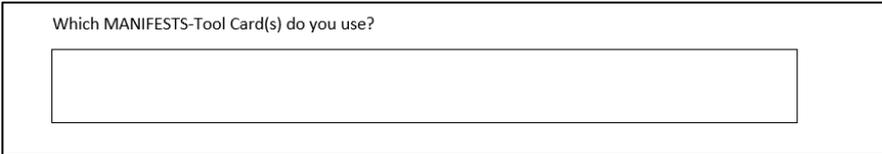
Three different incident scenarios have been developed for each workshop (different chemical, different location, different volume), but the general scenario structure remains identical. The incident scenario is tailored for the participants to use most of the tools developed in the MANIFESTS *Genius* project. The sequence of events in the three scenarios has been designed to better meet the workshop's objectives, rather than to reflect a fully realistic scenario.

1.1. Reference materials

Following the introductory part of the session, participants are briefed and provided with printed documents and cards to be used during the exercise. These documents and cards include:

- An exercise form;
- A response form;
- Tool cards;
- Equipment cards;
- A chemical table;
- A response algorithm (sheltering or evacuation decision chart).

As for the documents, the “Response Form” contains questions and guidelines for the participants. A “scenario description” is also provided for each workshop, completed by a sheet of “supplementary information”. These three documents were merged under the “Exercise form” for REMPEC, before being split into three different ones. Each card represents a tool from the MANIFESTS DSS (B.1. Tool cards) or first response equipment (B.2. Equipment Cards) and can be played during the exercise whenever considered appropriate. The use of cards provided trainers with a clear method for tracking the tools used during each stage of the response management. Participants have been systematically requested to report the cards used into the allocated white frame (Figure 23) available in the response form.



Which MANIFESTS-Tool Card(s) do you use?

Figure 23. White frame extracted from the Response form to report any card played.

Participants are instructed that at least one tool card has to be played per exercise part, and that each card can be played several times. Whenever a card is played, it allows online access to a

tool on the MANIFESTS website or to additional printed documents (inputs to the exercise) provided by the trainers.

1.2.Role of cards

The Tool Cards are numbered according to the order in which the tools appear on the website (Figure 24).

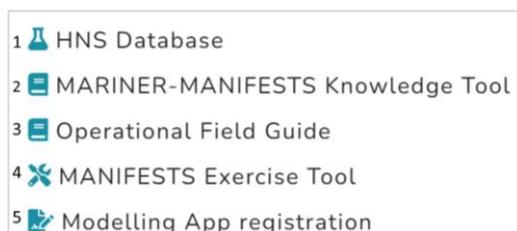


Figure 24. The Tools card are numbered according to the order of appearance of the corresponding tool on the MANIFESTS Genius website.

The **HNS Database Card (n°1)** provides access to the online HNS database on the project website and allows users to obtain the Chemical table (B.3. Chemical table) if necessary. The **Prediction Models Card (n°5)** provides access to printed modelling outputs from the explosion model, specific to each scenario. The **Algorithm Card (n°3)** gives access to a printed version of the ‘sheltering or evacuation’ decision chart (B.4. Response algorithm), on which the path towards a decision sheltering or evacuation of the population can be directly hand-written. The exercise response form, the chemical safety datasheets and the cards are stored in a folder given to each group of participants at the beginning of the workshop. The **Knowledge tool Card (n°2)** allows users to browse an online database containing a comprehensive collection of marine research and technical resources specifically related to the preparedness for and response to HNS spills. **Exercise tool (n°4)** card allows to browse the online tool containing materials, supports and guidelines to design marine pollution response exercises.

A Tool Card on the MAR-ICE service, while not part of the MANIFESTS DSS, was added to promote this service and make the exercise more realistic. If activated on time, the **MAR-ICE Service Card (n°6)** allows users to collect a product specific Mar-Cis data sheet, and a MAR-ICE synthetic report received one hour later.

1.3.Structure of the exercise

The exercise is divided into 4 different parts and lasts 2 hours in total:

- **1st part: Chemical expertise**
This part focuses on the chemical product at stake, its behaviour and potential hazard. Participants get to know how to use the HNS database. Use of **HNS Database Card (n°1)**.

– **2nd part: Risk assessment**

Participants are here introduced to the Risk Prediction Models of the DSS. Inputs are given to the entire audience to complete the scenario, under the form of a fictive call from an intervention team visiting the ship. The team provides the following information, adapted for each scenario:

- Volume of chemical in the ship's tank;
- Concentration of the chemical in the air (set within the explosive range on purpose);
- Changes in pressure or temperature on the ship.

The call script is provided in the response form so that each group can review it carefully during this part of the exercise.

The explosion model, **Prediction Models Card (n°5)**, provides an ellipse of danger for the area around the accident. The decision was made to focus on the explosion model to simulate the worst-case scenario, as its results are more striking and provide a better introduction to the next part of the exercise.

– **3rd part: Public Health risk**

Based on the results of the second part, participants can use the Operational Field Guide, **Algorithm Card (n°3)**, and its response algorithm, to assess the risk and decide whether to shelter or evacuate the impacted area.

– **4th part: Response**

Participants browse and select relevant documents on the MARINER-MANIFESTS Knowledge tool across categories like environmental monitoring, response protocols, risk analysis, and training. They are also introduced to the Exercise tool, which contains dissemination materials, presentations and guidelines to create and organise marine pollution response trainings.

During the exercise, trainers from CEDRE are moving from group to group to answer any questions or provide guidance if needed. At the end of each part, a brief summary of the actions taken (which card had been played and why) is presented by the trainers or shared between groups if time and number of people allow it. At the end of the exercise, participant feedback forms (Appendix F. Participant feedback form) are distributed and retrieved once filled.

The course of each workshop is detailed in the following sections.

2. REMPEC, Sliema, Malta

The 16th meeting of the Focal Points of REMPEC took place from 12 to 15 May in Sliema, Malta. The MANIFESTS training was presented by CEDRE on the morning of the 15th. About 40 people attended the exercise.

2.1.Scenario

For the REMPEC training session, the focus was set on an incident involving methanol at Piraeus Port in Greece. The complete scenario can be found in the second part of Appendix C (C.1. Exercise Form). The document depicts the course of the incident, starting with a description of the events along with descriptive schemes (Figure 25).

The coordinates of the location where the ship is docked at the Piraeus Port (37.9392, 23.6351 or 37°56'21.5"N 23°38'06.7"E) were provided for future use in the second part of the exercise.

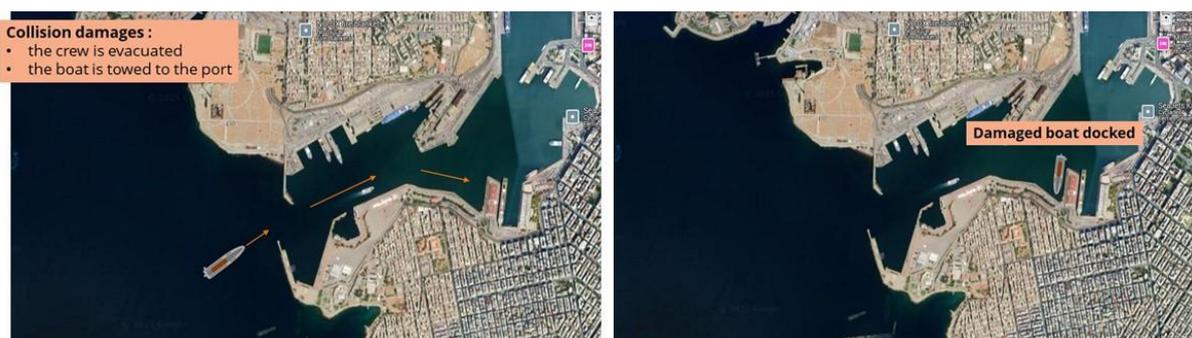


Figure 25. Scenario of accident at Piraeus Port, Greece. The ship is towed towards the port and stays docked at the Terminal, where the exercise starts.

The exercise started as soon as the ship was docked at the port. The crew was evacuated from the boat so the incident response management focused only on the chemical risk at stake. No methanol leak happened but the damaged state of the boat posed a risk. The wind direction was indeed chosen so that any toxic cloud would be directed towards a populated area.

2.2. Course of the exercise

The 40 participants were split into 10 different groups of 2 to 6 people. One group was made of French-speaking people only. There were no roles defined, all participants were working on the response management by sharing their own expertise. One person per group was assigned to take notes on the response form.

Before starting the exercise, each group received a folder containing the following documents:

- Merck Methanol safety datasheet;
- Response form (see C.1. Exercise Form).

The exercise was set to last one hour, with the following times allocated for each part:

- 1st part: Chemical expertise (HNS database): 15 min;
- 2nd part: Risk assessment (Modelling App): 20 min;
- 3rd part: Public Health risk (Operational Field guide): 10 min;
- 4th part: Response (knowledge tool): 15 min.

2.2.1. 1st part: Chemical expertise (HNS database)

The aim of this part was for the participants to learn more about methanol and its behaviour. Cards n°1 (HNS database) and n°6 (MAR-ICE) were expected to be played (Figure 26 and Figure 27). When the HNS database card was played, participants could use the HNS database available online. Depending on the profile of the participants, an additional “Chemical Table” could be provided to help them navigating in the database and look for the relevant chemical and physical parameters.

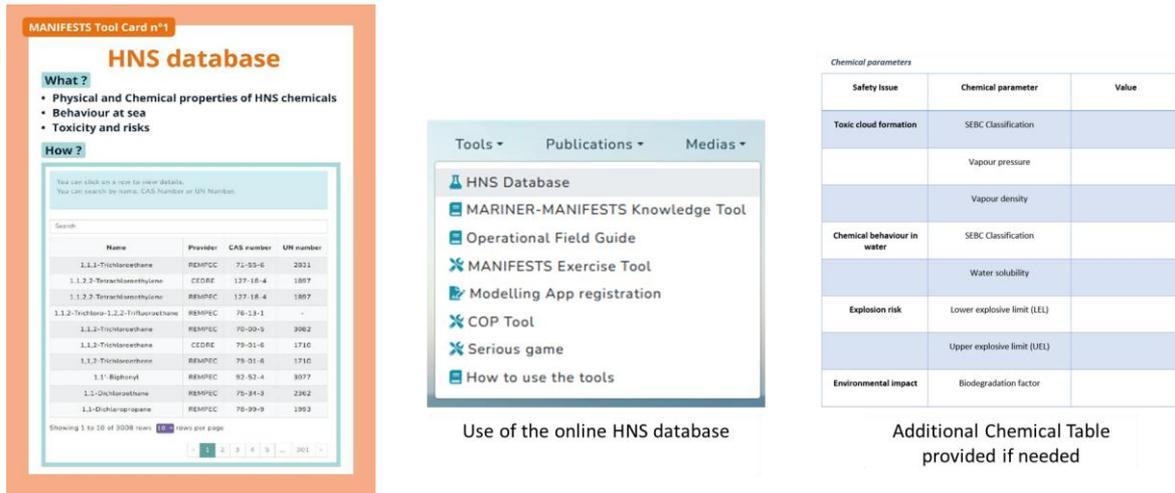


Figure 26. Cards no. 1 (HNS Database) is expected to be used during the first part of the exercise. Card no. 1 provides access to the online database and, if necessary, to the printed Chemical Table.

When the MAR-ICE card was played, a printed MAR-CIS datasheet on methanol was provided to the participants and a fictional service was activated. A synthetic report from MAR-ICE on the risk of methanol was presented to the audience one hour later.



Figure 27. Card no. 6 (MAR-Ice Service) is also expected to be played, granting access to the MAR-CIS datasheet of the product and a synthetic report one hour on recommendations later.

2.2.3.3rd part: Public Health risk (Operational Field guide)

Based on the information gathered in the last part, the participants were expected to play the card n°3 to take a decision to shelter or evacuate. When the card was played, the plasticized Algorithm and markers were given (Figure 30).

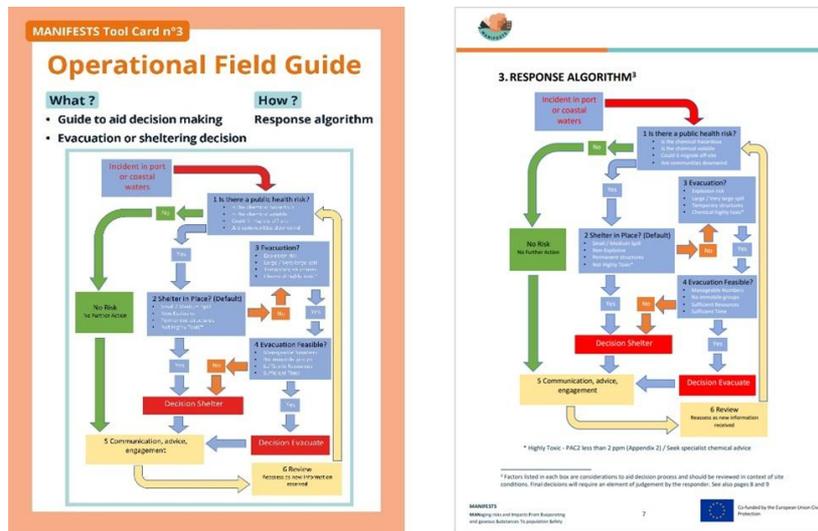


Figure 30. Playing the Card no. 3 gives access to the plasticized response algorithm where the path towards final decision (shelter or evacuation) can be hand-written.

Once evacuation or shelter was decided, the scenario was concluded and there was no longer any health risk. Final decisions could be shared between the groups to start discussions. There was no definitive answer, as the most important aspect was the thought process behind the decision. The situation is handled on a case-by-case basis, depending on the potential danger in the area.

2.2.4.4th part: Response (Knowledge and Exercise tools)

In this part, the participants were expected to play the cards n°2 and n°4, respectively the Knowledge Tool card and the Exercise tool card. Participants could access these tools and browse their contents online. They got to know the resources available, such as a record of past projects related to incident management or materials for organizing their own training session. For instance, guideline’s manuals on HNS incidents like the WestMoPoCo Guide are available. This manual can be found under “Resources”, “HNS Characterisation” with results sorted out by most recent publication year (Figure 31).

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Welcome to MARINER-MANIFESTS Knowledge Tool

User-friendly access to an inventory of HNS preparedness and response resources generated in the frame of research projects (i.e. Knowledge Outputs) or by specialised organisations. [Read more...](#)

Projects
Inventory of relevant research and cooperation projects on HNS and their Knowledge Outputs

Organisations
Inventory of key organisations working on maritime pollution and their main Resources

Resources
Inventory of all the Knowledge Outputs -compiled from projects- and the Resources -from organisations- dealing with HNS

Browse the list of resources by clicking on the Areas of Knowledge below:

Select All | Clear All

Case studies | Contingency planning | Environmental monitoring, impact & recovery | Exercising | Harbour, shipping & industrial facilities | **HNS characterisation** | Human health

Liability and compensation | Modelling | Response protocols and equipment | Risk analysis | Training

Select type of resource:
Select All | Clear All

LIST VIEW | STATISTICS 162 Results

Resources CUSTOMIZE TABLE [Download customized catalogues](#)

<input type="checkbox"/>	Title	Summary	Acronym	Organisations	Publication year
<input type="checkbox"/>	Study on Safe Bunkering of Biofuels	EMSA contracted the study EMSA OP/11/2023 to DNV to address a gap in standardisation of procedures for marine bunkering of biofuel. The study builds on expert knowledge of the physical-chemical...		European Maritime Safety Agency	2025
<input type="checkbox"/>	Marine HNS Response Manual - Multi-regional Bonn Agreement, HELCOM, REMPEC	The objective of the Marine HNS Response Manual is to provide operational guidance for first responders and decision-makers during a maritime incident at sea or in port involving HNS. The manual does...	WestMOPoCo	Baltic Marine Environment Protection Commission - Helsinki Commission, Bonn Agreement Secretariat, Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea	2021
<input type="checkbox"/>	West MOPoCo Layperson's Report	Report that describes all project results and feedback from the partners in West MOPoCo	WestMOPoCo		2021

Figure 31. Online search for the WestMoPoCo Manual on the MARINER-MANIFESTS Knowledge Tool.

