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Marine Environmental Emergency Preparedness and Response
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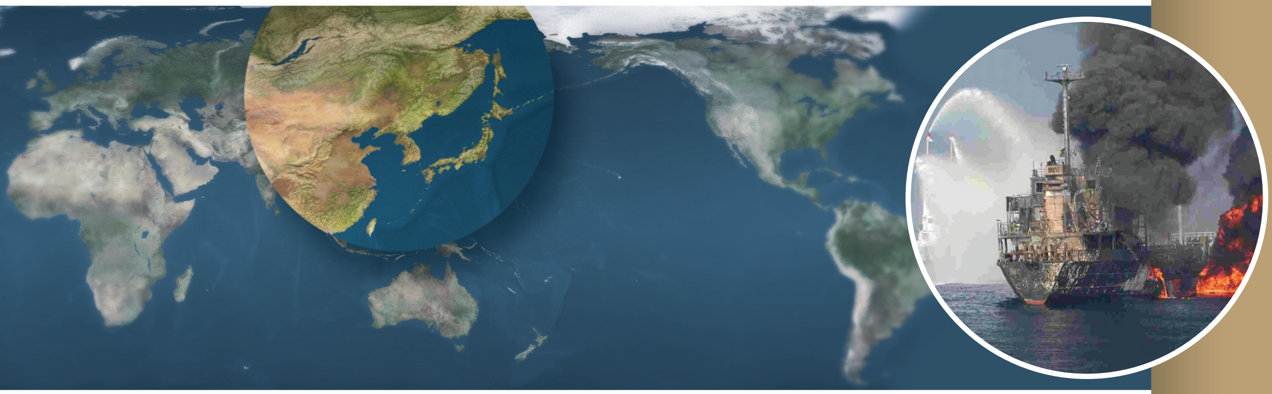
UNEP IMO

Manual for HNS Training



MERRAC Technical Report No. 8

Regional Seas

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Foreword

MERRAC, the Marine Environmental Emergency Preparedness and Response Regional Activity Centre, is one of four Regional Activity Centres of the Northwest Pacific Action Plan (NOWPAP) which was adopted in 1994 as a Regional Seas Programme of the United Nations Environment Programme (UNEP) by the People's Republic of China, Japan, Republic of Korea, and Russian Federation. MERRAC is responsible for regional co-operation on marine pollution preparedness and response in the region.

With technical support from the International Maritime Organization (IMO), MERRAC is currently functioning as secretariat for the NOWPAP MERRAC Focal Points Meeting, Expert Meeting, and Competent National Authorities Meeting for NOWPAP Regional Oil and HNS Spill Contingency Plan (CNA meeting). The Centre also carries out other special activities including the management of a regional information system, organization of training and exercise, capacity building, and co-ordination of research and development on the technical aspects of oil and HNS spills.

As one of main outcomes of MERRAC activities, the NOWPAP Regional Oil and HNS Spill Contingency Plan (RCP) has been developed and officially came into effect as being signed by all NOWPAP member states. The purpose of the NOWPAP RCP is to provide an operational mechanism for mutual assistance through which the member states will co-operate during major marine oil and HNS pollution incidents in the region

In order to provide practical and technical guidelines to promptly and effectively respond to major oil and HNS spill accidents within the framework of the NOWPAP RCP, it was agreed to carry out the MERRAC specific project related to HNS training manual.

Through the MERRAC Specific Project, the technical report was developed by NOWPAP MERRAC based upon the decision of the 11th MERRAC Focal Points Meeting. The Expert Group consisted of 4 experts who were nominated by MERRAC Focal Points as follows: Dr. Xiangshang Zhang (China), Capt. Ohnuki Shin (Japan, Leading Expert), Dr. Moonjin Lee (Korea), and Dr. Gennady Semanov (Russia), and contributed to developing the technical report. MERRAC staffs (Dr. Seong-Gil Kang, Dr. Jeong-Hwan Oh, Ms. Hyon-Jeong Noh, and Ms. Hye-Mi Lee) edited and finalized the report with technical support of MERRAC Focal Points, NOWPAP Regional Co-ordinating Unit (RCU), and International Maritime Organization (IMO).

As Director of MERRAC, I would like to thank the MERRAC Focal Points and all experts of the Expert Group for their support and contributions to finalizing the MERRAC Technical Report.

Seong-Gil Kang

Director of MERRAC

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Section 1. Goal and Objective

This Manual deals with incidents involving Hazardous and Noxious Substances (HNS) and aims to explain about training course for the purpose of giving sufficient preparedness for and response to marine Hazardous Noxious Substance (HNS) incidents to the participating trainees.

In order to respond to the incidents involving HNS promptly and properly, training should be conducted periodically in accordance with this Manual.

Section 2. Definition

For the purpose of this Manual, a Hazardous and Noxious Substance (HNS) is defined as any substance other than oil which, if introduced into the marine environment, is likely to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea.

It is estimated that more than 50% of packaged goods and bulk cargoes transported by sea today can be regarded as dangerous or hazardous from safety standpoint or harmful to the environment according to the criteria set by the International Maritime Organization (IMO). The bulk cargoes referred herein include commodities such as solid or liquid chemicals and other materials, gases and products for and of the oil refinery industry.

Section 3. First Stage of Training (Lessons at Classroom)

Lesson 1: Lecture about Basic Chemistry and Physical Properties of Chemicals

To build the awareness about HNS and aspect of response options, basic chemistry should be learned by trainees. The lecture should be as precise as possible by giving examples and by using slides for easier understanding by the trainees.
By this lesson, trainees are to learn following terminology.

(1) Symbol of chemical elements and periodic table
Example: "O" is the symbol of oxygen. "O_2" is molecular formula of oxygen. "H" is hydrogen.

Represents atomic number

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57−71 ランタノイド	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
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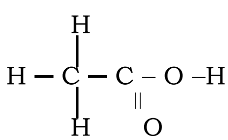
57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

(2) Group of atom
Due to strong connection of atom forming a group, a group is transferred to other chemical products, as a group through chemical reaction.
Example: Methyl Group Molecular formula is "CH_3". Hydroxyl Group Molecular formula is "OH". Ethyl Group Molecular formula is C_2H_5.

(3) Chemical Formula
Trainees should learn about the following chemical formulas which show composition of chemicals.

- Molecular formula
  Example: Molecular formula of acetic acid is $C_2H_4O_2$.
- Constitutional formula
  Example: Constitutional formula of acetic acid is the following.



- Rational formula
  Example: Rational formula of acetic acid is "CH_3COOH".

(4) Compounds
A substance formed by the chemical combination of two or more elements
Example: Ammonia "NH_3" is formed by nitrogen and hydrogen.

(5) Mixtures
Something mixed without combination through chemical reaction
Example: Mixture of nitrogen dioxide "NO_2" and nitrogen oxide "NO".

(6) Substances
Physical material which has discrete existence and matter

Lesson 2: Lecture about Basic Chemistry --- States of a matter ---

Explanation should be made on the following points:

(1) Basic physical states of matter
- solids   a body of stable shape
- liquids   a substance that is neither a solid nor a gas
- gases   any air-like substance

(2) Physical properties of chemicals
Each chemical has its own properties. Explanation about the following terminology and description should be given to trainees:
- density   degree of consistence
- solubility   quality of being soluble
- miscibility   quality of being mixed
- combustibility   quality of being combustible

Example: Xylene "$C_6H_4(CH_3)_2$" Density is 3.66 (air=1), Solubility with water is low, Miscibility with alcohol, ether is high (freely soluble with alcohol/ether).

Lesson 3: Lecture about Basic Chemistry --- Hazardous Properties ---

Following hazardous properties of chemicals in general, should be explained:

(1) Flammability: quality being flammable
- vapor pressure
- flash point
- fire point
- lower explosive limit (LEL)
- upper explosive limit (UEL)/upper flammable limit (UFL)
- flammable range/auto-ignition temperature
- explosivity   quality being explosive
- corrosivity   quality being corrosive
- reactivity   possible risk of chemical reaction
- toxicity   quality of being toxic
- radioactivity   property possessed by radio active substances

Lesson 4: Lecture about Basic Chemistry --- Hazardous Properties of HNS ---

As HNS has serious hazardous properties, explanation should be given about the following classification of groups of certain chemicals by the hazards they pose.

Also behavior classification system by the following groups and sub-groups should be made by taking some HNS from IMDG Code which classifies group into 9 classes, so that the trainees may become familiar with IMDG Code.

(1) Gas
- gas
- gas/dissolver

(2) Evaporator
- evaporator
- evaporator/dissolver

(3) Floater
- floater/evaporator
- floater/evaporator/dissolver
- floater
- floater/dissolver

(4) Dissolver
- dissolver/evaporator
- dissolver

(5) Sinker
- sinker/dissolver
- sinker

Lesson 5: Lecture about Basic Chemistry --- Fire, Explosion, Reaction and Corrosion ---

As fire, explosion, reaction and corrosion may be the most serious hazards associated with HNS releases, explanation about the following types of fires, explosion hazards, reactivity and corrosivity hazards should be made as precisely as possible.

It should be noted that slides and video movies are most useful tools to demonstrate serious hazards posed by release of HNS and, during lessons, the teachers/trainers had better use these tools as much as possible.

(1) Fire
- flames jets
- fire balls
- vapour cloud fires
- liquid pool fires

(2) Explosion
- shock waves
- chemical reaction
- release of energy
- release of compressed liquid gas
- explosive mixtures
- deflagration
- detonation
- explosive limits
- vapour cloud explosion
- boiling liquid expanding explosion
- explosion hazards
- static electricity hazards

(3) Reactivity and corrosivity hazards
- reactions with air, water or moist air
  Example: Sodium "Na" and calcium phosphate "$Ca_3(PO_4)_2$" causes exothermic reaction in contacting with water.
- reactions between incompatible HNS
- polymerization reactions
- decomposition reactions

Lesson 6: Lecture about Basic Chemistry --- Toxic Hazards to Human Health and Environment ---

To respond to HNS incident properly, trainees should learn about the following factors affecting the toxic potential of chemicals.

(1) Amount of chemicals released

(2) Time frame

(3) The properties of chemical

(4) Route of exposure

(5) Concentration and duration of exposure

(6) The strength of individual exposed

(7) Concentration The lecture should be made by giving example of toxic chemical

(8) Prevailing condition
In order for trainees to easily understand the toxic hazards, explanation should be made by giving two or three chemicals as an example.

Also the following possible routes of exposure should be explained:

- inhalation
- ingestion
- injection
- absorption

It should be clearly explained that toxic effects may be different depending upon the aforementioned factors as follows:

- local effect
- systematic effect
- reversible/irreversible effects
- acute effect
- chronic effect

The trainees, who may be the first responder to an HNS incident, should learn about common exposure limits values ("TLV") as those set by such competent authorities as American Conference of Governmental Industrial Hygienists ("ACGIH").

ACGIH sets TLV at a level of concentration, which may not pose serious hazards to human body after continuous exposure by a work.

Also for safety of the first responder and residents near the site of an incident, a sphere of potential diffusion of HNS should be estimated carefully.

U.S. Environmental Protection Agency ("EPA") and National Oceanic & Atmospheric Administration ("NOAA") developed software for simulation, known as Areal Locations of Hazardous Atmospheres ("ALOHA"). For setting the bench mark and table for determining dangerous zone, ALOHA may be used. To assist trainees to use ALOHA, during lesson, demonstration of ALOHA should be made by setting certain assumed conditions for a certain area.

In case of a HNS incident, effects not only on human health but also on environment are serious. Therefore the following effects should be explained to trainees for subsequent internal discussion before preparing contingency plan.

- acute aquatic toxicity
- tainting (of seafood) particularly at some area
- bioaccumulation
- persistence

Lesson 7: Lecture about Basic Chemistry --- Safety ---

In order to protect personnel involved in the incident, trainees should be instructed to give special considerations of effective health and safety strategy as follows.

(1) Identification of key personnel in case of incident
- incident manager
- health and safety officer

(2) Site safety plans

(3) Demarcation of work areas
- exclusion zone
- contamination reduction zone
- support zone

(4) Protective equipment

Also the use of protective equipment is necessary to protect human body. Explanation should be made about the use of the following personal protective equipment by using slides and samples of protective equipment.

(5) Respiratory equipment
- respirators
- self-containing breathing equipment

(6) Protective clothing
- strength
- chemical resistance
- thermal resistance
- flexibility
- clean-ability
- ageing resistance

Drawbacks of personal protective clothing should be explained in order to avoid unnecessary exposure by wearing old clothing.
- claustrophobia
- heat stress
- rapid fatigue
- impaired communications
- limiting vision
- false sense of protection
- overprotection

During explanation, trainees are encouraged to wear protective clothing and to get feeling about clothing. If possible, personnel who have experience of using the clothing should be invited and tell how the personnel felt during response works and by wearing protective clothing.

(7) Need to monitor personnel

Personnel engaged in HNS incident response may be exposed hazards of HNS without knowledge. Such personnel should be monitored in respect of:
- pulse rate
- body temperature
- skin color
- mental alertness
- blood pressure

- body weight/fluid balance

Explanation should be made about the need to monitor above conditions by using slides and video movies.

Lesson 8: International Legislation and Liability for Handling, Transportation & Storage of HNS

Explanation should be made on the followings:

(1) IMO-IMDG CODE

Gist of explanation should be as follows:
Works on the "transport by sea of dangerous and harmful goods" was initiated at the first Convention for the Safety of Life at Sea in 1914 in the aftermath of the Titanic disaster. A new Chapter VI was added to the 1948 SOLAS Convention specifically dealing with carriage of grain and dangerous goods. Following the establishment of IMO (then IMCO), carriage of dangerous goods was dealt with exclusively in Chapter VII of the revised 1960 SOLAS Convention. Further amendments were made to the revised 1974 SOLAS Convention on carriage of dangerous from 1981 through 1994. The revised Chapter VII, as amended in 1994, applies to all ships covered by SOLAS and also to cargo ships of less than 500 gross tonnages.

Through this lesson, participating trainees are lead to understand role, responsibility and primary goals of:

- operators
- supervisors
- lead agency
- industry
- local and central government
- other stake holders
- other participants in the event of an HNS incident

(2) The United Nations Convention on the Law of the Sea ("UNCLOS")

(3) The International Convention for the safety of Life at Sea ("SOLAS 74")

(4) The international Convention for Prevention of Pollution from Ships 1973/78 ("MARPOL")

(5) The International Convention on Oil Pollution Preparedness, Response, and Co-operation ("OPRC Convention")

(6) The Protocol on preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 ("OPRC-HNS PROTOCOL")

(7) The International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea, 1996 ("HNS Convention")

(8) Convention on the Marine Environment of the Baltic Sea Area, 1992 ("HELSINKI CONVENTION")

(9) Liabilities under the International Legislation

Following basic liability issue should be explained:

- Limitations of liability
- Compulsory insurance of the shipowner
- Aim of HNS Convention and HNS Fund

(10) International Standards for the Safe Carriage by Sea

- solid bulk cargoes (“BC CODE”)
- dangerous and noxious chemicals in bulk (“IBC CODE”)
- dangerous and noxious chemicals in bulk (“BCH CODE”)
- bulk liquefied gases and certain other Named substances (“IGC CODE”)

(11) International Maritime Dangerous Goods Code (“IMDG CODE”)

Lesson 9: Lecture about IMO-IMDG Visiting Website for reference and for gaining more knowledge

During course of this lesson, participating trainees are instructed to visit the following websites, books and multimedia files (Including CDs) for: further explanation, reports and discussion among trainees at a classroom.

- Economic Commission for Europe (ECE)
- International Association of Dry Cargo Ship-owners (Intercargo)
- International Cargo Handling Co-ordination Association (ICHCA)
- International Maritime Organization (IMO)

Learning from Books which should be recommended to trainees to read for further reference:

By reading the following books, trainees may be assisted to understand International Legislation fully:

- IMO 1994/1995 Amendments to the Code of safe practice for cargo stowage and securing
- IMO: Code of safe practice for cargo stowage and securing 1992 edition
- IMO: Dangerous, hazardous and harmful cargoes Compendium (T-110E)
- IMO: Multimodal dangerous goods form 1999 edition
- IMO: BC Code: Supplement 2001 to the 1998 edition
- IMO: Code of safe practice for ships carrying timber deck cargoes1991 edition
- IMO: Code of safe practice for solid bulk cargoes (BC Code). 1998 edition
- IMO: INF Code: International Code for the safe carriage of packaged irradiated nuclear fuel
- IMO: International Code for the safe carriage of grain in bulk (International Grain Code)
- IMO: International Maritime Dangerous Goods Code (IMDG Code)
- IMO: Recommendations on the safe transport of dangerous cargoes and related activities
- IMO: Recommendations on the safe use of pesticides in ships 1996 edition
- IMO: Wall chart: IMO dangerous goods labels, marks and signs

To assist trainees to understand contents of the lecture fully, it is recommended that the following multimedia Files of IMO additionally be opened and used for explanation:

- IMO: IMDG Code Available on CD-ROM (Version 5.0)IMDG Code
- IMO: IMO Labels and Symbols Available on CD-ROM IMO Labels and Symbols

Lesson 10: The ways in which HNS cargoes may be carried at sea

Lecture should be made to trainees about the ways in which HNS cargoes may be carried at sea, either in bulk or in packaged form. Common types of vessels, which carry HNS cargoes either in bulk, both liquid and solid, or in packaged form, should be explained by using slides, images and/or video clips.

After explaining types of vessels, types of maritime accidents, which may lead to release of HNS, should be described, and further, hazards associated with shipment of bulk liquid cargoes or bulk solid cargoes should be addressed.

During course of explanation, slides, and/or images, and/or video clips should be used as much as possible, so that the trainees may fully understand the risks and/or consequential damages resulting from maritime accidents.

Lesson 11: Case History

Lecture about various chemical incidents should be made by using slides, images, video movies with a view to helping trainees to understand serious effects of HNS incidents on environment and human life and importance of proper and timely response to the incident.

If possible, expertise who attended the case incident should be invited to make the supplemental lecture, and to make the total lecture as real as possible. Such case history as following Marine Casualties should be explained as precisely as possible.

(1) Mont Blanc (1917 – Halifax, Canada)
Explosion due to explosive cargo laden

(2) Yuyo Maru No.10 (1974 – Tokyo, Japan)
Explosion due to Collision and propane, butane cargo laden

(3) Grand Camp (1947 Texas City, USA)
Fire and Explosion due to explosive Cargo laden

(4) Tass (1994 Greece)
Stranding

(5) Multitank Ascania (1999 – GB)
Stranding Fire, Evacuation of the crew because of cargo Vinyl Acetate Flammable and polymerizable product laden

Establishment of a temporary 5km exclusion zone, necessitating the evacuation of 200 inhabitants. Reconnaissance by helicopter of the hot spots Onboard (risk of explosion) using the ship's IR camera.

(6) Brindsi incident

(7) Anna Broere Incident

(8) Levoli Sun incident (2000 – France)
Leakage at double bottom of the vessel. Cargo carried was styrene, methyl-ethyl-ketone and iso-propylic – alcohol.

As the vessel drifted ashore of Cote d'Amor, big risk of pollution was foreseen. Vessel was towed to a refuge but during towing vessel sank. Monitoring of the situation was continued by response team formed by and among the parties/countries concerned.

The response team monitored wreck hazard, surveillance of passing traffic & sea water quality and made a quick risk assessment by the technical team for further action. Wreckage investigation and decision based on the result & international norms in such cases for taking out remaining chemicals from the chambers of the tanker were carried out.

The response team also prepared for a possible toxic cloud, which luckily did not happen. The French authority called for support from the partners like British MCA, German Chemical / Oil response vessel etc. The communication among the response teams at site and authorities were maintained along with active mobilization of scientific expertise & activation of zone and national committees in this case. It was agreed that styrene and IFO chemicals would be pumped out, while MEK, IPA and diesel will be released in a controlled way.

The French navy and MCA controlled the activities. About 3000 m^3 of styrene and 88 m^3 of IFO recovered, with other products released.

(9) Andinet incident

Lesson 12: Contingency Plan

Lectures should be given to trainees about (A) Need for Contingency Plan, (B) Contents of a Contingency Plan, (C) Various measures to be taken to combat against HNS incidents, (D) Flow Chart to be made prior to making Contingency Plan, (E) Organizational Arrangements and (F) Response Measures to be taken on the scene in general.

Thousands of different chemical substances are transported by sea in bulk or in packaged form. The probability of an accident is limited but always present, as recent ship incidents involving HNS chemicals have shown. Dealing with individual chemicals during a chemical spill is complex and requires chemical expertise.

Through preceding lessons, trainees have understood that chemical substances can be grouped in behavior categories and hazard effect categories to facilitate decision making in the case of a chemical spill. This is in order to limit the number of standard response approaches to chemical spills.

The choice of the appropriate approach should be based on (i) short term behaviour of a spill released into the water and (ii) the potential hazards of a possible release.

(1) Need for a Contingency Plan
Contingency planning is essential for addressing to any kind of emergency. In case of chemical spill, a chemical contingency plan which is different from Oil spill contingency plan is required to be in place before hand.

In oil spill incident, primary effort is to contain spill recovery and cleaning the area of hydrocarbon. Contingency planning is equally necessary for any kind of transportation system whether it is pipeline, road transportation, rail transportation or vessel movement. Contingency plan should include the following items:

(a) Risk identification
I.e. physio-chemical properties like specific gravity, solubility in water, boiling point, freezing point, vapour pressure and density, fire and explosion hazardous data, health hazard data.

(b) Risk evaluation
Like site safety data, environmental effect data, containment action, abatement action, warning / evacuation

(c) Risk control

(d) Risk communication is essential

(2) Contents of Contingency Plan
Through this lecture, typical contents of a Contingency Plan, which consists of three sections as (i) Introduction and Strategy, (ii) Actions and Operations, and (iii) Data Directory are to be explained precisely by using slides, images, and/or video movies.

Main contents of (i) Introduction and Strategy, which need to be explained, are ①plan updates, ②purpose, ③scope, ④environmental policy, ⑤statutory requirements, ⑥interface and integration with other plans, ⑦risk assessment, ⑧facility information, ⑨response management, and ⑩waste management strategy.

Contents of the (ii) Actions and Operation section, which also need to be explained, are ①notification procedures, ②reporting procedures, ③control of operations, and ④design, contents and layout of Action Cards.

Contents of Data Section, are ①maps and charts of geographical coverage,②summary environmental information, ③equipment inventories, ④contact lists, ⑤suppliers details, and ⑥training and exercise programmes.

The lesson about Contingency Plan seeks to convey to trainee, who may possibly be the first responders or prevention officers, a sound understanding of the basic chemistry of hazardous materials so as to permit them to correctly assess the threat posed by hazardous materials incidents that may occur accidentally or through intentional means.

In order for trainees to clearly understand importance of Contingency Plan, the lesson should be made by using slides, images, graphics and video movies and explanation should be supplemented by the personnel who have experience in combating HNS spills.

The lesson should include interactive discussion among the participating trainees covering topics such as salts and inorganic no salts, hydrocarbons, hydrocarbon derivatives, and hydrocarbon radicals.

(3) Various measures to be taken to combat against HNS incidents

The activation of emergency measures depends on the nature of the chemical, the source location and the prevailing weather conditions. Measures taken at initial or critical phase may vary.

At least following typical measures for response should be explained:

(a) Containment, Protection and Recovery of HNS Released

In explaining this operation, types of operation, including shore-line cleanup operation, and equipment used should also be addressed.

Explanation should include such measures as

- use of sorbent
- in-situ burning

(b) Dispersion

(c) Biological Treatment

(d) Chemical Treatment

It should be told to trainees that possible integration with existing oil pollution plans may make contingency plan more effective through gaining effect of synergy and addition of extra resources.

As an example, response options to HNS incident at sea and in ports should be explained by using slides, images, and/or video movies as follows:

< Available response options at sea >

*vessel
- Extinguish fire
- Reduce or contain fire
- Move vessel
- Scuttle vessel
- Monitor

*cargo
- move cargo
- stop spill
- protect cargo
- destroy cargo
- immobilize cargo
- activate biological degradation
- monitor

*released HNS
- dispersion
- chemical treatment

・containment ・recovery
・biological treatment ・destroy
・immobilize ・monitor

< available response options in port >

*vessel

・extinguish fire ・reduce or contain fire
・move vessel ・scuttle vessel
・monitor

*cargo

・move cargo ・stop spill
・protect cargo ・destroy cargo
・immobilize cargo
・activate biological degradation ・monitor

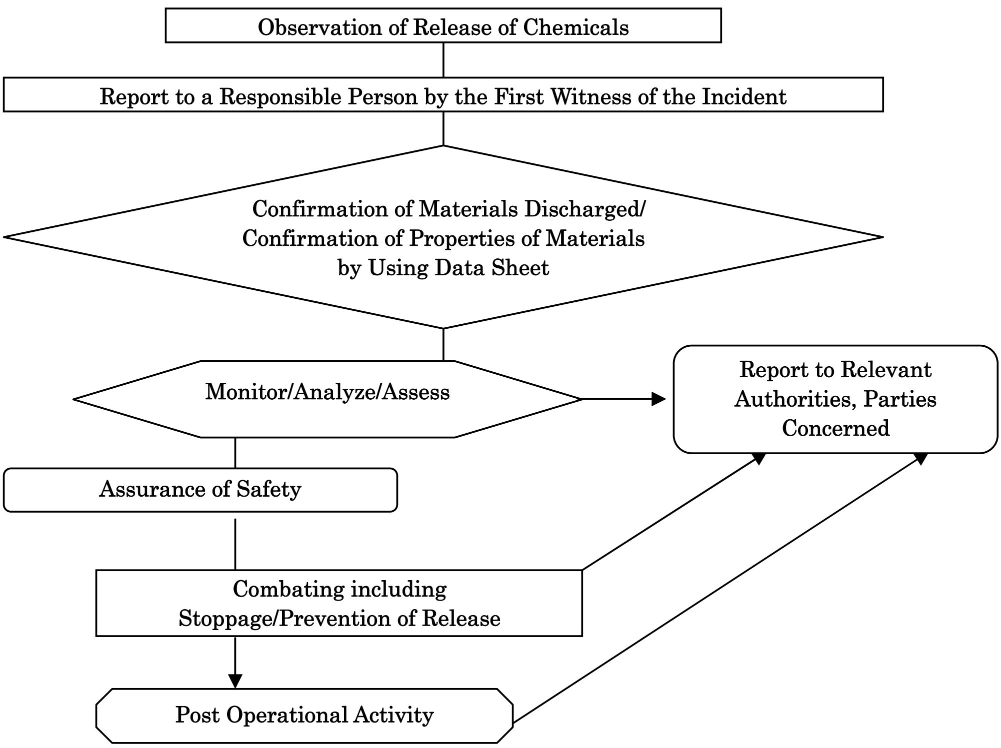
*released HNS

・dispersion ・chemical treatment
・containment ・recovery
・biological treatment ・destroy
・immobilize ・monitor

(4) Flow Chart

Flow chart should be the basis and integral part of Contingency Plan.

The following example of the basic flow chart should be explained for discussion among participants in the training course. Furthermore, after the explanation of example flow chart, trainees are instructed to prepare flow chart for each case of incident involving release of various categories of HNS.



(5) Organizational Arrangements

For effective response to the incident, emergency response organization should be established. During the course of above lecture about (d) Flow Chart, as an example, the following organizational arrangement for proper response to the HNS incident is to be explained.

Commander		
Name of Working Group	Role of the Group	Tools and Equipment
Commanding Group Monitoring/Assessing Group	Assisting Commander/Reporting to Authorities etc, Monitoring Analyzing Situation	Transceivers, Telescopes Speakers Remote Sensing Tools
Combating Group	Combat against accidents	Special Clothing Special Tools to protect human health

Emphasis should be made on the point that co-ordination and arrangement of equipment and tools for response is necessary for effective response, on-scene.

(6) Response Measures to be Taken on the Scene in General
As an example, the following explanation should be made to give trainees clear and proper idea about responding/ combating measure, in general:

(a) Importance of Monitoring and Analyzing Concentration Levels
Accurate information must be obtained as quickly as possible about the position of the casualty and about the type of substance released and its quantity. It should be stressed that the information stated hereinabove need to be confirmed after the first report.

The primary aims of a HNS spill response are to protect human health and safety and further to minimize environmental impacts; and to restore the environment, as far as practicable, to pre-spill conditions.

As the Analysis/Monitoring/Combating Procedures required to be followed as a step to respond to HNS incident may vary, pending Categories of Chemicals, explanation on the following typical measures taken at the initial stage, in general, are explained precisely by using slides and/or video movies:

(i) Stop or (partly) reduce release
The release can be either completely stopped or reduced. It should be clearly explained that this measure is one of the most effective response methods if it can be applied. Since hazardous substances may be involved, it should be clearly pointed out that response measures associated with the source of release may be particularly dangerous.

Stopping the release and transfer from the damaged tank/hold to an undamaged tank/hold or even to another vessel is one of the first options to consider.

(ii) Control release from source
Controlled release might be applied in order to reduce the dangers presented by the substance if there is risk of an uncontrolled release, methods applicable may include destruction/explosion of the package or destruction/explosion of the ship.

(iii) Containment/diverting substance:
Containment and diverting substances or packages from their course may enable easier collection of released substances. This method may also be used to prevent their further movement.

Methods applicable may include using containment booms or using chemical booms (herders).

It should be clearly pointed out to trainees that in the initial phase of the response, in the case of a ship accident in which chemicals are involved or potential losses in the marine environments are expected, the necessary measures need to be taken as quickly as possible in order to reduce or limit the effects.

(b) Response Plan in General

For trainees' guidance, Tiered Response approach and application of the tiered response approach to HNS incidents should also be explained to trainees as follows:

Tier one (local capability) Tier two (local mutual aid/co-operation) Tier three (national/international assistance)

In this session, response measures, in general, to be taken for the following categories of chemicals should be explained to trainees by using slides, images, graphics, and/or video movies.:

(i) Gases and Volatile Liquids

- Use of water sprays
- Monitor/Forecast dispensation
- Assessment
- Combating

(ii) Floaters

- Monitor/Forecast Spread:
- Assessment:
- Combating:

(iii) Dissolvers

- Monitor/Forecast
- Assessment
- Combating

(iv) Sinkers

- Monitor/Forecast
- Assessment
- Combating

(c) Arrangement of Safety Equipment

In explaining about combating against incident, trainees should be reminded that due consideration of effective health and safety strategy needs to be given.

In explaining about personal safety, the use of the following protective equipment and adoption of the following procedures are to be recommended.

While above recommendation to trainees on following equipment and clothing is important, at the same time, such drawbacks of the personal protective clothing as heat stress, rapid fatigue and claustrophobia should l be clearly explained to trainees.

(i) Respiratory Equipment

Respirators, self-contained breathing apparatus

(ii) Protective Clothing

Should have enough strength, chemical resistance, thermal resistance, flexibility, cleavability and ageing resistance

(d) Decontamination

As a post operational procedure, trainees should be lead to clearly understand.

(i) Decontamination

- by using such physical methods as sorption, vacuuming, dilution

and washing, and
- by using such chemical methods as chemical alteration, and
- isolation and disposal
- should be carried out

(ii) Condition of personnel involved in the HNS incident engaged in or including pulse rate and blood pressure should be monitored.

(iii) The following principle of decontamination should be explained precisely by using slides, images, and/or video clips.
- identification of level of decontamination required
- identification of supervision and control
- identification of work areas
  - exclusion zone
  - contamination reduction zone
  - support zone

(e) Disposal Options
The following management and disposal options for HNS waste should be clearly explained to trainees by using slides and video movies.
Principles of sustainable waste management including:

(i) Prevention and minimization

(ii) Recovery through reuse and re-cycle
- necessity of on-site temporary storage and storage medium
- separation of collected materials
- labeling and packing
- transport of recovered HNS including transport medium

(iii) Disposal Options including
- in-situ burning
- incineration
- wet air oxidation
- pyrolysis

(f) Post Operational Activity
In addition to explanation about Decontamination, the following post operational activity should be explained as precisely as possible by using slides, images and video movies.

(i) Monitoring of personnel involved in incident
(ii) Monitoring of response personnel
(iii) Monitoring incident site
(iv) Long term monitoring programme
(v) Debriefing of incident personnel
(vi) Compilation of incident report
(vii) Analysis of lessons learned

(g) Financial and Liability
Necessity to set up appropriate arrangements to cope with the incidents and possible consequential damages should be explained.

As an exercise and in order to grasp result of the lessons and to evaluate how trainees understood importance of contingency plan, question and answer session should be held at the classroom.

(h) Preparation of Stock List
In order to assure preparedness, trainees are trained to always prepare, keep and review stock list like the following example periodically.

Sample of Stock List of Equipment/Tools/Materials for HNS response

	Number of Available Materials	Condition of Materials	Number of Materials used	Number of materials to be replenished
Oil Fence				
Powder Oil Geltinizing Agents				
Polymers				
Gel Forming Foam				
Protective Clothing				
Skimmers				

(i) Preparation of a Contingency Plan

With a view to giving the last finishing touch to the training course at a classroom, and further to ensuring continued training, assuming an incident involving certain HNS at a certain place at certain condition, trainees are instructed to attend the table- top exercise of preparing flow chart and contingency plan for each incident of a contingency plan for the assumed condition.

Lesson 13: Coordination with Media

Media can be an effective medium to inform the public of and to communicate any essential safety advice. Handling media should be an important part of contingency plan in order to lead trainees to understand needs of media and to recognize when the media can help.

Apart from contingency plan, special lesson should be held, as one additional independent lesson because of the importance of the nature.

Main points of the lesson should be lecture about the following points and subsequent internal discussion among the trainees for clear understanding about media.

(1) Introduction of the common types of media and their requirements

- newspapers
- radio
- television
- internet

(2) Identification of factors involved in successful handling of media= Media Do's and Don'ts

- transparency
- factual information
- don't give intentionally false statements, lie or speculate
- don't contradict previous statements
- refrain from making statements that may give unrealistic expectations
- provide access to further information
- provision of technical information about the incident
- emphasize positive aspects of response, if possible
- explain the media handling person's (your) role and limits of knowledge and responsibility
- explain why you, the media handling person's (you) are too busy to help
- explain where media questions can be answered
- timely press briefings
- regular up-dates
- expect the unexpected
- remain on guard at all times
- there is no such term as "off the record"
- think before speak

- be polite at all times
- media facilities

(3) Preparations required before any contact with the media
- defining clear objectives
- understanding of what will concern the public
- develop key messages and points that need to be put across the media
- be sure of the facts
- plan the contact, write down important points and information
- use expertise where necessary
- appoint a coordinator to keep control of the interviews/press conference

(4) Factors required to control one-interview
- explain attending person's role and limits of knowledge and responsibility
- questions to be asked to reporters before going into interview
  - his/her name
  - his/her station (newspaper/TV/magazine/radio etc)
  - the angle or interest of his/her story
  - who else he/she is talking to
  - when the story will run/be aired
  - deadlines
- don't ramble, break attending person's words into small units
- refrain from use of technical jargon and acronyms
- leave out adjectives: small, large etc.
- expect the unexpected

(5) Main consideration for arranging press briefings
- regular up-dates
- the need to be conscious of media deadline
- these will vary depending on the media and their location
- ensure that the technical expertise is available
- ensure the participation of responsible authorities

(6) Use of press releases
- when and where to release information
- establish only one source/point of information
- what kind of information should be released
- only the facts
- do not speculate on any aspect of the incident
- try to emphasize positive aspects of the response measures taken
- always use understandable language, avoid industry terminology
- availability of background information
- publish the details of an inquiry route
- ensure all responders are aware of the details made available to the media

(7) Procedure and facilities required to establish media center
- location
- space and layout
- equipment such as faxes, phones, internet connection, etc.
- media tours and escorting

(8) Key points for effective News Conference
- be punctual
- make sure everyone is ready before making opening statement

The lesson should be conducted by using slides, images, and video. After the above lecture, in order to give trainees understanding about better handling of media, they should be instructed to discuss possible steps to handle the media internally at a classroom.

Section 4. Second Stage of Training ---- Field Practice

After finishing lessons at a classroom, a preliminary outdoor drill should be conducted at such place suitable for training as oil refineries, chemical factories, tanker berth.

This out door drill, by continuing the same periodically, may help trainees to keep spill preparedness and may assure proper and prompt response actions at the site of the incident and may further assure that the materials and equipment for response to the HNS incidents may be precisely handled and operated incase of an HNS incident.

Manual for HNS Training

Volume 2

Manager Level

MERRAC Technical Report No. 8

Section 1. Goal and Objective

This Manual Volume 2 supplements the Manual for Training Volume 1, and aims to bring trainees to managerial level, who can function as administrators and/or senior managers that can deal with incidents involving Hazardous and Noxious Substances(HNS) promptly, properly, effectively, and successfully. In order to qualify as a possible trainee to attend the Lessons, explained in this manual, possible trainees are required to review the contents of the Manual Volume 1 beforehand. With intent of giving lessons to trainees as clearly and easily as possible, use of following video movies, prepared and published by IMO, is strongly recommended.

In order to maintain the knowledge and skills obtained from this manual, it is recommended that field training should be conducted periodically, at least once a year.

Time Required to Complete the Training
It is recommended that the instructors complete each lesson, stated in this manual, within the duration set forth in the Manuals for Training HNS Manager Level Contents and Time Required. The entire training should be finished within two days.

Section 2. Lessons in Class Room

This section, lectures given in a class room, aims to give additional lessons to the possible managerial level candidates who may end up being administrators to cope with HNS incidents promptly and effectively.

Lesson M–1: Reconfirmation of Manual Volume 1

At the beginning of this lesson, review of the knowledge and skills gained by trainees concerning HNS in Volume 1 of this manual, more specifically, the understandings on following points should be covered.

(1) Symbol of chemical elements and periodic table
Example: "O" is the symbol of oxygen. "O_2" is molecular formula of oxygen. "H" is hydrogen.

Represents atomic number

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57-71 ランタノイド	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89-103 アクチノイド															
		57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	
		89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	

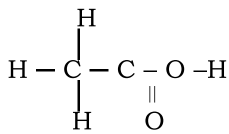
(2) Group of atom
Due to strong connection of atom forming a group, the group is transferred to other chemical products as it goes through chemical reaction.

Example: Methyl Group Molecular formula is “CH_3”. Hydroxyl Group Molecular formula is “OH”. Ethyl Group Molecular formula is C_2H_5.

(3) Chemical Formula

Trainees should learn about the following chemical formula, which shows the composition of chemicals.

- Molecular formula
  Example: Molecular formula of acetic acid is $C_2H_4O_2$.
- Constitutional formula
  Example: Following is the constitutional formula of acetic acid.



- Rational formula
  Example: Rational formula of acetic acid is “CH_3COOH”.

(4) Compounds

A substance formed by the chemical combination of two or more elements
Example: Ammonia “NH_3” is formed by nitrogen and hydrogen.

(5) Mixtures

Substance mixed through chemical reaction not through combination.
Example: Mixture of nitrogen dioxide “NO_2” and nitrogen oxide “NO”.

(6) Substances

Physical material which has discrete existence and matter

Lesson M–2: Introduction to HNS Response

It is important for trainees aiming for managerial level to know the current international legislation and liability regimes, and that they fully understand why such legislation and liability regimes have been developed. They must also know the responsibilities and requirements in managerial level to deal with HNS promptly and effectively. Also, trainess are to recognize that the aim of this lesson is to educate trainees to fully understand

- Role of IMO
- The legislation which affects carriage of HNS, and compensation and liability regimes inherent to HNS.

It is essential for manager level trainees to understand the necessity to comply with the International Legislation for safety and security of clean sea and oceans. For better understanding of the role, history, and purpose of IMO, it is recommended that video and other publications of IMO be used on the IMO website (http://www.imo.org/home.asp), which is visited frequently during the lesson.

(1) Definition of HNS

Although the definition has already been explained in Section 2 of Volume 1 of the manual, it should be clearly stated here again that the trainees for possible managerial level may reestablish their understanding to reinforce their abilities.

(a) Definition of HNS (per OPRC Protocol)

OPRC – HNS Protocol 2000 defines Hazardous and Noxious Substances as “Any substance other than oil, if introduced into the marine environment, is likely to be hazardous to human health, causing harm to living resources and marine life by damaging amenities and interfering with other legitimate uses of the sea". With this Definition, HNS shall include, but not limited to,

- oil derivatives
- liquid substances which are noxious and dangerous
- liquefied gas
- liquids with flashpoints not exceeding 60℃
- packaged dangerous, harmful, and hazardous materials
- solid bulk material with associated chemical hazards

(b) The Challenges and Dangers of HNS Response

In recent years, there has been rapid growth in the transport and storage of HNS. It should be clearly understood by the trainees that, if allowed to escape, the materials can present dangers to the ship's crew, the vessel coastal populations, and/or the environment. Public concern over the materials has grown, and both governments and industries have taken steps to address and respond to such HNS incidents, quickly and effectively. Trainees for managerial level should learn that marine spills, involving HNS, are not as frequent as oil spills, and may receive little publicity due to the less visible nature of HNS. It should be pointed to the trainees, however, that marine spills involving HNS are not rare.

Facts demonstrated by worldwide marine survey shall be shown to trainees in or order to explain that:

- There is a wide range of cargoes that should be considered as potential threats.
- Most accidents, mainly, involved two classes of HNS, to wit, flammable liquids, and corrosive materials
- Internationally, one to two major HNS accidents can be expected in each year
- History reveals that wide variety of ship types have been associated with HNS accidents
- Past HNS accidents were almost equally divided between "bulk" and "packaged goods"

For the purpose of successful handling of spills involving HNS and minimizing damages, careful planning is essential. Many factors that should be taken into account when preparing for HNS accidents, including a draw up of chemical spill plans, are similar to those plans required for oil spills. It is important to note that many countries have adapted their oil spill contingency plans to address chemical spill accidents. These countries have also relied on the same basic organizational arrangements, avoiding two separate response structures. With clear understanding about the wide range of chemicals and their diverse hazards and properties, industries concerned is required to train experts, within the industry, to ensure full observation of safe and practical procedures. It should, therefore, be clearly explained to trainees that differences may arise from a technical standpoint despite similarity in elements of the recommended preparedness and response for oil and HNS.

(c) HNS Incident

The lecture, then, proceed to the lecture about HNS with a view to reconfirming and further cultivating better understandings about HNS gained by trainees through lesson No.3 through 6 of the volume 1 of this Manual. The challenges and dangers of HNS incident can be broken down into following eight key areas:

(i) Operational

The main operational elements to include ;

- Safety
- Organizing people and resources
- Establishing a command organization/structure and command center
- Communication

- Planning
- Deploying equipment
- Logistics
- Cleanup, decontamination, and disposal

(ii) Political

It should be recognized that political factors can include both internal and external pressures. Trainees should understand clearly that internal pressure can come from other departments in the organization. Through this lesson, common understanding shall be promoted that external pressure may come from government, politicians, or various lobby groups.

(iii) Public pressures

It should be clearly understood that public pressures may also come from such affected groups as local fishermen, local business who rely on tourism, holiday makers, etc. Trainees should note that the public, as the local authorities, will have health concerns as well. Environmental organization will also apply pressure during an incident. For the purpose of better handling HNS incident, trainees for managerial level should be trained to recognize that there may be differing environments.

(iv) Health and safety

It should be understood that the local population and area could be affected by the carriage of HNS by both wind and tide.

(v) Environmental concerns

It is very important for trainees to recognize that the environmental concerns include:

- Health and safety of the public
- Need to minimize any secondary damages to the environment from the response effort
- Avoidance and prevention HNS spreading

(vi) Economic

It is important for those in managerial level to get full understanding about economic concerns that includes but not limited to damage to industry installations and financial losses that arise as a result of the spill.

(vii) Media

It is important for those in managerial level to recognize that the media will inevitably be part of the scene, and that they may also pose challenges for the response team as they will be constantly applying pressure for new information. Accordingly, a guideline must be established to communicate with the media on fair basis, and press release information shall be collated and released to the press on a regular basis.

(viii) Role of On-Scene Commander ("OSC")

For the purpose of effective and successful handling of HNS incidents:

OSC should be pre-designated in the contingency plan. Role of OSC is usually dependent on the organization. Normally, senior government aid or appointments are pre-designated as OSC. OSC is in charge of the response management for the spill and is also the response team leader and/or the co-coordinator of response activities. OSC is responsible for ensuring that the response is carried out in a safe, effective, and efficient manner. In order to fulfill such responsibility, OSC is responsible for response strategies and techniques that include people and equipment. Also, OSC should have the authority, both financially and organizationally, to deploy equipment and resources to the spill response site. Furthermore, OSC should have legal authority as defined by state's legislation. OSC should also have delegated emergency financial authority as well as the authority to direct other government departments and industries to respond. All in all, OSC is accountable for the entire response effort. The OSC, thus, shall be required to support decisions and costs relating to claims, and ensure that proper records are kept. They may also be required to support decisions and costs, in court.

(2) Nine Basic Steps in HNS Response

To complete this lesson, nine basic response steps or activities that describe what OSC must consider when responding to an HNS incident should be explained clearly so that the steps may be fully understood and recognized by trainees. These nine steps will form the basis of the response strategy which the OSC will be required to consider throughout the HNS response.

The nine steps are as follows:

(a) Assess the situation

- Report and document all incoming incidents. For easier reporting, use of standard reporting format is recommended.
- Identify type and source of the products involved
- Quantify the spill size
- Assess such hazards implications as fire and explosion, human health, shoreline type, or effects on a flora and fauna to ensure that actions are prioritized
- Identify the threats to people, environment, and facilities
- Actions to be taken in the response, needs to be prioritized
- The OSC shall identify the political and economic significance of the spill
- Gather samples or other supporting data sufficient to allow positive identification of the substances to take place

(b) Activate the contingency plan

- Inform the senior manager as per the organizational procedure and content of the plan.
- Notify appropriate authorities and key personnel according to the plan.
- Activate initial response, decide how, where and when. Coordinate identification and mobilization of initial response resources (personnel and equipment) as per the plan.

(c) Activate the organizational response according to the agreed strategy plan by

- Mobilizing and organizing the response team
- Identifying, assigning and delegating tasks
- Establishing both internal and external communication channels
- Set up a command post in an safe zone (site equipment, safety and security, procedures/resources)
- Implement safety, security and de-contamination procedures
- Notify, mobilize and co-ordinate contracted and sub contracted services
- Assess needs, define roles and execute contracts

(d) Prepare the response action plan and plan strategy

As step 4, managerial level should identify and prioritize resources at risk e.g. local populace, type of shoreline, local infrastructure.

- Identify the resources required taking into consideration the influence of the sea and weather conditions on the spill properties, the behavior of the HNS, spread rate and identify additional resources if necessary (e. g. regional/international agreements).
- Identify and prioritize response strategies, such as monitoring, containment and recovery, chemical treatment, shoreline cleanup, transfer and disposal.

- Maintain accurate records as required e.g. log and time keeping procedures for contractors and sub contractors, rented equipment, consumables.
- Develop response action plan to cover such items as resource time available, resources available, containment plan, and regular briefings on the response action plans.

(e) Activate the operational response

This step involves directing and supervising all monitoring, investigation, recovery clean up and decontamination procedures.

- Monitoring adherence to plans
- Coordinating containment, recovery, cleanup and decontamination procedures.
- Conducting regular briefings.
- Deploying personnel and ensuring logistical support

(f) Manage the ongoing response

This step involves gathering, assessing and adjusting response information, and interpreting and reviewing reports.

- Assessing, maintaining, advising, directing, and controlling response team activities and plan.
- Monitoring site safety plan and occupational hygiene
- Enforcing regulations and procedures.

(g) Deactivate the response

After taking step 6, it should be determined if the response should be continued, suspended or terminated and advise the OSC of such determination accordingly before making such determination.

- Rank the termination criteria, relevant to the operations. Use effort/ benefit analysis.
- Assess the potential for recontamination.
- Coordinate support to scientific monitoring of the area.
- Shutdown field operations and conduct an orderly termination of operations.
- Maintain, repair, and replace equipment as appropriate.

(h) Keep records and consolidate the costs

- Ensure that detailed records are kept.
- Verify / certify costs.
- Plan for recording and filing maintenance.
- Consolidate records and produce a report of expenditure by category.
- Produce cost documentation report.
- Construct simple coding structure, and produce a final cost report.

(i) Debrief and report

- Conduct operational review of the response with response teams and analyze strengths and weaknesses of the response.
- Conduct a review with the OSC and analyze strengths and weaknesses.
- Consolidate information, documentation and evidence.
- Submit and circulate the final operation report.
- Make and circulate recommendations for improved preparedness.
- Implement the lessons learned.
- Update contingency plan.

(3) Reminder

With this lesson, trainees for managerial level are led to understand the needs for pre-planning and response preparedness as follows:

< Structure and organization >

It is very important for trainees to clearly understand that an OSC and his team can only function effectively if provided with the structure and organization necessary to mount a response in a timely and appropriate manner, before HNS has a chance to affect the local populous or sensitive areas. It is important to be able to clearly explain this. However, this may not feasible due to the scale of emergency, the location, or the prevailing weather conditions. Also, it should be emphasized that the probability of small spills can be high, but with a rapid response, the damages they create can often be minor and their clean up costs relatively low. It is important to repeat that small spills are ugly and a constant reminder of the risks of much larger spills. Trainees are asked to remember that a good response to small spills will ensure an effective response to larger spills. Regardless of size, trainees should recognize that marine HNS spills tend to become unmanageable very quickly. The key for effective response is to have a comprehensive, realistic, and well exercised contingency plan, as well as a minimum amount of appropriate equipment. And, have a response organization of highly trained individuals who will react quickly, effectively, and knowledgeably.

Lesson M–3: International Legislation

(1) Role and work of IMO

(a) General

Picture of IMO Headquarter in London, and the symbol mark of IMO shall be shown to trainees to encourage feeling of intimacy with the IMO.

Explanation to trainees shall be made as follows:

IMO is the United Nations' specialized agency with the mandate for safe, secure, and efficient shipping on clean sea by way of improving maritime safety and preventing pollution from ships.

In 1999, the IMO's Assembly, at its 21st session, adopted resolution "A.900 (21) Objectives of the Organization in the 2000s", and confirmed the identification of IMO's main objectives for the 2000's as follows:

- Taking measures to implement the proactive policy, agreed in the 1990's, more actively than in the past, so that trends which might adversely affect the safety of ships and those on board and/or the environment may be identified at the earliest feasible stage so that actions may be taken to avoid or mitigate such effects. In implementing this directive, Formal Safety Assessment should be used to the fullest extent possible in any rule-making process.
- Shifting emphasis onto people.
- Ensuring the effective uniform implementation of existing IMO standards and regulations.
- Ensuring the early acceptance of those Annexes to the MARPOL Convention which has not yet entered into force.
- Developing safety culture and environmental conscience
- Avoiding excessive regulation.
- Strengthening the organization's technical cooperation programs.
- Promoting the intense efforts by the governments and industry to prevent and suppress unlawful acts that threaten the security of ships,

the safety of those on board, and the environment (in particular, terrorism at sea, piracy and armed robbery against ships, illicit drug trafficking, illegal migration by sea, and stowaway cases).
- Continue observing resolution A.500 (XII) Objectives of the Organization in the 1980's and resolution A.777 (18) Work methods and organization of work.

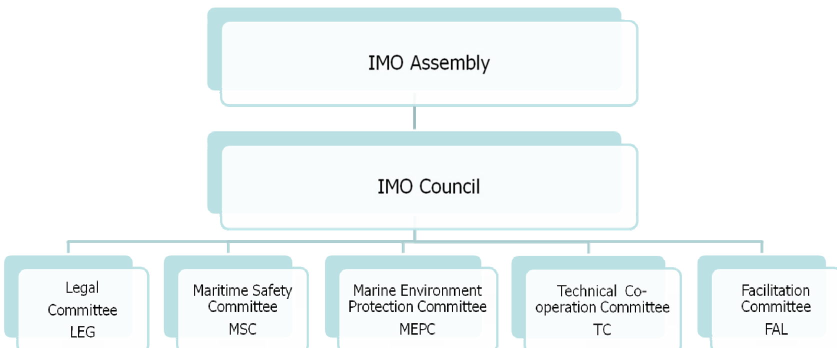
The resolution highlights the efforts of the Secretary-General to promote:
- The objectives of the organization (in particular, his decisive action and leadership towards enhancing the safety of ro-ro passenger ships and bulk carriers, and the expeditious revision of the STCW Convention).
- The world-wide implementation of the standards and regulations adopted by the organization (in particular, his efforts to ensure the wide and effective implementation of the revised STCW Convention, ISM Code, MARPOL 73/78, and the FAL Convention),

The resolution also notes that the special contribution of the World Maritime University, the IMO International Maritime Law Institute, and the IMO International Maritime Academy in achieving the IMO objectives.

(b) IMO Organization

IMO is based in the United Kingdom and has a history of over 60 years. IMO is a specialized agency of the United Nations with 168 Member States, 3 Associate Members, 65 Non-governmental organizations ("NGOs"), and 42 Inter-governmental organizations ("IGOs").

Also following IMO organizational Chart is to be explained:



Trainees should understand that IMO's specialized committees and sub-committees, stated in the above and below-mentioned organizational chart, are to focus on the technical work to update existing legislation and to develop and adopt new regulations, with meetings attended by maritime experts from Member Governments, together with those from interested inter-governmental and non-governmental organizations. It is essential for trainees to recognize that IMO has promoted the adoption of about 40 conventions and protocols, and may further adopt more than 800 codes and recommendations in order to achieve IMO's objectives. To become as a respectful managerial level with the capability to effectively handle HNS, trainees are required to understand the following Key Conventions and Codes for maritime safety and cleaner oceans.

(c) Key Conventions

Considerable quantities of hazardous and noxious substances are carried by sea each year. While ship safety has always been a priority, accidents can happen. HNS conventions are designed to protect life and the environment. When an incident does occur, it allows for compensation for actual damages caused, and improves the likelihood of victims of incidents to receive prompt and adequate compensation. Through this lesson, by visiting IMO's specific web-site related to the Convention (http://www.imo.org/Conventions/index.asp?topic_id=148), trainees are to be educated to recognize the contents, requirements, and objectives of the key conventions as follows:

- **The United Nations Convention on the Law of the Sea ("UNCLOS")**
  The United Nations Convention on the Law of the Sea (UNCLOS) lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources. It enshrines the notion that all problems of ocean space are closely interrelated and need to be addressed as a whole.

- **Safety of Life at Sea ("SOLAS")**
  The SOLAS Convention, in its successive forms, is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The first version was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948, and the fourth in 1960.

- **International Convention for the Prevention of Pollution from Ships, 1973/78 ("MARPOL")**
  The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships in operation or by accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively that had been updated by amendments throughout the years. The MARPOL Convention was adopted on 2 November 1973 at IMO and covered pollution by oil, chemicals, harmful substances in packaged form, and sewage and garbage. The Protocol of 1978 relating to the 1973 International Convention for the Prevention of Pollution from Ships (1978 MARPOL Protocol) was adopted at the Conference on Tanker Safety and Pollution Prevention in February 1978, in response to spate of tanker accidents from 1976 to 1977. Measures relating to tanker design and operation were also incorporated into a Protocol of 1978, which in part was related to 1974 Convention on the Safety of Life at Sea. As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent Convention. The combined instrument is referred to as the International Convention for the Prevention of Marine Pollution from Ships 1973, as modified by the Protocol of 1978 relating thereto (MARPOL), and it entered into force on 2 October 1983 (Annexes I and II).

  Trainees are asked to remember that the MARPOL Convention now has following Annexes:

Annex	Description
I	Regulations for the Prevention of Pollution by Oil
II	Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
III	Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
IV	Prevention of Pollution by Sewage from Ships
V	Prevention of Pollution by Garbage from Ships
VI	Prevention of Air Pollution from Ships

The MAREPOL Convention includes regulations aimed at preventing and minimizing pollution from ships by the way of accidental pollution and from routine operations. Currently, six technical Annexes are included. While State's Parties must accept Annexes I and II, the other Annexes are voluntary.

- **International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 ("OPRC Convention")**
  In July 1989, a conference of leading industrial nations in Paris called upon IMO to develop further measures to prevent pollution from ships. This call was endorsed by the IMO Assembly in November of the same year and work began on a draft convention aimed at providing a global framework for international co-operation in combating major incidents or threats of marine pollution. This Protocol, which entered into force May 1995, created a global framework for international co-operation in combating major incidents or threat of marine pollution. The Convention provides for IMO to play an important co-ordinating role. Parties to this Convention are obligated to ensure that their ships, offshore units, ports, and oil handling facilities shall have appropriate oil pollution emergency plans which must be co-ordinated with national systems for responding promptly and effectively to oil pollution incidents. Parties are also obligated to ensure that they implement a reporting system for all sightings, discharges, or probable discharges of oil and the subsequent response actions that are then to be taken. Parties to this Protocol are obligated to establish following measures to deal with pollution incidents, either nationally or in co-operation with other countries.
  - Oil pollution emergency plans.
  - Reporting procedures and actions.
  - Establishment of response equipment, exercises, training, communication, and response.

  Parties to this convention are further required to provide assistance to others in the event of a pollution emergency, and provision is made for reimbursement of any assistance provided. The Convention further calls for the establishment of stockpiles of oil spill combating equipment, the holding of oil spill training and combating exercises, and the development of detailed plans for dealing with pollution incidents.

  OPRC Convention has 19 articles. To confirm trainees' understanding about OPRC Convention, following important key articles appearing on OPRC Convention are explained during the lesson.
  - Article 3 – Oil pollution emergency plans: Parties to the convention shall require that ships, offshore units, ports, and oil handling facilities shall have approved oil spill emergency plans, which are coordinated with the national system under Article 6.
  - Article 4 – Oil pollution reporting procedures: Parties shall require any releases, probable releases of oil, or any sightings of pollution to be made to the appropriate authorities. This includes their vessels, offshore units, ports, overflying aircraft ships, or offshore units flying their flag anywhere in the world.
  - Article 5 – Action on receiving an oil pollution report: Whenever a party receives a report under Article 4, they shall assess the event, the nature and extent, and possible consequences, and then notify without delay all states whose interest are affected or are likely to be affected. If the incident is severe, the party shall also notify IMO directly or through one of their regional organizations.
  - Article 6 – National and regional systems for preparedness and response: Each party shall establish a national system for responding promptly and effectively to oil pollution incidents. They shall also establish a minimum level of equipment, programme of exercises and training, detailed plans and communications, and a

co-ordinating mechanism.
- Article 7 – International cooperation in pollution response: Parties agree that, subject to their capabilities and the availability of relevant resources, they will cooperate and provide advisory services, technical support, and equipment, if so requested.

For trainees' easier understanding and to further educate their staffs under their control, it should be explained to trainees that a booklet describing the OPRC Convention is published by IMO, and the trainees are recommended to get one from IMO and to always keep it on their desks.

- **Protocol on Preparedness, Response, and Co-operation to pollution incidents by Hazardous and Noxious Substances ("OPRC – HNS Protocol 2000")**
It is imperative for those in managerial level to clearly recognize that this Protocol on Preparedness, Response, and Cooperation to Pollution Incidents by Hazardous and Noxious Substances 2000 (OPRC-HNS Protocol) follows the principles of the International Convention on Oil Pollution Preparedness, Response, and Co-operation 1990 (OPRC), and extends the same to HNS substances. This Protocol was formally adopted by States already party to the OPRC Convention at a diplomatic conference held at IMO headquarters in London, in March 2000. The Protocol entered into force on June 14, 2007. Before getting the lesson, attending trainees are required to purchase and read the IMO publications describing the OPRC HNS Protocol as the very basic text of the lesson.

Among 18 articles contained in the protocol, following three articles constitute the key points, which managerial level people are required to always keep in their minds, are:
- Article 3 – **Emergency Plans and Reporting**: Parties to the convention shall require that ships, offshore units, ports, and hazardous and noxious substances handling facilities shall have approved pollution incident emergency plans, which are coordinated with the national system under Article 4.
- Article 4 – **National and Regional Systems for Preparedness and Response**: Each party to the convention shall establish a national system for responding promptly and effectively to pollution incidents. They shall designate a national competent authority, national operational contact point(s), and an authority entitled to act on behalf of the state. In addition, parties are to establish a minimum level of equipment, program of exercises and training, detailed plans and communications, and a coordinating mechanism.
- Article 5 – **International cooperation in pollution response**: Parties to this convention agree that according to their capabilities and the availability of relevant resources, they will cooperate and provide advisory services, technical support, and equipment, if so requested.

(d) International Standards
After full recognition of the important protocol and convention, trainees are required to learn the exist key international standards which govern the transport of HNS, which are important for successful implementation of the protocols It is imperative for trainees to fully understand IMO's responsibility for producing and keeping up to date other important codes that deal with the operational provisions related to vessels that transport dangerous goods. The codes are developed by the committees created under IMO Council with specific assignment. The purpose of the codes is to recommend suitable design criteria, construction standards, and other safety measures for ships transporting liquefied gases, dangerous and noxious liquid chemicals, and certain other substances in bulk so as to

minimize the risk to the ship, its crew, and the environment. At the least, managerial level people should understand following codes:

(i) **Solid Bulk Cargoes (BC Code) -** Code of Safe Practice for Solid Bulk Cargoes

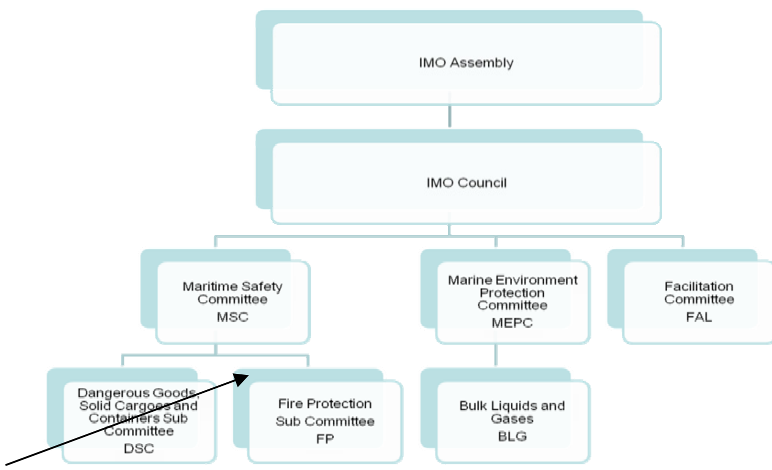
(ii) **Dangerous and noxious chemicals in bulk (IBC Code) -** International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk. This is dependent on when the vessel was built. This applies to chemical tankers build after July 1st, 1986.

(iii) **Dangerous and noxious chemicals in bulk (BCH Code) -** Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk. This is dependent on when the vessel was built. This applies to older chemical tankers, constructed before July 1st, 1986

(iv) **Bulk and Liquefied Gases (IGC Code) -** International Code for the Construction and Equipment of Ships Carrying liquefied Gases in Bulk. This is dependent on when the vessel was built. This applies to gas carriers constructed after July 1st, 1986. Other codes exist for ships constructed between December 1976 and July 1986, and before December 31st, 1976, for gas carrier.

(v) **The International Maritime Dangerous Goods (IMDG) Code** was developed as a uniform international code for the transport of dangerous goods by sea covering such matters as packing, container traffic, and stowage, with particular reference to the segregation of incompatible substances.

For clear understanding by trainees about role of committees and sub committees, as an example, following part of IMO Organisation Chart shall be shown to trainees as follows:



DSC shown in the bottom of the above chart is the special sub committee with the assignment for daily developing IMDG Code and is made up of members of IMO that have adopted the IMDG Code along with non-governmental organizations accredited to IMO with consultative status.

(e) GESAMP

It should be explained to trainees that, in addition to the above mentioned conventions and codes, within the IMO Organization exist groups of experts who plays important role for successful function of IMO. During this lesson, to fully and correctly understand the international legislation, trainees for managerial level are given an overview of the expert group that plays an important role in the Marine Environmental

Protection, as follows:

Group of Experts on Scientific Aspects of Marine Environmental Protection ("**GESAMP**")

- GESAMP is an advisory body, established in 1969, that advises the United Nations (UN) system on the scientific aspects of marine environmental protection. GESAMP itself consists of 25-30 experts, drawn from a wide range of relevant disciplines, each of whom acts in an independent individual capacity. At present GESAMP is jointly sponsored by eight UN organizations (IMO, FAO, UNESCO-IOC, WHO, IAEA, UN, UNEP) with responsibilities relating to the marine environment as a mechanism for coordination and collaboration within themselves. GESAMP has functions to conduct and support marine environmental assessments, and to undertake in-depth studies, analyses, reviews of specific topics, and identify emerging issues regarding the state of the marine environment.

- The task of GESAMP is
  - To provide advice relating to the scientific aspects of marine environmental protection.
  - To prepare periodic reviews and assessments of the state of the marine environment and to identify problems and areas requiring special attention.

(f) Compensation and Liability Regimes

Without understandings about compensation and liability regimes, effective and successful handling of HNS incidents can not be achieved. To complete this lesson, in addition to an overview about international legislation, trainees are given an overview of Compensation and Liability Regimes relating to oil and HNS, as follows:

(i) Oil

- International Convention on the Establishment of an International Fund for Compensation for Oil Damage, 1971 (**Fund Convention**)
- Protocols to the International Convention on Civil Liability for Oil Pollution Damage 1969 (**CLC**)

(ii) HNS

- 1996 International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances (**HNS Convention**)

Liability and compensation regimes for oil pollution incidents are covered by the 1992 Protocols to the International Convention on Civil Liability for Oil Pollution Damage, 1969, and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971. In 1996, IMO adopted the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances (HNS) by sea, which provides for compensations and liability regime for incidents involving these substances (it has not yet entered into force).

In order to avoid misunderstandings and to deal with HNS incidents effectively, trainees should take note that the definition of HNS, as defined by the OPRC-HNS Protocol 2000, differs widely from the definition of an HNS under the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances (HNS) by sea, (commonly known as the "HNS Convention" in the shipping industry). In the HNS Convention, HNS is defined in reference to lists of substances included in various IMO Conventions and Codes. These include oils (other liquid substances defined as noxious or dangerous), liquefied gases (liquid substances with a flashpoint not exceeding 60°C), dangerous, hazardous, and harmful materials and substances carried in packaged form, and solid bulk materials defined as possessing chemical hazards. The convention also covers residues left by the previous carriage of HNS, other than those carried in packaged form. For the sake of order, HNS Convention shall be explained again to trainees as follows:

(g) HNS Convention
It needs to be explained to trainees that the HNS Convention is created by modelling the existing regime for oil pollution from tankers. The purpose of the HNS Convention is to provide an adequate, prompt, and effective compensation for loss or damage to persons, property, and the environment in connection with the carriage of HNS by sea. The HNS Convention covers both pollution damage and damage caused by the risk incidental to the HNS incident, such as fire and explosion. Under the HNS Convention, trainees are to recognize that a ship owner is liable for the loss or damage up to a certain amount, which is covered by insurance (1st tier). A compensation fund called "HNS Fund" will provide additional compensation when the victims do not obtain full compensation from a ship owner or their insurer (2nd tier). The HNS fund will be funded by those companies and other entities which receive HNS after sea transport in a member state in excess of the threshold laid down in the convention. The convention introduces strict liability for ship owners and a system of compulsory insurance and insurance certificates. The ship owner is normally entitled to limit his liability under the HNS Convention to an amount calculated on the basis of the units of gross registered tonnage. It should be noted that the HNS Fund account, at the time of full operation, will have four accounts: oil, liquefied natural gas, liquefied petroleum gas, and a general account with two sectors – bulk solids and other HNS. The HNS Convention will enter into force eighteen months after ratification by at least 12 states, subject to certain conditions.

(h) Questions and Answers for consolidation purposes
To confirm trainees' understanding of this lesson, it might be desirable for the instructor to ask a trainee to explain about such important protocol as MARPOL and OPRC HNS Protocol.

Lesson M–4: Chemical Substances

(1) Purpose of this lesson
This Lesson is developed with a view to give trainees an introduction to chemicals' behavior, particularly with an insight into how HNS behave when they are released into the environment. By attending this lesson, trainees will understand and appreciate the hazards posed in the event of an accident. For such purpose, trainees shall be educated to be able to:
(a) Describe the physical properties of HNS in general.
(b) Describe HNS by their hazard and behaviour groupings.
(c) Explain the types of chemical reactions and incompatibilities.
(d) Explain the toxic effects of HNS.
(e) Explain the environmental effects of HNS.
(f) Have description about the work of GESAMP and the GESAMP classification guide.

This lesson will help trainees in managerial level to recognize the dangers and hazards of HNS exposure, and the effect that HNS has on both humans and the environment. This will assist those in managerial levels to make the proper and timely decisions in case of HNS incident.

(2) Physical Properties of HNS
For clear understanding by the trainees in managerial level, lecture shall be made with an overview of physical properties of HNS. It should be stressed to

trainees that effective and successful handling of HNS incident can not be achieved without the clear understanding about the properties of HNS. Detailed explanation about physical properties is required so that the trainees may understand that chemicals are identified and characterized by their properties. Physical properties are used to assist in the classification of substances. These properties include the followings:

(a) Density

It should be a general understanding that all matters including solids, liquids, and gases have a density. The density of a substance is determined by dividing its mass (weight) by the volume it occupies. The higher the resulting number the more dense the substance, and the lower the number the less dense. As the density of a substance can vary with temperature, density values are generally quoted with a temperature. Relative density is the comparison of the densities of different substances.

(b) Solubility

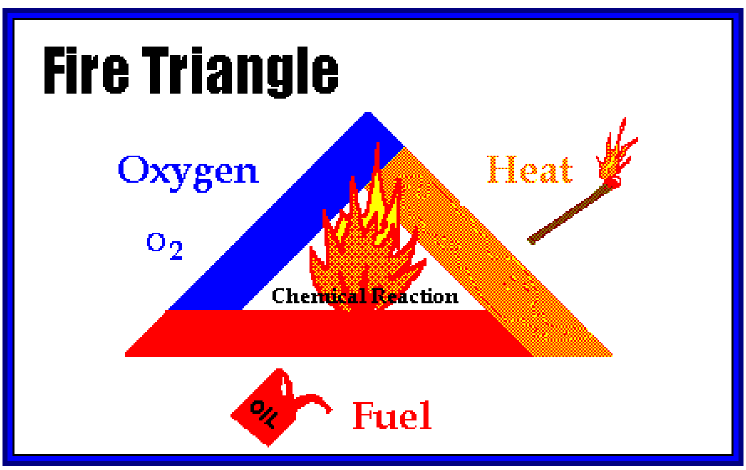
When a solid or a gas (solute) dissolves in a liquid a solution is formed (also known as a homogeneous mixture because it has the same constituents throughout i.e. totally mixed). The degree to which a solid dissolves is temperature dependent, generally hotter the solvent the more the solute will dissolve. The reverse is true of gases. The point at which solute will no longer dissolve is known as a saturated solution. This temperature/saturated solution effect is the reason why some solutions deposit crystals when they are stored at lower temperatures than that at which they were made.

(c) Miscibility

If two liquids are mixed completely to form a solution, it is said that the two liquids are miscible (e.g. ethanol), or acetone, a miscible with water. Some liquids will only partially mix and these are said to be partially miscible. Others will not mix and they are said to be immiscible (e.g. oil and water).

(d) Combustibility

This describes the ability of a material to burn under normal conditions. For combustion to occur, oxygen, fuel and an ignition source must be present. In the international standards, this is commonly referred to as the Fire Triangle or **Combustion Triangle**. This is a simple model, for easier understanding, by the practitioners of firefighting of the ingredients necessary for most fires, are as follows:



(e) Flammability

This describes the ease in which a material will ignite, either spontaneously from exposure to a high temperature, or from exposure to a spark or open flame. The flammability of a material can be described by the following properties.

(f) Vapor Pressure
This is the substance's ability to form vapor. The higher a substance's vapor pressure, the more it tends to evaporate.

(g) Flash Point
This is the lowest temperature a substance at which its vapors will ignite and burn when exposed to an ignition source, without self-sustaining combustion. The lower the flash point of a liquid, the easier it is for ignitable concentrations of vapor to exist. A substance cannot be ignited below its flash point. Brandy, for instance, has a flashpoint of about 30oC, hence the reason for warming it prior to lighting it.

(h) Fire Point
The fire point is the lowest temperature, at which a substance once ignited will continue to burn without any additional source of energy.

(i) Lower Explosive Limit (LEL) or Lower Flammable Limit (LFL)
This limit is the minimum concentration of a gas (or vapor) in air that will ignite and propagate a flame. It is expressed as a percentage, by volume of gas in air. If the gas percentage is below the LEL, the atmosphere is described as being "too lean" to burn.

(j) Upper Explosive Limit (UEL) or Upper Flammable Limit (LFL)
This is the maximum concentration of a gas (or vapor) in air that will ignite and propagate a flame. It is expressed as a percentage, by volume of gas in air. If the gas percentage is above the UEL, the atmosphere is described as being "too rich" to burn.

(k) Flammable Range
The difference between the upper and lower flammable limits is defined as "Flammable Range."
When the gas (or vapor) to air ratio is between the LEL and the UEL, fires and explosions can occur and the mixture is said to be within the flammable range.

(l) Auto-Ignition Temperature
This is the lowest temperature at which spontaneous combustion of a substance begins in the absence of any spark or flame. The closer the substances' temperature approaches its auto-ignition temperature, the greater the risk of a fire or explosion.

(m) Explosivity
This describes the ability of a substance to react rapidly to produce high local temperatures and to generate large volumes of gases. When a flammable material is limited to a confined area and ignited, an explosion will occur.

(n) Toxicity
This is the ability of a material to inflict damage to living tissue, to impair the central nervous system, cause severe illness, or, in extreme cases, cause death when inhaled, ingested, injected, or absorbed by the skin

(o) Reactivity
This describes the ability of a material to change chemically. Chemical reactions may be endothermic (requiring external heat to keep them running) or exothermic (creating heat in the process).

