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CONTIGENCY PLAN FOR HYDROCARBON SPILLS IN THE PORT OF IBIZA

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ABSTRACT

The main objective of this work is elaborating a Interior Contingency Plan for a hydrocarbon spill in the Port of Ibiza (Islas Baleares, Spain), in adherence to the Royal Decree 253/2004.

Firstly, marine and land environment of the Port of Ibiza is located and described. Secondly, technical characteristics of the unloading point are established in Ibiza's Port, so that the installations and existing connections. Thirdly, main operations carried out in the zone and which could generate some risk are described. In the fifth place, an inventory of the available human and material means is done. In the sixth place, an Activation Procedure of the plan is established. Here, activation systems in front of a hydrocarbon spill versus the category of the accident and the answer level are described. The conditions which reach to the declaration of the End of the Emergency are defined. However, the plan is not possible to be concluded without previously doing a Revision of the carried out Actuations, so the Contingency Plan on the whole. The object of this revision is the detection of the possible failures for the improvement of future answers. Finally, is necessary to establish Training Programs for the personnel, so doing periodical simulations and exercises, including the bibliography recommended for this course.

Key Words: Hydrocarbon spill, Contingency Plan, Simulation Models, Port of Ibiza.

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INTRODUCTION

Petroleum and its by-products are one of the most important sources of sea pollution mainly due to tanker accidents, oil extraction or load and unload docks. This fact is related to the great demand of these products nowadays. When an oil spill occurs so in the sea as in the land, the hydrocarbons which constitute the crude or the spilt mixture are affected by atmospheric agents (wind, temperature, solar radiation,…) and the physical chemistry properties of the hydrocarbons which constitute the crude oil or the mixture.

If the spill occurred in the sea, it would be also necessary knowing the swell and marine currents which make changes in the physical properties and displace hydrocarbons with the consequent increasing of the spill area. The total of these phenomena is called ageing.

Parallely to the ageing processes and for minimizing the effects of the hydrocarbon spill on the environment, a series of external actions for hydrocarbon retaining and recovering and for the cleaning and restoration of the affected areas (Bergueiro and Moreno, 2002). The total of these external actions are part of the Contingency Plan (Bergueiro and Domínguez, 2001; Bergueiro et al., 2004). Equally, the concretely prediction of every black tide, that is, the area, the place where it will go, the intensity of every ageing phenomena, … is tried to be predicted with the aim of minimizing the environmental impact with the minimum quantity of sources. This objective could be reached by the simulation models, which are computerised programmes connected to data banks with properties of the different crude oils and with climatic and geographical characteristics of the area where the spill occurred.

METHODOLOGY

Location of the probable spills

The first step is knowing the main oil tanker routes which surround the studied area, the main ports where hydrocarbons are unloaded, the kind and characteristics of them, the frequency with that the oil tankers pass, the transported tonnage, the predictable meteorological conditions and the kind and characteristics of the coastal areas susceptible to be affected by the spill.

Once the main oil tanker routes where spill could occur are known, the other conflictive point where the spills could occur is in the unload terminal in the Port of Ibiza.

Operations in the unload terminal

The main operations in the Port of Ibiza are the crude by-products unloading which are used in the means of transport which, by means of pipes are transported to the factory of the Logistic Company of Hydrocarbons (CLH) located in Ca Na Glaudis. Fuel is directly unloaded from the tanker to the power station of GESA. If

need be, fuel could be pumped from the tanker to the CLH installations and, from there, to the power station of GESA.

The 99% of fuel's consumption in Ibiza is for GESA (power station) and for the desalination plant of sea water.

Analyzing the activities in the mooring quay, it could be concluded that the most probable accidents which could occur were:

— Breakage of the unloading arms of hydrocarbons.
— Breakage of transportation pipes and/or impulsion pumps between the mooring quay and the factory in Ca Na Glaudis.
— Supply of fuel to the tankers.
— Cleaning operations of tanks and elimination of residues.
— Accidents during the operations of mooring place.