2.3. Feedback and improvements

2.3.1. Feedback

A feedback form (Appendix F. Participant feedback form) was shared after the exercise to the participants. A total of 33 forms were collected at the end of the exercise held at REMPEC. Results of the survey are presented in Figure 32.

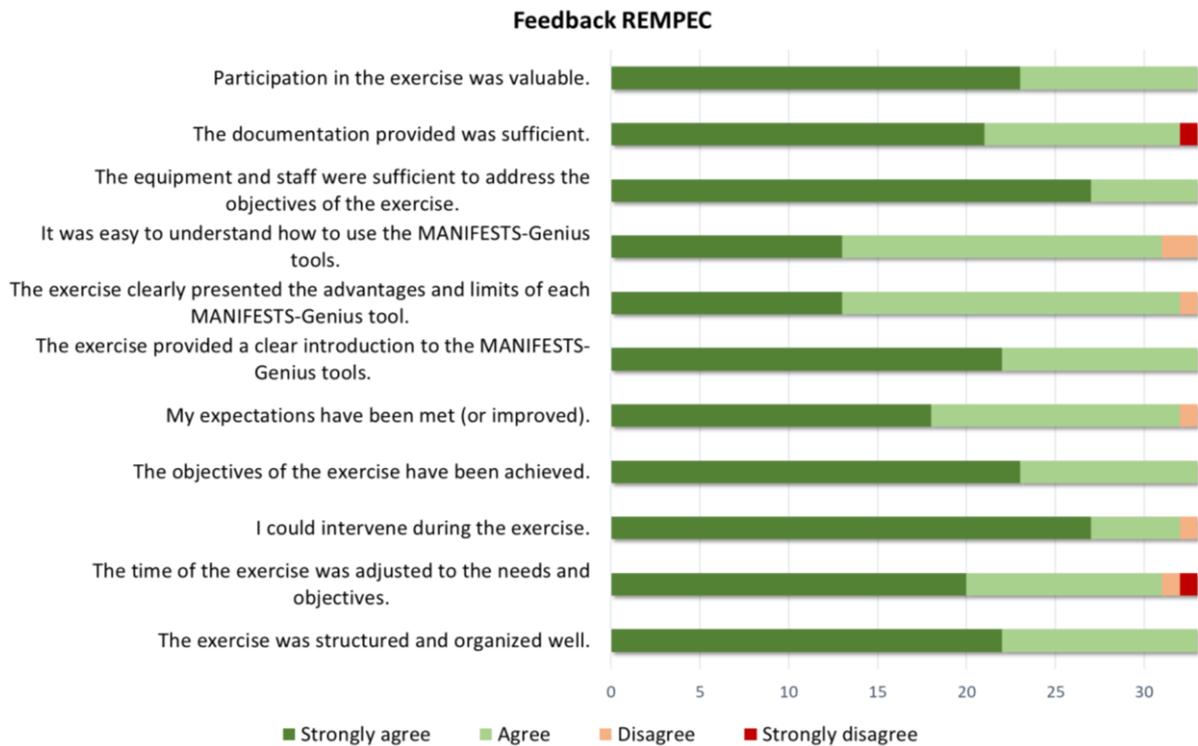


Figure 32. Feedback from the REMPEC participants. 33 forms were collected, with an overall response being really positive

All points received a majority of “Strongly agree”, except for the points “The exercise clearly presented the advantages and limits of each MANIFESTS *Genius* tool” and “It was easy to understand how to use the MANIFESTS *Genius* tools.” For these items, a majority of participants selected “Agree”, indicating a slight lack of clarity on how to use the tools.

The comment “Strongly disagree” was received only two times, for:

- “The documentation provided was sufficient”, with no further comment
- “The time of the exercise was adjusted to the needs and objectives” with the comment “not enough time to assimilate the entire DSS”.

2.3.2. Subsequent improvements

The main areas for improvement suggested in the comments were related to the lack of time and clear details to fully understand the tools. After closely reviewing the feedback from the participants, the following improvements were carried out:

- Temporary access to prediction models provided to the participants for the next workshop;
- More realistic and detailed scenario;
- Scenario description, response form and supplementary information printed on 3 different documents to improve information sharing among the group;
- Presentation on how to use the MANIFESTS *Genius* website during the introduction of the exercise.

3. Bonn Agreement, OTSOPA, Brest, France

The OTSOPA meeting took place from 20 to 22 May at CEDRE, in Brest, France. A total of 10 people attended the MANIFESTS *Genius* workshop organised by CEDRE on May 22nd afternoon.

3.1.Scenario

For the OTSOPA meeting, the focus was set on an incident involving refrigerated ammonia at the port of Le Havre, France. Additional equipment cards (B.2. Equipment Cards) were provided for the participants alongside the tool cards to introduce greater complexity into the exercise. The full scenario can be found in D.2. Scenario. The document depicts the course of the incident, starting with a description of the events along with descriptive schemes (Figure 33). The coordinates of the location where the boat is docked have to be provided for future use in the third part of the exercise.

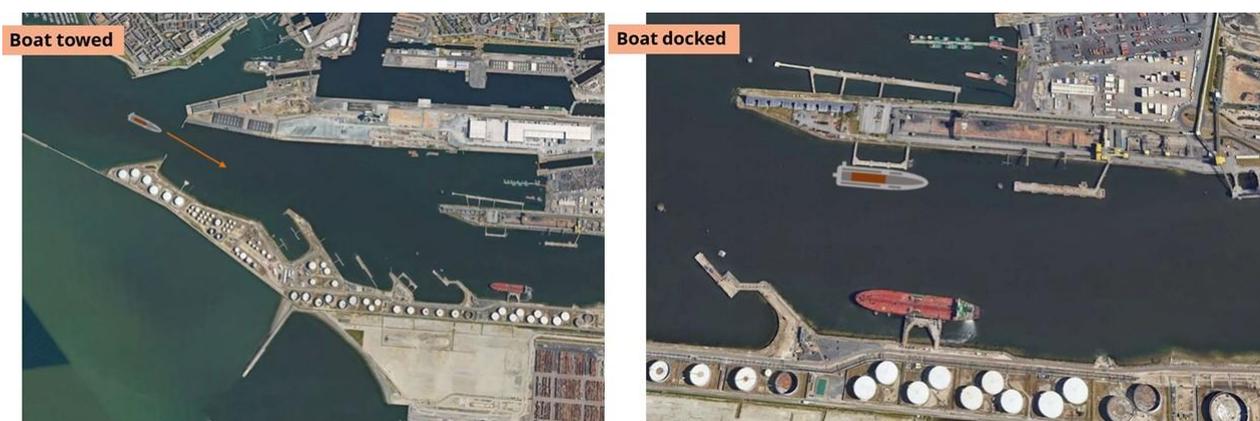


Figure 33. Part of OTSOPA Scenario at Le Havre harbour, France.

The exercise started when the boat was docked at the port. The crew had been evacuated from the boat so the crisis management focuses only on the chemical risk at stake. No methanol leak happened but the damaged state of the boat posed a risk. The wind direction was chosen to bring a possible toxic cloud towards a populated area.

3.2. Course of the exercise

The 10 participants present at OTSOPA were split into 3 different groups of 3 to 4 people. There were no roles defined, all participants were working on the response management by sharing their own expertise. One person per group was assigned to take notes on the response form.

Before starting the exercise, each group received a folder containing the following documents:

- Ammonia safety datasheet from Sigma Aldrich;
- Response form (see D.1. Response Form);
- Scenario (see D.2. Scenario);

- Supplementary Information (D.3. Supplementary Information).

The exercise was set to last 1 hour and 20 min, with the following time allocated for each part:

- 1st part: Chemical expertise (HNS database): 20 min;
- 2nd part: Risk assessment (Modelling App): 30 min;
- 3rd part: Public Health risk (response algorithm of the Operational Field guide): 15 min;
- 4th part: Response (knowledge tool): 15 min.

3.2.1. 1st part: Chemical expertise (HNS database)

The aim of this part was for the participants to learn more about ammonia and its behaviour thanks to the HNS database. Cards n°1 (HNS database) and n°6 (MAR-ICE) were expected to be played (Figure 34; Figure 35). By playing the HNS database card, participants could use the HNS database available online to look for Ammonia Anhydrous. Depending on the profile of the participants, an additional “Chemical Table” was provided to help them into navigating in the different chemical parameters.

The figure consists of three parts illustrating the HNS database card and its associated tools and table.

MANIFESTS Tool Card n°1: HNS database

What ?

- Physical and Chemical properties of HNS chemicals
- Behaviour at sea
- Toxicity and risks

How ?

You can click on a row to view details.
You can search by name, CAS number or UN number.

Search: _____

Name	Provider	CAS number	UN number
1.1.1-Trichloroethane	REMPCC	71-55-6	2821
1.1.3-Tetrahydroethane	CEORE	127-18-4	1887
1.1.3-Tetrahydroethane	REMPCC	127-18-4	1887
1.1.2-Trichloro-1,2,2-Trifluoroethane	REMPCC	76-13-1	-
1.1.2-Trichloroethane	REMPCC	70-00-9	3082
1.1.2-Trichloroethane	CEORE	79-01-6	1710
1.1.2-Trichloroethane	REMPCC	79-01-6	1710
1.1-Biphényl	REMPCC	82-52-4	3077
1.1-Dichloroethane	REMPCC	75-34-3	2362
1.1-Dichloropropane	REMPCC	70-09-9	1993

Showing 1 to 10 of 3028 rows | 10 rows per page

Tools - Publications - Medias -

- HNS Database
- MARINER-MANIFESTS Knowledge Tool
- Operational Field Guide
- MANIFESTS Exercise Tool
- Modelling App registration
- Modelling App
- COP Tool
- Serious game
- How to use the tools

Chemical parameters

Safety issue	Chemical parameter	Value
Toxic cloud formation	SEBC Classification	
	Vapour pressure	
Chemical behaviour in water	Vapour density	
	SEBC Classification	
Explosion risk	Water solubility	
	Lower explosive limit (LEL)	
Environmental impact	Upper explosive limit (UEL)	
	Biodegradation factor	

Figure 34. Cards no. 1 (HNS Database) is expected to be used during the first part of the exercise. Card no. 1 provides access to the online database and, if necessary, to the Chemical Table.

When the MAR-ICE card was played, a printed MAR-CIS datasheet on ammonia was provided to the participants. A synthetic report from MAR-ICE on the risk of ammonia was also shared with the participants one hour later.

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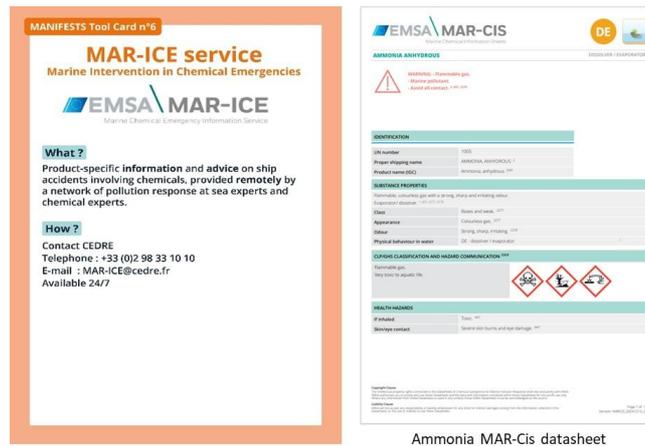


Figure 35. The card no. 6 (MAR-ICE Service) is expected to be used during the first part of the exercise. It grants access to the MAR-CIS datasheet for ammonia, as well as a synthetic report from MAR-Ice delivered one hour later.

3.2.2.2nd part: Risk assessment (Modelling App)

During the second part, a fictive call was played adding some inputs to the scenario. An intervention team provided information on the state of the ship, giving the volume of ammonia and its concentration in air (Figure 36).

2nd part: Risk assessment 30 min

While the chemical behaviour of the substance involved was determined, an investigation team was sent to assess the state of the boat, wearing proper personal protection equipment. The following report is received:

“Report from team A. We just got out the boat and noticed several important points:

The refrigeration system suffered from the damages. Inside tank no. 4, the temperature is unstable and has a tendency to rise, the pressure exceeds the atmospheric pressure and a level sensor indicates that **4 cubic meters** of liquid ammonia remains. The pressure relief system of the tank did not work properly and a leak from the tank shell occurred into the void space primarily filled with dry air. The concentration of ammonia reached **169,000 ppm** in the void space.

We are now leaving the area.”

Figure 36. Highlighted inputs from the fictive call.

The concentration of 169,000 ppm is within the explosive range for ammonia (160,000 to 250,000 ppm, [MANIFESTS - HNS Details](#)), meaning that the card n°5 of prediction models had to be used in this part to assess the damages of a potential explosion. Printed results of a modelling were given when the card is played (Figure 37), and a temporary login was provided to the trainees to enable the use of the model on the platform.

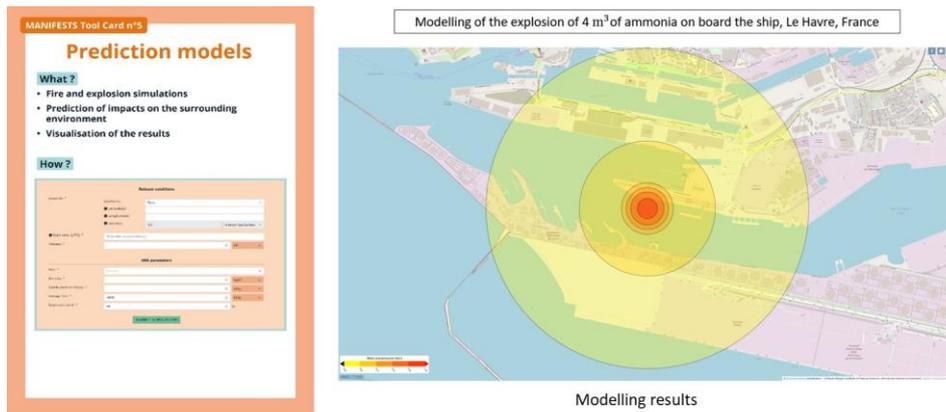


Figure 37. The card n°5 (Prediction models) is expected to be played during the second part of the exercise. The results of the modelling of a 4 m³ ammonia explosion are provided to the participants.