(p) Corrosivity
This describes the ability of a material to cause electro-chemical

degradation of metals or alloys. It also describes the destruction of body tissues by acids or alkalis

(q) Radioactivity
This is the ability of a substance to emit alpha-beta particles or gamma radiation.

(3) Chemicals by Hazards Groupings

Through this lecture, it is required for managerial level trainees to understand ways a chemical can behave to harm life or the environment. This is very important, simply, because an accident involving HNS may result in an uncontrolled release of a product, potentially damaging to life, the environment, or property. How this release affects the people and the environment depends on the characteristics of the chemicals involved, how much HNS has been released, how vulnerable the surrounding area is, and how effective the emergency measures taken to minimise the effect of the spill is the main point that the managerial level is required to assess at time of the HNS incidents. Chemicals can be grouped, depending on the way they behave, when they are spilled onto water.

Generally they react in following four different ways:
(a) Evaporator – evaporate rapidly when in contact with the water surface
(b) Floater – float on the surface
(c) Dissolver – dissolve rapidly in water
(d) Sinker – sinks to the bottom

Based on the above mentioned ways of behavior chemicals are classified and described. A chemical could behave in more than one of the above mentioned ways. For easier understanding by the trainees, it is recommendable that instructors explain symbol marks that appear in Council Directive 67/548/EEC of 27 June 1967 concerning the approximation of laws, regulations, and administrative provisions relating to the classification, packaging, and labeling of dangerous substances (as amended). This directive is commonly adopted and enforced as a law in the European countries.

In order to better assist their comprehensive understanding, after the above mentioned lecture about the simplified behavior groupings, full classification consisting of five behavior groups and twelve behavior subgroups shall be explained as follows:

- **gas**
  - gas
  - gas / dissolver
- **evaporator**
  - evaporator
  - evaporator / dissolver
- **floater**
  - floater / evaporator
  - floater / evaporator / dissolver
  - floater / dissolver
- **dissolver**
  - dissolver
  - dissolver / evaporator
- **sinker**
  - sinker
  - sinker / dissolver

Additional explanation shall be made that packages can also be considered to fall into three subgroups as a follows:

- **package**
  - package / floater
  - package / immersed (intermediate. not floating nor sinking)
  - package / sinker

(4) Toxic effects of hazardous/noxious substances

It is important for trainees to recognize that HNS is capable of causing both short term and long term damages to both humans and the environment. Therefore, trainees must always keep in their minds that the initial response to HNS incidents should be to protect human life and health. Trainees should be reminded that the toxic hazard posed by a released material will depend on a number of factors, therefore, must be trained to always determine before starting response to HNS incident, following points:

- The amount spilled
- The number of chemicals involved in the spill
- The time frame over which the spillage occurs (e.g. instantaneous or continuous)
- The properties of the chemical
- The path of exposure into the body
- The concentration and duration of exposure
- The stage of development of an individual and their current condition
- The prevailing meteorological conditions

With the above understanding in their mind, trainees will become accustomed to considering the factors that determine the level of hazards from a toxic spill. For clear understanding by trainees about the chemical behavior groupings, in the lecture, IMO Video “Response to Marine Chemical Spills” Part 2 Assessment and Analysis shall be demonstrated.

(5) Toxic effects of hazardous/noxious substances

Important points for trainees in this lesson is that there are four primary ways in which a substance can make it’s way into the body. For easier understanding by trainees about the toxic effects on the human body, video or pictures prepared by IMO, which demonstrates 4 primary routes, i.e. (a)inhalation, (b)ingestion, (c)skin and eye contact, (d) injection shall be shown to the trainees with following remarks:

(a) Inhalation

The major route of entry for gases and particles into the human body. Human body has several warning mechanisms that can be used to let human beings be aware that a hazard is present. Warning mechanisms include smell, sneezing, coughing, and a runny nose. The body can filter out some normal pollutants but it cannot eliminate everything. Smaller particles are more difficult to eliminate. Chemicals, when they are inhaled, may target and damage other organs as well as the lungs.

(b) Ingestion

Ingestion occurs when a hazardous agent is swallowed. Some of these ingested agents may be destroyed or neutralised by acid in the stomach. However, some can be absorbed rapidly into the blood stream. Trainees are to be educated to understand that ingestion should not be of concern when proper protective clothing is used and adequate hygiene and decontamination procedures are followed. However, it should be remembered that ingestion of contaminated food and water may present a risk for the local populations following the release of HNS. The body tries to remove certain toxic substances from the digestive system by vomiting or diarrhoea, however, these mechanisms cannot remove all ingested agents from the body as they are evidence of ingestion of chemical and biological agents, so therefore, they must be investigated.

(c) Skin and Eye Contact

Skin is an important protective cover for the body, but it cannot always protect human body against work place hazards. This is because chemicals can be absorbed directly into the body, even though healthy skin. When they are in the bloodstream, they can be transported to internal organs with damaging effects. They may also damage the surface of the skin by burn or causing skin conditions such as dermatitis.

(d) Injection

Chemicals can also enter the bloodstream by puncture or cut in the skin. This is known as injection.

(6) Exposure limits

After the release of toxic gas or vapor into the atmosphere, it should be determined by those in the managerial level what concentration of the release can be tolerated by the exposed population. This will determine the extent of the exclusion zone and the response strategy. Those in the managerial level should note that this toleration is called the exposure limit.

Terminology of Threshold Limit Values ("TLV") or otherwise known as maximum accepted concentrations ("MAC") should be explained and understood by the trainees. TLV reflects the level of exposure for airborne gases and vapors a typical worker can experience without an unreasonable risk of disease or injury. These are published by various government agencies and are readily available.

Another important terminology is the immediate danger to life or health (IDLH). This is another exposure limit which describes an atmosphere that is an immediate danger to life or health, and would pose an immediate threat to life, and cause irreversible adverse health effects. This would also impair an individual's ability to escape from a dangerous situation. IDLH limits were originally created to assist in making decisions regarding respirator use. Two factors are considered in regards IDLH limits. Workers must be able to escape such an environment without suffering permanent health damage, and workers must be able to escape without severe eye or respiratory tract irritation or other conditions that might impair their escape.

(7) Environmental Effects

Trainees for managerial level should be educated repeatedly about environmental effects of HNS incidents as this is one of the most important points to be constantly considered in the HNS handling. It is essential for those in managerial level to know that assessing the impact of substances in the marine environment needs to take account not only of the toxicity to marine life, but also the persistence of the substance that has the potential to bio-accumulate and other potential to disrupt marine activities through tainting of fish or closure of beaches.

Those in the managerial level should be educated to fully understand the various biotic and biotic processes that can modify the toxicity of HNS, and that this point must be considered in the planning for the chronic hazards. It should be important for trainees to remember that the concentration, distribution, transformation, and long-term fate of a substance in the marine environment are primarily controlled by the following factors:

- The rate of release of the substance into the environment.
- The physic-chemical properties of the substance.
- The physic-chemical, meteorological, and oceanographically conditions of the environment, and the biodegradation and biotransformation properties of the ecosystem.

Trainees should note that these factors will affect the availability of the toxic substance to the organisms (bioavailability). To assist their clear understandings about environmental effects, an overview of the factors affecting the concentration of some substances shall be demonstrated by showing the factors in a diagram. Also, managerial levels are required to get the full knowledge about MARPOL Classification as the revised Annex II of MARPOL regulates the control of operational pollution from noxious liquid substances in bulk and provides information on the dangers presented. Noxious liquid substances carried in bulk, under the revised Annex II of MARPOL, are classified into following four pollution categories, according to the hazards they present to marine resources, human health, and amenities.

(a) **Category X major hazard**
Substances deemed to present a major hazard to either marine resources or human health, therefore, justifying the prohibition of the discharge into the marine environment.

(b) **Category Y hazard**
Substances deemed to present a hazard to either marine resources or human health, or cause harm to amenities or other legitimate uses of the sea. It, therefore, justifies the limitation on the quality and the quantity of the discharge into the marine environment.

(c) **Category Z minor hazard**
Substances deemed to present a minor hazard to either marine resources or human health. It, therefore, justifies less stringent restrictions on the quality and quantity of the discharge into the marine environment.

(d) **Category OS no harm**
Other substances considered to present no harm to marine resources, human health, amenities, or other legitimate uses of the sea.

Pollution categories, under the revised Annex II of MARPOL 73/78, are based on hazard profiles for chemicals transported in bulk at sea. "GESAMP", Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection, has developed the evaluation procedure to assign hazard profiles, and such profiles were adopted in 2003. Following explanation about GESAMP and its recommending classification shall be made.

(8) GESAMP and GESAMP classification

As explained before, the Group of Experts on Scientific Aspects of Marine Environmental Protection (GESAMP) is an advisory body established in 1969 to advise the United Nations (UN) system on the scientific aspects of marine environmental protection. At present, it is jointly sponsored by eight UN organizations (IMO, FAO, UNESCO-IOC, WHO, IAEA, UN, UNEP) with responsibilities relating to the marine environment as a mechanism for coordination and collaboration between them. GESAMP functions are to conduct and support marine environmental assessments to undertake in-depth studies, analyses, and reviews of specific topics, and to identify emerging issues regarding the state of the marine environment.

Their task is to:

- To provide advice relating to the scientific aspects of marine environmental protection.
- To prepare periodic reviews and assessments of the state of the marine environment and to identify problems and areas requiring special attention.

Ideally, GESAMP consists of 25-30 experts drawn from a wide range of relevant disciplines, who act in an independent individual capacity. GESAMP have produced hazard evaluation procedures, which contains criteria for evaluating the hazards of chemical substances that enter the marine environment through operational discharge, accidental spillage, or loss overboard from ships. Both hazards to the people and the environment are considered. This information is collated into a hazardous profile, which breaks down the hazard characteristics for each substance. Trainees are required to note that the hazard evaluation procedure is broken down into five categories, as follows:

(a) **Bioaccumulation and Biodegradation –** Bioaccumulation refers to a process when substances increase in concentration in living organisms as they take in contaminated air, water, or food because the substances are very slowly metabolised or excreted. Low values of log Pow or BCF indicate low bioaccumulation potential. Biodegradation is the ability of a substance to be broken down, usually through the metabolic action of microbes (although hydrolysis and photolysis may also be important for some chemicals). Knowledge of the rate at which organic substances degrade in the environment is of great importance in determining their impact and preventing biological effects

(b) **Aquatic toxicity –** This is the adverse effects to aquatic organisms that result from being exposed to a toxic substance within a short specified time. It is expressed in terms of IC50, EC50, or LC50 values. These values are the minimal concentrations likely to cause, within 72, 48 or 96 hours, inhibitory reproductive or growth effects (IC50), deleterious effects (EC50), or lethal effects (LC50)to 50% of the tested organisms. (Inhalation). The rating system is based on the lethal dose (LD50) for oral and dermal hazards, and on lethal concentration

(c) **Acute mammalian toxicity** – this is when a substance causes harmful effects to an animal through single or short term exposure and is expressed in relation to the three routes of exposure, swallowing (oral), skin penetration (dermal), and inhalation

- Inhalation – The rating system is based on the lethal dose (LD50) for oral and dermal hazards, and on lethal concentration (LC50) for inhalation.

(d) **Irritation, corrosion and long-term mammalian health effects** – This refers to skin and eye irritation and corrosion and other long term health affects.

(e) **Interference of other uses of the sea** – This refers to tainting. Behaviours of chemicals in the marine environment and the physical effects on the wildlife and on their habitats. Also, it refers to any interference with coastal amenities including closing of beaches.

By attending this lesson, it is hoped that trainees are to gain full knowledge about behavior of HNS, which gives them sufficient abilities to deal with HNS incidents as responsible managers.

Lesson M–5: HNS Transportation

In this lesson, various ways in which HNS cargoes are carried by sea are explained . Through this lesson, trainees for managerial level are educated to recognize how different chemicals are transported by sea. It is expected that this lesson will contribute to trainees' familiarization with the varying design and construction standards required for minimizing the risks to the ships, their crews, and the environment from HNS cargoes, while taking into consideration the nature of their products. It is important to reconfirm, before starting the lesson, that trainees attending this lesson have clear understandings about classification of different substances so that they may be able to identify what hazards are present and what remedial action will be effective.

(1) Methods of Carrying HNS by sea

It is recommended that videos, movies, or pictures are to be shown to the trainees with images to introduce methods used to transport HNS cargoes, and give knowledge to trainees on how the handling and storage of both packaged and bulk hazardous and noxious substances are managed. Trainees are reminded that there are many different chemicals transported by sea, and the volume and types are highly variable. Important point is that the trainees are educated to understand that as a result of these different types of transportation, ships of varying designs and construction standards are required to minimize the risks for ships, their crews, and environment from HNS cargoes. Videos, movies, and/or photographs are shown to trainees so that trainees may get clear image of various methods of transportation by sea, as follows:

(a) A bulk carrier transports bulk cargo and has large box like hatches for carriage of solid bulk cargoes such as grain, fishmeal, ores, and semi-manufactured products.

(b) Oil bulk or carrier or combination carriers are multi-purpose carriers for bulk cargoes. The cargo can be transported in either liquid or solid form and are designed to avoid having to make the return voyage in ballast.

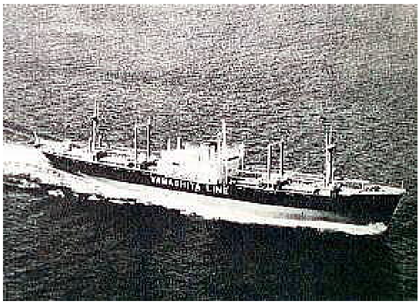
(2) Different form and nature of HNS carried

Methods and types of ships may also be different depending on nature and form of the products carried. Trainees are required to understand how cargoes are moved in packages, in gas, or in liquid form.

(a) In package form, there are following types of ships:

- Containerships – One type of the specialised carriers that transport packaged goods in containers and are mainly designed for general dry cargo (box-type), while certain specialised containers can take solids (e.g. powder) or liquid chemicals in portable (ISO) tanks.
- General cargo ships – One type of ships usually carrying cargo in relatively small consignments (i.e. crates, boxes, drums, or sacks), all

placed in close proximity in several large holds.



- Ro-Ro – These are designed with facilities for quick loading and discharging with cargoes being moved on and off using road trailers or rail tank cars.

(b) In liquid or gas form, there are following types of ships:

- Chemical Tankers - A specialised class of tankers designed to carry the most dangerous of liquid chemicals.

- Product Tankers – Ships generally built for carriage of a broader range of chemicals. Also referred to as parcel tankers because of the large number of individual tanks and pumping systems.

- Gas Carriers – Ships built for carriage of gas in either a pressurised or refrigerated form.

(3) Types of accidents

It is imperative for those in the managerial level that they know the classification of different substances so that they may identify what hazards are present and what remedial action will be effective. To assist trainees' familiarization with such action of identification of substances and classification of substances and hazards, types of past maritime accidents, which lead to a release of HNS, shall be explained. This lecture will assist trainees in learning ways of handling HNS incidents through simulation games of HNS incidents, to be used at a class room. To have trainees recognize the serious effects of the HNS accidents, actual results of typical HNS accidents are to be shown using diagrams.

(4) International Regulation

Without the full understanding of international regulations, proper and effective handling of HNS can not be expected. It is essential for those in the managerial level to get full knowledge of International Regulation which should be explained in detail in the class room so that those in the managerial level are educated enough to have the statute book, relating to the maritime laws, always on their hand. Regulations governing the carriage of chemicals by ships are contained in the International Convention for the Safety of Life at Sea (**SOLAS**), and the International Convention for the Prevention of Marine Pollution from Ships, as modified by the Protocol of 1978 relating thereto (**MARPOL**).

Trainees are required to get a full knowledge of name of regulations including the abbreviated form of the regulations. And, the regulations cover chemicals carried in bulk on chemical tankers, and chemicals carried in packaged form are as follows:

- Carriage of chemicals in bulk is covered by regulations in **SOLAS Chapter VII -** Carriage of dangerous goods and **MARPOL Annex II** - Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk. **MARPOL Annex III** includes regulations for the prevention of pollution by harmful substances in packaged form and includes general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions, and notifications for preventing pollution by harmful substances. For the purpose of Annex III, "harmful substances" are those identified as "marine pollutants" in the IMDG Code.

(5) IMO Conventions

It is essential for trainees to recognize fully that there exist IMO Conventions which require certain chemical tankers to comply with international standards for safe carriage of chemical substances by sea. Explanation about the IMO Conventions, which shall be made at the class room, shall include following points:

(a) **IMO Conventions** require chemical tankers built after 1 July 1986 to comply with the International Bulk Chemical Code (IBC Code) which gives international standards for the safe transport by sea in bulk of liquid dangerous chemicals, by prescribing the design and construction standards of ships involved in such transport and the equipment they should carry so as to minimize the risks to the ship, its crew, and to the environment, having regard to the nature of the products being carried. The basic philosophy is ship type being related to the hazards of the products covered by the Codes. Each of the products may have one or more hazard properties which include flammability, toxicity, corrosivity, and reactivity.

(b) **The IBC Code** lists chemicals and their hazards, and gives both the ship type required to carry that product as well as the environmental hazard rating. Chemical tankers constructed before 1 July 1986 should comply with the requirements of the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH Code), the predecessor of the IBC Code. Trainees are reminded that there are similar codes for the construction, and equipment of ships carrying liquefied gases in bulk.

(6) Carriage Guidance

In addition to the above-mentioned IMO Conventions, instructors should explain to trainees that **international guidance** exists for safe carriage and response.

The IMO's Code of Safe Practice for Solid Bulk Cargoes (**BC Code**) highlights the dangers associated with the shipment of certain types of bulk cargoes. It also lists typical products which are shipped and gives advice on their properties. The various IMO codes for the carriage of bulk HNS can be used to respond effectively to incidents. Sections of the codes contain details on chemical hazards, pollution category, etc.

HNS packaged in small quantities is usually known as dangerous goods. The International Maritime Dangerous Goods Code (**IMDG Code**) is used for the carriage of dangerous goods. It describes how the packaging should be designed and tested, marked and labelled, what documentation needs to accompany the goods, and what the stowage and segregation requirements are. This code applies to all ships carrying dangerous goods in a packaged form. The IMDG Code places all the dangerous goods into nine classes. All the substances, materials, and articles which appear in the IMDG Code are listed in its general index. It gives the product its UN number, its emergency schedule number, its medical first aid guide table number, and the IMDG Code page number of the individual schedule for the product concerned. Substances recognised as marine pollutants are also indicated as such in this index. The IMDG code has been written primarily with the mariner in mind but provides guidelines for all those involved in the storage, transport, and handling of the substances referred to in the document. This can include port authorities and all those involved in the transport chain from the manufacturer to the receiver.

In case of emergencies, specific information can be obtained from the individual schedules, as well as from the health and safety information of the Code. However it may not contain detailed occupational health and safety information or data on the substances, and materials listed in the code and responders should ensure they have access to complimentary information from other sources.

A recommendation on safe practice for dangerous goods in ports and harbors was first circulated by IMO in November 1973. The subsequent development of new techniques in shore and ship operations as well as the desirability of having more comprehensive recommendations, which included dangerous goods in packaged form, liquid and solid dangerous substances, and liquefied gases carried in bulk made it necessary to revise and update the recommendation. This was published by IMO in 2007.

For trainees' clear understanding about the IMDG Code, **The IMDG Code Volume 1 and 2,** shall be shown to trainees so that they may be reminded that the IMDG Code is an international agreement for the transport of dangerous goods by sea, published by the IMO. Also it should be recommended to trainees that they get full volume of IMDG Code and that they should keep the code on their desks.

Explanation shall also be made that it is a SOLAS requirement that all dangerous goods on container and cargo ships should be stowed and carried in accordance with its requirements. The guidance contained in the code is intended for use by all personnel involved in the shipment of dangerous goods by sea. This includes mariners, manufacturers, consignors, agents, and any associated feeder or support industries, services, and competent authorities.

As explained to the trainees, the IMDG Code is split into following two volumes:

- Volume 1 – General provisions, definitions and training, classification, packing and tank provisions, consignment procedures, construction and testing, road tank vehicles, and transport operations.
- Volume 2 – This contains the dangerous goods list, which includes limited quantities exceptions, the index and generic names, and a glossary.

There is also a supplement that contains an emergency schedule to gives fire fighting and spillage advice. There is a medical guide that gives advice on first aid, reporting procedures, packing cargo transport units, safe use of pesticides, and the INF Code. **INF Code** is the international code for the safe carriage of packaged Irradiated Nuclear Fuel, plutonium, and high-level radioactive waste onboard ships.

(7) Hazards

After explaining about the above codes to trainees, as a next step, explanation shall be made about the hazards associated with the transporting HNS, as follows:

- Structural damage due to improper distribution of the cargo.
- Loss or reduction of stability during the voyage. This could be a shift in the cargo, or the cargo liquefying under combined factors of vibration and motion of the ship.
- Chemical reactions such as the emission of toxic or explosive substances.
- Accidents – This point is the key, and the explanation shall be made separately

(8) IMDG Hazard Classification

It is important to explain to trainees about IMDG code by using slides so that they may get a clear understanding, as follows: Dangerous goods are divided into nine different classes according to the hazard or the most predominant of the hazards they present. They are then subdivided to define and describe the characteristics and properties of the substances, materials, and articles which fall within each of the classes. Some of these substances have also been labelled as marine pollutants to indicate that they are harmful to the marine environment. Substances are assigned to one of the classes 1-9, according to the hazard. Note that the numerical order of the classes and divisions do not reflect the degree of danger posed.

(a) Class 1 – Explosives and their hazard signs

- Division 1.1 – Substances and articles that have a mass explosion hazard.
- Division 1.2 – Substances and articles which have a projection hazards but not a mass explosion hazard.
- Division 1.3 – Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.

- Division 1.4 – Substances and articles which present no significant hazard.
- Division 1.5 – Very insensitive substances which have a mass explosion hazard.
- Division 1.6 – Extremely insensitive articles that do not have a mass explosion hazard.

(b) Class 2 – Gases and their hazard signs

- Class 2.1 – Flammable gases
- Class 2.2 – Non flammable, non-toxic gases.
- Class 2.3 – Toxic gases.

(c) Class 3 – Flammable liquids and their hazard signs

(d) Class 4 Flammable solids and their hazard signs

These substances are liable to spontaneous combustion. When they come into contact with water they will emit flammable gases.

- Class 4.1 – Flammable solids, self reactive substances, and desensitised explosives.
- Class 4.2 – Substances liable to spontaneous combustion.
- Class 4.3 – Substances which emit flammable gases when they come into contact with water.

(e) Class 5 – Oxidizing substances and organic peroxides, and their hazard signs

- Class 5.1 - Oxidising substances
- Class 5.2 – Organic peroxides

(f) Class 6 – Toxic and infectious substances and their hazard signs

- Class 6.1 – Toxic substances
- Class 6.2 – Infectious substances

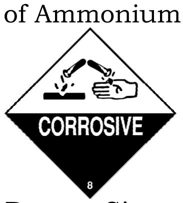
(g) Class 7 – Radioactive material

(h) Class 8 – Corrosive substances

(i) Class 9 – Miscellaneous and dangerous substances

As many substances have more than one hazard associated with their transportation, all the relevant signs are to be displayed. For easier recognition and use of the IMDG hazard classification, examples should be shown to trainees who are taking the sample case of carriage of dangerous goods identified as ammonium solution whose primary hazard is class 8 (Corrosive substances, and subsidiary hazard is associated with class 6) toxic substances, as follows:

Carriage of Ammonium Polysulphide Solution



Danger Sign

Subsidiary Hazard Sign

In this sample case, the two hazards are differentiated by the fact that the subsidiary hazard does not have its class number on the hazard diamond.

(9) Other key Hazard Classification by IMDG

IMDG Hazard Classification needs detailed explanation, which trainees for the managerial level are required to understand, on many of the substances assigned to class 1 to 9 as being marine pollutants under IMDG as follows:

– Marine pollutants
- P
- PP

– Wastes

– Packing Groups
- Group I
- Group II
- Group III

(a) Marine pollutants

Certain marine pollutants have an extreme pollution potential and are identified as marine pollutants. Marine pollutants mean substances, because of their potential to bioaccumulate in sea food or because of their high toxicity to aquatic life, are subject to the provisions of Annex III of MARPOL 73/78. The index contains a comprehensive listing of substances, materials, and articles that are identified as marine pollutants as follows:
- Substances, materials, and articles, which has a pollution potential (marine pollutants) are identified in the index.
- P in the column headed MP
- Substances, materials and articles which have an extreme pollution potential (severe marine pollutants) are identified in the index with PP in the column headed MP.
- A solution or mixture containing 10% or more of a marine pollutant is classified as a marine pollutant.
- A solution or mixture containing 1% or more of a severe marine pollutant is classified as a marine pollutant.

(b) Wastes – wastes shall be transported under the provisions of their appropriate class. Wastes are not covered by the code but covered under the BASEL Convention and may be transported under class 9.

(c) Packing Groups – For packing purposes, substances other than those of classes 1, 2, 5.2, 6.2 and 7, and other than self-reactive substances of class 4.1, are assigned to three packing groups in accordance with the degree of danger they present.
- Packing group I – substances presenting high danger
- Packing group II – substances presenting medium danger
- Packing group III – substances presenting low danger

The packing group to which a substance is assigned is indicated in the dangerous goods list in chapter 3.2.

(10) IMDG Hazard Classification - UN Number

For further explanation about marine pollutants, UN Number, assigned to all dangerous goods, is to be explained as understanding that is essential for proper and effective handling of dangerous goods.

(a) UN Numbers – Dangerous goods are assigned to UN numbers and proper shipping names according to their hazard classification and their composition. The IMDG Code also states what packing group has been assigned, stowage properties, etc.

(b) The Dangerous Goods List in chapter 3.2 lists many of the dangerous goods most commonly transported. The list includes entries for specific chemical substances and articles, and "generic" or "not otherwise specified entries." Since it is not practical to include a separate entry for every chemical substance or article of commercial importance specifically by name, especially names for mixtures and solutions of various chemical constituents and concentrations, the Dangerous Goods List also includes generic or "not otherwise specified" names (e.g. EXTRACTS, FLAVOURING, LIQUID, UN 1197 or FLAMMABLE LIQUID, N.O.S., UN 1993). On this basis, it should be explained to trainees that the Dangerous Goods List is intended to include an appropriate name or entry for any dangerous good which may be transported.

(c) Where a dangerous good is specifically listed by name in the Dangerous Goods List, it shall be transported in accordance with the provisions in the list which are appropriate for that dangerous good. A "generic" or "not otherwise specified" entry may be used to permit the transport of substances, materials, or articles, which do not appear specifically by name in the Dangerous Goods List. Such a dangerous good may be transported only after its dangerous properties have been determined. Dangerous goods shall be classified according to the class definitions, tests, and criteria. The name which most appropriately describes the dangerous goods shall be used. Only when the specific name of the dangerous goods does not appear in the Dangerous Goods List or the associated primary or subsidiary hazards assigned to it are not appropriate, may a generic or "not otherwise specified" name be used. The classification shall be made by the shipper/consignor or by the appropriate competent authority where so specified in the code. Once the class of the dangerous good has been so established, all conditions for transport, as provided in this code, shall be met.

(11) Supplements to the IMDG code

In order to cope with recent development in the IMO, further explanation about Supplements to the IMDG Code is necessary. As explained above, The IMDG Code relates to the safe carriage of dangerous goods by sea. It does not, however, include details concerning the packing of dangerous goods, any actions to take in the event of an emergency, or accident involving personnel who handle goods at sea. For this purpose, a supplement has been created containing information on the following subjects:

(a) EMS Guide – this contains guidance on emergency response procedures for ships carrying dangerous goods including the emergency schedules to be followed in case of incidents involving dangerous substances, materials, articles, or harmful substances regulated under the international maritime dangerous goods code. This guide also provides guidance for dealing with fires and spillages on board ships involving dangerous goods. This guide is intended for fire and spillage emergencies on board a ship involving packaged dangerous goods and should not be used for emergencies involving bulk cargoes. The guide covers an introduction into the emergency schedules for fire and introduction to the emergency schedules for spillages.

(b) The Medical First Aid Guide (MFAG) for use in accidents involving dangerous goods. MFAG refers to the substance, material, and articles covered by the IMDG Code and the materials covered by Appendix B of the Code of Safe Practise for Solid Bulk Cargoes (BC Code). It provides advice for initial management of chemical poisoning and diagnosis within the limits of the facilities available at sea. It also provides information on the particular toxic effects likely to be encountered.

The guide is divided into sections which are grouped to facilitate a three step approach. These steps are emergency actions and diagnosis, tables which give brief instructions for special circumstances, appendices which provide comprehensive information, a list of all medicines and drugs, and a list of chemicals referred to in the tables. To assist in clear understanding, workbook prepared by IMO with an example of emergency action and diagnosis flow chart is detailed is to be delivered to trainees.

Information is also provided in the supplement for:
- Reporting procedures.
- Packing cargo transport units.
- The safe use of pesticides.

Irradiated nuclear fuel is covered by the International Code for the safe carriage of packaged Irradiated Nuclear Fuel, plutonium, and high level radioactive waste on board ship (INF Code). The code assigns ships to three different classes:
- **Class INF 1** – Ships that are certified to carry INF cargo with an aggregate activity of less than 4000 TBq (Terabecquerel – SI unit of radioactivity and measures the rate of decay).
- **Class INF 2** – Ships that are certified to carry irradiated nuclear fuel or high level radioactive wastes with an aggregate activity less than 2 x 106 TBq, and ships certified to carry plutonium with an aggregate activity less than 2 x 105 TBq.
- **Class INF 3** – Ships that are certified to carry irradiated nuclear fuel or high-level radioactive wastes, and ships which are certified to carry plutonium with no restriction of the maximum aggregate activity of the materials.

Before finishing this lesson, it should be stressed to trainees that they should be able to describe the ways HNS cargoes may be carried at sea. They should have full recognition of the International Regulations and Guidelines available. They have recognized types of Marine Accidents, which may lead to a release of HNS. They should understand fully about detailed use of IMDG Code and IMDG Code Supplements.

(12) Types of accidents

This is the key point of the lesson, and trainees are reminded to keep in their minds that a major chemical incident is a low probability event. But, it could have very high consequences and will generally fall into or be a combination of several different categories.

Explanation shall be made on following types of accidents::
- Collision – Striking together of two vessels.
- Contact – A vessel which strikes a fixed object or the sea bottom.
- Grounding – A vessel that touches the bottom and remains aground for an appreciable period.
- Fire/Explosion – A fire or explosion is started by cargo or in its vicinity, and is the first step in a chain of events leading to the casualty.

A fire in an installation will have the same impact.
- Sinking – A vessel sinks as the result of bad weather or hull failure.
- Container loss – Power failure to the container storing the hazardous chemical, or the loss of container's due to bad weather or structural failure.
- Sabotage.
- Poor handling or storage of a chemical substance.
- Chemical reactions.
- Structural damage.
- Negligence.
- Terrorism.
- Tank / Pipeline failure – Loss of integrity in the tank / pipeline system, or as a result of contact.
- Loss or reduction in stability.
- Structural failure of a vessel.

Lesson M–6: Response

Through this lesson, explanation shall be made to trainees about the response system so that basic steps of response may be inculcated in the trainees' mind. And, so that trainees may be brought up to the qualified managerial level and may take timely, proper, and effective steps and methods responding to HNS incidents by using their full understandings about emergency response, gained through the lessons.

(1) 9 basic steps of HNS Response

It is essential that trainees are to learn the very basic point that there are nine basic response steps or activities which describe what the OSC must consider when responding to an HNS incident. As the nine steps will form the basis of the response strategy, which the OSC will be required to consider, lecture shall be made clearly by using videos and slides so that trainees may understand the key essence and requirements of each step as follows:

(a) Step One – Assess the situation

The first step of the HNS response is to assess the situation.

- Report and document accurately all incoming incident information using a standard reporting form.
- Identify the type and source of products involved.
- Quantify the size of the spill.
- Assess the hazards implications, e.g. fire and explosion, human health, shoreline type, and effects on flora and fauna. Ensure that actions are prioritised.
- Identify the threat to people, environment, and facilities.
- The OSC needs to prioritise what actions will be taken.
- Important point is that the OSC identifies the political and economic significance of the spill.
- Gather samples or other supporting data sufficient to allow for the positive identification of the substances to take place.

(b) Step Two – Activate Contingency Plan

Step two is to activate contingency plan.

- Inform the senior manager as per the organisational procedure and content of the plan.
- Notify appropriate authorities and key personnel according to the plan.
- Activate initial response. Decide how, where, and when. Coordinate identification and mobilisation of initial response resources (personnel and equipment) as per the plan.

(c) Step Three – Activate Organisational Response

Step three of the response is to activate the organisation's response, according to the agreed strategy plan, including:

- Mobilising and organising the response team.
- Identifying, assigning and delegating tasks.
- Establishing both internal and external communication channels.
- Set up a command post in the safe zone (site equipment, safety and security, procedures/resources).
- Implement safety, security and de-contamination procedures.
- Notify, mobilise, and co-ordinate contracted and sub contracted services.
- Assess needs, define roles, and execute contracts.

(d) Step Four – Prepare Response Action Plan

Step four is to prepare a response action plan strategy. Response organisation should;

(i) Identify and priority resources at risk e.g. local populace, type of shoreline, local infrastructure.

(ii) Identify the resources required, taking into consideration the influence of the sea and weather conditions on the spill properties, the behaviour of the HNS, spread rate and identify additional resources if necessary (e.g. regional / international agreements), and so on.

(iii) Identify and prioritise response strategies, such as for monitoring, containment and recovery, chemical treatment, shoreline clean up, transfer, and disposal.
(iv) Maintain accurate records as required e.g. log and time keeping procedures for contractors and sub contractors, rented equipment, consumables.
(v) Develop response action plan to cover items such as any resource time available, resources available, containment plan, regular briefings on the response action plans, etc.

(e) Step Five – Activate Operational Response

Step five involves activating the operational response. This involves:
(i) Directing and supervising all monitoring, investigation, recovery, clean up and decontamination procedures.
(ii) Monitoring adherence to plans.
(iii) Coordinating containment, recovery and disposal of all pollutants.
(iv) Conducting regular briefings.
(v) Deploying personnel and ensuring logistical support.

(f) Step Six – Managing the Response

Step six is managing the on-going response. This involves gathering, assessing, and adjusting response information, and interpreting and reviewing reports as follows:
(i) Assessing, maintaining, advising, directing and control response team activities, and plan.
(ii) Monitoring, evaluating, and adjusting strategies as required.
(iii) Monitoring site safety plan and occupational hygiene.
(iv) Enforcing regulations and procedures.

(g) Step Seven – Deactivate the Response

Step seven involves deactivating the response. It should be determined whether the response should be continued, suspended, or terminated, and advise the OSC accordingly. Rank the termination criteria relevant to the operations by using effort/ benefit analysis.
(i) Assess the potential for recontamination.
(ii) Coordinate support to scientific monitoring of the area.
(iii) Shutdown field operations and conduct an orderly termination of operations.
(iv) Maintain, repair, and replace equipment as appropriate.

(h) Step Eight –Consolidate Costs

As this is the key point for the next stage of the response and follow-up, it is essential that trainees are instructed to keep detailed records by taking following actions:
(i) Verify / certify costs.
(ii) Plan for record and filing maintenance.
(iii) Consolidate records and produce a report of expenditure by category.
(iv) Produce costs documentation report.
(v) Construct simple coding structure and produce final cost report.

(i) Step Nine – Debrief the Response

Step nine is to debrief the response. Trainees learn that OSC is required to take following actions at this step:
(i) Conduct operational review of the response with the response teams, and analyse strengths and weaknesses of response.
(ii) Conduct a review with the OSC and analyse strengths and weaknesses of response. Identify the lessons learned and the areas that may require improvement.
(iii) Consolidate information, documentation, and evidence. Submit and circulate the final operations report.
(iv) Make and circulate recommendations for improved preparedness.
(v) Implement the lessons learned.
(vi) Update contingency plan

After explaining the nine basic steps, it is imperative that the trainees are reminded about the very basic key points so that trainees may take timely actions, effectively and properly during the HNS incident. Trainees are taught to recognize that an OSC and his team can only function effectively if provided with the structure and organisation necessary to mount a response in a timely and appropriate manner, before the HNS has a chance to affect the local populous or sensitive areas. It should, therefore, be emphasized that:

(i) Sometimes, this is not possible due to the scale of the emergency, the location or the prevailing weather conditions.

(ii) The probability of small spills can be high, but with a rapid response the damage they cause are often minor and their clean up costs are relatively low.

(iii) Small spills are ugly and a constant reminder of the risks of much larger spills. A good response to small spills will ensure an effective response to larger spills.

(iv) Regardless of size, marine HNS spills tend to become unmanageable very quickly.

(v) The key to effective response is to have a comprehensive, realistic, and well exercised contingency plan, a minimum of appropriate equipment and a response organisation of highly trained individuals who will react very quickly and knowledgeably.

Trainees are also reminded that there exist some important interested parties and that the OSC and his team should always pay attention to these parties. Therefore, it is important to explain further that:

(i) During a major incident, there will be multiplicity of agencies involved that can be of great assistance in the response. These will include government agencies and private groups alike.

(ii) In terms of government groups, most countries have developed joint command centers for spill response or unified command teams that include many agencies.

(iii) In addition to government agencies, there will also be an influx of outside individuals such as media persons, equipment, sales people, and curious parties of all sorts, who have legitimate interests and some not so legitimate. It is important to recognize that such groups will inevitably be part of the scene and that mechanisms must be established to communicate with them on a fair basis without interfering with the emergency job at hand at the same time.

(iv) The OSC and his team must be allowed to implement the response strategies with the minimum outside interference.

(2) Key essential components of an emergency response system

Key components of an emergency system shall be explained clearly to trainees by illustrating them in the following diagram.

Following key remarks shall be briefly explained to trainees during the time the diagram is shown to trainees. Purpose of this is to give trainees rough idea about key elements.

- Organizational Arrangements - It is essential that all roles are defined clearly and that all responsibilities and capabilities have been clearly identified.
- Planning requirements should provide specific guidance in responding to an incident.
- Monitoring and reporting. Ensure that all incidents are assessed, evaluated, and followed up as appropriate.
- Defined operational procedures to allow a tiered response to an incident.
- Training and exercising to provide response personnel with the skills necessary to do their jobs safely.
- Financial and liability arrangements. Determine financial responsibilities and liabilities of the various parties involved.

To have trainees get concrete idea about emergency response system, further explanation shall be made that:

(a) Organizational Arrangements

It is important that all roles are defined clearly and that all responsibilities and capabilities have been clearly identified. Essential point is to clearly identify who is responsible:

- For responding to the incident.
- For conducting specific tasks during the incident.

In teaching the organisational arrangements, trainees are instructed to consider the following elements step by step:


Prevention


Preparedness


Response


Recovery/Remediation

(i) Prevention

Prevention consists of taking measures to reduce the likelihood of an incident occurring and, in the event of an incident occurring, measures for minimising the effects is critical to the emergency response team.

The response team should first consider what they already have in place and evaluate existing documentation such as:

- Policies
- Guidelines
- Legislation

After considering above elements, response team need to consider what they have to put in place:

- What mandatory compliance requirements exist?
- What does the legislation require to be implemented?
- What is missing?

(ii) Preparedness

Explanation shall be made that the next element the response team is required to consider is “Preparedness”. Trainees are reminded that preparedness is simply being prepared and being prepared will enhance the ability to respond to emergencies. Trainees are instructed to keep in mind the important phrase “Failing to plan is planning to fail.” Key considerations are:

- Develop an emergency response plan.
- Ensure that response resources and equipment are available.
- Make sure the response team personnel are trained by simulating scenarios regularly.
- Make sure that communication and alert channels are established, including the media.
- Take into account the various scenarios relevant to probable spills and the organization, and activities likely to be involved. This should involve joint planning and training of those who may need to work together if an accident occurs, including industries and the surrounding communities.

At this point, as a first step, trainees are instructed to consider and discuss among the class members on following points/questions:
- How do we, as a response team, prepare for an incident?
- What do we, as a response team, need to have in place?
- What support should the administration provide?

To assist the trainees to get the full knowledge about preparedness related to the answers to the above question, following points need to be explained. The administrations should provide:
- All relevant guidelines and policies for dealing with incidents.
- Define what reporting procedures are required, and what the incident reporting requirements are.
- Prepare and implement periodic inspection and auditing protocols, and ensure that appropriate equipment, systems, and procedures are being implemented and adhered to.
- Collect and disseminate information.
- Define the emergency response planning requirements and the response capability and preparedness standards for vessels, facilities, and port/harbour authorities.
- Establish information databases pertaining to shipping information (e.g. stowage plans, bills of landing, ship passage, ports of call), chemical and physical properties, and response protocols. Levels of confidentiality required for this information must be established in conjunction with the relevant stakeholders.
- Establish a pool of experts to act as an advisory group. Individuals with expertise in navigation, ship technology, ship operations, salvage, naval architecture, chemical hazards, marine biology, physical and chemical oceanography, dispersion, modelling, spill response, and fire fighting.
- Establish a co-ordination group made up of individuals with proven expertise in the areas of emergency, crisis management, and transfer operations.

It is necessary to explain to trainees that the administration can provide further support including:
- Identification of Ocean Centre to provide access to information databases, standard operating procedures, advisory personnel, and communications equipment.
- Identification of chemical response units.
- Training the personnel of the chemical response unit.
- Coordination with national, regional, and international organisations and information sources such as IMO in both routine and emergency situations.

To have trainees understand this essential element of preparedness clearly, it is recommended that discussion among trainees about the above-mentioned questions are encouraged. It is recommended that trainees are trained to be accustomed to plan and exercise with key participants so that “preparedness” is always kept in their minds.

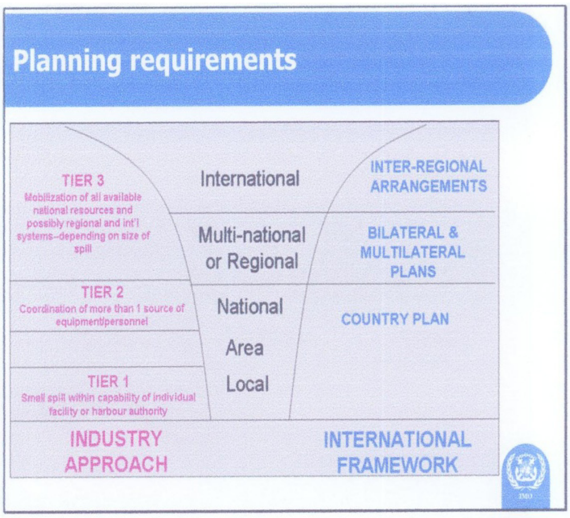
(b) Planning requirements

Planning requirements, including the preparation of detailed and specific plans for responding to a marine incident, are also to be explained in details. The points explained to trainees were:

- At an international level with the framework of an operational contingency plan.
- At the regional level for multi-lateral assistance and mutual aid.
- At the national level.
- At the local level (e.g. for terminals and harbours/ports).

Should the magnitude of an accident be such that assistance is required, these plans should be integrated in such a way that it will be easy to incorporate additional response capabilities. For example, a port emergency plan should be co-ordinated with the neighboring industrial facilities and local regional plans, as well as with the national plan. Above international, regional, national, and local emergency response plans should be prepared to summarise roles and responsibilities for all parties, providing standard operating procedures, lists of available resources, etc.

Following diagram, which shows the relationship between the differing levels of plans, shall be shown to trainees. Planning requirement may best be summarized and the trainee may be able to get a clear understanding about the requirements.



(i) Planning and assessment tools

After explaining to trainees about four levels of planning, lecture shall be made about assessment tools so that the trainees, as the responder and/or decision makers, may manage the response effectively and satisfactorily. It should be clearly explained to trainees that each organisation should develop its own system, meeting its own requirements. However, there are some fundamental planning and assessment tools which each organization should have as a basic planning and assessment tool. Trainees should be reminded that the important assessment tool is information and that various types of information, including but not limited to the following information, should be gathered before an accident takes place.

- Inventory of the different response plans that can be activated in different areas, and the procedures required to activate them.
- Inventory of transportation patterns and commodities transported in different areas.
- Chemical and physical properties of transported substances.

- Toxicological effects and exposure limits of substances.
- Chemical fate of substances.
- Spill scenarios, describing the substances transported for each sensitive area.
- Identification of sensitive areas.
- Possible recovery techniques.
- Personal protective equipment requirements.

(ii) Response tools

The next step after getting sufficient knowledge about assessment tools is to get knowledge about the following response tools:

- An incident assessment system.
- A list of experts on maritime and chemical aspects.
- Predictive air dispersion modelling and related monitoring capabilities.
- Predictive water dispersion and related monitoring capabilities.
- An inventory of incident assessment capabilities.
- Access to the ship's manifest and loading plan.
- Search and rescue capabilities.
- Decontamination techniques for responders and exposed public.

After explanation and subsequent consideration on planning requirement, assessment tools, and response tools, trainees, as a candidate for a qualified managerial level, may be instructed to consider monitoring and reporting.

(c) Monitoring, reporting, and record keeping

Before explaining about monitoring and reporting, it should be explained to trainees that a key facet in the preparation process is the establishment of reporting procedures that will indicate:

- Who is responsible for reporting?
- To whom are the reports to be made?
- What format should be used for the reports?
- When are the reports to be made?

The reporting procedures should be linked to an appropriate record keeping process.

(d) Defined Operational Procedures

This is necessary to allow a tiered response to an incident. The key point to ensure an initiation of an appropriate and effective response in a timely fashion is development of operational procedures. It is of paramount importance that these procedures are clearly defined, properly coordinated, and that all roles and responsibilities are clearly identified and defined. Explanation about this point of procedures should be repeatedly emphasized to trainees, because the understanding about operational procedures is the core of this lesson. After the lecture about operational procedures, training program can proceed to the next point, training and exercising.

(e) Training and Exercising

It is essential for all trainees to clearly recognize that the training standards should be prescribed for all response personnel, whether performing at the decision-making or operational levels. Explanation should be made that the training standards should include:

- Training should be content specific with the job performance expectations.
- There should be schedules for implementation and compliance dates.
- There should be requirements for issuing certificates and their specific content.
- Requirements for periodic refresher training are defined. (Example: three yearly requalification.)
- Exercises and drills are planned for regular intervals to ensure that

the response program is effective.

- Ensure that all training organisations used are approved/certified prior to conducting the training.
- The training delivered is of an equivalent standard as international training requirements.

(f) Financial and Liability Arrangements

After the lecture about training and excercise, lecture should proceed to the last point, organisational arrangement, or in other words, Financial and Liability Arrangements. While these aspects of financial and liability arrangements are explained earlier in the Emergency Response System, explanation should be made again as these aspects play an important and fundamental part in the system.

With regard to the **financial aspects**, the level of preparedness required shall need to be funded in addition to the sufficient provisions to fund any response. In the latter, it is essential that good record keeping is established at an early stage to assist in the collation and management of any claim.

With respect to **the liability aspects**, the administration, and relevant international, legal, and insurance bodies will determine the level of liability for differing parties. As a reminder, explanation should be made that this level of liability shall be established with reference to national legislation and international conventions, which were covered in the lessons already completed.

Lecture about training and exercise completes explanation about key components of an emergency response system. Then, lecture to trainees may proceed to the next subject of consideration. Key components for this subject are phases of the response organisation, and systematic approach to decision making at any time during a response.

(g) Optimized response organization on a ship

The first key point to be explained to and understood by trainees is the definite need for effective response organization. Explanation shall include the followings:

- When an incident involving HNS occurs, the first personnel to be involved will be the ship's crew. They should be trained for emergency response on board, but many of the crew members may not be aware of the potential environmental impact of spills at sea. In addition, it should be emphasized that, in the event of an HNS incident, a ship's crew may need to take shelter on board or abandon ship. Each coastal state should have an effective response organisation in place to deal with such events.
- Response personnel, intervening on the pollution, are more likely to be those involved in oil spill response; therefore, they will be aware of certain environmental concerns. However, they may not be suitably familiar with the particular hazards of chemical spills. Alternatively, they could come from shore-based chemical response units, such as a Fire Brigade who has limited knowledge of pollution response or maritime operations.
- As a result of this, it is essential that there exist a well co-ordinated response system to ensure incident management, including the recovery of lost packages and combating an HNS spill. The system must be established on a permanent basis and must identify the personnel who will respond and perform specific tasks in the event of an accident. They should also be aware of emergency procedures that are to be followed by the ship's crew.
- After recognition by trainees about the definite need for effective response organization and co-ordinated response system, lecture should proceed to explanation about response organization.

(h) Response Organization

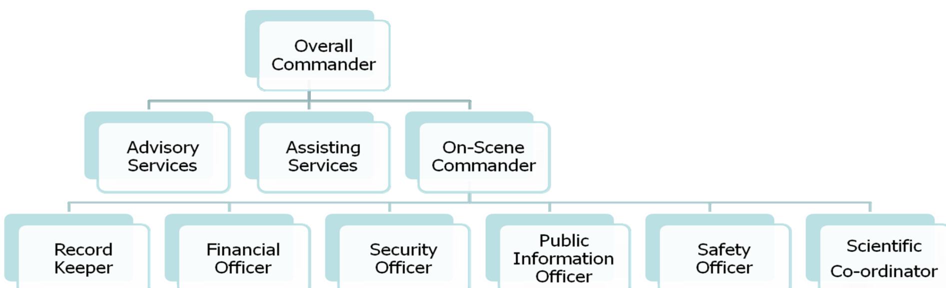
The number of personnel, organizations, and activities involved in response can vary greatly. To be effective, however, the various response personnel and their activities must be organized into a structure unit that is capable of conducting the operations that is required. Advisory and/or assisting experts from the chemical industry, chemical accident emergency teams from fire brigades, and civil emergency authorities should be an integrated part of the response organization.

The primary aim of this lesson is to educate trainees the methods in which to establish a response organization capable of effectively managing and directing the successful mitigation of an incident. The structure of the organization and the functions performed should be modified on a case by case basis so as to adjust to the specific requirements of each situation. Despite the difference in structure and/or functions of the organizations, it should be pointed out that there are common feature of HNS incidents, which can be used to design a generic organizational structure and be included at the planning stage. Trainees are instructed to recognize the following elements for establishment of effective response organizations:

- The identification of an agency for overall command and on scene coordination
- The definitions of responsibilities and functions, including ship salvage, search and rescue, and pollution operations.
- The delineation of authority.
- The establishment of internal and external communications.
- The coordination of activities and functions.
- The identification of resources including information sources on HNS response personnel, equipment, chemical specialists, and the financial aspect, in order to cover the costs involved.

(i) Response Personnel

To have trainees get the clear image and recognition, competent personnel must be selected and assigned the responsibility for conducting specific operations to manage the various activities required in a response situation. Slides and/or movies have to be used in the explanation. In explaining the response organization, use of the following sample organizational chart is recommended.



Through the explanation, it is expected that the trainees are educated to recognize the following key points:

- Overall commander – The overall commander is responsible for general policy and strategic decisions. He provides the link to higher government authority or port management. In certain cases, the overall commander could also be responsible for such international co-operation as may be required. The overall commander may be assisted and advised by internal and external experts such as legal, compensation, scientific, etc.

- On-scene commander – The on-scene commander or co-ordinator (OSC) is the person responsible for organizing the local response and coordinating the deployment of required resources. The OSC may be a government or an industry representative.

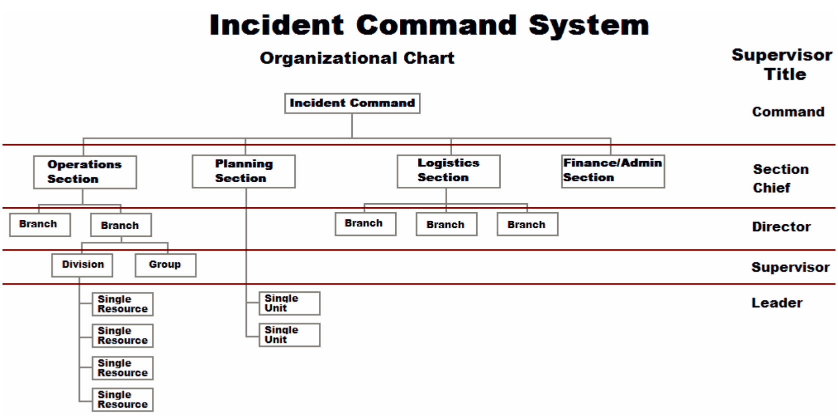
The OSC is a decision maker, a communicator, and a manager of personnel. The OSC is responsible for directing the employment of needed resources. The OSC establishes an operations center for the collection of information, incorporating concerns or sensitivities of a participating organisation / public / media, and is responsible for reporting all aspects of the spill.

The OSC will be assisted by the response team leaders in the field.

- The scientific coordinator is responsible for directing and coordinating activities related to the scientific aspects of the situation, including analysis, remedial actions, sample collection, field monitoring, and analysis of data.
- The safety officer provides advice and consultation on all matters related to health and safety of those involved in response operations. He establishes and directs the safety program.
- The public information officer is responsible for releasing all information concerning response activities to the news media and to the public. He should be kept informed of the latest information on the situation, as well as the strategies and tactics to be implemented. He is responsible for verifying the press releases.
- The security officer is responsible for general response area security (This will usually be with the local law enforcement personnel).
- The financial officer provides financial and contractual support.
- The record keeper is responsible for the official record of response activities.

As a sample of common response system, the US originated Incident Command System (ICS) should be explained by using the following slides:

(j) Incident Command System (ICS)



The Incident Command System (ICS) is a standardized, on-scene, all-hazard incident management concept developed in the United States. It is a management protocol originally designed for emergency management agencies and later federalized. ICS, or variations of ICS are being used in more and more countries around the world. ICS is based upon a flexible, scalable response organization providing a common framework within which people can work together effectively. These people may be drawn from multiple agencies that do not routinely work together, and ICS is designed to give standard response and operation procedures to reduce the problems and potential for miscommunication on such incidents. ICS has been summarized as a "first-on-scene" structure, where the first responder on a scene has charge of the scene until the incident is resolved or the initial responder transitions incident command to an arriving, more qualified individual.

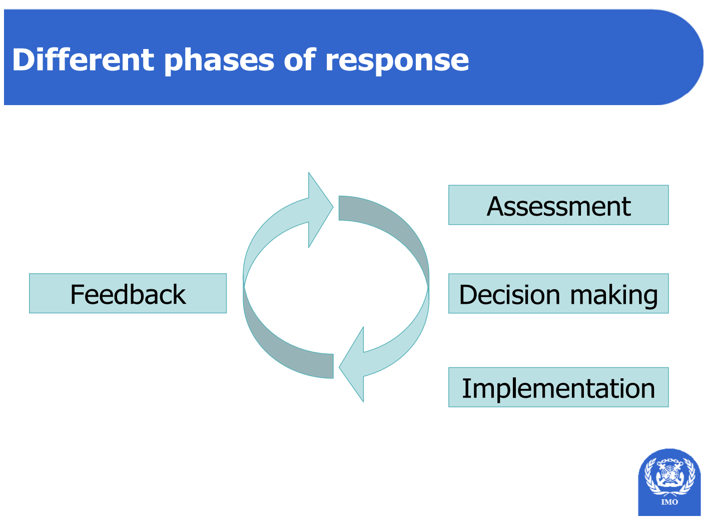
Trainees are lead to recognize that the ICS is and was easily applied to HNS response organization. Through the lesson, definition of response was repeated and trainees are lead to clearly understand that the definition is an effort to minimize the risks created in an emergency, to protect people, the environment, and property, and to restore it back to normal, pre-emergency conditions. It should be noted that marine HNS accidents share the following crisis components:

- There are large uncertainties.
- Important values are at risk. This includes the risk to human life.
- Tight time constraints.
- The outcome is unpredictable and unexpected.

The response to a marine accident is a complex issue requiring highly specialised skills and technology, and the involvement of numerous organizations. The decision making process must be flexible enough to handle a broad spectrum of different incident related issues in a timely, efficient, and effective manner. The decisions reached must be simple enough to be clearly understood by all those involved in the response operations. After gaining knowledge about response personnel, lecture about different phase of response should be known to those in the managerial level for decision making.

(3) Different phases of response

It needs to be explained to trainees that the systematic approach to response was originally developed by the chemical industry to assist the decision makers involved in the management of HNS emergency situations. To assist trainees to learn about different phase of response, following chart is to be used for explanation:

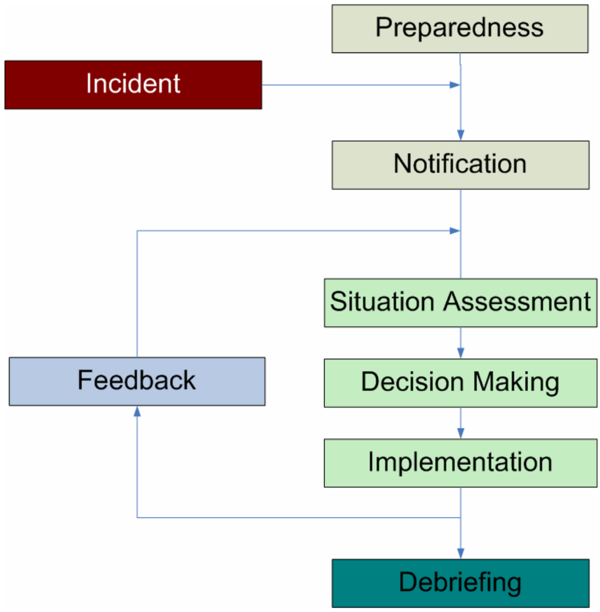


Though the above chart may be easily understood, it is a systematic sequence of steps for collecting information and making decisions in a logical and methodical manner. It is broken down into four steps:

- Assessment – Where all the information on the incident is gathered.
- Decision making – Where the information is processed and interpreted to define priorities, strategies, and tactics.
- The implementation where appropriate response actions are put into practice.

- The feedback loop where the decisions made and the actions implemented are reassessed against the evolving situation.

The relationship between the four basic response steps, and the general preparedness and response framework shall be explained by using the following diagram:



(a) Assessment phase

The assessment of the situation will occur in following two phases.

(i) First, an initial assessment of maritime casualty will be made to decide whether any environmental response is needed.

(ii) Should an HNS response operation be required, a detailed assessment will follow to identify the best strategies and tactics, and to facilitate their safe implementation.

In order to conduct a comprehensive assessment as a part of the training, trainees are instructed to discuss among themselves and find the answers to the following questions:

- What are the circumstances of the incident?
- What are the modifying conditions, the conditions that change the incident, location, weather conditions, time of year, etc?
- What are the potential impact and losses from exposure?
- What response capabilities are available?
- What are the anticipated reactions of interested group (media, local communities, etc)?

(b) Decision making phase

Based on the description of the problem and of possible losses identified in the assessment phase, lecture shall proceed to explaining the next phase of decision making.

(i) Following points need to be clearly explained:
- The authority in charge may decide what is feasible and acceptable, to trigger an environmental response operation.
- The goals and objectives of the intervention, including the followings, must be clearly defined.
- Saving lives, preserving the environment, and protecting property being the overall priorities.

(ii) It should be stressed that:
The decision should be based on identifying the most critical issues. The more accurate the description of an accident and its circumstances, the more adequate the understanding of the critical issues. Decisions will be taken on issues such as:
- Is a response necessary?
- If the situation warrants a response, what type of action needs to be taken?
- Whether the response action is possible due to prevailing conditions?
- Whether the response action has to be postponed as a result of a requirement for further resources?

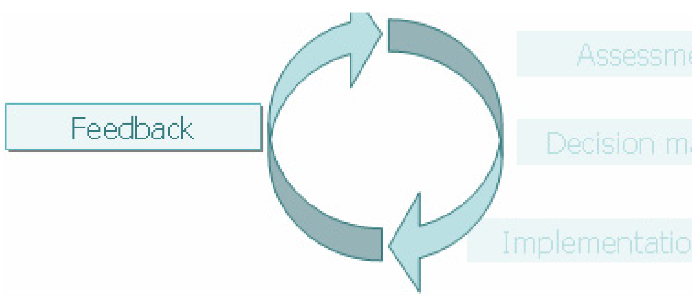
Trainees are to learn that response priorities can be established by taking into consideration the modifying conditions, the response capabilities at hand and the reaction of the different interest groups.

(iii) The priorities should address both preventative and corrective strategies. Only then should response activities and tactics be undertaken, taking into consideration the following three different forms of action:
- Actions on the vessel
- Actions on the cargo
- Actions on the released HNS

(iv) Trainees are explained to note the following items:
- Data such as chemical and toxicological properties, ship structure, and last port of call is usually made available from various government agencies, the master, the ship owner, maritime authorities, international organisations, and P&I clubs.
- Other information can only be obtained by direct observation from the accident site. The data can either be collected from a distance (conservative assessment), or by a direct entry into the contaminated site by an assessment team using appropriate personal protective clothing and monitoring equipment. The information collected should be verified and, if necessary, complemented. Special care should be taken when approaching any stricken vessel whether by sea or air.

(c) Implementation phase
The IMPLEMENTATION PHASE consists of putting into effect the response strategies and plans. It should be clearly explained to trainees that decisions on whether or not field operations are carried out shall be made at this stage.

(d) Feedback loop
Explanation shall be clearly made that any HNS incident is a dynamic situation. It requires an ongoing reassessment of the entire situation to identify new elements which may require changing the original plans or stopping activities taking place.



Trainees are lead to recognize that this continuous reassessment of the situation and each of its elements brings the process back to the first stage, allowing the decision maker to permanently ensure a safe, effective, and efficient response. Trainees are also educated to further recognize that this systematic approach is a dynamic method, which constantly examines and reassesses the facts and the situation. It endeavours to anticipate changes to prevent any possible escalation of the situation. It should be emphasized that the systematic approach requires decision makers to carefully consider all aspects of the operation, to develop and maintain effective communications with all response personnel and keep in mind any possible eventuality. It should be repeatedly told to trainees that the important point is that effective communication must be maintained.

Explanation shall be made that, in using this approach, consideration of the following seven critical issues will ensure substantially positive decisions:
- The approach enables a broad spectrum of alternative actions to be sought.
- It allows all possible objectives to be considered.
- The costs and risks can be carefully balanced as well as the impact, both positive and negative of each course of action.
- New information is constantly being sought to continually assess possible alternative courses of action.
- All information is considered, even if it does not corroborate the initial response strategy.
- All alternative courses of action are reassessed prior to making a decision. This includes reassessing those courses of action that were initially discarded.

Explanation about the benefits of this approach shall also be made that:
- A broad spectrum of alternative actions can be sought.
- All possible objectives can be considered.
- Costs and risks can be balanced as well as assessing the impact of every action.
- New information is constantly being sought for possible alternatives.
- All information is considered even if it does not corroborate the initial response strategy.
- All alternative courses of action are re-assessed prior to making a decision.
- It ensures that the plan of action is fulfilled.

Explanation shall further be made clearly to trainees as follows:
- The systematic approach method is to unite the various decision making organisations around a common objective.
- The method provides a series of actions for decision making, which will reduce the risks of conflict related to the choice of priorities or varying points of view.

During an exercise or an incident, clear advantages can be obtained from a systematic approach to decision making:
- A better understanding of the key decisions and of the decision making process by all personnel.
- The fact that the situation is continually reassessed means that the pertinent facts are not forgotten.
- This system helps ensure that priorities are established.
- The method enables the most effective use of resources.
- The method also increases safety for both the response teams and the public in general.

(e) Training and exercising

At this stage, trainees are asked to run a tabletop exercise to reconfirm and reinforce their understanding, which is necessary for responsible officers to do their jobs safely, gained from the lessons stated in this manual.

(f) Financial and liability arrangements
To determine financial responsibilities and liabilities of the various parties involved.

(4) Response Methods

(a) Response – Categories
Following three categories shall be explained to trainees:

- Forecasting
- Monitoring
- Combating

(b) Response – Physical Characteristics
As shown below, it should be explained to trainees that the behavior of HNS, when released, can be classified into following 12 different subgroups.

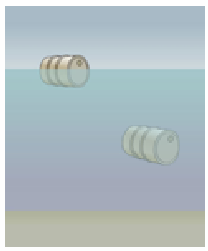
Gas - Gas (G)
- Gas/dissolver (GD)

Evaporator - Evaporator (E)
- Evaporator/dissolver (ED)

Floater - Floater (F)
- Floater/evaporator (FE)
- Floater/evaporator/dissolver (FED)
- Floater/dissolver (FD)

Dissolver - Dissolver (D)
- Dissolver/evaporator (DE)

Sinker - Sinker (S)
- Sinker/dissolver (SD)



This classification system can be used to identify appropriate forecasting and response methods.

The table shown below shall be explained to trainees as the table summarizes the response methods against the classification groups.

The table is applicable for methods against HNS releases only								Solid Subst F	Solid Subst FD		Solid Subst D	Solid Subst SD	Solid Subst S
		Gas		Liquid									
Group	Method	G	GD	E	ED	FE	FED	F	FD	DE	D	SD	S
Forecasting													
F1	Forecasting spread in air	X	X	X	X	X	X			X			
F2	Forecasting the spread on water surface					X	X	X	X				
F3	Forecasting the spread in water body		X		X		X		X	X	X	X	
Monitoring													
M1	Monitoring the spread in air	X	X	X	X	X	X			X			
M2	Monitoring the spread in water body		X		X		X		X	X	X	X	1
Combating methods													
C1	Combating water soluble gas clouds		X										
C2	Combating spills that float on water							X					
C3	Combating spills that dissolve in water		X		X		X		X	X	X	X	
C4	Combating spills that sink to the bottom											X	X

1 It may also be appropriate to monitor sinkers that move over bottom in the water body

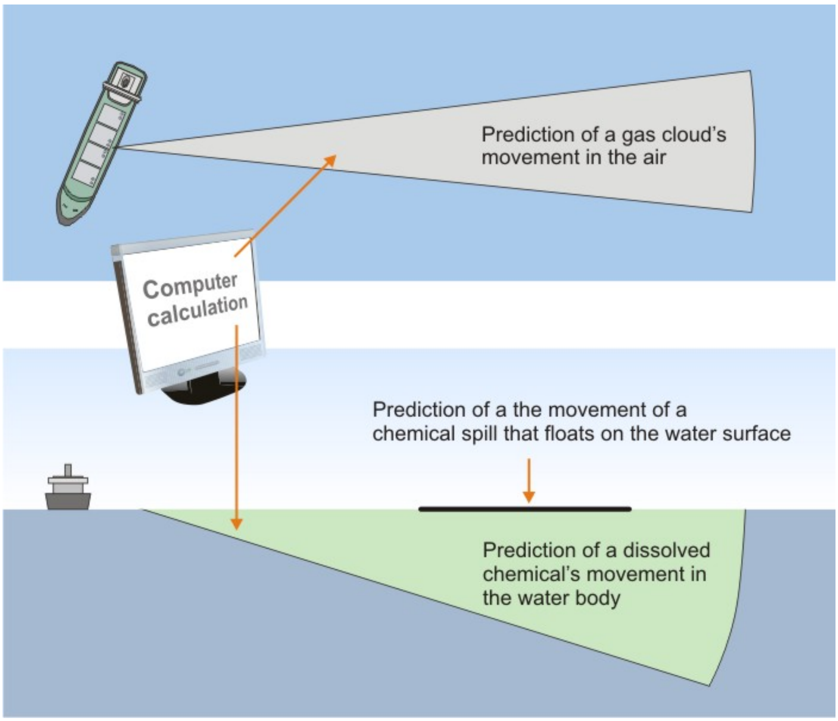
(c) Response – Forecasting

Forecasting can be sub-divided into three sections:

- F1 – Forecasting the spread of in air
- F2 – Forecasting the spread on the water surface
- F3 – Forecasting the spread in water body
- Forecasting HNS that sinks is a separate problem to consider.

(d) Response – Simulation Models

To get image of the response, following simulation model, prepared by IMO, shall be shown to trainees.



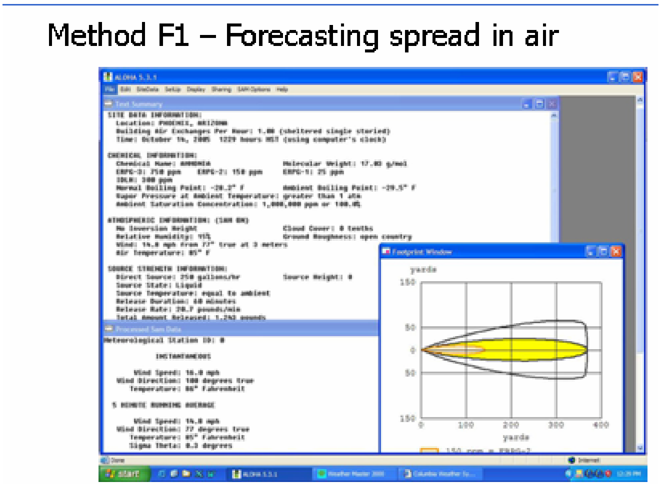
Trainees are reminded that the reliability of a computer simulation depends on:

- The accuracy of the input data.
- The skill and expertise of the user.
- The validity of the model.

Trainees are also reminded to be aware that any model is a simplified version of the reality it attempts to simulate. As an example, it should be explained to trainees that forecasting models simplify the behavior of clouds of evaporated HNS by ignoring the effect of the underlying terrain (calm or rough). Trainees should remember that the model may be too simple to adequately forecast the behavior of the HNS in a real world. On the other hand, realistic models may be very complex and require a lot of information to be collected and inputted. Special training or expertise will be required to use such models.

(e) Response – Forecasting – F1

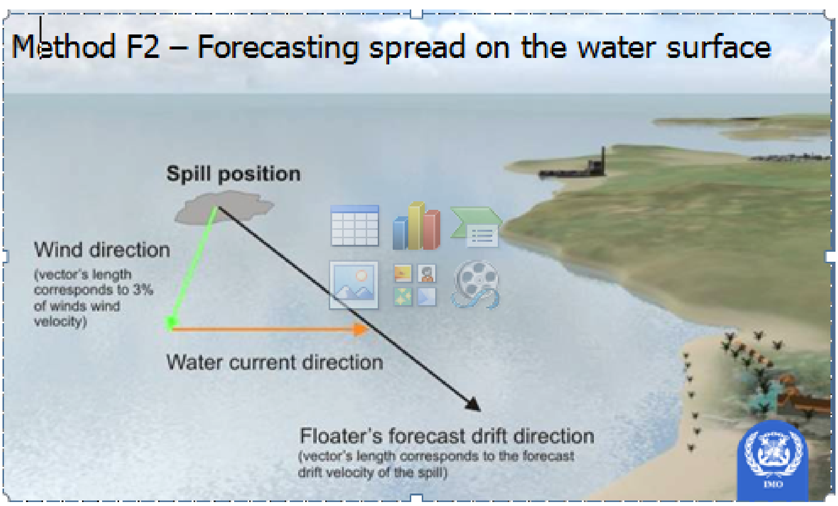
Method F1 – "Forecasting spread in air" is used to forecast the spread of gas clouds from volatile liquids (groups G and E) and from flammable and toxic HNS. Trainees should note that computer models are used to predict the movement of gases under different scenarios. Tables, shown below that predict the spread of the gases, are produced and can be used to provide estimates of spread in an emergency.



Quantity released	Health Risk		Fire/Explosion Risk
	Ammonia, vinyl chloride, chlorine	Methane (LNG), propane, butane, ethylene, butylene-butadiene	Ammonia, vinyl chloride, ethane(LNG), propane, butane, ethylene, butylene-butadiene
tonnes	Metres/nautical miles downwind	Metres/nautical Miles downwind	Metres/nautical miles downwind
0.1	1 000 / 0.62	200 / 0.12	200 / 0.12
1	2 000 / 1.24	400 / 0.25	400 / 0.25
10	5 000 / 3.11	1 000 / 0.62	1 000 / 0.62
100	10 000 / 6.21	2 000 / 1.24	2 000 / 1.24
1 000	20 000 / 12.43	4 000 / 2.49	4 000 / 2.49

It must be stressed to trainees that these estimates are no substitutes for monitoring, as the models cannot take into account the specific atmospheric and physical conditions at the time of the incident.

(f) Response – Forecasting – F2



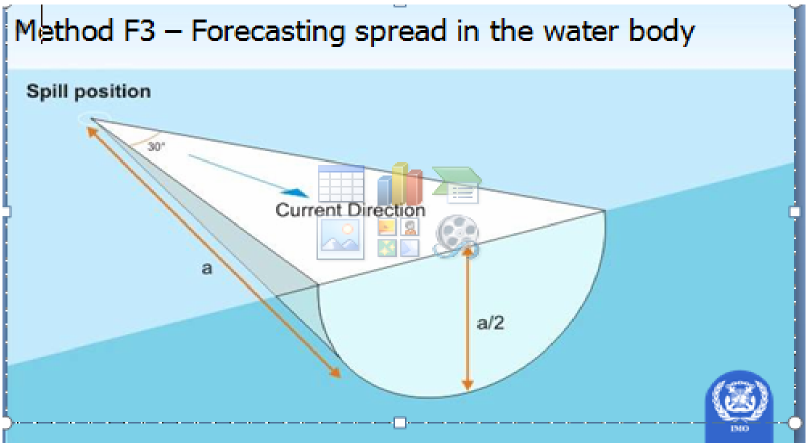
Slide show below, which is also prepared by IMO shall be used to explain to trainees about Method F2. Method F2 is used to forecast the spread on the water surface of floating HNS – group F.

Trainees are reminded that:

- A simple vector diagram is used to calculate the effects of wind and current on a spill. This simple model does not take into factors such as evaporation or dissolution into account, but assumes that chemicals belonging to sub-groups, FE, FD, and FED will disappear within 10 hours approximately.