These operations are the main reason of hydrocarbon spills in the terminal. Consequently, it is necessary the elaboration of an Interior Contingency Plan for this area.

The oil tankers which habitually supply the fuel to the island of Ibiza are: Mar Rocío, Alcudia and Castillo de Trujillo.

DEVELOPMENT

Identification of the areas susceptible to hydrocarbon spills in the island of Ibiza

According to the Royal Decree 253/2004 of 13 of February, the first step for the elaboration of the Interior Contingency Plan is the identification of those areas that, due to the activities in these areas, are highly susceptible to suffer a hydrocarbon spill. Areas susceptible to hydrocarbon spills near the unloading terminal which CLH has in the island of Ibiza must be identified and classified. It is expected to obtain a list from this classification of all the areas where the spill could be diverted to know the environmental impact and the necessary means for minimizing this impact. Equally, all the necessary means for the spill treatment and restoration of the polluted environment could be known. The susceptible areas which could be affected by a hydrocarbon spill in the unload-

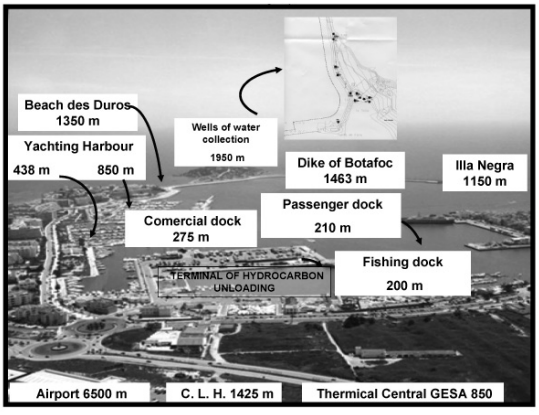

Figure 1. Main areas susceptible to be affected by the spill and their distance to the unloading hydrocarbon Terminal.

ing Terminal are mooring quays of passenger ships, mooring docks for the pleasure boats of the yachting harbour, just as the Beach des Duros, the points of water collection and the city of Ibiza (Figure 1).

Kinds and quantities of hydrocarbon unloaded in the port of Ibiza

The products consumed in the island of Ibiza could be classified in four great groups:

— Petrol DE 95, 97 and 98 octanes.
— Aviation gas (light aircrafts) called 100 LL.
— Aviation kerosene called JET A-1 (jet planes).
— Diesel oils A, B y C.
— Fuel oils: Fuel oil nº1 and Fuel oil BIA (Low Index of sulphur).

Quantities unloaded during 2005 in the Port of Ibiza, from where it is transported to the Island of Formentera, just like the ones unloaded in all the Balearic Islands during 2004 are shown in Table 1.

PRODUCT	UNITS	IBIZA AND FORMENTERA	BALEARIC ISLANDS
Gasoline 95	Lts.	44222165	308159285
Gasoline 97	Lts.	2063593	8278166
Gasoline 98	Lts.	4224985	41212863
Avgas 100LL	Lts.	161030	713079
JET A-1	Lts.	65176940	583093916
JP-8	Lts.	0	1814108
Crude Oil	Lts.	0	13907
Diesel Oil A	Lts.	52423446	462256443
Diesel Oil B	Lts.	14593784	103120732
Diesel Oil C	Lts.	24977527	479382251
TOTAL	Lts.	207843470	1988044750
PRODUCT	UNITS	IBIZA AND FORMENTERA	BALEARIC ISLANDS
Fuel Oil BIA	Kg.	0	112465720
TOTAL	Kg.	0	112465720
TOTAL	Lts./Kg.	207843470	2100510470

Table 1. Kinds and quantities of hydrocarbons unloaded in the Balearic Islands during 2005

Meteorological and geographical conditions in the port of Ibiza

Values of direction and intensity of the wind which could affect to a hydrocarbon spill in the Port of Ibiza were obtained in the meteorological station in the

Ibiza's Airport, property of the National Institute of Meteorology (INM). The average of velocities and directions predominant per months and seasons are shown in Table 2.