Additional explanations regarding the formation of the explosive atmosphere were provided in order to make the scenario more realistic. The ship was supposed to have emptied and drained its cargo of liquid ammonia, but it turned out that one tank still contained a certain volume of liquid ammonia. Due to damage caused by the collision, the refrigeration system stopped working, causing the refrigerated ammonia to boil. The pressure relief device malfunctioned, causing the tank's inner hull to rupture under excessive pressure. The gas escaped into the void space, filled with dried air, causing an explosive atmosphere. If the pressure kept increasing, the emergency release hatch could open and a toxic ammonia cloud would spread onto the ship's deck. Detailed schemes are presented in D.3. Supplementary Information.

3.2.3.3rd part: Public Health risk (Operational Field guide)

Based on the results of the modelling obtained in the last part, participants were expected to play card n°3 to decide whether to shelter or evacuate the population in the impacted area. Once the card was played, the plasticized algorithm was given to the participants so that they could mark the path that led them to their final decision.

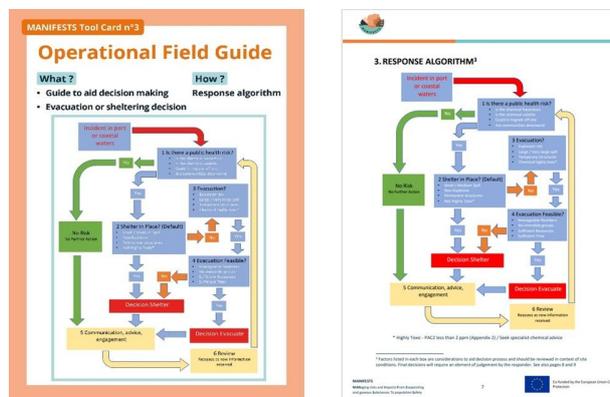


Figure 38. Playing the Card no. 3 gives access to the plasticized response algorithm where the path towards final decision (shelter or evacuation) can be hand-written.

Once the evacuation or sheltering was decided, the scenario was concluded and there was no longer any health risk. Final decisions could be shared between the groups to start discussions. There was no definitive answer, as the most important aspect was the thought process behind the decision. The situation is handled on a case-by-case basis, depending on the potential danger in the area. For example, a low-risk residential area will not be evacuated during the night, while the high-risk area near the port will be evacuated because night workers may be present.

3.2.4.4th part: Response (knowledge tool)

In this part, the participants were expected to play the cards n°2 and n°4, respectively the Knowledge Tool card and the Exercise tool card. Participants could access these tools and browse their contents online. They got to know the resources available, such as a record of past projects related to incident management or materials for organizing their own training session, which can help them prepare for such accidents.

3.3. Feedback and improvements

3.3.1. Feedback

A feedback form (Appendix F. Participant feedback form) was shared after the exercise to the participants. A total of 9 forms were collected at the end of the exercise held at OTSOPA. Results are presented in Figure 39.

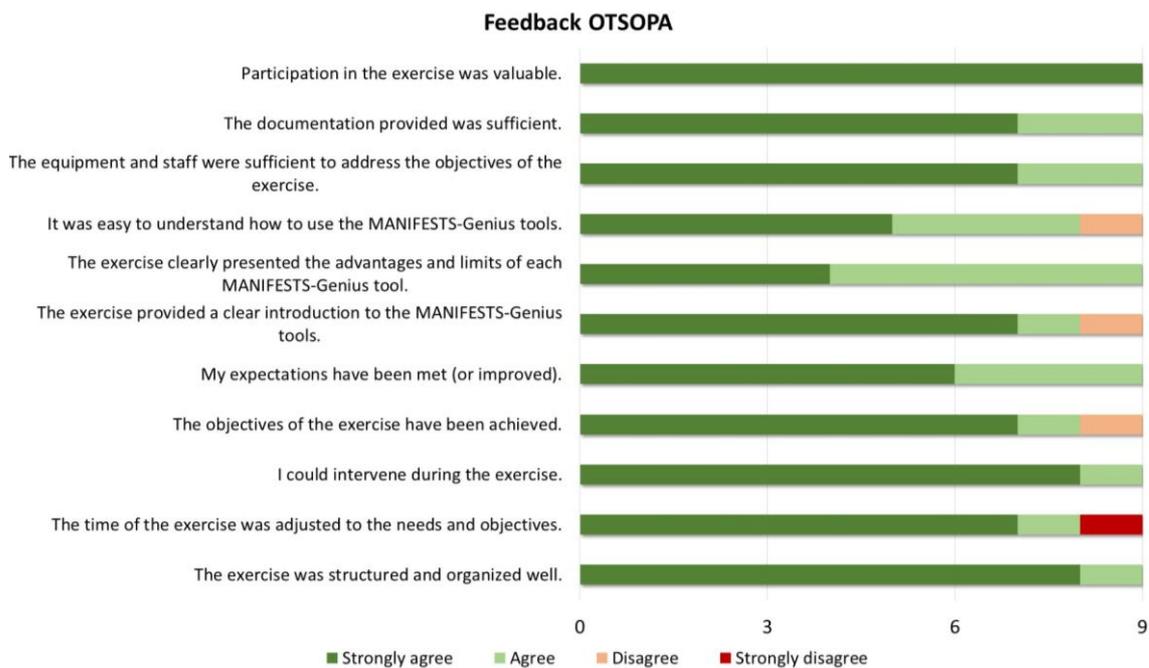


Figure 39. Feedback from the OTSOPA participants. 9 forms were collected, with an overall response being really positive.

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All points received a majority of “Strongly agree”, except the point: “The exercise clearly presented the advantages and limits of each MANIFESTS *Genius* tool.”

“Strongly disagree” was received only once for: “The time of the exercise was adjusted to the needs and objectives” with the comment “I would prefer a full day starting up with running through the tools.”

3.3.2. Subsequent improvements

After reviewing the feedback from the participants, some improvements were made:

- More information on time/date in the scenario, additional time steps;
- Explanation of permanent/temporary structures on the response algorithm.

4. Training on MAR-ICE for IPA/ENP Countries, Brest, France

Following the expansion of the MAR-ICE service to Instrument for Pre-accession Assistance ([IPA](#)) and European Neighbourhood Policies ([ENP](#)) beneficiary countries in January 2025, CEDRE hosted the first in-person training on the use of the service in its premises in Brest, France. Representatives from Egypt, Lebanon, Moldova, Morocco, Montenegro, Tunisia, Turkey and Ukraine gathered for this 3-day session. The training objectives were the following ones:

- Improving knowledge on the behaviour of chemicals when accidentally released at sea and the associated hazards;
- Improving knowledge of the actions and strategies to be implemented following a HNS spill;
- Increasing awareness of key technical support organizations and experts that can be mobilized;
- Enhance understanding of the functioning and support provided by the MAR-ICE service.

This training took place from 21 to 23 October 2025. A total of 12 people attended the MANIFESTS *Genius* workshop organised by CEDRE on October 23rd.

4.1.Scenario

For the training on MAR-ICE for IPA/ENP Countries, the focus was set on an incident involving LNG at the terminal of Nynäshamn, Sweden. The full scenario can be found in E.2. Accident Scenario. The document depicts the course of the incident, starting with a description of the events along with descriptive schemes (Figure 40). The coordinates of the location where the boat is docked have to be provided for future use in the second part of the exercise. Time slots were added to the scenario.



Figure 40. Part of exercise scenario at Nynäshamn, Sweden.

The exercise started when the boat was docked at the port. The crew had been evacuated from the boat so the crisis management focuses only on the chemical risk at stake. The boat is in poor conditions, but no leak happened at this stage.

4.2. Course of the exercise

The 12 participants present were split into 3 different groups of 4 to 5 people. There were no roles defined, all participants were working on the response management by sharing their own expertise.

Before starting the exercise, each group received a folder containing the following documents:

- Methane safety datasheet from Air Liquide;
- Response form (see E.1. Exercise response form);
- Scenario (see E.2. Accident Scenario);
- Supplementary Information (E.3. Supplementary information);
- One set of MANIFESTS Tool Cards.

The exercise was set to last 1 hour and 20 min, with the following time allocated for each part:

- 1st part: Chemical expertise (HNS database): 20 min;
- 2nd part: Risk assessment (Modelling App): 30 min;
- 3rd part: Public Health risk (response algorithm of the Operational Field guide): 15 min;
- 4th part: Response (knowledge tool): 15 min.

4.2.1. 1st part: Chemical expertise (HNS database)

The aim of this part was for the participants to learn more about LNG and methane thanks to the HNS database. Cards n°1 (HNS database) and n°6 (MAR-ICE) are expected to be played (Figure 41 and Figure 42). By playing the HNS database card, participants could use the HNS database available online to look for Methane. When the MAR-ICE card was played, a printed Ericard datasheet on methane was provided to the participants as the MAR-Cis datasheet is not available for methane. A synthetic report from MAR-ICE on the risk of an LNG spill was also presented one hour later.

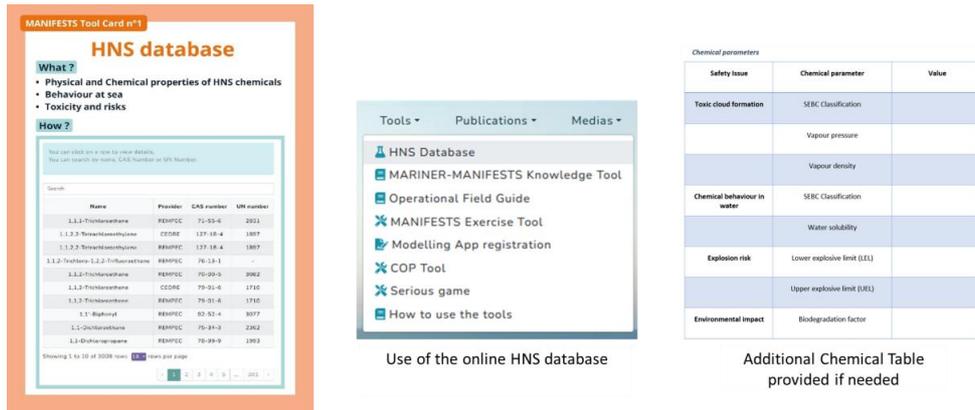


Figure 41. Cards no. 1 (HNS Database) is expected to be used during the first part of the exercise. Card no. 1 provides access to the online database and, if necessary, to the printed Chemical Table.

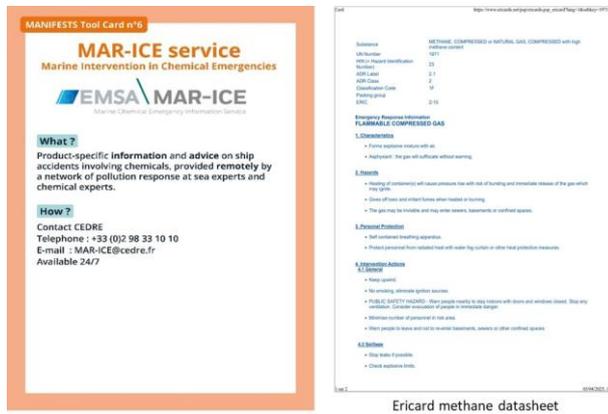


Figure 42. The card no. 6 (MAR-ICE Service) is expected to be used during the first part of the exercise. It grants access to the Ericard datasheet for methane, as well as a synthetic report from MAR-Ice delivered one hour later.

4.2.2.2nd part: Risk assessment (Modelling App)

During the second part, a fictive call was played at loud adding some inputs to the scenario. An intervention team provided information on the state of the ship by sending a drone equipped with an infrared camera and a methane explosimeter, giving the volume of methane and its concentration in the air (Figure 43).

2nd part: Risk assessment 30 min

While the chemical behaviour of the substance involved was determined, an alarm went on the ship and the port authority requested the sending of a drone equipped with an IR camera and an explosimeter. The following report call is then received:

“Report from drone pilot A1. Local time 00:10. The drone has completed its initial pass. The collision did not cause any major breaches in the LNG tanks. But some seals are impacted on top of one LNG tank and this causes a methane leak on top of the ship’s deck. Thermal imaging shows the leak direction and growth. Estimated volume of gas: **30 cubic meters** and that has reached an enclosed space on the ship. Concentration measured in the enclosed space is **60 000 ppm**. Thermal images are being sent now. Over.”

Figure 43. Highlighted inputs from the fictive call.

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The concentration of 60,000 ppm is within the explosive range for methane (53,000 to 140,000 ppm [MANIFESTS - HNS Details](#)), meaning that the card n°5 of prediction models had to be used in this part to assess the damages of a potential explosion. The gas volume of 30 m³ was chosen based on the modelling by Nubli et al.² This value was also chosen because an explosion of this size could reach the populated area of Nynäshamn, creating a realistic and controlled scenario for discussing sheltering or evacuation in the next part of the exercise. As the participants have access to the model, they can also decide to model the explosion of the whole capacity of the ship (6,000 cubic meters). This would impact wider areas and modify the risk assessment.

Printed results of a modelling (Figure 44) were given when the card is played, and a temporary login was provided to enable the use of the model on the platform.

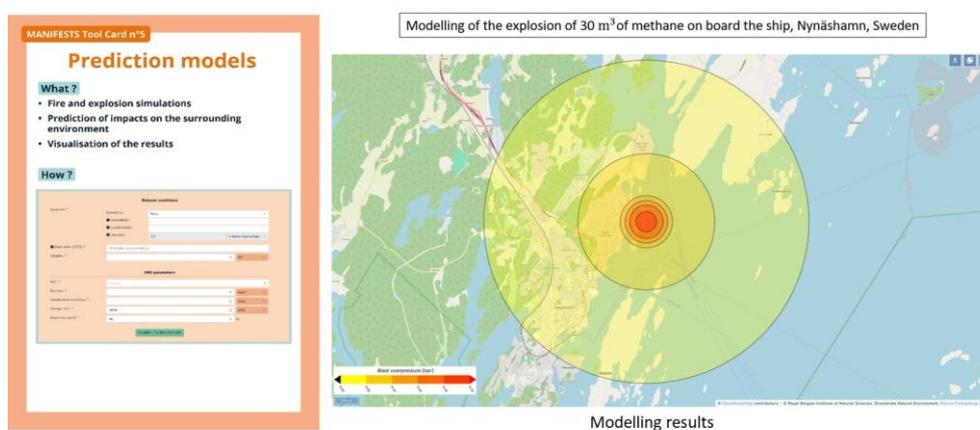


Figure 44. The card n°5 (Prediction models) is expected to be played during the second part of the exercise. The results of the modelling of a 30 m³ methane explosion are provided to the participants.