(g) Response – Forecasting – F3

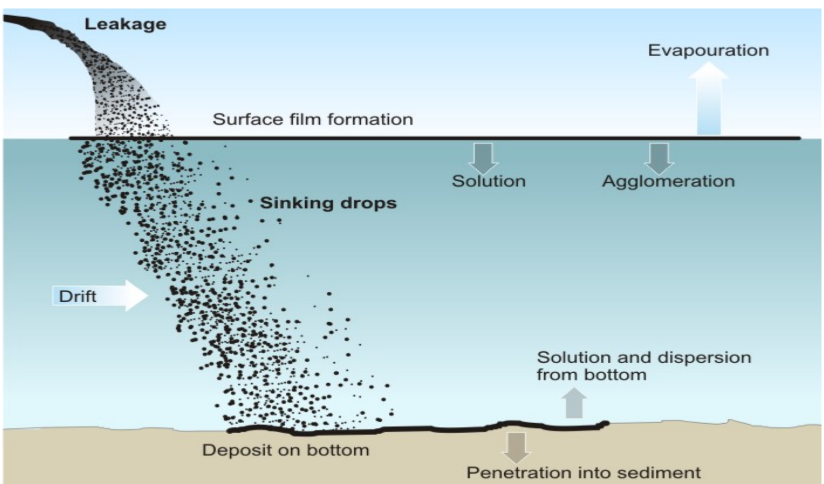
Slide shown below, which is also prepared by IMO, is used for telling trainees about Method F3.



Method F3 is used to forecast the spread of group D HNS in the body of water. It is a simple geometric model and it is dependent on knowing the direction of the current. It cannot be used in stagnant water.

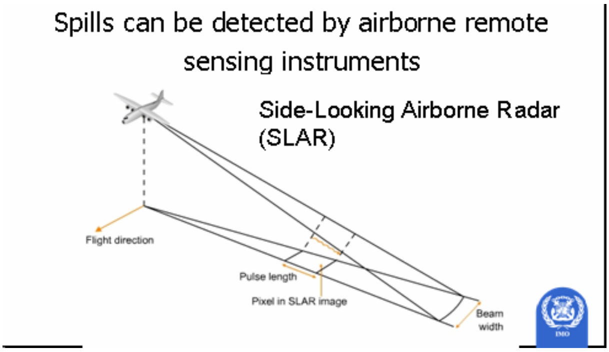
(h) Response – Forecasting Chemicals that sink

Forecasting the spread of chemicals that sink (group S) is very difficult because of the large number of interacting factors that influence the process such as the density of the chemical, and the degree to which it evaporates, drifts, dissolves, and penetrates the bottom. To assist the trainees to get the correct image, following slide shall be used for explanation:



(i) Response – Monitoring – M2

Spills can be detected by airborne remote sensing instruments. To assist trainees in getting clear image about this Monitoring method – M2, slide prepared by IMO, is to be used as follows:



(i) Aerial reconnaissance

It may be possible for HNS surface spills to be detected and monitored by various types of airborne remote sensing instruments, depending on the substances' properties. Remote sensors function by detecting properties of the sea surface: color, reflectance, temperature, or roughness. Pollutants can be detected on the water surface when it modifies one or more of these properties. Cameras, relying on visible light, are widely used, and may be supplemented by airborne sensors, which detect oil outside the visible spectrum and are thus able to provide additional information about the substance. The most commonly employed combinations of sensors include Side-Looking Airborne Radar (SLAR), downward-looking thermal infra-red (IR), and ultra-violet (UV) detectors or imaging systems. All sensors must be calibrated and require highly trained personnel to operate them and interpret the results.

(ii) Satellite imagery

Satellite-based remote sensing systems have had some success in detecting oil spills and should also be able to detect HNS spills on water. The sensors on board are either optical, detecting in the visible and near infra red regions of the spectrum, or use radar. Optical observation of spilt HNS, by satellite, requires clear skies, thereby severely limiting the usefulness of such systems. SAR (Synthetic Aperture Radar) is not restricted by the presence of cloud, therefore, is a more useful tool. However, with radar imagery, it is often difficult to be certain that an anomalous feature on a satellite image is caused by the presence of HNS. Consequently, radar imagery from SAR requires expert interpretation by suitably trained personnel to avoid other features being mistaken for HNS spills. To date, operational use has not been possible because of the time intervals between satellite overpasses and the time necessary to process the data. However, such imagery can be used later to complement aerial observations and provide a wider picture of the extent of pollution. It is a simple geometric model and depends on knowing the direction of the current. It cannot be used in stagnant water.

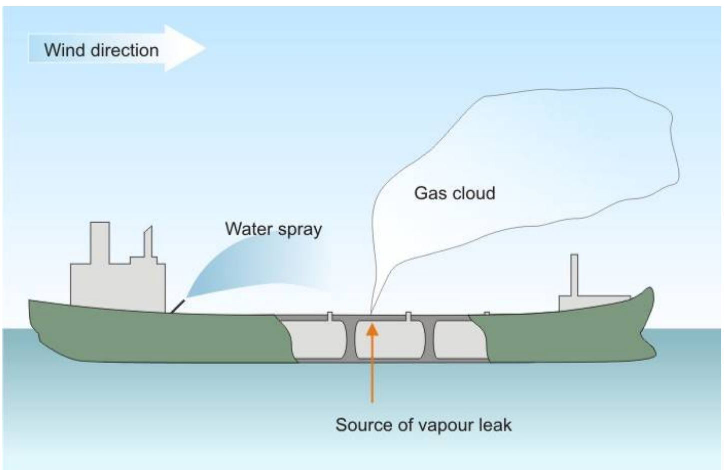
(j) Monitoring methods – miscellaneous

Occasionally unusual substances such as radioactive or infectious substances need to be monitored. Only specialist personnel should be engaged for this type of work. And finally, the principle of canine olfaction is the ability that trained sniffer dogs have to detect trace gases at concentrations lower than those that can be detected by monitoring instruments.

(k) Response – Combating

It should be explained to trainees, by using slides, that combating can be sub-divided into four sections as follows:

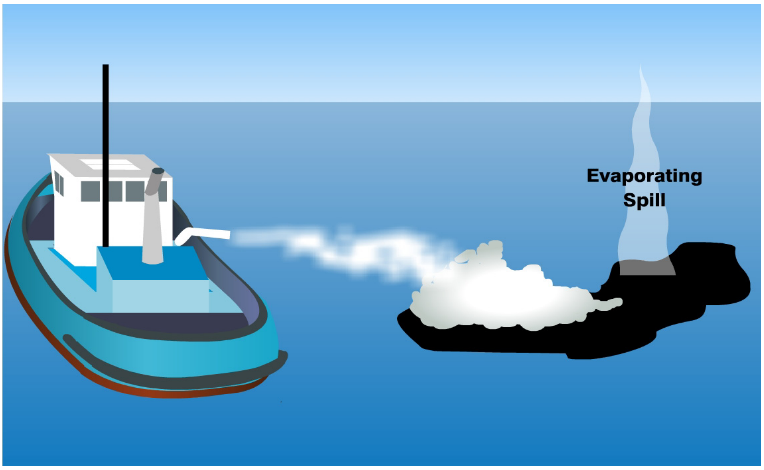
(i) C1 – Combating water soluble gas clouds



Small gas clouds can be 'knocked down,' washed out by water sprays produced by the on-board pumps. This method can be used with any water soluble gases, such as ammonia and sulphur dioxide. It can also be used against non-water soluble gases to reduce the risk of fire and explosion by cooling down hot surfaces, and suppressing sparks and flames.

(ii) C2 – Combating spills that float on water

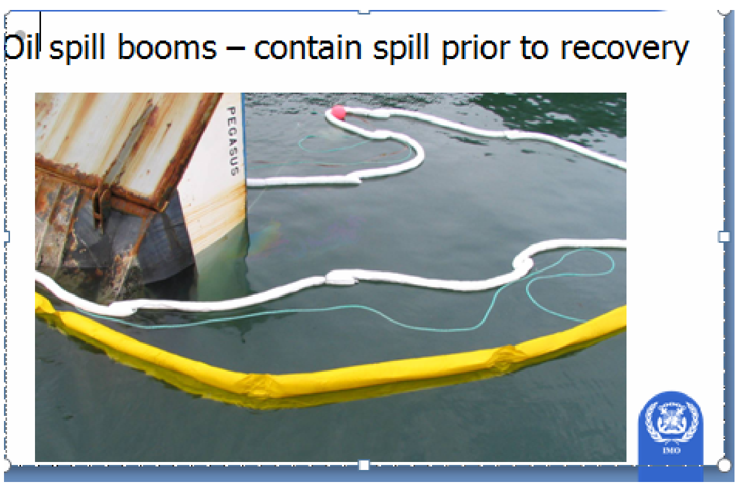
Spilled HNS that floats on the water surface will spread and form a large contact surface in the air. Depending on its vapor pressure, it may evaporate rapidly and produce high gas concentration. When responding to floating chemical spills on the water surface, it is therefore, especially important to monitor air concentrations, in order to assess fire and explosion risks as well as danger to health.



Group F substances, which evaporate quickly, should be treated with foam to reduce vaporizing, and risk of fire and explosion. Those that do not evaporate easily can be treated with sorbents and some other types of treating or gelling agents that make the spill thicker and easier to collect.

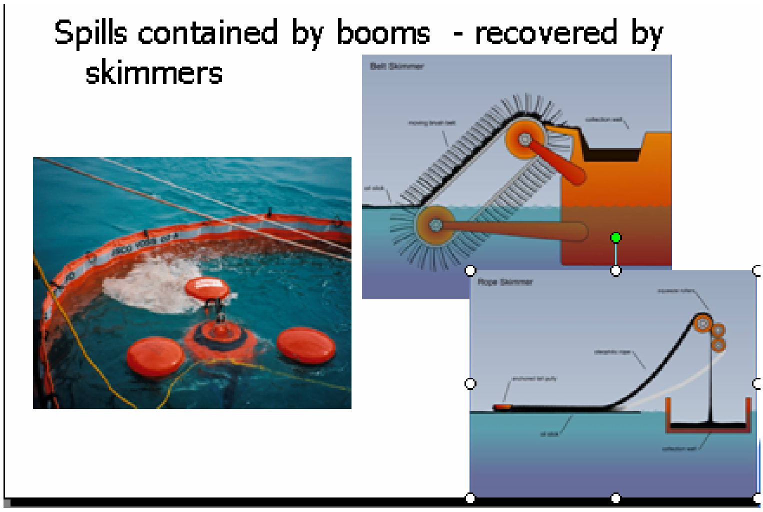
For trainees' guidance, photo of sample sorbents shall be shown.

As shwn below, some spills can be contained by booms (for a short time only, due to chemicals' generally low viscosity), before being picked up by recovery equipment.



During all such response work, special attention must be given to risks of health, fire, and explosion. On some occasions, these risks can be reduced by covering the spill with foam as previously pointed out.

Recovery of floating spills, using various types of skimmers.



This method consists of applying certain types of skimmers on the floating spill. It can be applied to spills of substances that float on the water surface and do not evaporate or dissolve significantly. Vortex systems can be used for the recovery of chemicals on the water surface in the same way as light petroleum products. The chemicals should not be pre-treated with response agents when applying vortex recovery systems. Belt skimmers have turned out to be usable for recovery of certain chemicals, e.g. octanol and dioctyl phthalate. The process may sometimes be facilitated by pre-treatment with e.g. sorbents. Sorbent rope systems can sometimes be used to pick up chemical spills from the water surface. When using these systems, the chemical should not be pre-treated with any response agents.

Recovery of floating spills using polypropylene sorbent plates or pillows

This method involves distributing sorbents over the floating spill on the water surface for the recovery of the sorbent-spill mixture. Sorbents can sometimes be used for chemical spills on inland or coastal water surfaces. Normally, they are useless in the high sea. There are a lot of different sorbents, designed for chemical spills, available on the market. These agents have various appearances and compositions. Most of them are aimed and tested for spills on land, but only a few are suitable for absorbing spills from the water surface. It currently appears that the most efficient products are made out of polypropylene. This polymer is available as foam plastic plates or felt-like pieces that can be easily distributed over the spill. Alternatively, powdered sorbents are packed in pillows to make them easier to distribute. To give an image to the trainees, slide shown below shall be used for explanation.

(iii) C3 – Combating spills that dissolve in water

A spilled chemical, which dissolves in water, will form a growing "cloud" in the body of water. It is important to monitor the concentration gradients in the cloud to track the chemicals' spread and drift, in order to judge the hazards for the environment, fishery, recreational areas, fresh water intakes, etc.

HNS spills that dissolve in shallow water may sometimes be mixed in with various treating agents in order to reduce deleterious effects on humans and the environment. Examples of such treating agents are:

- Activated carbon
- Oxidizing agents
- Reduction agents
- Complexing agents
- Ion exchangers
- Floculating agents

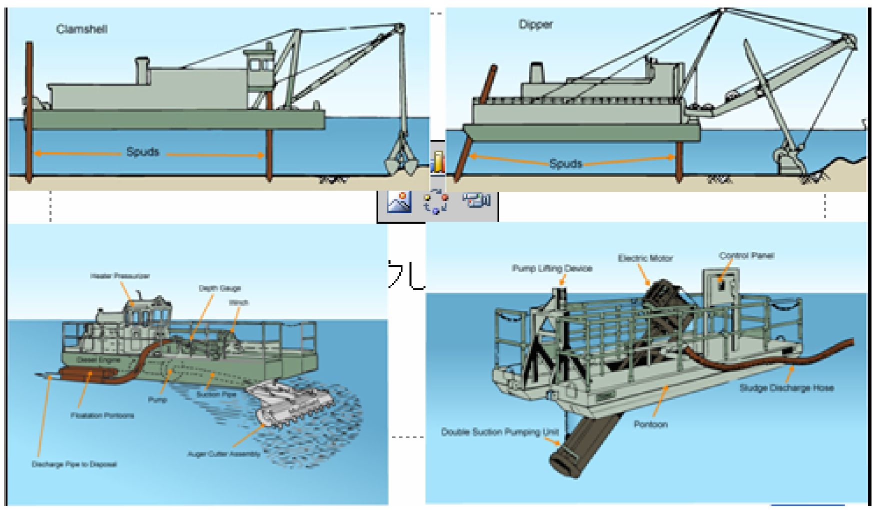
Flocculation agents, gelling agents, activated carbon, complexing agents, and ion exchangers can also be used for the treatment of mixtures of chemicals and water that have been recovered from a spill site and pumped into barges or other intermediate storing containers. Activated carbon is often used in this way and is a well-known, efficient agent for absorption of many different organic chemicals. Releases of acids and bases in streams, creeks, and rivers have, on some occasions, turned out to have devastating ecological effects, even with a relatively small volume. The explanation of the seriousness of the impact of such a spill is that even in a momentary or short time occurrence, it can form a relatively concentrated "cloud" that moves downstream, and damages or destroys the life in the water, all along its course. Spills of acids and bases in confined water areas should, therefore, be quickly located, mapped, and treated with neutralizing agents.

As shown below, the following neutralizing agents have turned out to be suitable choices:

- For spills of acids - sodium acid carbonate (sodium bicarbonate, nahco3)
- For spills of bases - sodium dihydrogen phosphate (monosodium phosphate, nah2po4)

Adding treating or neutralising agents

(iv) C4 – Combating spills that sink to the bottom



Discharges of chemicals that sink to the bottom can heavily contaminate the impacted bottom sediments. Careful planning should be done for such occasions and decontamination work. A more sophisticated system may be needed to take care of and clean the contaminated sediments. Sunken spills on the bottom can be recovered by different kinds of dredging techniques and there are various types of suitable dredges.

Lesson M–7: Media Awareness

It should be emphasized to trainees that they shall never ignore the media and always pay attention to the media so that the response may be better understood by them, and get supportive actions from the media.

(1) Different types of media communications

To establish good relationship with the media, trainees should fully understand following points:

(a) Newspapers

- Newspapers will conduct in-depth reporting.

- They will also require detailed information, pictures, and graphics.
- They also require background information concerning the incident,
- They must meet deadlines. The deadline for the morning papers is the previous evening and the deadline for the afternoon papers is mid-morning.

(b) Radio

- Radios have very tight deadlines.
- They conduct hourly or half hourly reports.
- Radio news is frequently updated and the reports are kept brief.
- They keep the emphasis on what is happening right now.
- They will try to conduct on the spot interviews.
- They also try to contain live sounds.
- They feature only the most important facts.

(c) Television

- Television messages are very visual.
- Information spots are kept short and often rely on satellite space.
- Interviews can either be in-depth in the studio or brief at or near the incident scene.
- Press conferences are to be held regularly.

It is also important for trainees to remember that, in these days, much of what appears in the media will also appear on the internet.

(2) Factors involved in successful handling of the media

It is important that trainees are lead to recognize that. The media can be a very effective way of ensuring that the public is well informed about the incident and its effects. This is the reason why careful handling of the media is important. You must ensure that the media gets the correct information, and that means that it must come from you as opposed to from unauthorised sources of information. It is essential that the authorities provide the media with information it needs to do its job and tell its story. It should be remembered, by the job of the OSC and any Media Liaison Officer, that they are to provide the media with as much of the truth that is known, at the specific time. The unfolding nature of the information should be recognized. This is often the case, after an HNS spill, that the full story is not always known. This is particularly true when the response team is investigating the cause, impact, and nature of the spill.

The key point is "be aware and be prepared for the potential interest and size of the media contingent." There are many factors that can influence the size of the media contingent. On some occasions, the media may only be interested in the identity of the polluter, however, in other cases there may be a threat to wildlife or coastline, which will attract more interest. It is important to schedule regular briefings and updates. Briefings should be held once or twice a day, and updates should be posted as required. Be always conscious of the media deadlines, and make response authorities and their technical experts available.

Press releases should be provided regularly during the incident response. A good press release will contain the following:

- The facts as known with no speculation.
- Emphasis on the positive points.
- Use of understandable language (avoid technical jargon and acronyms).
- Provision of an enquiry route to where the media can get more information.

Additional tools that can be used to supplement news releases include background information, fact sheets, and media kits. It should be emphasized to trainees that this is especially important when trying to explain technical issues with which the public is not conversant. These can be prepared ahead of the incident as part of the preparedness and planning. It is also important that facilities are provided for the media. This should include establishing a media center with background, pictures, charts and updates, telephones, fax machines, outlets for laptops, and a workspace. Parking facilities for specialized communication vehicles should also be considered. Always try to provide the media with tours, but always escort them through the response areas to avoid unrestricted access to response sites and personnel, and to ensure that all safety precautions and standards are observed.

(3) Guidelines for a successful media interview

It should be reminded to trainees that they should remember the seven key elements to a successful interview, assuming that a trainee for the possible managerial level is acting as an OSC.

(a) **Preparation** – OSC must define its own needs and objectives in advance. It is important that OSC identify the public's concerns so that OSC can address them properly. OSC should memorise OSC's principle message and key points. Make sure that OSC plans the interview, writes a list of points that OSC wants to make, and not be afraid to repeat OSC, if it have to. Identify opportunities that the interview may present. Be succinct, to the point, and not longwinded. Anticipate questions and keep your answers short and simple.

(b) **Positioning statement –** It is important to decide, in advance, what the key message of the interview is. This is what you want to see in the first few lines of a news story. Explain why OSC is there, what OSC's efforts will accomplish, and who will benefit.

(c) **Negotiate the interview –** Where possible, negotiate the topics and types of questions beforehand. Explain OSC's role, responsibility and limits, and obtain agreement to stay within those limits. Ask the reporter for their name and what station they are with. Find out what subject they are interested in and what angle they are working on. Find out who else they have or have plans to speak with. Find out when this story will be run or aired, and what their deadline is. If OSC can find out of all this, then OSC will be much better prepared. Most important of all, expect the unexpected.

(d) **Use of quotes and sound bites –** It is important to keep these short. Try to keep it to 15 second sound bite, and break the words into short self-contained units for easy editing. Leave out adjectives. What may be a small spill in industry terms may be a large spill in journalistic terms or the public's perception.

(e) **On the record and off the record –** As far as this is concerned, consider every word OSC say as being on the record. Remain on the guard at all times as journalists are never off duty. Comments that are supposedly made off the record have a habit of turning up in print. In a major news story, the media will be present everywhere, especially in hotels. Hotel lobbies and restaurants are very useful fishing grounds for information.

(f) **Handling difficult questions –** If a difficult question is asked, it is important not to lose temper or show that OSC is finding the situation difficult to deal with. Stay calm and be polite at all times.

(g) **Look and act the part –** It is important to look and act the part. Dress appropriately for the occasion and reflect the mood of the information that is being divulged. If it is serious, then look serious, and if the situation is improving, then look relieved.

(h) **One on one interviews**

Trainees are instructed to remember that one on one interviews generally fall into two categories:

- On the spot / stand up interviews – These are usually in the field or at the command post and can be arranged with little or no warning. The OSC or the other responsible persons may have little or no time to negotiate the interview, and it may be live with many reporters in competition .

- The personal interview – In this scenario, advance warning should be given and time to negotiate the interview. The OSC or the other responsible person should also have time to prepare. This interview should take place in comfortable surroundings, probably with just the one interviewer and be focused on predetermined topics. These interviews are good opportunities to deliver the OSC's message, with the aid of drawings.

(i) Key points to be followed for effective news conference

Trainees are educated to remember certain key points when preparing for news conference:

- Make sure that everybody is ready, especially TV cameramen, before making the opening statement. It may be possible that request for reading the opening statement again for someone wanting a different location, a latecomer, or a TV crew with equipment problems. Limit the time available for such request.
- Hand out a prepared statement. Make a concise summary of what it contains.
- Tape the speaker (or other response person), whether talking to one reporter or one hundred. Be open about it. Bring out the recorder and then switch it on, and without commenting, start the news conference. If asked about the recorder, clearly state that it is corporate / government policy.
- When inviting questions, ask journalists to give their names and organization, and try to remember them. Write them down, if possible.
- If an immediate answer is not available on hand, then clearly state it as such with the offer to obtain the information as soon as possible. If a question cannot be answered for policy reasons, then clearly state it as such.
- If arrangement is made to speak with a reporter or provide information, be sure to be punctual.

(j) Common questions asked

Explain to trainees that following common questions are usually asked at the news conference, so that they may be well prepared for the conference before the interview:

(i) Types of the first questions that could be asked at the new conference:

- What happened?
- How did it happen?
- When and where did it happen?
- Who is involved?
- What caused it?
- What is being done about it?
- Who is to blame?
- Who is responsible / liable?

(ii) Additional questions that could be asked at the news conference:

- What operations are going on?
- Has it happened before?
- Was it preventable?
- Are there any witnesses?
- What is the impact?
- What are the health and safety risks?
- Is anyone injured?
- Do we need to evacuate?
- How much will it cost?

(k) HNS incidents

It should be repeatedly told to trainees that there are specific public concerns, during HNS incidents, which the media will usually focus on. In comparison to oil incidents, with which the public is more familiar due to greater exposure from media coverage of high profile incidents, chemical incidents hold greater fears in the public. This stems from a heightened sense of alarm, and the comparisons with chemical and biological warfare, terrorism attacks, and nuclear emergencies. Terminology used such as what is the substance involved, what does it do, and how can it harm me, is often not understood and the words convey a sense of alarm. This, coupled with the very real dangers posed by some substances, can be very alarming and the public may be drawn, or directed, to media sources for the latest information. This may include safety messages such as instructions to remain inside with all doors and windows closed or to evacuate. HNS incidents and the response to the incidents may be very visual, and the sight of ruptured and burning tanks, response personnel in gas suits, and emergency vehicles can also convey a sense of alarm and fascination. Equally, given the physical behavior of some substances, there may be little to see, which in turn can raise fears over “hidden” dangers.

(l) News Conference – Do’s and Don’ts

(i) Do’s

- Prepare positioning statement and key messages, and keep returning to those key messages. Communicate information at the earliest.
- Keep track of what was being said during the interview.
- Answer reporter’s question, but return to the key message.
- Stay cool, calm, and clear headed.
- Give the full story.
- Be honest, accessible, and understanding.
- Ask for the questions to be repeated, if you don’t understand them.
- Put the story into context.
- Define the real problem.
- Stick to what you know, the facts.
- Break bad news.

(ii) Don’t's

- Don’t be sarcastic.
- Don’t lose your temper.
- Don’t speculate.
- Don’t offer a personal opinion.
- Don’t lie.
- Don’t give exclusive interviews.
- Don’t be evasive.

After the recognition of media awareness, including the news conference on Do’s and Don’ts, exercise shall be held inside a classroom by selecting volunteers for a role-play, so that trainees may confirm their knowledge about the media awareness so that they may take proper actions.

For easier simulation of interviews, following sample scenario of an extreme case may be used. Before going into simulation, explain to the class what shall be in the exercise, simulation of an interview between a reporter and the OSC of HNS response. And, instruct trainees to write down any problems with the way the OSC is portraying themselves, and ways in which they can improve. Alternative suggestions for what they could say. Trainees should bear in mind that this example is rather extreme in order to emphasize the points already explained in the lesson. After the interview, discussion will take place in class.

Give the volunteer a card with the interview questions on them, and start the simulation.

- [Trainees]: How serious is the spill?

- [Teacher/Instructor]: Well, I'm not really too sure about that. It might be very small, even insignificant. On the other hand, it might be very big, or even with the possibility of being catastrophic.
- [Trainees]: Who is responsible?
- [Teacher/Instructor]: Well, personally, I think it could be the transportation company.
- They have.......um.........well, that's what I think.
- [Trainees]: Is it possible that, maybe, other companies may be involved and are responsible? Perhaps, even your own company?
- [Teacher/Instructor]: (Angrily) That's ridiculous! Out of the question! Completely ridiculous!
- [Trainees]: What was the cause of the spill?
- [Teacher/Instructor]: (Sarcastically) The spill was caused by the substance leaking from the vessel.
- [Trainees]: Ok then, what caused the substance to start leaking from the vessel?
- [Teacher/Instructor] I really don't know. Maybe, it hit something, ran aground, or maybe there was some kind of problem with maintenance on the vessel. I don't know for sure.

On completion, ask the class following:

- First, ask the class if they thought it was a good interview. Then, ask them why they thought it was or wasn't. Write down their suggestions on a flipchart. Once complete, ask the class how he could have responded to the questions that was asked. Encourage suggestions from the class by encouraging individual students to answer, even if the answers are incorrect.

Lesson M–8: Contingency Planning

In this lesson. Trainees are to be educated to learn:

- The purpose of contingency planning.
- The main considerations in the development of a contingency plan.
- The essential elements of a contingency plan that will be applicable to their role.
- The various levels of response, and describe the typical procedures for the escalation of a response.

(1) The purpose of the contingency plan

Firstly, trainees are to be reminded that:

(a) Careful planning is essential for a successful operation

(b) When there is an accidental spill of HNS, or the potential for a spill, there are many different agencies and organisations involved, where each has a responsibility and a role to play.

(c) A well developed contingency plan contains basic requirements, and provides a policy and response framework for the government and/or the industry organisation to respond to an incident.

(d) It is important to have a plan in place as there are many issues, which are difficult enough that need to be resolved. With the added pressure of an emergency situation, these issues can become quite contentious.

(e) The plan will help the response team in fulfilling their role and ensure that a broad consensus of opinion has been achieved on response measures.

(f) The plan will meet or set legislative requirements, and is an important requirement under the OPRC-HNS Protocol 2000.

(2) Response Regime - Key Elements

It is important for trainees to recognize that a coordinating framework and a series of standard operating procedures must be established for administrations to ensure a safe, timely, and effective response Trainees are to learn that this will facilitate early definition of the specific commodities involved, reducing the potential magnitude of the incident. A "decision tree" approach can be used to initially evaluate the magnitude of the incident, and assign the incident to a specific category or level. The assigned level may then be used to determine the appropriate response mechanisms and to allocate roles and responsibilities. Key elements of an emergency response system are to be explained as follows:

Trainees should remember that the following components are based on a review of several national regimes and IMO guidance documents, and that the key elements should be considered as essential to any regime.

- Organizational arrangements: to provide a clear identification of roles, responsibilities, and capabilities.
- Planning requirements: to provide specific guidance in responding to an incident.
- Monitoring and reporting: to ensure all incidents are assessed, evaluated, and followed up as appropriate.
- Defined operational procedures: to allow a tiered response to an incident.
- Training and exercising: to provide response personnel with the skills necessary to do their job effectively and safely.
- Financial and liability arrangements: to determine financial responsibility and liabilities of the various parties involved.

(3) Organizational Arrangements

It should be stressed that, in any response regime, it is essential that the roles, responsibilities, and capabilities of the various parties be clearly identified. The fundamental issue with respect to roles and responsibilities is to establish clearly who has the burden of response. In other words, who is responsible for responding to an incident, including the implementation of response plans. Consideration must also be given to the many tasks throughout the development, implementation, and maintenance phases. Elements can be placed in four general categories, prevention, preparedness, response, and recovery/remediation. Some of these tasks are briefly outlined and explained to trainees.

(4) Prevention

Trainees should be reminded that activities directed toward prevention of incidents and reductions of their magnitude are critical elements in the emergency response regime.

Explanation should be made that, in addition to providing overall coordination, the administration may…

- Evaluate existing documentation, policies, guidelines, and legislation, to identify duplication and/or information gaps.
- Prepare relevant policies and legislative elements.
- Establish mandatory compliance requirements.
-

(5) Preparedness

Preparedness activities should be explained to trainees as activities that will enhance the ability to respond to emergencies. This involves a number of sub elements such as:

- Development of emergency response plans.
- Ensuring the availability of certain response resources and equipment.
- Training and fitness of personnel.
- Establishment of communication and alert channels, including among others, linkage with the media.

Trainees are told that preparedness should take into account the various scenarios, relevant to probable spills, based on risk assessments, the history of previous incidents, and the organizations and activities likely to be involved. Also trainees are asked to remember that preparedness should involve joint planning and training of those who may need to work together if an accident occurs, including industries and the surrounding communities. It is important to let trainees recognize the importance of the role the administration has in providing plans and expert assistance to ensure that operational center(s) exist for the collection of routine and emergency information. With regards to this administrations' role, it should be explained that incident monitoring and overall co-ordination should also be provided.

In addition to the above, explanation shall be made to trainees about the specific issues of concern including followings:
- To prepare relevant guidelines and policies.
- To define reporting procedures and incident reporting requirements.
- To prepare and implement periodic inspection and auditing protocols to ensure that appropriate equipment, systems, and procedures are being implemented and adhered to.
- To collect and disseminate information.
- To define emergency response planning requirements, response capability, and preparedness standards for vessels, facilities, and port/harbor authorities.
- To establish information databases pertaining to shipping information (e.g., stowage plans, bills of lading, ship passage, and ports of call), chemical and physical properties, and response protocols. The level of confidentiality required for this information must be established in conjunction with the relevant stakeholders.
- To create a "pool of experts" to act as an advisory group. Individuals with expertise in the following areas:
  - Navigation.
  - Ship technology.
  - Naval architecture.
  - Chemical hazards.
  - Marine biology.
  - Physical and chemical oceanography.
  - Dispersion modeling.
  - Spill response.
  - Fire lighting.
- To identify a coordination unit made up of individuals with proven expertise in the areas of emergency, crisis management, and transfer operations.
- To identify an operation center to provide access to information databases, standard operating procedures, advisory personnel, and communications equipment.
- To identify chemical response units.
- To train the personnel of the chemical response unit.
- To coordinate with IMO, international and national organizations, and information sources, both in routine and emergency situations.

Also, trainees are educated to recognize that planning requirements include the preparation of detailed and specific plans for responding to a marine incidents follows. International, multilateral, national, and local emergency response plans should be prepared to summarize roles and responsibilities for all parties, providing standard operating procedures, lists of available resources, etc.

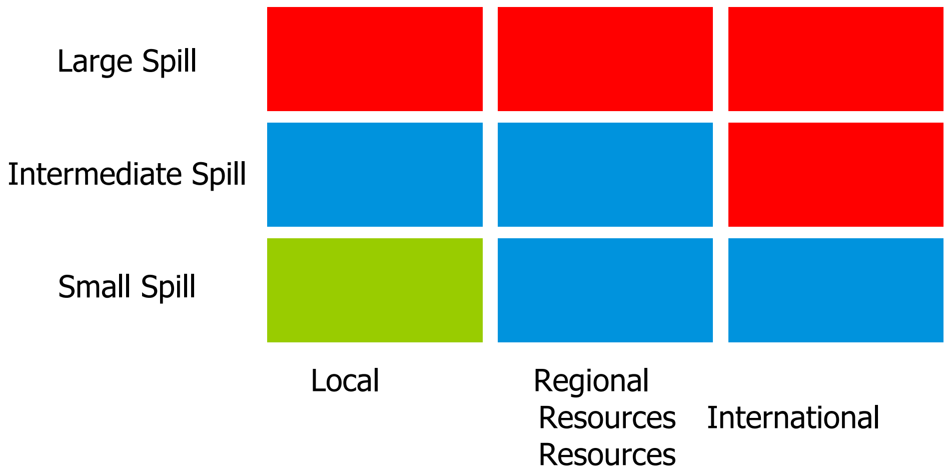
Furthermore, trainees are instructed to remember that plans are required at the following three levels:
- At an international level with the framework of an operational contingency plan.
- At a national level.
- At a local (e.g., for terminals and harbors/ports) and area level.

Should the magnitude of an accident be such that assistance is required, these plans should be integrated in such a way that it will be easy to incorporate additional response capabilities. For example, a port emergency plan should be coordinated with neighboring industrial facilities' plans as well as with the national plan.

At this stage, it should be explained to trainees that a tiered response is a categorisation of response levels as a practical basis for planning and organising. Explanation shall also be made that most contingency plans are based on this tiered response approach, which initially is small but is capable of expanding logically to higher levels, if the spill requires additional response resources. The tiers are estimated on spill size or spill damage potential.

- **Tier One** is a small localized spill. Plans for tier one should address local authorities, resources, and personnel. It can be for a specific facility such as a port or a terminal, or can be for a short length of shoreline, at risk from small spills. Resources are usually on the scene very quickly.
- **Tier Two** is for intermediate size spill overtaxing the capabilities of the local authorities and requiring further assistance. Tier Two plans are usually for a larger district or area where the mobilization of resources and facilities from both public and private enterprises would be combined to respond. Mobilization of resources usually occurs within few hours.
- **Tier Three** response is for large spills of national interest that are beyond the capabilities of the relevant Tier Two response.

Trainees are to be told that the numbered tier concept is one that was originally applied to oil spill incidents, but is also being commonly applied to HNS incidents. To assist trainees for easier and comprehensive understanding about this tiered response, the following image shall be shown:



(6) Monitoring, Reporting and Record-keeping

Before the concluding explanation, key facet of the preparedness process shall be explained. A key facet in the preparedness process is the establishment of reporting procedures that will indicate:

- Who is responsible for reporting?
- To whom reports are to be made?
- What format should be used?
- When reports are to be made?

The reporting procedures should be linked to an appropriate record- keeping process.

(7) Defined Operational Procedures

To ensure that appropriate and effective response is initiated in a timely fashion, trainees are asked to understand that it is necessary to develop clearly defined procedures for the critical assessment of marine accidents. Emphasis shall be made that it is most important that responsibilities and roles are clearly defined and operational procedures are properly coordinated. Consideration shall be given to various potential and possible scenarios. Trainees should also be reminded that it is necessary to integrate different response resources and incorporate lessons learned from actual incidents or exercises.

(8) Contingency Plan

It should further be explained that a contingency plan should consist of a minimum of four sections:

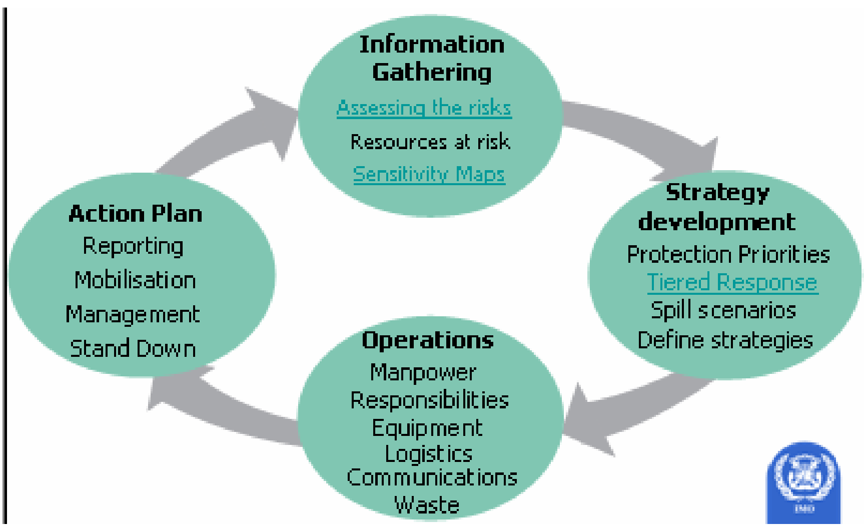
- **The introduction** will contain the distribution plan and any updates that have been made. It will also include the purpose, scope, and environmental policy of the plan.
- **The strategy section** describes the scope of the plan. The geographical coverage, the perceived risks, roles, and responsibilities of those charged with implementing the plan and the proposed response strategy.
- **The action and operations section** will set out the emergency procedures, which will allow rapid assessment of the spill and mobilization of appropriate resources.
- The data directory will contain the relevant maps, resource lists, and data sheets to support the HNS spill response effort.

It is necessary to explain to trainees that there are seven key steps to develop a contingency plan;

(a) Define the scope of the plan.
(b) Conduct risk assessments.
(c) Develop your strategy.
(d) Decide on the structure and layout.
(e) Procure appropriate equipment.
(f) Conduct training and exercises.
(g) Update your plan as circumstances change along with feedback from incidents or exercises.

(9) Information Gathering

This information gathering actions involve assessing the risks, identifying resources that could be at risk, and sensitivity maps. Information to be considered shall include historic data, HNS properties, climate, local meteorological, and environmental sensitivities. These are important factors in assessing the risk, behavior, fate, and potential consequences of an HNS incident. In producing a contingency plan, it is necessary to gather information about the factors, in order to develop appropriate response strategies that are considered to be the best to mitigate the threat. In order to explain to trainees how a contingency plan may be developed, details of some of the key components of a good plan, and the sequence of events shall be shown to trainees by using the following sample drawing:



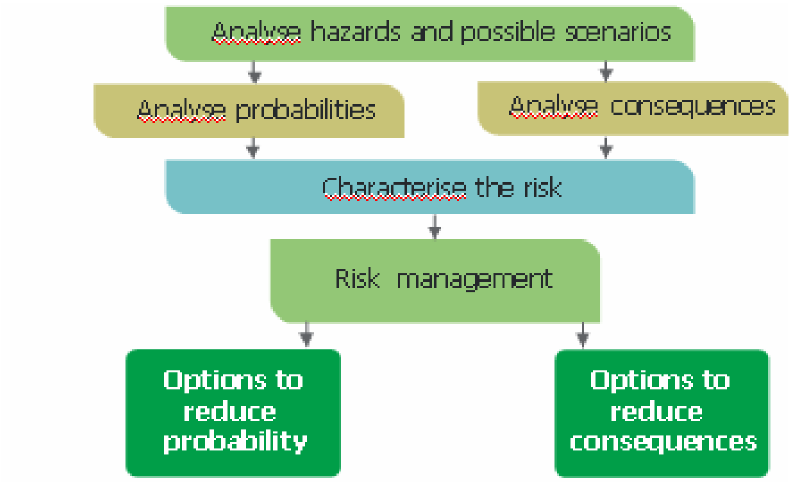
(10) Risk Assessment

The first step of risk assessment is to correctly identify all the hazards. Trainees shall be reminded not to be narrow-minded and to take all possibilities into account.

The second step is to analyze the probability of the incident or the aspect of the incident occurring. In addition, an assessment should be made of the potential damage, which could be done as a result of the hazards, and who they could affect.

The risk is then assigned a category. It will then need to be managed. It should be determined, whether or not it will be possible to control the risks with minimum costs and risk to health. It should then be determined what measures can be put in place, in order to reduce the consequences, if the full potential of the risk be realized.

In order to assist the trainees to gain more comprehensive understanding about risk assessment process, following flow chart shall be explained:



(11) Making Maps

Making and updating sensitivity maps are key activities in the planning process. These maps may be either paper based or linked into a geographical information system (GIS). The maps should convey essential information for both ecological and socio-economic resources, and indicate the priority for protection. Other information, including beach types, access points, and clean up advice, should be detailed on the maps. When using paper based maps, it is very important to keep the information simple and clear, with a view to avoid making the maps from becoming too cluttered and too difficult to interpret. Sensitivity maps should show various types of information such as classification of different parts of the shoreline and how sensitive they are to hazardous substances. Managers can look at sensitivity maps of an area, threatened by a spill, to quickly find the most sensitive locations. At the end of the lesson, reconfirm understandings by trainees about contents of this lesson, the IMO video – Response to Marine Chemical spills – Part 4. Contingency Planning, Operations, and Training will reinforce the lessons of this module.

Lesson M–9: Case History

In this lesson, IMO video series “Response to Marine Chemical Spills” shall be used for training trainees to consider each incident and to look more closely at the response.

Select two case histories of incidents involving HNS.

The first case history involves a bulk shipment of HNS. The second is a shipment of packaged HNS. We will look at the basic facts of each case and then discuss how to approach similar incidents.

(1) Anna Broere

On May 27, 1988, the Dutch chemical carrier Anna Broere, on her way from Rotterdam to England, collided with the Swedish container ship, Atlantic Compass. Atlantic Compass could continue its journey towards Antwerp, while Anna Broere was severely damaged and sank in the shallow water. The cargo of Anna Broere consisted of 547 tons of acrylonitrile and 500 tons of dodecylbenzene, of which the latter was not regarded as a marine pollutant and, therefore, was left untreated. Acrylonitrile is a liquid, which if spilled will dissolve and evaporate. It is highly flammable and is considered moderately toxic to marine living resources. It is not considered to bio accumulate and is assigned a MARPOL B category. In summary, it is considered a very dangerous chemical, both to humans and as a marine pollutant. Dodecylbenzene is a liquid, which if spilled, will float. It is not considered flammable, or acutely toxic to marine living resources, and does not bio accumulate. It falls outside of the MARPOL pollution categories.

An exclusion zone with a radius of 18 km and a height of 200 m was established.
Acrylonitrile was considered to be more harmful to the marine environment and priority was given to recovery of chemicals from the vessel.

Salvage operation to recover the acrylonitrile commenced with the help of a large floating crane. The initial plan was to lift a maneuver the vessel over the submerged main deck of a semi-submersible barge, and then transport the wreck to port. In the first righting and lifting attempt, the cables broke and the ship sank again. It was then decided to saw the ship in two, to tranship underwater the acrylonitrile from the leaking tank, and to lift the two sections separately.

The salvers mobilized a fleet, which include a floating crane that acts as an accommodation base, a semi-submersible barge, a vessel outfitted as an emergency hospital with a medical evacuation helicopter, and a technical support/chemical monitoring vessel. Salvage workers were equipped with PPE (i.e. protective clothing and SCBA). The crane was fitted with an automatic gas alarm system. Chemical specialists also formed part of the salvage team. Naval frigates patrolled the area.

Both parts of the ship were eventually lifted, and about half of the acrylonitrile was recovered. The other half had leaked out and quickly dispersed into the sea. During the operation, the concentrations of acrylonitrile in air and water was continuously monitored due to the safety of the personnel. The entire operation lasted 73 days, of which only 25 were productive working days. Delays were caused by bad weather and high concentrations of HNS in the atmosphere. Sampling of the seawater and air around the area of the wreck showed dangerous levels of acrylonitrile, indicating that a tank might have been breached.

(2) Cason

This is a very interesting incident. It is a very complex situation, primarily due to the variety of substances onboard, but useful as an example of assessment of priorities in a response incident. The MV Cason was a general cargo ship on a voyage from Antwerp to Shanghai on November 1987.

She was carrying over 1,1000mt of packaged chemicals (23 Different types and covering all IMDG code groups except 1, 5, and 7) and 750mt of Heavy fuel oil. She caught fire in bad weather about 20 Nm from La Coruna in N Spain. The crew abandoned ship very quickly due to fears that drums loaded with sodium metal coming into contact with water, violently reacting and exploding. Regrettably, only 8 of the 31 crew survived and this was primarily due to exposure to the low water temperature and the lack of personal protective equipment.

She drifted ashore off Cape Finisterre, close to a town of over 20,000 people. The ships bottom was damaged and water had entered a number of cargo holds. The ship was severely damaged and the environmental and human situation became critical. Some pictures of the case shall be shown to trainees to assist their understanding about the seriousness of the incident.

There was limited information available on the vessel's cargo and both the IMO and the European Union were asked to assist in identifying the cargo. Without having any immediate information concerning the cargo, it was very difficult to evaluate the risks.

The cargo aboard the ship included about 1,100 tons of packaged HNS as well as 750 tons of bunker fuel. Of the 23 different kinds of substances, only IMDG Codes 1, 5, and 7 were not represented. The presence of 126 tons of sodium metal, together with 600 tons of highly flammable liquids and 750 tons of fuel, created an explosive/flammable cocktail as in the case of the sodium-water contact. Many of the drums containing sodium were damaged, resulting in fire and explosions.

Table. List of Cargo on Board of MV "Cason"

SUBSTANCE	QUANTITY Mt	IMDG NO	UN NO
n-Butanol	228	3.3	1120
Xylenes	254	3.3	1307
Cyclohexanone	8.6	3.3	1916
Formaldehyde	86	3.3	1198
Sodium Metal	126	4.3	1428
Aniline oil	110	6.1	1547
Diphenylmethe 4.4 Diisocyanate	0.7	6.1	2489
Ortho cresol	110	6.1	2076
Bunker fuel	750	X	1270
Phosphoric Acid	50	8.0	1805

It was decided that refloating would be too difficult due to the bottom damage caused by the grounding. The vessel was, therefore, discharged in situ, albeit with difficulty due to bad weather.

The following plan of action was prepared as a result of a survey done on board:
- Discharge the sodium drums from the deck.
- Discharge the hold containing the other drums of sodium.
- Unload the dangerous goods located on deck, giving priority to the most polluting substance.
- Transfer the bunker fuel.
- Unload the good from the holds, beginning with the most hazardous materials.

Sea and air monitoring were conducted at the start of the salvage operation. The recovery of dangerous goods was completed within three months. One main problem that arose during the emergency was the issue of dealing with the media. Uninformed declarations made by individuals and different authorities led to panic among the population living in the vicinity of the coast. This resulted in a massive evacuation of people (15,000) living in the proximity of the accident (5 km radius).

Lesson M–10: Training and Exercising

At the end of this training, trainees are asked to run tabletop exercise to reconfirm and reinforce the understandings gained from the lessons stated in this manual, that are necessary for responsible officers to do their jobs safely.

(1) Mette Jorgensen

Tabletop exercise is run by using the case of MV "Mette Jorgensen", and the following necessary data are information sheets are distributed to trainees. Trainees are reminded that this is just an example and shall, in no way, be regarded as the complete model. Response always followed by response officers regardless of the extent of incidents.

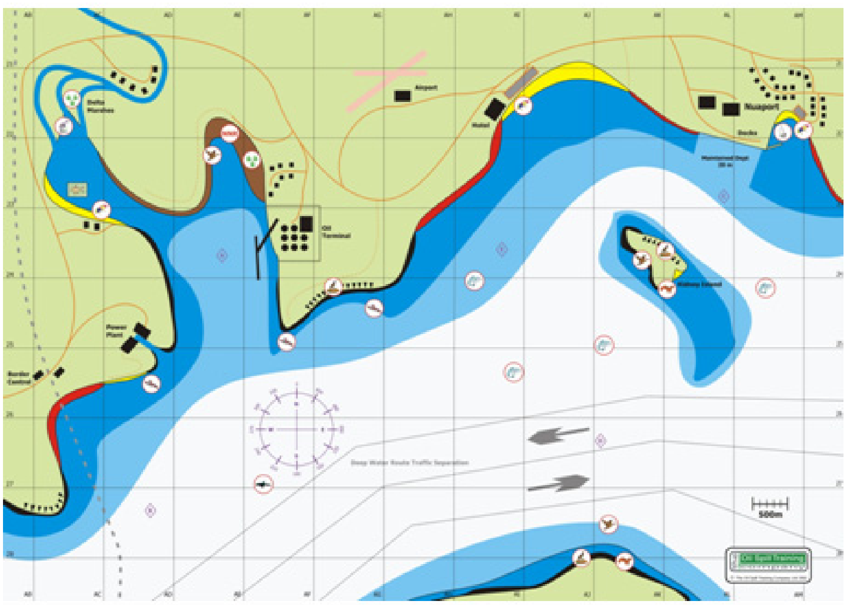


Figure. Map.

(a) Objectives of the Exercise

You are the responsible authority for this area. You will need to put into practice all that you have learned on the course to respond to an incident in Nuaport, in a realistic manner.

(b) How to Play

- Injects will be projected onto this screen.
- The exercise will be run in accelerated time.
- You must respond as a team to the incident with the resources available.
- All actions must be recorded. If it is not written down, it hasn't happened.

(c) Material distributed trainees

Following materials are delivered to trainees for this exercise:

- Nuaport Chart
- Chart Key
- Organisation Chart
- Log Sheet
- Equipment Availability Sheet

For easier guidance, materials are attached to this manual and marked as Attachment No. 1, 2,3,4, and 5.

① **First Step**

- Appoint your On-Scene Commander.
- Assign roles and responsibilities (stick to your roles during the exercise).

② **Radio Message**

Time: 0635hrs
From: MT Mette Jorgensen
To: Nuaport Port Control

This is MT Mette Jorgensen, just departed Oil Terminal, proceeding to join Traffic Separation Scheme at AG-275, hence eastbound to sea. Pilot onboard.

③ **Weather report**

Time: 0637hrs
Nuaport Control Weather Report
Wind Direction: 210o
Wind Speed: 12 - 15 knots
Visibility: Good
Air Temperature: 130C
Sea Temperature: 110C
Sea State: Slight - Moderate
First Light: 0730hrs

④ **Radio Message**

Time: 0640hrs
From: MT Mette Jorgensen
To: Nuaport Port Control

In position AF-260, fire alarms sounding from engine-room and experiencing some power and steering difficulties.
Crew investigating.
Trying to head north to anchor. Need tug assistance.
Pilot launch standing-by.

⑤ **Radio Message**

Time: 0641hrs
From: Nuaport Port Control

To: MT Mette Jorgensen
Tugs alerted and proceeding.
Nua Tug No. 1. In position AM-250. ETA 30 minutes
Nua Tug No. 2 In position AM-265. ETA 30 minutes
Nua Tug No. 3 Alongside Nuaport. ETA 50 minutes

⑥ **Radio Message**
Time: 0645hrs
From: MT Mette Jorgensen
To:Nuaport Port Control

Fire reported in engine-room. Crew evacuated, and discharged CO2. Very limited maneuverability. Anchors prepared.

⑦ **Question to Trainees**
Time: 0646hrs
What are your initial reactions?
What are your initial concerns?
What will you do now?

⑧ **Radio Message**
Time: 0659hrs
From: MT Mette Jorgensen
To:Nuaport Port Control

Anchors dropped in position AF5-251. Appear to be holding. Accommodations full of smoke. Have shut down vessel and are abandoning ship.

⑨ **Question to Trainees**
Time: 0706hrs
What are your initial reactions?
What information do you need?
What will be your initial response?
When can you start responding?

⑩ **Weather Forecast**
Time: 0715hrs
Nuaport Control Weather Report
Weather Forecast for next 12 hours
Wind Direction: 2100 backing 1800 by 1300hrs
Wind Speed: 15 knots increasing 20 knots by 1300hrs
Air Temperature: 130C Sea Temperature: 110C
Sea State: Slight to moderate
Sunset: 1946hrs

⑪ **Radio Message**
Time: 0720hrs
From: Nua Tug N0.1
To:Nuaport Port Control

Tugs No 1. and No. 2 standing by Mette Jorgensen.
Appears anchored at position AF6-250.
Lots of smoke from accommodation.
Pilot launch have evacuated crew.

⑫ **Radio Message**
Time: 0745hrs
From: Nuaport Coast Guard
To:Nuaport Port Control

Rescue helicopter Romeo One over vessel.
Crew evacuated to Pilot launch and Tug Nua No. 1

Smoke still coming from accommodation area. Aircraft now returning to airport and available on 10 minutes notice.

⑬ **Question to Trainees**
Time: 0749hrs
Do you need any further information?

⑭ **Task 1.**
Time: 0805hrs
What are your concerns?
Prioritise your concerns and record them

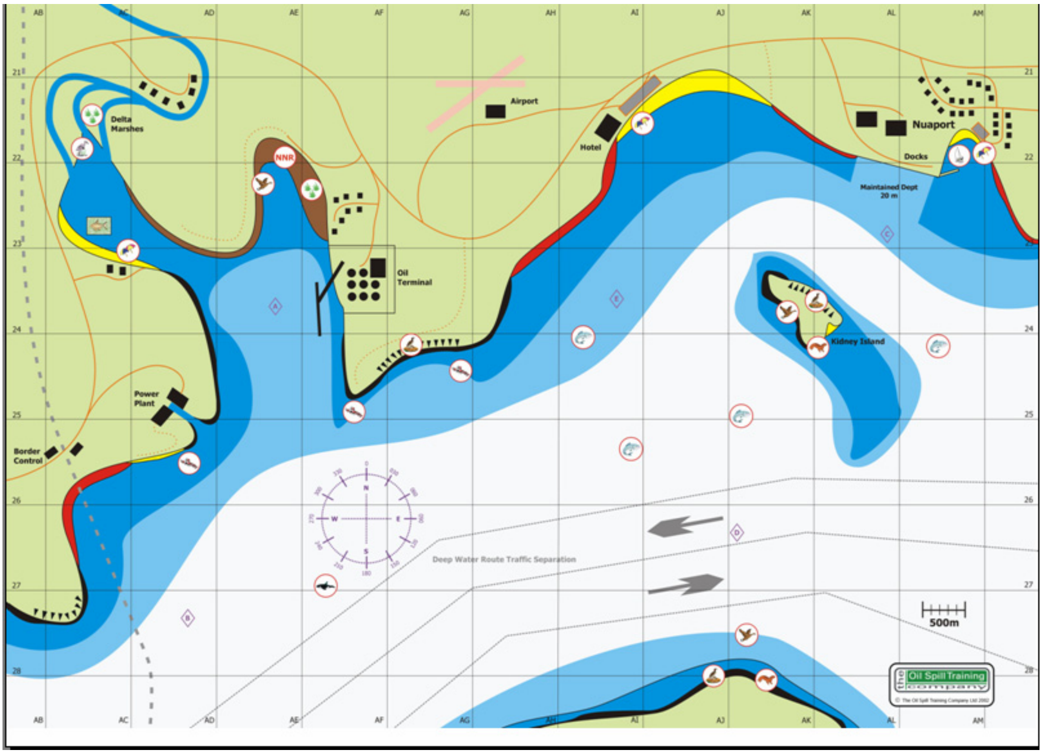
⑮ **Task 2.**
Time: 0810hrs
What is your response strategy?

⑯ **Task 3.**
Time: 0830hrs
Prepare a press release.

Prepare a statement for your government minister that contains the summary of the incident, the risks, your actions so far, and your intentions.

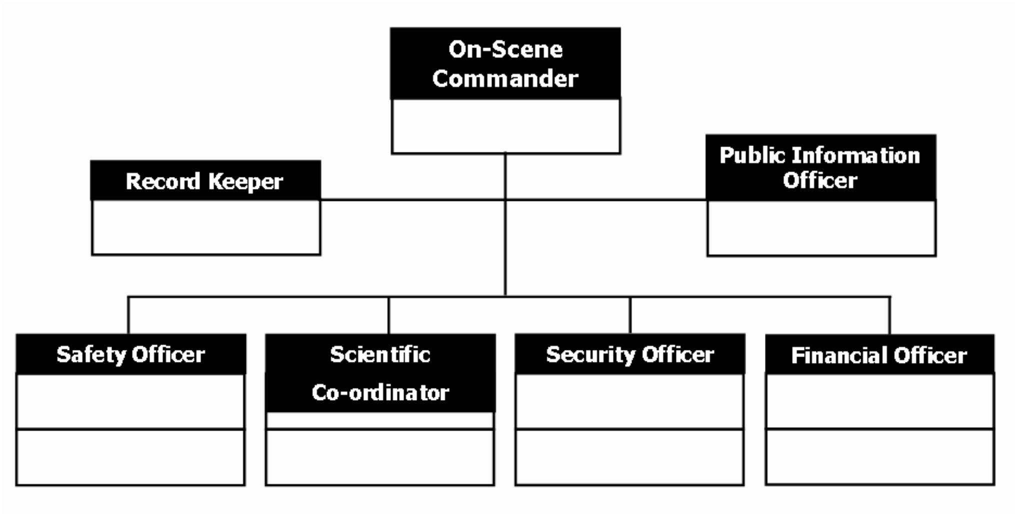
Within this task, when the small tabletop exercise is finished, trainees are asked to speak about their impression of this lesson and/or comments. With those impressions and/or comments, instructor shall encourage trainees to discuss among themselves to review the knowledge gained through this training.

Attachment No.1
Exercise Area Chart



Attachment No.2
Area Key

Attachment No.3
Organisational Structure for Team



Attachment No.4
EMS Guide

FIRE SCHEDULE Alpha

F - A
GENERAL FIRE SCHEDULE

General comments		In a fire, exposed cargos may explode or their containment may rupture. Fight fire from a protected position, as far away as possible.
Cargo fire on deck	**Packages**	Create water spray, as many hoses as possible.
	Cargo Transport Units	
Cargo fire under deck		Stop ventilation and close hatches. Use the fixed cargo space fire-extinguishing system. If this is not available, create water spray using copious quantities of water.
Cargo exposed to fire		If practicable, remove or jettison packages which are likely to be involved in fire. Otherwise, keep cool using water.
Special cases:		
UN 1381, UN 2447		After extinguishing the fire, immediately treat the spillage (see relevant EmS SPILLAGE SCHEDULE).

FIRE SCHEDULE Echo

F - E
NON-WATER-REACTIVE FLAMMABLE LIQUIDS

General comments		Cargoes in tanks, exposed to heat, may explode suddenly during or after a fire situation by a *Boiling Liquid-Expanding Vapor Explosion* (BLEVE). Keep tanks cool with copious quantities of water. Fight fire from a protected position as far away as possible. Stop leakage or close open valve if practicable. Flames may be invisible.
Cargo fire on deck	**Packages**	Create water spray from as many hoses as possible.
	Cargo Transport Units	Cool burning transport units and nearby cargo exposed to the fire with copious quantities of water.
Cargo fire under deck		Stop ventilation and close hatches. Use the fixed cargo space fire-extinguishing system. If this is not available, create water spray using copious quantities of water.

Cargo exposed to fire	If practicable, remove or jettison packages which are likely to be involved in the fire. Otherwise, keep cool for several hours using water.
Special cases:	
UN 1162, UN 1250, UN 1298, UN 1717, UN 2985	Cargoes will create hydrochloric acid in contact with water. Stay away from effluent.

FIRE SCHEDULE Hotel

F - H
OXIDIZING SUBSTANCES WITH EXPLOSIVE POTENTIAL

General comments		In a fire, exposed cargos may explode or their containment may rupture. Crew members should be aware of the explosion hazard and take appropriate action. Fight fire from a protected position, as far away as possible. SUDDEN OR SHORT-TERM EVENTS (E.G. EXPLOSIONS) MAY ENDANGER THE SAFETY OF THE SHIP.
Cargo fire on deck	**Packages**	Create water spray from as many hoses as possible.
	Cargo Transport Units	
Cargo fire under deck		OPEN HATCHES to provide maximum ventilation. Fixed gas fire-extinguishing systems may not be effective on these fires. Create water-spray from as many hoses as possible.
Cargo exposed to fire		Do not move packages that have been exposed to heat. If practicable, remove or jettison packages which are likely to be involved in a fire. If the packages are not directly involved in the fire, efforts should be concentrated on preventing the fire from reaching the cargo. This is done by keeping the packages wet by using water jets from as far away as practicable to drive the fire away. If the fire reaches the cargo, the fire-fighters should withdraw to a safe area and continue to fight the fire from a safe position. Where practicable, articles having been exposed to the fire should be kept separate from unexposed articles. They should be kept wet and monitored from a safe distance.
Special cases: None.		

SPILLAGE SCHEDULE Bravo

S - B
CORROSIVE SUBSTANCES

<table>
<tr><td colspan="2">General comments</td><td>Wear suitable protective clothing and self-contained breathing apparatus.
Avoid contact, even when wearing protective clothing.
Keep clear of effluent. Keep clear of evolving vapors.
Even short-time inhalation of small quantities of vapor can cause breathing difficulties.
Use of water on the substance may cause a violent reaction and produce toxic vapors.
Substance may damage ship's construction materials.
Contaminated clothing should be washed off with water and then removed.</td></tr>
<tr><td rowspan="2">Spillage on deck</td><td>Packages (small spillage)</td><td>Wash overboard with copious quantities of water. Do not direct water jet straight onto the spillage. Keep clear of effluent. Clean the area thoroughly.</td></tr>
<tr><td>Cargo Transport Units (large spillage)</td><td>Keep bridge and living quarters up wind. Protect crew and living quarters against corrosive or toxic vapors by using water spray to drive vapors away.
Wash overboard with copious quantities of water. Do not direct water jet straight onto the spillage. Keep clear of effluent. Clean the area thoroughly.</td></tr>
<tr><td rowspan="2">Spillage under deck</td><td>Packages (small spillage)</td><td>Provide adequate ventilation. Do not enter space without self-contained breathing apparatus. Check atmosphere before entering (toxicity and explosion hazard). If atmosphere can not be checked, do not enter. Let vapor evaporate. Keep clear.
Liquids: Provide good ventilation of the space. Wash down to the bottom of the hold. Use copious quantities of water. Pump overboard.
Solids: Collect spillage. Dispose overboard. Wash residues down to the bottom of the hold. Use copious quantities of water. Pump overboard.</td></tr>
<tr><td>Cargo Transport Units (large spillage)</td><td>Keep bridge and living quarters up wind. Protect crew and living quarters against corrosive or toxic vapors by using water-spray to drive vapors away.
Do not enter space. Keep clear. Radio for expert ADVICE. After hazard evaluation by experts, you may proceed.
Provide adequate ventilation. Do not enter space without self-contained breathing apparatus. Check atmosphere before entering (toxicity and explosion hazard). If atmosphere cannot be checked, do not enter. Let vapors evaporate, and keep clear. Where ventilation system is used, particular attention should be taken in order to prevent toxic vapors or fumes from entering occupied areas of the ship, e.g.</td></tr>
</table>

		living quarters, machinery spaces, working areas. ***Liquids***: Provide good ventilation of the space. Wash down to the bottom of the hold. Use copious quantities of water. Pump overboard. ***Solids***: Collect spillage. Dispose overboard. Wash residues down to the bottom of the hold. Use copious quantities of water. Pump overboard.
Special cases:		
Marine Pollutant Mark		Report incident according to MARPOL reporting requirements.
UN 2802, UN 2809		No reaction with water. Not highly corrosive to protective clothing. Collect spillages if practicable. Try to avoid disposing overboard. Radio for expert ADVICE.

SPILLAGE SCHEDULE Charlie

S - C
FLAMMABLE CORROSIVE LIQUIDS

General comments		Wear suitable protective clothing and self-contained breathing apparatus. Avoid contact, even when wearing protective clothing. Keep clear of effluent. Keep clear of evolving vapors. Even short-time inhalation of small quantities of vapor can cause breathing difficulties. Use of water on the substance may cause violent reaction and produce toxic vapors. Substance may damage the ship's construction materials. Spillage or reaction with water may evolve flammable vapors. Avoid all sources of ignition (e.g. naked lights, unprotected light bulbs, electric hand tools, friction). Contaminated clothing must be washed off with water and then removed.
Spillage on deck	**Packages (small spillage)**	Wash overboard with copious quantities of water. Do not direct water jets straight onto the spillage. Keep clear of effluent. Clean the area thoroughly.
	Cargo Transport Units (large spillage)	Keep bridge and living quarters upwind. Protect crew and living quarters against corrosive or toxic vapors by using water-spray to drive vapors away. Wash overboard with copious quantities of water. Do not direct water jets straight onto the spillage. Keep clear of effluent. Clean the area thoroughly.
Spillage under deck	**Packages (small spillage)**	Provide adequate ventilation. Do not enter deck without self-contained breathing apparatus. Check atmosphere before entering (toxicity and explosion hazard). If atmosphere cannot be checked, do not enter. Let vapors evaporate.

		Keep clear. ***Liquids***: Provide good ventilation of the space. Use water-spray on effluent in hold to avoid ignition of flammable vapors. Wash down to the bottom of the hold. Use copious quantities of water. Pump overboard. ***Solids***: Collect spillage. Dispose overboard. Wash residues down to the bottom of the hold. Use copious quantities of water. Pump overboard.
	Cargo Transport Units (large spillage)	Keep bridge and living quarters upwind. Protect crew and living quarters against corrosive or toxic vapors by using water-spray to drive vapors away. Do not enter space. Keep clear. Radio for expert ADVICE. After hazard evaluation by experts, you may proceed. Provide adequate ventilation. Do not enter space without self-contained breathing apparatus. Check atmosphere before entering (toxicity and explosion hazard). If atmosphere cannot be checked, do not enter. Let vapors evaporate. Keep clear. Where ventilation system is used, particular attention should be taken in order to prevent toxic vapors or fumes from entering occupied areas of the ship, e.g. living quarters, machinery spaces, working areas. ***Liquids:*** Provide good ventilation of the space. Use water-spray on effluent to avoid ignition of flammable vapors. Wash down to the bottom of the hold. Use copious quantities of water. Pump overboard. ***Solids:*** Collect spillage. Dispose overboard. Wash residues down to the bottom of the hold. Use copious quantities of water. Pump overboard.
Special cases:		
Marine Pollutant Mark		Report incident according to MARPOL reporting requirements.
UN 2029		Self-ignition of spilt material is possible.

SPILLAGE SCHEDULE Juliet

S - J

WETTED EXPLOSIVES AND CERTAIN SELF-HEATING SUBSTANCES

General comments		Wear suitable protective clothing and self-contained breathing apparatus. Avoid all sources of ignition (e.g. naked lights, unprotected light bulbs, electric hand tools, friction). Wear non-sparking footwear. Stop leak if practicable. Dried out material may explode if exposed to heat, flame, friction, or shock.
Spillage on deck	**Packages (small spillage)**	Keep spillage wet. Dispose of solid material overboard. Wash overboard with copious quantities of

	Cargo Transport Units (large spillage)	water. Keep clear of effluent.
Spillage under deck	**Packages (small spillage)**	Keep spillage wet. Collect and contain spillage if practicable. Dispose overboard. Collect spillage using soft brushes and plastic trays.
	Cargo Transport Units (large spillage)	
Special cases: None.		

SPILLAGE SCHEDULE Quebec

S - Q
OXIDIZING SUBSTANCES

General comments		Wear suitable protective clothing and self-contained breathing apparatus. Avoid all sources of ignition (e.g. naked lights, unprotected light bulbs, electric hand tools, friction). Wear non-sparking footwear. May ignite combustible material (e.g. wood, paper, and clothing). Stop leak if practicable.
Spillage on deck	**Packages (small spillage)**	Wash overboard with copious quantities of water. Keep clear of effluent.
	Cargo Transport Units (large spillage)	
Spillage under deck	**Packages (small spillage)**	Do not enter space without self-contained breathing apparatus. *If dry*, contain and collect spillage if practicable. Dispose overboard. *If wet*, use inert absorbent material. Do not use combustible material. *If liquid*, wash down to the bottom of the hold using copious quantities of water. Pump overboard. Dispose of overboard.
	Cargo Transport Units (large spillage)	Provide adequate ventilation. Do not enter space without self-contained breathing apparatus. *If dry*, contain and collect spillage if practicable. Dispose of overboard. *If wet*, use inert absorbent material. Do not use combustible material. *If liquid*, wash down to the bottom of the hold using copious quantities of water. Pump overboard. Dispose overboard.
Special cases: None.		

Attachment No.5
Equipment Hire Availability and Cost Sheet

Description	Mobilization	Cost per hr.	Hrs on hire	Total Cost
Fixed wing light aircraft *On contract with the local coast guard for aerial surveillance, and search and rescue.*	15 min.	Free of Charge		
Helicopter *For aerial assessments, movement of personnel, etc*	*1 hour*	$600		
Harbor Tugs *Availability: One moored at the Oil Terminal and two moored at Nuaport Docks. Each tug has sufficient deck space for 2 containers*	1 hour	$500		
Workboats *Availability: One moored at the Oil Terminal and three moored at Nuaport.* *Suitable for transporting personnel and small equipment*	1 hour	$75		
RIB *Two 6mtr RIBs are available from the water sports center at Nuaport*	2 hours	$55		
4X4 Vehicle *Can carry up to five people. Minimum charge is 8 hours*	1 hour	$15		
Truck *Includes driver. Can carry up to 7.5 tons of equipment and two extra people. Minimum charge is 8 hours.*	1 hour	$45		
Crane *Includes driver. Can load and unload trucks. Minimum charge is 8 hours*	1 hour	$60		
Respiratory Protection – 6 man pack	30 min.	$10		
SCBA – 6 man pack c/w 12 cylinders & compressor	30 min.	$30		
Level A Protection – 6 man pack	30 min.	$40		
Level B Protection – 6 man pack	30 min.	$30		
Level C Protection – 6 man pack	30 min.	$20		
Decontamination Pack – container	30 min.	$40		
Investigation Pack – mini containers	30 min.	$40		

Description	Mobilization	Cost per hr.	Hrs on hire	Total Cost
Fixed wing light aircraft *On contract with the local coast guard for aerial surveillance and search and rescue.*	15 min.	Free of Charge		
Helicopter *For aerial assessments, movement of personnel, etc*	*1 hour*	$600		
Harbour Tugs *Availability: One moored at the Oil Terminal and two moored at Nuaport Docks. Each tug has sufficient deck space for 2 containers*	1 hour	$500		
Workboats *Availability: One moored at the Oil Terminal and three moored at Nuaport.* *Suitable for transporting personnel and small equipment*	1 hour	$75		
RIB *Two 6mtr RIBs are available from the water sports center at Nuaport*	2 hours	$55		
4X4 Vehicle *Can carry up to five people. Minimum charge is 8 hours*	1 hour	$15		
Truck *Includes driver. Can carry up to 7.5 tons of equipment and two extra people. Minimum charge is 8 hours.*	1 hour	$45		
Crane *Includes driver. Can load and unload trucks. Minimum charge is 8 hours*	1 hour	$60		
Respiratory Protection – 6 man pack	30 min.	$10		
SCBA – 6 man pack c/w 12 cylinders & compressor	30 min.	$30		
Level A Protection – 6 man pack	30 min.	$40		
Level B Protection – 6 man pack	30 min.	$30		
Level C Protection – 6 man pack	30 min.	$20		
Decontamination Pack – container	30 min.	$40		
Investigation Pack – mini containers	30 min.	$40		

Attachment No.6
Equipment Catalogue

Containment Systems

Offshore Containment Boom

Length	200 meters
Logistics Req'd	1 Tug 1 Workboat 5 Trained operators
Deployment ⏱	Loading and set-up time, 1 hr. Deployment time, 30 min. per 100 meters.
Information	Boom section can be connected together up a max length of 800 meters.

Sheltered Water Containment Boom

Length	20 meters
Logistics Req'd	1 small workboat 4 Trained operators
Deployment ⏱	45 min. set-up on site. 30 min. per 100 meters for deployment.
Information	Boom can be connected together to the required length. Can be used with the Shoreline Containment Boom.

Shoreline Containment Boom

Length	20 meters
Logistics Req'd	1 small workboat 4 Trained operators
Deployment ⏱	45 min. set-up on site. 45 min. per 100mtr for deployment.
Information	Boom can be connected together to the required length. Can be used with the Sheltered Water Containment Boom.

Recovery Systems

Sheltered Water Disc Skimmer

Capacity	15 tons per hour
Logistics Req'd	2 Trained operators Storage system
Deployment	Set-up and deployment, 30 min.
Information	Expect 90% oil/10% water.

Shoreline Vacuum System

Capacity	10 tons per hour
Logistics Req'd	2 Trained operators Storage system
Deployment	Set-up time, 30 min.
Information	Expect 50% oil/50% water. Can also be used in sheltered waters.

Offshore Weir Skimmer

Capacity	45 tons per hour
Logistics Req'd	2 Trained operators Crane Storage system
Deployment	45 min.
Information	Power Pack weight, 1.5 tons. Skimmer weight 350kgs. Expect 20% oil/80% water.

Offshore Vacuum Skimmer

Capacity	40 tons per hour
Logistics Req'd	2 Trained operators Crane
Deployment	Set-up time, 60 min.
Information	Powerpack weight, 4 tons. 2 tons storage onboard. Skimmer head weight, 20 kg. Expect 10% oil/90% water.

Recovery Systems cont.

Heavy Oil Skimmer

Capacity	50 tons per hour
Logistics Req'd	2 Trained operators Crane Storage system
Deployment ⏱	45 min.
Information	Power Pack weight, 1.5 tons. Skimmer weight 375 kg. Expect 80% oil/20% water.

Storage Systems

Temporary Storage Tank

Capacity	5000 liters
Logistics Req'd	1 Trained operator
Deployment ⏱	15 min.
Information	Requires level firm ground

Floating Pillow Tank

Capacity	50,000 liters
Logistics Req'd	Crane 3 Trained operators Workboat
Deployment ⏱	1 hour
Information	May have difficulty removing oil from tank, following deployment.