MONTH	WIND DIRECTION	WIND VELOCITY AVERAGE (km/h)
JANUARY	SW/W/NW	8.1/13.7/7.2
FEBRUARY	SW/W/NW	7.5/12.2/8.1
MARCH	E/SW/NW	11.6/7.6/6.8
APRIL	SW/W/NW	8.0/12.1/8.4
MAY	E/SW/NW	11.1/7.6/6.6
JUNE	E/SW/NW	11.9/7.6/6.0
JULY	E/SW/NW	11.7/7.1/5.4
AUGUST	E/SW/NW	11.9/6.7/5.4
SEPTEMBER	E/SW/NW	12.0/8.1/5.7
OCTOBER	SW/W/NW	7.7/10.1/6.1
NOVEMBER	SW/W/NW	9.7/12.9/7.7
DECEMBER	SW/W/NW	8.6/13.2/7.3
SEASON	WIND DIRECTION	WIND VELOCITY AVERAGE (km/h)
SPRING	E/SW/NW	11.5/7.7/7.3
SUMMER	E/SW/NW	11.8/7.2/5.6
AUTUMN	SW/W/NW	8.4/11.5/6.6
WINTER	SW/W/NW	8.1/13.2/7.5

Table 2. Direction and velocity average of the wind in months and seasons

Simulation models of hydrocarbon spills in the sea

— Simulation models EUROSPILL and OILMAP were used to the simulation of the different spills in the Port of Ibiza.
— By means of these models, next parameters were set:
— Possible trajectories which could follow the hydrocarbon mixtures.
— Possible coastal areas which could be affected.
— Variation depending on time of the spilt emulsioned and deposited in the coast quantity.
— Variation depending on time of the area and thickness of the spill, diameter and length of the stain.
— Variation depending on time of the density, viscosity and flash point of the spilt hydrocarbon mixture.

A total of a hundred and eight simulations with petrol, aviation kerosene JET A1 and diesel oil have been done. The spilt quantity is 12500 l, maximum quantity that, theoretically, could be spilt from the oil tankers which unload fuels in the Port of Ibiza.

As an example, a simulation for every one of the models mentioned above has been selected. In the case of OILMAP, a simulation did in the interior of the Port of Ibiza considering a spill of 12500 l of Diesel Oil C has been selected. Currents are typical in the area and the wind velocity is 3 m/s in the West direction (Figures 2 and 3).

The impact point is located at the geographical coordinates 38º 54' N and 01º 28'E (Figure 4).

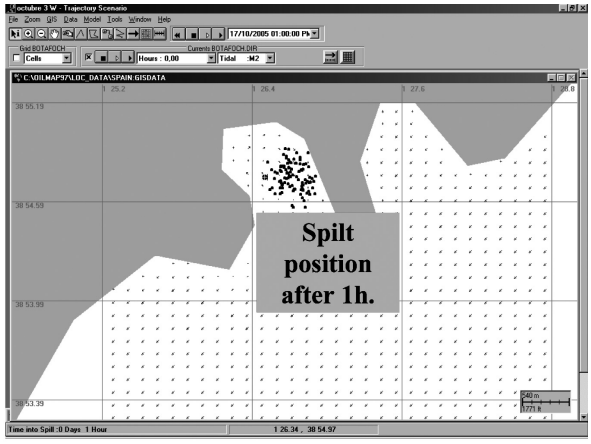

Figure 2. Spilt position after 1 hour.

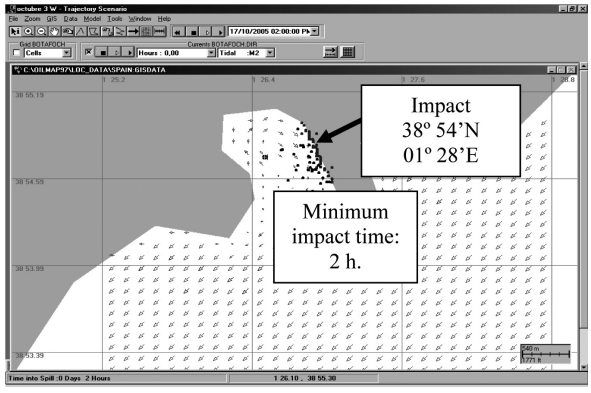

Figure 3. Spilt position after 2 hours.