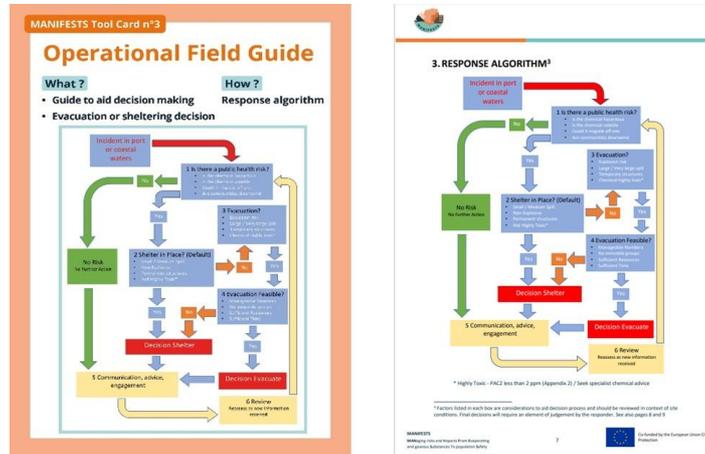
Additional explanations and schemes regarding the formation of the explosive atmosphere were provided in order to make the scenario more realistic (see E.4. Supplementary information – LNG Leak Scenario). It was assumed that the collision energy impacted the seals on top of the LNG tank, causing boil-off methane vapours to migrate towards the ship's deck and to escape through a damaged valve seal. As the cold gas is escaping from the refrigerated tank, the low temperature caused crackles on the surroundings, worsening the state of the boat. On the ship's deck, the gas was trapped near the ground at high concentration before rising up when warming up in contact with the atmosphere. Assuming this scenario, methane vapours were stuck on the main's deck, and settled in an area in which a concentration of 60,000 ppm was recorded.

4.2.3.3rd part: Public Health risk (Operational Field guide)

Based on the information gathered in the last part, participants were expected to play card n°3 to decide whether to shelter or evacuate the population in the area. Once the card was played,

² Haris Nubli, Jung-Min Sohn, and Dongho Jung, 'Consequence Analysis of Accidental LNG Release on the Collided Structure of 500 Cbm LNG Bunkering Ship', *Journal of Marine Science and Engineering*, 10.10 (2022), p. 1378, doi:10.3390/jmse10101378.

the plasticized response algorithm was given to the participants so that they could mark the path that led them to their final decision.



Playing the Card no. 3 gives access to the plasticized response algorithm where the path towards final decision (shelter or evacuation) can be hand-written.

All groups came to the same conclusion to evacuate the port area, but shelter the inhabitants in their houses in the populated area located further away from the port. Then, the MAR-ICE report was presented, the leak was assumed to be contained and the scenario was concluded.

4.2.4.4th part: Response (Knowledge and Exercise tools)

In this part, the participants were expected to play the cards n°2 and n°4, respectively the Knowledge Tool card and the Exercise tool card. Participants could access these tools and browse their contents online. They got to know the resources available, such as a record of past projects related to incident management or materials for organizing their own training session.

4.3. Feedback and improvements

4.3.1. Feedback

A feedback form (Appendix F. Participant feedback form) was shared after the exercise to the participants. A total of 12 forms were collected at the end of the exercise, results of the survey are presented in Figure 45.

All points received a majority of “Strongly agree” or “agree” and “disagree” was received only once for the following items:

- The documentation provided was sufficient;
- The exercise provided a clear introduction to the MANIFESTS *Genius* tools;
- It was easy to understand how to use the MANIFESTS *Genius* tools;
- The time of the exercise was adjusted to the needs and objectives.

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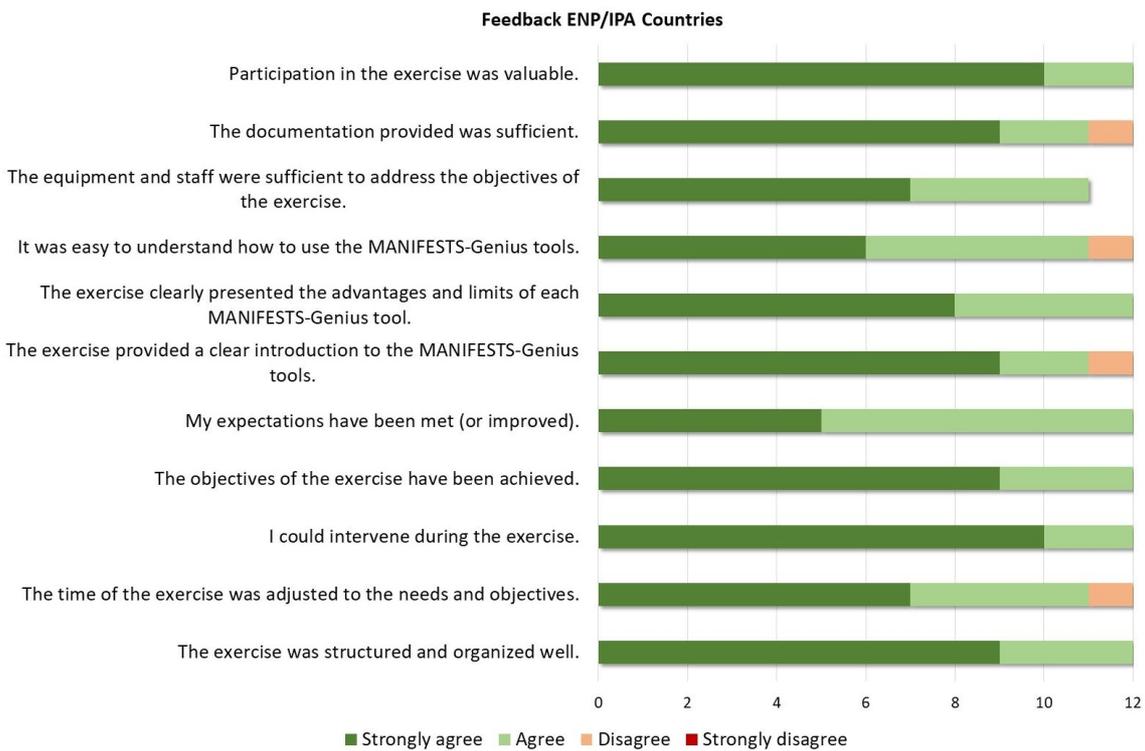


Figure 45. Feedback from the IPA/ENP participants. Twelve forms were collected, with an overall response being really positive.

4.3.2. Subsequent improvements

After reviewing the feedback from the participants, some improvements were made:

- The first question on the exercise form “How will react LNG if spilled into water?” was unclear and changed to “What physical processes might occur if LNG spills into the water or onto the ship's deck?”.
- The name of the last exercise part was changed

Unfortunately, the time allocated to the exercise could not be adjusted, as it needed to fit within specific training schedules.

5. Conclusion

One of the objectives of the MANIFESTS Genius project was to transfer knowledge and decision-making tools developed both within the project and through previous EU and national initiatives, including databases, guidance, and practical tools, to stakeholders and authorities involved in maritime pollution response.

This was achieved through the organisation of several training courses at both national and European levels, designed to instruct stakeholders in the use and application of the available tools.

The MANIFESTS project's Decision Support System (DSS) provides practical support for organizing simulated exercises that train responders and decision-makers. These training programs effectively showcased the project's outputs and demonstrated their relevance in addressing pollution response challenges. They were also tailored to the specific needs and interests of each target audience.

A total of 62 participants from 27 countries, in addition to the European Union, attended these training sessions:

- **Contracting Parties from the Barcelona Convention:** Bosnia and Herzegovina, Libya, Cyprus, Malta, Croatia, Morocco, Egypt, Montenegro, Spain, Monaco, France, Slovenia, Greece, Turkey, Italy, Lebanon and the EU.
- **Contracting Parties from the Bonn Agreement:** Belgium, Denmark, France, Germany, Ireland, Netherlands, Norway, Spain, Sweden, UK and the EU.
- **New beneficiaries of the MAR-ICE service:** Egypt, Lebanon, Moldova, Morocco, Montenegro, Tunisia, Turkey and Ukraine.

Overall, the trainings received very positive feedback from participants, who valued both the practical exercises and the guidance provided. These sessions contributed to:

- Raising awareness of HNS-related issues among the various stakeholders involved in the pollution response sector;
- Demonstrating the existence and usefulness of the MANIFESTS and MANIFESTS Genius DSS;
- Improving these tools through the feedback received after each training.

The success of these sessions suggests that similar training initiatives could be highly beneficial if organised in the future, reinforcing the project's impact and supporting ongoing capacity building in maritime pollution response.

Appendix A. Stage Chimie, Cedre, France

A.1. Exercise response form

Formulaire de réponse



<https://manifests-project.eu/>

1ère partie : Expertise chimique

20 min 

La première partie de cet exercice se concentre sur le produit chimique en jeu. À l'aide des cartes d'outils MANIFESTS, trouvez les données physico-chimiques à étudier en réponse aux risques potentiels.

Quelle(s) carte(s) outil MANIFESTS utilisez-vous ?

- Quels sont les phénomènes physiques possibles en cas de déversement de GNL dans l'eau ou sur le pont du navire ?

- Le GNL est-il toxique, nuisible à l'environnement ou dangereux ?

2ème partie : Évaluation des risques

30 min 

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Maintenant que les paramètres chimiques de la substance impliquée sont déterminés, une première équipe d'évaluation est envoyée pour évaluer l'état du bateau. Le rapport suivant est reçu :

"Rapport pilote de drone A1. Heure locale 00h10. Premier passage du drone terminé. Pas de brèches majeures dans les réservoirs de GNL. Plusieurs joints d'étanchéité endommagés sur le dessus d'un réservoir. Fuite de méthane sur le pont du navire constatée, observation via la caméra IR. Volume de gaz estimé : trente mètres cubes. Gaz accumulé dans un espace confiné à bord du navire. Concentration mesurée dans cet espace : 60 000 ppm. Images thermiques et données en cours de transmission. Terminé."

Quelle(s) carte(s) outil MANIFESTS utilisez-vous ?

- Quels sont les risques possibles ?

3ème partie : Risque pour la santé publique

15 min 

Sur la base des informations recueillies dans les dernières parties de l'exercice, existe-t-il un risque potentiel pour le port et les zones plus larges ?

Quelle(s) carte(s) outil MANIFESTS utilisez-vous ?

- Évacuation ou mise à l'abri de la population ?

4ème partie : Préparation

15 min 

Le système d'aide à la décision du projet MANIFESTS-Genius aide à se préparer à l'éventualité de tels scénarios. Cette section se concentre sur la réponse possible qui pourrait être mise en place pour faire face à de tels événements.

Quelle(s) carte(s) outil MANIFESTS utilisez-vous ?

- Sélectionnez trois documents différents dans les outils MANIFESTS-Genius sélectionnés qui vous aideraient à préparer de tels événements.

A.2. Accident Scenario

Scenario d'accident

Briefing

Explication de l'exercice

Objectifs de l'exercice :

- Présentation et utilisation des outils MANIFESTS *Genius*
- Évaluer les différentes utilisations potentielles des outils lors de la gestion de crise
- Convaincre les participants de promouvoir les outils MANIFESTS *Genius* auprès de leurs experts chimistes

Un scénario est présenté afin de former les participants à l'utilisation des outils développés dans le cadre du projet MANIFESTS *Genius*. Les événements ont été choisis pour mieux répondre aux objectifs de l'atelier, plutôt que pour offrir un scénario 100 % véridique. Les participants sont rassemblés en groupes, une personne par groupe étant chargée de prendre des notes pour faire des remarques ou des commentaires, et une autre personne chargée de poser des questions.

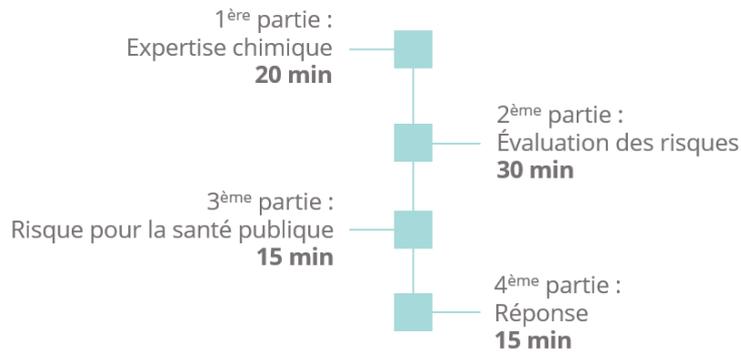
Pour une utilisation optimale des outils MANIFESTS-Genius, scénario dans lequel :

- L'équipage n'est **pas impliqué**
- Navire amarré au **port**
- **GNL** à bord

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L'exercice est séparé en 4 parties différentes :



Des documents imprimés sont à la disposition des participants pour être utilisés pendant l'exercice :

- **Cartes Outils MANIFESTS** : peuvent être jouées à tout moment du scénario, au moins une par partie d'exercice. Chaque carte active l'utilisation d'un outil du système d'aide à la décision MANIFESTS *Genius*.



Scénario

Description des événements

Les événements se sont déroulés dans la nuit du 15 septembre 2025, près du port de Nynäshamn, en Suède.

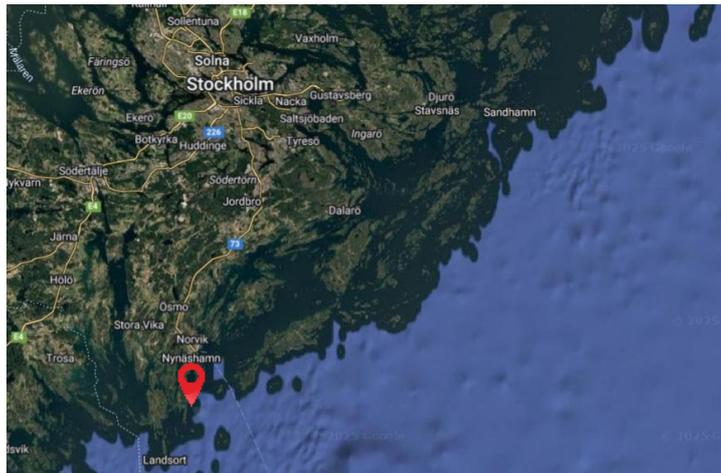


Figure 46. Terminal GNL Nynäshamn, Suède.

Une **collision** entre le navire de ravitaillement en **GNL Arctic Pearl** et un navire de service côtier s'est produite à 22h15 heure locale, près du port de Nynäshamn, en Suède. Le navire de service côtier effectuait une manœuvre de traversée, mais a brièvement perdu le contrôle en raison d'une défaillance de son système de navigation automatique.

L'impact a entraîné la **perte de propulsion** de l'Arctic Pearl, laissant le navire à la dérive. Le capitaine a pris contact avec les autorités portuaires qui ont lancé les opérations de sauvetage. L'équipage a été évacué sans encombre et **aucun blessé** n'a été signalé. Des remorqueurs ont été dépêchés pour **remorquer le navire vers le port**.

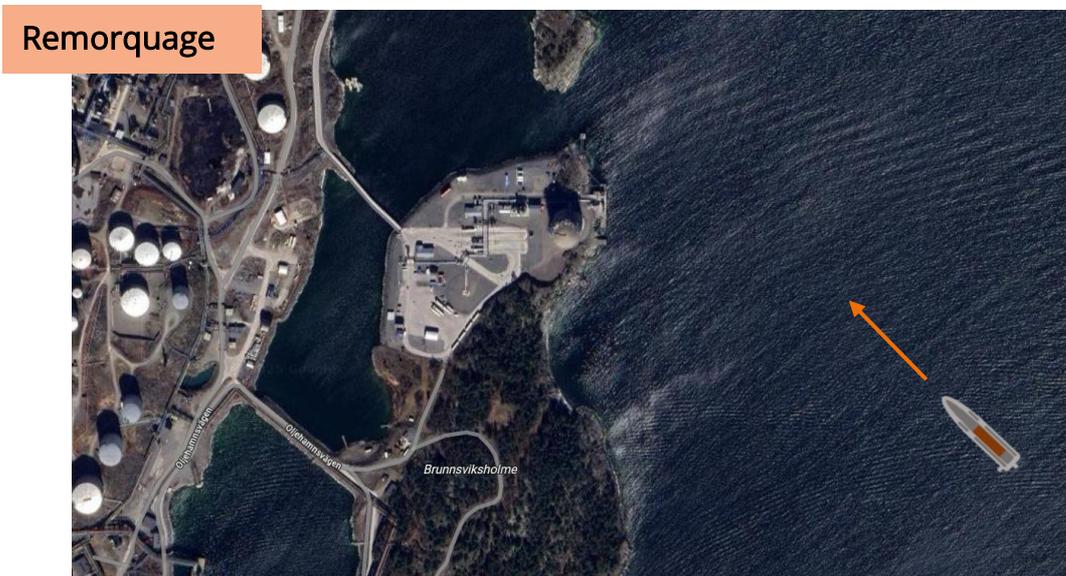


Figure 47. Remorquage du bateau vers le terminal de Nynäshamn.