Inflatable Barge Tank

Capacity	25,000 liters
Logistics Req'd	Crane 2 Trained operators Workboat
Deployment ⏱	30 min.
Information	Open top for easy oil removal.

Miscellaneous

High Pressure Washer

Capacity	Clean 0.5 mtr^2 per minute
Logistics Req'd	1 Trained operator Assistance to move machine
Deployment ⏱	Set-up, 30 min.
Information	Containment system must be in place to recover run-off

Wide Platform Workboat

Capacity	Deck area, 10 mtr^2
Logistics Req'd	Slipway and light commercial truck required for launch. 2 Trained Personnel
Deployment ⏱	30 min.
Information	For use in sheltered waters only

Beach Sand Cleaner

Capacity	Up to 1 hectare per hour
Logistics Req'd	Low loader required for transportation
Deployment ⏱	Set-up, 2 hrs
Information	For light contamination only

Sorbent Materials

Capacity	50 liters per 3 meters section
Logistics Req'd	1 Person Storage bags or barrel
Deployment ⏱	Immediate
Information	Capacity quoted above is for sorbent boom. The material is available in squares, sheets, rolls, pillows, and loose.

PPE

Respiratory Protection

Capacity	
Logistics Req'd	
Deployment ⏱	1 man operation, 3 min.
Information	Air purifying respirator. Not suitable for use in an oxygen deficient atmosphere

SCBA

Capacity	20 min. work maximum
Logistics Req'd	Operated by trained personnel only. Requires spare cylinders and re-charging facilities
Deployment ⏱	Individual carrying case 1 man operation, 10 min.
Information	Positive pressure set

Level A Protection

Capacity	Chemical resistant suit complete with integral gloves and boots
Logistics Req'd	Operate by trained personnel only
Deployment ⏱	Individual carrying case 1 man operation, 20 min.
Information	Use with SCBA, coveralls. Hard hat and 2 way radio communication

Level B Protection

Capacity	Splash protection suit
Logistics Req'd	Separate gloves and boots
Deployment ⏱	Individual carrying case 1 man operation, 15 min.
Information	Requires SCBA, 2 way radio communications, hard hat and trained SCBA operator.

Level C Protection

Capacity	Splash protection suit
Logistics Req'd	Separate gloves and boots
Deployment ⏱	Individual carrying case 1 man operation, 10 min.
Information	Requires air-purifying respirator, 2 way radio communication, hard hat

Decontamination Pack

Capacity	
Logistics Req'd	Source of wash water, collection and removal
Deployment ⏱	2 man operation to erect, 20 min.
Information	Needs calm conditions, sorbents, trained operators

Investigation Pack

Capacity	6 man team
Logistics Req'd	2 man operation
Deployment ⏱	15 min. to assemble and test
Information	2 way communication, gas analyzers, oxygen meters, sample and collection equipment

Vessels

Oil Terminal Tugs	
Name	Nua Port No. 1 Nua Port No. 2
Capacity	50 tons bollard pull
Deployment 🕒	Request through Port Control
Information	FiFi 1 Fire-fighting cannons Azimuth stern drive

Port Tugs	
Name	Nua Port No. 3
Capacity	24 tons bollard pull
Deployment 🕒	Request through Port Control
Information	

Pilot Launch	
Name	Pilot Launch
Capacity	
Deployment 🕒	Request through Port Control
Information	

Attachment No.7
Equipment Order Form

Description	Unit	Cost	Qty	Loc'n	Total
Helicopter Dispersant Spray System	1	$40,000			
Boat Dispersant Spray System	1	$15,000			
Beach Dispersant Spray System	1	$6,000			
Dispersant, 200ltr	1	$600			
Offshore Containment Boom	200mtr	$65,000			
Sheltered Water Containment Boom	20mtr	$2000			
Shoreline Containment Boom	20mtr	$2000			
Sheltered Water Disc Skimmer	1	$20,000			
Shoreline Vacuum System	1	$15,000			
Offshore Weir Skimmer	1	$80,000			
Offshore Vacuum Skimmer	1	$150,000			
Heavy Oil Skimmer	1	$90,000			
Temporary Storage Tank	1	$2,500			
Floating Pillow Tank	1	$30,000			
Inflatable Barge Tank	1	$15,000			
High Pressure Washer	1	$6,000			
Wide Platform Workboat	1	$22,000			
Beach Sand Cleaner	1	$125,000			
Sorbent Material, 4 X 3 meters (12 meters)	1	$150			
Respiratory Protection	1	$50			
SCBA c/w spare cylinder	1	$500			
Level A Protection	1	$450			
Level B Protection	1	$300			
Level C Protection	1	$150			
Decontamination Pack	1	$30,000			
Investigation Pack	1	$15,000			

Equipment Total [ ]

Personnel Budget Form

Description	Unit	Cost	Qty	Total
Full Time Team Leader/Supervisor	1	$60,000		
Full Time Technician/Operator	1	$40,000		
Annual Training for On-Scene Commander	1	$4,500		
Annual Training for Supervisor/Technician	1	$2,500		
Annual Training for Equipment Operator	1	$1,500		

Personnel Total [ ]

Equipment & Personnel Total [ ]

Attachment No.8
Information Sheet

Scale
The chart is divided into 1km^2 grids. There is also a 500m scale shown.
For the purposes of this exercise, it can be assumed that one nautical mile measures 115mm on the chart.

Nautical Mileage Conversion
The table below is a quick conversion chart from Nautical miles to distance on the chart in millimeters.

Nautical Miles	0.1	0.2	0.25	0.3	0.5	0.6	0.75	1
Distance mm	12	23	29	35	58	69	86	115

Environmental Sensitivities
There are a number of sensitivities in the area. The main locations are indicated on the chart.

The following table provides some extra useful information:

Shell Fisheries	There are three main areas for shell fisheries. The industry is worth approximately $1,000,000 annually. The majority of the harvest is exported, with a small proportion sold locally.
Sea Fisheries	The main area for sea fisheries lies to the east and west of Kidney Island. Six local fishing boats operate out of Nuaport. They land a catch of over 1000 tons per year worth over $3,000,000 annually. The fishes are processed locally providing employment for a staff of 25 employees.
Marine Leisure	There is a marina located in the Nuaport Harbour area, providing berths for over 50 yachts. The area to the south of Nuaport is also a popular area for waterskiing and power boating.
Tourism	The sandy beach at Nuaport is very popular, attracting local and foreign tourists. There is a large hotel located to the west of the town. There is also a quieter beach close to Delta Marshes.
Seabirds	Kidney Island in uninhabited. It is home to various colonies of seabirds and is an important nesting site. A colony of Waders occupies Delta Marshes. This area, along with mudflats and salt marshes to the east, also hosts large numbers of migratory birds. There is also a colony of birds nesting on the cliffs to the south of the Oil Terminal.
Whales	A pod of whales are regularly seen in the area around grid reference 27AE.

Commercial Resources
Various commercial resources are indicated on the chart. The following table provides some useful extra information:

Power Plant	The power plant is gas-fired and is an important contributor to the national electrical grid. Seawater is used as a coolant, resulting in a 2 - 3 knot current at the intake.
Oil Terminal & Petro-chemical Terminal	The oil terminal is an import and storage point for crude oil for the national refinery located inland. It also imports and stores Gas Oil, Heavy Fuel Oil, and Gasoline. The terminal imports around 200,000 tons of crude every week, delivered by two 100,000 dwt tankers. Product is delivered in smaller parcel sizes of 10,000 dwt tankers. The terminal has a small petro-chemical plant which produces small quantities of chemicals for the agricultural industry locally and for export.

Nuaport Docks	The docks area is used to import a variety of goods, usually delivered by container or general cargo vessels. A substantial amount of wood is exported through the port. An international ferry operates on daily basis. Container ship of up to 50,000 TEU and general cargo vessels of up to 25,000 DWT regularly uses the port. There are some repair facilities but no dry-docks.

Oil & Hydrocarbon Properties
The table below details the typical characteristics of the oils and hydrocarbons handled at the Oil Terminal and carried as fuel on vessels using the harbor area.

Oil Type	S.G.	API	Pour Point (°C)	Viscosity @ 20 °C (cSt)	% Asphaltene
Gasoline	0.73	62	N/A	0.5	0.0
Naptha	0.70	57	N/A	0.97 (@25°C)	0.0
Gas Oil	0.84	35	N/A	5.5	0.0
Heavy Fuel Oil	0.95	17	-1.0	3000	7.0
Naniun Crude	0.84	37	-15	5.8	0.8
Talang Crude	0.85	33	12	3.7	0.3

Material Safety Data Sheets (MSDS) are available for all exported HNS from the petro-chemical terminal.

Sea Temperature
The sea temperature in the area varies from 5°C during the winter months to 18°C during the summer months.

Currents
The table below shows the current direction and speed at the Tidal Diamonds, shown on the chart.

A		B		C		D		E	
Dir.	*Speed*	*Dir.*	*Speed*	*Dir.*	*Speed*	*Dir.*	*Speed*	*Dir.*	*Speed*
180	0.1	225	0.3	120	0.25	270	0.25	045	0.30

Attachment No.9
Log Sheet

Page No.	

Time	Details

Attachment No.10
Dangerous Goods Manifest & Cargo Stowage Plan

Name of Ship: Mette Jorgensen
Nationality of Ship: Danish

IMO Number: 437279
Master's Name: Example

Voyage Reference: 2087
Port of Discharge: Vreckhaven

Port of Loading: Nuaport
Shipping Agent: Chemship

Tank Number	Port			Starboard		
	Capacity*	Actual	Cargo	Capacity*	Actual	Cargo
1	165	164	VA	165	165	VA
2	222	221	MA	222	222	MA
3	256	254	VA	256	255	VA
4	240	239	MA	240	235	MA
5	237	237	VA	237	237	VA
6	175	174	MA	175	173	MA
7	127				127	VA
8	194	194	MA	194	194	MA
9	242	241	VA	242	240	VA

***Note: Capacity in m³ at 98%**

Cargo Carried:

Cargo	Reference	Quantity (m^3)	Density	Quantity (mt)	UN Number
Methyl Acrylate	MA	1920	0.9302	1786	1919
Vinyl Acetate	VA	1652	0.93402	1543	1301

AGENT'S SIGNATURE: ______________________________

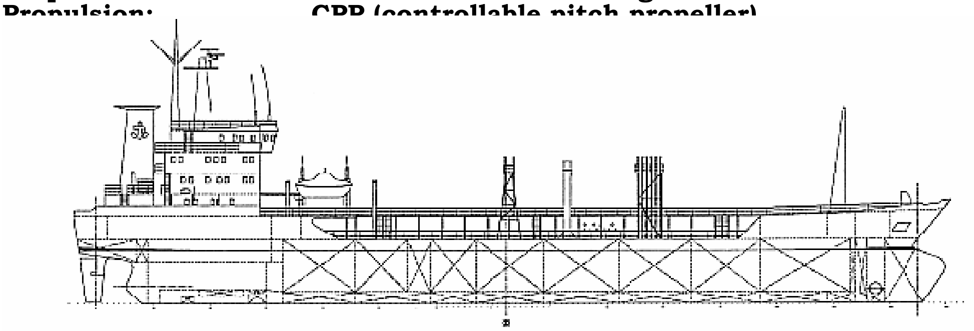
MASTER'S SIGNATURE: ______________________________

PLACE AND DATE: ______________________________

PLACE AND DATE: ______________________________

Attachment No.11
MV METTE JORGENSEN

Type:	**IMO Class 2 Chemical Tanker**
Flag:	**Denmark**
Call Sign:	**OWXM3**
IMO Number:	**437279**
Built:	**1980**
DWT:	**3,466 t.**
GRT:	**2,401 t.**
LOA:	**92.98 m**
Beam:	**13.80 m**
Max Draft:	**5.70m**
Propulsive Power:	**MAN B&W two-stroke engine**
Propulsion:	**CPP (controllable pitch propeller)**



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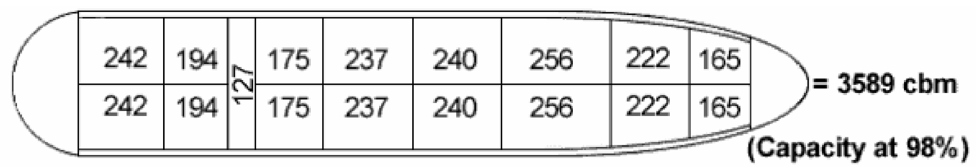
with



Cargo Tanks:
17 Stainless steel cargo tanks
Cargo heating: up to 60⁰ Celsius
Cargo Handling:
Deep well pumps 12 x 100m³ /hr
5 x 80m³/hr

Attachment No.12
Safety Data for Methyl Acrylate

The information on this web page is provided to help you during Exercise Mette Jorgensen only.

It is intended to be an overview of hazards, not a replacement for a full Material Safety Data Sheet (MSDS).

General

Synonyms: 2-propenoic acid methyl ester, methyl propenate, methyl-2-propenoate
Molecular formula: $C_4H_6O_2$
CAS No: 96-33-3
EC No: 202-500-6

Physical data

Appearance: colorless liquid
Melting point: - 75 C
Boiling point: 80 C
Vapor density: 3
Vapor pressure: 67.5 mm Hg at 20 C
Specific gravity: 0.956
Flash point: 6 C
Explosion limits: 2.1 - 14.5 %
Auto ignition temperature: 467 C

Stability

Stable. Incompatible with bases, acids, oxidizing agents, and peroxides. May polymerize on exposure to light. Highly flammable. Commercial product may be inhibited by the presence of hydroquinone monomethyl ether.

Toxicology

Harmful if inhaled, ingested or contact with skin. Severe irritant. May cause allergic reaction. Typical TWA 10 ppm.

Toxicity data

ORL-RAT LD50 277 mg kg^{-1} (Dosage required to kill 50% of test subject)

Risk phrases

R11 R20 R22 R36 R37 R38.

Transport information

Hazard class: 3.2. Packing group: II

Personal protection

Safety glasses, gloves, adequate ventilation. Protective clothing and SCBA.

Safety phrases

S9 S16 S33.

Attachment No.13
Safety Data for Vinyl Acetate

The information on this web page is provided to help you during Exercise Mette Jorgensen only.

It is intended to be an overview of hazards, not a replacement for a full Material Safety Data Sheet (MSDS).

General

Synonyms: acetic acid ethenyl ester, acetic acid ethylene ether, acetoxyethene, 1-acetoxyethylene, ethenyl ethanoate, ethenyl acetate, vinyl acetate monomer, acetic acid vinyl ester, vyac, zeset T
Molecular formula: $C_4H_6O_2$
CAS No: 108-05-4
EC No:

Physical data

Appearance: colorless mobile liquid with a sweet, irritating odor (odor threshold recognition 0.5 ppm)
Melting point: -100 C
Boiling point: 72 C
Vapor density:
Vapor pressure: 100 mm Hg at 22 C
Specific gravity: 0.933
Flash point: -8 C (open cup)
Explosion limits: 2.6% - 14%
Auto ignition temperature: 385 C

Stability

Stable. Highly flammable. Incompatible with acids, bases, oxidizing agents, peroxides, chlorosulfonic acid, ethylene imine, hydrochloric acid, oleum, nitric acid, sulfuric acid, 2-aminoethanol, light. Susceptible to polymerization; commercial product may be stabilized by the addition of hydroquinone.

Toxicology

Possible carcinogen. May affect fertility. Risk of irreversible effects. Possible mutagen. Harmful if swallowed, inhaled, or absorbed through the skin. Severe eye irritant. May cause skin burns if trapped in contact with skin. Typical STEL 20 ppm.

Toxicity data

ORL-RAT LD50 2920 mg kg^{-1}
IHL-RAT LCLO 4000 ppm/4h
IHL-RBT LC50 2500 ppm/4h
IPR-GPG LDLO 500 mg kg^{-1}

Risk phrases

R11 R20 R21 R22 R36 R45.

Personal protection

Safety glasses and gloves. Good ventilation. Protective clothing and SCBA.

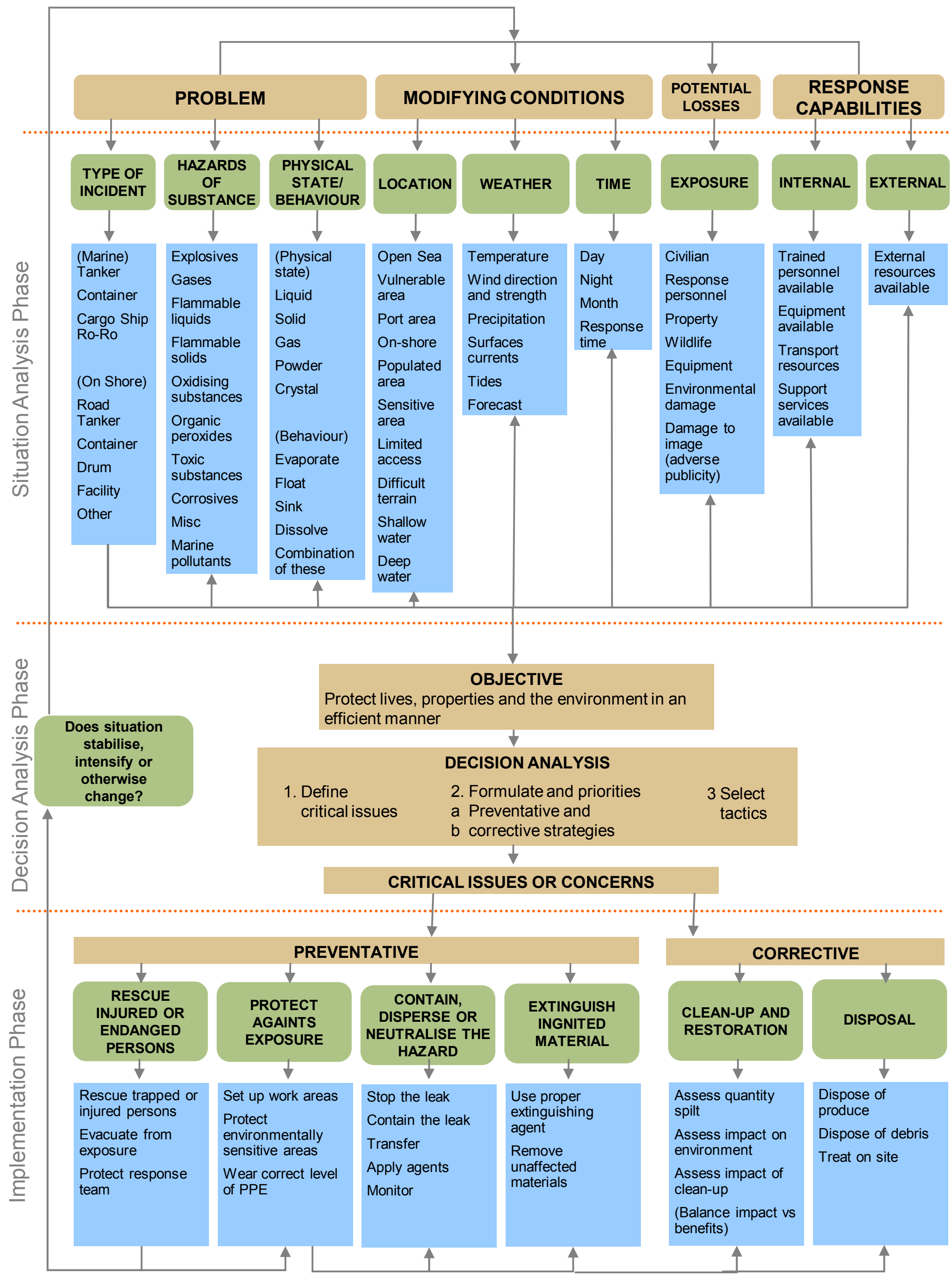
Safety phrases

S16 S23 S29 S33.

Annex to the Manual

Contents

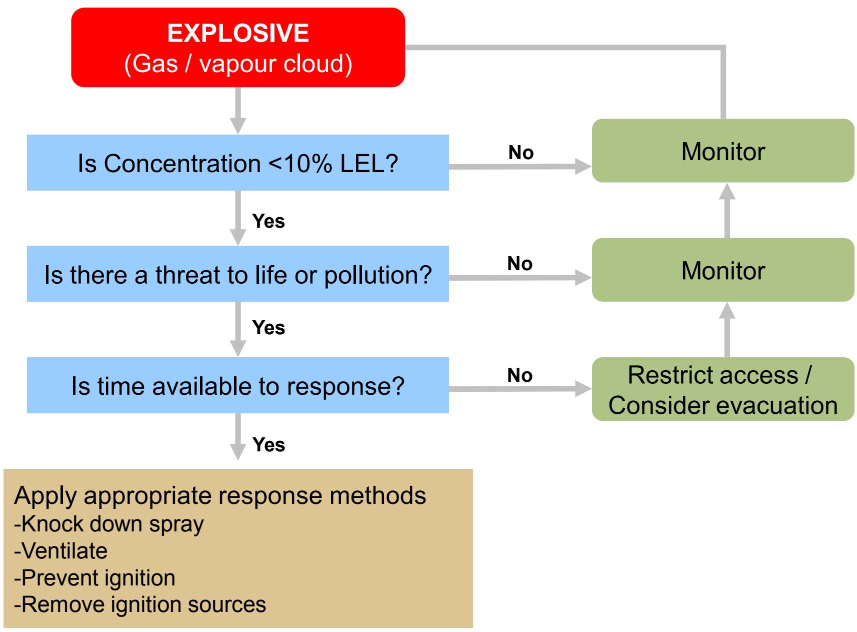
1. Systematic Approach to Emergency Response



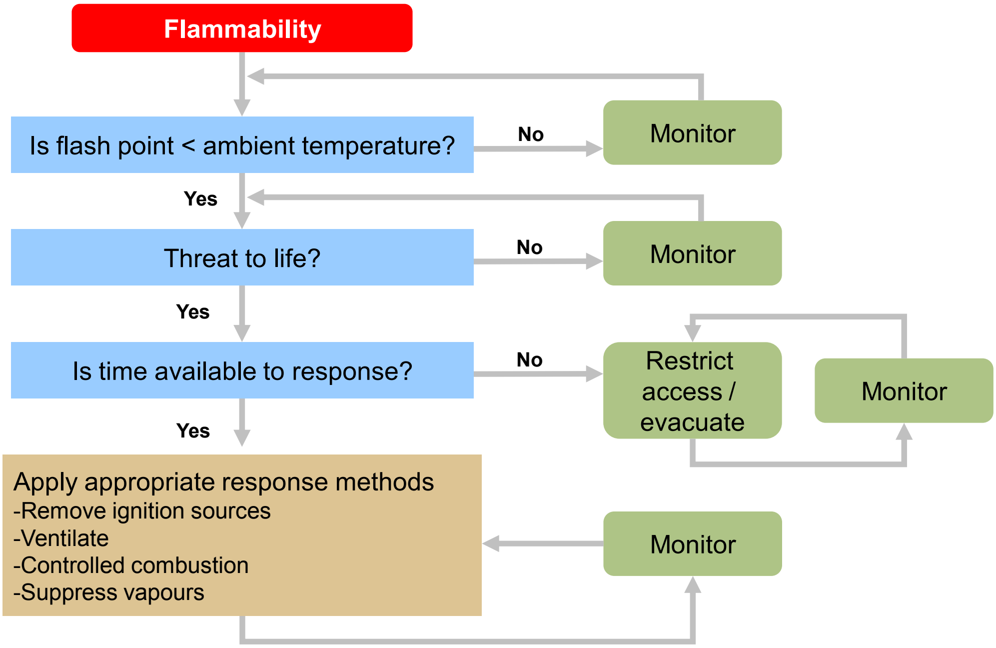
2. HNS Emergency Response Checklist

1.	Risk assessment completed	□
2.	PPE selection completed	□
3.	Emergency Response Procedures completed	□
4.	Work zones established	□
5.	PPE checks completed	□
6.	Decontamination line assembly completed	□
7.	Instruments calibrated	□
8.	Communication plan completed	□
9.	Pre-entry medical monitoring completed	□
10.	Initial entry objectives established	□
11.	Action levels established	□
12.	Sampling plan completed	□
13.	Pre-entry brief completed	□
14.	Practice run through decontamination line	□
15.	Communications check	□
16.	Authorization for entry	□
17.	Post-entry medical monitoring completed	□
18.	Entry team debrief completed	□
19.	Emergency Response and Site Safety Plan modifications	□
20.	Equipment decontamination/inventory completed	□
21.	Contaminated materials disposed	□
22.	Potential Exposure Record forms completed	□
23.	Debrief conducted with OSC	□

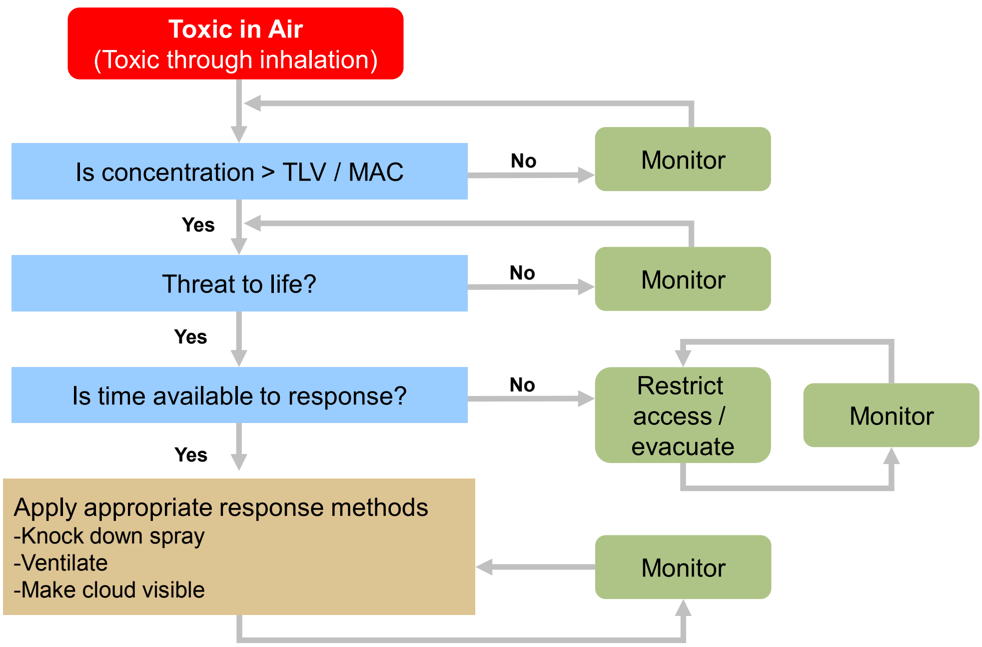
3. Decision Tree for an Explosive Gas or Vapor Cloud



4. Decision Tree for a Flammable Gas or Vapor Cloud



5. Decision Tree for a Toxic Gas or Vapor Cloud

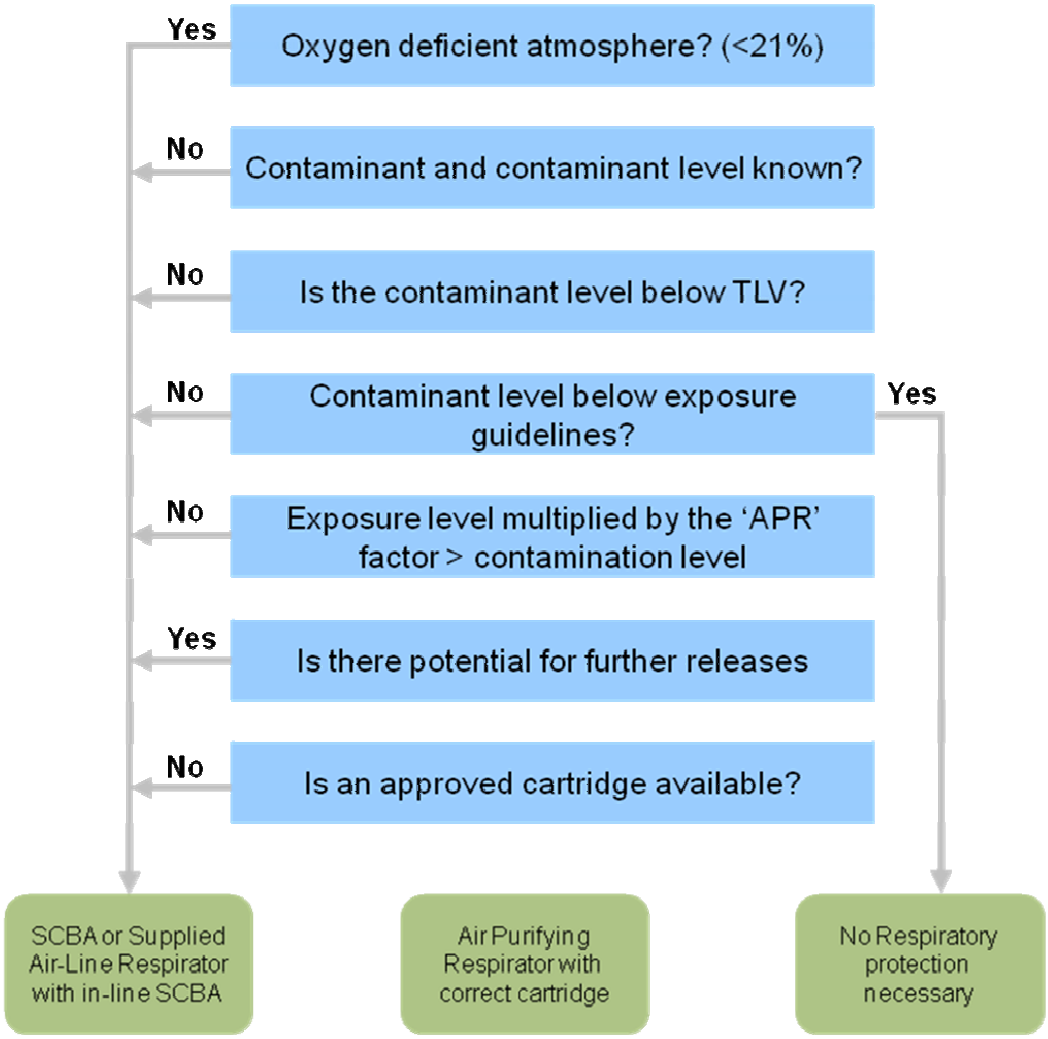


6. Response Techniques for Different Behavior Groups

The table is applicable for methods against HNS releases only							Solid Subst			Solid Subst		
							F	FD		D	S D	S
	Gas		Liquid									
Group Method	G	GD	E	ED	F E	FED	F	FD	DE	D	S D	S
Forecasting												
F1 Forecasting the spread in air	X	X	X	X	X	X			X			
F2 Forecasting the spread on water surface					X	X	X	X				
F3 Forecasting the spread in water body		X		X		X		X	X	X	X	
Monitoring												
M1 Monitoring the spread in air	X	X	X	X	X	X			X			
M2 Monitoring the spread in water body		X		X		X		X	X	X	X	1
Combating methods												
C1 Combating water soluble gas clouds		X										
C2 Combating spills that float on water							X					
C3 Combating spills that dissolve in water		X		X		X		X	X	X	X	
C4 Combating spills that sink to the bottom											X	X

1. It may also be appropriate to monitor sinkers that move over the bottom in the water body

7. Respiratory Protection Decision Flowchart



8. The Revised GESAMP Hazard Evaluation Procedure

Columns A & B	**Aquatic Environment**				
Numerical Rating	**A Bioaccumulation**			**B Aquatic Toxicity**	
	A 1 Bioaccumulation		**A 2 Biodegradation**	**B 1 Acute Toxicity** $LC/EC/IC_{50}$(mg/l)	**B 2 Chronic Toxicity** NOEC (mg/l)
	log Pow	BCF			
0	<1 or > ca. 7	not measurable	**R:** readily biodegradable	>1000	>1
1	≥1 - ≤2	≥1 - ≤10		>100 - ≤1000	>0.1 - ≤1
2	≥2 - ≤3	≥10 - ≤100	**NR:** not readily biodegradable	>10 - ≤100	>0.01 - ≤0.1
3	≥3 -≤4	≥100 -≤500		>1 - ≤10	>0.001 - ≤0.01
4	≥4 -≤5	≥500 -≤4000		>0.1 - ≤1	<0.001
5	≥5	≥4000		>0.01 - ≤0.1	
6				<0.01	

Columns C & D	**Human Health (Toxic Effects to Mammals)**					
Numerical Rating	**C Acute Mammalian Toxicity**			**D Irritation, Corrosion & Long term health effects**		
	C 1 Oral Toxicity LD_{50} (mg/kg)	**C 2** Dermal Toxicity LD_{50} (mg/kg)	**C 3** Inhalation Toxicity LC_{50} (mg/l)	**D 1** Skin irritation & corrosion	**D 2** Eye irritation & corrosion	**D 3** Long-term health effects
0	>2000	>2000	>20	not irritating	not irritating	**C** – Carcinogen **M** – Mutagenic **R** – Reprotoxic **S** – Sensitizing **A** – Aspiration haz. **T** – Target organ systematic toxicity **L** – Lung injury **N** – Neurotoxic **I** - Immunotoxic
1	>300 - ≤2000	>1000 - ≤2000	>10 - ≤20	mildly irritating	mildly irritating	
2	>50 - ≤300	>200 - ≤1000	>2 - ≤10	irritating	irritating	
3	>5 - ≤50	>50 - ≤200	>0.5 - ≤2	severely irritating or corrosive **3A** Corr. (≤4hr) **3B** Corr. (≤1hr) **3C** Corr. (≤3m)	severely irritating	
4	≤5	≤50	≤0.5			

Column E	**Interference with other uses of the sea**		
E 1 Tainting	**E 2** Physical effects on wildlife and benthic habitats	**Numerical Rating**	**E 3** Interference with Coastal Amenities
NT: not tainting (tested)	**Fp:** Persistent Floater **F:** Floater	0	no interference **no warning**
T: tainting test positive	**S:** Sinking Substances	1	slightly objectionable **warning, no closure of amenity**
		2	moderately objectionable **possible closure of amenity**
		3	highly objectionable **closure of amenity**

9. How to Use MFAG – IMDG Code

In any case of exposure, start with Emergency Action and act as advised.

For the convenience of users, and to ensure rapid access to the recommendations during an emergency, the guide is divided into sections, which are grouped to facilitate a three step approach.

Step 1:	Emergency Action and Diagnosis	Start here!
Step 2:	Tables	The tables give brief instructions for special circumstances.
Step 3:	Appendices	The Appendices provide comprehensive information, a list of medicines/drugs, and a list of chemicals referred to in the tables.

NOTE: The list of chemicals is limited to those few chemicals requiring special treatment. The list is given both in alphabetical and numerical order (UN No) in Appendix 15 of the guide.

Emergency action

Does the casualty need to be rescued from a polluted atmosphere?	Yes →	Go to Table 1
No ↓		
Has breathing stopped?	Yes →	Go to Tables 2 and 3
No ↓		
Is the casualty unconscious?	Yes →	Go to Table 4
No ↓		
Is the casualty convulsing (fitting)?	Yes →	Go to Table 5
No ↓		
Are the eyes contaminated?	Yes →	Go to Table 7
No ↓		

Is the skin contaminated?	Yes →	Go to Table 8
↓ No		
Has the chemical been inhaled?	Yes →	Go to Table 9
↓ No		
Has the chemical been ingested?	Yes →	Go to Table 10
↓ No		
Is there severe pain?	Yes →	Go to Table 13
↓ No		↓
Proceed to diagnosis		

Diagnosis

Is the chemical known? (e.g. by UN No., product label,shipping documents)	Yes →	Only few substances need specific treatment (see also appendix 15): Calcium oxide, calcium hydroxide (table 7) Phosphorus, white or yellow (table 8) Coumarin derivated pesticides (table 14) Hydrofluoric acid, hydrogen fluoride, fluorides (table 16) Organophosphorus and carbonate insecticides (table 17) Cyanides (table 18) Methanol and ethylene glycol (table 19) Radioactive material (table 20)
↓ No		
What is the casualty's present state?		
Breathing is rapid, shallow, irregular or deep.	→	Table 3 and Appendix 3

The casualty has a cough, wheezing, hoarseness, or severe breathlessness.	Table 9 and Appendix 9
The pulse is slow, weak, or rapid:	Table 11 and Appendix 11
Blisters, burns, or frostbite are present.	Table 8 and Appendix 8
The casualty is in a coma.	Table 4 and Appendix 4
The casualty has convulsions (seizures, fits).	Table 5 and Appendix 5
The casualty is vomiting.	Table 10 and Appendix 10
The casualty is restless, excited, confused or hallucinating.	Table 6 and Appendix 6
The casualty is jaundiced (yellow discoloration of skin or eyes).	Table 15
Urine output is decreased or absent.	Table 12 and Appendix 12
Blood is in the urine, vomit, or stool. The gums are bleeding. There are small haemorrhages (petechia) in the skin.	Table 14

What is the history of the present illness?
How did the illness start?
What are the symptoms?
Which symptoms are most troublesome?

What illnesses has the casualty suffered previously?
Make a record of any past illnesses, injuries, operations, and present drug treatment.

10. HNS Glossary

Acid, Acidic
See pH.

Active Ingredient
An active ingredient is the part of a product, which actually does what the product is designed to do. It is not necessarily the largest or the most hazardous part of the product. For example, an insecticidal spray may contain less than 1% pyrethrin, the ingredient which actually kills insects. The remaining ingredients are often called inert ingredients.

Acute
Acute means sudden or brief. Acute can be used to describe either an exposure or a health effect. An acute exposure is a short-term exposure. Short-term could mean lasting for minutes, hours, or days. An acute health effect is an effect that develops either immediately or a short time after an exposure. Acute health effects may appear minutes, hours, or even days after an exposure. (See also Chronic.)

Aerosol
An aerosol is a collection of very small particles suspended in air. The particles can be liquid (mist) or solid (dust or fume). The term aerosol is also commonly used for a pressurized container (aerosol can), which is designed to release a fine spray of a material, such as paint.
Inhalation of aerosols is a common route of exposure to many chemicals. Also, aerosols may be fire hazards.

Alkali, Alkaline
See pH.

ANSI
ANSI stands for American National Standards Institute.

Auto-ignition Temperature
The auto-ignition temperature is the lowest temperature at which a material begins to burn in air, in the absence of a spark or flame. Many chemicals will decompose (break down) when heated. The auto-ignition temperature is the temperature at which the chemicals formed by decomposition begin to burn. Auto-ignition temperatures for a specific material can vary by one hundred degrees Celsius or more, depending on the test method used. Therefore, values listed in documents such as a Material Safety Data Sheet may be rough estimates. To avoid the risk of fire or explosion, materials must be stored and handled at temperatures well below the auto-ignition temperature.

Base, Basic
See pH.

Bioaccumulation
Bioaccumulation describes the process by which a chemical accumulates in a living organism, either from the surrounding environment (air, water or soil) or from other means such as consuming food containing the substance. See also Bioconcentration.

Bioavailability
Bioavailability is a measurement of the degree to which a chemical in the environment can be taken up into a living organism. Reduced bioavailability, which can occur if the chemical is bound to something else, means a lower exposure.

Bioconcentration
Bioconcentration describes the process by which a chemical can build up in a living organism to levels higher than those found in the surrounding environment. For example, a fish will have a higher concentration of a chemical in its body than what

is present in the water it swims in. Bioconcentration refers to the uptake of the chemical from water only. Not all sources of exposure are chemical. See also Bioaccumulation.

Biodegradation
Biodegradation is a measure of the ability of a chemical to be broken down into smaller units by living organisms. Biodegradation is a key process for the natural reduction of hazardous chemicals.

Biomagnification
Biomagnification is the accumulation of higher concentrations of a chemical in a living organism at each successive level in the food chain. The chemical is transferred to organisms further up the food chain, as they consume organisms lower in the food chain.

Biotransformation
This is the process by which living organisms transform chemicals in the environment.

Biohazardous Infectious Material
A biohazardous infectious material is a material that contains organisms which can cause disease in humans or animals. Included in this category are bacteria, viruses, fungi and parasites. Because these organisms can live in body tissues or fluids (blood, or urine), the tissues and fluids are also treated as toxic. For example, a person exposed to a blood sample from someone with hepatitis B may contract the disease.

BOD
BOD stands for biological oxygen demand or biochemical oxygen demand. It is used as a method for determining how much contamination has entered the water supply. It is used primarily for waters, which receive pollution from sewage and industrial wastes. Refer to the results of the BOD Test.

BOD Test
A test that measures the amount of oxygen that is consumed as microbial life decomposes organic matter in water.

Boiling Point
The boiling point is the temperature at which the material changes from a liquid to a gas. Below the boiling point, the liquid can evaporate to form a vapor. As the material approaches the boiling point, the change from liquid to vapor is rapid and vapor concentrations in the air can be extremely high. Airborne gases and vapors may pose fire, explosion, and health hazards.
Sometimes, the boiling point of a mixture is given as a range of temperatures. This is because different ingredients in a mixture can boil at different temperatures.
If the material decomposes (breaks down) without boiling, the temperature at which it decomposes may be given with the abbreviation "dec." Some of the decomposition chemicals may be hazardous. (See also Thermal Decomposition Products.)

Burning Rate
The time it takes a sample of solid material to burn a specified distance.

CANUTEC
CANUTEC stands for Canadian Transport Emergency Centre, which is part of the Transport Dangerous Goods Directorate of Transport Canada. CANUTEC provides information and communications assistance, in case of transportation emergencies involving dangerous goods.

Carcinogen, Carcinogenic, Carcinogenicity
A carcinogen is a substance that can cause cancer. Carcinogenic means that it is capable of causing cancer. Carcinogenicity is the ability of a substance to cause cancer.

CAS Registry Number
The CAS Registry Number is a number assigned to a material by the Chemical Abstracts Service (CAS) of the American Chemical Society (ACS). The CAS number provides a single unique identifier. A unique identifier is necessary because the same material can have many different names. For example, the name given to a specific chemical may vary from one language or country to another. The CAS Registry Number is similar to a telephone number and has no significance in terms of the chemical nature or hazards of the material. The CAS Registry Number can be used to locate additional information on the material, for example, when searching in books or chemical databases.

CC
Depending on the context, CC can stand for closed cup, cubic centimeters, or ceiling concentration.

CCC
CCC stands for Cleveland closed cup, a standard method of determining flash points.

CCOHS
CCOHS stands for the Canadian Center for Occupational Health and Safety. CCOHS provides an occupational health and safety information service through answers to inquiries, publications, and a computerized information service. The computerized information is available both on the internet and on CD-ROM.

Ceiling (C)
See Exposure Limits for a general explanation.

Chemical Family
The chemical family describes the general nature of the chemical. Chemicals belonging to the same family often share certain physical and chemical properties and toxic effects. However, there may also be important differences. For example, toluene and benzene both belong to the aromatic hydrocarbon family. However, benzene is a carcinogen, and toluene is not.

Chemical Formula
The chemical formula, sometimes called the molecular formula, tells which elements (carbon, hydrogen, oxygen, and so on) make up a chemical. It also gives the number of atoms of each element in one unit or molecule of the chemical. The chemical formula can be used to confirm the identity of ingredients or to indicate the presence of a potentially hazardous element.
For example, zinc yellow has the chemical formula ZnCrO4, which shows that it contains not only zinc (Zn) but also chromium (Cr).

Chemical Name
The chemical name is a proper scientific name for an ingredient of a product. For example, the chemical name of the herbicide 2, 4-D is 2, 4-dichlorophenoxyacetic acid. The chemical name can be used to obtain additional information.

Chemical Reactivity
Chemical reactivity is the ability of a material to undergo a chemical change. A chemical reaction may occur under conditions such as heating, burning, contact with other chemicals, or exposure to light. Undesirable effects such as pressure buildup, temperature increase, or formation of other hazardous chemicals may result. (See also Dangerously Reactive Material and Reactive Flammable Material.)

Chronic
Chronic means long-term or prolonged. It can describe either an exposure or a health effect. A chronic exposure is a long-term exposure. Long-term means months or years. A chronic health effect is an adverse health effect resulting from long-term exposure or a persistent adverse health effect resulting from a short-term exposure. The Canadian Controlled Products Regulations describe technical criteria for identifying materials, which cause chronic health effects. These regulations are part

of the Workplace Hazardous Materials Information System (WHMIS). (See also Acute.)

Closed Cup
A test procedure used to measure the flash point of a material, using a closed cup, which prevents the vapor from escaping. A closed cup flash point is generally lower than a flash point measured using an open cup method.

CNS
CNS stands for central nervous system.

COC
COC stands for Cleveland open cup, a standard method of determining flash points. This open cup method allows the vapors to escape, generally producing a flash point value that is higher than a flash point measured by a closed cup method.

COD
COD stands for chemical oxygen demand. COD is the amount of oxygen used to oxidize reactive chemicals in water. It is a measure of water quality.

Coefficient of Oil/water Distribution
The coefficient of oil/water distribution, also called the partition coefficient (abbreviated as P), is the ratio of the solubility of a chemical in an oil to its solubility in water. The P value is typically presented as a logarithm of P (log P). It indicates how easily a chemical can be absorbed into or stored in fatty tissues in the body. The P value is also used to help determine the fate of the chemical in the environment through its tendency to partition into the water, soil and living organisms.

Combustible
Combustible means able to burn. Broadly speaking, a material is combustible if it can catch fire and burn. However, in many jurisdictions, the term combustible is given a specific regulatory meaning. (See Combustible Liquid.)
The terms combustible and flammable both describe the ability of a material to burn. Commonly, combustible materials are less easily ignited than flammable materials.

Compressed Gas
A compressed gas is a material which is a gas at normal room temperature and pressure but is packaged as a pressurized gas, pressurized liquid, or refrigerated liquid.
Regardless of whether a compressed gas is packaged in an aerosol can, a pressurized cylinder, or a refrigerated container, it must be stored and handled very carefully. Puncturing or damaging the container or allowing the container to become hot may result in an explosion.

Corrosive Material
A corrosive material can attack (corrode) metals or human tissues such as the skin or eyes. Corrosive materials may cause metal containers or structural materials to become weak and eventually lead to leak or collapse. Corrosive materials can burn or destroy human tissues on contact and can cause effects such as permanent scarring or blindness.

Cubic Centimeter
Metric unit of volume. Equal to one thousandth of a liter. It is a metric unit of volume equal to 1000 liters.

CU M or CU.M
This stands for cubic meter

Dangerously Reactive Material
A dangerously reactive material can react vigorously:
- With water to produce a very toxic gas.
- On its own by polymerization or decomposition.

- Under conditions of shock, or an increase in pressure or temperature.

A dangerously reactive material may cause a fire, explosion, or other hazardous condition. It is very important to know which conditions (such as shock, heating or contact with water) may set off the dangerous reaction so that appropriate preventive measures can be taken.

Density
The density of a material is its weight for a given volume. Density is usually given in units of grams per milliliter (g/mL) or grams per cubic centimeter (g/cc). Density is closely related to specific gravity (relative density). The volume of a material in a container can be calculated from its density and weight.

Dilution Ventilation
See General Ventilation.

DOT
DOT stands for the U.S. Department of Transportation.

DSL
See Domestic Substances List.

Embryo
An embryo is an organism in the early stages of its development prior to birth. In humans, the embryo is the developing child from conception to the end of the second month of pregnancy. (See also Fetus/Foetus.)

Embryo toxic, Embryo toxicity
Embryo toxic means harmful to the embryo. Embryo toxicity is the ability of a substance to cause harm to the embryo.

Engineering Controls
Engineering controls help reduce exposure to potential hazards either by isolating the hazard or by removing it from the work environment. Engineering controls include mechanical ventilation and process enclosure. They are important because they are built into the work process.

Engineering controls are usually preferred to other control measures such as the use of personal protective equipment. Substitution of a less hazardous material or industrial process is the best way to reduce a hazard and is often considered to be a type of engineering control.

Environmental Fate
The environmental fate of a chemical is a statement of what tends to happen to the chemical when it is released into the environment. Fate depends on properties of the chemical such as solubility, vapor pressure, partition coefficient, stability and reactivity. A chemical may preferentially end up in air, in water, or in soil, and may break down quickly or slowly.

EPA
EPA stands for the U.S. Environmental Protection Agency.

EU
EU stands for the European Union, formerly known as the EEC (European Economic Community) and the EC (European Community).

Evaporation Rate
The evaporation rate is a measure of how quickly the material becomes a vapor at normal room temperature. Usually, the evaporation rate is given in comparison to certain chemicals, such as butyl acetate, which evaporate fairly quickly. For example, the rate might be given as "0.5 (butyl acetate=1)." This means that, under specific conditions, 0.5 grams of the material evaporates during the same time that 1 gram of butyl acetate evaporates. Often, the evaporation rate is given only as

greater or less than 1, which means the material evaporates faster or slower than the comparison chemical.

In general, a hazardous material with a higher evaporation rate presents a greater hazard than a similar compound with a lower evaporation rate.

Explosion Data
Explosion data is information on the explosive properties of a material. Quantitative explosion data is seldom available and is usually given in descriptive terms such as low, moderate or high. The following types of information can be used to describe the explosive hazard of a material:

- **Sensitivity to mechanical impact**. This information indicates whether or not the material will burn or explode on shock (for example, dropping a package) or friction (for example, scooping up spilled material).
- **Sensitivity to static discharge**. This information indicates how readily the material can be ignited by an electric spark.

Detailed information is available on the properties of commercial explosives.

Explosive Limits
Explosive limits specify the concentration range of a material in air, which will burn or explode in the presence of an ignition source (spark or flame). Explosive limits may also be called flammable limits or explosion limits.

The lower explosive limit (LEL), or lower flammable limit (LFL), is the lowest concentration of gas or vapor which will burn or explode if ignited. The upper explosive limit (UEL), or upper flammable limit (UFL), is the highest concentration of gas or vapor which will burn or explode if ignited. From the LEL to the UEL, the mixture is explosive. Below the LEL, the mixture is too lean to burn. Above the UEL, the mixture is too rich to burn. However, concentrations above the UEL are still very dangerous because, if the concentration is lowered (for example, by introducing fresh air), it will enter the explosive range.

In reality, explosive limits for a material vary since they depend on many factors such as air temperature. Therefore, the values given on a Material Safety Data Sheet are approximate.

The explosive limits are usually given as the percent by volume of the material in the air. One percent by volume is 10,000 ppm. For example, gasoline has a LEL of 1.4% and a UEL of 7.6%. This means that gasoline vapors at concentrations of 1.4% to 7.6% (14,000 to 76,000 ppm) are flammable or explosive.

Exposure Limits (or Occupational Exposure Limits (OELs))
An exposure limit is the concentration of a chemical in the workplace air to which most people can be exposed without experiencing harmful effects. Exposure limits should not be taken as sharp dividing lines between safe and unsafe exposures. It is possible for a chemical to cause health effects, in some people, at concentrations lower than the exposure limit.

Exposure limits have different names and different meanings depending on who developed them and whether or not they are legal limits. For example, Threshold Limit Values (TLVs) are exposure guidelines developed by the American Conference of Governmental Industrial Hygienists (ACGIH). Permissible Exposure Limits (PELs) are legal exposure limits in the U.S. Sometimes, a manufacturer will recommend an exposure limit for a material.

Exposure limits have not been set for many chemicals for many different reasons. For example, there may not be enough information available to set an exposure limit. Therefore, the absence of an exposure limit does not necessarily mean the material is not harmful.

There are three different types of exposure limits in common use:
1) **Time-weighted average (TWA) exposure limit** is the time-weighted average

concentration of a chemical in air for a normal 8-hour work day and 40-hour work week to which nearly all workers may be exposed day after day without harmful effects. Time-weighted average means that the average concentration has been calculated using the duration of exposure to different concentrations of the chemical during a specific time period. In this way, higher and lower exposures are averaged over the day or the week.

2) **Short-term exposure limit (STEL)** is the average concentration to which workers can be exposed for a short period (usually 15 minutes) without experiencing irritation, long-term or irreversible tissue damage, or reduced alertness. The number of times the concentration reaches the STEL and the amount of time between these occurrences can also be restricted.
3) **Ceiling (C) exposure limit** is the concentration which should not be exceeded at any time.
   "SKIN" notation (SKIN) means that contact with the skin, eyes, and moist tissues (for example, the mouth) can contribute to the overall exposure. The purpose of this notation is to suggest that measures be used to prevent absorption by these routes; for example, the use of protective gloves. If absorption occurs through the skin, then the airborne exposure limits are not relevant.

Extinguishing Media
Extinguishing media are agents which can put out fires involving the material. Common extinguishing agents are water, carbon dioxide, dry chemical, "alcohol" foam, and halogenated gases (Halons). It is important to know which extinguishers can be used so they can be made available at the worksite. It is also important to know which agents cannot be used since an incorrect extinguisher may not work or may create a more hazardous situation. If several materials are involved in a fire, an extinguisher effective for all of the materials should be used.

FDA
FDA stands for the Food and Drug Administration (U.S.).

Fetotoxic, Fetotoxicity
Fetotoxic means the substance is harmful to the fetus/foetus. Fetotoxicity describes the ability of a substance to harm the fetus. (See also Embryo toxicity, Teratogenicity and Reproductive Effects.)

Fetus / Foetus
A fetus is an organism in the later stages of development prior to birth. In humans, it is the unborn child from the end of the second month of pregnancy to birth. (See also Embryo.)

First Aid
First aid is emergency care given immediately to an injured person. The purpose of first aid is to minimize injury and future disability. In serious cases, first aid may be necessary to keep the victim alive.

Flammable, Flammability
Flammable means able to ignite and burn readily. Flammability is the ability of a material to ignite and burn readily. (See also Combustible.)

Flammable Aerosol
A material is identified as a flammable aerosol if it is packaged in an aerosol container which can release a flammable material. A flammable aerosol is hazardous because it may form a torch (explosive ignition of the spray) or because a fire fuelled by the flammable aerosol may flash back.

Flammable and Combustible Material
A material may be classified as a flammable and combustible material if it meets specific criteria for a flammable gas, flammable liquid, combustible liquid, flammable solid, flammable aerosol, or reactive flammable material.

Flammable Gas
A flammable gas is a gas which can ignite readily and burn rapidly or explosively.

Flammable gases can be extremely hazardous in the workplace; for example:

- If the gas accumulates so that it's lower explosive limit (LEL) is reached and if there is a source of ignition, an explosion may occur.
- If there is inadequate ventilation, flammable gases can travel a considerable distance to a source of ignition and flash back to the source of the gas.

Flammable Limits
See Explosive Limits.

Flammable Liquid
A flammable liquid gives off a vapor which can be readily ignited at normal working temperatures.

Flammable liquids can be extremely hazardous in the workplace; for example:

- If there is inadequate ventilation, vapors can travel considerable distances to a source of ignition and flash back to the flammable liquid.
- It may be difficult to extinguish a burning flammable liquid with water because water may not be able to cool the liquid below its flash point.

Flammable Solid
A flammable solid is a material which can ignite readily and burn vigorously and persistently. Flammable solids may be hazardous because heat from friction (for example, surfaces rubbing together) or heat from processing may cause a fire. Flammable solids in the form of a dust or powder may be particularly hazardous because they may explode if ignited.

Flash Back
Flash back occurs when a trail of flammable gas, vapor or aerosol is ignited by a distant spark, flame or other source of ignition. The flame then travels back along the trail of gas, vapor or aerosol to its source. A serious fire or explosion could result.

Flash Point
The flash point is the lowest temperature at which a liquid or solid gives off enough vapor to form a flammable air-vapor mixture near its surface. The lower the flash point, the greater the fire hazard. The flash point is an approximate value and should not be taken as a sharp dividing line between safe and hazardous conditions. The flash point is determined by a variety of test methods which give different results. Two types of methods are abbreviated as OC (open cup) and CC (closed cup).

Freezing Point
See Melting Point.

Fumes
Fumes are very small, airborne, solid particles formed by the cooling of a hot vapor. For example, a hot zinc vapor may form when zinc-coated steel is welded. The vapor then condenses to form fine zinc fume as soon as it contacts the cool surrounding air. Fumes are smaller than dusts and are more easily breathed into the lungs.

Gas
A gas is a material without a specific shape or volume. Gases tend to occupy an entire space uniformly at normal room pressure and temperature. The terms vapor and fume are sometimes confused with gas.

General Ventilation
As used in a Material Safety Data Sheet, general ventilation, also known as dilution ventilation, is the removal of contaminated air from the general area and the bringing in of clean air. This dilutes the amount of contaminant in the work environment. General ventilation is usually suggested for non-hazardous materials. (See also Mechanical Ventilation, Local Exhaust Ventilation and Ventilation.)

GHS
GHS stands for the Globally Harmonized System of Classification and Labeling of

Chemicals. It is intended that GHS be adopted worldwide. GHS addresses the classification of chemicals by types of hazard (health, fire, reactivity, environmental) and proposes harmonized hazard communication elements (labels and safety data sheets).

GI
GI stands for gastrointestinal (relating to the stomach and intestines).

Hazard, Hazardous
Hazard is the potential for harmful effects. Hazardous means potentially harmful. The hazards of a material are evaluated by examining the properties of the material, such as toxicity, flammability, and chemical reactivity, as well as how the material is used. How a material is used can vary greatly from workplace to workplace and, therefore, so can the hazard.

In Canada and the U.S., the term hazardous is used by many different regulatory agencies. Definitions may vary. For example, OSHA defines a "hazardous chemical" as any chemical which is a physical hazard or a health hazard according to the OSHA Hazard Communication (Hazcom) criteria.

Hazardous Combustion Products
Hazardous combustion products are chemicals which may be formed when a material burns. These chemicals may be toxic, flammable or have other hazards. The chemicals released and their amounts vary, depending upon conditions such as the temperature and the amount of air (or more specifically, oxygen) available. The combustion chemicals may be quite different from those formed by heating the same material during processing (thermal decomposition products). It is important to know which chemicals are formed by hazardous combustion in order to plan the response to a fire involving the material.

Hazardous Decomposition Products
Hazardous decomposition products are formed when a material decomposes (breaks down) because it is unstable, or reacts with common materials such as water or oxygen (in air). This information should be considered when planning storage and handling procedures.

Hazardous Ingredient
A chemical must be listed in the Hazardous Ingredients Section of a Material Safety Data Sheet (MSDS) if:

- It meets the criteria for a controlled product.
- It is on the Ingredient Disclosure List.
- There is no toxicological information available.
- The supplier has reason to believe it might be hazardous.

Hazardous Polymerization
See Polymerize, Polymerization.

Henry's Law Constant
Henry's Law Constant is a measure of the tendency of a chemical to evaporate from a solution in water. It indicates whether a chemical accumulates in water or in air at equilibrium.

Hepatotoxin
Hepatotoxins are agents that can cause toxic effects on the liver.

Hr
Hr stands for hour.

IARC
IARC stands for the International Agency for Research on Cancer. IARC evaluates information on the carcinogenicity of chemicals, groups of chemicals and chemicals associated with certain industrial processes. IARC has published lists of chemicals which are generally recognized as human carcinogens, probable human

carcinogens, or carcinogens in animal tests.

IATA
IATA stands for International Air Transport Association.

IDLH
IDLH stands for Immediately Dangerous to Life or Health. For the purposes of respirator selection, the National Institute for Occupational Safety and Health (NIOSH) defines the IDLH concentration as the airborne concentration that poses a threat of exposure to airborne contaminants when that exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment. The purpose of establishing an IDLH exposure concentration is to ensure that the worker can escape from a given contaminated environment in the event of failure of the respiratory protection equipment. In the event of failure of respiratory protective equipment, every effort should be made to exit immediately.

ILO
ILO stands for the International Labor Office.

Impervious
Impervious is a term used to describe protective gloves and other protective clothing. If a material is impervious to a chemical, then that chemical cannot readily penetrate through the material or damage the material. Different materials are impervious (resistant) to different chemicals. No single material is impervious to all chemicals. If a Material Safety Data Sheet recommends wearing impervious gloves, you need to know the type of material from which the gloves should be made.

Incompatible Materials
Incompatible materials can react with the product or with components of the product and may:

- Destroy the structure or function of a produce.
- Cause a fire, explosion or violent reaction.
- Cause the release of hazardous chemicals.

Inert Ingredient
An inert ingredient is anything other than the active ingredient of a product. It may be a solvent, colorant, filler or dispersing agent. In some cases, inert ingredients may be hazardous.

Ingestion
Ingestion means taking a material into the body by mouth (swallowing).

Inhalation
Inhalation means taking a material into the body by breathing it in.

Irritancy, Irritation
Irritancy is the ability of a material to irritate the skin, eyes, nose, throat or any other part of the body that it contacts. Signs and symptoms of irritation include tearing in the eyes and reddening, swelling, itching and pain of the affected part of the body.

Irritancy is often described as mild, moderate or severe, depending on the degree of irritation caused by a specific amount of the material. Irritancy may also be described by a number on a scale of 0 to 4, where 0 indicates no irritation and 4 means severe irritation. Irritancy is usually determined in animal experiments.

ISO
ISO stands for the International Organization for Standardization.

Kg
Kg stands for kilogram

Kow
Kow stands for octanol/water partition coefficient.

LC50
LC stands for lethal concentration. LC50 is the concentration of a material in air which causes the death of 50% (one half) of a group of test animals. The material is inhaled over a set period of time, usually 1 or 4 hours. The LC50 helps determine the short-term poisoning potential of a material.

LD50
LD stands for lethal dose. LD50 is the amount of a material, given all at once, which causes the death of 50% (one half) of a group of test animals. The LD50 can be determined for any route of entry, but dermal (applied to skin) and oral (given by mouth) LD50's are most common. The LD50 is one measure of the short-term poisoning potential of a material. (See also LC50.)

LCLO
LCLO stands for lowest lethal airborne concentration tested. (See also LC50 and LD50.)

LDLO
LDLO stands for lowest lethal dose tested. (See also LC50 and LD50.)

LEL
See Explosive Limits.

LFL
See Explosive Limits.

Local Exhaust Ventilation
Local exhaust ventilation is the removal of contaminated air directly at its source. This type of ventilation can help reduce worker exposure to airborne materials more effectively than general ventilation. This is because it does not allow the material to enter the work environment. It is usually recommended for hazardous airborne materials. (See also Mechanical Ventilation and Ventilation.)

Lower Explosion Limit
See Explosive Limits.

Lower Explosive Limit
See Explosive Limits.

Lower Flammable Limit
See Explosive Limits.

Means Of Extinction
See Extinguishing Media.

Mechanical Ventilation
Mechanical ventilation is the movement of air by mechanical means (for example, a wall fan). There are two kinds of mechanical ventilation: general ventilation and local exhaust ventilation. (See also Ventilation.)

Melting Point
The melting point is the temperature at which a solid material becomes a liquid. The freezing point is the temperature at which a liquid material becomes a solid. Usually one value or the other is given on the Material Safety Data Sheet.
It is important to know the freezing or melting point for storage and handling purposes. For example, a frozen or melted material may burst a container. As well, a change of physical state could alter the hazards of the material.

mg/m^3
The abbreviation mg/m^3 stands for milligrams (mg) of a material per cubic meter

(m^3) of air. It is a unit of metric measurement for concentration (weight/volume). The concentrations of any airborne chemical can be measured in mg/m^3, whether it is a solid, liquid, gas or vapor.

MIN
MIN can stand for minute or minimum.

Miscible
Miscible means able to be mixed. Two liquids are said to be miscible if they are partially or completely soluble in each other. Commonly, the term miscible is understood to mean that the two liquids are completely soluble in each other. (See also Solubility.)

Mist
A mist is a collection of liquid droplets suspended in air. A mist can be formed when spraying or splashing a liquid. It can also be formed when a vapor condenses into liquid droplets in the air. (See also Aerosol.)

mL
mL stands for milliliters (mL).

mm Hg
The abbreviation mm Hg stands for millimeters (mm) of mercury (Hg). It is a common unit of measurement for the pressure exerted by gases such as air. Normal atmospheric pressure is 760 mm Hg.

Molecular Formula
See Chemical Formula.

Molecular Weight
The molecular weight of a chemical is a number showing how heavy one molecule (or unit) of the chemical is compared to the lightest element, hydrogen, which has a weight of 1. The molecular weight has various technical uses, such as calculating conversions from parts per million (ppm) to milligrams per cubic meter (mg/m3) in air.

MSDS
MSDS stands for Material Safety Data Sheet. The MSDS is a document that contains information on the potential health effects of exposure and how to work safely with the material it is written about. It is an essential starting point to a health and safety program. It contains hazard evaluations on the use, storage, handling, and emergency procedures all related to the material.

Mutagen, Mutagenic, Mutagenicity
A mutagen is a substance which can cause changes in the DNA of cells (mutations). Mutagenic means able to cause mutations. Mutagenicity is the ability of a substance to cause mutations.

DNA determines the characteristics that children inherit from their parents. DNA also determines how cells in the body divide or reproduce.

A number of mutagenicity tests are used to screen chemicals for possible carcinogenicity or reproductive effects. This is because there is some evidence that mutations may increase the risk of cancer and reproductive problems such as infertility or birth defects. However, mutagenicity test results are not very reliable predictors of these effects. One reason for this is that the human body can repair mutations while most mutagenicity tests cannot.

Mutagenicity is included on Material Safety Data Sheets because it is an early indicator of potential hazard, and often there is very little other evidence available on possible carcinogenic or reproductive effects.

NA Number
See UN Number.

Natural Ventilation
Natural ventilation is a type of general ventilation which depends on natural instead of mechanical means for air movement. Natural ventilation can depend on the wind or the difference in temperature from one area to another to move air through a building. Therefore, it is unpredictable and unreliable. (See also Local Exhaust Ventilation, Mechanical Ventilation and Ventilation.)

Nephrotoxins
Nephrotoxins are agents that can cause toxic effects on the kidney.

Neurotoxins
Neurotoxins are agents that can cause toxic effects on the nervous system.

NIOSH
NIOSH stands for National Institute for Occupational Safety and Health. NIOSH is a branch of the United States government which undertakes research and develops occupational health and safety standards.

NOEL
NOEL stands for No Observable Effect Level.

NOS
NOS stands for Not Otherwise Specified.

Nuisance Dust, Nuisance Particulate
Nuisance particulate is a term used historically by the ACGIH (American Conference of Governmental Industrial Hygienists) to describe airborne materials (solids and liquids) which have little harmful effect on the lungs and do not produce significant disease or harmful effects when exposures are kept under reasonable control. Nuisance particulates may also be called nuisance dusts. High levels of nuisance particulates in the air may reduce visibility and can get into the eyes, ears and nose. Removal of this material by washing or rubbing may cause irritation. (Also see Particulates Not Otherwise Classified)

OC
OC stands for open cup.

Odor Threshold
The odor threshold is the lowest concentration of a chemical in air that is detectable by smell. The odor threshold should only be regarded as an estimate. This is because odor thresholds are commonly determined under controlled laboratory conditions using people trained in odor recognition.

As well, in the workplace, the ability to detect the odor of a chemical varies from person to person and depends on conditions such as the presence of other odorous materials.
Odor cannot be used as a warning of unsafe conditions since workers may become used to the smell (adaptation), or the chemical may numb the sense of smell, a process called olfactory fatigue. However, if the odor threshold for a chemical is well below its exposure limit, odor can be used to warn of a problem with your respirator.

OECD
OECD stands for Organization for Economic Cooperation and Development. The OECD is an international agency which supports programs designed to facilitate trade and development.

The OECD has published "Guidelines for Testing of Chemicals." These guidelines contain recommended procedures for testing chemicals for toxic and environmental effects and for determining physical and chemical properties.

OEL
OEL stands for Occupational Exposure Limit. (See Exposure Limits for a general explanation.)

OSHA
OSHA stands for Occupational Safety and Health Administration. It is the branch of the United States government which sets and enforces occupational health and safety regulations. For example, OSHA sets the legal exposure limits in the United States, which are called Permissible Exposure Limits (PELs). OSHA also specifies what information must be given on labels and Material Safety Data Sheets for materials which have been classified as hazardous using their criteria.

Oxidizing Agent, Oxidizing Material
An oxidizing agent or material gives up oxygen easily or can readily oxidize other materials. Examples of oxidizing agents are oxygen, chlorine, and peroxide compounds. These chemicals will support a fire and are highly reactive.

Particulates Not Otherwise Classified (PNOC)
Particulates Not Otherwise Classified is a term defined by the ACGIH (American Conference of Governmental Industrial Hygienists). It is used to describe particulates for which there is no evidence of specific toxic effects such as fibrosis or systemic effects. These materials are not to be considered inert, however, can produce general toxic effects depending on the airborne concentration.

Partition Coefficient
See Coefficient of Oil/Water Distribution.

PEL
PEL stands for Permissible Exposure Limit. PELs are legal limits in the United States set by the Occupational Safety and Health Administration (OSHA). (See Exposure Limits for a general explanation.)

Pensky-Martens Closed Cup
Pensky-Martens Closed Cup (PMCC) is a specific method for determining flash points.

Personal Protective Equipment
Personal protective equipment is clothing or devices worn to help isolate a person from direct exposure to a hazardous material or situation. Recommended personal protective equipment is often listed on an MSDS. This can include protective clothing, respiratory protection, and eye protection.

The use of personal protective equipment is the least preferred method of protection from hazardous exposures. It can be unreliable and, if it fails, the person can be left completely unprotected. This is why engineering controls are preferred. Sometimes, personal protective equipment may be needed along with engineering controls. For example, a ventilation system (an engineering control) reduces the inhalation hazard of a chemical, while gloves and an apron (personal protective equipment) reduce skin contact. In addition, personal protective equipment can be an important means of protection when engineering controls are not practical: for example, during an emergency or other temporary condition such as maintenance operations.

pH
The pH is a measure of the acidity or basicity (alkalinity) of a material when dissolved in water. It is expressed on a scale from 0 to 14. Roughly, pH can be divided into the following ranges:

- pH 0 - 2 Strongly acidic
- pH 3 - 5 Weakly acidic
- pH 6 - 8 Neutral
- pH 9 - 11 Weakly basic
- pH 12 - 14 Strongly basic

PIN
See UN Number.

PMCC
See Pensky-Martens Closed Cup

PNS
PNS stands for peripheral nervous system.

Poisonous And Infectious Material
A material which meets the criteria for a Material Causing Immediate and Serious Toxic Effects, a Material Causing Other Toxic Effects, or a Biohazardous Infectious Material.

Polymer
A polymer is a natural or man-made material formed by combining units, called monomers, into long chains. The word polymer means many parts. Examples of polymers are starch (which has many sugar units), polyethylene (which has many ethylene units), and polystyrene (which has many styrene units).

Most man-made polymers have low toxicity, low flammability, and low chemical reactivity. In these ways, polymers tend to be less hazardous than the chemicals (monomers) from which they are made.

Polymerize, Polymerization
Polymerization is the process of forming a polymer by combining large numbers of chemical units or monomers into long chains. Polymerization can be used to make some useful materials. However, uncontrolled polymerization can be extremely hazardous. Some polymerization processes can release considerable heat, can generate enough pressure to burst a container or can be explosive. Some chemicals can polymerize on their own without warning. Others can polymerize upon contact with water, air or other common chemicals. Inhibitors are normally added to products to reduce or eliminate the possibility of uncontrolled polymerization.

ppb
ppb stands for parts per billion.

ppm
The abbreviation ppm stands for parts per million. It is a common unit of concentration of gases or vapor in air. For example, 1 ppm of a gas means that 1 unit of the gas is present for every 1 million units of air. One ppm is the same as 1 minute in 2 years or 1 penny in $10,000.00, or 1 inch in 16 miles.

Process Enclosure
As used on a Material Safety Data Sheet, process enclosure means that the operation in which the material is used is completely enclosed. A physical barrier separates the worker from the potential health or fire hazard. Process enclosure is usually recommended if the material is very toxic or flammable.

PSI
PSI stands for pounds per square inch and is a unit of pressure.

Pyrophoric
Pyrophoric chemicals are defined in the U.S. OSHA Hazcom Standard as chemicals which will ignite spontaneously in air at a temperature of 130 degrees F (54.4 degrees C) or below. Regulatory definitions in other jurisdictions may differ.

Reactive Flammable Material
A reactive flammable material is a material which is a dangerous fire risk because it can react readily with air or water. This category includes any material which:

- Is spontaneously combustible, that is, a material which can react with air until enough heat builds up that it begins to burn.
- Can react vigorously with air under normal conditions without actually catching fire.
- Gives off dangerous quantities of flammable gas on reaction with water.
- Becomes spontaneously combustible when it contacts water or water vapor.

Reactive flammable materials must be kept dry and isolated from oxygen (in air) or other oxidizing agents. Therefore, they are often stored and handled in an atmosphere of unreactive gas, such as nitrogen or argon.

The Controlled Products Regulations are part of the national Workplace Hazardous Materials Information System (WHMIS).

Relative Density
See Specific Gravity.

Reproductive Effects
Reproductive effects are problems in the reproductive process which may be caused by a substance. Possible reproductive effects include reduced fertility in the male or female, menstrual changes, miscarriage, embryo toxicity, fetotoxicity, teratogenicity, or harmful effects to the nursing infant from chemicals in breast milk.

Most chemicals can cause reproductive effects if there is an extremely high exposure. In these cases, the exposed person would experience other noticeable signs and symptoms caused by the exposure. These signs and symptoms act as a warning of toxicity. Chemicals which cause reproductive effects in the absence of other significant harmful effects are regarded as true reproductive hazards. Very few workplace chemicals are known to be true reproductive hazards.

Respiratory Sensitization
See Sensitization.

RQ
RQ stands for reportable quantity.

SEC
SEC stands for second or section.

Sensitization
Sensitization is the development, over time, of an allergic reaction to a chemical. The chemical may cause a mild response on the first few exposures but, as the allergy develops, the response becomes worse with subsequent exposures. Eventually, even short exposures to low concentrations can cause a very severe reaction.