Referring to the EUROSPILL model, one of the simulations did in the environment of the Island of Ibiza is shown. A spill of 100000 tonnes of Arabian Light oil come from the refinery of Tarragona is considered. The initial coordinates of the spill are 38º 50'N y 01º 50'E, considering typical marine currents of the area and a wind of 3,3m/s in East direction. (Figures 5, 6 and 7).

The coordinates of the impact point are 38º 86'N and 1º 93'E, belonging to the beach Es Cavallet, very near to the Natural Park of Ses Salines. The minimum impact time is 130h.

Antipollution means available in the island of Ibiza

In the surrounding area of the Port of Ibiza, the next antipollution means are available:

— Two barriers FENCE BOOM 61m long, placed in the CLH factory and the power station GESA.
— A barrier SENTEC/TROIL BOOM 500 m long, in the CLH factory.
— One skimmer VIKOMA-KOMARA with a recovery capacity of 12m^3/h, located in the CLH factory.
— Barriers and adsorbent blankets located in the CLH factory.
— 2000l FINASOL OSR-2 dispersant, located in the power station of GESA.
— 10000l FINASOL dispersant in the unloading terminal of the port.

In the case of a emergency, it could resort to the antipollution means that CLH and GESA have in the Port of Palma de Mallorca and its installations and the ones which the State Society of Maritime Rescue and Security has in Madrid.

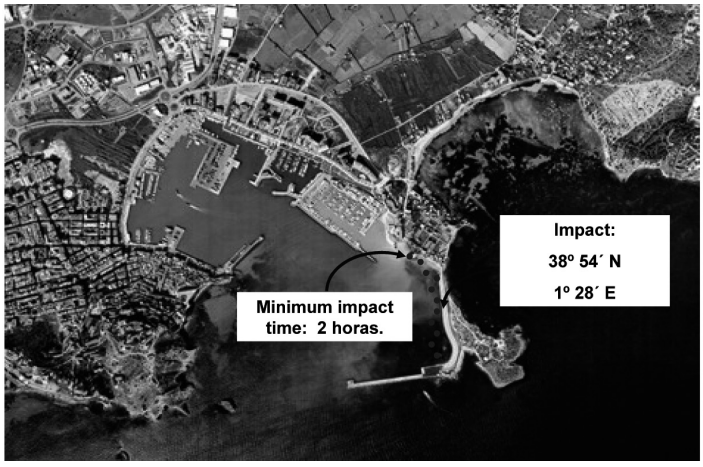

Figure 4. Location of the impaoint and minimum impact time to the coast.

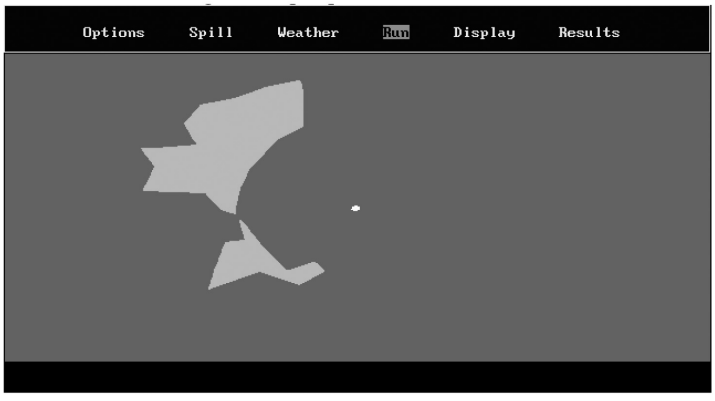

Figure 5. Spill position after 1 hour.