Artic Pearl à quai

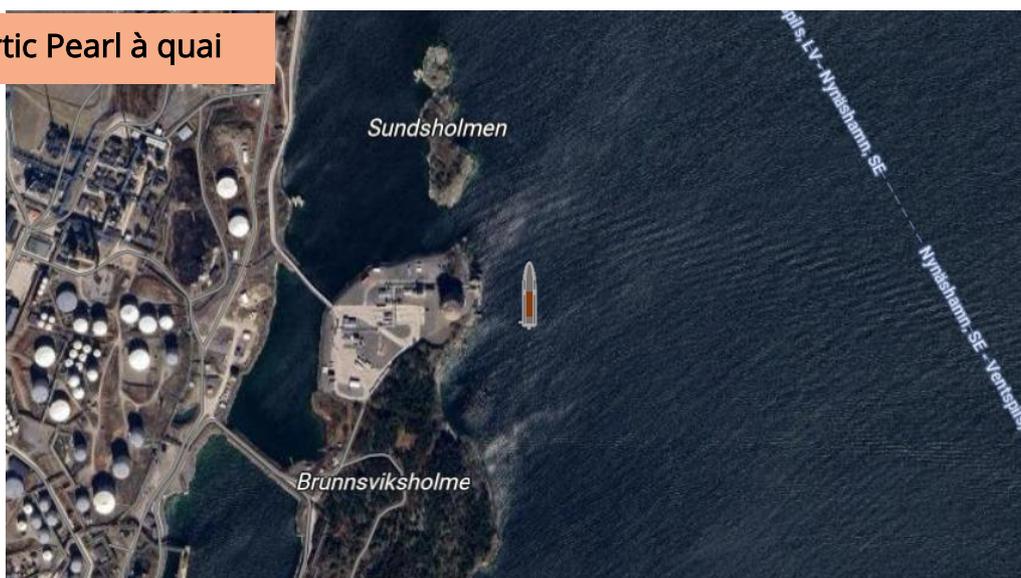


Figure 48. Artic pearl amarré au terminal GNL de Nynäshamn, coordonnées 58°55'20.4"N 17°58'40.1"E.

Le Artic pearl arrive sans encombre au terminal de GNL (coordonnées 58.922333, 17.977806) à 22h50 heure locale.

A.3. Supplementary information

Informations supplémentaires

Table 1. Conditions environnementales à Nynäshamn, Suède

Température de l'air	18 °C
Humidité ambiante	58 %
Température de l'eau	15 °C
Vitesse du vent, direction*	4 m/s, 8 kts, North
Courant, direction	0.16 m/s, 0.3 kts, South
Etat de la mer	Force 3

*A 10 m



Figure 49. Etat de la mer sous force 3 force 3 sur l'échelle de Beaufort

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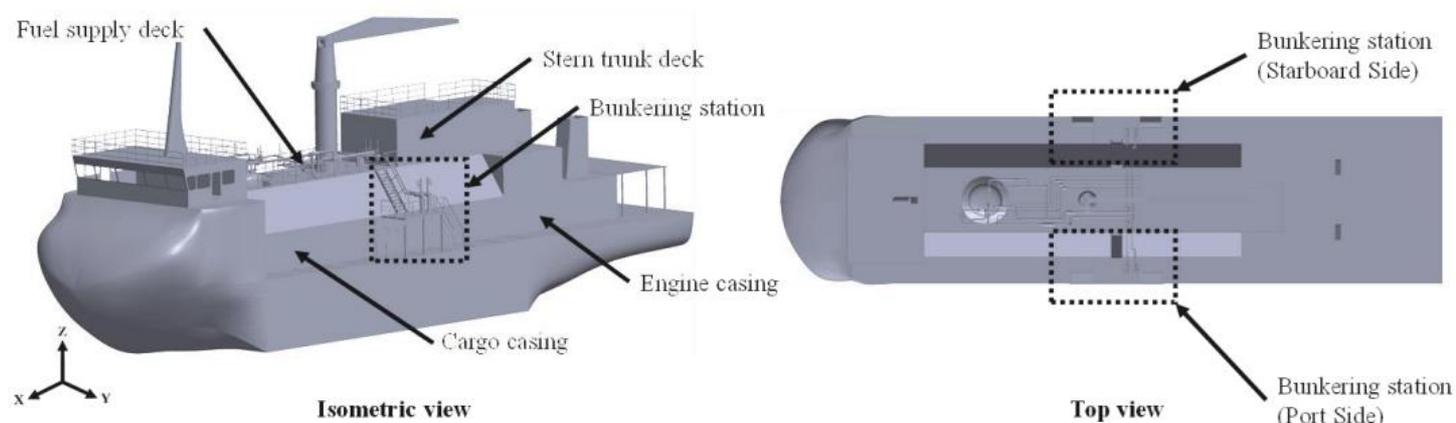


Figure 50. Structure du navire de ravitaillement en GNL Arctic Pearl. Tiré de Nubli, Haris, et al. « Consequence Analysis of Accidental LNG Release on the Collided Structure of 500 Cbm LNG Bunkering Ship ». *Journal of Marine Science and Engineering*, vol. 10, no 10, September 2022, p. 1378.

Table 2. Caractéristiques du navire

Longueur	100 – 130 m
Rayon (Largeur)	20 – 25 m
Profondeur	10 – 12 m
Tirant d'eau	6 – 8 m
Port en lourd (DWT)	10,000 – 18,000 tonnes
Jauge brute (GT)	8,000 – 15,000
Carburant	GNL et gaz de dégazage provenant de la citerne de cargaison
Capacité de cargaison de GNL	6 000 m ³

A.4. Supplementary information – LNG Leak Scenario

Informations supplémentaires – Scenario fuite de GNL

L'énergie de collision a **endommagé les joints** situés au sommet du réservoir de GNL, provoquant la migration des vapeurs de méthane vers le **pont du navire** et leur fuite à travers un joint de vanne endommagé. Lorsque le gaz froid s'échappe du réservoir réfrigéré, la basse température provoque des **craquements** dans les environs, aggravant l'état du bateau. Sur le pont du navire, le gaz pourrait être **piégé près du sol** à une concentration élevée avant de s'élever lorsqu'il se réchauffe au contact de l'atmosphère. Dans ce scénario, les vapeurs de méthane pourraient rester bloquées sur le pont principal et se concentrer dans des zones où leur concentration atteint des **niveaux explosifs**.

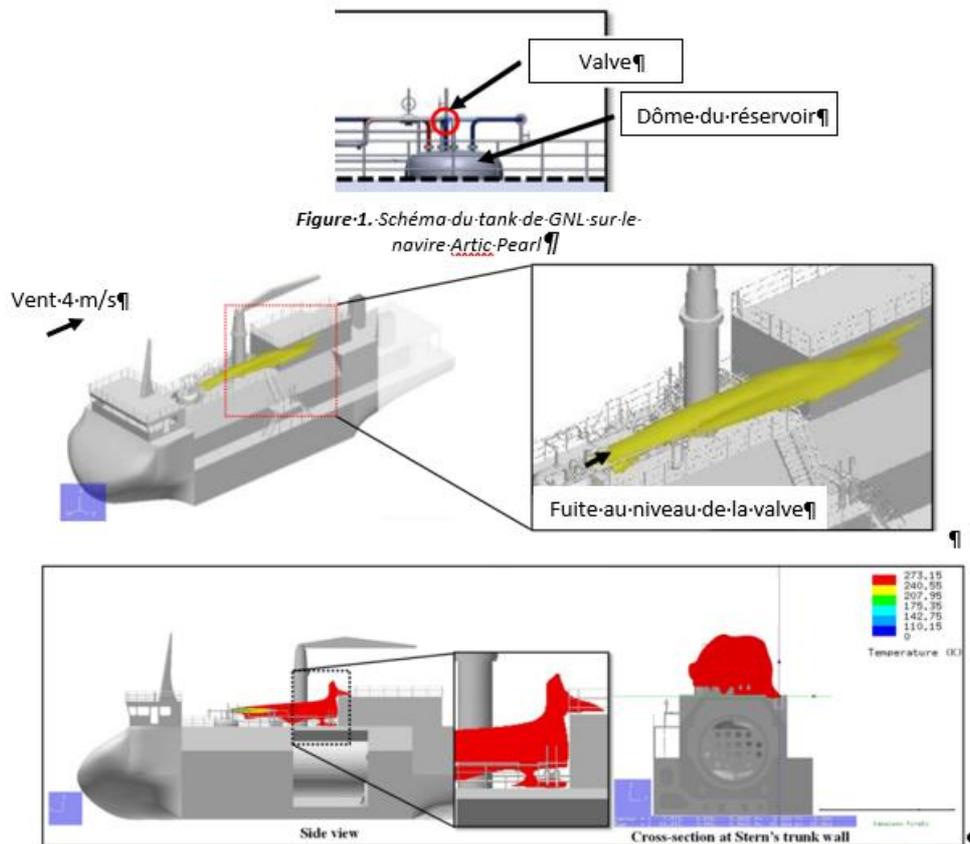


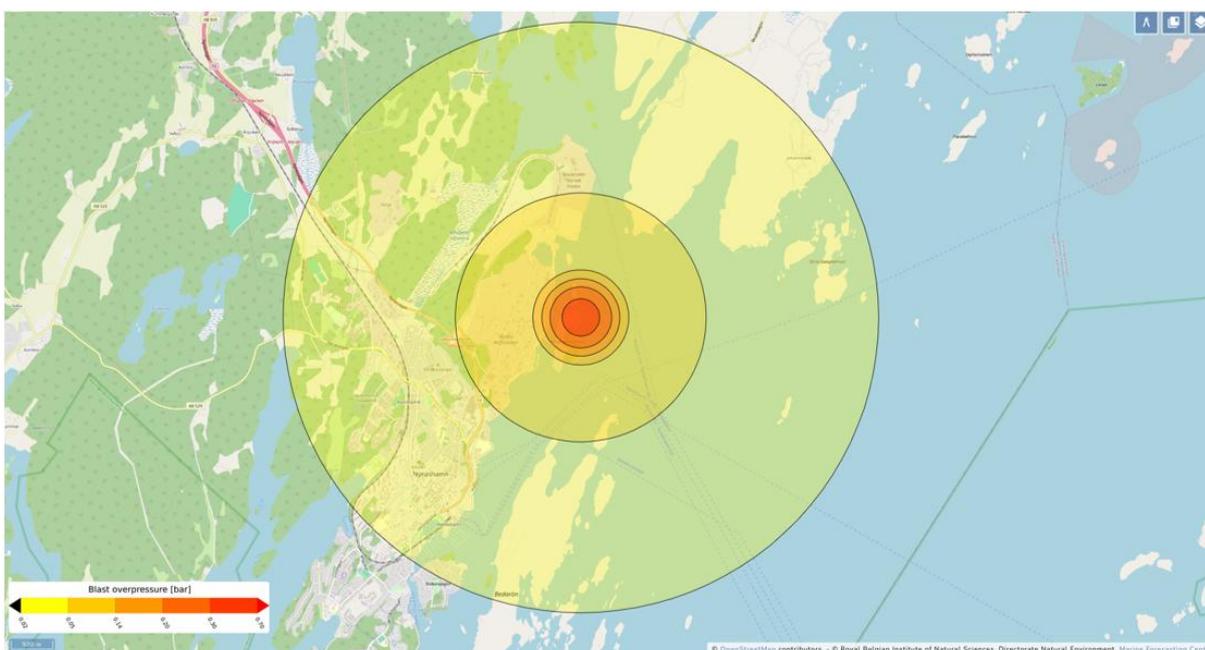
Figure 51. Fuite de méthane provenant d'une vanne sur un navire de ravitaillement en GNL. Adapté de Nubli, Haris, et al. « Consequence Analysis of Accidental LNG Release on the Collided Structure of 500 Cbm LNG Bunkering Ship ». *Journal of Marine Science and Engineering*, vol. 10, no 10, September 2022.

Table 2. Résumé du scénario de fuite

Direction	90° par rapport à la poupe du navire
Localisation	Valve
Température du réservoir	- 163 °C
Concentration de méthane dans la poche de gaz	60 000 ppm
Volume de la poche de gaz	30 mètres cubes
Vitesse du vent	4 m/s

A.5. Prediction models

Explosion de 30 m³ de méthane à bord du navire, Nynäshamn, Suède



Appendix B.

B.1. Tool cards

MANIFESTS Tool Card n°1

HNS database

What ?

- Physical and Chemical properties of HNS chemicals
- Behaviour at sea
- Toxicity and risks

How ?

You can click on a row to view details.
You can search by name, CAS Number or UN Number.

Search

Name	Provider	CAS number	UN number
1.1.1-Trichloroethane	REMPEC	71-55-6	2031
1.1.2.2-Tetrachloroethylene	CEDRE	127-18-4	1887
1.1.2.2-Tetrachloroethylene	REMPEC	127-18-4	1887
1.1.2-Trichloro-1,2,2-Trifluoroethane	REMPEC	76-13-1	-
1.1.2-Trichloroethane	REMPEC	70-09-5	3082
1.1.2-Trichloroethane	CEDRE	79-01-6	1710
1.1.2-Trichloroethane	REMPEC	79-01-6	1710
1.1'-Biphenyl	REMPEC	92-52-4	3077
1.1-Dichloroethane	REMPEC	75-34-3	2362
1.1-Dichloropropane	REMPEC	78-99-9	1993

Showing 1 to 10 of 3008 rows | 10 rows per page

MANIFESTS Tool Card n°2

MARINER-MANIFESTS Knowledge Tool

What ?

- Resourcing database focused on the preparedness and response to HNS spills
- Projects, deliverables, operational guides

How ?

Database search according to types of documents, area of knowledge or geographic area

MANIFESTS Tool Card n°3

Operational Field Guide

What ?

- Guide to aid decision making
- Evacuation or sheltering decision

How ?

Response algorithm

MANIFESTS Tool Card n°4

Exercise Tool

What ?

To design and develop marine pollution response exercises

How ?

- Exercises database
- Guidelines, presentations
- Dissemination materials, supports
- Agenda

Learn about marine pollution response exercising and HNS, and formulate your own exercises

The MANIFESTS exercise tool will guide you through the whole process: learn the basic principles, review the exercise database, create your programme and formulate your exercises.

MANIFESTS Tool Card n°5

Prediction models

What ?