There are two different types of occupational sensitization: skin and respiratory. Typical symptoms of skin sensitivity are swelling, redness, itching, pain, and blistering. Sensitization of the respiratory system may result in symptoms similar to a severe asthmatic attack. These symptoms include wheezing, difficulty in breathing, chest tightness, coughing and shortness of breath.

"Skin" Notation
See Exposure Limits for a general explanation.

Skin Sensitization
See Sensitization.

Solubility
Solubility is the ability of a material to dissolve in water or another liquid. Solubility may be expressed as a ratio or may be described using words such as insoluble, very soluble or miscible.

Often, on a Material Safety Data Sheet, the "Solubility" section describes solubility in water since water is the single most important industrial solvent. Solubility information is useful for planning spill clean-up and fire fighting procedures.

Solvent
A solvent is a material, usually a liquid, which is capable of dissolving another chemical. Chemicals commonly called solvents can dissolve many different chemicals. Examples of common solvents are water, ethanol, acetone, hexane, and toluene.

Specific Gravity
Specific gravity is the ratio of the density of a material to the density of water. The density of water is about 1 gram per cubic centimeter (g/cc). Materials which are lighter than water (specific gravity less than 1.0) will float. Most materials have specific gravities exceeding 1.0, which means they are heavier than water and so will sink. Knowing the specific gravity is important for planning spill clean-up and fire fighting procedures. For example, a light flammable liquid such as gasoline may spread and, if ignited, burn on top of a water surface.

Stability
Stability is the ability of a material to remain unchanged in the presence of heat, moisture, or air. An unstable material may decompose, polymerize, burn or explode under normal environmental conditions. Any indication that the material is unstable gives warning that special handling and storage precautions may be necessary.

STEL
STEL stands for Short-Term Exposure Limit. (See Exposure Limits for a general explanation.)

STP
STP stands for Standard Temperature and Pressure (0 degrees Celsius and one atmosphere pressure).

Synergistic, Synergism
Synergism means that exposure to more than one chemical can result in health effects greater than expected when the effects of exposure to each chemical are added together. Very simply, it is like saying 1 + 1 = 3. When chemicals are synergistic, the potential hazards of the chemicals should be re-evaluated, taking their synergistic properties into consideration.

Synonyms
Synonyms are alternative names for the same chemical. For example, methanol and methyl hydrate are synonyms for methyl alcohol. Synonyms may help in locating additional information on a chemical.

Target Organ Effects
Under the U.S. OSHA HAZCOM Standard, chemicals are identified as having target organ effects if there is statistically significant evidence of an acute or chronic health effect determined in a scientifically valid study. The following agents would be included (note, the list is not all-inclusive): hepatotoxins, agents which damage the lungs (including irritants), agents which act on the hematopoietic system, neurotoxins, nephrotoxins, reproductive toxins (mutagens, embryo toxins, teratogens and reproductive toxins), cutaneous hazards (chemicals which affect the dermal layer of the skin) and eye hazards (chemicals which affect the eye or visual capacity).

TCC
TCC stands for Tagliabue closed cup; a standard method of determining flash points. Generally, this appears in abbreviated form as Tag closed cup.

TCLO
TCLO stands for lowest toxic airborne concentration tested (see also LCLO and LC50).

TDLO
TDLO stands for lowest toxic dose tested (see also LDLO and LD50).

Teratogen, Teratogenic, Teratogenicity
A teratogen is a substance which can cause birth defects. Teratogenic means able to cause birth defects. Teratogenicity is the ability of a chemical to cause birth defects. Teratogenicity results from a harmful effect to the embryo or the fetus/foetus.

Thermal Decomposition Products
Thermal decomposition products are chemicals which may be formed when the material is heated but does not burn. These chemicals may be toxic, flammable, or have other hazards. The chemicals released and their amounts vary depending upon conditions such as the temperature. The thermal decomposition products may be quite different from the chemicals formed by burning the same material (hazardous combustion products). It is important to know which chemicals are formed by thermal decomposition because this information is used to plan ventilation requirements for processes where a material may be heated.

TLM
TLM stands for Threshold Limit, median (aquatic toxicity rating).

TLV
TLV stands for Threshold Limit Value. It is the occupational exposure limit established by the American Conference of Governmental Industrial Hygienists (ACGIH). TLV is a registered trademark of ACGIH. TLVs are adopted by some governments as their legal limits. (See Exposure Limits for a general explanation.)

TLV-C
TLV-C stands for the ACGIH (American Conference of Governmental Industrial Hygienists) Threshold Limit Value-Ceiling. See also TLV.

TOC
TOC stands for Tagliabue open cup; a standard method of determining flash points. Generally, this appears in abbreviated form as Tag open cup.

Toxic, Toxicity
Toxic means able to cause harmful health effects. Toxicity is the ability of a substance to cause harmful health effects. Descriptions of toxicity (e.g. low, moderate, severe, etc.) depend on the amount needed to cause an effect or the severity of the effect.

Trade Name
A trade name is the name under which a product is commercially known. Some materials are sold under common names, such as Stoddard solvent or degreaser, or internationally recognized trade names, like Varsol. Trade names are sometimes identified by symbols such as (R) or (TM).

TWA
TWA stands for Time-Weighted Average. (See Exposure Limits for a general explanation.)

UEL
See Explosive Limits.

UFL
See Explosive Limits.

uG
uG stands for microgram, a unit of mass.

UN
UN stands for United Nations. See also UN Number.

UN Number
UN number stands for United Nations number. The UN number is a four-digit number assigned to a potentially hazardous material (such as gasoline, UN 1203) or class of materials (such as corrosive liquids, UN 1760). These numbers are used by firefighters and other emergency response personnel for identification of materials during transportation emergencies. UN (United Nations) numbers are internationally recognized. NA (North American) numbers are used only for shipments within Canada and the United States. PINs (Product Identification

Numbers) are used in Canada. UN, NA and PIN numbers have the same uses.

Unstable (Reactive)
Under the U.S. OSHA HAZCOM standard, a chemical is identified as unstable (reactive) if in the pure state, or as produced or transported, it will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure or temperature.

Upper Explosion Limit
See Explosive Limits.

Upper Explosive Limit
See Explosive Limits.

Upper Flammable Limit
See Explosive Limits.

Vapor
A vapor is the gaseous form of a material which is normally solid or liquid at room temperature and pressure. Evaporation is the process by which a liquid is changed into a vapor. Sublimation is the process by which a solid is changed directly into the vapor state.

Vapor Density
Vapor density is the weight per unit volume of a pure gas or vapor. The vapor density is commonly given as the ratio of the density of the gas or vapor to the density of air. The density of air is given a value of 1. Light gases (density less than 1) such as helium rise in air. If there is inadequate ventilation, heavy gases and vapors (density greater than 1) can accumulate in low-lying areas such as pits and along floors.

Vapor Pressure
Vapor pressure is a measure of the tendency of a material to form a vapor. The higher the vapor pressure, the higher the potential vapor concentration. In general, a material with a high vapor pressure is more likely to be an inhalation or fire hazard than a similar material with a lower vapor pressure.

Ventilation
Ventilation is the movement of air. One of the main purposes of ventilation is to remove contaminated air from the workplace. There are several different kinds of ventilation. (See General Ventilation, Local Exhaust Ventilation, Mechanical Ventilation and Natural Ventilation.)

VOC
VOC stands for Volatile Organic Compound.

Volatile, Volatility
Volatile means a material can evaporate. Volatility is the ability of a material to evaporate. The term volatile is commonly understood to mean that a material evaporates easily.

On an MSDS, volatility is commonly expressed as the "% volatile." The percent volatile can vary from 0% (none of the material will evaporate) to 100% (all of the material will evaporate if given enough time).
If a product contains volatile ingredients, there may be a need for ventilation and other precautions to control vapor concentrations.

Water Reactive
A chemical is identified as water reactive if it reacts with water to release a gas that is either flammable or presents a health hazard.

Glossary from CCOHS Canada's National Occupational Health and Safety Resource www.ccohs.ca

Manual for HNS Training

Volume 3

Operational Level

MERRAC Technical Report No. 8

Section 1. Goal and Objective

This Manual supplements the Manual for Training Volume 1 and 2, and aims to train students, who will possibly be the first responders, supervisors, and on-scene commanders in case of the HNS incidents, to acquire skills and knowledge for handling of HNS incidents so that they may be well practiced and prepared for HNS incidents.

In order to maintain the skills and techniques learned, per this training manual, training and exercise shall be repeated periodically at least once a year.

Section 2. Lessons at Class Room

Lesson O–1: Definition of HNS

Trainees are explained about the following definition of HNS and are asked to remember this definition so that they may take timely action at the time of HNS incident.

The OPRC – HNS Protocol 2000 defines Hazardous and Noxious Substances as "any substance other than oil which, if introduced into the marine environment, is likely to create hazards to human health, to harm living resources and marine life to damage amenities or to interfere with other legitimate uses of the sea"

It should be reminded to trainees that

(1) They include, but are not limited to:
- oil derivatives
- liquid substances which are noxious and dangerous
- liquefied gases
- liquids with flashpoints not exceeding 600C
- packaged dangerous, harmful, and hazardous materials
- solid bulk material with associated chemical hazards

(2) In recent years, there has been a rapid growth in the transport and storage of HNS. If allowed to escape, these materials can present a danger to the ship's crew, the vessel, coastal populations, and/or the environment. Accordingly, public concern over these materials has grown, and both Governments and industries have taken steps to address and respond to such incidents.

(3) Marine spills involving HNS are not as frequent as oil spills, and may receive little publicity due to their less visible nature. However, on a global basis, marine spills involving HNS are not rare.

In fact, a worldwide survey of marine emergencies demonstrates that
(a) There is a wide range of cargos, which need to be considered as potential threats.
(b) Most accidents involve mainly two classes of HNS: flammable liquids and corrosive materials.
(c) Internationally, one to two major HNS accidents can be expected each year.
(d) A wide variety of ship types may be associated with HNS accidents.
(e) HNS accidents were almost equally divided between "bulk" and "packaged" goods shipments.

It should be emphasized to trainees that:
(a) For the purpose of successfully handling a spill involving HNS and minimizing damages, careful planning is essential.
(b) Many of the factors that need to be taken into account when preparing for

HNS events, including the drawing up of chemical spill plans, are similar to those required for oil spills. A number of countries have adapted their oil spill contingency plans to address chemical spill incidents. In addition to using the oil spill planning framework, these countries have also tended to rely on the same basic organizational arrangements in order to avoid creating two separate response structures.

(c) Given the wide range of chemicals and their diverse hazards and properties, experts from the chemical industry may be required to ensure that safe and practical procedures are followed. In this sense, trainees are required to remember that, although elements of preparedness and response for oil and HNS are similar in the recommended organizational and administrative structures, there are some differences from a technical standpoint in terms of protective and safety measures and pollution response equipment.

Lesson O–2: International Legislation

While recognition of important points of HNS response is essential for successful operation, trainees should be asked to obtain knowledge about international legislation, without which effective handling of HNS incident cannot be expected.

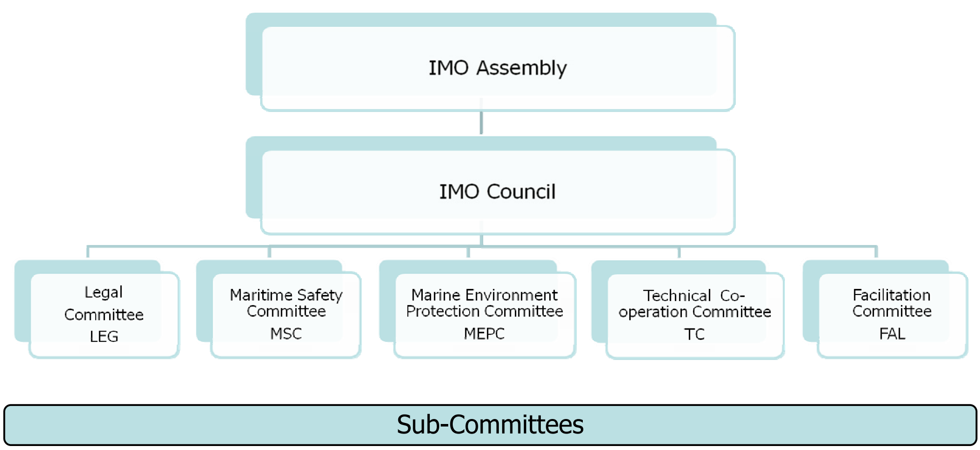
(1) The role and work of the IMO

The International Maritime Organisation was established in 1948 as the United Nations' specialized agency with the responsibility for the safety and security of shipping, and the prevention of marine pollution from ships. Member governments use the IMO to draw up internationally agreed standards that can be applied to all ships. The IMO's mandate can be summarized into one phrase, safe, secure, and efficient shipping on clean oceans. Today (April 2008), IMO has 167 Member States and 3 Associate Members, representing a wide range of shipping interests throughout the world.

In addition, there are Organizations with consultative status or agreements of co-operation. The purposes of consultative status are to enable IMO to obtain information or expert advice from non-governmental organizations (NGOs) with special knowledge in a particular section of IMO's activities. And, to enable such non-governmental organizations representing large groups, whose activities have an important and direct bearing on IMO's work, to express their points of view to IMO.

(2) IMO Organization

Structure of IMO shall be briefly explained to trainees by using the following organization chart and video prepared by IMO, entitled as IMO Video "Safer Shipping and Cleaner Oceans":



IMO's governing body is the Assembly, which meets every two years. Between sessions of the Assembly, a council consisting of 40 Member Governments elected by the Assembly acts as IMO's governing body.

IMO is a technical organization and most of its work is carried out in a number of committees and sub-committees. It consists of an Assembly, a Council, and four main Committees: the Maritime Safety Committee (MSC); the Marine Environment Protection Committee (MEPC); the Legal Committee; and the Technical Co-operation Committee. There is also a Facilitation Committee and a number of Sub-Committees who support the work of the main technical committees.

Only member states have the right to vote and to make proposals for new activities to be considered by the organization. Associated members, inter-governmental and non-governmental organizations with observer status, may submit technical documents and present oral statements, but have no voting rights

(3) Key Conventions

Trainees should be told and asked to remember various key conventions, recognition of which is essential for effective operation.

(a) The United Nations Convention on the Law of the Sea (UNCLOS)

The United Nations Convention on the Law of the Sea (UNCLOS) lays down a comprehensive regime of law and order in the world's oceans and seas, establishing rules governing all uses of the oceans and their resources. It enshrines the notion that all problems of ocean space are closely interrelated and need to be addressed as a whole.

(b) Safety of Life at Sea (SOLAS)

The SOLAS Convention, in its successive forms, is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The main objective of the SOLAS Convention is to specify minimum standards for the construction, equipment, and operation of ships, compatible with their safety.

(c) International Convention for the Prevention of Pollution from Ships, 1973/78 (MARPOL)

The MARPOL Convention is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and updated by amendments throughout the years.

(d) International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention)

Parties to the OPRC convention are required to establish measures for dealing with pollution incidents, either nationally or in co-operation with other countries.

(e) Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC- HNS Protocol)

Extends the OPRC convention to cover pollution incidents by noxious and hazardous substances.

(f) MARPOL

The International Convention for the Prevention of Pollution from Ships (MARPOL) was adopted on November 2, 1973 at IMO. And the areas covered are pollution by oil, chemicals, and harmful substances in packaged form, sewage and garbage. The Protocol of 1978 relating to the 1973 International Convention for the Prevention of Pollution from Ships (1978 MARPOL Protocol) was adopted at a Conference on Tanker Safety

and Pollution Prevention in February 1978, held in response to a spate of tanker accidents from 1976-1977. Measures relating to tanker design and operation were also incorporated into a Protocol of 1978, relating to the 1974 Convention on the Safety of Life at Sea, 1974.
As the 1973 MARPOL Convention had not yet entered into force, the 1978 MARPOL Protocol absorbed the parent convention. The combined instrument is referred to as the International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL), and it entered into force on October 2, 1983 (Annexes I and II). The Convention includes regulations aimed at preventing and minimizing pollution from ships both accidental pollution and that from routine operations, and currently includes six technical Annexes. States Parties must accept Annexes I and II, but the other Annexes are voluntary.

- International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978

Annex	Description
I	Regulations for the Prevention of Pollution by Oil
II	Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
III	Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
IV	Prevention of Pollution by Sewage from Ships
V	Prevention of Pollution by Garbage from Ships
VI	Prevention of Air Pollution from Ships

(g) OPRC Convention

Parties to the OPRC convention are required to establish measures for dealing with pollution incidents, either nationally or in cooperation with other countries. They are to ensure that their ships, offshore units, ports and oil handling facilities shall have appropriate oil pollution emergency plans, which must be coordinated with national systems for responding promptly and effectively to oil pollution incidents. Parties shall ensure that they implement a reporting system for all sightings, discharges, or probable discharges of oil and the subsequent response actions that are then to be taken. The Convention calls for the establishment of stockpiles of oil spill combating equipment, the holding of oil spill training and combating exercises, and the development of detailed plans for dealing with pollution incidents. Parties to the convention are required to provide assistance to others in the event of a pollution emergency and provision is made for the reimbursement of any assistance provided. The Convention provides for IMO to play an important co-ordinating role.

The convention contains 19 articles, but there are some key articles that we need to consider. These are:

- **Article 3** – Oil pollution emergency plans: Parties to the convention shall require that ships, offshore units, ports, and oil handling facilities shall have approved oil spill emergency plans, which are co-ordinated with the national system under Article 6.
- **Article 4** – Oil pollution reporting procedures: Parties shall require any releases or probable releases of oil or any sightings of pollution to be made to the appropriate authorities. This includes their ships or offshore units, flying their flag anywhere in the world, vessels, offshore units, ports or overflying aircraft.

- **Article 5** – Action on receiving an oil pollution report: Whenever a party receives a report under Article 4 they shall assess the event, the nature and extent, possible consequences, and then notify without delay to all states whose interest are affected or are likely to be affected. If the incident is severe, the party shall also notify IMO directly or through one of their regional organizations.
- **Article 6** – National and regional systems for preparedness and response: Each party shall establish a national system for responding promptly and effectively to oil pollution incidents, and establish a minimum level of equipment, program of exercises and training , detailed plans and communications, and a co-ordinating mechanism.
- **Article 7** – International cooperation in pollution response: Parties agree that, subject to their capabilities and the availability of relevant resources, they will cooperate and provide advisory services, technical support, and equipment, if so requested.

As the booklet, describing the OPRC Convention, is published by IMO, each trainee is asked to get one and always keep it on hand.

(h) OPRC – HNS Protocol

The Protocol on Preparedness, Response and Cooperation to pollution Incidents by Hazardous and Noxious Substances, 2000 (OPRC-HNS Protocol) follows the principles of the OPRC Convention. This was formally adopted by the states already party to the OPRC Convention at a Diplomatic Conference held at IMO headquarters in London in March 2000. The Protocol entered into force on June 14, 2007.

Like the OPRC Convention, the HNS Protocol aims to provide a global framework for international cooperation in combating major incidents or threats of marine pollution.

For the purposes of the OPRC-HNS Protocol, Hazardous and Noxious Substance is defined as any substance other than oil, which if introduced into the marine environment, is likely to create hazards to human health, harm to living resources and marine life, damage to amenities, or interfere with other legitimate uses of the sea.

The protocol will ensure that ships, offshore units, ports and noxious substances handling facilities will be covered by preparedness and response regimes similar to those already in existence for oil incidents.

The protocol contains 18 articles, but there are some key articles that need to be considered. These are:

- **Article 3** – Emergency plans and reporting: Parties to the convention shall require that ships, offshore units, ports, and hazardous and noxious substances handling facilities shall have approved pollution incident emergency plans, which are coordinated with the national system under Article 4.
- **Article 4** – National and regional systems for preparedness and response: Each party shall establish a national system for responding promptly and effectively to pollution incidents. They shall designate a national competent authority, national operational contact point(s), and an authority entitled to act on behalf of the state. In addition, parties are to establish a minimum level of equipment, program of exercises and training, detailed plans and communications, and a co-ordinating mechanism.
- **Article 5** – International cooperation in pollution response: Parties agree that, subject to their capabilities and the availability of relevant resources, they will cooperate and provide advisory services, technical support, and equipment if so requested.

As the booklet describing the OPRC Convention is published by IMO, each trainee is asked to get one and to always keep it on hand.

(i) International Standards
IMO is also responsible for producing and keeping up to date a number of other codes that deal with the operational provisions, relating to vessels that transport dangerous goods. The purpose of these codes is to recommend suitable design criteria, construction standards, and other safety measures for ships transporting liquefied gases, dangerous and noxious liquid chemicals, and certain other substances in bulk so as to minimize the risk to the ship, its crew, and the environment. These include the followings:

(j) Solid Bulk Cargoes (BC Code) – Code of Safe Practice for Solid Bulk Cargoes

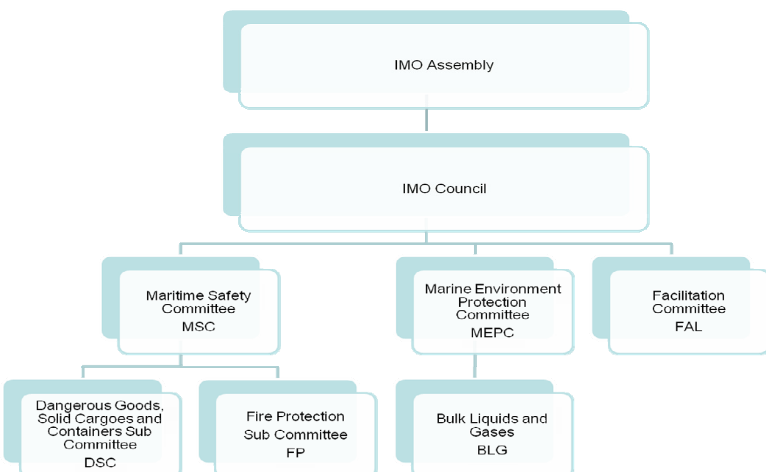
(k) Dangerous and noxious chemicals in bulk (IBC Code) –
International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk. This applies to chemical tankers build after July 1, 1986.

(l) Dangerous and noxious chemicals in bulk (BCH Code) –
Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk. This applies to older chemical tankers, constructed before July 1, 1986.

(m) Bulk and Liquefied Gases (IGC Code) –
International Code for the Construction and Equipment of Ships Carrying liquefied Gases in Bulk. This applies to gas carriers constructed after July 1, 1986. Other codes exist for ships constructed between December 1976 and July 1986, and for gas carriers constructed before December 31, 1976.

(n) The International Maritime Dangerous Goods (IMDG) Code
This code was developed as a uniform international code for the transport of dangerous goods by sea covering such matters as packing, container traffic, and stowage, with particular reference to the segregation of incompatible substances.

(o) IMO Organization
Those committees, which impact on the IMDG Code, are shown to trainees by showing the organizational chart of IMO partly as below: The day to day work of developing the IMDG Code rest with DSC, which is made up of members of IMO that have adopted the IMDG Code along with non-governmental organizations accredited to IMO with consultative status.



(p) GESAMP and GESAMP classification

The Group of Experts on Scientific Aspects of Marine Environmental Protection (GESAMP) is an advisory body, established in 1969, that advises the United Nations (UN) system on the scientific aspects of marine environmental protection. At present, it is jointly sponsored by eight UN organizations (IMO, FAO, UNESCO-IOC, WHO, IAEA, UN, UNEP) with responsibilities relating to the marine environment as a mechanism for coordination and collaboration among them.

GESAMP functions are to conduct and support marine environmental assessments, to undertake in-depth studies, analyses, and reviews of specific topics, and to identify emerging issues regarding the state of the marine environment. Their task is to:

- To provide advice relating to the scientific aspects of marine environmental protection.
- To prepare periodic reviews and assessments of the state of the marine environment, and to identify problems and areas requiring special attention.

Ideally, GESAMP itself consists of 25-30 experts, drawn from a wide range of relevant disciplines, who act in an independent individual capacity.

(q) Compensation and Liability Regimes

Liability and compensation regimes for oil pollution incidents are covered by the 1992 Protocols to the International Convention on Civil Liability for Oil Pollution Damage, 1969, and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971. In 1996, IMO adopted the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances (HNS) by sea, which provides for a compensation and liability regime for incidents involving these substances (it has not yet entered into force).

At this point in time, reminder shall be made to trainees that the definition of an HNS as defined by the OPRC-HNS Protocol 2000 differs widely from the definition of an HNS under the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances (HNS) by sea, otherwise knows as the HNS Convention. In the HNS Convention, HNS are defined by reference to lists of substances included in various IMO Conventions and Codes. These include oils, other liquid substances defined as noxious or dangerous liquefied gases, liquid substances with a flashpoint not exceeding 60°C, dangerous, hazardous and harmful materials and substances carried in packaged form, and solid bulk materials defined as possessing chemical hazards. The Convention also covers residues left by the previous carriage of HNS, other than those carried in packaged form.

(r) HNS Convention

The HNS Convention is modelled on the existing regime for oil pollution from tankers. The purpose of which is to provide adequate, prompt, and effective compensation for loss or damage to persons, property, and the environment arising from the carriage of HNS by sea. The HNS Convention covers both pollution damage and damage caused by the risk e.g. fire and explosion.

Under the Convention, the ship owner is liable for the loss or damage up to a certain amount, which is covered by insurance (1st tier). A compensation fund will provide additional compensation when the victims do not obtain full compensation from the ship owner or their insurer (2nd tier). The HNS fund will be funded by those companies and other entities which receive HNS after sea transport in a member state in excess of the threshold laid down in the convention. The convention introduces strict liability for the ship owner, and a system of compulsory insurance and insurance certificates. The ship owner is normally entitled to limit his liability under the HNS Convention to an amount calculated on the basis of the units of gross registered tonnage (GRT).

The HNS fund account, when fully operational, will have four accounts, oil, liquefied natural gas, liquefied petroleum gas, and a general account with two sectors – bulk solids and other HNS.

The HNS Convention will enter into force eighteen months after ratification by at least 12 states subject to number of conditions. As per April 2008, the convention was ratified by 10 states.

Lesson O–3: Basic Chemistry

Trainees are asked to understand basic chemistry as knowledge about basic chemistry, and hazardous properties of chemicals are essential for their handling HNS incidents timely, effectively, and successfully.

(1) Chemical Elements

Trainees are explained the basic chemistry and learn symbol of chemical elements, periodic table, constitutional formula, mixtures, compounds, and physical states (solids, liquids or gases.). Chemical elements are the basic building blocks from which all chemical compounds are made through chemical combination. Trainees should remember that they cannot be broken down into simpler substances. There are over 100 elements, most of which are easily divided into two main classes; metals which conduct electric current and heat and non-metals which do not. Explanation shall be made that the two classes of metallic and non-metallic elements gradually merge into one another, the intermediate class exhibiting properties associated with both metals and non metals. For convenience sake, trainees are told that every element is assigned an internationally agreed symbol which represents either their English or Latin name. Symbols for some of the elements are shown in following periodic table:

Example:"O" is the symbol of oxygen. "O_2" is molecular formula of oxygen. "H" is hydrogen.

Periodic Table and Atomic Number

1 H																	2 He
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57–71 ランタノイド	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
87 Fr	88 Ra	89–103 アクチノイド															

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

(2) Mixtures

It is explained that a mixture is a composition of two or more chemical substances, which are discrete and, in principle, separable from the mixture. A mixture covers all types of combinations of two or more chemical substances whether made by mixing, by reaction, or by accident. A mixture may be a solid, such as gunpowder (sodium nitrate, carbon, sulphur), liquid (cordial and water), solid/liquid (sugar in tea/coffee), or gas (air – being composed of oxygen and nitrogen). The parts of a mixture are referred to a component or constituent.

(3) Compounds

Explanation shall also be made that compounds are sets of elements which are chemically bonded together e.g. sodium chloride and carbon dioxide. Compounds possess a definite composition and their properties may be very different from the elements from which they have been formed.

Compounds are traditionally divided into inorganic, organic, or organo-metallic.

(a) Organic compounds are essentially everything which contains carbon except for inorganic carbonates, oxides, or cyanides. There are approximately half a million known organic compounds and it is the largest group of chemicals. Many organic chemicals are the basis for life, proteins, sugars, etc, and also of many industrial materials e.g. plastics. Examples of organic chemicals are: acetone, carbon tetrachloride, ethanol, sucrose (sugar), etc.

(b) Inorganic compounds are essentially everything else and usually comprise of acids, alkalis (bases), or salts.

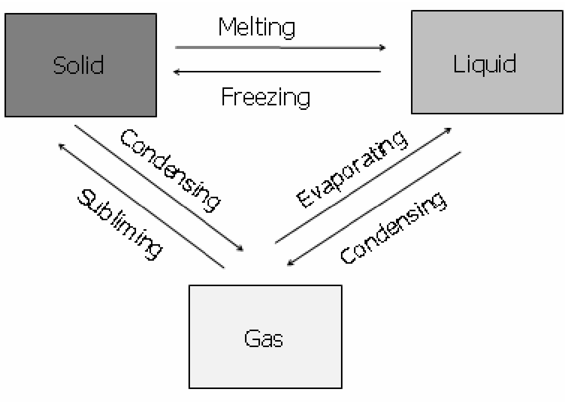
(c) Organo-metallic compounds have a metallic element part and an organic part. However organo-metallics are generally less common and have specific properties and applications in manufacturing and high-tech applications.

(4) Physical States of Matter

All matter exists and are categorised as being in one of three states: solids, liquids or gases.

These states of matter are important for determining the way a material can be easily packaged and safely transported and also, in the event of a spillage, what the potential hazards are.

What the physical state of many substances is will vary depending upon the temperature and pressure applied to them. When ice is heated, it melts and becomes water, and on further heating, it boils to produce steam (a gas). However, there are some substances which go straight from solids to gas such as, ammonium chloride. This process is called sublimation.
Following diagram shall be shown to trainees so that trainees may get a clear image of physical states of the matter.



The density of color in each box indicates the number of molecules that are held within the same volume, at the same temperature and pressure.

(a) Solids
As seen from the diagram, the solid contains the most molecules for the same volume, and hence, the particles are packed in the most orderly way. In the solid state, molecules are considered to be at "rest." The bonds between them are very strong and the molecular movement is that of vibration within the structure. It is very difficult to compress solids.

(b) Liquids
When a solid is heated, the molecules vibrate with increasing intensity until they break free from the forces holding them together. When this point is reached, the solid becomes liquid. This is known as the melting point. Liquids have a definite mass and volume, but no shape. They take up the shape of the container in which they are held. Some liquids, like water, flow easily and are said to be mobile, whilst others, like treacle, are said to be viscous. Liquids are difficult to compress.

(c) Gas
On heating a liquid, the molecules gain greater energy and move much faster causing them to leave the liquid. This is called evaporation. As the heating process continues, a point is reached where the molecules break away completely and gas is formed. This is known as the boiling point. The volume of gas is not definite and has a low density.

For the majority of applications, the state of a material is assumed to be at normal working temperatures and pressures. For example, water is liquid at a normal temperature. Certain materials are transported at lower or higher temperatures to convert them to different states to normal for reasons of convenience. Also some are used at higher temperatures than those at which they are supplied such as waxy solids.

(5) Physical Properties of HNS
Chemicals are identified and characterized by their properties. Physical properties are used to assist in the classification of substances. These properties include:

(a) Density
All solids, liquids, and gases have density. The density of a substance is determined by dividing its mass (weight) by the volume it occupies. The higher the resulting numbers the denser the substance. The lower the number, the less dense it is. The density of a substance can vary according its temperature, so any density values are generally quoted with a temperature. Relative density is the comparison of the densities of different substances.

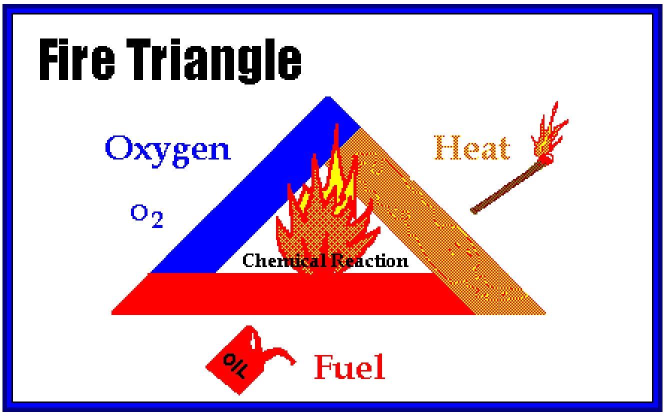
(b) Solubility
When a solid or gas (solute) dissolves in a liquid, a solution is formed (also known as a homogeneous mixture because it has the same constituents throughout i.e. totally mixed).

The degree to which a solid dissolves is temperature dependent. Generally, the hotter the solvent the more solute will dissolve. The reverse is true of gases. The point at which solute will no longer dissolve is known as a saturated solution. This temperature/saturated solution effect is the reason why some solutions deposit crystals when they are stored at lower temperatures than that at which they were made.

(c) Miscibility
If two liquids mixed, completely, to form a solution, it is said that the two liquids are miscible e.g. ethanol or acetone are completely miscible in water. Some liquids will only partially mix and these are said to be partially miscible. Others will not mix and they are said to be immiscible e.g. oil and water.

(d) Combustibility

This describes the ability of a material to burn under normal conditions. For combustion to occur oxygen, fuel, and an ignition source must be present. Following diagram is referred to as the Fire Triangle.



(e) Flammability

This describes the ease with which a material will ignite, either spontaneously from exposure to a high temperature, or from exposure to a spark or open flame. The flammability of a material can be described by the following properties;

(f) Vapor Pressure

This is the ability of the substance to form vapor. Trainees should remember that higher a substance's vapor pressure, the more it tends to evaporate.

(g) Flash Point

This is the lowest temperature of a substance at which its vapors will ignite and burn when exposed to an ignition source, without self-sustaining combustion. The lower the flash point of a liquid, the easier it is for ignitable concentrations of vapor to exist. A substance cannot be ignited below its flashpoint. Brandy for instance, has a flashpoint of about 30℃, hence the reason for warming it prior to lighting it.

(h) Fire Point

The fire point is the lowest temperature of a substance. Once ignited will continue to burn without any additional source of energy.

(i) Lower Explosive Limit (LEL) or Lower Flammable Limit (LFL)

This is the minimum concentration of gas (or vapor) in air that will ignite and propagate a flame. It is expressed as a percentage by volume of gas in air. If the gas percentage is below the LEL, the atmosphere is described as being "too lean" to burn.

(j) Upper Explosive Limit (UEL) or Upper Flammable Limit (UFL)

This is the maximum concentration of gas (or vapor) in air that will ignite and propagate a flame. It is expressed as a percentage by volume of gas in air. If the gas percentage is above the UEL, the atmosphere is described as being "too rich" to burn.

(k) Flammable Range

This is the difference between the upper and lower flammable limits. When the gas (or vapor) to air ratio is between the LEL and the UEL, fires and explosions can occur and the mixture is said to be within the flammable range.

(l) Auto-Ignition Temperature
This is the lowest temperature at which spontaneous combustion of a substance begins in the absence of any spark or flame. The closer the substances' temperature approaches its auto-ignition temperature, the greater the risk of a fire or explosion.

(m) Explosivity
This describes the ability of a substance to react rapidly to produce high local temperatures and to generate large volumes of gases.
When a flammable material is limited to a confined area and ignited, an explosion will occur.

(n) Toxicity
This is the ability of a material to inflict damage to living tissue, to impair the central nervous system, cause severe illness or, in extreme cases, cause death when inhaled, ingested, injected, or absorbed by the skin.

(o) Reactivity
This describes the ability of a material to change chemically. Chemical reactions may be endothermic (requiring external heat to keep them running) or exothermic (creating heat in the process).

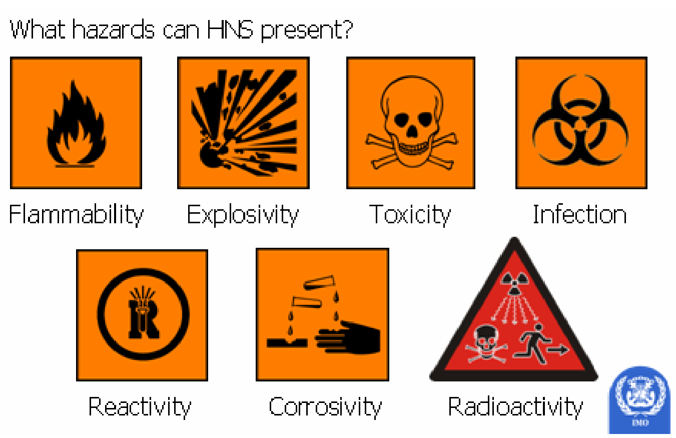
(p) Corrosivity
This describes the ability of a material to cause electro-chemical degradation of metals or alloys. It also describes the destruction of body tissues by acids or alkalis.

(q) Radioactivity
This is the ability of a substance to emit alpha-beta particles or gamma radiation.

(6) Chemicals by hazards groupings
After recognizing the physical states of chemical elements, trainees are asked to learn about chemical groupings by hazards.

As an accident involving HNS may result in an uncontrolled release of a product potentially damaging to life, the environment, or property, trainees are required to recognize how the release affects human being, how the environment depends on the characteristics of the chemicals involved, how much has been released, how vulnerable the surrounding area is, and how effective the emergency measures taken to minimize the effect of the spill are.

Trainees are asked to consider the ways in which a chemical behaves to harm life or the environment, taking the physical properties of chemicals into consideration.



(a) Flammability

Trainees are asked to recognize the following types of fire associated with HMS release.

Types of fires associated with HNS releases are:

(i) Fireballs – Formed from fires that burn so fast that the burning mass will rise up into the air as a cloud or ball.

(ii) Vapor cloud fires – These are formed when a cloud or plume of flammable gas or vapor is ignited. This may flash back to the spill source engulfing all in its path.

(iii) Liquid pool fires – These are formed when some flammable liquid is spilled on to the surface e.g. ship's deck, jetty or water.

(iv) Flame jets – Formed when a gas escapes to the atmosphere from a hole in a high pressure line and encounters an ignition source.

Trainees are also asked to remember that following three products are produced by fire:

(i) Heat – Heat can cause burns of varying degrees. For example, 1st degree burns will affect the outer layer of the skin. 2nd degree burns will cause blistering and penetrate further into the skin. And, the 3rd degree burns will penetrate even further in and cause damage to the nerve endings.

(ii) Solid particles – Solid particles (e.g. soot and ashes) can cause severe health damage, which can result in permanent injuries and death.

(iii) Toxic gases – Toxic gases are generated by fire. Generally, most deaths in fires are caused by asphyxiation and not from direct contact with the flame or exposure to heat.

(b) Explosivity

Trainees are reminded that following hazards can be associated with explosions:

(i) Blast – Shockwaves can destroy buildings and blow away anything in its path with considerable force.

(ii) Projectiles can pose a considerable threat and is the one threat that can extend the furthest.

(iii) When there is a flammable gas or liquid involved, there is a serious threat from fire and thermal radiation.

(iv) Toxic or corrosive substances may be released as the result of an explosion. This will disperse as a hazardous cloud, which will impact everything downwind.

It should be remembered by the trainees that all risks associated with explosions diminish the further away one is from the site of an explosion. These risks are:

(i) Shockwaves - Explosions are a sudden release of energy that generates a shock or a strong pressure wave. These shockwaves are referred to as blast waves and are associated with a loud bang. The explosion may be as a result of a rapid chemical action and may lead to combustion, and a sudden release of contained thermal or mechanical energy (e.g. the bursting of a pressure vessel).

(ii) Compressed liquefied gases – In this case, the energy of the explosion is stored in the difference of pressure between the inside of the container and the pressure outside. When the compressed liquefied gas reaches a temperature, which is above its normal boiling point, a sudden release of pressure will trigger the boiling of the liquid. This in turn will create a sudden large increase in the material volume. This condition may be explosive.

(iii) Vapor cloud explosion – A large atmospheric release of a gaseous or vaporized flammable substance is the first step of a vapor cloud explosion. The substance then has to mix in open air in an amount that will allow the mixture to form a cloud. As soon as this cloud encounters an ignition source, a flash fire, deflagration or detonation may occur with devastating consequences.

(c) Boiling Liquid Expanding Vapor Explosion("BLEVE")

The sudden and catastrophic vaporization of contained liquid results in a boiling liquid expanding vapor explosion called "BLEVE" (pronounced "bevy"), which is a physical process. Pressurized tanks, containing liquefied gas, may partially fail and vent off their content, or may fail suddenly and catastrophically, leading to BLEVE.

To cause a BLEVE, a liquefied substance does not need to be flammable. However, if flammable, the likelihood of a fire resulting from the BLEVE is high. If there is no ignition source, the resulting cloud will drift off. If a sufficiently large flammable cloud develops, a flash fire, fireball or vapor cloud explosion is possible. A corrosive or toxic cloud drifting off will jeopardize living organisms found in its path.

A BLEVE can occur in a container where a stored substance, which is normally gas at atmospheric pressure but a liquid when pressurised is contained. The substance will be stored partially as liquid form with a gaseous vapor filling the remainder of the container.

If the vessel is ruptured, the vapor portion may rapidly leak, dropping the pressure inside the container and releasing a wave of overpressure from the point of rupture. This drop in pressure inside the container causes violent boiling of the liquid, which creates large amounts of vapor in the process. The pressure of this vapor creates an explosion.

(d) Static electricity hazards

Static electricity can pose a considerable explosion or fire hazard. The accumulation of an electrical charge can be released suddenly. This electrostatic discharge can provide enough energy to ignite a flammable environment. As a result of this, there have been many accidents at petrol stations where petrol been ignited by an electrostatic release which has developed on hair or clothing.

(e) Reactivity hazards

Some substances will react spontaneously when affected by an energy source. For example, heat or friction or when it comes into contact with another substance. Damage happens when the reaction releases energy in quantities and rates that are too high to dissipate into the environment.

The most common reactions are with water, air, or moist air.

Some substances will:

- Generate heat when mixed with water
- Become spontaneously flammable
- Give off flammable or toxic gases

Knowledge of the reactivity of a substance with water is essential in marine spill response, as the application of water and the water based foams, in the presence of a water, reactive HNS can lead to the worsening of the situation

(f) Reactions between Incompatible HNS

Strong oxidising or reducing agents can react violently with organic or inorganic material. These reactions can generate heat, and flammable or toxic gases. Combinations of HNS cargoes may generate a new substance. This may present hazards which are more severe than those associated with the original materials.

(g) Polymerization

Some HNS are capable of reacting by themselves. This is called polymerization. It can be triggered by heat or common substances such as water or rust. When this process does take place, heat can be emitted or the volume may expand. This can cause a rupture of the container.

(h) Decomposition reactions
Some HNS will decompose at room temperature from exposure to light, heat, friction, or pressure.

(i) Corrosivity
This is a special type of chemical reaction. Corrosive substances have three types of properties, which are of concern;

- Cause chemical burns – They can cause chemical burns to the human skin tissue at the point of contact.
- They can corrode materials used in the construction of response equipment. For example, steel pumps can be damaged on contact by chlorosulphuric acid.
- They can also produce flammable vapors when they come into contact with some materials such as metals or fibrous products. For example, iron may react with some strong acids or alkalis to release hydrogen, which in air produces an explosive hydrogen-air mixture.

(7) Chemical Compatibility Chart
For reconfirmation purpose, following compatibility chart is shown, and the general information on the inadvertent mixing of substances is delivered to the trainees:

Chemical Compatibility Chart

1	Inorganic Acids	1																							
2	Organic acids	X	2																						
3	Caustics	X	X	3																					
4	Amines & Alkanolamines	X	X		4																				
5	Halogenated Compounds	X		X	X	5																			
6	Alcohols, Glycols & Glycol Ethers	X					6																		
7	Aldehydes	X	X	X	X		X	7																	
8	Ketone	X		X	X			X	8																
9	Saturated Hydrocarbons									9															
10	Aromatic Hydrocarbons	X									10														
11	Olefins	X				X						11													
12	Petrolum Oils												12												
13	Esters	X		X	X									13											
14	Monomers & Polymerizable Esters	X	X	X	X	X	X								14										
15	Phenols			X	X			X							X	15									
16	Alkylene Oxides	X	X	X	X		X	X							X	X	16								
17	Cyanohydrins	X	X	X	X	X		X									X	17							
18	Nitriles	X	X	X	X												X		18						
19	Ammonia	X	X					X	X					X	X	X	X	X		19					
20	Halogens			X			X	X	X	X	X	X	X	X	X	X				X	20				
21	Ethers	X													X						X	21			
22	Phosphorus, Elemental	X	X	X																	X		22		
23	Sulfur, Molten									X	X	X	X				X						X	23	
24	Acid Anhydrides	X		X	X		X	X							X		X	X	X	X					24

X Represents Unsafe Combinations

Represents Safe Combinations

1 Inorganic Acid 1
2 Organic acids X 2
3 Caustics X X 3
4 Amines & Alkanolamines X X 4
5 Halogenated Compounds X X X 5
6 Alcohols, Glycols & Glycol Ethers X 6
7 Aldehydes X X X X X 7
8 Ketone X X X X 8
9 Saturated Hydrocarbons 9
10 Aromatic Hydrocarbons X 10
11 Olefins X X 11
12 Petroleum Oils 12
13 Esters X X X 13
14 Monomers & Polymerizable Esters X X X X X X 14
15 Phenols X X X X 15
16 Alkylene Oxides X X X X X X X X 16

17 Cyanohydrins X X X X X X X 17
18 Nit riles X X X X X 18
19 Ammonia X X X X X X X X X X 19
20 Halogens X X X X X X X X X X X X X 20
21 Ethers X X X 21
22 Phosphorus, Elemental X X X X 22
23 Sulfur, Molten X X X X X X 23
24 Acid Anhydrides X X X X X X X X X X X 24
X Represents Unsafe Combinations
Represents Safe Combinations

Group 1: Inorganic Acids

Chlorosulfonic acid	Hydrochloric acid (aqueous)
Hydrofluoric acid (aqueous)	Hydrogen chloride (anhydrous)
Hydrogen fluoride (anhydrous)	Nitric acid
Oleum	Phosphoric acid
Sulfuric acid	

Group 2: Organic Acids

Acetic acid	Butyric acid (n-)
Formic acid	Prop ionic acid
Rosin Oil	Tall oil

Group 3: Caustics

Caustic potash solution	Caustic soda solution

Group 4: Amines and Alkanolamines

Aminoethylethanolamine	Aniline
Diethanolamine	Diethylenetriamine
Diisopropanolamine	Dim ethylamine
Ethylenediamine	Hexamethylenediamine
2-Methyl-5-ethylpyridine	Monoethanolamine
Monoisopropanolamine	Morpholine
Pyridine	Triethanolamine
Triethlamine	Triethylenetetramine
Trimethylamine	

Group 5: Halogenated Compounds

Ally chloride	Carbon tetrachloride
Chlorobenzene	Chloroform
Chlorohydrins, crude	Dichlorobenzene (o-)
Dichlorobenzene (p-)	Dichlorodifluoromethane
Dichloroethyl ether	Dichloropropane
Dichloropropene	Ethyl chloride
Ethylene dibromide	Ethylene dichloride
Methyl bromide	Methyl chloride
Methylene chloride	Monochlorodifluoromethane
Perchloroethylene	Propylene dichloride
1,2,4-Trichlorobenzene	1,1,1-Trichloroethane
Trichloroethylene	Trichlorofluoromethane

Group 6: Alcohols, Glycols and Glycol Ethers

Ally alcohol	Amyl alcohol
1,4-Butanediol	Butyl alcohol (iso, n, sec, tert)
Butylenes glycol	Corn syrup
Cyclohexyl alcohol	Decyl alcohol (n, iso)
Dextrose solution	Diacetone alcohol
Diethylene glycol	Diethylene glycol dimethyl ether
Diethylene glycol monobutyl ether	Diethylene glycol monoethyl ether
Diethylene glycol monomethyl ether	Diisobutyl carbitol
Dipropylene glycol	Dodecanol
Ethoxylated dodecanol	Ethoxylated pentadecanol
Ethoxylated tetradecanol	Ethoxylated tridecanol

Ethoxytriglycol
Ethyl alcohol
Ethyl butanol
2-Ethylbuytl alcohol
2-Ethylhexyl alcohol
Ethylene glycol
Ethylene glycol monobutyl ether
Ethylene glycol monoethyl ether
Ethylene glycol monomethyl ether
Furfuryl alcohol
Glycerine
Heptanol
Hexanol

Group 6: Alcohols, Glycols and Glycol Ethers (cont.)
Hexylene glycol
Isoamyl alcohol
Isooctyl alcohol
Methyoxytriglycol
Methyl alcohol
Methylamyl alcohol
Molasses, all
Nonanol
Octanol
Pentadecanol
Polypropylene glycol methyl ether
Propyl alcohols (n, iso)
Propylene glycol
Sorbitol
Tetradecanol
Tetraethylene glycol
Tridecyl alcohol
Triethylene glycol
Undecanol

Group 7: Aldehydes
Acetaldehyde
Acrolein (inhibited)
Butyraldehyde (n, iso)
Crotonaldehyde
Decaldehyde (n, iso)
2-Ethyl-3-proplyacrolein
Formaldehyde solutions
Furfural
Hexamethylenetetramine
Isooctyl aldehyde
Methyl butyraldehyde
Methyl formal
Paraformaldehyde
Valeraldehyde

Group 8: Ketones
Acetone
Acetophenone
Camphor oil
Cylcohexanone
Diisobutyl ketone
Isophorone
Mesityl oxide
Methyl ethyl ketone
Methyl isobutyl ketone

Group 9: Saturated Hydrocarbons
Butane
Cyclohexane
Ethane
Heptane
Hexane
Isobutane
Liquified natural gas
Liquified petroleum gas
Methane
Nonane
N-Paraffins
Pentane
Petrolatum
Petroleum ethers
Petroleum naphtha
Polybutene
Propane
Propylene butylene polymer

Group 10: Aromatic Hydrocarbons
Benzene
Cumene
p-Cymene
Coal tar oil
Diethybenzene
Dodecyl benzene
Dowtherm
Ethylbenzene
Naphtha, coal tar
Naphthalene (includes molten)
Tetrahdyronaphthalene
Toluene
Triethyl benzene
Xylene (m-, o-, p-)

Group 11: Olefins
Butylene
Decene
Dicylcopentadiene
Diisobuytlene
Dipentene
Dodecene
Dodecene
Ethylene
Liquefied petroleum gas
1-Heptene
1-Hexane
Isobutylene

Nonene
1-Octene
1-Pentene
Polybutene
Propylene
Propylene butylene polymer

Group 11: Olefins (cont.)
Propylene tetramer (dodecene)
1-Tetradecene
1-Tridecene
Turpentine
Undecene

Group 12: Petroleum Oils
Asphalt
Gasolines
Casingead
Automotive
Aviation
Jet Fuels
JP-1 (kerosene)
JP-3
JP-4
JP-5 (kerosene, heavy)
Kerosene
Mineral spirits
Naphtha (non aromatic)
Naphtha
Solvent
Stoddard solvent
VM&P
Oils
Absorption oil
Clarified oil
Crude oil
Diesel oil
Fuel oil
No. 1 (kerosene)
No. 1-D
No. 2
No. 2-D
No. 4
No. 5
No. 6
Lubricating oil
Mineral oil
Mineral seal oil
Motor oil
Penetration oil
Range oil
Road oil
Spindle oil
Spray oil
Transformer oil
Turbine oil

Group 13: Esters
Amyl acetate
Amyl tallate
Butyl acetates (n, iso, sec)
Butyl benzyl phthalate
Castor oil
Croton oil
Dibutyl phthalate
Diethyl carbonate
Dimethyl sulfate
Dioctyl adipate
Dioctyl phthalate
Epoxidized vegetable oils
Ethyl acetate
Ethyl diacetate
Ethylene glycol monoethyl ether acetate
Ethylhexyl tallate
Fish oil
Glycol diacetate
Methyl acetate
Methyl amyl acetate
Neatsfoot oil
Olive oil
Peanut oil
Propyl acetates (n, iso)
Resin oil
Soya bean oil
Sperm oil
Tallow
Tanner's oil
Vegetable oil
Wax, carnauba

Group 14: Monomers and Polymerizable
Esters
Acrylic acid (inhibited)
Acrylonitrile
Butadiene (inhibited)
Butyl acrylate (n, iso)
Ethyl acrylate (inhibited)
2-Ethylhexyl acrylate (inhibited)
Isodecyl acrylate (inhibited)
Isoprene (inhibited)
Methyl acrylate (inhibited)
Methyl methacrylate (inhibited)
o-Propiolactone
Styrene (inhibited)
Vinyl acetate (inhibited)
Vinyl chloride (inhibited)
Vinylidene chloride (inhibited)
Vinyl toluene

Group 15: Phenols
Carbolic oil
Creosote, coal tar

Cresols
Phenol
Nonylphenol

Group 16: Alkylene Oxides
Ethylene Oxide
Propylene Oxide

Group 17: Cyanohydrins
Acetone cyanohydrin
Ethylene cyanohydrin

Group 18: Nitriles
Acetonitrile
Adiponitrile

Group 19: Ammonia
Ammonium hydroxide

Group 20: Halogens
Bromine
Chlorine

Group 21: Ethers
Diethyl ether (ethyl ether)
Isoprophyl ether
Tetrahydrofuran
1, 4, Dioxane
Ethers (cont)

Group 22: Phosphorus, elemental

Group 23: Sulfur, molten

Group 24: Acid Anhydride
Acetic anhydride
Propionic anhydride

(8) NUCLEAR RADIATION HAZARDS

Although radioactive materials can share other hazardous properties, for example corrosivity, with non radioactive materials, the main concern is their ionizing radiation properties. Uranium Hexafluoride is an exception to this as its corrosivity is generally the primary hazard. Ionizing radiation is created when the nuclei gives off excess energy. This radiation will lose its energy as it passes through matter, which includes living tissue. The resulting absorbed energy will break down some molecules into ionized fragments.

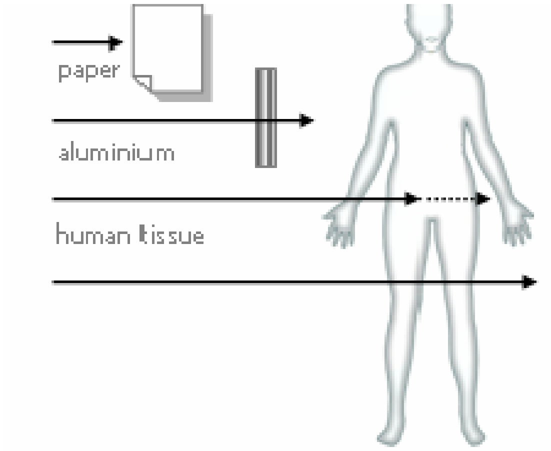
There are four types of ionizing radiation, which may be encountered from packages being transported:

(a) **Alpha** – Alpha particles are completely absorbed by few centimeters of air. Outside the body, alpha radiation energy will dissipate while penetrating the clothing or the dead cells of the epidermis. If it is ingested, alpha emitters will strongly ionize internal tissues.

(b) **Beta** – Beta particles can travel more than a meter through the air and penetrate several millimeters of aluminium and plastic. Beta emitters represent both external and internal hazards. This type of emission can damage skin and internal organs.

(c) **Neutron** –Neutrons interact with atoms and molecules in complex ways. Collisions between the neutron and the smallest atom, hydrogen, result in the greatest transfer of energy from the neutron to the absorbing medium. Neutrons have a range of many meters through the air and many centimeters in tissue. Slowed down, the neutrons will eventually pass through the human body.

(d) **Gamma** – Gamma rays are the most penetrating of all radiations. They will pass through the human skin, similar to the way that x-rays do. Gamma rays can burn skin and damage internal organs.



(9) Nuclear Radiation Protection

Protection from ionizing radiation has two important aspects:

(a) External sources of radiation – Exposure from an external source (such as an intact package of radioactive material or one that has damaged shielding) can be reduced by increasing your distance from the sources, reducing your time in the vicinity of the source, and providing intervening shielding between you and the source.

(b) Internal and external contamination – Protective clothing and respiratory equipment will minimize the potential for intake and skin contamination from loose material (such as from a damaged or leaking package).

(10) Chemicals by behaviour groupings

Chemicals can also be grouped depending on the way they behave when they are spilled onto water.

It should be told to trainees that, generally, they react in four different ways.

(a) Evaporator – Evaporate rapidly in contact with the water surface
(b) Floater – Float on the surface
(c) Dissolver – Dissolve rapidly in water
(d) Sinker – Sinks to the bottom

(11) Chemicals by behavior groupings – continued –

A chemical could, for instance, behave in more than one of these ways. For example, it could float but at the same time dissolve.

The full classification consists of five behavior groups and twelve behavior subgroups;

(a) gas

- gas
- gas / dissolver

(b) evaporator

- evaporator
- evaporator / dissolver

(c) floater

- floater / evaporator
- floater / evaporator / dissolver
- floater / dissolver

(d) dissolver
- dissolver
- dissolver / evaporator

(e) sinker
- sinker
- sinker / dissolver

In addition, packages can also be considered to fall into three subgroups:
- package
- package / floater
- package / immersed (intermediate not floating not sinking)
- package / sinker

(12) Chemicals by hazards and behavior groupings

IMO Video "Response to Marine Chemical Spills" Part 2 Assessment and Analysis shall be shown to trainees so that they may reconfirm their understandings gained through this lesson.

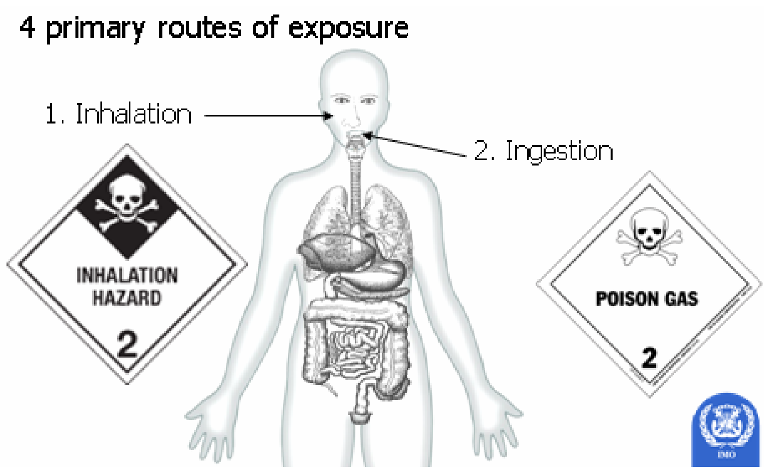
(13) Toxic effects of hazardous/noxious substances

HNS are capable of causing both short and longterm damage to both humans and the environment. Therefore, the initial response should be to protect human life and health.

Instructor shall explain to trainees what factors will determine how much of a hazard a toxic spill can be? It should be told to trainees that the toxic hazard posed by a released material will depend on a number of factors.
- The amount spilled
- The number of chemicals involved in the spill
- The time frame over which the spillage occurs e.g. instaneous or continuous
- The properties of the chemical
- The routes of exposure into the body
- The concentration and duration of exposure
- The stage of development of an individual and their current condition
- The prevailing meteorological conditions

(14) Toxic effects of hazardous/noxious substances (continued)

It should be clearly explained to trainees that there are four primary ways in which a substance can make its way into the body. To assist the trainees to get clear understanding, following diagram shall be shown in explaining the toxic effects of HNS:



(a) Inhalation

The major route of entry for gases and particles into the human body. Human body has several warning mechanisms that can be used to let human being know that a hazard is present.

Warning mechanisms include smell, sneezing, coughing, and a runny nose. The body can filter out some normal pollutants, but it cannot eliminate everything. Smaller particles are more difficult to eliminate. Chemicals, when they are inhaled, may target and damage other organs as well as the lungs.

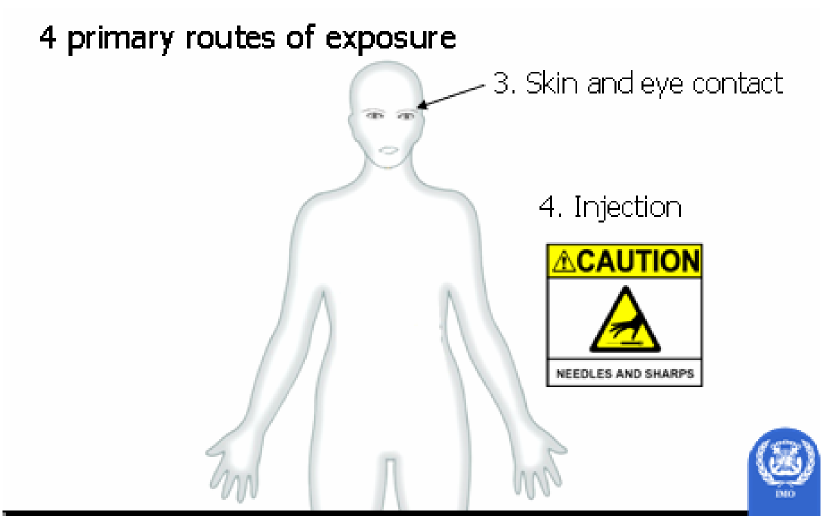
(b) Ingestion

Ingestion occurs when a hazardous agent is swallowed. Some of these ingested agents may be destroyed or neutralised by acid in the stomach, however, some can be absorbed rapidly into the blood stream. Ingestion should not be of concern when proper protective clothing is being used and adequate hygiene and decontamination procedures are followed. Trainees should note that ingestion of contaminated food and water may present a risk for the local populations following a release of HNS. The body tries to remove certain toxic substances from the digestive system by vomiting or diarrhoea, however, these mechanisms cannot remove all ingested agents from the body and as they are signals of ingestion of chemical and biological agents, they must be investigated.

(c) Skin and Eye Contact

Skin is an important protective cover for the body, but it cannot always protect you against work place hazards. This is because chemicals can be absorbed directly into the body though healthy skin. When they are in the bloodstream, they can be transported to internal organs with damaging effects. They may also damage the surface of the skin by burn or causing skin conditions such as dermatitis. Chemicals can also enter the bloodstream by puncture or cut in the skin. This is known as **Injection**.

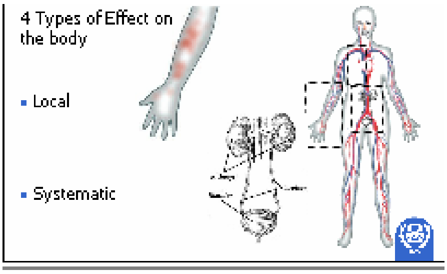
To assist the trainees to get clear understanding, in addition to the diagram shown above, the following diagram shall also be shown to the trainees:



(15) Toxic effects of hazardous and noxious substances (continued)

Although some of these terms may be familiar to trainees, it is important for them to understand the body's reaction to toxic materials. Knowing what to look for may alert the person to the signs and symptoms early.

Toxic substances can cause four types of effects on the body:



(a) Local – Some substances have only a localized effect on one part of the body. This is where the hazardous agent comes into contact with, or enters the body. For example, a local effect may occur on the skin such as an acid burn.

(b) Systematic – Systematic effects occur once the substance has been absorbed and circulated throughout the body. Some systematic effects can occur in the blood when a substance has been absorbed into the bloodstream and in the organs. Organs, such as the brain, or bones may store toxic material, neutralize it like the liver, or remove it like the kidneys and the bladder.

(c) Acute – Acute effects occur within a short period of time. Acute effects often disappear soon after exposure stops and are often reversible. It is, however, possible with HNS that extreme affects can follow within a relatively short time of exposure to the hazard. The most severe effect being death.

(d) Chronic – Chronic effects usually appear a long time after exposure occurred and persist over a period of time. Some chronic conditions may develop after just a short exposure, whereas others may only develop after repeated contact with the substance. Like acute effects, chronic effects can be localized to just one part of the body, but it can also be systematic.

Exposure to some hazards may only cause either an acute or a chronic response. It is possible that hazards can cause both kinds of effects. For example, short term exposure to formaldehyde may cause eye irritation or headaches, but long term exposure may cause recurring skin reactions or cancer.

(16) Exposure limits

Although explanation about the chemical groupings by hazards may be too long and too difficult for trainees to understand, instructors shall clearly explain to trainees that:

It is essential for trainees to get full knowledge to protect themselves in the response operation and to avoid damages to human body. It is important, after a release of toxic gas or vapor into the atmosphere, that it is determined what concentration of the release can be tolerated by exposed populations. This will determine the extent of the exclusion zone and determine the response strategy. This toleration is called the exposure limit.

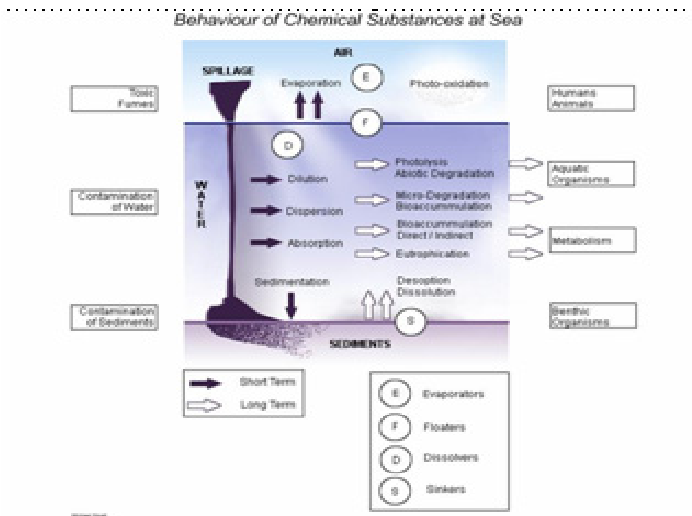
(a) Threshold limit values (TLV) or otherwise known as maximum accepted concentrations (MAC). TLV reflects the level of exposure for airborne gases and vapors. A typical worker can experience without an unreasonable risk of disease or injury. These are published by various government agencies and are readily available.

(b) Immediately dangerous to life or health (IDLH) – This is another exposure limit which describes an atmosphere, which is immediately dangerous to life or health. In other words, this atmosphere would pose an immediate threat to life, cause irreversible adverse health effects, or impair an individual's ability to escape from a dangerous atmosphere.

(c) IDLH limits were originally created to assist in making decisions regarding respirator use. Two factors are considered regarding IDLH limits. Workers must be able to escape such an environment without suffering permanent health damage, and workers must be able to escape without severe eye or respiratory tract irritation or other conditions that might impair their escape.

(17) Environmental Effects

Trainees are further asked to remember following points:



(a) Assessing the impact of substances in the marine environment, one needs to take account not only of the toxicity to marine life, but also the persistence of the substance, the potential for it to bio-accumulate, and the potential to disrupt marine activities – for example, through tainting of fish or closure of beaches.

(b) Various biotic and biotic processes can modify the toxicity of HNS and must be considered in the planning for chronic hazards. The concentration, distribution, transformation, and long-term fate of a substance in the marine environment are primarily controlled by:

- The rate of release of the substance into the environment.
- The physico-chemical properties of the substance.
- The physic-chemical, meteorological and oceanographical conditions of the environment.
- The biodegradation and biotransformation properties of the ecosystem.

(c) These factors will affect the availability of the toxic substance to the organisms (bioavailability). The figure above shows an overview of the factors affecting the concentration of some substances.

(18) Environmental Effects – MARPOL Classification

Here again, trainees should reconfirm MARPOL, which trainees are required to remember, is the most important regulation relating to HNS incident.

(a) MARPOL – The revised Annex II of MARPOL regulates the control of operational pollution from noxious liquid substances in bulk and provides information on the dangers presented. Noxious liquid substances carried in bulk, under the revised Annex II of MARPOL, are classified into four pollution categories, according to the hazard they present to marine resources, human health, or amenities.

(i) **Category X** – Substances deemed to present a major hazard to either marine resources or human health and, therefore, justify the prohibition of the discharge into the marine environment.

(ii) **Category Y** – Substances deemed to present a hazard to either marine resources or human health, or cause harm to amenities or other legitimate uses of the sea, which therefore, justify a limitation on the quality and quantity of the discharge into the marine environment.

(iii) **Category Z** – Substances deemed to present a minor hazard to either marine resources or human health, therefore, justify less stringent restrictions on the quality and quantity of the discharge into the marine environment.

(iv) **Category OS** – "Other substances" considered to present no harm to marine resources, human health, amenities, or other legitimate uses of the sea.

Pollution categories under the revised Annex II of MARPOL are based on hazard profiles for chemicals transported in bulk at sea. The evaluation procedure to assign hazard profiles has been developed by the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP)

(19) GESAMP and GESAMP classification

The Group of Experts on Scientific Aspects of Marine Environmental Protection (GESAMP) is an advisory body, established in 1969, that advises the United Nations (UN) system on the scientific aspects of marine environmental protection.

At present, it is jointly sponsored by eight UN organizations (IMO, FAO, UNESCO-IOC, WHO, IAEA, UN, UNEP) with responsibilities relating to the marine environment as a mechanism for coordination and collaboration among themselves.

GESAMP functions are to conduct and support marine environmental assessments, to undertake in-depth studies, analyses, and reviews of specific topics, and to identify emerging issues regarding the state of the marine environment.

Their task is to:
- To provide advice relating to the scientific aspects of marine environmental protection.
- To prepare periodic reviews and assessments of the state of the marine environment and to identify problems and areas requiring special attention.

GESAMP have produced hazard evaluation procedures, which contains criteria for evaluating the hazards of chemical substances that enter the marine environment through operational discharge, accidental spillage, or loss overboard from ships. Both hazards to people and the environment are considered. This information is collated into a hazardous profile, which breaks down the hazard characteristics for each substance.

The hazard evaluation procedure is broken down into five categories:
- Bioaccumulation and Biodegradation– Bioaccumulation refers to a process when substances increase in concentration in living organisms as they take in contaminated air, water, or food because the substances are very slowly

metabolized or excreted. Low values of log Pow or BCF indicate low bioaccumulation potential. Biodegradation is the ability of a substance to be broken down, usually through the metabolic action of microbes (although hydrolysis and photolysis may also be important for some chemicals). Knowledge of the rate at which organic substances degrade in the environment is of great importance in determining their impact and preventing biological effects.

Lesson O–4: HNS Transportation

In this lesson, trainees are taught to be able to:

- Describe the ways in which HNS cargoes may be carried at sea
- Get full knowledge about the regulations and guidance available
- Describe the types of maritime accidents that could lead to a release of HNS
- Use the International Maritime Dangerous Goods Code effectively
- Use the International Maritime Dangerous Goods Code Supplements effectively

(1) Instructor shall, by using slides and videos, show trainees how different chemicals are transported by sea. It will familiarize trainees with the varying design and construction standards that are required to minimize the risks to the ships, their crews, and the environment from HNS cargoes while taking into consideration the nature of their products. It is imperative that trainees understand the classification of different substances so that trainees can identify what hazards are present and what remedial action will be effective.

(2) Methods of carrying HNS at sea

HNS cargoes can be carried at sea either in bulk or packaged form. There are many different types of ship which carry HNS.

If carriage of bulk cargos is considered,

- A bulk carrier transports bulk cargo and can be recognised by its large box like hatches. These carry solid bulk cargos such as grain, fishmeal, ores, and semi-manufactured products.
- Oil bulk carrier or combination carriers are multi-purpose carriers for bulk cargos. The cargo can be transported in either liquid or solid form, and are designed to avoid having to make the return voyage in ballast.

If carriage of HNS in packages is considered, following vessel types are recognized:

- Containerships – These are specialised carriers that transport packaged goods in containers and are mainly designed for general dry cargo (box-type), even though specialised containers can take solids (e.g. powder) or liquid chemicals in portable (ISO) tanks.
- General cargo ships – These usually carry cargo in relatively small consignments (e.g. crates, boxes, drums or sacks), all placed in close proximity in several large holds.
- Ro-Ro – These are designed with facilities for quick loading and discharging with cargos being moved on and off using road trailers or rail tank cars.

If carriage of HNS in liquid or gas is considered, following types of vessels are recognized:

- Chemical Tankers - These are a specialised class of tankers designed to carry the most dangerous of liquid chemicals.
- Product Tankers – Generally built to carry a broader range of chemicals. They are also referred to as parcel tankers because of the large number of individual tanks and pumping systems.
- Gas Carriers – Built to carry gas in either a pressurised or refrigerated form.

(3) International Regulations

Trainees are asked to remember that:

- Regulations governing the carriage of chemicals by ship are contained in the International Convention for the Safety of Life at Sea (SOLAS) and the

International Convention for the Prevention of Marine Pollution from Ships, as modified by the Protocol of 1978 relating thereto **(MARPOL).**

The regulations cover chemicals carried in bulk on chemical tankers, and chemicals carried in packaged form.

Carriage of chemicals in bulk is covered by regulations **in SOLAS Chapter VII** – Carriage of dangerous goods and **MARPOL Annex II** – Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk.

MARPOL Annex III includes regulations for the prevention of pollution by harmful substances in packaged form and includes general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions, and notifications for preventing pollution by harmful substances. For the purpose of Annex III, “harmful substances” are those identified as “marine pollutants” in the IMDG Code.

(4) IMO Conventions

Trainees should understand that:

- IMO Conventions require chemical tankers, built after July1, 1986, to comply with the International Bulk Chemical Code (IBC Code). This code gives international standards for the safe transport by sea in bulk of dangerous liquid chemicals, by prescribing the design and construction standards of ships involved in such transport and the equipment they should carry so as to minimize the risks to the ship, its crew, and to the environment, having regard to the nature of the products carried.

The basic philosophy is a ship type, related to the hazards of the products covered by the codes. Each of the products may have one or more hazard properties, which include flammability, toxicity, corrosivity, and reactivity.

The IBC Code lists chemicals and their hazards, and gives both the ship type required to carry that product as well as the environmental hazard rating.

Chemical tankers, constructed before July 1, 1986, should comply with the requirements of the code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (BCH Code) – the predecessor of the IBC Code.