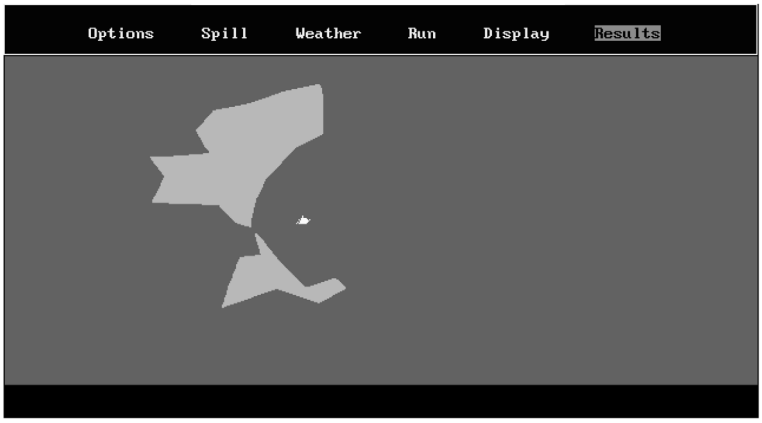

Figure 6. Spill position after 80 hours.

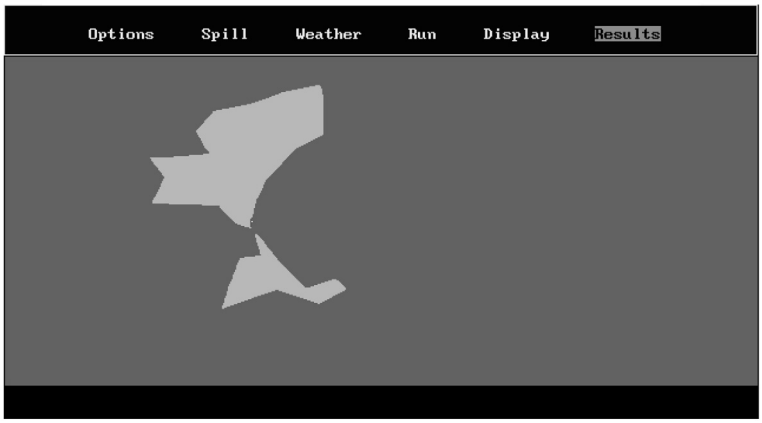

Figure 7. Spill position after 130 h, when the spill reaches the coast.

CONCLUSIONS

1. An Interior Contingency Plan is expected to be done for the CLH dock in the Port of Ibiza, applying the Royal Decree 253/2004, of 13 of February, which establishes the prevention measures and the fight against the pollution in the loading, unloading and hydrocarbon manipulation in the marine field.
2. The Interior Contingency Plan must be fast and easy to access, so a computerised medium containing updated databases belonging to the information needed for combating a spill is pretended to be developed.
3. The oceanographic and meteorological conditions predominant in the area would be detailed.

4. The main operations in the dock, the main kind of hydrocarbons unloaded with their belonging manipulated quantities are described.
5. Simulation Models are computerised systems that allow the determination of the most probable trajectory of a spill depending on the oceanographic and meteorological conditions.
6. As well as the simulation models, the location of the susceptible areas of impact and the minimum time is pretended. Because of this, models allow the estimation of the answer time for combating the spill in the impact area and taking the most suitable measures depending on the environmental characteristics of this area.

ACKNOWLEDGEMENT

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PLAN DE CONTINGENCIA ANTE UN VERTIDO DE HIDROCARBUROS EN EL PUERTO DE IBIZA.