- Fire and explosion simulations
- Prediction of impacts on the surrounding environment
- Visualisation of the results

How ?

MANIFESTS Tool Card n°6

MAR-ICE service

Marine Intervention in Chemical Emergencies

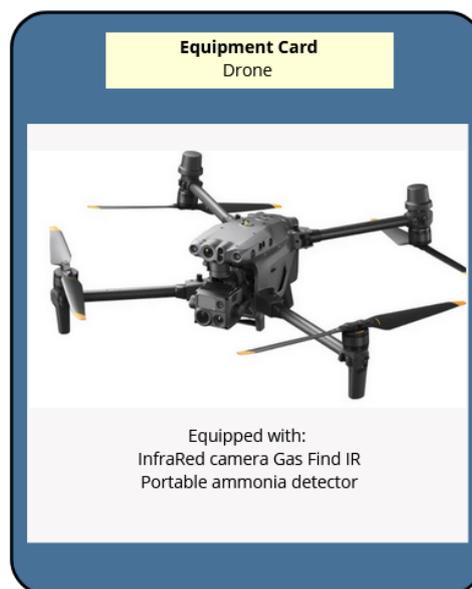
What ?

Product-specific information and advice on ship accidents involving chemicals, provided remotely by a network of pollution response at sea experts and chemical experts.

How ?

Contact CEDRE
Telephone : +33 (0)2 98 33 10 10
E-mail : MAR-ICE@cedre.fr
Available 24/7

B.2. Equipment Cards

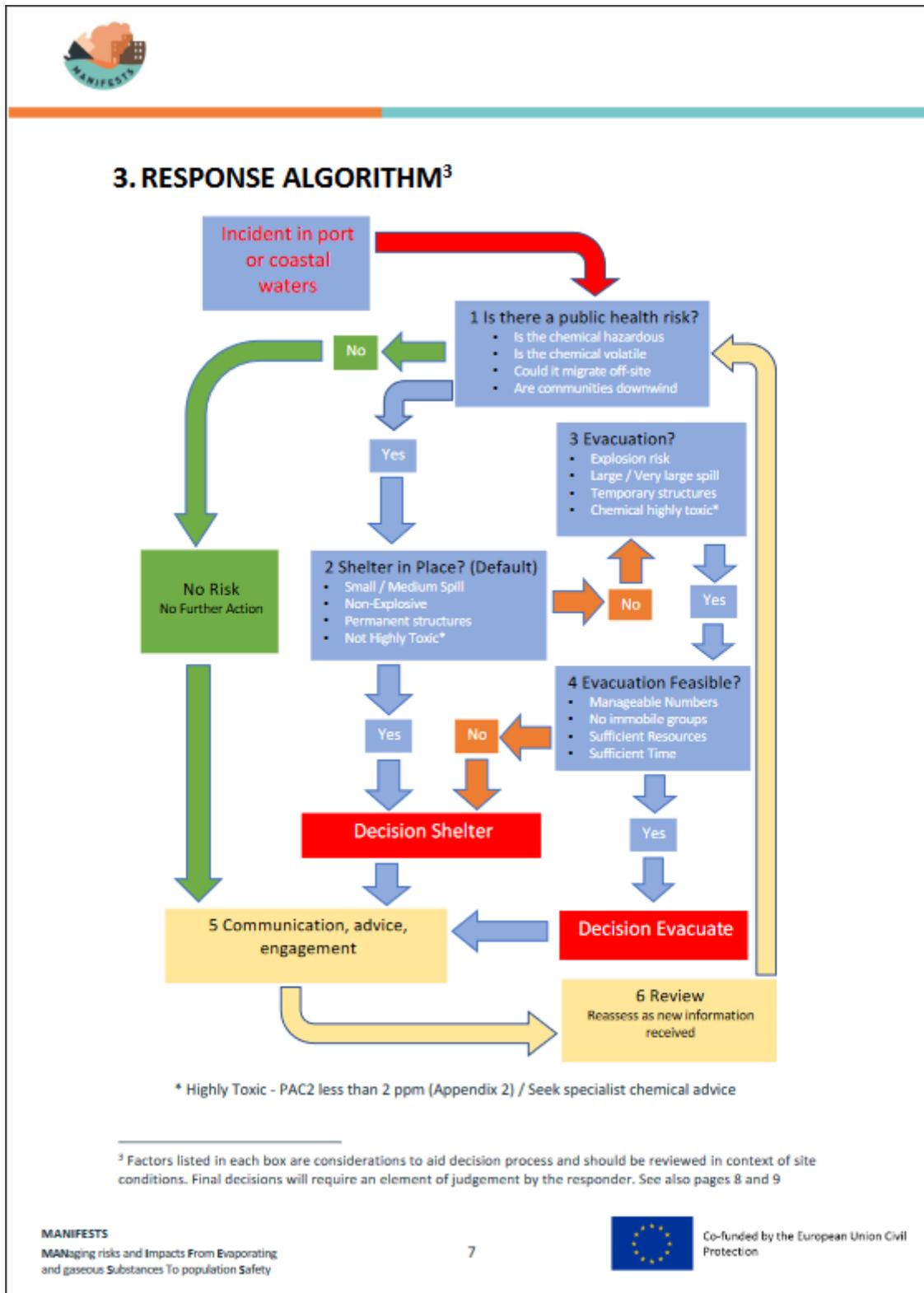


B.3. Chemical table

Chemical parameters

Associated Safety Issue	Chemical parameter	Value
Toxic cloud formation	SEBC Classification	
	Vapour pressure	
	Vapour density	
Chemical behaviour in water	SEBC Classification	
	Water solubility	
Explosion risk	Lower explosive limit (LEL)	
	Upper explosive limit (UEL)	
Environmental impact	Biodegradation factor	
	Bioaccumulation	

B.4. Response algorithm



Appendix C. REMPEC, Malta

C.1. Exercise Form

Sixteenth Meeting of the Focal Points of the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC)
Sliema, Malta, 13-15 May 2025
MANIFESTS-Genius tabletop exercise

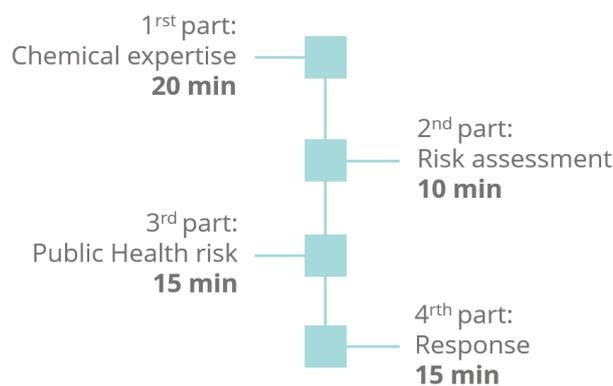
Briefing

Explanation of the tabletop exercise

Objectives of the tabletop exercise:

- Presentation and use of the MANIFESTS-Genius tools;
- Assess the different potential uses of the tools during crisis management;
- Convince participants to promote MANIFESTS-Genius tools to their chemical experts.

A scenario is presented in order to train the participants to use the tools developed in the MANIFESTS-Genius project. The events were chosen to better meet the workshop's objectives, rather than to offer a 100% truthful scenario. The participants are gathered in small groups, with one person per group assigned to take notes, and another person assigned to ask questions. The exercise is separated into 4 different parts:



Printed documents are available for the participants to be used during the exercise:

- **MANIFESTS Tools Cards:** can be played at any moment of the scenario, at least one per exercise part. Each card activates the use of a tool from the MANIFESTS-Genius decision support system.



Scenario

Events description

The event happened on 6th May 2025, at 11:15 PM local time, next to the Piraeus Port, Greece. The MV GreenSea chemical tanker transporting **methanol** was navigating through a narrow passage when it collided with a submerged rock formation, causing significant structural damage. The impact resulted in water flooding several compartments and a loss of propulsion, leaving the vessel adrift. The hull was compromised, but **no methanol leakage** occurred at this stage. The ship lost engine power and navigational control, making it vulnerable to worsening sea conditions. The crew declared an emergency, prompting nearby vessels and maritime authorities to respond. The crew was successfully evacuated, with minor injuries reported, and tugboats were dispatched to tow the vessel to the port.



Figure 52. MV GreenSea vessel carrying methanol towed to the Piraeus Port after collision damages.

The vessel arrived at the Cargo Terminal (37°56'21.5"N 23°38'06.7"E) in worse condition, causing a **real threat of tank rupture and methanol leakage into the port.**

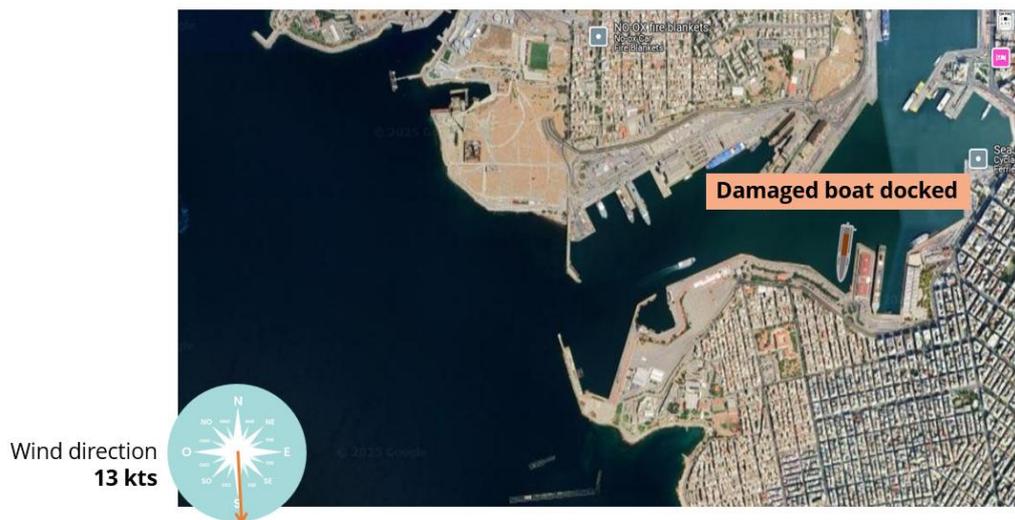


Figure 53. Damaged boat docket at 37°56'21.5"N 23°38'06.7"E, serious risk of methanol leak.

Supplementary information

Environmental conditions	
Air Temperature	18 °C
Water Temperature	17 °C
Wind speed, direction	13 kts, 6.7 m/s, North
Sea Current speed, direction	0 kts, 0.16 m/s, South West
Sea state	Force 4 on Beaufort's Scale



Figure 54. Sea state with Force 4 on Beaufort's Scale

D4.3 – Report on training activities at national and international levels

16/02/2026

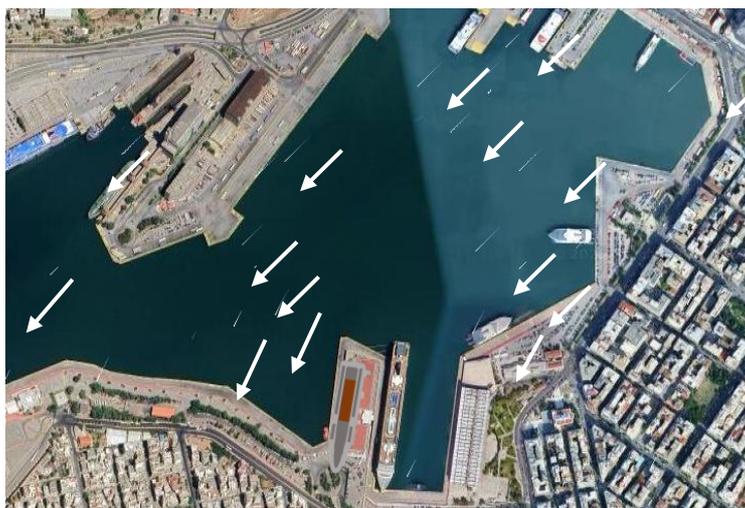


Figure 55. Sea current at Piraeus Port. Source: Oceandatalab.com

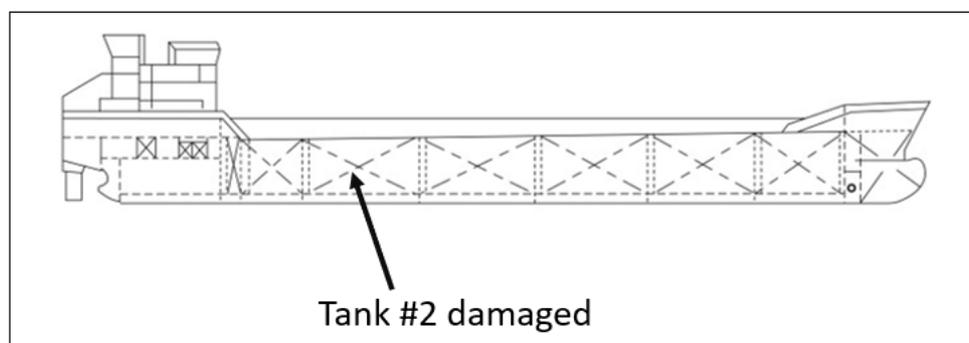


Figure 56. MV GreenSea vessel ship's structure

Vessel Particulars	
IMO number	9284191
Vessel Name	MV GreenSea
Ship Type	Chemical Tanker
Flag	Greece
Year of Build	2006
Length Overall (m)	145
Length BP (m)	135
Beam (m)	22
Draught (m)	9
Depth (m)	12,5
Gross Tonnage	11 500
Net Tonnage	4 200
Deadweight (t)	16 000
Builder	Mitsubishi Heavy Industries
Place of Build	Nagasaki, Japan
Hull	1234
Material	High-strength steel

D4.3 – Report on training activities at national and international levels

16/02/2026

Engine Builder	Wärtsil
Storage tanks	Stainless steel integral tanks
Loaded Volume (m ³)	?
Cargo type	Methanol

1st part: Chemical expertise

20 min 

The first part of this exercise focuses on the chemical at stake, methanol. Using the MANIFESTS Tool Cards, find the relevant chemical parameters to be studied in response to the potential risks.

Which MANIFESTS-Tool Card(s) do you use?

- Which chemical parameters need to be considered, and what are the associated safety risks?

- Regarding the chemical parameters selected and their values, what could be said about the risk analysis?

2nd part: Risk assessment

10 min 

Now that the chemical parameters of the substance involved are determined, a first investigation team is sent to assess the state of the boat. The following report is received:

“Report from Team A. Local time: 23:59. We got off the boat and observed two important things:

1. The methanol concentration sensor in tank 2 indicates 80,900 ppm in the tank’s atmosphere.
 2. No methanol leaks have been reported. The tank level sensor confirms that tank no. 2 currently contains 1 m³ of methanol.”
- What are the possible risks ?

D4.3 – Report on training activities at national and international levels

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Which MANIFESTS-Tool Card(s) do you use?

3rd part: Public Health risk

15 min 

Based on the information gathered in the last parts of the exercise, is there a potential risk to the port and wider areas?

Which MANIFESTS-Tool Card(s) do you use?

- Evacuation or sheltering of the population?

4th part: Response

15 min 

The MANIFESTS-Genius project's Decision Support System helps to prepare for the eventuality of such scenarios. This section focuses on the possible response that could be put in place to deal with such events.