There are similar codes for the construction and equipment of ships carrying liquefied gases in bulk.

(5) Carriage Guidance

The IMO’s Code of Safe Practice for Solid Bulk Cargoes (BC Code) highlights the dangers associated with the shipment of certain types of bulk cargos. It also lists typical products which are shipped, and gives advice on their properties. The various IMO codes for the carriage of bulk HNS can be used to respond effectively to incidents. Sections of the codes contain details on chemical hazards, pollution category, etc. These are vital for an effective response, since a hazard evaluation of the product in question can be obtained from consulting the relevant sections.

HNS packaged in small quantities is usually known as dangerous goods. The International Maritime Dangerous Goods Code is used for the carriage of dangerous goods. It describes how the packaging should be designed and tested, marked and labelled, what documentation needs to accompany the goods, and what stowage and segregation requirements there are. This code applies to all ships carrying dangerous goods in a packaged form.

This code places all the dangerous goods into nine classes, which we will cover later on in the module. All the substances, materials, and articles which appear in the IMDG Code are listed in its general index. This gives the product its UN number, its emergency schedule number, its emergency schedule number, its medical first aid guide table number, and the IMDG Code page number of the individual schedule for the product concerned. Substances recognised as marine pollutants are also indicated as such in this index.

This code has been written primarily with the mariner in mind but provides guidelines for all those involved in the storage, transport, and handling of the substances referred to in the document. This can include port authorities and all those involved in the transport chain from the manufacturer to the receiver.

(6) Hazards

Trainees are explained about the hazards associated with the transporting HNS as follows:

- Structural damage due to improper distribution of the cargo.
- Loss or reduction of stability during the voyage. This could be a shift of the cargo, or the cargo liquefying under combined factors of vibration, and motion of the ship.
- Chemical reactions such as the emission of toxic or explosive substances.
- Accidents – We will consider the range of these, later in the module.

(7) Types of Accidents

Instructor shall explain that a major chemical incident is a low probability event, but that it is the one that could have very high consequences and will generally fall into or be a combination of several different categories.

Trainees are educated to recognize that following type of accidents could cause a chemical spill:

- Collision – The striking together of two vessels
- Contact – A vessel which strikes a fixed object or the sea bottom.
- Grounding – A vessel that touches the bottom and remains aground for an appreciable period.
- Fire/explosion – A fire or explosion is started by the cargo or in it’s vicinity, and is the first step in a chain of events leading to casualty.
- Trainees are reminded that a fire in an installation will have the same impact.
- Sinking – A vessel sinks as the result of bad weather or hull failure.
- Container loss – Power failure to the container storing the hazardous chemical or the loss of containers due to bad weather or structural failure.
- Sabotage.
- Poor handling or storage of chemical substance.
- Chemical reactions.
- Structural damage.
- Negligence.
- Terrorism.
- Tank / pipeline failure – Loss of integrity in the tank / pipeline system, possibly as a result of contact.
- Loss or reduction in stability.
- Structural failure of a vessel.

(8) The International Maritime Dangerous Goods Code (IMDG)

The IMDG Code is an international agreement for the transport of dangerous goods by sea, published by the IMO. Trainees are told about the contents of the code and are required to understand it completely. The Code covers the transportation of goods in packaged form or bulk solids. It is a SOLAS requirement that all dangerous goods on container and cargo ships should be stowed and carried in accordance with its requirements. The guidance contained in the code is intended for use by all personnel involved in the shipment of dangerous goods by sea. This includes mariners, manufacturers, consignors, agents, and any associated feeder or support industries, services, and competent authorities.

The IMDG Code is split into two volumes.

(a) Volume 1 – General provisions, definitions and training, classification, packing and tank provisions, consignment procedures, construction and testing, road tank vehicles, and transport operations.
(b) Volume 2 – This contains the dangerous goods list, which includes limited quantities exceptions, the index and generic names, and a glossary.

There is also a supplement which contains an emergency schedule, which gives fire fighting and spillage advice. There is a medical guide giving first aid advice, reporting procedures, packing cargo transport units, instructing safe use of pesticides and the INF Code, which is the International Code for the safe carriage of packaged Irradiated Nuclear Fuel, plutonium and high-level radioactive waste onboard ships.

(9) IMDG Hazard classification

Dangerous goods are divided into nine different classes according to the hazard or the most predominant of the hazards they present. They have then been subdivided to define and describe the characteristics and properties of the substances, materials, and articles, which fall within each of the classes. Some of these substances have also been labelled as marine pollutants to indicate that they are harmful to the marine environment.

Substances are assigned to one of the classes 1-9, according to the hazard. Note that the numerical order of the classes and divisions do not reflect the degree of danger posed.

Class 1 - Explosives

- Division 1.1 – Substances and articles that have a mass explosion hazard.
- Division 1.2 – Substances and articles which have a projection hazards but not a mass explosion hazard.
- Division 1.3 – Substances and articles that have a fire hazard, either a minor blast hazard, or a minor projection hazard, or both, but not a mass explosion hazard.
- Division 1.4 – Substances and articles which present no significant hazard
- Division 1.5 – Very insensitive substances, which have a mass explosion hazard
- Division 1.6 – Extremely insensitive articles, which do not have a mass

(10) IMDG Hazard classification

Class 2 – Gases

- **Class 2.1 – Flammable gases**
- **Class 2.2 – Non flammable, non-toxic gases**
- **Class 2.3 – Toxic gases**

Class 3 – Flammable Liquids

Class 4 – Flammable Solids

these are substances liable to spontaneous combustion. Substance, which when they come into contact with water, will emit flammable gases.

- Class 4.1 – Flammable solids, self reactive substances, and desensitised explosives.
- Class 4.2 – Substances liable to spontaneous combustion.
- Class 4.3 – Substances which, when they come into contact with water,

emit flammable gases.

Class 5 – Oxidizing substances and organic peroxides.

- Class 5.1 – Oxidising substances
- Class 5.2 – Organic peroxides

Class 6 – Toxic and infectious substances

- Class 6.1 – Toxic substances
- Class 6.2 – Infectious substances

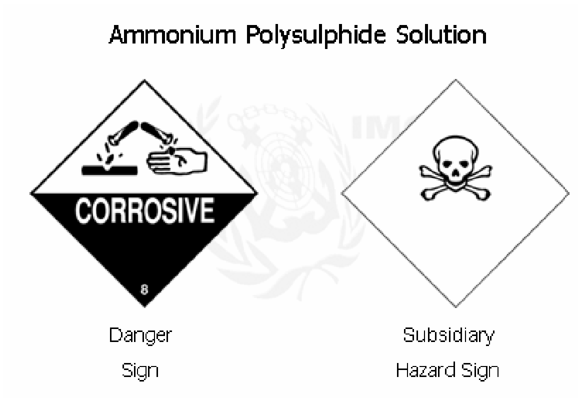
Class 7 – Radioactive material

Class 8 – Corrosive substances

Class 9 – Miscellaneous and dangerous substances

Trainees are explained that:

- Many substances have more than one hazard associated with their transportation. In such a case, all of the relevant hazard signs are displayed on the transport.



As an example, one substance is shown above, and instructor should tell trainees the following:

- The substance is identified as being corrosive and toxic.
- The primary hazard is Class 8 – corrosive substances.
- The subsidiary hazard is associated with Class 6 - toxic substances.
- The two hazards are differentiated by the fact that the subsidiary hazard does not have its class number on the hazard diamond.

(11) Marine Pollutants

It should be further explained to trainees that:

- Many of the substances assigned to classes 1 to 9 are deemed as being marine pollutants. Certain marine pollutants have an extreme pollution potential and are identified as marine pollutants. Marine pollutants mean substances, because of their potential to bio-accumulate in sea floor or because of their high toxicity to aquatic life, are subject to the provisions of Annex III of MARPOL 73/78.

The index contains a comprehensive listing of substances, materials, and articles that are identified as following marine pollutants:

- Substances, materials, and articles that have a pollution potential (marine pollutants) are identified in the index with P in the column titled MP
- Substances, materials, and articles that have an extreme pollution potential (severe marine pollutants) are identified in the index with PP in the column titled MP.

A solution or mixture, containing 10% or more of a marine pollutant, is classified as a marine pollutant. A solution or mixture, containing 1% or more of a severe marine pollutant, is classified as a marine pollutant.

Wastes – Wastes shall be transported under the provisions of their appropriate class. Wastes are not covered by the code but covered under the BASEL Convention may be transported under class 9.

Packing groups - For packing purposes, substances other than those of classes 1, 2, 5.2, 6.2 and 7 and self-reactive substances of class 4.1, are assigned to three packing groups in accordance with the degree of danger they present.

- Packing group I – substances presenting high danger
- Packing group II – substances presenting medium danger
- Packing group III – substances presenting low danger

The packing group to which a substance is assigned is indicated in the dangerous goods list in chapter 3.2.

(12) UN Number

Trainees are explained that:

(a) UN Numbers – Dangerous goods are assigned UN numbers and proper shipping names according to their hazard classification and their composition. The IMDG Code also states the packing group that was assigned, stowage properties, etc.

(b) The Dangerous Goods List in chapter 3.2 lists many of the dangerous goods most commonly transported. The list includes entries for specific chemical substances and articles and "generic" or "not otherwise specified entries." Since it is not practical to include a separate entry for every chemical substance or article of commercial importance specifically by name, especially names for mixtures and solutions of various chemical constituents and concentrations, the Dangerous Goods List also includes generic or "not otherwise specified" names (e.g. EXTRACTS, FLAVOURING, LIQUID, UN 1197 or FLAMMABLE LIQUID, N.O.S., UN 1993). On this basis, the Dangerous Goods List is intended to include an appropriate name or entry for any dangerous good, which may be transported.

(c) Where a dangerous good is specifically listed by name in the Dangerous Goods List, it shall be transported in accordance with the provisions in the list, which is appropriate for that dangerous good. A "generic" or "not otherwise specified" entry may be used to permit the transport of substances, materials, or articles that do not appear specifically by name in the Dangerous Goods List. Such a dangerous good may be transported only after its dangerous properties have been determined. Dangerous goods shall be classified according to the class definitions, tests, and criteria. The name that most appropriately describes the dangerous goods shall be used. Only when the specific name of the dangerous goods does not appear in the Dangerous Goods List, or the associated primary or subsidiary hazards assigned to it are not appropriate, may a generic or "not otherwise specified" name be used. The classification shall be made by the shipper/consignor or by the appropriate competent authority where so specified in the code. Once the class of the dangerous good has been so established, all conditions for transport, as provided in this code, shall be met.

(13) Supplements to the IMDG code

In addition to IMDG Code, supplements to IMDG code shall be explained to trainees for their clear understanding about developments in the area of International Legislation. The IMDG Code relates to the safe carriage of dangerous goods by sea. It does not however include details concerning the packing of dangerous goods, any actions to take in the event of an emergency, or accident involving personnel who handle goods at sea. For this purpose, a supplement has been created containing information on the following subjects:

- EMS Guide – This contains guidance on emergency response procedures for ships carrying dangerous goods, including the emergency schedules to be followed in case of incidents involving dangerous substances, materials, articles, or harmful substances regulated under the international maritime dangerous goods code. This guide also provides guidance for dealing with fires and spillages on board ships involving dangerous goods. This guide is intended for fire and spillage emergencies on board a ship involving packaged dangerous goods, and should not be used for emergencies involving bulk cargos. The guide covers an introduction into the emergency schedules for fire, and introduction to the emergency schedules for spillages.
- The Medical First Aid Guide (MFAG) for use in accidents involving dangerous goods – MFAG refers to the substance, material, and articles covered by the IMDG Code and the materials covered by Appendix B of the Code of Safe Practise for Solid Bulk Cargoes (BC Code). It provides advice for initial management of chemical poisoning, and diagnosis within the limits of the facilities available at sea. It also provides information on the particular toxic effects likely to be encountered.
- The guide is divided into sections that are grouped to facilitate a three step approach. These steps are emergency actions and diagnosis, tables that give brief instructions for special circumstances and appendices that provide comprehensive information, a list of all medicines and drugs, and a list of chemicals referred to in the tables. An example of the emergency action and diagnosis flowchart is detailed in the workbook.

Information is also provided in the supplement for:

- Reporting procedures.
- Packing cargo transport units.
- The safe use of pesticides.

Irradiated nuclear fuel is covered by the International Code for the safe carriage of packaged Irradiated Nuclear Fuel, plutonium, and high level radioactive waste on board ship (INF Code). The code assigns ships to three different classes:

(a) Class INF 1 – Ships that are certified to carry INF cargo with an aggregate activity of less than 4000 TBq (Terabecquerel – SI unit of radioactivity and measures the rate of decay).
(b) Class INF 2 – Ships that are certified to carry irradiated nuclear fuel or high level radioactive wastes with an aggregate activity of less than 2 x 106 TBq and ships certified to carry plutonium with an aggregate activity of less than 2 x 105 TBq.
(c) Class INF 3 – Ships that are certified to carry irradiated nuclear fuel or high-level radioactive wastes, and ships that are certified to carry plutonium with no restriction of the maximum aggregate activity of the materials.

Lesson O–5: Challenges and Dangers of an HNS incident

Trainees are to be told and asked to remember the following points:

The challenges and dangers of HNS incident can be broken down into following six key areas:

(a) Operational
The main operational elements include
- Safety
- Organizing people and resources
- Establishing a command organization/structure and command centre
- Communications
- Planning
- Deploying equipment
- Logistics
- Clean-up, decontamination, and disposal

(b) Political
Political factors can include both internal and external pressure
- Internal pressure can come from other departments in the organization
- External pressure may come from government, politicians, or lobby groups

(c) Public pressures
Public pressure may come from affected groups such as local fishermen, local business who rely on tourism, holiday makers, etc. The public will have health concerns as well as the local authorities. Environmental organizations will also apply pressure during an incident, and there may be differing environmental priorities.

(d) Economic
Economic concerns include –
- Damage to industry installations
- Financial losses that arise as a result of the spill

(e) Environmental
Environmental concerns include –
- Health and safety of the public
- The need to minimize any secondary damage to the environment from the response effort to avoid and prevent the spreading of the HNS.

(f) Media.
The media also poses challenges for the response team. They will be constantly applying pressure for new information. Press release information will have to be collated and released to the press on a regular basis. The OSC may be called upon to conduct interviews on the incident and the response.

Lesson O–6: Monitoring, reporting and record keeping

Trainees are to be reminded about the following points before they actually get training and exercise. Important point in the preparation process is the establishment of reporting procedures that shall indicate:
- Who is responsible for reporting
- To whom are the reports to be made
- What format should be used for the reports
- When are the reports to be made
- Also the reporting procedures should be linked to an appropriate record keeping process

Lesson O–7: Financial and Liability Arrangements

While these aspects of Financial and Liability Arrangements have been covered in the earlier stage of this training, trainees should again be reminded that they play an important and fundamental part in the Emergency Response System.

With regard to the financial aspects, the level of preparedness required will need to be funded as well as having sufficient provisions to fund any response. Trainees are told the essential point a good record keeping needs to be established at an early stage to assist in the collation and management of any claim.
In respect to the liability aspects, the administration and relevant international, legal, and insurance bodies will determine the level of liability for differing parties. This will be established by reference to national legislation and international conventions, which have already been covered earlier in this training.

Trainees are asked, at least, to remember the following points:

In 1996, IMO adopted the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances (HNS) by sea, which provides for a compensation and liability regime for incidents involving these substances (it has not yet entered into force).

Trainees are reminded that the definition of an HNS, as defined by the OPRC-HNS Protocol 2000, differs widely from the definition of an HNS under the International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances (HNS) by sea, otherwise known as the HNS Convention.

Trainees are also asked to always remember that, in the HNS Convention, HNS are defined by reference to lists of substances included in various IMO Conventions and Codes. These include oils; other liquid substances defined as noxious or dangerous; liquefied gases; liquid substances with a flashpoint not exceeding 60°C; dangerous, hazardous and harmful materials and substances carried in packaged form; and solid bulk materials defined as possessing chemical hazards. The Convention also covers residues left by the previous carriage of HNS, other than those carried in packaged form.

Lesson O–8: Operational procedures

It should also be reminded to trainees that:
It is necessary to develop operational procedures to ensure that an appropriate and effective response is initiated in a timely fashion. It is of utmost importance that these procedures are clearly defined, properly co-ordinated, and that all roles and responsibilities are clearly identified and defined.

Lesson O–9: Response Organisation

It should be reminded to trainees that the establishment of an organization capable of effectively managing and directing successful mitigation of an incident is the most important point to be observed.

The number of personnel, organizations, and activities involved in response can vary greatly. To be effective, however, the various response personnel and their activities must be organized into a structure unit capable of conducting the operations required. Advisory and/or assisting experts from the chemical industry, chemical accident emergency teams from fire brigades, and civil emergency authorities should be an integrated part of the response organization.

The primary aim is to establish a response organization capable of effectively managing and directing the successful mitigation of an incident. The structure of the organization and the functions performed should be modified on a case by case basis to adjust to the specific requirements of each situation. There are, however, common features of HNS incidents which can be used to design a generic organizational structure, which need to be included at the planning stage.

At this stage, key elements are again told to trainees as follows:

- The identification of an agency for overall command and on scene coordination.
- The definitions of responsibilities and functions, including ship salvage, search and rescue, and pollution operations.
- The delineation of authority.
- The establishment of internal and external communications.
- The co-ordination of activities and functions.
- The identification of resources including information sources on HNS response personnel, equipment, chemical specialists, and the financial aspect in order to cover the costs involved.

(1) Optimized response organization

Taking the case of response organization on the ship, explanation shall be made that:

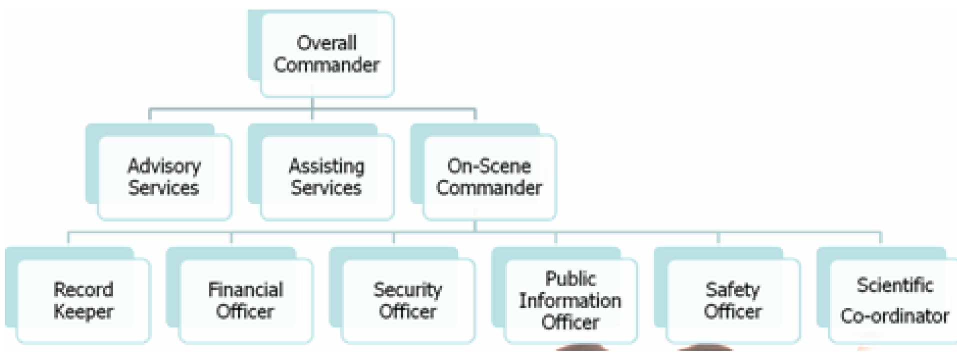
When an incident involving an HNS spill occurs, the first personnel to be involved will be the ship's crew. They are trained for emergency response on board but many of the crew members may not be aware of the potential environmental impact of spills at sea. In addition, in the event of an HNS incident, a ship's crew may need to take shelter in place or abandon ship. As a result of this case, each coastal state should have an effective response organization in place to deal with such events.

Response personnel intervening on the pollution are more likely to be those involved in oil spill response and, therefore, they will be aware of certain environmental concerns. However, they may not be suitably familiar with the particular hazards of chemical spills. Alternatively, they could come from shore-based chemical response units, such as a Fire Brigade, with limited knowledge of pollution response or maritime operations.

As a result of this, it is essential that there is a well coordinated response system to ensure incident management, including the recovery of lost packages and combating an HNS spill. The system must be established on a permanent basis and must identify the personnel who will respond and perform specific tasks in the event of an accident. They should also be aware of emergency procedures that are to be followed by the ship's crew.

(2) Organization Chart

To assist trainees to have clear image about response organization and response personnel. Following sample organization chart shall be shown to trainees:



To manage the various activities required in a response situation, personnel must be selected and assigned the responsibility for conducting specific operations.

- Overall commander – The overall commander is responsible for general policy and strategic decisions. He provides the link to higher government authority or port management. In certain cases the overall commander could also be responsible for international cooperation, if this was required.
- The overall commander may be assisted and advised by internal and external experts such as legal, compensation, scientific, etc.
- On-scene commander – The on-scene commander or coordinator (OSC) is the person responsible for organizing the local response and coordinating the deployment of required resources. The OSC may be a government or an industry representative.
  - ✧ The OSC is a decision maker, a communicator, and a manager of personnel. The OSC is responsible for directing the employment.
  - ✧ Of needed resources, the OSC establishes an operations center for the collection of information incorporating concerns.
  - ✧ Sensitivities of a participating organization / public / media is responsible for reporting all aspects of the spill. The OSC will be assisted by response team leaders in the field.
- The scientific coordinator is responsible for directing and coordinating activities related to the scientific aspects of the situation, including analysis, remedial actions, sample collection, field monitoring and analysis of data.
- The safety officer provides advice and consultation on all matters related to health and safety of those involved in response operations. He establishes and directs the safety program.
- The public information officer is responsible for releasing all information concerning response activities to the news media and the public. He should be kept informed of the latest information on the situation, as well as the strategies and tactics to be implemented. He is responsible for verifying the press releases.
- The security officer is responsible for general response area security.
- The financial officer provides financial and contractual support.
- The record keeper is responsible for the official record of response activities.

(3) Response personnel

The definition of response is the effort of minimizing the risks created in an emergency, to protect people, the environment, and property, and to restore normal pre-emergency conditions. There is a systematic approach to responding to HNS incidents, which we will consider shortly. However, marine HNS accidents share the following crisis components:

- There are large uncertainties.
- Important values are at risk. This includes the risk to human life.
- Tight time constraints.
- The outcome is unpredictable and unexpected.

The response to a marine accident is a complex issue requiring highly specialised skills and technology, and the involvement of numerous organizations. Critical decision need to be made rapidly to prevent escalation, and turn a developing disastrous situation into a non-hazardous one.

The decision making process must be flexible enough to handle a broad spectrum of different incident related issues in a timely, efficient, and effective manner. The decisions reached must be simple enough to be clearly understood by all those involved in the response operations.

(4) Definition of Response

The definition of response is the effort to minimize the risks created in an emergency, to protect people, the environment and property, and to restore normal pre-emergency conditions. There is a systematic approach to responding to HNS incidents, which we will consider shortly. However, marine HNS accidents share the following crisis components:

- There are large uncertainties

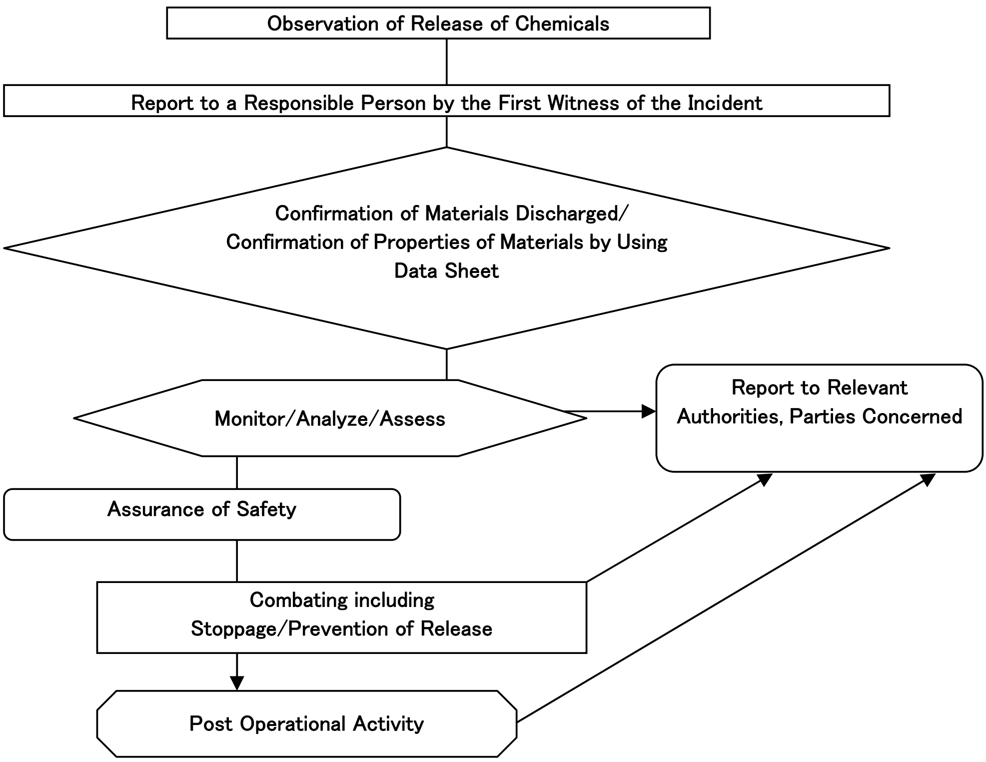
- Important values are at risk – this includes the risk to human life
- Tight time constraints
- The outcome is unpredictable and unexpected

The response to a marine accident is a complex issue requiring highly specialized skills and technology and the involvement of numerous organizations. Critical decision need to be made rapidly to prevent escalation, and turn a developing disastrous situation into a non-hazardous one.

The decision making process must be flexible enough to handle a broad spectrum of different incident related issues in a timely, efficient, and effective manner. The decisions reached must be simple enough to be clearly understood by all those involved in the response operations.

(5) Flow Chart of Contingency Plan

As a next step, trainees are reminded of the contingency plan that has already been explained in the Volume 1 of this Manual. To refresh the memory, following chart shall be shown to the trainees:



Lesson O–10: The Role of the On-Scene Commander ("OSC")

It is important to tell trainees that they should recognize that:

(a) The OSC is pre-designated in the contingency plan. Whoever fills the role is usually dependent on the organization. It is normally a senior government aide or appointment.

(b) The OSC is in charge of the response management of the spill. They are the response team leader and the co-coordinator of response activities.

Trainees are also asked to remember that:

- The OSC is responsible for ensuring that the response is carried out in a safe, effective, and efficient manner.
- He is responsible for response strategies and techniques including people and equipment.
- He should have the authority, both financially and organizational, to deploy equipment and resources to the spill response.
- He should have legal authority as defined by a state's legislation.
- He should also have delegated emergency financial authority and the authority to direct other government departments and industry to respond as directed.
- The OSC is accountable for the whole response effort.
- The OSC will be required to support decisions and costs relating to claims and ensure that proper records are kept. They may also be required to support decisions and costs in court.
- Generally, the OSC manages and coordinates all media activity and media briefings, and may be called upon to act as the overall spokesman for the organization responsible for managing the spill response.

Lesson O–11: Response

Before starting the lecture, to assist the trainees to visualize the response, IMO's video entitled as " IMO video – Response to Marine Chemical spills – Part 3 - Response Options" shall be shown to trainees.

Since this is the most important point of the training for the trainees of possible respondent in the HNS incident, at this lesson, trainees are reminded of key components of emergency response system, as follows. (Some trainees may be tired of listening to the same elements. However, they should be patient in order to gain knowledge correctly and completely.)

(1) Key components of an emergency response system

(a) Organisational Arrangements – It is essential that all roles are defined clearly and that all responsibilities and capabilities have been clearly identified.

Who is responsible for responding to the incident? - the fundamental issue with respect to identifying the roles, responsibilities, and capabilities is to establish who is responsible for responding to the incident, and who is responsible for implementing the response plan.

Who is responsible for conducting specific tasks? Consideration must be given to the many tasks that will take place during the course of the operation.

In assessing the organizational arrangements, the following elements shall be considered:

(i) Prevention

Prevention, which consists of taking measures to reduce the likelihood of an incident occurring and, in the event of an incident occurring, measures to minimize the effects, is critical to the emergency response team.

Response team need to consider what the team already has in place and should evaluate existing documentation such as:

- Policies
- Guidelines
- Legislation.

Then consideration must be given on:

- What shall be put in place?
- What mandatory compliance requirements exist?
- What does the legislation require to be implemented?
- What is the team missing?

(ii) Preparedness

Preparedness is simply being prepared, as being prepared will enhance your ability to respond to emergencies. Remember the phrase "failing to plan is planning to fail."
Key considerations are:

- Develop an emergency response plan.
- Ensure that response resources and equipment are available.
- Make sure your personnel are trained, and simulate scenarios regularly.
- Make sure that communication and alert channels are established, including the media.
- Take into account the various scenarios relevant to probable spills, and the organization and activities likely to be involved. This should involve joint planning and training of those who may need to work together if an accident occurs, including industries and the surrounding communities.

Trainees are asked to consider what the administrations should provide and recognize that:

① The administrations should provide:

- All relevant guidelines and policies for dealing with incidents.
- Define what reporting procedures are required and what the incident reporting requirements are.
- Prepare and implement periodic inspection and auditing protocols, and ensure that appropriate equipment, systems and procedures are being implemented and adhered to.
- Collect and disseminate information.
- Define the emergency response planning requirements and the response capability and preparedness standards for vessels, facilities, and port/harbor authorities.
- Establish information databases pertaining to shipping information (e.g. stowage plans, bills of landing, ship passage, ports of call), chemical and physical properties, and response protocols. Levels of confidentiality required for this information must be established in conjunction with the relevant stakeholders.
- Establish a pool of experts to act as an advisory group. Individuals with expertise in navigation, ship technology, ship

operations, salvage, naval architecture, chemical hazards, marine biology, physical and chemical oceanography, dispersion modelling, spill response, and fire fighting.
- Establish a coordination group made up of individuals with proven expertise in the areas of emergency, crisis management, and transfer operations.

② Trainees should remember that further support administration can provide the followings;
- Identify an operations center to provide access to information databases, standard operating procedures, advisory personnel, and communications equipment.
- Identify chemical response units.
- To train the personnel of the chemical response unit.
- To coordinate with national, regional, and international, e.g. IMO, organizations and information sources in both routine and emergency situations.

(b) Planning Requirements
Trainees should be told that PLANNING REQUIREMENTS include the preparation of detailed and specific plans for responding to a marine incident. International, regional, national, and local emergency response plans should be prepared to summarise roles and responsibilities for all parties, providing standard operating procedures, lists of available resources, etc.
Plans are required at four levels.
- At an international level with the framework of an operational contingency plan
- At the regional level for multi-lateral assistance and mutual aid
- At the national level
- At the local level (e.g. for terminals and harbours/ports)

Should the magnitude of an accident be such that assistance is required, these plans should be integrated in such a way that it will be easy to incorporate additional response capabilities. For example, a port emergency plan should be coordinated with the neighbouring industrial facilities and local regional plans as well as with the national plan.

To assist responders and decision makers in managing the response, various types of information should be gathered before an accident takes place.

Each organization should develop its own system, meeting its own requirements. A response support system can be anything, from a list of experts to a computer based system. However, there are some fundamental planning and assessment tools:
- Inventory of the different response plans that can be activated in different areas and the procedures required to activate them.
- Inventory of transportation patterns and commodities transported in different areas.
- The chemical and physical properties of transported substances.
- Toxicological effects and exposure limits of substances.
- Chemical fate of substances.
- Spill scenarios, describing the substances transported for each sensitive area.
- The identification of sensitive areas.
- Possible recovery techniques.
- Personal protective equipment requirements.

Trainees are asked to remember that:
(i) Response tools should include:
- An incident assessment system
- A list of experts on maritime and chemical aspects
- Predictive air dispersion modelling and related monitoring capabilities

- Predictive water dispersion and related monitoring capabilities
- An inventory of incident assessment capabilities
- Access to the ship's manifest and loading plan
- Search and rescue capabilities
- Decontamination techniques for responders and exposed public

(c) Monitoring and reporting – Ensure that all incidents are assessed, evaluated, and followed up as appropriate.
The key element in the preparation process is the establishment of reporting procedures which will indicate:
- Who is responsible for reporting?
- To whom are the reports to be made?
- What format should be used for the reports?
- When are the reports to be made?

The reporting procedures should be linked to an appropriate record keeping process.

(d) Defined operational procedures – To ensure that an appropriate and effective response is initiated in a timely fashion, it is necessary to develop operational procedures. It is utmost important that these procedures are clearly defined, properly coordinated, and that all roles and responsibilities are clearly identified and defined.

(e) Training and exercising
Trainees are asked to remember that training standards should be prescribed for all response personnel, whether performing at the decision-making or operational levels. It should be clearly told to trainees that they should include the following points:
- Training should be content specific with the job performance expectations
- There should be schedules for implementation and compliance dates
- There should be requirements for issuing certificates and their specific content
- Requirements for periodic refresher training are defined with terms like, 3 yearly requalification.
- Exercises and drills are planned for regular intervals to ensure that the response program is effective
- Ensure that all training organizations used are approved/certified prior to training
- That the training delivered is of an equivalent standard as international training requirements.

(f) Financial and liability arrangements – To determine financial responsibilities and liabilities of the various parties involved. While these aspects will have been covered earlier in the Emergency Response System, nevertheless, these aspects are again told to trainees, since they play an important and fundamental part in the system.

With regard to the financial aspects the level of preparedness required, they will need to be funded as well as having sufficient provisions to fund other responses. In the latter, it is vital that good record keeping is established at an early stage, in order to assist in the collation and management of any claim.

In respect to the liability aspects, the administration and relevant international, legal, and insurance bodies will determine the level of liability for differing parties. This will be established with reference to national legislation and international conventions. Trainees are asked to reconfirm the lessons already given (Lesson O – 6 International Legislation)

(2) Response organization
(a) On the ship
When an incident involving an HNS spill occurs, the first personnel to be

involved will be the ship's crew. They are trained for emergency response on board but many of the crew members may not be aware of the potential environmental impact of spills at sea. In addition to this, in the event of an HNS incident, a ship's crew may need to take shelter in place or abandon ship. As a result of this, each coastal state should have an effective response organization in place to deal with such events.

Response personnel intervening on the pollution are more likely to be those involved in oil spill response; therefore, they will be aware of certain environmental concerns. Trainees are told, however, that they may not be suitably familiar with the particular hazards of chemical spills. Alternatively, they could come from shore-based chemical response units, such as a Fire Brigade, with limited knowledge of pollution response or maritime operations.

As a result of this, it is essential that there is a well coordinated response system to ensure incident management, including the recovery of lost packages and combating an HNS spill. The system must be established on a permanent basis and must identify the personnel who will respond and perform specific tasks in the event of an accident. They should also be aware of emergency procedures that are to be followed by the ship's crew. Trainees should remember that the number of personnel, organizations, and activities involved in response can vary greatly. To be effective, however, the various response personnel and their activities must be organized into a structure unit capable of conducting the operations required. Advisory and/or assisting experts from the chemical industry, chemical accident emergency teams from fire brigades, and civil emergency authorities should be an integrated part of the response organization

Trainees are reminded that the primary aim is to establish a response organization capable of effectively managing and directing the successful mitigation of an incident. The structure of the organization and the functions performed should be modified on a case by case basis to adjust to the specific requirements of each situation. There are, however, common feature of HNS incidents which can be used to design a generic organizational structure that needs to be included at the planning stage. Elements to be considered include the followings:

- The identification of an agency for overall command and on scene coordination
- The definitions of responsibilities and functions, including ship salvage, search and rescue, and pollution operations.
- The delineation of authority
- The establishment of internal and external communications
- The co-ordination of activities and functions
- The identification of resources including information sources on HNS response personnel.
- Equipment, chemical specialists, and the financial aspect in order to cover the costs involved

(b) RESPONSE PERSONNEL – In order to manage the various activities required in a response situation, trainees should be told that personnel must be selected and assigned the responsibility for conducting specific operations as follows:

- Overall commander – The overall commander is responsible for general policy and strategic decisions. He provides the link to higher government authority or port management. In certain cases, the overall commander could also be responsible for international cooperation that was required. The overall commander may be assisted and advised by internal and external experts such as legal, compensation, scientific, etc.
- On-scene commander – The on-scene commander or coordinator (OSC) is the person responsible for organizing the local response and

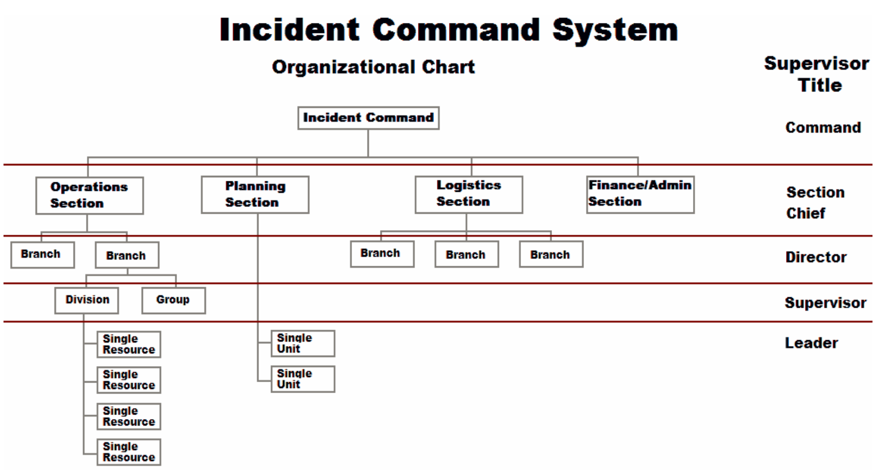
coordinating the deployment of required resources. The OSC may be a government or an industry representative.

The OSC is a decision maker, a communicator, and a manager of personnel. The OSC is responsible for directing the employment of needed resources. The OSC establishes an operations center for the collection of information, incorporating concerns or sensitivities of a participating organisation / public / media, and reporting all aspects of the spill. The OSC will be assisted by response team leaders in the field.

- The scientific coordinator is responsible for directing and coordinating activities related to the scientific aspects of the situation, including analysis, remedial actions, sample collection, field monitoring, and analysis of data.
- The safety officer provides advice and consultation on all matters related to health and safety of those involved in response operations. He also establishes and directs the safety program.
- The public information officer is responsible for releasing all information concerning response activities to the news media and the public. He should be kept informed of the latest information on the situation, as well as the strategies and tactics to be implemented. He is responsible for verifying the press releases.
- The security officer is responsible for general response area security (this will usually be with local law enforcement personnel).
- The financial officer provides financial and contractual support.
- The record keeper is responsible for the official record of response activities.

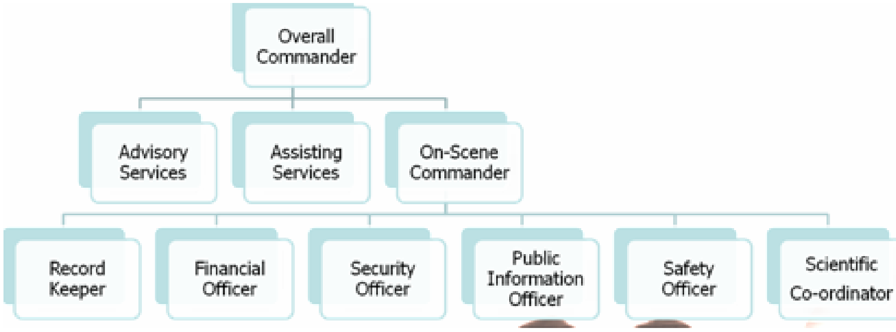
For trainees' guidance, a common response system, the US originated **Incident Command System (ICS)** is described hereunder:

(c) **The Incident Command System (ICS)** is a standardized, on-scene, all-hazard incident management concept developed in the United States. It is a management protocol, originally designed for emergency management agencies and later federalized. ICS or variations of ICS are being used in more and more countries around the world. ICS is based upon a flexible, scalable response organization, providing a common framework within which people can work together effectively. These people may be drawn from multiple agencies that do not routinely work together, and ICS is designed to give standard response and operation procedures to reduce the problems and potential for miscommunication on such incidents. ICS has been summarized as a "first-on-scene" structure, where the first responder on a scene has charge of the scene until the incident is resolved or the initial responder transitions incident command to an arriving, more-qualified individual.



Trainees are lead to recognize that the ICS is and has always been easily applied to HNS response organization.

For trainees' clear guidance, organizational sample structure, which demonstrates relationship of each response personnel, is shown to trainees as hereunder:



At this stage, trainees are asked to recall that:

(i) **The definition of response is the effort of minimizing the risks** created in an emergency, to protect people, the environment, and property and to restore normal pre-emergency conditions. There is a systematic approach to responding to HNS incidents, which we will consider shortly. However, marine HNS accidents share the following crisis components:

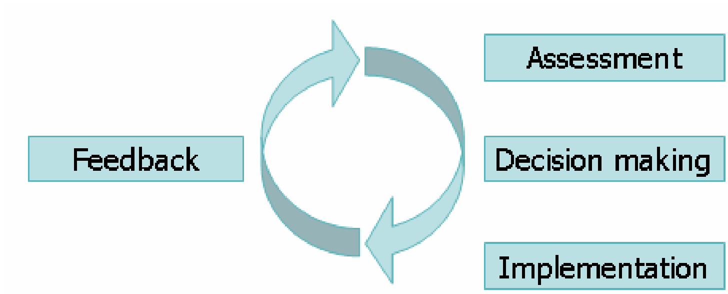
- There are large uncertainties
- Important values are at risk – this includes the risk to human life
- Tight time constraints
- The outcome is unpredictable and unexpected

(ii) The response to a marine accident is a complex issue requiring highly specialized skills and technology, and the involvement of numerous organizations. Critical decisions need to be made rapidly to prevent escalation, and turn a developing disastrous situation into a non-hazardous one.

It should be emphasized to trainees that the decision making process must be flexible enough to handle a broad spectrum of different incident related issues in a timely, efficient, and effective manner. The decisions reached must be simple enough to be clearly understood by all those involved in the response operations.

(d) Different phases of response

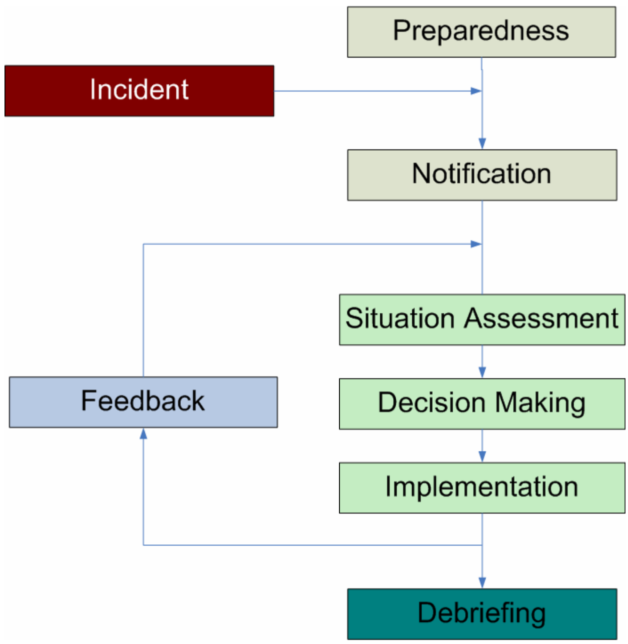
It should be explained to trainees that they should fully recognize the following diagram of different phase of response so that trainees may handle HNS incident effectively and successfully.



Trainees should note that the systematic approach to response was originally developed by the chemical industry to assist the decision makers involved in the management of HNS emergency situations.

It is a systematic sequence of steps for collecting information and making decisions in a logical and methodical manner. It is broken down into four steps:

- Assessment – Where all the information on the incident is gathered
- Decision making – Where the information is processed and interpreted to define priorities, strategies, and tactics
- The implementation where appropriate response actions are put into practise
- The feedback loop where the decisions made and the actions implemented are reassessed against the evolving situation.



Detailed explanation about the relationship between the four basic response steps and the general preparedness and response framework shall be made by using this flow chart.

(e) ASSESSMENT PHASE

The assessment of the situation will occur in two phases. First, an initial assessment of any maritime casualty will be made to decide whether any environmental response is needed. Should an HNS response operation be required, a detailed assessment will follow to identify the best strategies and tactics to facilitate their safe implementation.

In order to conduct a comprehensive assessment, following questions should be asked:

- What are the circumstances of the incident?
- What are the modifying conditions, the conditions that change the incident such as location, weather conditions, time of year, etc?
- What are the potential impact and losses from exposure?
- What response capabilities are available?
- What are the anticipated reactions of interested groups?

For data such as chemical and toxicological properties, ship structure, last port of call, etc, the information is usually available from various government agencies, the master, the ship owner, maritime authorities, international organisations, and P&I clubs.

Other information can only be obtained by direct observation from the accident site. The data can either be collected from a distance (conservative assessment), or by a direct entry into the contaminated site by an assessment team using appropriate personal protective clothing and monitoring equipment. The information collected should be verified and, if necessary, complemented. Special care should be taken when approaching, by sea or air, any stricken vessel.

(f) DECISION MAKING PHASE

Based on the description of the problem and of possible losses identified in the assessment phase, trainees shall remember that the authority in charge may decide, where feasible and acceptable, to trigger an environmental response operation. Trainees shall also confirm that the goals and objectives of the intervention should be clearly defined and that saving lives, preserving the environment, and protecting property are the overall priorities.

The decision should be based on identifying the most critical issues. The more accurate the description of the accident and its circumstances, the more adequate the understanding of the critical issues. Decisions will be taken on issues such as:

- Is a response necessary?
- If the situation does warrant a response, what type of action needs to be taken?
- If the response action is possible due to prevailing conditions?
- Whether the response action has to be postponed as a result of a requirement for further resources?

Response priorities can then be established by taking into consideration the modifying conditions, the response capabilities at hand, and the reaction of the different interest groups. The priorities should address both preventative and corrective strategies. Only then should response activities and tactics be undertaken, taking into consideration three different forms of action:

- Actions on the vessel
- Actions on the cargo
- Actions on the released HNS

(g) IMPLEMENTATION PHASE

The implementation phase consists of putting into effect your response strategies and plans. It is at this stage trainees are reminded that field operations are carried out.

(h) FEEDBACK LOOP

At this point, lecture shall be made to trainees that:

(i) Any HNS incident is a dynamic situation. It requires an on-going reassessment of the entire situation to identify new elements that may require changing the original plans or stopping activities that is currently taking place.

(ii) This continuous reassessment of the situation and each of its elements brings the process back to the first stage, allowing the decision maker to permanently ensure a safe, effective, and efficient response.

(iii) This systematic approach is a dynamic method that constantly examines and reassesses the facts and the situation. It endeavours to anticipate changes to prevent any possible escalation of the situation.

(iv) The systematic approach requires decision makers to carefully consider all aspects of the operation, to develop and maintain effective communications with all response personnel, and to keep in mind any possible eventuality.

It should be emphasized to trainees that:
By using this approach, consideration of the following seven critical issues will ensure substantially positive decisions:

- The approach enables a broad spectrum of alternative actions to be sought.
- It allows all possible objectives to be considered
- The costs and risks can be carefully balanced as well as the impact, both the positive and the negative of each course of action.
- New information is constantly being sought to continually assess possible alternative courses of action.
- All information is considered, even if it does not corroborate the initial response strategy.
- All alternative courses of action are re-assessed prior to making a decision. This includes reassessing those courses of action that were initially discarded.
- It ensures that the plan of action is fulfilled

Benefits of this approach shall be explained further:
The main advantage of the systematic approach method is to unite the various decision making organizations around a common objective.
The method provides a series of actions for decision making, which will reduce the risks of conflict, related to the choice of priorities or varying points of view.
During an exercise or an incident, trainees are to understand that clear advantages can be obtained from a systematic approach to decision making:

- A better understanding of the key decisions and of the decision making process by all personnel
- The fact that the situation is continually reassessed means that the pertinent facts are not forgotten.
- This system helps to ensure that priorities are established.
- The method enables the most effective use of resources
- The method also increases safety for both the response teams and the public in general.

With these explanations, lecture shall proceed to response method as shown below:

(i) Response - General

When responding to accidents involving HNS, trainees should understand that some general first steps must often be taken, which are the same for many accidents, no matter what substances are involved, no matter what the circumstances are, or no matter where the incident occurs.
Trainees are reminded to never rush into a chemical incident, but try to use common sense and assess the situation carefully. Trainees are also reminded to plan the work on a worst possible case basis, to realize that each chemical is different, and that a new incident is not going to be the same as an earlier one. As there is nothing like a typical incident, trainees are asked to focus on the health and safety aspects as these are crucial to the successful outcome of the response to HNS incident.

To assist the trainees, following check list of a response shall be shown:

- Assess the situation
- Alert the relevant authorities and public
- Identify all substances involved
- Judge the risks
- Establish exclusion zones
- Activate response procedures
- Arrange restriction of access to beaches, etc

The above includes some general routines that should be applied, regardless of the size of the incident. Also, tell the trainees that the following important points in the response are to be remembered:

- Get a rapid general view of the situation and judge the need for the most urgent actions to be taken, such as medical care of victims, restriction of access, evacuation, reduction of leakages, etc.
- Warn passers-by, seafarers, public, etc. Inform appropriate authorities, agencies, and the media .Identify all involved chemicals. Note their mode of transport (bulk, container, palletized goods, etc.) as well as type of spill or discharge (escaped chemicals, lost packaged dangerous goods).
- Judge the risk for fire, explosion, leakage as well as health risks and risks for adjacent areas (utilize e.g. the IMDG Code, Material Safety Data Sheets, Chemical Safety Cards, Chemical Information Databases).
- Establish restriction areas (exclusion zones) and restrict access to these areas by guarding the entrances.
- Activate response procedures; investigation, assessment, response, decontamination, relieving and replacement of response personnel, materials, and equipment.
- Make appropriate arrangements such as restriction of access or restriction of right to use for beaches, swimming areas, fishing grounds, fresh water intakes, etc.
- Use monitoring devices continuously for fire, explosion, and health risks.
- Assess emission rates, volumes, properties, and reactivity for involved chemicals. Assess initial drift, spread, and evaporation (direction, distance, volumes). Calculate and forecast these behaviors by modelling programs and observations.
- Continuously monitor drift and spread in order to assess the risk, and continuously take appropriate actions based on the judgements.
- Take appropriate steps to stop or reduce damage to environment and property.
- Contact, as soon as possible, relevant environmental bodies, and plan for appropriate handling of the hazardous waste that the accident and the operation may yield.

(j) Response – Priorities

In planning a response, it is appropriate to prioritise actions no matter what substances are involved, what the circumstances are, or where the incident occurs. The priorities should include:

- Life saving search for casualties and rescue from the risk area
  - First aid and decontamination of casualties
  - Remove casualties to a safe area
- Stop, limit or combat discharge
  - Contain or collect
  - Neutralize
  - Wash overboard
  - Reduce damage
  - Fight fire
  - Cool products
  - Move products

(3) Response methods – vessels

(a) Responding to an Incident at Sea:

Trainees are asked to recognize that:

(i) Any ships carrying HNS, whether packaged or in bulk, is faced with the possibility of a spill, either contained on board or leaking out into the environment.

(ii) Such a spill could be life threatening, harmful to the environment, and ultimately lead to the loss of cargo and ship. For accidents at sea, there is “no place to run”, and usually, immediate outside assistance is not readily available. Every effort should be made on board to limit the release of spilled material from packages or cargo tanks to the environment. To achieve this, it is essential that ship personnel are aware of the hazards of the product and that a specific shipboard emergency action plan is in place.

(iii) Trainees are asked to remember that knowledge of the hazardous properties and characteristics of the substances can help to prevent accidents from occurring as well as aiding in the response to a spill. Confined space, due to the compartmentation and the presence of other cargo, may limit the establishment of specific work areas and zones used in shore-based response.

In determining the best course of action, response team needs to consider the following factors:

- Is it possible and safe to transfer at sea? (Note that there are guidance and recommendations available on ship to ship transfers)
- What is the extent of damage to the cargo and bunker tanks?
- Is the release continuing or complete?
- Is there progressive tank damage? Is the threat of further spillage greater at sea than in sheltered waters?
- Can some action be taken to control/reduce the spillage while towing it to the sheltered water? This might include transfer to another intact tank on board, or a limited ship-to-ship transfer.
- If there is a fire situation, can the fire be successfully fought at sea?
- Is there a safe area of sheltered water?
- Is the risk of moving the ship to sheltered waters acceptable?

(b) Response – On Board

When a spill on board creates toxic, corrosive, or flammable vapors, the vessel should be maneuvered, if conditions permit, so that vapors may move away from the accommodation and operations space.

Ventilation may not always be effective for removing gas clouds, particularly for those that are heavier than air gases that settle and accumulate in low spaces.

In the event of a vapor release, response action considered is maneuvering the vessel. Other considerations are to eliminate all ignition sources when dealing with flammable vapors and to consider using water mists to knock down any vapors. However, be aware of the possible reactions with water, and balance any consequences against the risks.

The usual response to liquid release on board is to wash the spillage away with large quantities of water. This can, however, cause severe marine pollution, especially in shallow or enclosed waters, environmentally sensitive area, or in proximity to intakes of drinking water.

Where possible, spillages should be collected with sorbent material and placed in receptacles for disposal ashore. Alternatively, they can be transferred to empty tanks using portable pumps.

(c) Release of Vapor and Liquid

In the event of a vapor release, trainees are urged to consider maneuvering the vessel. Other considerations are to eliminate all ignition sources when dealing with flammable vapors and to consider using water mists to knock down any vapors. However, trainees should be aware of the possible reactions with water and balance any consequences against the risks.

Trainees are urged to consider use of water for fire fighting, as fire fighting at sea presents unique problems, not the least the limited space to maneuver and the danger that the vessel may rest or even sink, especially with extra water being pumped onboard.

On the other hand there is a ready supply of water as a fire-fighting agent. Trainees are asked to consider the possibility of HNS cargo reacting violently to water. In this case only, trainees are clearly taught that dry inert powders should be used. Paradoxically, if these materials are not available, very large quantities of water may be effective as this can have a cooling effect, even if a chemical reaction is occurring.

Trainees should remember that the usual response to a liquid release on board is to wash the spillage away with large quantities of water. This can however, cause severe marine pollution, especially in shallow or enclosed waters, environmentally sensitive areas, or in proximity to water intakes. Where possible, spillages should be collected with sorbent material and placed in receptacles for disposal ashore. Alternatively, they can be transferred to empty tanks using portable pumps. In addition to having an emergency plan for dealing with spillages of hazardous materials, repair and patching equipment, specific to the type of containers and packages carried, should be available on board. Coordinated planning between the shipper, owner, and master will ensure a comprehensive and effective response to hazardous material incidents on board. It should be emphasized to trainees that trainees are to always remember that the consequences of the response actions must be balanced against the risks.

(d) Evaluation of Response

When assessing the options in marine related HNS incidents, trainees are explained that:

It is almost always preferable to prevent the chemical leaving the vessel by rendering the situation safe and stable. The evaluation of modes of action will be taken in the decision making phase of the operation, and will be the result from the comparison of the possible results and the consequences of the different actions including:

- The risk to human health and safety
- The damage to property (vessel, cargo)
- The damage to the environment
- The potential cost
- The legal implications

Trainees are asked to recognize that evaluation of intervention capabilities can be evaluated in following two ways:

- Can it be done?
- Do we have the expertise and the equipment to carry it out?

Trainees are asked to note that the question of resources should easily be answered if sufficient contingency and pre-planning has been carried out prior to the actual incident.

It is essential for trainees to understand the basic theory that once the decision has been made to undertake an intervention, then the response should be done by the specialists as quickly as possible to reduce a potentially evolving dangerous situation.
As the response operation unfolds, trainees are asked to assess the options available. Sometimes, however, it may be appropriate to do nothing except monitor the situation.

(e) Response Options

Trainees are asked to also remember various response options:

(i) Fire

In case of fire, the following response options can be considered for the vessel:

- Extinguish fire
- Reduce or contain fire
- Move vessel
- Scuttle vessel
- Monitor

(ii) Cargo

For cargos, trainees are asked to consider the following response options:

- Move cargo
- Stop spill / leakage
- Protect cargo
- Destroy cargo
- Neutralize cargo
- Activate biological degradation
- Monitor

(iii) Released HNS

The following response options can be considered for any released HNS:

- Containment
- Recovery
- Neutralize
- Destroy
- Chemical treatment
- Biological treatment
- Monitor

Further to the understanding about response options, trainees are asked to understand the method of evaluating response:

(f) Method of Evaluation of Incident

As soon as the alert is given the initial assessment phase should be undertaken in-order to obtain as much information as possible on the casualty:

- Its condition
- The name and details of the ship
- Contact with the owners
- The cargo onboard
- The nature of the casualty
- Is the crew still onboard; and
- The weather situation and forecast

An evaluation team should preferably be placed onboard. This will consist of an appropriate number of persons with experience in salvage techniques, chemical spill response, and engineering. This team should be equipped with protective clothing and be placed onboard by boat or helicopter. Their role is to ascertain the full status of the vessel in order to allow the incident management team to progress to the detailed assessment phase. Information that will be required is:

- Cargo status and disposition
- Equipment available onboard
- Carry out a full risk assessment of an intervention operation
- Measure gas levels
- Determine the operational status of machinery onboard
- Take any residual action that may be necessary top stabilize the situation

The full scope of the inspection will have been agreed in an initial briefing and checklists, if not, pre-prepared should be agreed at that time. (A similar approach will be used in non-marine spills to quickly analyze the magnitude and affect of a chemical spill).

Emergency responders boarding a ship will require:

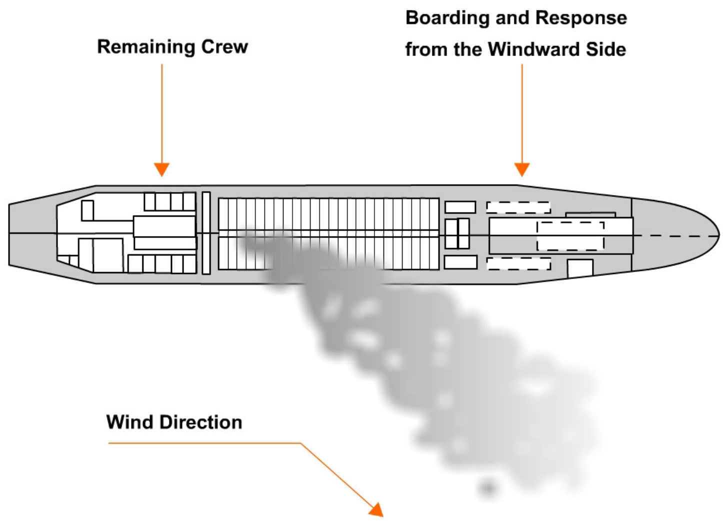
- Appropriate personal protection equipment
- Appropriate monitoring devices (e.g. for toxic or flammable environments)
- Appropriate safety equipment (e.g. for communication, decontamination and life saving)

- Appropriate response equipment (e.g. for fire fighting, cooling, recovery and neutralizing)

While response action is important, it is also important to plan safety measures that include:
- Safe return spaces with clean areas shall be prepared on board
- Response backup teams shall be readily available and appropriately equipped
- A safe number of extra air bottles or a clean air supply shall be readily available close to the responders

(g) A chemical accident on board a ship
During a chemical accident on board a ship, a hazardous smoke (visible or invisible) may be generated and carried by the wind. In such a case, the ship should be moved so that the smoke will move obliquely from the crew's accommodation as shown in the diagram below.

Boarding and accident response should also be performed from the opposite side of the smoke.



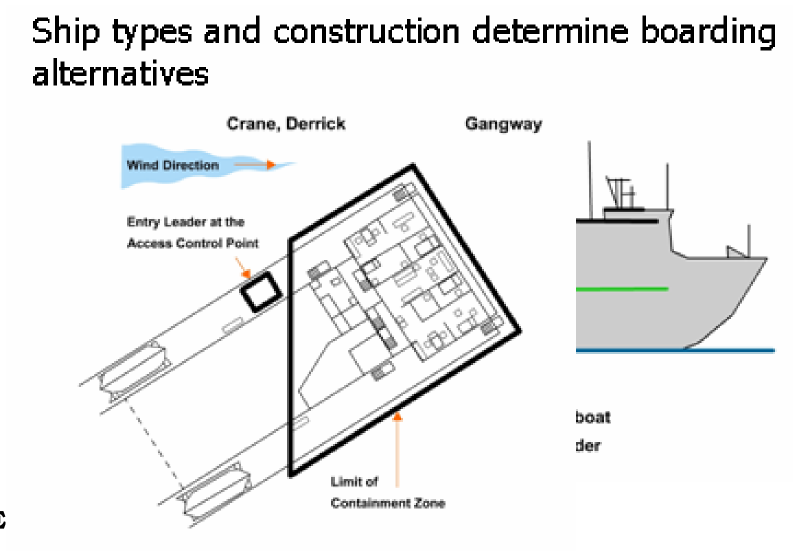
(i) How to board safely.
Theory on boarding and accident response from the opposite side of the hazardous cloud should be approached from upwind and on the opposite side of any gas cloud. The vessel may be able to help by maneuvering.
The advantages and disadvantages of different means of access shall be explained to trainees by using the following diagram:

	Advantages	Disadvantages
By response vessel	Good work platform Contains work equipment Well-known working environment	Slow Boarding is difficult Weather dependant
By helicopter	Rapid Easy to deploy responders independent of weather	Limited flight time Limited load capacity Special safety regulations

(ii) To board a disabled ship

The disabled ship's type and construction will determine the available practical alternatives for boarding. Depending on the ship's available crew and power supply, there are various points at which the ship can be boarded directly.

The alternative is to use a helicopter, but in a gas cloud situation, this could be very dangerous as the induced air is an explosive vapor and engine can over-speed, explode, or shut down.
To assist trainees to get clear image, following picture shall be shown:



(iii) E

Trainees are taught, by using the above picture, that once on board, the exclusion zone must be defined and access restricted except only to the emergency responders.

It should also be clearly explained that:
The responders must always wear the appropriate PPE.
Response actions always start from the limit of the exclusion zone where a decontamination station is placed. However, trainees are reminded to be aware that, on board ships, it is not always possible to follow these rules, especially when the wind speed is not enough to safely blow away hazardous gases.

The decontamination station may, on such occasions, be located on board a response vessel that is alongside or nearby, which can then also be used as the response base.

(iv) Evacuation

The decision to evacuate or shelter is very incident specific and the use of careful judgement is necessary.

Evacuation is a complex operation and is considered one of the most sweeping and aggressive response measures that are taken in the event of a chemical release. In this context, it is important to distinguish between mass evacuation of an entire area and the selective evacuation from parts of the area at risk.

It is highly likely that any decision, as to whether a large-scale public evacuation is necessary, will be taken by the emergency services in conjunction with other local authorities.

Trainees are to recognize, as a general guideline, that evacuation is a viable option when:

- There is time to relocate people.
- The discharge has already taken place, but personnel are sufficiently far downwind to permit evacuation.
- The release is expected to be over a prolonged period of time.
- A fire has also occurred, which may get out of control.
- People are not yet in the direct path of the cloud and are not threatened by a future wind shift.

(v) Aspects of in-place sheltering

An alternative to evacuation is to seek shelter indoors. This could be a viable option to protect personnel from the effects of toxic gas or vapor discharges into the atmosphere. The potential for exposure of people inside a building to a chemical release is a function of:

- The construction and air-tightness of the building
- The size and nature of the gas cloud
- The rate of entry into the building

(4) Response methods – HNS releases

(a) Different Categories of Response

Trainees are told about the different categories of response based on the physical characteristics of the substances involved.
The three response categories available are:

- Forecasting
- Monitoring
- Combating

Trainees are asked to recall that the behavior of HNS when released can be classified into 12 different subgroups.

This classification system can be used to identify appropriate forecasting and response methods.

(b) Response – Simulation Models

(i) Simulation Models

At this stage, trainees are told that:

① Various computer models exist by which an operator, after some education and training, can elaborate a forecast of the spill's future fate. However, it should be emphasized to trainees that the forecast's reliability depends fully on:

- The model's construction and validity
- How correct is all input data
- How professionally the model is run

② Many computer models exhibit astounding limitations. Trainees should recognize that it is usual that forecasting models for gas clouds are not able to consider the structure of the ground or water surface (e.g. flat country, forest, calm water, rough sea). Trainees should also note that some models cannot even consider mountains as obstacles for the cloud drift. Some drift models are not able to account for the chemical's physical properties (e.g. water solubility), which gives a misleading or erroneous picture of their drift.

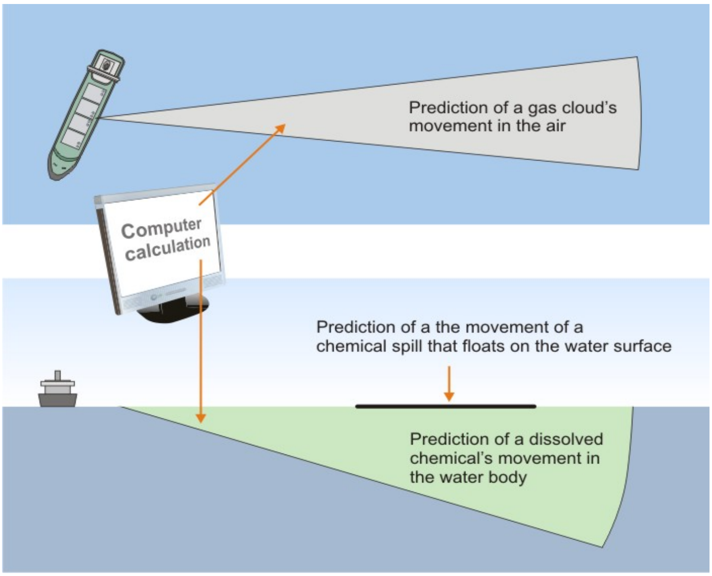
Trainees shall be told that, for table-top training and exercise, these simulation models are useful and that they should use these models with the full knowledge about the inherent problem as explained hereinabove.

(ii) Modeling systems

There exist hundreds of highly sophisticated forecasting modeling systems for prediction of the drift and spread of chemical spills.

Trainees should recognize that many of them are highly theoretical and not so easy to use. It is a difficult task to find models that might be usable in an operational organization, suitable for the situation.

For trainees' guidance, sample model system shall be demonstrated as follows:



(c) Response – Forecasting

Trainees are to be told that forecasting can be sub-divided into following three sections:

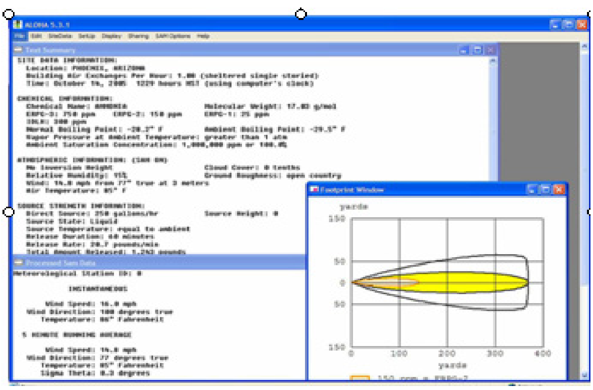
- F1 – Forecasting the spread in air.
- F2 – Forecasting the spread on water surface.
- F3 – Forecasting the spread in body of water.

During the explanation of these three categories, warning shall be given to trainees that forecasting HNS that sinks is a separate problem to consider

(i) Method F1 - Forecasting the spread in air

Method F1 is applicable to gases and to any liquid, volatile enough to produce vapor cloud. This includes all groups with G and E component in their property groups (i.e., G, GD. E, ED, FE, FED, DE). Computer models are used to predict the movement of gases under different scenarios.

For trainees' guidance, image below is shown:



Forecasting the spreading of a gas cloud could be too lengthy a process to be practical during emergencies, even with the assistance of computerized air dispersion models. Running several plausible local scenarios in advance has been shown to be the best way to ensure a rapid implementation of adequate preventive measures.

Forecasting the spread of gas clouds in air can be estimated for groups G and GD by means with the table below. Computerized models are also available from commercial sources. Estimates should never be relied on as an alternative to monitoring, as the combination of substance properties with specific atmospheric conditions may result in peculiar behavior patterns.

The following table can also be used for flammable and toxic liquid HNS in groups F, ED, FE, FED and DE. The spread of evaporated gas from spills can be estimated by multiplying the values in table 5.C.4 by the ratio VP / 100, where VP is the liquid's vapor pressure in kilopascals (kappa) at ambient temperature.

Quantity released	Health Risk		Fire / Explosion Risk
	Ammonia, vinyl chloride, chlorine	Methane (LNG), propane, butane, ethylene, butylenes-butadiene	Ammonia, vinyl chloride, ethane (LNG), propane, butane, ethylene, butylenes-butadiene
tonnes	meters / nautical miles downwind	meters / nautical miles downwind	meters / nautical miles downwind
0.1	1,000 / 0.62	200 / 0.12	200 / 0.12
1	2,000 / 1.24	400 / 0.25	400 / 0.25
10	5,000 / 3.11	1,000 / 0.62	1,000 / 0.62
100	10,000 / 6.21	2,000 / 1.24	2,000 / 1.24
1,000	20,000 / 12.43	4,000 / 2.49	4,000 / 2.49

Estimated hazardous exclusion zones for different quantities of HNS spilled (Source: HELCOM)

It is often difficult to find time to calculate the spread of instantaneously formed gas clouds in accidents, even if computerized models are available. Sometimes, it is impossible to calculate and predict a gas cloud distribution, even with the aid of very sophisticated modeling tools. Certain atmospheric conditions and/or substance properties may result in peculiar gas behavior that makes forecasting difficult.

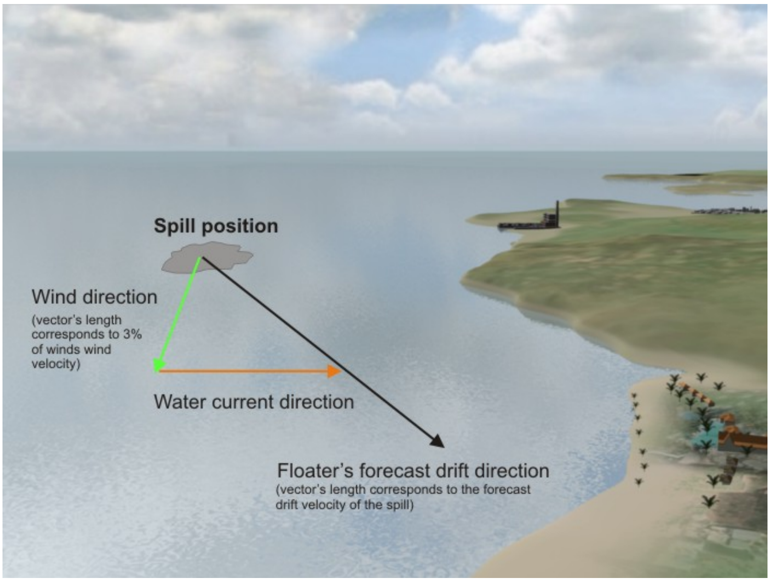
(ii) Method F2 – Forecasting the spread on water surface

This method is applicable for groups FE, FED, F and FD (all groups with F).

It is complicated to forecast the behavior of a chemical spill that floats on the water surface. The spill's fate is influenced by the following processes:

- The drift on the surface
- The spread on the surface
- Evaporation
- Dissolution
- Chemical reactions and other conversion processes

Simple forecasting models have been developed for spills of chemicals that float on the water surface. For the sake of simplicity, the spills are supposed neither evaporate nor dissolve. This principle can also be used for manual calculations and is briefly explained by using the diagram shown below.



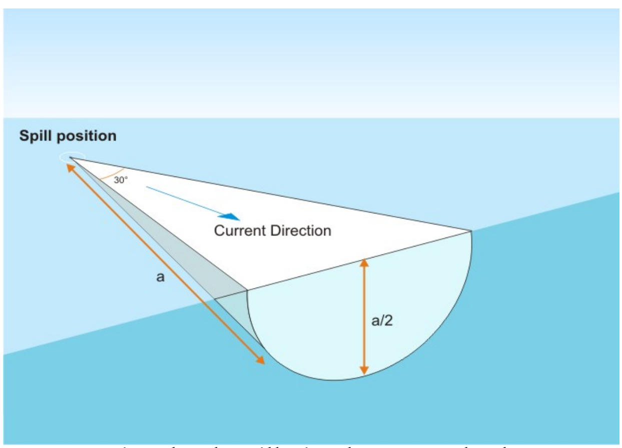
Calculation of drift using vector diagram

The calculation of the spread or drift can be done by vector diagram using the same principle as for oil spills. However, most HNS spills belonging to these groups, except for F, will disappear by evaporation and/or dissolution within approximately 10 hours. Under opposing current and wind conditions, it is critical to consider the relative forces of wind and current, since these will determine the position of the spill. In certain cases, a stricken or response vessel, which had an original upwind position may end up downwind. Various laboratory models have been developed, but very few have been validated against real spills under operational conditions at sea.

(iii) Method F3 – Forecasting the spread in water body

The spread can be estimated with the use of the diagram shown above and the diagram shown below, if the current of the water body is slow and even. This method cannot be used for stagnant (or almost stagnant) water for HNS where the density differs too much from that of water or for very turbulent water.

The method described below is applicable to the Group D only.