Resumen

El objetivo principal de este trabajo es el de elaborar un Plan Interior de Contingencia, para el puerto de Ibiza (Islas Baleares, España), ante un vertido de hidrocarburos, de acuerdo con el Real Decreto 253/2004. Inicialmente, se describe todo lo referente al medio ambiente terrestre y acuático de dicho puerto. Seguidamente, se describen las características de la zona de descarga de derivados del petróleo, al igual que las instalaciones y las conexiones existente con la zona de almacenamiento. En tercer lugar, se indican las principales operaciones de carga y descarga, los riesgos que de las mismas puedan derivarse y los medios materiales y humanos disponibles. Se establece el procedimiento de activación del plan desarrollado. En este punto, se describe el sistema de activación frente a un vertido de hidrocarburos en función de la categoría del accidente y del nivel de respuesta. No obstante, no se puede finalizar el plan sin una revisión de las actuaciones realizadas para detectar los posibles fallos para tenerlos en cuenta en futuras aplicaciones. Finalmente, es necesario establecer cursos de formación, incluyendo simulaciones y ejercicios periódicos, para el entrenamiento del personal. En dichos cursos, y como complemento, deberá recomendarse la bibliografía más actualizada.

INTRODUCCIÓN

Las principales causas mediante las cuales crudos de petróleo y productos derivados pueden derramarse en el mar incluyen los procesos de extracción, el transporte y las operaciones de carga y descarga de los mismos. Con el objeto de minimizar el efecto de los hidrocarburos en el medio ambiente, es necesario tomar una serie de acciones externas encaminadas a la contención y recuperación de la mayor parte de los hidrocarburos derramados (Bergueiro y Moreno, 2002). Todas estas acciones se deben contemplar prioritariamente en el Plan de Contingencia (Bergueiro y Domínguez, 2001; Bergueiro y otros, 2004). La trayectoria seguida por los hidrocarburos se puede estimar mediante modelos de simulación.

METODOLOGÍA

Para la elaboración del Plan Interior de Contingencia del puerto de Ibiza, se han analizado los datos de vientos y corrientes marinas, parámetros indispensables para la alimentación de los modelos de simulación mediante los cuales se pueden obtener las diferentes trayectorias de los vertidos planteados. De esta forma se podrá determinar, en función del tiempo y de la cantidad y tipo del hidrocarburo vertido, los

siguientes factores: longitud y anchura del derrame, cantidades evaporadas, dispersadas y emulsionadas, coordenadas del centroide del derrame y el punto de impacto en la costa. De igual forma se determinará el tiempo mínimo de impacto.

DESARROLLO

El inicio del estudio se centró en la descripción de las áreas de importancia socio-económica que podían ser susceptibles de contaminarse por un vertido. Las mezclas de hidrocarburos simuladas fueron gasolinas de automoción, queroseno de aviación Jet A1, gas-oils y fuel-oil BIA. Las condiciones meteorológicas que afectan a los diversos vertidos se obtuvieron del Instituto Nacional de Meteorología, clasificadas por meses y por estaciones, con datos de direcciones predominantes y velocidades medias. Se han realizado 108 simulaciones de vertidos de 12500 litros de hidrocarburos, mediante la utilización de los modelos OILMAP y EUROSPILL. Bajo el efecto de un viento de 3 m/s que sopla en dirección oeste, y tomando como origen del vertido la zona de descarga en el puerto de Ibiza, el vertido tarda dos horas en impactar un punto de la costa de coordenadas 38º 54' N y 01º 28' E.

CONCLUSIONES

1. Se ha desarrollado un Plan Interior de Contingencia para el puerto de Ibiza, de acuerdo con el R.D. 253/2004.

2. El Plan Interior de Contingencia permite acceder a un sistema informatizado que contiene la información necesaria para prevenir y combatir los derrames de hidrocarburos.

3. Se indican las condiciones meteorológicas y oceanográficas predominantes en el puerto de Ibiza y se describen las principales operaciones de carga y descarga de hidrocarburos y las cantidades de los mismos.

5. Mediante los modelos de simulación EUROSPILL y OILMAP, se han obtenido las trayectorias más probables que seguirán diferentes vertidos, bajo condiciones meteorológicas y oceanográficas diversas.

6. Del análisis de las trayectorias obtenidas con los diferentes modelos, se determinaron las áreas de costa susceptibles de ser afectadas por los vertidos y el tiempo de impacto mínimo de los mismos. En base a lo anterior, se pueden estimar las medidas y los medios necesarios para combatir un derrame que ha impactado en un área concreta.