Which MANIFESTS-Tool Card(s) do you use?

- What documents could help you to better prepare to such accidents?

Debriefing

- Feedback/remarks
- Presentation of the remaining MANIFESTS-Genius tools.



MANIFESTS-Genius Project Website

Appendix D. OTSOPA annual meeting, Cedre, France

D.1. Response Form



<https://manifests-project.eu/>

Exercise Response form

1st part: Chemical expertise 20 min

The first part of this exercise focuses on the chemical at stake. Using the MANIFESTS Tool Cards, find the relevant chemical parameters to be studied in response to the potential risks.

Which MANIFESTS-Tool Card(s) do you use?

- Which chemical parameters need to be considered, and what are the associated safety risks?

- Regarding the chemical parameters selected and their values, what could be said about the risk analysis?

- What would happen if refrigerated ammonia mixes with water?

2nd part: Risk assessment 30 min

While the chemical behaviour of the substance involved was determined, an investigation team was sent to assess the state of the boat, wearing proper personal protection equipment. The following report is received:

“Report from team A. We just got out the boat and noticed several important points:

The refrigeration system suffered from the damages. Inside tank no. 4, the temperature is unstable and has a tendency to rise, the pressure exceeds the atmospheric pressure and a level sensor indicates that 4 cubic meters of liquid ammonia remains. The pressure relief system of the tank did not work properly and a leak from the tank shell occurred into the void space primarily filled with dry air. The concentration of ammonia reached 169,000 ppm in the void space. We are now leaving the area.”

Which MANIFESTS-Tool Card(s) do you use?

- What are the possible risks?

Under increasing pressure, the **emergency hatch** on the boat's deck, giving access to tank no. 4, was **blown off**. A **cloud of ammonia** spreads across the deck.



Emergency release hatch of tank no.4 on the Gas Atlas deck

Reassess the risk and use the **equipment cards** available when needed.

Which MANIFESTS-Tool and equipment Card(s) do you use?

- What are the possible risks and how can you respond?

D4.3 – Report on training activities at national and international levels

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3rd part: Public Health risk 15 min

Based on the information gathered in the last parts of the exercise, the risk for public health can now be assessed.

- Which MANIFESTS-Tool Card(s) do you use?

- Is there a potential risk to the port and wider areas?

4th part: Response 15 min

The MANIFESTS-Genius project's Decision Support System helps to prepare for the eventuality of such scenarios. This section focuses on the possible response that could be put in place to deal with such events.

- Which MANIFESTS-Tool Card(s) do you use?

- To what extent can these tools contribute to contingency planning?

- What kind of resources/documents could help you to better prepare to such accidents?

D.2. Scenario

OTSOPA meeting
Brest, France, 20-22 May 2025
MANIFESTS-Genius tabletop exercise

Scenario, Le Havre, France

Briefing

Explanation of the tabletop exercise

Objectives of the tabletop exercise:

- Presentation and use of the MANIFESTS-Genius tools
- Assess the different potential uses of the tools during crisis management
- Convince participants to promote MANIFESTS-Genius tools to their chemical experts

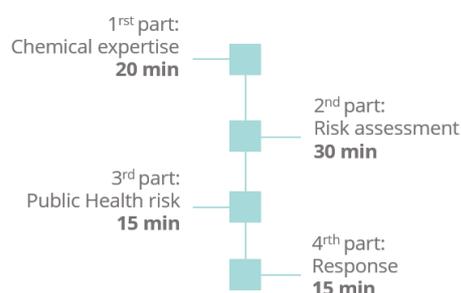
A scenario is presented in order to train the participants to use the tools developed in the MANIFESTS-Genius project.

The events of the scenario were chosen to better meet the workshop's objectives, rather than to offer a 100% truthful scenario.

For an optimum use of the MANIFESTS-Genius tools, the scenario needs:

- the **crew to not be involved**
- a boat **docked at the port**
- **toxic chemical** on board

The participants are gathered in small groups, with one person per group assigned to take notes for remarks or feedback, and another person assigned to ask questions. The workshop is separated into 4 different parts:



Printed documents are available for the participants to be used during the exercise:

- **Tools and Equipment Cards:** can be played at any moment of the scenario, at least one per exercise part. Cards can be used in several parts of the exercise.

D4.3 – Report on training activities at national and international levels

16/02/2026



Scenario

Events description

The events happened on the 21 May 2025, at 23:15 local time, near the port of Le Havre, France (49°28'20.9"N 0°07'47.1"E).

The **gas tanker *Gas Atlas*** was navigating towards Le Havre after having **discharged and drained its refrigerated ammonia** cargo to a neighbor port. The boat was navigating through a narrow passage when it **collided with a submerged rock formation**, causing significant damage. The crew declared an **emergency**, prompting nearby vessels and maritime authorities to respond. The crew was successfully **evacuated** before the situation deteriorated, with minor injuries reported. Tugboats were dispatched to tow the vessel towards the port.

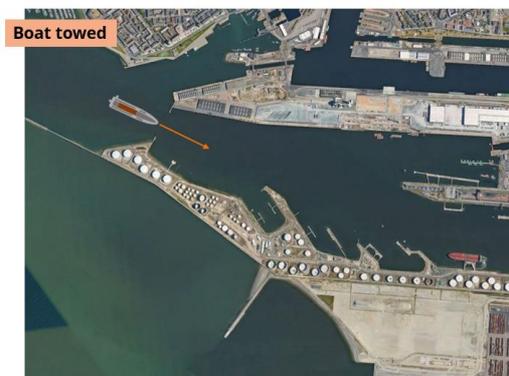


Figure 57. Damaged boat towed towards the port, Le Havre, France

The vessel arrived at the Cargo Terminal in worse conditions.

D4.3 – Report on training activities at national and international levels

16/02/2026

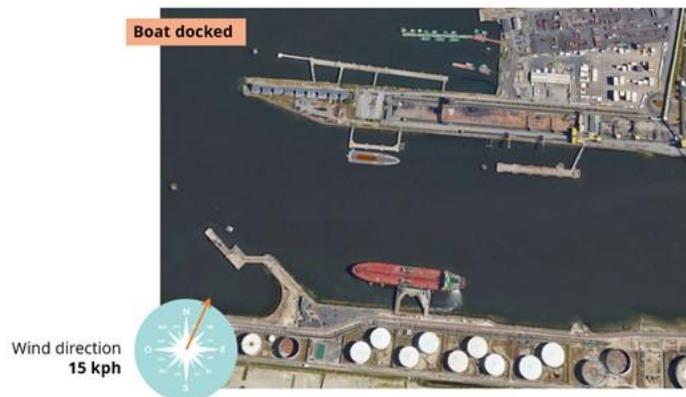


Figure 58. Boat docked at the terminal 49°28'20.9"N 0°07'47.1"

D.3. Supplementary Information

Environmental conditions	
Air Temperature	18 °C
Air humidity	58 %
Water Temperature	17 °C
Wind speed, direction*	7.5 m/s, 15 kts, North East
Sea Current speed, direction	0.16 m/s, 0.3 kts, South West
Sea state	Force 4

*At 10 m high



Figure 1. Force 4 on Beaufort's scale

D4.3 – Report on training activities at national and international levels

16/02/2026

Vessel Particulars	
IMO number	9284177
Vessel Name	Gas Atlas
Ship Type	LPG Carrier
Flag	France
Year of Build	2009
Length Overall (m)	229
Length BP (m)	218
Beam (m)	36
Draught (m)	11
Depth (m)	22
Deadweight (t)	56,146
Cargo capacity (4 x IMO Type A tanks) (m ³)	80,000
Builder	Mitsubishi Heavy Industries
Place of Build	Nagasaki, Japan
Hull	1234
Material	High-strength steel
Engine Builder	Wärtsilä
Tank volume (m ³)	20 000
Loaded Volume (m ³)	?*
Cargo type	Refrigerated Ammonia (-33 °C)

er tanks of the ship are empty to focus on tank no.4 only

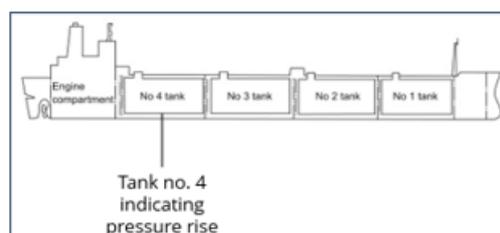
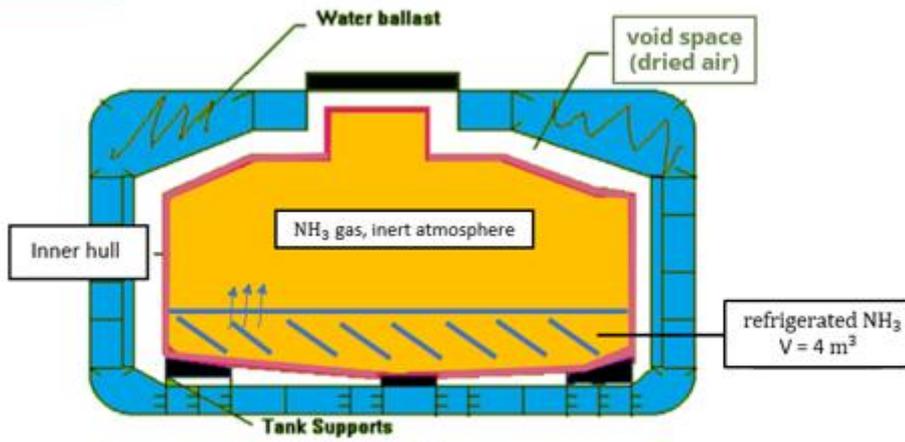
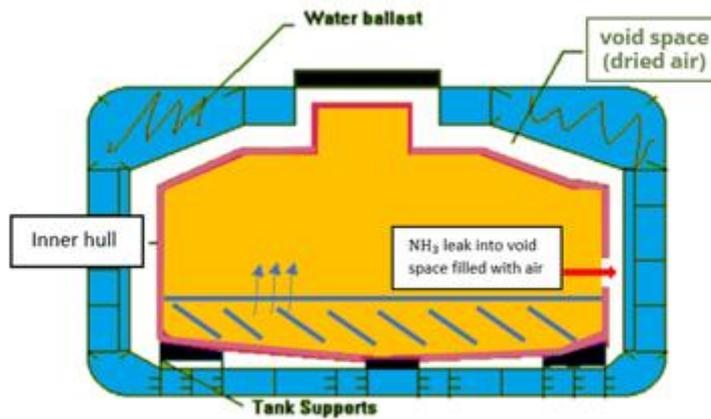


Figure 59. Ship structure.

2nd Part



NH₃ evaporation
pressure rise causing tank
rupture, leak into void
space filled with air



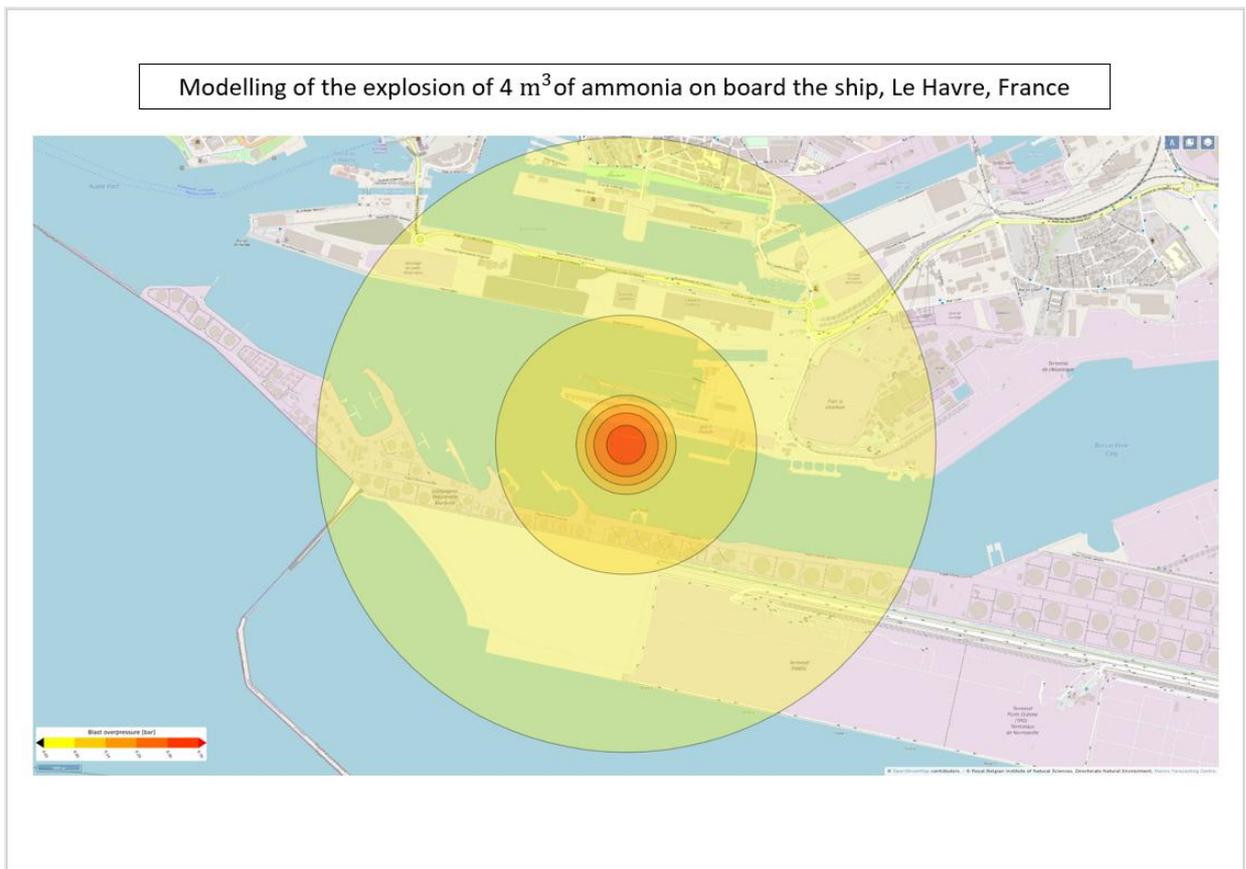
**Risk of explosive atmosphere
inside the void space**

D4.3 – Report on training activities at national and international levels

16/02/2026

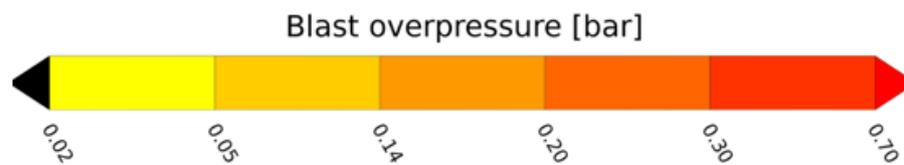
IMO Tank A characteristics	
Maximum vapour pressure	0.25 barg
Minimum temperature	- 48 °C
Maximum density	682 kg/cbm
Tank internal volume	20 000 cbm
Void space volume	5 000 cbm

D.4. Prediction models



D4.3 – Report on training activities at national and international levels

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From yellow to red:

Overpressure >20 mbar (0.02 bar): Risk of direct injuries, e.g., due to glass breakage. Significant risk of glass breakage.

Overpressure >50 mbar (0.05 bar): Risk of direct injuries. Small impact on structures: Deterioration and destruction of window frames according to their nature.