Dissolved spills in the water body

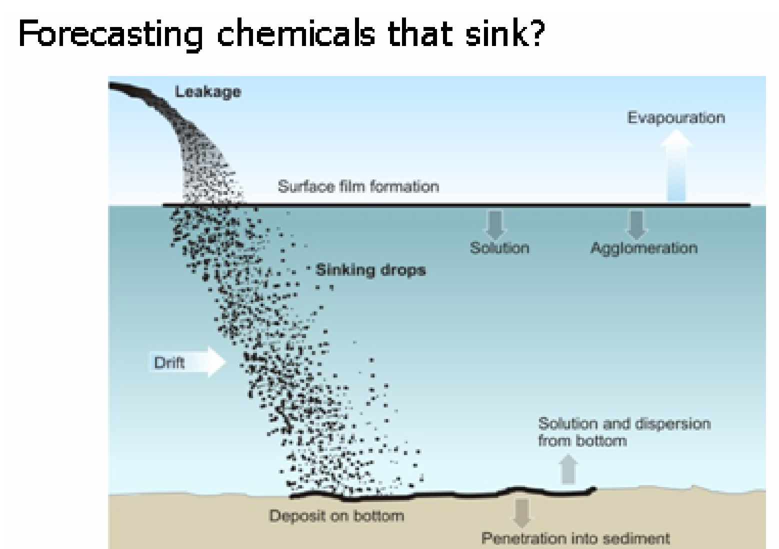
	Concentration $1\ g/m^3$		Concentration $1\ mg/m^3$	
Release tons	meters	nautical miles	meters	nautical miles
1	500	0.3	5,000	3
10	1,000	0.5	10,000	5
100	2,000	1	20,000	11
1,000	4,000	2	40,000	22

Quantity released	Health Risk		Fire / Explosion Risk
	Ammonia, vinyl chloride, chlorine	Methane (LNG), propane, butane, ethylene, butylene-butadiene	Ammonia, vinyl chloride, ethane (LNG), propane, butane, ethylene, butylene-butadiene
tons	meters / nautical miles downwind	meters / nautical miles downwind	meters / nautical miles downwind
0.1	1,000 / 0.62	200 / 0.12	200 / 0.12
1	2,000 / 1.24	400 / 0.25	400 / 0.25
10	5,000 / 3.11	1,000 / 0.62	1,000 / 0.62
100	10,000 / 6.21	2,000 / 1.24	2,000 / 1.24
1,000	20,000 / 12.43	4,000 / 2.49	4,000 / 2.49

Above tables predicting the spread of the gases are produced and can be used to provide estimates of spread in an emergency. It must be emphasized that these estimates are no substitute for monitoring as the models cannot take into account the specific atmospheric and physical conditions at the time of the incident.

Method F2 is used to forecast the spread on the water surface of floating HNS – group F. To assist trainees in getting a clear image of this method, following picture shall be shown. A simple vector diagram is used to calculate the effects of wind and current on a spill. This simple model does not take factors such as evaporation or dissolution into account, but assumes that chemicals belonging to sub-groups, FE, FD and FED will disappear within approx. 10 hours.

Method F3 is used to forecast the spread of group D HNS in the body of water. It is a simple geometric model and it depends on knowing the direction of the current. It cannot be used in stagnant water. To assist the trainees in getting a clear image of this method, following diagram shall be shown:



A sinking chemical’s behavior (Source: HELCOM)

Following table shall be shown to explain result of released HNS and its consequence (Spread)

	Concentration 1 g/m³		Concentration 1 mg/m³	
Release tons	meters	nautical miles	meters	nautical miles
1	500	0.3	5,000	3
10	1,000	0.5	10,000	5
100	2,000	1	20,000	11
1,000	4,000	2	40,000	22

From the diagram shown above, trainees should understand that:
The chemical's persistence on the bottom is, among other factors, dependant on its solubility. If the solubility is, for example 1% or 0.001%, it must obviously have a pronounced effect on its persistence on the seabed. Also, the existence of water currents, close to the bottom, influences the duration. The chemical may also penetrate into the bottom sediment. The degree of penetration also depends on the sediment's properties and structure.

Trainees should also recognize that:
It is very difficult to calculate the fate of a product that sinks to the bottom. The reason for this is the number of parameters that influence the process.
The chemical's density affects the velocity by which the chemical sinks to the bottom. Its surface tension and solubility (even if very low) influence its behavior on the water surface, as well as its dispersing and spread in the water body while it's sinking towards the seabed. The water current, together with the water depth and the chemical's density, have a decisive influence on the distance the chemical will move in the current's direction before it touches the bottom.

(d) Monitoring

Monitoring can be sub-divided into two sections:

- M1 – Monitoring the spread in air
- M2 – Monitoring the spread in water

However, before explaining these methods, trainees are urged to consider the purpose of monitoring as follows:

(i) Purpose of monitoring

When HNS is spilled, it is crucial to monitor the air for concentrations of hazardous substances.
The aim of gas monitoring is to:

- Assess both toxic and fire/explosion hazards
- Map the area where unprotected personnel should be evacuated
- Judge the appropriate level of personal protection for response personnel.

On some occasions, the instrument read-out values can be used directly for identifying risk areas. In other circumstances, the instruments can be used to check risk areas that are already assessed or defined according to some calculation method or forecasting model.

The most difficult measuring task on a site of a chemical accident is to make rapid identification of unknown airborne substances by means of portable instruments. Such work requires sophisticated instruments and trained expertise, often not available when the first risk assessment is made. Proper use of portable gas monitoring instruments generally requires the exact knowledge of the gas's identity, but new detectors are also able to identify threat levels rather than individual substances.

(ii) Monitoring Gas – General

When HNS is spilled, it is crucial to monitor the air for concentrations of hazardous substances.
Trainees are urged to recognize that the aim of gas monitoring is to:

- Assess both toxic and fire/explosion hazards.
- Map the area where unprotected personnel should be evacuated.
- Judge the appropriate level of body protection for response personnel.

On some occasions, the read-out values can be used directly for designing risk areas. In other circumstances, the instruments shall be used to check risk areas that are already assessed or defined according to some calculation method or forecasting model.

It should be emphasized to trainees that the most difficult measuring task on a site of a chemical accident is to make rapid identification of unknown airborne substances by means of portable instruments as such work requires sophisticated instruments and trained expertise that are often not available when the first risk assessment is made. Proper use of portable gas monitoring instruments generally requires the exact knowledge of the gas's identity, but new detectors are able to identify threat levels rather than individual substances.
For trainees' guidance, following picture of sample models of hand-held, portable, transportable or mobile gas detection, and monitoring instruments shall be shown.

Trainees should recognize that there are hundreds of manufacturers offering thousands of different models of hand-held, portable, transportable or mobile gas detection, and monitoring instruments that can be used during chemical accidents for risk assessment and evaluation.

It is a rapidly developing market and instructor shall tell trainees that it is difficult to give good advice on particular brands and models of instruments. However, trainees are asked to note that many instruments require calibration before using. Therefore, trainees should note further that it is crucial to follow the instructions carefully in this respect.

(iii) Method M1. Monitoring the Spread in Air

The main objectives of trace gas monitoring, in case of a chemical accident, are to find dangerous locations of a toxic gas contaminated area and assess the outer limits where it is reasonably safe for unprotected personnel. This type of instruments must be able to detect very low concentrations of hazardous gases (ppm-levels).

Types of hand-held or mobile trace gas detection and monitoring devices are:

- Gas detection tubes
- IR trace gas detectors
- Semiconductor instruments
- Mobile mass spectrometers

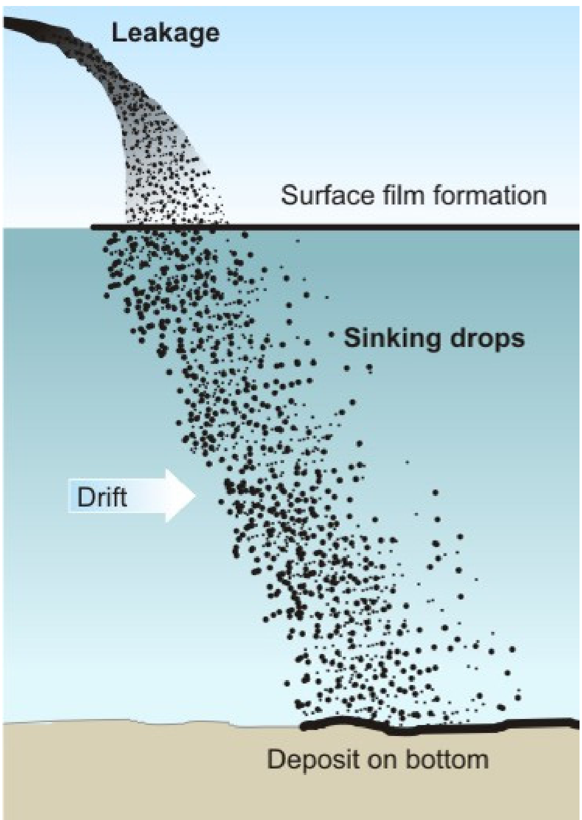
Gas detector tubes, semiconductor instruments, and some photo-ionization instruments are relatively simple hand-held devices. Note that these instruments cannot be used for accurate readings. The results are approximate. The monitoring should perform according to the "Performance" section below.

Portable gas chromatographs and mobile mass spectrometers are examples of more sophisticated instruments. These instruments are miniaturized and automatized laboratory equipments. They generally give rather accurate readings, but require skilled personnel to handle it.

(iv) Method M2. Monitoring the Spread in Air

As shown below, different methods are used to monitor spills on water, depending on whether the HNS is:

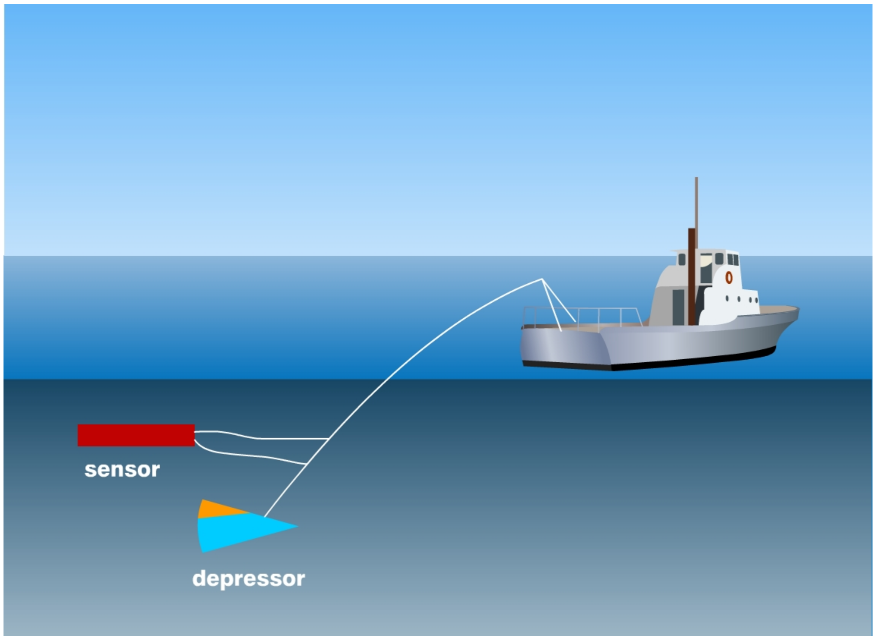
- In the water column
- On the surface
- On the seabed



Shallow water samples can be collected by hand and either be analyzed on site using portable equipment or be sent to laboratories for analysis.

Trainees should recognize that "at sea monitoring systems" have been developed, consisting of probes that contain analytical equipment.

The probe is towed behind the ship and automatically analyzes the samples. A picture shall be shown to trainees so that they may have a clear image.



① **Aerial reconnaissance**
It may be possible for HNS surface spills to be detected and monitored by various types of airborne remote sensing instruments, depending on the substances' properties.

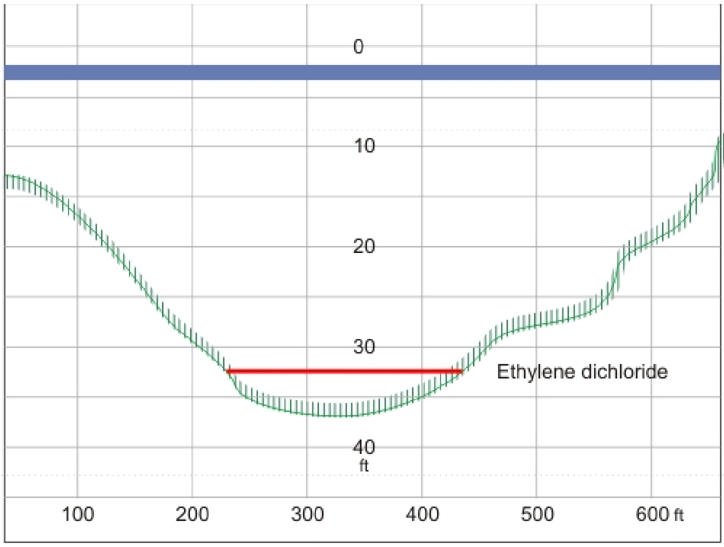
Remote sensors work by detecting properties of the sea surface: color, reflectance, temperature, or roughness. Pollutants can be detected on the water surface when it modifies one or more of these properties. Cameras relying on visible light are widely used, and may be supplemented by airborne sensors which detect oil outside the visible spectrum and are thus able to provide additional information about the substance. The most commonly employed combinations of sensors include Side-Looking Airborne Radar (SLAR) and downward-looking thermal infra-red (IR) and ultra-violet (UV) detectors or imaging systems. All sensors must be calibrated and require highly trained personnel to operate them and interpret the results.

② **Satellite imagery**
Satellite-based remote sensing systems have had some success in detecting oil spills and should also be able to detect HNS spills on water.

The sensors on board are either optical, detecting in the visible and near infra red regions of the spectrum, or use radar. Optical observation of spilt HNS by satellite requires clear skies, thereby severely limiting the usefulness of such systems. SAR (Synthetic Aperture Radar) is not restricted by the presence of cloud and is a more useful tool. However, with radar imagery, it is often difficult to be certain that an anomalous feature on a satellite image is caused by the presence of HNS. Consequently, radar imagery from SAR requires expert interpretation by suitably trained personnel to avoid other features being mistaken for HNS spills. To date, operational use has not been possible because of the time intervals between satellite overpasses and the time necessary to process the data. However, such imagery can be used later to complement aerial observations and provide a wider picture of the extent of pollution.

(v) Monitoring sunken substances on the seabed

From the diagram shown below, trainees should understand Echo-sounders locate pools on the sea-bed.



HNS that sink when spilled in water will tend to scatter and form pools on the sea bed. They are difficult to monitor, but they are a potential hazard to the environment and commercial interests, therefore, they must be located and the risk must be assessed.

The phase-boundary surface of the chemical pool can be detected by echo-sounding equipment attached to the bottom of a boat. The diagram shows an echo-sounder recording of a pool of 1,300 cubic meters of sunken ethylene dicholoride at a depth of 12 meters.

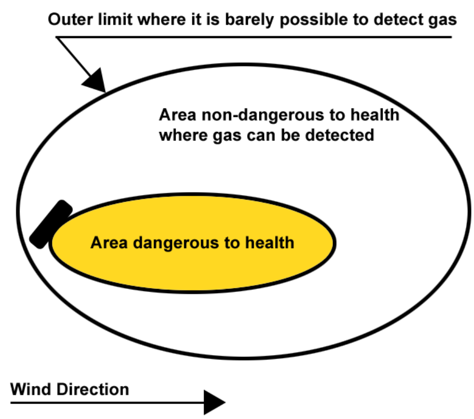
Divers or ROVs can also be used to monitor sunken spills.

(vi) Monitoring methods - miscellaneous

Occasionally, unusual substances such as radioactive or infectious substances need to be monitored. Only specialist personnel should be engaged for this type of work along with dogs – canine olfaction. The principle of canine olfaction is the ability the trained sniffer dogs have in detecting trace gases at concentrations lower than those that can be detected by monitoring instruments.

(e) Performance

Monitoring should be performed by personnel, equipped with breathing apparatus, trained in monitoring instruments and are familiar with their functioning. The measurements should be carried out from outside (gas-free area) moving inward from the dangerous area. The position, where the first recording is noticed, is on the fringe of the evacuation area. By doing further monitoring around the place of the accident, a map of the evacuation area can be drawn.

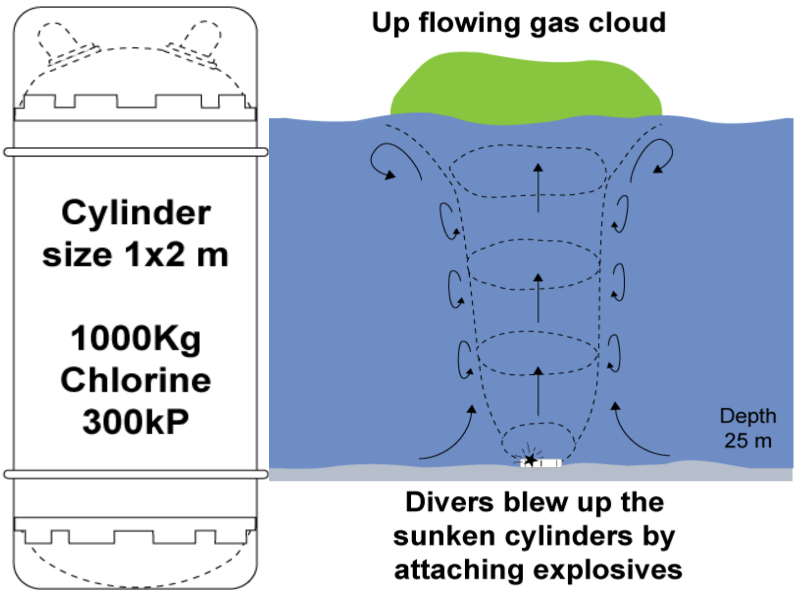


The outer limit of measurable concentrations and the area of gas concentrations that are dangerous to health (Source: HELCOM). However, it should be emphasized that a gas cloud, in the reality, often doesn't give uniform and smooth curves. The boundary line, however, should be leveled along the outermost area of detectable gas concentrations.

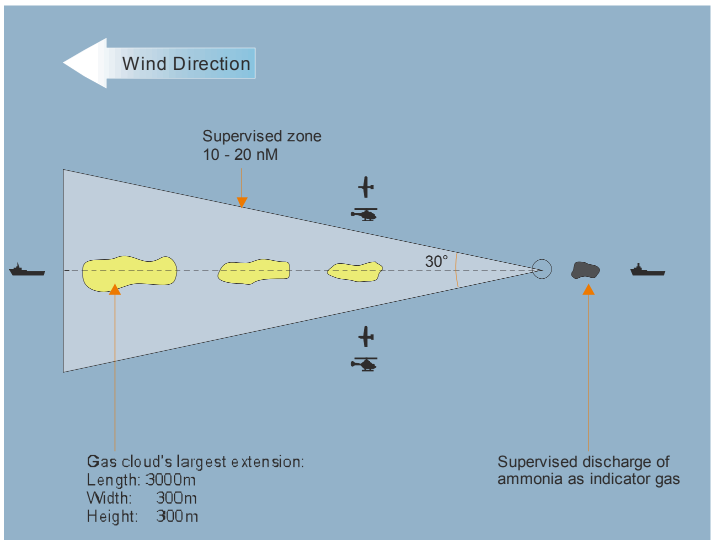
Gas clouds often move irregularly due to air turbulence and other environmental conditions. If no monitoring device is available, a safe evacuation area must be established around the scene of the accident, initially with a great margin of safety, until more information can support a change of the judgment.

As an example of this method, an accident from the coast of the Netherlands is shown below. This method involves seeding the hazardous gas cloud with ammonia to make it more visible to monitoring aircraft, helicopters, and vessels. It has applications for monitoring large gas clouds at a safe distance from populated areas. Its limitations are that it requires very careful planning, a safe distance from populated areas, and strict warnings to seafarers and the local population.

Sunken steel cylinders containing chlorine were breached by explosives and the gas escaped through the water column, into the air. The rising chlorine gas cloud was strictly supervised by fully protected personnel. An exclusion zone was established and patrolled by ships, helicopters, and aircraft. Ammonia gas was released upwind as an indicator gas that seeded the chlorine gas cloud and made it clearly visible as a white smoke over a large area.



Showing chlorine cylinders blown up by explosives (Source: HELCOM)



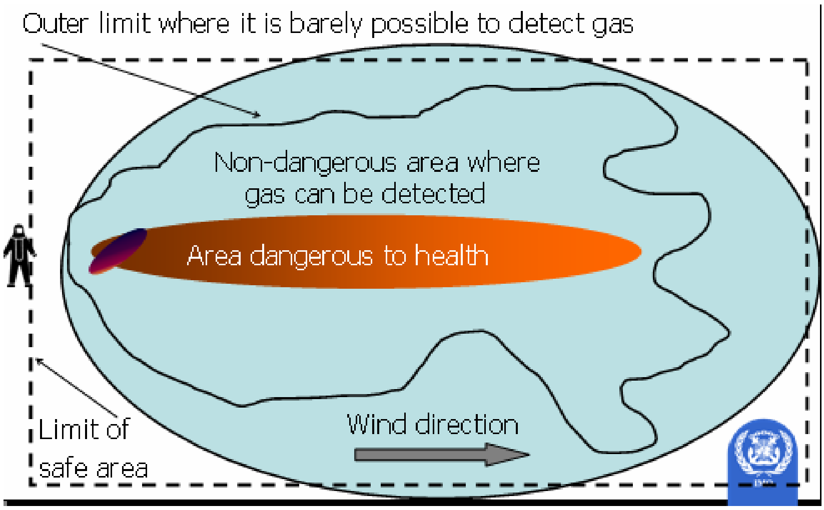
Showing exclusion zone during release (Source: HELCOM)

(f) Oxygen – deficient air monitoring

The oxygen level in confined spaces, such as cargo holds or tanks, can decrease because of work being done, such as welding or cutting operations. It can also be decreased by oxygen-consuming reactions (metal rusting or cargo oxidation) or through microbial action (fermentation). The oxygen concentration is also decreased if air is displaced by another gas, such as inert gas, carbon dioxide, nitrogen or hydrocarbons. If such a gas causes total displacement of oxygen, an unprotected person will rapidly become unconscious and die. Oxygen-deficient means that there is not enough oxygen in the space to safely breathe. Normal fresh air contains 20.8 percent oxygen compared to less than 19.5 percent in an oxygen-deficient atmosphere. Air that has less than 10 percent oxygen can rapidly cause unconsciousness, and levels below 8 percent can quickly cause death.

The objective of oxygen-deficient air monitoring instruments is to assess the outer limits of an oxygen deficient area where it is reasonably safe for unprotected personnel (Oxygen concentration above 19.5%). Any atmosphere with less than 19.5% oxygen should not be entered without an approved self-contained breathing apparatus (SCBA).

Examples of monitoring devices are chemical cell oxygen meters. The measurements should be carried out from outside (gas-free area) inward, from the dangerous area. The position, where the first recording is noticed, is the fringe of the exclusion zone. By doing further monitoring around the scene of the accident, a map of the exclusion zone can be drawn.



Gas clouds often move irregularly due to the air turbulence and other environmental conditions. As shown below, if no monitoring device is available, a safe exclusion zone must be established around the scene of the accident, initially with a great margin of safety until more information can support a change in judgement.

Response team should consider establishing automatic sensors, and wind speed and direction meters in key locations to alert team to changes in circumstances or weather. Trainees should note that there may be confined spaces, which may be oxygen deficient This is a special case of gas monitoring for the absence of a gas, oxygen in this case.

Oxygen deficiency is associated with confined spaces such as cargo holds or tanks. It can be caused by:

- Oxygen-consuming reactions such as rusting or fermentation
- Oxygen depletion during activities such as welding or brazing
- Oxygen displacement by inert gases such as carbon dioxide or nitrogen

Trainees should be told that instruments such as chemical cell oxygen meters are used to detect oxygen levels. Also, trainees are told that any area with less than 19.5% oxygen should not be entered unless wearing an approved self-contained breathing apparatus (SCBA).

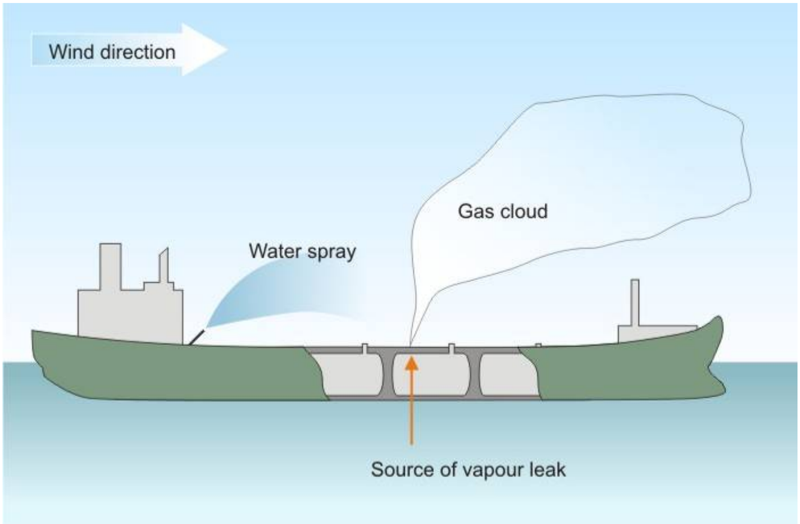
(g) Response – Combating

Trainees are to be explained that combating can be sub-divided into four sections:

- C1 – Combating water soluble gas clouds
- C2 – Combating spills that float on water
- C3 – Combating spills that dissolve in water
- C4 – Combating spills that sink to the bottom

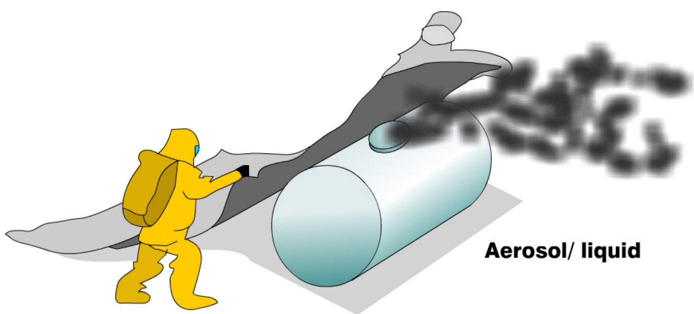
(i) Combating – C1 Combating gas clouds by re-condensing into the liquid state

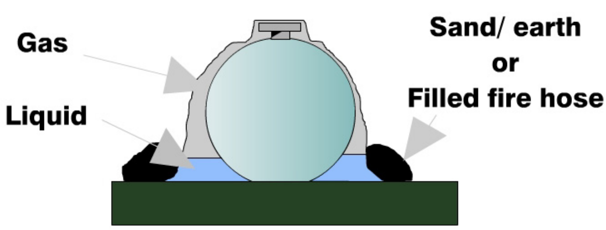
This method can be used with any water soluble gases, such as ammonia and sulphur dioxide. It can also be used against non-water soluble gases to reduce the risk of fire and explosion by cooling down hot surfaces and suppressing sparks and flames.



This method re-condenses leaking gases by covering the container with a flat tarpaulin or collecting the jet stream with a tarpaulin made as a funnel or a cone.

For trainees' guidance, a diagram below shall be shown:



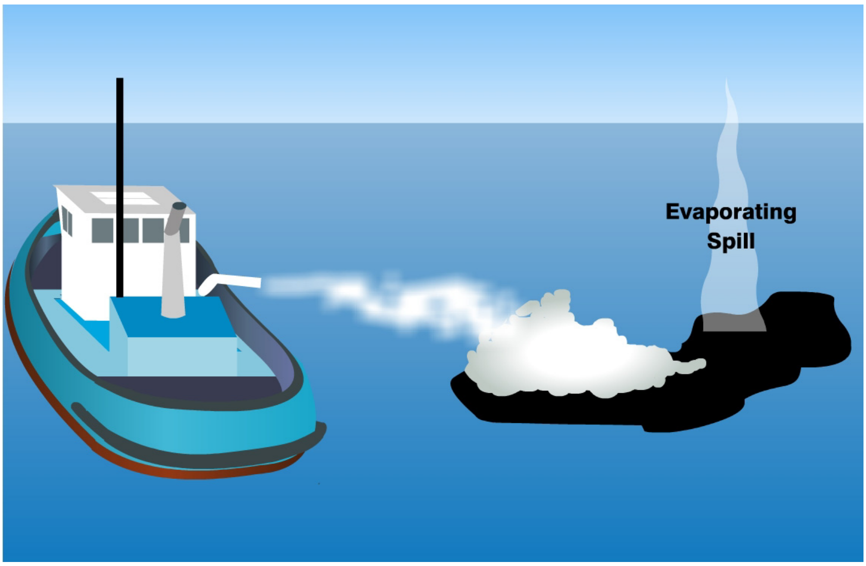


It can be applied mainly to ammonia, sulphur dioxide, and chlorine that are released to form aerosol clouds, which are extremely dangerous for both health and environment. The method of re-condensing is based on the fact that the aerosol droplets in the clouds, under certain conditions, can be merged into the liquid state. Released gases from tank containers and similar reservoirs can be re-condensed by covering them with a tarpaulin. A release, giving rise to a jet stream within easy reach, can be re-condensed by a funnel or a cone with appropriate anchoring close to the point of release. The jet stream is led into the cone after which the re-condensed liquid is collected in a pool.

The limitations of this method are that it is only applicable to small or limited gas releases.

(ii) Combating – C2

Foam reduces risk of explosion



Trainees should recognize that spilled HNS that floats on the water surface will spread and form a large contact surface to the air. Depending on its vapor pressure, it may evaporate rapidly and produce high gas concentration. When responding to floating chemical spills on the water surface, it is therefore especially important to monitor air concentrations in order to assess fire and explosion risks as well as danger to health.

Group F substances, which evaporate quickly, should be treated with foam to reduce vaporization and reduce the risk of fire and explosion

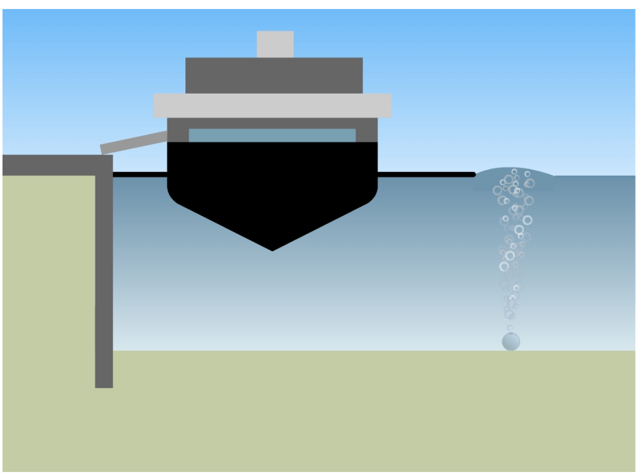
① **Sorbents thicken and aid recovery**
Trainees are told that those that do not evaporate easily can be treated with sorbents and some other types of treatment or gelling agents that make the spill thicker and easier to collect. Use of treating agents on a chemical spill floating on the water surface can restrict its spread and facilitate containment and recovery. There are special sorbents for chemical spills, but conventional oil spill sorbents can sometimes also be used. Other types of treating agents are so called gelling agents. An example of a gelling agent is a substance that is mixed with the chemical as a “thickener.” However, special gelling agents are needed against floating chemical spills on the water surface. Some gelling

agents, specially designed for chemical spills on the water surface, have been tested and are now available on the market.

Some sorbents, shaped like small cubes or pellets, made of foam plastic are used by special systems that can spray (deliver) the sorbents onto the affected area (deliver) and then recover the sorbents and product. A simple re-generator then removes the sorbet substance and makes it ready for redistribution by the spraying device.

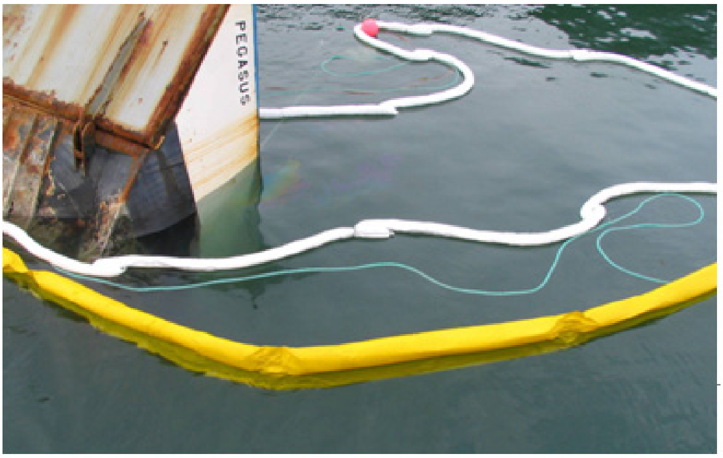
② Suppressing vapours from floating spills
This method involves the application of foam using specialized delivery devices. It is applicable for spills of substances that float on the water surface and give off toxic or flammable vapors. Confined chemical spills, which do not form large slicks on the water surface, can be covered with various types of foam, which are normally used for fire-fighting applications. The foam cover can temporarily suppress vapor formation from the spill and thus reduce the risk of formation of noxious or flammable gas concentrations.

③ Using bubble barriers to contain spills that float on the surface or disperse in the water body
Bubble barriers can be used to contain spills. This method involves the application of bubble screens (also called bubble barriers, air curtains or pneumatic booms) around floating or dispersing spills by pumping compressed air into a perforated hose, which is placed on the bottom around the incident site. It has applications in shallow water (bays, harbours) for spills floating on the surface or dispersed into the water column. To assist the trainees to get a clear image, following picture shall be shown:



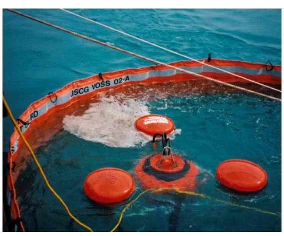
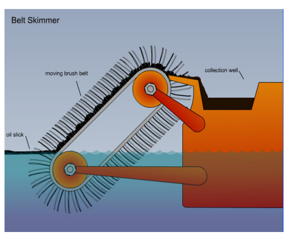
④ **Oil spill booms contain spill prior to recovery**
Some spills can be contained by booms (for a short time only, due to chemicals' generally low viscosity), before being picked up by recovery equipment. During all such response work, special attention must be given to risks of health, fire, and explosion. On some occasions, these risks can be reduced by covering the spill with foam, as pointed out before.

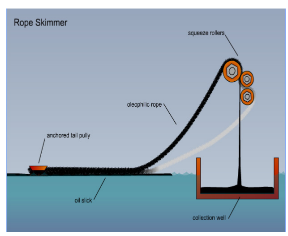
To assist the trainees to get a clear image, following picture shall be shown:



⑤ **Recovery of floating spills using various types of skimmers**
This method consists of applying certain types of skimmers on the floating spill. It can be applied to spills of substances that float on the water surface and do not evaporate or dissolve significantly.

- Vortex systems can be used for recovery of chemicals on the water surface in the same way as light petroleum products. The chemicals should not be pre-treated with response agents when applying vortex recovery systems.
- Belt skimmers have turned out to be usable for recovery of certain chemicals, e.g. octanol and dioctyl phthalate. The process may sometimes be facilitated by pre-treatment with e.g. sorbents.
- Sorbent rope systems can sometimes be used to pick up chemical spills from the water surface. When using these systems, the chemical should not be pre-treated with any response agents.
- To assist the trainees to get a clear image, sample pictures are shown below:



⑥ **Recovery of floating spills using polypropylene sorbent plates or pillows**
As shown in the above picture, this method involves distributing sorbents over the floating spill on the water surface and recovering of the sorbent-spill mixture. Sorbents can sometimes be used for chemical spills on inland or coastal water surfaces. Normally, they

are useless in the high sea. There are a lot of different sorbents designed for chemical spills, available on the market. These agents have various appearances and compositions. Most of them are aimed and tested for spills on land but a few are suitable for absorbing spills from the water surface. It currently appears that the most efficient products are made of polypropylene. This polymer is available as foam plastic plates or felt-like pieces that can be easily distributed over the spill. Alternatively powdered sorbents are packed in pillows to make them easier to distribute.

⑦ **Adding treatments or neutralising agents**

(iii) Combating – C3

A spilled chemical that dissolves in water will form a growing “cloud” in the body of water. It is important to monitor the concentration gradients in the cloud to track the chemicals’ spread and drift in order to judge the hazards for the environment, fishery, recreational areas, fresh water intakes, etc.

HNS spills that dissolve in shallow water may sometimes be mixed in with various treating agents in order to reduce deleterious effects on humans and the environment. Examples of such treating agents are:

- Activated carbon

- Oxidizing agents
- Reduction agents
- Complexing agents
- Ion exchangers, and
- Floculating agents

Flocculation agents, gelling agents, activated carbon, complexing agents, and ion exchangers can also be used for treatment of mixtures of chemicals and water that have been recovered from a spill site and pumped into barges or other intermediate storing containers.

Activated carbon is often used in this way and is a well-known efficient agent for absorption of many different organic chemicals.
Releases of acids and bases in streams, creeks, and rivers have, on some occasions, turned out to have devastating ecological effects, even if the volumes are relatively small. The explanation to the serious impact is that such a spill, if it is momentary or occurs in a short time, forms a relatively concentrated ”cloud” that moves downstream and damages or destroys the life in the water all along its course. Spills of acids and bases in confined water areas should, therefore, be quickly located, mapped, and then treated with neutralizing agents.

The following neutralizing agents have turned out to be suitable choices:
- For spills of acids - sodium acid carbonate (sodium bicarbonate, nahco3)
- For spills of bases - sodium dihydrogen phosphate (monosodium phosphate, nah2po4)

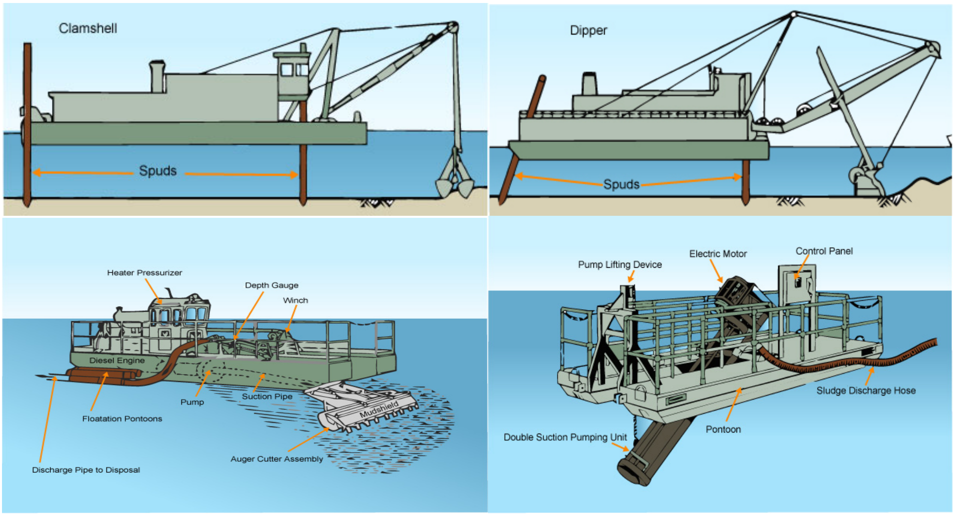
(iv) C4. Combating chemical spills that sink to the bottom

Discharges of chemicals that sink to the bottom can heavily contaminate the impacted bottom sediments. Careful planning should be done on such occasions, for the decontamination work. A sophisticated system may be needed to take care of and clean the contaminated sediments.
Sunken spills on the bottom can be recovered by different kinds of dredging techniques, and there are various types of suitable dredges. Different dredges are more or less suitable for removal of chemicals from the bottom. There are three main types of dredges of which airlift pneumatic dredges have been used successfully in well-documented accidents.

<table>
<tr><td>Type</td><td colspan="2">Examples</td></tr>
<tr><td>Mechanical dredges</td><td colspan="2">Bucket ladder, clamshell, dipper</td></tr>
<tr><td rowspan="3">Hydraulic dredges</td><td>Plain section</td><td>Hopper</td></tr>
<tr><td>Dustpan</td><td>Mudcat</td></tr>
<tr><td>Cutterhead</td><td>PIJESP
(Peripheral Injector Jet Suction Pump)</td></tr>
<tr><td>Pneumatic dredges</td><td colspan="2">Pneuma, airlift</td></tr>
</table>

Appropriate safety precautions should always be taken in all dredging operations of sunken hazardous materials. Divers surveying the operation should be aware of the risk of chemicals as well as mechanical hazards. Personnel working on the surface must wear relevant personal protective gear.

Following pictures shall be shown to trainees to get an image of this method:



(h) Summary of Response Methods

Following table, which summarizes the response methods against the classification groups, shall be shown to trainees and explained:
The following table summarizes the response methods against the classification groups.

The table is applicable for methods against HNS releases only								Solid Subst			Solid Subst		
								F	F D		D	S D	S
		Gas		Liquid									
Group Method		G	GD	E	E D	F E	FED	F	F D	D E	D	S D	S
Forecasting													
F1	Forecasting spread in air	X	X	X	X	X	X			X			
F2	Forecasting the spread on water surface					X	X	X	X				
F3	Forecasting the spread in the body of water		X		X		X		X	X	X	X	
Monitoring													
M 1	Monitoring the spread in air	X	X	X	X	X	X			X			
M 2	Monitoring the spread in the body of water		X		X		X		X	X	X	X	1
Combating methods													
C1	Combating water soluble gas clouds		X										
C2	Combating spills that float on water							X					
C3	Combating spills that dissolve in water		X		X		X		X	X	X	X	
C4	Combating spills that sink to the bottom											X	X
It may also be appropriate to monitor sinkers that move over bottom in the body of water.													

Following table of commonly carried HNS and the application of various response strategies to different behavior group is shown, and methods of combat diagram, clearly explained to trainees:

Commonly Carried HNS

GROUP	PROPERTIES	EXAMPLES	COMBATING METHODS (examples)	
G	Evaporate immediately	butane, vinyl chloride	-	-
GD	Evaporate immediately significant solubility in water	ammonia	C1	« Knock down » vapor clouds with water fog for ammonia see also method C3
E	Evaporate rapidly	benzene, hexane, cyclohexane	-	-
ED	Evaporate rapidly significant solubility in water	acrylonitrile, n-butylaldehyde, ethylacetate, methyl t-butyl, ether, vinyl acetate	-	-
FE	Float, evaporate	heptane, toluene, turpentine, xylene	-	-
FED	Float, evaporate, dissolve	n-butyl, acetate-ethylacrilate	-	-
F(and Fp)	Float	phtalates, fatty oils, ethylexyl alcohol, styrene, nonene	C2	mixing with special treating agents and/or recovery by skimmers
FD	Float, dissolve	n-butanol, butyl acrylate	-	-
DE	Dissolve rapidly, evaporate	acetone, monoethyl, amine, propylene oxide	-	-
D	Dissolve rapidly	some acids and bases, some alcohols, glycols, acetone cyanohydrin, ethyl ethyl ketone	C3	acids could be neutralized with sodium bicarbonate ; bases could be neutralized with sodium dihydrogen phosphate
SD	Sink, dissolve	aniline, carbon disulphide dichlormethane 1,2-ichloroethane	C4	recovery from seabed with dredging systems (e.g. airlift or peripheral injector jet pipe)
S	Sink	butyl benzyl phtalate, chlorobenzene, coal tar, coal tar oil creosote, phtalic anhydride, tetraethyl lead	C4	recovery from seabed with dredging systems (e.g. airlift or peripheral injector jet pipe)

The drift and spread of a chemical spill in the aquatic environment should, as early as possible after the start of the release, be assessed or calculated so as to form a basis for a risk analysis. A simple, rough estimation is often better than nothing. The estimation should, as far as possible, be based on the spills physical properties as well as environmental conditions like temperature, wind, water current, etc.

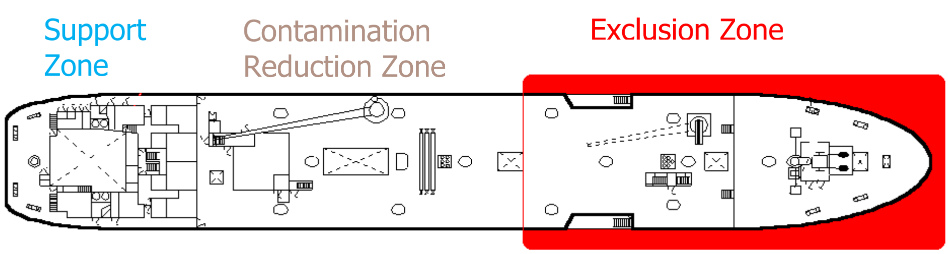
(5) Health and safety

(a) Health and safety officer

A wide range of toxicological and physical properties of HNS increases the need for heightened protection of first responses to a chemical emergency. Chemical response personnel may not realize that they are being exposed to chemicals. In some cases, a very low exposure level may generate major or delayed effects. Very strict response procedures are necessary to protect personnel and the public. Measures should be taken to systematically decontaminate personnel and equipment, so as to halt the spread of contamination. When an on-scene commander is appointed, one of his first duties is to designate a health and safety officer for all response related work. He will ensure that safety procedures are effectively being carried out. He will be responsible for re-evaluating the risk level periodically or as the need arises. It's also possible that he may be required to set up new safety procedures during the operation. A medical team will also be set up including at least one physician, to ensure that the periodic checks of workers that have been exposed to HNS and to other dangers during operations. The officer is also responsible for disseminating all useful information about the spilled HNS to the team, who are likely to come into contact with contaminated personnel, and the workers who could possibly have come into contact with the spilled materials. They are also responsible for ensuring that all devices necessary for the monitoring and detecting are calibrated and in good working condition. The officer should set up a site safety plan for each workstation, specific to the HNS spilled or used. A sample site safety plan is shown below.

(b) SITE SAFETY PLAN

The purpose of the site safety plan is to establish the requirements for the protection of team members during all activities conducted during an incident. It should contain safety information, instructions, and procedures. The plan must be prepared by qualified personnel and should address each activity of the HNS event. Before operations commence, safety requirements must be written and posted or distributed to all responders and discussed with them. The site safety plan must be periodically reviewed to ensure that it is up to date. All work areas should be divided into three categories. This indicates the level of risk for workers and the level of training and protection required. The diagram shows the possible arrangement for an incident, although there is not a fixed format that can adequately address all accidents. The exclusion zone immediately surrounds the contaminated zone. It must extend far enough to prevent adverse effects from the releases of hazardous substances on people outside the zone. Only trained personnel, wearing appropriate clothing, should be permitted to access this zone. The contamination reduction zone is the area in which personnel and equipment decontamination occurs and where support is provided to workers entering the exclusion zone. This area should have controlled entry points in order to limit access to authorized personnel only. This is to reduce the spread of contamination. As stated before, personnel working inside this area should have adequate training and wear appropriate PPE. The support zone contains the command post and other support functions necessary to control the incident such as first aid, maintenance for equipment, offices and administration, laboratories, etc. Personnel entering this zone may wear conventional work clothes and their training need only be related to their jobs.

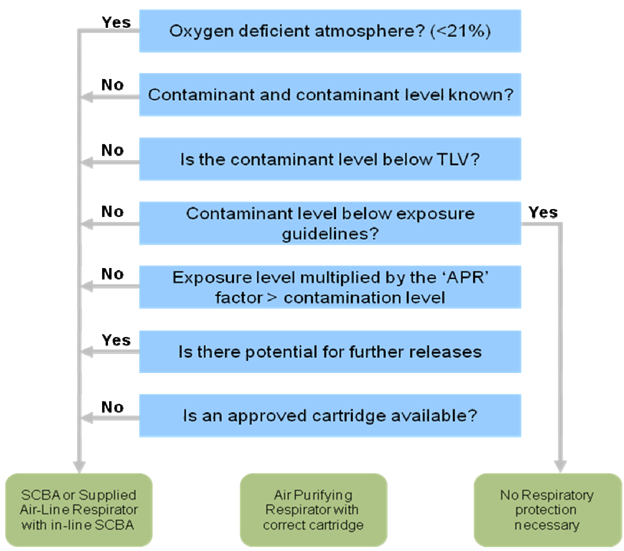


(c) Individual protection

One of the key elements of a health and safety is the protection of response personnel. Personnel protective equipment provides vital protection in the event of a HNS incident. What protection is required depends on different factors such as fire, toxicity, corrosivity, volatility, and radioactivity. It also is determined by the severity of the chemical hazard, in addition to the individual circumstances encountered. PPE consists of respiratory apparatus and protective clothing. Respiratory equipment needs to be worn by response personnel when the surrounding atmosphere is contaminated or can potentially become contaminated with particulate, vapors or gases, or when the surrounding atmosphere is deficient in oxygen. The normal oxygen content in the air should be close to 21% by volume. Respirators can be worn over the mouth and nose or cover the entire face or head. And, it will protect against airborne physical and chemical hazards, either by removing the contaminant from the air or by supplying an independent supply of clean air.

Air purifying respirators use a filter which acts passively on the air, inhaled by the wearer. As this type of respirator does not supply oxygen, it should never be used in an oxygen deficient environment. Unless the hazard is known, an air purifying respirator should not be used. Self contained breathing apparatus (SCBA) is the respirator most commonly used by fire fighters. They use their own air tank so you won't need to worry about filters. They also protect against higher concentrations of dangerous chemicals than air purifying respirators. They are quite heavy and may weigh 30lbs or more and require special training to use and maintain them. SCBAs can either be by demand or pressure demand. With the demand system, air flows into the face piece only upon inhalation or by the demand of the wearer. The problem with this system is that the negative pressure in the face piece, caused by the inhalation of the wearer, not only causes air flow from the regulator but can also cause leaks into the face piece from the atmosphere outside. The pressure demand system releases a small continuous airflow to be passed into the face piece from the regulator. It, therefore, doesn't matter if the wearer is inhaling or not. There will be positive pressure in the face piece. This system prevents the negative pressure causing leaks. A demand type SCBA should never be used in an atmosphere considered to be immediately dangerous to health. A pressure demand system should be used instead.

The flow chart below is a guide to determining the correct level of respiratory protection.



(d) Protective Clothing

Protective clothing ranges from safety glasses, hard hat, and safety shoes to fully encapsulating suits, with a supplied source if breathing air. It also includes disposable coveralls, fire-retardant clothing, cryogenic clothing, splash suits, and many other types of clothing utilizing different materials to provide a barrier against the hazard.

The primary safeguard of any protective clothing is the material from which it is manufactured. The six main characteristics of a material to be considered for acceptable performance are:

- Strength – the ability to resist damage
- Chemical resistance – the ability to resist degradation and penetration
- Thermal resistance – protection under adverse heat (or cold) conditions
- Flexibility – does not constrain your activities, ease of movement
- Clean ability – ease of cleaning and decontamination
- Ageing resistance – durability over time

Personnel protective equipment is essential to protect the responder from exposure. PPE can however cause inconvenience or disable the responder. In can do this is a number of ways.

- It may cause the responder to feel claustrophobic.
- It may also induce heat stress.
- It can induce rapid fatigue due to the additional physical effort required to move in the protective suit.
- It could also impair communication and vision

It is important that the PPE selected is appropriate for the circumstances of the incident. Once the PPE is in use, the response personnel should be monitored closely during the course of the response for changes in their pulse rate, body temperature, skin color, mental alertness, blood pressure, and body weight.

Selecting the appropriate PPE for an HNS spill can be confusing. You will need to consider the resistance of the materials or fabric to the chemical spilled, the respiratory support requirements, the heat stress, what reaction by products exist when other chemicals are present, and the phase of response. To assist in this decision however, some response organizations define four levels of protection.

(i) **Level A –** This is designed to provide the highest level of eye, skin, and respiratory protection from the chemical threat. The responder's entire body is shielded at this level, and protection is achieved by using a SCBA inside a totally encapsulating suit. This suit is used when highly concentrated chemical vapors or gases are present, when the possibility of skin contact with an aggressive liquid or solid is to be avoided, or when the circumstances of the accident are not clear. This level of protection includes positive pressure (pressure demand) self contained breathing apparatus, or air respirator with escape SCBA. It consists of a fully encapsulating chemical protective suit, both inner and outer chemical resistant gloves, chemical resistant boots with a steel toe and shank (the type of boot will determine whether or not it is worn under or over the suit), cotton underwear (long john style), hard hat to be worn under the suit, and coveralls which should be worn under the suit two way radio communications which should be intrinsically safe / non sparking. It is important that the responder is trained extensively in the use of the PPE. A two man entry team should be operating during the response with a back up team on standby. The suit's bulky design not only impairs vision, but it also removes a fair degree of mobility and agility when the individual may already be encountering a difficult situation. Tight spaces, vessel movement, bad weather, and the level of physical effort required can cause serious problems. On a hot day, heat exhaustion may be rapidly induced, whereas in cold temperatures the garment may stiffen and dramatically impair mobility.

(ii) **Level B –** Level B protection is designed to provide splash protection while still using SCBA's for maximum respiratory protection. It affords adequate protection in situations where the concentration of known substances involved requires full respiratory protection, while presenting a lesser hazard for the skin. It is selected for entering oxygen deficient atmospheres, as it is less bulky and gives more maneuverability to its user. Level B PPE includes, as stated before, a positive pressure self contained breathing apparatus or positive pressure supplied air respirator with escape SCBA. The main difference, however, with level B is that breathing apparatus is worn outside the suit. Level B protection consists of a chemical resistant suit, gloves as before, chemically resistant, outer and inner gloves, and boots which are chemical resistant with steel toe and shank. These are worn outside of the suit. Boot covers should be chemical resistant and disposable. Two way radio communications, as mentioned before, should be intrinsically safe / non-sparking. A hard hat and face shield should also be worn.

(iii) **Level C –** Level C is designed for situations where a sufficiently low concentration of a known substance allows the use of air-purifying respirators. Level C protection includes a full face mask, and an air purifying respirator. Chemical resistant clothing is also included. This can be a one piece coverall, a hooded two piece chemical splash suit, a chemical resistant hood, and apron or disposable chemical resistant coveralls. As before, inner and outer chemical gloves are required as well as steel and shank chemical resistant boots are required, and they should be worn with boot covers. Cloth covers should be worn inside the chemical protection clothing. As before two-way radio communications should be used as well as a hard hat, escape mask and face mask.

(iv) **Level D** is the minimum level of protection. It does not include any special protection against vapor or liquids. It may be used with a hard hat, gloves, and eye protection, and may be supplemented by dust masks. Level D is a work uniform used for nuisance contamination only. It requires only coveralls and safety shoes / boots. Other PPE is based upon the situation. It should not be used when there are respiratory or skin hazards.

The type of environment and overall level of protection should be assessed regularly as more information about of the site comes in, and workers are required to conduct more varied tasks.

① **Reasons for upgrading may include:**

- If there is a suspected or known presence of dermal hazards
- If there has been or is likely to be an occurrence of a gas or vapor leak
- If there has been a change in the work tasks that will increase contact or potential contact with hazardous materials
- If an individual who is performing the task requests an upgrade to their PPE

② **Reasons for downgrading may include:**

- New information indicates that the situation is less hazardous than was originally thought
- A change in site conditions has decreased the hazard
- A change in the work tasks will reduce the contact with hazardous materials
- Situations may arise when the level of chemical protection required will place responders at an unacceptably high risk of injuries

(6) Decontamination

Decontamination is often overlooked, when responders enter a hazardous area they are well aware of being exposed to hazardous substances and are equipped with PPE to protect themselves. When their role in the response is complete, it is more likely that the responder will come into contact with the hazardous substance. This is because they are more relaxed and likely to remove the contaminated clothing and gloves. Decontamination is the process for neutralizing or removing contaminants. This is necessary when personnel are moving from the spill site into a clean area. The best way of preventing the spread of contamination is avoidance. Every effort should be made to prevent any contact with contaminants.

Contamination can be avoided by following these rules:

- Plan carefully
- Know what contaminants you are dealing with
- Pay attention to where you are putting your hands and feet
- Don't sit down
- Don't lean against drums or debris
- Don't put any equipment on the ground

It is important to limit the number of people involved. As a result, the exposure will then be limited to minimum number of personnel, reducing the risk of contamination.

(a) Decontamination Control Officer

After the decontamination area has been set up, a person should be placed in charge of the area. His responsibilities will be to:

- Determine the level and type of decontamination that will be required.
- Supervise or operate the station, including upgrading or downgrading the level and type of decontamination required.
- Control and monitor the movement of personnel through the decontamination station.
- Ensure that personnel are suitably attired.
- Maintains the availability of replacement clothing and equipment.
- Organize the handling and removal of contaminated waste from the site.
- Organize the handling and removal of decontaminated equipment.
- Signing personnel and equipment out of the station when decontamination has been completed.
- Cleaning up the decontamination site, post incident.
- A full list of the equipment required can be found later in this workbook.

It is important when developing decontamination operating procedures that are required to be thorough; they also need to be sufficiently flexible to deal with every possible eventuality. These procedures, in conjunction with experience, will enable the OSC or decontamination station officer to determine the exact level of decontamination required.

Trainees should recognize that:
There are many methods of decontamination but they all fall into two categories.

- Physical methods – This is where the chemical is removed form the contaminated item without changing the chemical structure of the contaminant.
- Chemical methods – This is where the chemical is removed from the contaminated item using a process which changes the chemical into another product.

Examples of decontamination are:

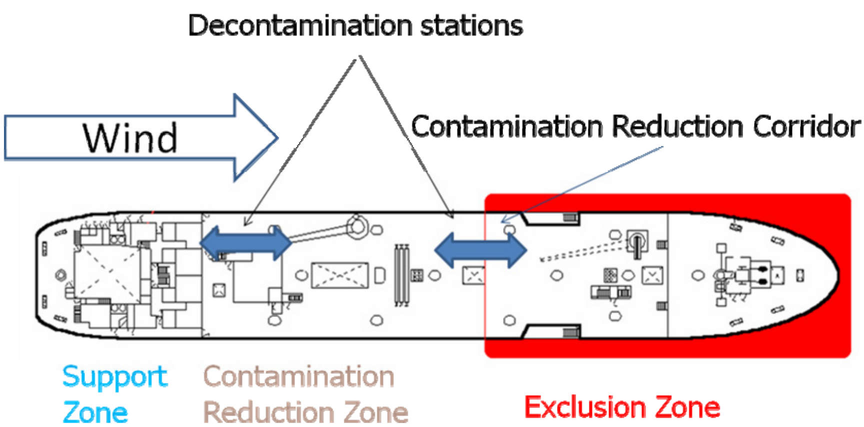
- Sorption – This is a dry technique which involves removing the contaminant using a suitable material such as a paper towel or an inert natural product such as sand. The advantages to this method are that there is no potential for a reaction with water. Disposal of waste is straightforward, costs are reduced, and there is very little waste produced. The disadvantage is, however, that although the contaminant has been removed, it has not been eliminated or reduced. It will need to be stored and transported securely.

- Vacuuming – This technique is mainly used for solids and powders.
- Chemical alteration – This is a method where the contaminant is changed into a non-hazardous product such as when acids and bases neutralize each other. This method should only be used with the expert advice, as it can create new hazards if carried out incorrectly.
- Dilution and washing is the most common method and uses water to flush away the contaminant. Water is used on water soluble substances, and in the case of substances that are not water soluble, a detergent mix is used. There are very few cases where neither of these solutions would be totally effective. In this event, however, a specialist solution can be used. The disadvantage of this method is that a supply of clean water is required and a large amount of waste is created, which leaves the potential for contamination of the surrounding area.
- Isolation and disposal – If clothing or equipment is severely contaminated and cannot be cleaned to a satisfactory standard, it should be treated as hazardous waste and disposed of in accordance with the appropriate legislation.

Trainees should also recognize that:
Ideally, on site decontamination should be carried out as close as possible to the incident as this will prevent any spread of the contaminant. The selection of the layout of the decontamination area will form the part of the incident plan that has been implemented by the on-scene commander. The area should be reasonably small and take into account several factors:

- The weather should be considered as an upwind location is the best option.
- How practical is the terrain and the amount of space?
- What services are available, such as water and electricity?
- How accessible is the location and the spill itself?

To assist the trainees to get a clear image of decontamination station, following diagram shall be shown to the trainees:



Terminology of the above zone needs to be explained to trainees clearly as follows:

- **Exclusion Zone** – The exclusion zone is the area with the greatest potential for contamination. The highest level of PPE needed for the incident will be used in this area. All equipment and personnel working in this area should be considered contaminated.
- **Contamination Reduction Zone** – This is the area where personnel and equipment decontamination occurs, and where support is

provided to workers entering the exclusion zone. Boundaries should be conspicuously marked, with entry and exit restricted. Personnel leaving the exclusion zone must go through the decontamination stations. The size of the zone depends on the number of stations in the decontamination procedure, the overall dimensions of exclusion zone, and the amount of space available at the site. Whenever possible, it should be a straight path. The decontamination area will contain a wash down tank or a similar method for decontamination. The area should be equipped with drop bins for equipment and clothing that has been decontaminated, and waste bins for any contaminated waste.

- **Support Zone** – After decontamination, personnel can exit the CRC and into the support zone. Personal protective clothing, respirators, monitoring equipment, and sampling supplies should all be maintained outside of the CRC.

(b) Equipment Required

The following is a list of equipment and materials that may be used for decontamination:

- A source of clean water, for washing and rinsing. This may be from main water or tank.
- Water spraying devices and pumps
- Shower assembly
- Eye wash stations
- Brushes (long and short handled) and sponges
- Low foaming detergent and/ or decontamination solutions
- Absorbents to wipe of contaminants
- Rags, cloths and paper towels

(c) Decontamination Solutions

For trainees' guidance only, following information sheet is shown. Trainees are asked to consult with a chemist for guidance in the required solution strength that is to be used.

Solutions	Concentrations*	Remarks
Water		Suitable for all water soluble substances, where the contaminant is known in advance
Aqueous solution of a low foaming detergent	As per label	Widely used. Suitable at sites where contaminant is not known or where a variety of contaminants exist.
Aqueous solution of trisodium phosphate	1-2% Na3PO4 5% Na3PO4	Good general purpose decontamination solution, including organic solvents.
Aqueous solution of sodium carbonate (Washing soda)	5% Na2CO3	Effective in neutralising inorganic acids, although the reaction is exothermic (HEAT GIVEN OFF)
Aqueous solution of sodium Bicarbonate (baking powder)	5% Na HCO3	Effective in neutralising acids and is a preferable choice over Na2CO3
Aqueous solution of calcium hypochlorite (bleaching powder)	10% Ca Cl (OCI) 5-6% Ca Cl (OCI)	Good for cyanide salts

** Important Note: This information is a guideline only and a chemist should be consulted for guidance in the usage of required solution strength.*

(i) Containment

Trainees are to understand the collection and wash-down tank, with protective shielding to prevent overspray of water or contaminant.

- Tape, flags and poles for marking boundaries
- Plastic sheeting for lining the decontamination station
- Portable pump to recover wash water
- Storage facilities for disposing of contaminated water
- Heavy duty waste bags
- Absorbents for bounding the area
- Protective overshoes
- Heavy duty waste bags and ties
- Drums for the removal of liquid waste

Trainees are also told that the following points can be useful in developing decontamination procedures:

- Minimize contact with contaminated surfaces (sitting down etc).
- Responders should be checked for wounds and abrasions prior to entry, and these should be covered. The same operation should be carried out on exit.
- Good personnel hygiene needs to be enforced (no smoking, eating, or touching exposed parts of their body until the hands have been scrubbed).
- Drinking water should be available to prevent dehydration.
- Decontamination should, where possible, be carried out under the "buddy" system and the minimum number of additional personnel.
- Protective clothing should be removed from the inside outwards to minimize contamination of the inner surfaces.
- In order to avoid compromising the breathing air reserves of the responder, air may be supplied by a supplementary airline during the decontamination process.
- Gas monitoring or detection equipment should be used inside a plastic bag, with only the detection element open. This will reduce the need for decontamination.
- Contaminated and clean equipment should not be mixed.
- Contaminated equipment and clothing should be decontaminated as promptly as possible as it may be required later. In this situation, the level of decontamination will be that of the level required to remove all free and visible contaminant. This level of decontamination is not acceptable once the incident is over and the equipment is removed from site.
- The surrounding ground should be protected by using industrial strength polythene. Any joints should be double folded and taped to avoid leakage.

(7) Disposal

(a) Methods of Disposal

It should be told to trainees that there are various methods for disposing of chemicals and chemical contaminated wastes. These methods are normally applied after the response plan. Some of these techniques will be conducted at the site, but most are conducted at special facilities. The management and disposal of HNS is an important part of any response and should be included as part of the HNS spill contingency planning process.

Consideration should always be given to cleanup techniques and treatment methods that will reduce the amount of material to be sent for final disposal. Any method utilized should follow the established principles of sustainable waste management. These are:

- Prevent and minimize
- Recovery through reuse and recycling
- Disposal without harm to human health and the environment

The final disposal of large amounts of HNS and HNS contaminated debris can present major logistical problem. Environmental factors and local regulations may restrict where contaminated materials can be disposed of, and in what concentrations and quantities.

(b) Disposal Options HNS Waste

Trainees are urged to remember the followings:

Whenever possible, recovered HNS should be recycled and processed through a refinery. Unlike oil, recycling to produce other HNS products is rarely possible due to the weathering of the recovered HNS with sand, salt, and debris. It is important to remember health and safety considerations when handling, transporting, and storing the recovered HNS and its debris. Appropriate safety procedures should be put in place to ensure compliance to local and national legislation. Operators must also be properly trained. Recovered materials may consist of:

- HNS recovered at sea
- HNS recovered during the shoreline clean-up operations
- HNS contaminated sand, mud, etc, from dredging activities
- HNS contaminated beach debris (wood, plastic or seaweed), birds, and mammals
- HNS contaminated clean up materials, equipment, and protective clothing
- HNS contaminated equipment
- Residues generated by decontamination wash down stations employed to decontaminate response equipment.

It should be pointed out to trainees that:

(i) Temporary storage facilities are needed when the recovered material requires processing or treatment before disposal, or when transport of the HNS collected to the final disposal site is impractical or uneconomic.

(ii) HNS recovered at sea will normally be stored in integral tanks on board recovery vessels.

(iii) If the hazards properties permit, they may be also recovered into towed floating tanks, in towed or self propelled barges prior to offloading into larger vessels or direct to storage facilities on land.

(iv) Temporary on-site storage facilities should be identified and established at an early stage. And where possible, it should be identified in local contingency plans. The size, number, and type of the facilities involved will depend on the amount and nature of the material recovered. It is important to ensure that segregation into the various waste streams is possible, and keep separate the liquids from the solids. All materials must be labeled in accordance with the relevant documentation.

(v) Temporary storage facilities should be near the center of the clean-up operations with good access to roads. Cleaning facilities should be nearby, so as not to spread any pollution. There should be clear delineation between the contaminated and clean areas. The areas should be remote from residential areas and outside any areas that are considered to be vulnerable to groundwater contamination. They should be outside any areas that are considered to be of high environmental sensitivity and not within 10 meters of any water course (ideally as remote as is practically possible). It is also essential that these areas are provided with facilities to treat or contain spillages and rainfall.

(vi) It may be unavoidable on occasion to locate temporary storage facilities in an area that is sensitive to groundwater or surface contamination. If this is the case, then additional containment safeguards will need to be provided that will include bundled and sealed lagoons or double lined cells together with drainage to prevent contaminated surface water run off.

Trainees are asked to remember the above points as they may always be asked to make decisions on these points. Trainees are further asked to remember the following options:

- **In Situ Burning** – Many substances emit highly toxic vapors when burning. This method is used in exceptional cases only, and approval is generally required from the authorities. Floating spills on the water surface are normally difficult to ignite and usually require special ignition techniques like incendiary bombs containing thermite flame throwers or air curtains.
- **Incineration** – High temperature burning in a special combustion chamber gives complete oxidation of substances, if the burning is performed under carefully controlled conditions. There are various types of incinerator systems. Incineration is generally very effective in disposing of a wide range of substances where the process gives minimum pollution.
- **Wet air oxidation** of chemicals under moderate temperatures and elevated pressure with proper combinations of temperature pressure and reaction time can give complete oxidation of substances in specially designed equipment. The process is energy conserving with a proper chemical feed and the oxidation reaction is thermally self sustaining once started.
- **Pyrolysis** – A combustion process in two steps based on insufficient oxygen supply. It is used for complex waste mixtures that are converted by heat to solid, easy to handle char in a paralyzing chamber with no oxygen. The volatile fractions are given off in a fume incinerator.
- **Landfill** – This is the burial of chemical waste in ground cavities or excavated trenches. The material should be pre-treated according to applicable regulations, in order to reduce the contents of certain components.
- **Deep well storage** – Underground storage require selection of a geologic formation, and drilling of a well to an appropriate depth. The method is often strictly regulated and surround by requirements regarding low seismic activity, low site value as a resource, careful geologic investigation, and perfect encapsulation technique.

(8) Post operational activity

Once the response to an HNS incident has been completed, all response personnel and their equipment de-contaminated are returned ready for use and all waste disposed of. There are still several factors to be considered. These factors include debriefing the incident personnel, compiling the incident report, and analyzing the lessons learned. These are divided into short term and long term objectives.

(a) SHORT TERM OBJECTIVES

De-briefing response personnel : The de-brief's attendees should include all key witnesses and response personnel. It is important as it provides the opportunity to update contingency plans, review response strategies, and procedures; review financial, equipment, human, and training resources.

The debriefing should be conducted as soon as possible after the incident response is complete and while all the information is fresh in the minds of the participants. The debrief will focus on strengths, weaknesses, and opportunities for improvement. The OSC must keep focused on opportunities for improvements rather than level any criticism. If the response team is too large to meet together an alternative would be to issue a questionnaire on the operation which could be reviewed by key members of the team. It may also be necessary to assign problem solving tasks to team members or small working parties that can report back to the team at a later date. It is important that one member of the team is responsible for updating the response and contingency plan, as a result of the evaluation.

At the post incident de-briefing, the following areas should be reviewed:

- Human resources – Were sufficiently trained workers available? Were

the shift patterns effective? Were response personnel fatigued? How many man-hours were lost due to injury, weather, etc?
- Equipment resources – Was the equipment appropriate to the HNS type, spill size, and weather conditions? What equipments were available and was it available at the appropriate time for an effective response? What were the contractual arrangements and were they cost effective? Were all the equipments compatible?
- Response strategies – Were the strategies appropriate to the chemical type, the spill size, and the weather conditions? Were the strategies acceptable to the regulatory authorities? Were key strategies implemented in a timely and effective manner?
- Decision making – Was technical advice available when it was needed? How effective was the team at formulating and acting upon key decisions? How adequate was the financial support?
- Interaction with outside agencies – How effectively was the government approvals processes utilized? Was the information provided to the public timely and accurately? How effective was the claims process? Were other interest groups accommodated where possible?

An incident report should be compiled, published, and shared with the relevant authorities both regional and international. This should include the analysis of lessons learned as understanding, and acting on the lessons learned is a key preparation for the next incident. It is especially useful for those who were not actively involved in the response. Although no response is perfect, every incident can reveal better techniques, processes, or solutions. It is important that this information is passed around so that every one can prepare and respond better next time.

Independent expenditure review – All response activities should be logged in a daily log. It is the responsibility of the OSC to ensure that all activities are recorded. This includes all financial transactions and recording all costs that have been incurred. This will help with budgeting, cost recovery, any third party claims, legal, and insurance questions.

- Cost justification – OSC may be required to justify why certain cost was incurred and whether they were necessary. This also helps when explaining the rationale for undertaking response actions.
- Activity log – It is important that all response activities, decisions, and communications are entered into an activity log. This will help when explaining the costs of the response, such as what equipment and labor has been used, what contractor have been brought in, what vessels, aircraft and facilities used. Remember to document what was used, where it was used, why it was used, and when it was sued.
- Equipment costs should be logged such as the purchase cost, hiring costs, mobilisation costs, and operational maintenance costs.
- Labor costs will include the number of people involved, what types of people, and what tasks were carried out.
- Contractor services costs – Any invoices received from contractors should be checked for accuracy and cross checked with your own records. Make sure that you pay your contractors promptly to ensure good working relationships.
- Travel costs – Again check these for accuracy. Check to make sure that the travel was necessary and that it was reasonable. Ensure that the travel was authorised by the appropriate person.

An incident cost report should also be included as part of the incident report. This report is more detailed and relies heavily on references to incident response actions and decisions. Its organization may be structured on the types of costs that were incurred, and by whom. This will form part of your claim to recoup your incident costs.

(b) Long term objectives

Long term objectives include the monitoring of personnel that were affected by the incident, monitoring of response personnel, local populace and workers involved, the monitoring of the incident site, and the monitoring of the affected environment.

The scale and depth of the program will be determined by the HNS substances involved. Advice and assistance on determining and conducting such a program can be accessed through the relevant UN agencies. The objective of post spill monitoring is to assess the physical, chemical, and biological recovery of the shoreline.

- Physical recovery – This involves assessing damage to the beach structure, assessing the degree that the sediment has been affected, and comparing with pre-spill surveys, if possible.
- Chemical recovery – To monitor chemical recovery, surveys will be required to document the HNS distribution. Surveys should define shoreline segments and assess surface and subsurface contamination using standard technology so that valid comparisons can be made.
- Biological recovery – Biological monitoring is more complex and requires trained experts. It involves studying living organisms to assess recovery. An indication of the biological conditions prior to the spill is required in order to select the appropriate species, methods, and define recovery. Monitoring should include uncontaminated areas in order to distinguish the natural effects from those caused by the HNS.

Restoration can speed up recovery in some cases. Transplant programs have proven successful following the removal of bulk contamination and weathering exercise to explore the use of the IMDG Code. The tables attached to the end of Module 4 in your workbooks show a typical dangerous cargo manifest. Using this table and the extracts from the IMDG Code Supplements can answer the following questions?

In the event of a spillage of UN Number 1470, what actions would you take?

In the event of a fire onboard whilst carrying Acetyl Chloride, what concerns would you have and what actions would you consider to mitigate those concerns?

Of the HNS substances on the dangerous good manifest, which ones would give you concern, if there was a fire onboard?

If Ammonium Nitrate was spilled on deck, what protective clothing would you use to investigate or respond to the spillage?

What actions would you consider when responding to a spill of UN 1717? In an emergency, specific information can be obtained from the individual schedules, as well as from the health and safety information code. However, it does not contain detailed occupational health and safety information, or the data on the substances and materials listed in the code. The responders should ensure that they have access to complimentary information from other sources.

A recommendation on safe practice for dangerous goods in ports and harbors was first circulated by IMO in November of 1973. The subsequent development of new techniques on shore and ship operations as well as the desirability of having more comprehensive recommendations, which included dangerous goods in packaged form, liquid, and solid dangerous substances. And, liquefied gases carried in bulk made it necessary to revise and update the recommendation. This was published by IMO in 2007.