Overpressure >140 mbar (0.14 bar): Risk of severe and potentially lethal injuries. Heavy impact on structures: Partial collapse of the walls and tiles of the houses. Destruction of metallic frames.

Overpressure >200 mbar (0.2 bar): High risk for human life, 1 % of direct lethality. Domino effects. Destruction of lightweight metal frame buildings. Rupture storage tanks (including oil tanks).

Overpressure >300 mbar (0.3 bar): Extremely high risk of direct lethality. Huge impact on structures: Almost complete destruction of houses. Light industrial buildings blown away.

Overpressure >700 mbar (0.7 bar): 99 % of direct lethality. Destruction of reinforced concrete walls. Probable total destruction of buildings.

Appendix E. Training on MAR-ICE for IPA/ENP countries, Cedre, France

E.1. Exercise response form

Exercise Response form



<https://manifests-project.eu/>

1st part: Chemical expertise 20 min

The first part of this exercise focuses on the chemical at stake. Using the MANIFESTS Tool Cards, find the relevant physical and chemical parameters to be studied in response to the potential risks.

Which MANIFESTS-Tool Card(s) do you use?

- How will react LNG if spilled into water?

- Is LNG vapour (methane) toxic? Flammable? Harmful to the environment?

2nd part: Risk assessment 30 min

While the chemical behaviour of the substance involved was determined, an alarm went on the ship and the port authority requested the sending of a drone equipped with an IR camera and an explosimeter. The following report call is then received:

D4.3 – Report on training activities at national and international levels

16/02/2026

“Report from drone pilot A1. Local time 00:10. The drone has completed its initial pass. The collision did not cause any major breaches in the LNG tanks. But some seals are impacted on top of one LNG tank and this causes a methane leak on top of the ship’s deck. Thermal imaging shows the leak direction and growth. Estimated volume of gas: 30 cubic meters and that has reached an enclosed space on the ship. Concentration measured in the enclosed space is 60 000 ppm. Thermal images are being sent now. Over.”

Based on this information, what could happen?

Which MANIFESTS-Tool Card(s) do you use?

- What are the possible risks?

3rd part: Public Health risk 15 min

Based on the information gathered in the last parts of the exercise, the risk for public health can now be assessed.

- Which MANIFESTS-Tool Card(s) do you use?

- Is there a potential risk to the port and wider areas? Evacuation or sheltering of the population?

4th part: Response 15 min

The MANIFESTS-Genius project's Decision Support System helps to prepare for the eventuality of such scenarios. This section focuses on improving preparedness to deal with such events.

- Which MANIFESTS-Tool Card(s) do you use?

- Select three different documents in the selected MANIFESTS-Genius tools that would help you in preparing such events.

E.2. Accident Scenario

Accident Scenario

Briefing

Explanation of the tabletop exercise

Objectives of the tabletop exercise:

- Presentation and use of the MANIFESTS-Genius tools
- Assess the different potential uses of the tools during crisis management
- Convince participants to promote MANIFESTS-Genius tools to their chemical experts

A scenario is presented in order to train the participants to use the tools developed in the MANIFESTS-Genius project.

The events of the scenario were chosen to better meet the workshop's objectives, rather than to offer a 100% truthful scenario.

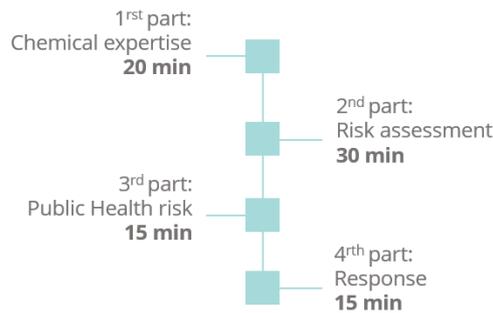
For an optimum use of the MANIFESTS-Genius tools, the scenario needs:

- the **crew to not be involved**
- a boat **docked at the port**
- **a chemical** on board

The workshop is separated into 4 different parts:

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Printed documents are available for the participants to be used during the exercise. The **Tools Cards** can be played at any moment of the scenario, at least one per exercise part. The cards can be used in several parts of the exercise.



Scenario

Events description

The events happened on the night of the 15th of September 2025, near the port of Nynäshamn, Sweden.

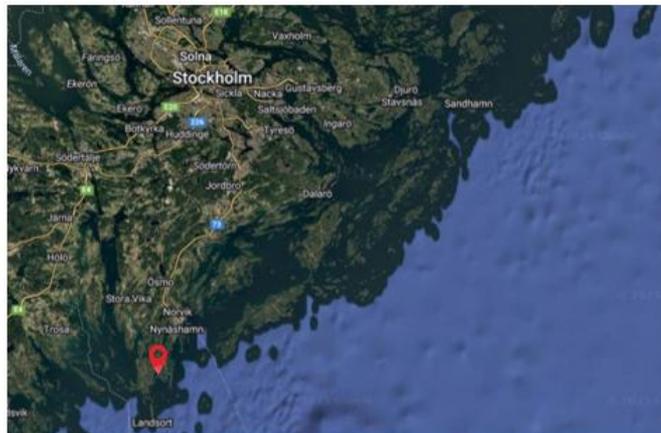


Figure 60. Location of Nynäshamn LNG Terminal, Sweden.

A **collision** between the Arctic Pearl LNG bunkering ship and a coastal service vessel happened at 22:15 local time, next to the port of Nynäshamn. The coastal service vessel was performing a crossing manoeuvre but briefly lost control due to a failure in its automatic navigation system. The impact resulted in loss of propulsion for the Arctic Pearl, leaving the vessel adrift. The captain took contact with the port authorities that started the salvation. The crew **was successfully**

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evacuated with no injuries reported and tugboats were dispatched at 22:36 to tow the vessel towards the port.

Boat towed



Figure 61. Boat towed towards the LNG Terminal of Nynäshamn.

Boat docked

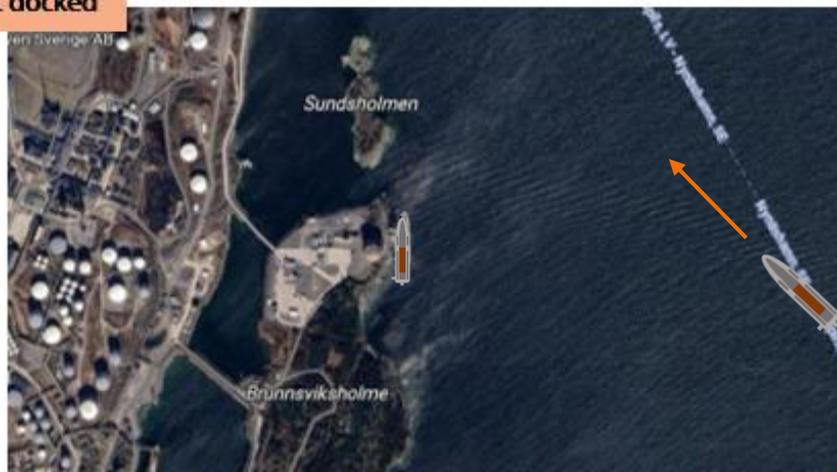


Figure 62. Boat docked at the LNG terminal, at the coordinates 58°55'20.4"N 17°58'40.1"E.

The boat arrives safely at the LNG Terminal (location 58.922333, 17.977806) at 22:50 local time.

E.3. Supplementary information

Supplementary information

Air Temperature	18 °C
Air humidity	58 %
Water Temperature	15 °C
Wind speed, direction*	4 m/s, 8 kts, North
Sea Current speed, direction	0.16 m/s, 0.3 kts, South
Sea state	Force 3

*At 10 m high



Figure 1. Sea state with force 3 on Beaufort's scale

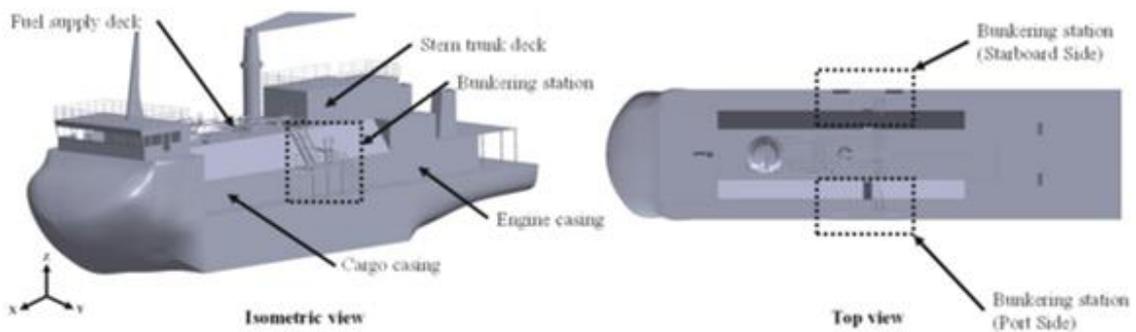


Figure 2. Artic Pearl LNG bunkering ship's structure. Adapted from Nubli, Horis, et al. « Consequence Analysis of Accidental LNG Release on the Collided Structure of 500 Cbm LNG Bunkering Ship ». *Journal of Marine Science and Engineering*, vol. 10, no 10, September 2022, p. 1378.

E.4. Supplementary information – LNG Leak Scenario

Supplementary information – LNG Leak Scenario

The collision energy impacted the seals on top of the LNG tank, causing **boil-off methane vapours** to migrate towards the ship's deck and to escape through a damaged valve seal. As the cold gas is escaping from the refrigerated tank, the **low temperature** causes crackles on the surroundings, worsening the state of the boat. On the ship's deck, the gas could be trapped **near the ground at high concentration** before rising up when warming up in contact with the atmosphere. Assuming this scenario, methane vapours could be stuck on the **main's deck**, and settle in areas with concentrations within the **explosive range**.

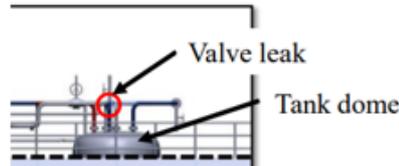


Figure 1. Scheme of the leak on the LNG tank on board the Arctic Pearl

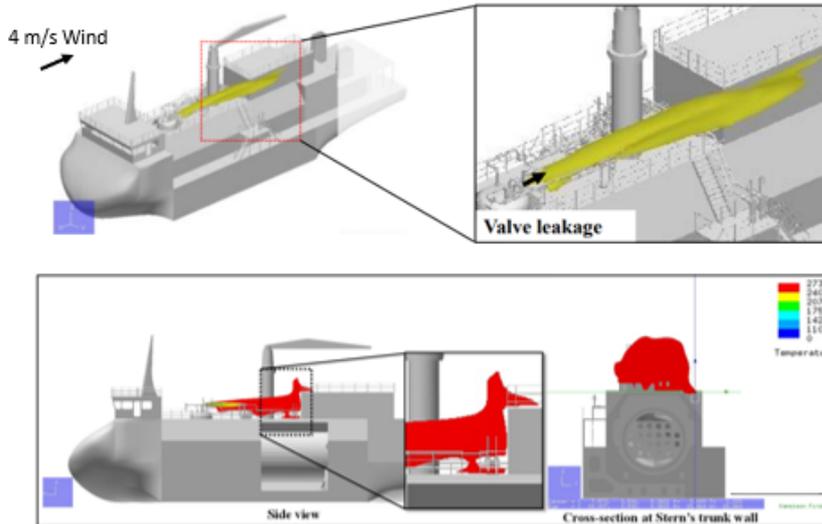


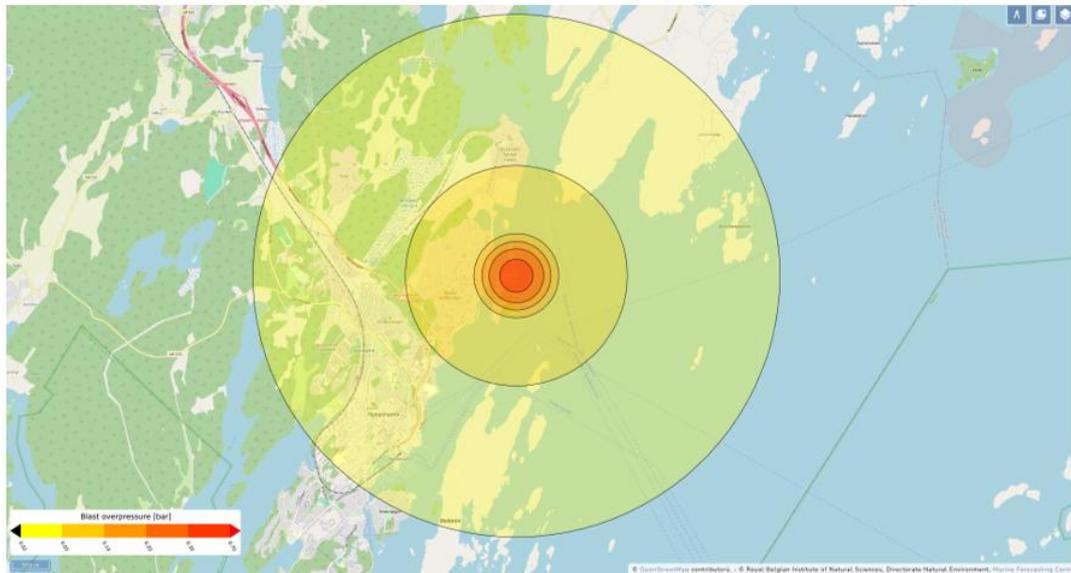
Figure 2. Methane leakage from a valve on the LNG bunker vessel. Adapted from Nubli, Haris, et al. « Consequence Analysis of Accidental LNG Release on the Collided Structure of 500 Cbm LNG Bunkering Ship ». Journal of Marine Science and Engineering, vol. 10, n° 10, September 2022.

Table 1. Summary of leakage scenario

Leak direction	90° to the ship's stern
Leak location	Valve
Reservoir temperature	-163 °C
Methane concentration in the gas pocket	60 000 ppm
Volume of the gas pocket	30 cubic meters
Wind speed	4 m/s

E.5. Prediction models

Modelling of the explosion of 30 m³ of methane on board the ship, Nynäshamn, Sweden



Appendix F. Participant feedback form

This form was extracted from the MANIFESTS-Genius Exercise tool and adapted for the exercise.

Exercise:

Evaluator/Organisation:

Date:

Place:

Name (optional):

Please score your degree of agreement or disagreement with the following statements:

1: Strongly disagree/ 2: Disagree/ 3: Agree/ 4: Strongly agree

Statement	Score	Comment
The exercise was structured and organized well.		
The time of the exercise was adjusted to the needs and objectives.		
I could intervene during the exercise.		
The objectives of the exercise have been achieved.		
My expectations have been met (or improved).		
The exercise provided a clear introduction to the MANIFESTS-Genius tools.		
The exercise clearly presented the advantages and limits of each MANIFESTS-Genius tool.		
It was easy to understand how to use the MANIFESTS-Genius tools.		
The equipment and staff were sufficient to address the objectives of the exercise.		
The documentation provided was sufficient.		
Participation in the exercise was valuable.		

D4.3 – Report on training activities at national and international levels

16/02/2026

Good practices to maintain
Deficiencies found
Suggestions for improving the workshop and MANIFESTS tools

Thanks!