Lesson O–12: Key Components of Emergency Response System

By showing the following diagram, trainees are strongly asked to memorize the key components of Emergency Response System, which should contain at least the following points:
(As this is most important point, explanation shall be made repeatedly.)

(1) Key components of an emergency response system

Since this is the most important point of the training for the trainees of possible respondent in the HNS incident, in this lesson, trainees are again reminded of key components of emergency response system as follows (Some trainees may be tired of listening to the same elements explained in the Lesson 11. However, they should be asked to be patient in order to gain knowledge about Emergency System correctly and completely):

(a) Organisational Arrangements – It is essential that all roles are defined clearly and all responsibilities and capabilities have been clearly identified.

- Who is responsible for responding to the incident? - The fundamental issue with respect to identifying the roles, responsibilities, and capabilities, it is important to establish who is responsible for responding to the incident and who is responsible for implementing the response plan.
- Who is responsible for conducting specific tasks? -Consideration must be given to the many tasks that will take place during the course of the operation.

In assessing the organisational arrangements, the following elements shall be considered:

(i) Prevention

Prevention, which consists of taking measures to reduce the likelihood of an incident occurring and, in the event of an incident occurring, taking measures to minimize the effects, is critical to the emergency response team.

Response team needs to consider what the team already has in place and should evaluate existing documentation, such as:

- Policies
- Guidelines
- Legislation.

Then consideration is must be given to:

- What shall be put in place?

- What mandatory compliance requirements are there?
- What does the legislation require to be implemented?
- What is the team missing?

(ii) Preparedness

Preparedness is simply being prepared as being prepared will enhance your ability to respond to emergencies. Remember the phrase "Failing to plan is planning to fail."

Key considerations are:

- Develop an emergency response plan
- Ensure that response resources and equipment are available
- Make sure your personnel are trained, and simulate scenarios regularly
- Make sure that communication and alert channels are established including the media.
- Take into account the various scenarios relevant to probable spills and the organization and activities likely to be involved. This should involve joint planning and training of those who may need to work together if an accident occurs, including industries and the surrounding communities.

Trainees are asked to consider what should the administrations provide and recognize that:

The administrations should provide:

* All relevant guidelines and policies for dealing with incidents.
* Define what reporting procedures are required what the incident reporting requirements are.
* Prepare and implement periodic inspection and auditing protocols, and ensure that appropriate equipment, systems, and procedures are being implemented and adhered to.
* Collect and disseminate information.
* Define the emergency response planning requirements, and the response capability and preparedness standards for vessels, facilities, and port/harbor authorities.
* Establish information databases pertaining to shipping information (e.g. stowage plans, bills of landing, ship passage, ports of call), chemical and physical properties, and response protocols; levels of confidentiality required for this information must be established in conjunction with the relevant stakeholders.
* Establish a pool of experts to act as an advisory group. Individuals with expertise in navigation, ship technology, ship operations, salvage, naval architecture, chemical hazards, marine biology, physical and chemical oceanography, dispersion modelling, spill response, and fire fighting
* Establish a coordination group made up of individuals with proven expertise in the areas of emergency, crisis management, and transfer operations
* Trainees should remember that further support administration can provide, includes;
* Identify an operations center to provide access to information databases, standard operating procedures, advisory personnel, and communications equipment.
* Identify chemical response units
* Train the personnel of the chemical response unit
* Coordinate with national, regional, and international, e.g. IMO, organisations and information sources in both routine and emergency situations.

(b) PLANNING REQUIREMENTS

Trainees should be told that PLANNING REQUIREMENTS include the preparation of detailed and specific plans for responding to a marine incident. International, regional, national, and local emergency response plans should be prepared to summarize roles and responsibilities for all parties, providing standard operating procedures, lists of available resources, etc.

Plans are required at four levels.

- At an international level with the framework of an operational contingency plan
- At the regional level for multi-lateral assistance and mutual aid
- At the national level
- At the local level (e.g. for terminals and harbors/ports)

Should the magnitude of an accident be such that assistance is required, these plans should be integrated in such a way that it will be easy to incorporate additional response capabilities. For example, a port emergency plan should be coordinated with the neighboring industrial facilities and local regional plans, as well as with the national plan.

To assist responders and decision makers in managing the response, various types of information should be gathered before an accident takes place. Each organization should develop its own system that meets its own requirements. A response support system can be anything from a list of experts to a computer based system. However, there are some fundamental planning and assessment tools:

- Inventory of the different response plans that can be activated in different areas and the procedures required to activate them.
- Inventory of transportation patterns and commodities transported in different areas.
- The chemical and physical properties of transported substances.
- Toxicological effects and exposure limits of substances
- Chemical fate of substances
- Spill scenarios, describing the substances transported for each sensitive area
- The identification of sensitive areas
- Possible recovery techniques
- Personal protective equipment requirements

Trainees are asked to remember that:

(i) Response tools should include:

- An incident assessment system
- A list of experts on maritime and chemical aspects
- Predictive air dispersion modelling and related monitoring capabilities
- Predictive water dispersion and related monitoring capabilities
- An inventory of incident assessment capabilities
- Access to the ship's manifest and loading plan
- Search and rescue capabilities
- Decontamination techniques for responders and exposed public

(c) Monitoring and reporting – Ensure that all incidents are assessed, evaluated, and followed up as appropriate. The key element in the preparation process is the establishment of reporting procedures, which will indicate:

- Who is responsible for reporting?
- To whom are the reports to be made?
- What format should be used for the reports?
- When are the reports to be made?

The reporting procedures should be linked to an appropriate record keeping process.

(d) Defined operational procedures – To ensure that an appropriate and effective response is initiated in a timely fashion. It is necessary to develop operational procedures. It is of utmost importance that these procedures are clearly defined, properly coordinated, and that all roles and responsibilities are clearly identified and defined.

(e) **Training and exercising –** Trainees are asked to remember that training standards should be prescribed for all response personnel, whether performing at the decision-making or operational levels. It should be clearly told to trainees that they should include following points.
- Training should be content specific with the job performance expectations.
- There should be schedules for implementation and compliance dates.
- There should be requirements for issuing certificates and their specific content.
- Requirements for periodic refresher training are defined, for example 3 yearly requalification.
- Exercises and drills are planned for regular intervals to ensure that the response program is effective.
- Ensure that all training organizations used are approved/certified prior to conducting training.
- The training delivered is of an equivalent standard as international training requirements.

(f) **Financial and liability arrangements –** To determine financial responsibilities and liabilities of the various parties involved. While these aspects will have been covered earlier in the Emergency Response System, nevertheless, these aspects are again told to trainees since they play an important and fundamental part in the system.

With regard to the financial aspects, the level of preparedness required will need to be funded as well as having sufficient provisions to fund any response. In the latter, it is vital that good record keeping is established at an early stage in order to assist in the collation and management of any claim.

In respect of the liability aspects, the administration and relevant international, legal, and insurance bodies will determine the level of liability for differing parties. This will be established by reference to national legislation and international conventions. Trainees are asked to reconfirm the lessons already given to them (Lesson O-7 Financial and Liability Arrangements)

Lesson O–13: Nine Steps of Response to HNS Incident

There are nine basic response steps or activities which describe what the OSC must consider when responding to an HNS incident.

These nine steps will form the basis of the response strategy, which the OSC will be required to consider.
- Assess the situation
- Activate the contingency plan
- Activate the organizational response
- Prepare the response action plan
- Activate the operational response
- Manage the ongoing response
- Deactivate the response
- Keep records and consolidate the cost
- Debrief and report

(1) Step One – Assess the Situation

The first step of the HNS response is to assess the situation.
- Report and document accurately all incoming incident information using a standard reporting form.

- Identify the type and source of products involved
- Quantify the size of the spill
- Assess the hazards implications e.g. fire and explosion, human health, shoreline type, effects on flora and fauna. Ensure that actions are prioritized.
- Identify the threat to people, environment, and facilities.
- Prioritize the actions OSC needs to take.
- Identifies the political and economic significance of the spill.
- Gather samples or other such supporting data, sufficient to allow the positive identification of the substances to take place.

(2) Step Two – Activate Contingency Plan

Step two is to "activate contingency plan".

- Inform the senior manager as per the organizational procedure and content of the plan.
- Notify appropriate authorities and key personnel according to the plan.
- Activate initial response. Decide how, where and when. Coordinate identification and mobilization of initial response resources (personnel and equipment) as per the plan.

(3) Step Three – Activate Organization's Response

Step three of the response is to activate the organization's response according to the agreed strategy plan involving:

- Mobilizing and organizing the response team
- Identifying, assigning and delegating tasks
- Establishing both internal and external communication channels
- Set up a command post in a safe zone (site equipment, safety and security, procedures/resources)
- Implement safety, security and de-contamination procedures
- Notify, mobilize and co-ordinate contracted and sub contracted services
- Assess needs, define roles and execute contracts

(4) Step Four – Prepare Response Action Plan

Step four is to prepare a response action plan strategy.

- Identify and priority resources at risk e.g. local populace, type of shoreline, local infrastructure.
- Identify the resources required, taking into consideration the influence of the sea and weather conditions on the spill properties, the behavior of the HNS, and spread rate. Identify additional resources if necessary (e.g. regional / international agreements).
- Identify and prioritise response strategies, such as for monitoring, containment and recovery, chemical treatment, shoreline clean up, transfer, and disposal.
- Maintain accurate records as required e.g. log and time keeping procedures for contractors and sub contractors, rented equipment, consumables.
- Develop response action plan to cover items such as any resource time available, resources available, containment plan, and regular briefings on the response action plans.

(5) Step Five – Activate Operational Response

Step five involves activating the operational response, including:

- Directing and supervising all monitoring, investigation, recovery, clean up, and decontamination procedures.
- Monitoring adherence to plans.
- Coordinating containment, recovery, and disposal of all pollutants.
- Conducting regular briefings.
- Deploying personnel and ensuring logistical support.

(6) Step Six – Managing the Response

Step six is managing the on-going response, which includes gathering, assessing and adjusting response information, and interpreting and reviewing reports.

- Assessing, maintaining, advising, directing, and control response team activities and plan.
- Monitoring, evaluating, and adjusting strategies as required.
- Monitoring site safety plan and occupational hygiene
- Enforcing regulations and procedures

(7) Step Seven – Deactivate the Response

Step seven is deactivating the response.
In this step, it should be determined if the response should be continued, suspended, or terminated, and advise the OSC accordingly. In order to make such determination, trainees are told that following actions are necessary:

- Rank the termination criteria, relevant to your operations. Use effort/ benefit analysis.
- Assess the potential for recontamination.
- Coordinate support to scientific monitoring of the area.
- Shutdown field operations and conduct an orderly termination of operations.
- Maintain, repair, and replace equipment as appropriate.

(8) Step Eight – Consolidate Costs

Step eight is to consolidate costs. It is required to:

- Ensure that detailed records are kept,
- Verify / certify costs
- Plan for record and filing maintenance
- Consolidate records
- Produce a report of expenditure by category.
- Furthermore, it is required to:
- Produce costs documentation report
- Construct simple coding structure and produce final cost report.

(9) Step Nine – Debrief the Response

Step nine is to debrief the response. In this step, trainees are told to:

- Conduct operational review of the response with the response teams and analyze strengths and weaknesses of the response.
- Conduct a review with the OSC and analyze strengths and weaknesses of the response. Identify the lessons learned and the areas that may require improvement.
- Consolidate information, documentation, and evidence. Submit and circulate the final operations report.
- Make and circulate recommendations for improved preparedness.
- Implement the lessons learned.
- Update contingency plan

(10) Conclusion

While recognition of the fundamental 9 steps is important, trainees should be told that it is most important for trainees to confirm the following very basic point of successful response:

- An OSC and his team can only function effectively, if provided with the structure and organisation necessary to mount a response in a timely and appropriate manner before the HNS has a chance to affect the local populous or the sensitive areas.

It should be noted by trainees, however, that sometimes the above structure is not possible due to the scale of the emergency, the location, or the prevailing weather conditions. The probability of small spills can be high, but with a rapid response the damage they cause are often minor and their clean up costs are relatively low. Small spills are ugly and a constant reminder of the risks of much larger spills. A good response to small spills will ensure an effective response to larger spills. Regardless of size, marine HNS spills tend to become unmanageable very quickly. The key to effective response is to have a comprehensive, realistic, and well exercised contingency plan, a minimum of appropriate equipment, and a response organization of highly trained individuals who can react very quickly and knowledgeably.

(11) Interest of other parties

In addition to the explanation about the 9 steps of response, trainees are also reminded of the following interest of other parties, as forgetting other parties' interest may, sometimes, change situation for the worse:

Therefore, it should be clearly told to trainees that during a major incident, there will be a multiplicity of agencies involved that can be of great assistance in the response. These will include government agencies and private groups alike.

In terms of government groups, most countries have developed joint command centers for spill response, or unified command teams that include these agencies.
In addition to government agencies, there will also be an influx of outside individuals, such as media persons, equipment, sales people, and curious parties of all sorts who have legitimate interests and some not so legitimate. It is important to recognize that such groups will inevitably be part of the scene and that mechanisms must be established to communicate with them on a fair basis without interfering with the emergency job at hand.

The OSC and his team must be allowed to implement the response strategies with the minimum of outside interference.

Lesson O–14: Contingency Planning

In this lesson, trainees are explained about and asked to be able to describe the following at any time. As this lesson includes one of the most important lectures, some of the elements, which have already been told to trainees, are repeatedly explained for reconfirmation purpose:

- Outline the purpose of contingency planning
- Describe the main considerations in the development of a contingency plan
- Describe the essential elements of a contingency plan that will be applicable to their role
- Describe the various levels of response and describe the typical procedures for the escalation of a response

(1) Purpose of the Contingency Plan

It should be emphasized to trainees that:

- Careful planning is essential for a successful operation and is always the case when responding to an unexpected emergency. When there is an accidental spill of HNS, or the potential for a spill, there are many different agencies and organizations involved that have responsibilities and a role to play.

A well developed contingency plan addresses these requirements and provides a policy and response framework for the government, and/or the industry organization to respond to an incident. It is important to have this in place as there are many issues that need to be resolved, which are difficult enough when calmly sitting around a table. With the added pressure of an emergency situation, these can become quite contentious issues. The plan will help ensure that a broad consensus of opinion has been achieved on response measures, rather than rely on who is on hand at the time of an accident. The plan shall meet or set legislative requirements, and is a requirement under the OPRC-HNS Protocol 2000.

(2) Response Regime - Key Elements

For administrations, in order to ensure a safe, timely, and effective response, a coordinating framework and a series of standard operating procedures must be established.

It will facilitate early definition of the specific commodities involved, reducing the potential magnitude of the incident. A "decision tree" approach can be used to initially evaluate the magnitude of the incident and to assign the incident to a specific category or level. The assigned level may then be used to determine appropriate response mechanisms and to allocate roles and responsibilities.

In this lesson trainees are to look at the essential components of an emergency response system. Trainees are told that the following is based on a review of several national regimes and of the IMO guidance documents, and also that there are some key elements that should be considered as essential to any regime:

- Organizational arrangements: to provide a clear identification of roles, responsibilities, and capabilities
- Planning requirements: to provide specific guidance in responding to an incident
- Monitoring and reporting: to ensure all incidents are assessed, evaluated, and followed up as appropriate
- Defined operational procedures: to allow a tiered response to an incident
- Training and exercising: to provide response personnel with the skills necessary to do their job effectively and safely.
- Financial and liability arrangements: to determine financial responsibility and liabilities of the various parties involved.

(3) Organizational Arrangements

It should be emphasized and repeatedly told to trainees that:

- In any response regime, it is most essential that the roles, responsibilities, and capabilities of the various parties be clearly identified.

The fundamental issue, with respect to roles and responsibilities, is to establish clearly the person with the onus of response. That is, who is responsible for responding to an incident, including the implementation of response plans?

Consideration must also be given to the many tasks throughout the development, implementation, and maintenance phases. Elements can be placed in four general categories: prevention, preparedness, response and recovery/remediation. Some of these tasks are briefly outlined on the next slide.

(4) Prevention

Trainees are to recognize that:

- Activities directed toward prevention of incidents and reduction of their magnitude is critical elements in the emergency response regime.

In addition to providing overall coordination, the administration may:

- Evaluate existing documentation, policies, guidelines and legislation, to identify duplication and/or information gaps.
- Prepare relevant policies and legislative elements.
- Establish mandatory compliance requirements.

(5) Preparedness

Trainees are to recognize that:

(a) Preparedness activities are meant to enhance the ability to respond to emergencies. This involves a number of sub elements such as:
  - Development of emergency response plans.
  - Ensuring the availability of certain response resources and equipment.
  - Training and exercising of personnel.
  - Establishment of communication and alert channels, including, among others, linkage with the media.

(b) Preparedness should take into account the various scenarios relevant to probable spills, based on risk assessments and the history of previous incidents, and the organizations and activities likely to be involved.

(c) It should involve the joint planning and training of those who may need to work together if an accident occurs, including industries and the surrounding communities.

(d) Administrations should provide plans and expert assistance, and should ensure that operational center(s) exist for the collection of routine and emergency information.

(e) Incident monitoring and overall coordination should also be provided

(f) Specific issues of concern should include;
- To prepare relevant guidelines and policies
- To define reporting procedures and incident reporting requirements
- To prepare and implement periodic inspection and auditing protocols, to ensure that appropriate equipment, systems, and procedures are being implemented and adhered to.
- To collect and disseminate information
- To define emergency response planning requirements, response capability and preparedness standards for vessels, facility, and port/harbor authorities.
- To establish information databases pertaining to shipping information (e.g., stowage plans, bills of lading, ship passage, ports of call), chemical and physical properties, and response protocols. The level of confidentiality required for this information must be established in conjunction with the relevant stakeholders.
- To create a "pool of experts" to act as an advisory group, consisting of individuals with expertise in the following areas:
  - navigation
  - ship technology
  - naval architecture
  - chemical hazards
  - marine biology
  - physical and chemical oceanography
  - dispersion modeling
  - spill response
  - fire lighting
- To identify a coordination unit made up of individuals with proven expertise in the areas of emergency, crisis management, and transfer operations.
- To identify an operation centre to provide access to information databases ,standard operating procedures, advisory personnel and communications equipment.
- To identify chemical response units.
- To train the personnel of the chemical response unit.
- To coordinate with IMO, international and national organizations, and information sources, both in routine and emergency situations.

(6) Planning

Planning requirements include the preparation of detailed and specific plans for responding to a marine incident. International multilateral, national, and local emergency response plans should be prepared to summarize roles and responsibilities for all parties, providing standard operating procedures, lists of available resources, etc.

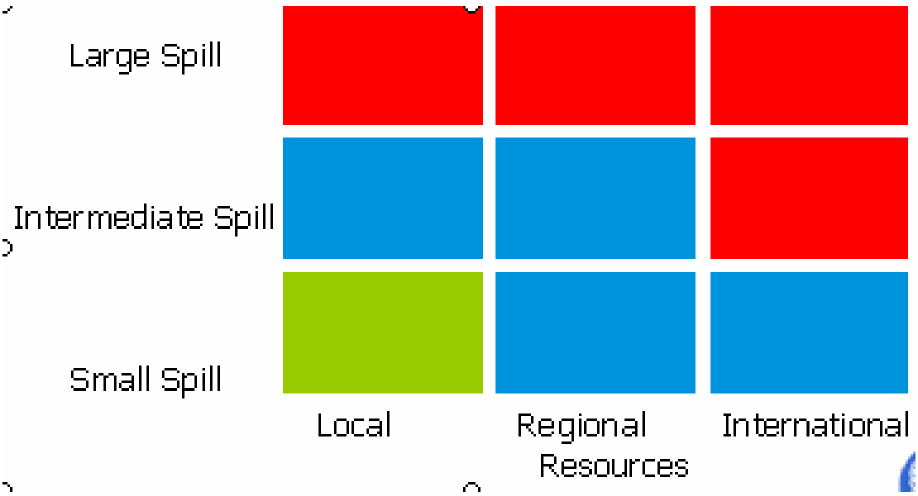
Plans are required at three levels:
- At the international level with the framework of an operational contingency plan.
- At the national level.
- At the local (e.g., for terminals and harbors/ports) and area level.

Should the magnitude of an accident be such that assistance is required, these plans should be integrated in such a way that it will be easy to incorporate additional response capabilities. For example, a port emergency plan should be coordinated with neighboring industrial facilities' plans as well as with the national plan.

The tiered approach to planning should be explained to trainees fully as follows:

(7) Tiered Response

Following diagram shall be shown to assist trainees to get a clear understanding:



A tiered response is a categorization of response levels as a practical basis for planning and organizing. Most contingency plans are based on this tiered response approach, which initially is small but is capable of expanding logically to higher levels, if the spill requires additional response resources. The tiers are estimated based on spill size or spill damage potential.

(a) Tier One is a small localized spill. Plans for tier one should address local authorities, resources, and personnel. It can be for a specific facility such as a port or a terminal, or it can be for a short length of shoreline at risk from small spills. Resources are usually able to be on the scene very quickly.

(b) Tier Two is for an intermediate size spill overtaxing the capabilities of the local authorities and requiring further assistance. Tier Two plans are usually for a larger district or area where the mobilization of resources and facilities from both public and private enterprises would be combined to respond. Mobilization of resources usually occurs within a few hours.

(c) Tier Three response is for large spills of national interest that are beyond the capabilities of the relevant Tier Two response.

Trainees shall note that the numbered tier concept is one that was originally applied to oil spill incidents, but is also being commonly applied to HNS incidents.

(8) Monitoring, Reporting and Record-keeping

A key facet in the preparedness process is the establishment of reporting procedures which will indicate:

- Who is responsible for reporting?
- To whom reports are to be made?
- What format should be used?
- When reports are to be made?

The reporting procedures should be linked to an appropriate record- keeping process.

(9) Defined Operational Procedures

To ensure that an appropriate and effective response is initiated in a timely fashion, trainees are to understand that it is necessary to develop clearly defined procedures for the critical assessment of marine accidents.

It is of paramount importance that responsibilities and roles are clearly defined and operational procedures are properly coordinated. Consider potential and possible scenarios. Integrate different response resources and incorporate lessons learned from actual incidents or exercises.

(10) Contingency Plan

A contingency plan should consist of minimum of four sections:

(a) The introduction will contain the distribution plan and any updates that have been made. It will also include the purpose, scope, and environmental policy of the plan.

(b) The strategy section describes the scope of the plan. The geographical coverage, the perceived risks, roles and responsibilities of those charged with implementing the plan, and the proposed response strategy.

(c) The action and operations section will set out the emergency procedures, which will allow rapid assessment of the spill and mobilization of appropriate resources.

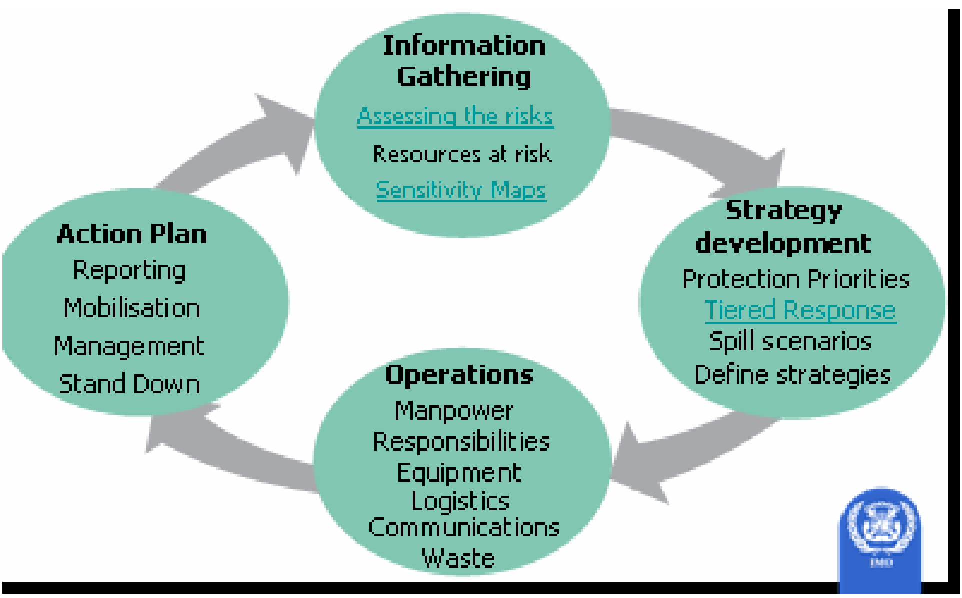
(d) The data directory will contain the relevant maps, resource lists, and data sheets to support the HNS spill response effort.

There are seven key steps to developing a contingency plan;

- Define the scope of the plan
- Conduct risk assessments
- Develop your strategy
- Decide on the structure and layout
- Procure appropriate equipment
- Conduct training and exercises
- Update your plan as circumstances change with feedback from incidents or exercises

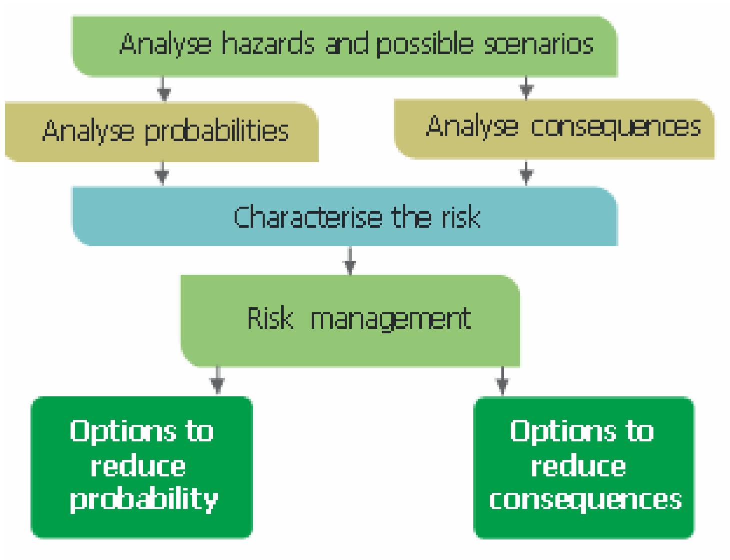
(11) Information Gathering

Trainees are to recognize that this action involves assessing the risks, identifying resources that could be at risk, and sensitivity maps. Information to be considered should include; historic data, HNS properties, climate, local meteorological and environmental sensitivities, behavior, fate, and potential consequences of an HNS incident. In order to produce a contingency plan, we need to collate information about these factors in order to develop appropriate response strategies to best mitigate the threat. The sequence of events shown hereunder is an example of how a contingency plan may be developed, and details some of the key components of a good plan.



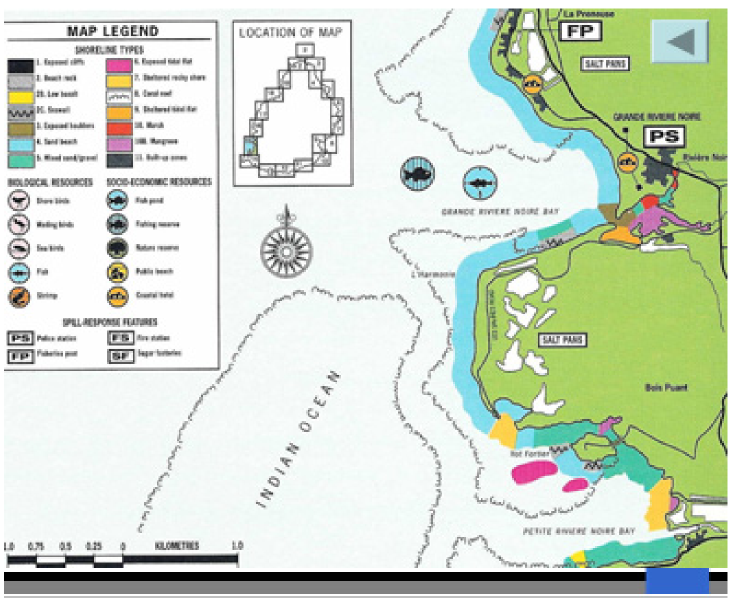
(12) Risk Assessment

The first step of a risk assessment is a correct identification of all hazards. Try not to be narrow-minded. Take into account all possibilities. From there, the probability of this incident or aspect of the incident occurring should then be analyzed. In addition to this, it should be assessed what damage could be done as a result of these hazards, and who they could affect. The risk is then assigned a category. It will then need to be managed. For trainees' assistance, following diagram shall be shown to explain the steps.



(13) Making Map

For explanation about making maps, a sample shall be shown to trainees as shown below:



Trainees are to understand that making and updating sensitivity maps are key activities in the planning process. These maps may be either paper based or linked into a geographical information system (GIS).

As trainees can notice easily from the map, the maps should convey essential information for both ecological and socio-economic resources, and indicate the priority for protection. Other information including beach types, access points, and clean up advice should be detailed on the maps. However, when using paper based maps, it is important to keep the information simple and clear to avoid the maps from becoming too cluttered and difficult to interpret.

Also, trainees may easily notice that sensitivity maps show various types of information. They classify different parts of the shoreline by how sensitive they are to hazardous substances. Managers can look at the sensitivity maps of an area threatened by a spill, to quickly see the most sensitive locations.

(14) Consolidation

To consolidate the learning from this lesson, IMO video – Response to Marine Chemical spills – Part 4 – Contingency Planning, Operations, and Training shall be shown to trainees. In order to practice some of the concepts and ideas learned from this lesson, a short tabletop exercise shall be carried out in Lesson 11.

Lesson O–15: Fundamental Planning and Assessment Tools

Reconfirmation shall be made that there are some fundamental planning and assessment tools, and the trainees are asked to list up them as follows:

- Inventory of the different response plans that can be activated in different areas and the procedures required to activate them.
- Inventory of transportation patterns and commodities transported in different areas.
- The chemical and physical properties of transported substances.
- Toxicological effects and exposure limits of substances
- Chemical fate of substances
- Spill scenarios, describing the substances transported for each sensitive area
- The identification of sensitive areas
- Possible recovery techniques
- Personal protective equipment requirements

Response tools should include:

- An incident assessment system
- A list of experts on maritime and chemical aspects
- Predictive air dispersion modeling
- Predictive water dispersion modeling
- An inventory of incident assessment capabilities
- Access to the ship's manifest and loading plan
- Search and rescue capabilities
- Decontamination techniques

Lesson O–16: Media Awareness

(1) Different types of media communications

In order to carry out response operation successfully, trainees are reminded that a special attention to media is essential. In this lesson, trainees are told about the media and urged to carryout operation with full understanding about the media.

It is also important for trainees to remember that, as a result of recent development in the internet, much of what appears in the media will also instantly appear on the internet. At first, trainees are urged to understand that there are different types of media communications as follows:

- Newspapers
- Newspapers will conduct in-depth reporting
- They will also require detailed information, pictures, and graphics

- They also require background information concerning the incident
- They must meet deadlines. The deadline for the morning papers is the previous evening and the afternoon papers have a deadline of mid-morning.
- Radio
- Radio operates to very tight deadlines
- They conduct hourly or half hourly reports.
- Radio news is frequently updated and the reports are kept brief
- They keep the emphasis on what is happening right now
- They will also conduct on-the-spot interviews
- They contain live sounds
- They feature only on the most important facts.
- Television
- Television messages are very visual
- Information spots are kept short and often rely on satellite space
- Interviews can either be in depth, in the studio, or brief, at or near to the incident scene
- Press conferences are held

(2) Factors involved in successful handling of the media

The media can be a very effective way of ensuring that the public is informed about the incident and its effects. Therefore, trainees are to recognize that careful handling of the media is very important. Response team must ensure that the media gets the correct information, and that means that it must come from the response team as opposed to un-authorised sources of information. It is important that the authorities provide the media with information it needs to do its job and tell its story. The job of the OSC and any Media Liaison Officer is to provide the media with as much of the truth that is known, at the specific time. Followings are the key points to be remembered about media awareness:

Recognise the unfolding nature of the information. It is often the case after an HNS spill that the full story is not always known. This is particularly the case when the response team is investigating the cause, impact, and nature of the spill.

Be aware and prepared for the potential interest and size of the media contingent. There are many factors that can influence the size of the media contingent. On some occasions, the media may only be interested in the identity of the polluter, however, in other cases there may be a threat to wildlife, coastline, etc, which will attract more interest.

It is important to schedule regular briefings and updates. Briefings should be held once or twice a day and updates posted as required. Be conscious of media deadlines and make response authorities and their technical experts available.

Press releases should be provided regularly during the incident response. A good press release will contain the following; the facts as known with no speculation, emphasis on the positive points, use understandable language (avoid technical jargon and acronyms), and include an enquiry route to where the media can get more information.

Additional tools that can be used to supplement news releases include background information, fact sheets, and media kits. This is especially important when trying to explain technical issues with which the public is not conversant. These can be prepared ahead of the incident as part of your preparedness and planning.

Facilities should be provided for the media. This should include establishing a media center with background, pictures, charts and updates, telephones, fax machines and outlets for laptops, and a workspace. Parking facilities for specialized communication vehicles should also be considered.

Provide the media with tours but escort them through the response areas, avoiding unrestricted access to response sites and personnel, and ensure that all safety precautions and standards are observed

(3) Media interviews
Trainees should understand that these are the seven key elements to a successful interview:

(a) Preparation – You must define your own needs and objectives in advance. It is important that you identify the public's concerns so that you can address them properly. You should memorize your principle message and key points. Make sure that you plan the interview, write a list of points that you want to make, and don't be afraid to repeat yourself if you have to. Identify opportunities that the interview may present. Be succinct, to the point, and not longwinded. Anticipate questions and keep your answers short and simple.

(b) Positioning statement – It is important to decide in advance what the key message of the interview is. This is what you want to see in the first few lines of a news story. Explain why you are there, what your efforts will accomplish, and who will benefit.

(c) Negotiate the interview – Where possible negotiate the topics and types of questions beforehand. Explain your role, responsibility, and limits, and obtain agreement to stay within those limits. Ask the reporter their name and the station they are from. Find out what subject(s) they are interested in, and what angle they are working on. Find out who else they have or are intending to speak to. Find out when this story will be run or aired, and what their deadline is. If you can find out all of this then you will be much better prepared. Most important of all, expect the unexpected.

(d) Use of quotes and sound bites – It is important to keep this short. Try to keep it to a 15 second sound bite and break your words into short self-contained units for easy editing. Leave out adjectives as what may be a small spill in industry terms may be a large spill in journalistic terms or the public's perception.

(e) On the record and off the record – As far as this is concerned consider every word you say as being on the record. Remain on your guard at all times as journalists are never off duty. Comments that are supposedly made off the record have a habit of turning up in print. In a major news story the media will be present everywhere, especially in hotels. Hotel lobbies and restaurants are very useful fishing grounds for information.

(f) Handling difficult questions – If you are asked a difficult question it is important that you don't lose your temper or show that you are finding the situation difficult to deal with. Stay calm and be polite at all times.

(g) Look and act the part – It is important that you look and act the part. Dress appropriately for the occasion and reflect the mood of the information that is being divulged. In other words, if it is serious then look serious, if the situation is improving, then look relieved.

(4) One to one interviews
One to one interviews generally fall into two categories;

On the spot / stand up interviews – These are usually in the field or at the command post, and can be arranged with little or no warning. You may have little or no time to negotiate the interview and it may be live with many reporters in competition for your attention.

The personal interview – In this scenario you will be given advance warning and time to negotiate the interview. You will also have time to prepare. This interview will take place in comfortable surroundings, probably with just the one interviewer and will usually focus on pre-arranged topics. These interviews are good opportunities to deliver your message, with the aid of drawings, etc.

(5) News conferences

Trainees should be told about some key points to remember when preparing for a news conference:

- Make sure that everybody is ready, especially TV cameramen, before making your opening statement. You may be asked to read the opening statement again for someone wanting a different location, a latecomer, or a TV crew with equipment problems. Limit the time you make available.
- Hand out a prepared statement. Make it short and precise.
- Tape yourself, whether you are talking to one reporter or one hundred. Be open about it. Bring out your recorder, switch it on, and without commenting, start the news conference. If asked about the recorder, say that it is corporate / government policy.
- When you invite questions, ask journalists to give their names and organization, and try to remember them. Write them down if you can.
- If you don't have an immediate answer, then say so, but offer to obtain the information as soon as possible. If you cannot answer a question for policy reasons, then say so.
- If you make arrangement to speak with a reporter or set a time to provide information, then be punctual.

(6) Common questions

Trainees are reminded that followings are the kind of questions that could be asked at the new conference:

- What happened?
- How did it happen?
- When and where did it happen?
- Who is involved?
- What caused it?
- What is being done about it?
- Who is to blame?
- Who is responsible / liable?

(7) Common questions – 2

Trainees are also told that further questions could be asked at the news conference, are as follows:

- What operations are going on?
- Has it happened before?
- Was it preventable?
- Are there any witnesses?
- What is the impact?
- What are the health and safety risks?
- Is anyone injured?
- Do we need to evacuate?
- How much will it cost?

(8) HNS incidents

Trainees should remember that there are specific public concerns during HNS incidents, which the media will focus on.

It should be emphasized that, in comparison to oil incidents, with which the public is more familiar having had a greater exposure to media coverage of high profile incidents, chemical incidents hold greater fears for the public.

This stems from a heightened sense of alarm and the comparisons with chemical and biological warfare, terrorism attacks, and nuclear emergencies. Terminology used is often not understood and the words convey a sense of alarm – what is the substance involved, what does it do, how can it harm me? This coupled with the very real dangers posed by some substances can be very alarming and the public may be drawn, or directed, to media sources for the latest information. This may include safety messages such as instructions to remain inside with all doors and windows closed or to evacuate.

HNS incidents and the response to the incidents may be very visual and the sight of ruptured and burning tanks, response personnel in gas suits, and emergency vehicles can also convey a sense of alarm and fascination. Equally, given the physical behavior of some substances, there may be little to see, which in turn can raise fears over "hidden" dangers

(9) Do's

Trainees are urged to always remember News Conference – Do's, as follows:

- Prepare your positioning statement and key messages, and keep returning to those key messages. Communicate information at the earliest possibility.
- Keep track of what was being said during the interview.
- Answer the reporter's question, but return to your key message.
- Stay cool, calm, and clear headed
- Give the full story
- Be honest, accessible, and understanding.
- Ask for questions to be repeated if you don't understand them.
- Put the story into context.
- Define the real problem.
- Stick to what you know, the facts.
- Break bad news.

(10) Don'ts

Trainees are further urged to always remember News Conference – Don'ts, as follows:

- Don't be sarcastic
- Don't lose your temper
- Don't speculate
- Don't offer a personal opinion
- Don't lie
- Don't give exclusive interviews
- Don't be evasive

Lesson O–17: Training Program and Exercise Schedule

(1) After reconfirmation of understandings about Emergency Response System and refreshing their memory, trainees may then, proceed to the stage of training and exercise. However, before running the exercise, instructors should make sure that the standards including the followings are explained to trainees:

- Training should be content specific with the job performance expectations
- There should be schedules for implementation and compliance dates
- There should be requirements for issuing certificates and their specific content
- Requirements for periodic refresher training are defined. (Example: 3 yearly requalification.)
- Exercises and drills are planned for regular intervals to ensure that the response program is effective
- Ensure that all training organizations used are approved/certified prior to conducting the training
- Training delivered is of an equivalent standard as international training requirements.

(2) To start the training, trainees are to review an IMO video entitled "Response to Marine Chemical Spills" so that they may grasp the essential point of operation.

The instructor shall summarize the following challenges and dangers of an HNS incident and ask trainees to always remember them during operation:

(a) operational

The main operational elements include

- Safety
- Organizing people and resources
- Establishing a command organization/structure and command center
- Communications
- Planning
- Deploying equipment
- Logistics
- Clean-up, decontamination, and disposal

(b) Public pressure

- Public pressure may come from affected groups such as local fishermen, local business who rely on tourism, holiday makers, etc.
- The public will have health concerns as well as the local authorities
- Environmental organizations will also apply pressure during an incident, and there may be differing environmental priorities.

(c) Political

Political factors can include both internal and external pressure -

- Internal pressure can come from other departments in the organization
- External pressure may come from government, politicians or lobby groups.

Lesson O–18: Case History

In this lesson, trainees shall consider the two case histories of marine incidents involving HNS, which have already been introduced to trainees during the watching of the IMO video series "Response to Marine Chemical Spills".

(1) Anna Broere

The first case history involves a bulk shipment of HNS, and the second a shipment of packaged HNS. We will look at the basic facts of each case and then discuss how we might approach similar incidents.

On May 27 ,1988, the Dutch chemical carrier Anna Broere, on her way from Rotterdam to England, collided with the Swedish container ship Atlantic Compass. Atlantic Compass could continue its journey towards Antwerp while Anna Broere was severely damaged and sank in the shallow water.
The cargo of Anna Broere consisted of 547 tons of acrylonitrile and 500 tons of dodecylbenzene, of which the latter is not regarded as a marine pollutant and was therefore left untreated.

Acrylonitrile is a liquid which, if spilled will dissolve and evaporate. It is highly flammable and is considered moderately toxic to marine living resources. It is not considered to bioaccumulate and is assigned a MARPOL B category. In summary it is considered a very dangerous chemical, both to humans and as a marine pollutant.

Dodecylbenzene is a liquid which if spilled, will float. It is not considered flammable, nor acutely toxic to marine living resources and does not bioaccumulate. It falls outside of the MARPOL pollution categories.

(a) Air and Sea exclusion zone established

An exclusion zone with a radius of 18 km and a height of 200 m was established.

(b) Acrylonitrile main priority

Acrylonitrile was considered to be more harmful to the marine environment and priority was given to recover the chemical from the vessel.

(c) Salvage operation to recover vessel

A salvage operation to recover the acrylonitrile commenced with the help of a large floating crane. The initial plan was to lift and maneuver the vessel over the submerged main deck of a semi-submersible barge and then transport the wreck to port. In the first righting and lifting attempt, the cables broke and the ship sank again. It was then decided to saw the ship in two, to transship underwater the acrylonitrile from the leaking tank, and to lift the two sections separately. The salvagers mobilized a fleet that includes a floating crane, which acted as an accommodation base, a semi-submersible barge, a vessel outfitted as an emergency hospital with a medical evacuation helicopter, and a technical support/chemical monitoring vessel. Salvage workers were equipped with PPE (i.e. protective clothing and SCBA). The crane was fitted with an automatic gas alarm system. Chemical specialists also formed a part of the salvage team. Naval frigates patrolled the area. Both parts of the ship were eventually lifted and about half of the acrylonitrile was recovered. The other half had leaked out and rather quickly dispersed into the sea. During the operation, the concentrations of acrylonitrile in air and water, was continuously monitored due to the safety of the personnel. The entire operation lasted 73 days, of which only 25 were productive working days. Delays were caused by the bad weather and high concentrations of HNS in the atmosphere. Sampling of the seawater and air around the area of the wreck showed dangerous levels of acrylonitrile, indicating that a tank might have been breached.

After watching the case, trainees are asked to explain what they have observed from the case.

(2) Cason

This is a very interesting incident, as it is a very complex situation, primarily due to the variety of substances onboard, but useful as an example of the assessment of priorities in a response incident. The MV Cason was a general cargo ship on a voyage from Antwerp to Shanghai in November 1987. She was carrying over 1,1000mt of packaged chemicals (23 Different types and covering all IMDG code groups except 1,5,7) and 750mt of Heavy fuel oil. She caught fire in bad weather about 20 Nm from La Coruna in N Spain. The crew abandoned ship very quickly due to drums loaded with Sodium metal coming into contact with water and violently reacting and exploding. Regrettably only 8 of the 31 crew survived and this was primarily due to exposure to the low water temperature and the lack of personal protective equipment. She drifted ashore off Cape Finisterre, close to a town of over 20,000 people. The ships bottom was damaged and water had entered a number of cargo holds. The ship was severely damaged and the environmental and human situation was critical. The picture shown below may demonstrate how serious the incident was.

There was limited information available on the vessel's cargo and both the IMO and the European Union were asked to assist in identifying the cargo. This led to difficulties in evaluating the risks without having any immediate information concerning the cargo. It may be easily notice from the table shown below, the cargo aboard the ship included approximately 1,100 tons of packaged HNS as well as 750 tons of bunker fuel. Of the 23 different kinds of substances, only IMDG Codes 1, 5, and 7 were not represented. The presence of 126 tons of sodium metal, together with 600 tons of highly flammable liquids, and 750 tons of fuel, created an explosive/flammable cocktail as in the case of the sodium-water contact. Many of the drums containing sodium were damaged, resulting in fire and explosions.

SUBSTANCE	QUANTITY Mt	IMDG NO	UN NO
n-Butanol	228	3.3	1120
Xylenes	254	3.3	1307
Cyclohexanone	8.6	3.3	1916
Formaldehyde	86	3.3	1198
Sodium Metal	126	4.3	1428
Aniline oil	110	6.1	1547
Diphenylmethe 4.4 Diisocyanate	0.7	6.1	2489
Ortho cresol	110	6.1	2076
Bunker fuel	750	X	1270
Phosphoric Acid	50	8.0	1805

It was decided that refloating would be too difficult due to the bottom damage caused by the grounding. The vessel was, therefore, discharged in situ, albeit with difficulty due to bad weather.
The following plan of action was prepared as a result of a survey done on board:

- Discharge the sodium drums from the deck
- Discharge the hold containing the other drums of sodium
- Unload the dangerous goods located on deck, giving priority to the most polluting substance
- Transfer the bunker fuel
- Unload the good from the holds, beginning with the most hazardous materials.

Sea and air monitoring were conducted at the start of the salvage operation. The recovery of dangerous goods was completed within three months. One main problem that arose during the emergency was the issue of dealing with the media. Uninformed declarations made by individuals and different authorities led to panic among the population living in the vicinity of the coast. This resulted in a massive evacuation of people (15,000) living in the proximity of the accident (5 km radius).

After looking at the case, trainees are asked to explain what they have observed from the case and discuss among the trainees to confirm what lessons can be learned from this incident.

Lesson O–19: Training & Exercise

(1) Training standards, which have already been explained to trainees, are repeatedly told to trainees so that they may confirm their understanding.
The standards should include, at the least, the followings:
- Specific training content, pursuant to individual job performance expectations.
- Schedules for implementation and compliance dates.
- Requirements for the issuing of training certificates and their specific content.
- Requirements for periodic refresher training (e.g., every three years).
- Requirements for exercises or drills, to evaluate response program implementation/ effectiveness;
- Certification/approval of training delivery organizations.
- Equivalency with international training requirements.

(2) Tabletop exercise
For the purpose of gaining knowledge about operation in the incidents, trainees are to attend tabletop exercise by using the case of M.S. "Onward Prince" as an example. Materials, which are necessary for the exercise and demonstrated hereunder, shall be distributed to trainees before starting the exercise. Trainees are reminded that this is an example of a vessel and is for exercise purposes only. No similarity is intended between actual vessels or vessels with these characteristics. Through this table top exercise, it is hoped that trainees will get accustomed to the operation and may run field training to get skills by using the knowledge gained through the tabletop exercise.

This is the end of the Manual for Operational Level. Trainees are asked to run this tabletop exercise and/or other simulation models periodically e.g. once a year and also to carryout field exercise for the purpose of reconfirming and reinforcing understandings and skills gained through this lesson, at least once a year.

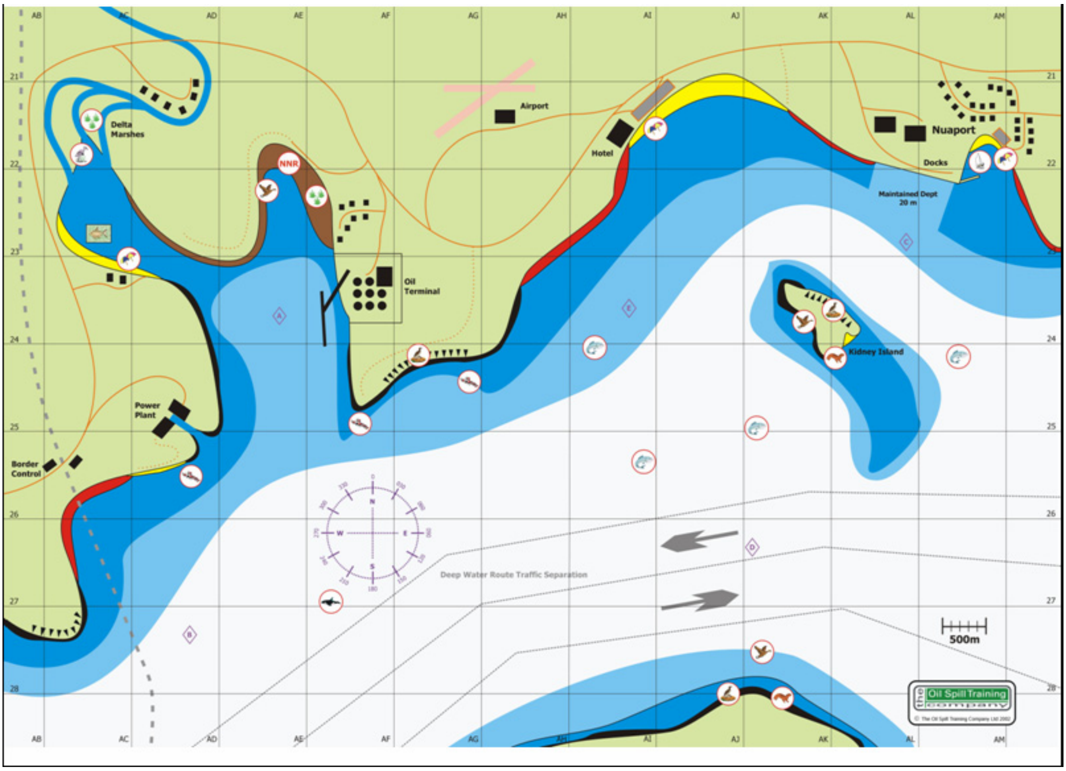
Exercise Nuatown HNS

MV	**Onward Prince vessel data**
Type :	**Container Vessel**
Flag :	**Panama**
Call Sign :	**3FKT5**
IMO Number :	**8478894**
Built:	**November 1996**
DWT :	**15,906 t.**
GRT:	**14,808 t.**
LOA :	**169.00 m**
Beam :	**27.20 m**
Max Draft :	**9.0m**

Capacity :	**1,164 teu**
Propulsive Power :	**MAN B&W two-stroke engine**
Propulsion :	**CPP (controllable pitch propeller)**
Speed :	**> 20 knots**
Maneuvering :	**Bow and stern thrusters**
Crew :	**17**

Materials provided

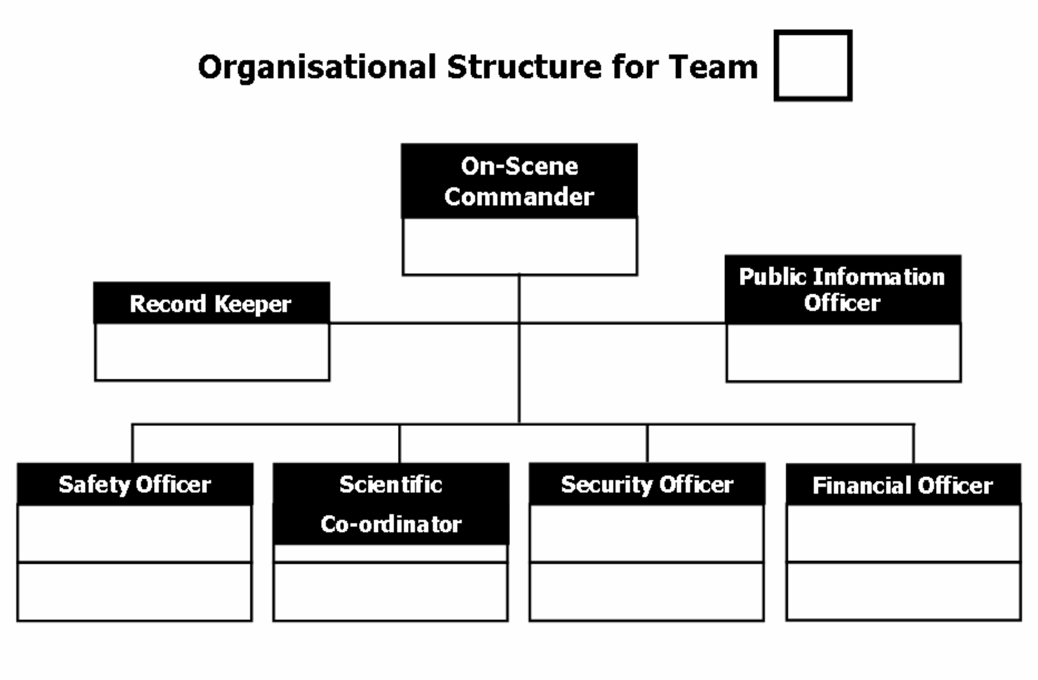
① Map Nuaport Chart



② **Chart Key**


Key
Shell Fishery
Saltmarsh/Mangrove
Nesting Birds
Wading Birds
NNR
National Nature Reserve
Sea Birds
Marine Mammals
Marine Leisure
Leisure/Tourism
Fishery
Mammal Haul-out
D
Tidal Reference Point
Fish Farm
Building/Structure
Rocky Shoreline
Track
Road
Sandy Shoreline
Pipeline
Sheltered/Mud Shoreline
Depth 10mtr or less
Shingle/Mixed Shoreline
Cliffs
Depth 20mtr or less

③ Organization Chart



④ Information sheet

MV	**Onward Prince**
Type :	**Container Vessel**
Flag :	**Panama**
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Propulsive Power :	**MAN B&W two-stroke engine**
Propulsion :	**CPP (controllable pitch propeller)**
Speed :	**> 20 knots**
Maneuvering :	**Bow and stern thrusters**
Crew :	**17**

Note: This is an example of a vessel and the data shown herein are for exercise purposes only. No similarity is intended between actual vessels or vessels with these characteristics

⑤ EmS Guide

FIRE SCHEDULE Alpha

F - A
GENERAL FIRE SCHEDULE

General comments		In a fire, exposed cargos may explode or their containment may rupture. Fight fire from a protected position from a distance as far away as possible.
Cargo fire on deck	**Packages**	Create water spray from as many hoses as possible.
	Cargo Transport Units	
Cargo fire under deck		Stop ventilation and close hatches. Use cargo space fixed fire-extinguishing system. If this is not available, create water spray using copious quantities of water.
Cargo exposed to fire		If practicable, remove or jettison packages which are likely to be involved in fire. Otherwise, keep cool using water.
Special cases:		
UN 1381, UN 2447		After extinguishing the fire, treat immediately as for spillage (see relevant EmS SPILLAGE SCHEDULE).

FIRE SCHEDULE Echo

F - E
NON-WATER-REACTIVE FLAMMABLE LIQUIDS

General comments		Cargos in tanks exposed to heat may explode suddenly in or after a fire situation by a *Boiling Liquid-Expanding Vapor Explosion* (BLEVE). Keep tanks cool with copious quantities of water. Fight fire from a protected position from a distance as far away as possible. Stop leakage or close open valve if practicable. Flames may be invisible.
Cargo fire on deck	**Packages**	Create water spray from as many hoses as possible.
	Cargo Transport Units	Cool burning transport units and nearby cargo exposed to the fire with copious quantities of water.
Cargo fire under deck		Stop ventilation and close hatches. Use cargo space fixed fire-extinguishing system. If this is not available, create water spray using copious quantities of water.
Cargo exposed to fire		If practicable, remove or jettison packages which are likely to be involved in the fire. Otherwise, keep cool for several hours using water.

Special cases:	
UN 1162, UN 1250, UN 1298, UN 1717, UN 2985	Cargoes will create hydrochloric acid in contact with water: stay away from effluent.

FIRE SCHEDULE Hotel

F - H
OXIDIZING SUBSTANCES WITH EXPLOSIVE POTENTIAL

General comments		In a fire, exposed cargoes may explode or their containment may rupture. Crew members should be aware of the explosion hazard and take appropriate action. Fight fire from a protected position from a distance as far away as possible. SUDDEN OR SHORT-TERM EVENTS (E.G. EXPLOSIONS) MAY ENDANGER THE SAFETY OF THE SHIP.
Cargo fire on deck	**Packages**	Create water spray from as many hoses as possible.
	Cargo Transport Units	
Cargo fire under deck		OPEN HATCHES to provide maximum ventilation. Fixed gas fire-extinguishing systems may not be effective on these fires. Create water-spray from as many hoses as possible.
Cargo exposed to fire		Do not move packages that have been exposed to heat. If practicable, remove or jettison packages which are likely to be involved in the fire. If the packages are not directly involved in the fire, efforts should be concentrated on preventing the fire from reaching the cargo. This is done by keeping the packages wet by using water jets from a distance as far away as practicable to drive the fire away. If the fire reaches the cargo, the fire-fighters should withdraw to a safe area and continue to fight the fire from a safe position. Where practicable, articles having been exposed to the fire should be kept separated from unexposed articles. They should be kept wet and monitored from a safe distance.
Special cases: None.		

SPILLAGE SCHEDULE Bravo

S - B
CORROSIVE SUBSTANCES

General comments	Wear suitable protective clothing and self-contained breathing apparatus. Avoid contact, even when wearing protective clothing. Keep clear of effluent. Keep clear of evolving

		vapors. Even short-time inhalation of small quantities of vapor can cause breathing difficulties. Use of water on the substance may cause a violent reaction and produce toxic vapors. Substance may damage ship's construction materials. Contaminated clothing should be washed off with water and then removed.
Spillage on deck	**Packages (small spillage)**	Wash overboard with copious quantities of water. Do not direct water jet straight onto the spillage. Keep clear of effluent. Clean the area thoroughly.
	Cargo Transport Units (large spillage)	Keep bridge and living quarters up wind. Protect crew and living quarters against corrosive or toxic vapors by using water spray to drive vapors away. Wash overboard with copious quantities of water. Do not direct water jet straight onto the spillage. Keep clear of effluent. Clean the area thoroughly.
Spillage under deck	**Packages (small spillage)**	Provide adequate ventilation. Do not enter space without self-contained breathing apparatus. Check atmosphere before entering (toxicity and explosion hazard). If atmosphere can not be checked, do not enter. Let vapor evaporate. Keep clear. ***Liquids***: Provide good ventilation of the space. Wash down to the bottom of the hold. Use copious quantities of water. Pump overboard. ***Solids***: Collect spillage. Dispose overboard. Wash residues down to the bottom of the hold. Use copious quantities of water. Pump overboard.
	Cargo Transport Units (large spillage)	Keep bridge and living quarters up wind. Protect crew and living quarters against corrosive or toxic vapors by using water-spray to drive vapors away. Do not enter space. Keep clear. Radio for expert ADVICE. After hazard evaluation by experts, you may proceed. Provide adequate ventilation. Do not enter space without self-contained breathing apparatus. Check atmosphere before entering (toxicity and explosion hazard). If atmosphere cannot be checked, do not enter. Let vapors evaporate, and keep clear. Where a ventilation system is used, particular attention should be taken in order to prevent of toxic vapors or fumes from entering occupied areas of the ship, e.g. living quarters, machinery spaces, working areas. ***Liquids***: Provide good ventilation of the space. Wash down to the bottom of the hold. Use copious quantities of water. Pump overboard. ***Solids***: Collect spillage. Dispose overboard. Wash residues down to the bottom of the hold. Use copious quantities of water. Pump overboard.

Special cases:	
Marine Pollutant Mark	Report incident according to MARPOL reporting requirements.
UN 2802, UN 2809	No reaction with water. Not highly corrosive to protective clothing. Collect spillages if practicable. Try to avoid disposal overboard. Radio for expert ADVICE.

SPILLAGE SCHEDULE Charlie

S - C
FLAMMABLE CORROSIVE LIQUIDS

General comments		Wear suitable protective clothing and self-contained breathing apparatus. Avoid contact, even when wearing protective clothing. Keep clear of effluent. Keep clear of evolving vapors. Even short-time inhalation of small quantities of vapor can cause breathing difficulties. Use of water on the substance may cause violent reaction and produce toxic vapors. Substance may damage the ship's construction materials. Spillage or reaction with water may evolve flammable vapors. Avoid all sources of ignition (e.g. naked lights, unprotected light bulbs, electric hand tools, friction). Contaminated clothing must be washed off with water and then removed.
Spillage on deck	**Packages (small spillage)**	Wash overboard with copious quantities of water. Do not direct water jets straight onto the spillage. Keep clear of effluent. Clean the area thoroughly.
	Cargo Transport Units (large spillage)	Keep bridge and living quarters upwind. Protect crew and living quarters against corrosive or toxic vapors by using water-spray to drive vapors away. Wash overboard with copious quantities of water. Do not direct water jets straight onto the spillage. Keep clear of effluent. Clean the area thoroughly.
Spillage under deck	**Packages (small spillage)**	Provide adequate ventilation. Do not enter deck without self-contained breathing apparatus. Check atmosphere before entering (toxicity and explosion hazard). If atmosphere cannot be checked, do not enter. Let vapors evaporate, and keep clear. ***Liquids***: Provide good ventilation of the space. Use water-spray on effluent in hold to avoid ignition of flammable vapors. Wash down to the bottom of the hold. Use copious quantities of water. Pump overboard. ***Solids***: Collect spillage. Dispose overboard. Wash residues down to the bottom of the hold. Use copious quantities of water. Pump overboard.

	Cargo Transport Units (large spillage)	Keep bridge and living quarters upwind. Protect crew and living quarters against corrosive or toxic vapors by using water-spray to drive vapors away. Do not enter space. Keep clear. Radio for expert ADVICE. After hazard evaluation by experts, you may proceed. Provide adequate ventilation. Do not enter space without self-contained breathing apparatus. Check atmosphere before entering (toxicity and explosion hazard). If atmosphere cannot be checked, do not enter. Let vapors evaporate, and keep clear. Where a ventilation system is used, particular attention should be taken in order to prevent toxic vapors or fumes from entering occupied areas of the ship, e.g. living quarters, machinery spaces, working areas. ***Liquids:*** Provide good ventilation of the space. Use water-spray on effluent to avoid ignition of flammable vapors. Wash down to the bottom of the hold. Use copious quantities of water. Pump overboard. ***Solids:*** Collect spillage. Dispose overboard. Wash residues down to the bottom of the hold. Use copious quantities of water. Pump overboard.
Special cases:		
Marine Pollutant Mark		Report incident according to MARPOL reporting requirements.
UN 2029		Self-ignition of spilt material is possible.

SPILLAGE SCHEDULE Juliet

S - J

WETTED EXPLOSIVES AND CERTAIN SELF-HEATING SUBSTANCES

General comments		Wear suitable protective clothing and self-contained breathing apparatus. Avoid all sources of ignition (e.g. naked lights, unprotected light bulbs, electric hand tools, friction). Wear non-sparking footwear. Stop leak if practicable. Dried out material may explode if exposed to heat, flame, friction, or shock.
Spillage on deck	**Packages (small spillage)**	Keep spillage wet. Dispose of solid material overboard. Wash overboard with copious quantities of water. Keep clear of effluent.
	Cargo Transport Units (large spillage)	
Spillage under deck	**Packages (small spillage)**	Keep spillage wet. Collect and contain spillage if practicable. Dispose of overboard. Collect spillage using soft brushes and plastic
	Cargo	

	Transport Units (large spillage)	trays.
Special cases: None.		

SPILLAGE SCHEDULE Quebec

S - Q
OXIDIZING SUBSTANCES

General comments		Wear suitable protective clothing and self-contained breathing apparatus. Avoid all sources of ignition (e.g. naked lights, unprotected light bulbs, electric hand tools, friction). Wear non-sparking footwear. May ignite combustible material (e.g. wood, paper, and clothing). Stop leak if practicable.
Spillage on deck	**Packages (small spillage)**	Wash overboard with copious quantities of water. Keep clear of effluent.
	Cargo Transport Units (large spillage)	
Spillage under deck	**Packages (small spillage)**	Do not enter space without self-contained breathing apparatus. *If dry*, contain and collect spillage, if practicable. Dispose of overboard. *If wet*, use inert absorbent material. Do not use combustible material. *If liquid*, wash down to the bottom of the hold using copious quantities of water. Pump overboard. Dispose of overboard.
	Cargo Transport Units (large spillage)	Provide adequate ventilation. Do not enter space without self-contained breathing apparatus. *If dry*, contain and collect spillage, if practicable. Dispose of overboard. *If wet*, use inert absorbent material. Do not use combustible material. *If liquid*, wash down to the bottom of the hold using copious quantities of water. Pump overboard. Dispose of overboard.
Special cases: None.		

⑥ Equipment Hire Availability and Cost Sheet

Description	Mobilization	Cost per hr.	Hrs on hire	Total Cost
Fixed wing light aircraft *On contract to the local Coast guard for aerial surveillance and search and rescue.*	15 mins	Free of Charge		
Helicopter *For aerial assessments, movement of personnel, etc*	*1 hour*	$600		
Harbor Tugs *Availability: One moored at the Oil Terminal, Two moored at Nuaport Docks. Each tug has sufficient deck space for 2 containers*	1 hour	$500		
Workboats *Availability: One moored at the Oil Terminal, Three moored at Nuaport. Suitable for transporting personnel and small equipment*	1 hour	$75		
RIB *Two 6mtr RIBs are available form the water sports center at Nuaport*	2 hours	$55		
4X4 Vehicle *Can carry up to five people. Minimum charge is 8 hours*	1 hour	$15		
Truck *Includes driver. Can carry up to 7.5 tons of equipment and two extra people. Minimum charge is 8 hours.*	1 hour	$45		
Crane *Includes driver. Can load and unload trucks. Minimum charge is 8 hours*	1 hour	$60		
Respiratory Protection – 6 man pack	30 mins	$10		
SCBA – 6 man pack c/w 12 cylinders & compressor	30 mins	$30		
Level A Protection – 6 man pack	30 mins	$40		
Level B Protection – 6 man pack	30 mins	$30		
Level C Protection – 6 man pack	30 mins	$20		
Decontamination Pack – container	30 mins	$40		
Investigation Pack – mini containers	30 mins	$40		


Equipment
Catalogue

Containment Systems

Offshore Containment Boom

Length	200 meters
Logistics Req'd	1 Tug 1 Workboat 5 Trained operators
Deployment ⏱	Loading and set-up time, 1 hr. Deployment time, 30 mins per 100 meter.
Information	Boom section can be connected together up a max length of 800 meters

Sheltered Water Containment Boom

Length	20 meters
Logistics Req'd	1 small workboat 4 Trained operators
Deployment ⏱	45 mins set-up on site. 30 mins per 100mtr for deployment.
Information	Boom can be connected together to the required length. Can be used with the Shoreline Containment Boom.

Shoreline Containment Boom

Length	20 meters
Logistics Req'd	1 small workboat 4 Trained operators
Deployment ⏱	45 mins set-up on site. 45 mins per 100mtr for deployment.
Information	Boom can be connected together to the required length. Can be used with the Sheltered Water Containment Boom.

Recovery Systems

Sheltered Water Disc Skimmer

Capacity	15 tons per hour
Logistics Req'd	2 Trained operators Storage system
Deployment	Set-up and deployment, 30 mins
Information	Expect 90% oil/10% water.

Shoreline Vacuum System

Capacity	10 tons per hour
Logistics Req'd	2 Trained operators Storage system
Deployment	Set-up time, 30 mins
Information	Expect 50% oil/50% water. Can also be used in sheltered waters.

Offshore Weir Skimmer

Capacity	45 tons per hour
Logistics Req'd	2 Trained operators Crane Storage system
Deployment	45 mins
Information	Power Pack weight, 1.5 tons. Skimmer weight 350kgs. Expect 20% oil/80% water.

Offshore Vacuum Skimmer

Capacity	40 tons per hour
Logistics Req'd	2 Trained operators Crane
Deployment	Set-up time, 60 mins
Information	Power pack weight, 4 tons. 2 tones storage onboard. Skimmer head weight, 20 kegs. Expect 10% oil/90% water.

Recovery Systems *cont.*

Heavy Oil Skimmer

Capacity	50 tons per hour
Logistics Req'd	2 Trained operators Crane Storage system
Deployment ⏱	45 mins
Information	Power Pack weight, 1.5 tons. Skimmer weight 375kgs. Expect 80% oil/20% water.

Storage Systems

Temporary Storage Tank

Capacity	5000 liters
Logistics Req'd	1 Trained operator
Deployment ⏱	15 mins
Information	Requires level firm ground

Floating Pillow Tank

Capacity	50,000 liters
Logistics Req'd	Crane 3 Trained operators Workboat
Deployment ⏱	1 hour
Information	May have difficulty removing oil from tank, following deployment.

Inflatable Barge Tank

Capacity	25,000 liters
Logistics Req'd	Crane 2 Trained operators Workboat
Deployment ⏱	30 mins
Information	Open top for easy of oil removal.

Miscellaneous

High Pressure Washer

Capacity	Clean 0.5 mtr^2 per minute
Logistics Req'd	1 Trained operator Assistance to move machine
Deployment ⏱	Set-up, 30 mins
Information	Containment system must be in place to recover run-off

Wide Platform Workboat

Capacity	Deck area, 10 mtr^2
Logistics Req'd	Slipway and light commercial truck required for launch. 2 Trained Personnel
Deployment ⏱	30 mins
Information	For use in sheltered waters only

Beach Sand Cleaner

Capacity	Up to 1 hectare per hour
Logistics Req'd	Low loader required for transportation
Deployment ⏱	Set-up, 2 hrs
Information	For light contamination only

Sorbent Materials

Capacity	50 liter per 3mtr section
Logistics Req'd	1 Person Storage bags or barrel
Deployment ⏱	Immediate
Information	Capacity quoted above is for sorbent boom. The material is available in squares, sheets, rolls, pillows, and loose.

PPE

Respiratory Protection	
Capacity	
Logistics Req'd	
Deployment ⏱	1 man operation, 3 mins
Information	Air purifying respirator not suitable for use in an oxygen deficient atmosphere

SCBA	
Capacity	20mins work maximum
Logistics Req'd	Operated by trained personnel only. Requires spare cylinders and re-charging facilities
Deployment ⏱	Individual carrying case 1 man operation, 10 mins
Information	Positive pressure set

Level A Protection	
Capacity	Chemical resistant suit complete with integral gloves and boots
Logistics Req'd	Operate by trained personnel only
Deployment ⏱	Individual carrying case 1 man operation, 20 mins
Information	Use with SCBA, coveralls. Hard hat and 2 way radio communications

Level B Protection	
Capacity	Splash protection suit
Logistics Req'd	Separate gloves and boots
Deployment ⏱	Individual carrying case 1 man operation, 15 mins
Information	Requires SCBA, 2 way radio communications, hard hat and trained SCBA operator.

Level C Protection

Capacity	Splash protection suit
Logistics Req'd	Separate gloves and boots
Deployment ⏱	Individual carrying case 1 man operation, 10 mins
Information	Requires air-purifying respirator, 2 way radio communications, hard hat

Decontamination Pack

Capacity	
Logistics Req'd	Source of wash water, collection and removal
Deployment ⏱	2 man operation to erect, 20 mins
Information	Needs calm conditions, sorbents, trained operators

Investigation Pack

Capacity	6 man team
Logistics Req'd	2 man operation
Deployment ⏱	15 mins to assemble and test
Information	2 way communications, gas analyzers, oxygen meters, sample and collection equipment

⑧ Equipment Order Form

Description	Unit	Cost	Qty	Loc'n	Total
Helicopter Dispersant Spray System	1	$40,000			
Boat Dispersant Spray System	1	$15,000			
Beach Dispersant Spray System	1	$6,000			
Dispersant, 200ltr	1	$600			
Offshore Containment Boom	200mtr	$65,000			
Sheltered Water Containment Boom	20mtr	$2000			
Shoreline Containment Boom	20mtr	$2000			
Sheltered Water Disc Skimmer	1	$20,000			
Shoreline Vacuum System	1	$15,000			
Offshore Weir Skimmer	1	$80,000			
Offshore Vacuum Skimmer	1	$150,000			
Heavy Oil Skimmer	1	$90,000			
Temporary Storage Tank	1	$2,500			
Floating Pillow Tank	1	$30,000			
Inflatable Barge Tank	1	$15,000			
High Pressure Washer	1	$6,000			
Wide Platform Workboat	1	$22,000			
Beach Sand Cleaner	1	$125,000			
Sorbent Material, 4 X 3mtr (12mtr)	1	$150			
Respiratory Protection	1	$50			
SCBA c/w spare cylinder	1	$500			
Level A Protection	1	$450			
Level B Protection	1	$300			
Level C Protection	1	$150			
Decontamination Pack	1	$30,000			
Investigation Pack	1	$15,000			

Equipment Total [ ]

Personnel Budget Form

Description	Unit	Cost	Qty	Total
Full Time Team Leader/Supervisor	1	$60,000		
Full Time Technician/Operator	1	$40,000		
Annual Training for On-Scene Commander	1	$4,500		
Annual Training for Supervisor/Technician	1	$2,500		
Annual Training for Equipment Operator	1	$1,500		

Personnel Total [ ]

Equipment & Personnel Total [ ]

⑨ Information Sheet

Scale

The chart is divided into 1km² grids. There is also a 500m scale shown. For the purposes of this exercise, it can be assumed that one nautical mile measures 115mm on the chart.

Nautical Mileage Conversion

The table below is a quick conversion chart from Nautical miles to distance on the chart in millimeters.

Nautical Miles	0.1	0.2	0.25	0.3	0.5	0.6	0.75	1
Distance mm	12	23	29	35	58	69	86	115

Environmental Sensitivities

There are a number of sensitivities in the area. The main locations are indicated on the chart.

The following table provides some extra useful information:

Shell Fisheries	There are three main areas for shell fisheries. The industry is worth approximately $1,000,000 annually. The majority of the harvest is exported with a small proportion sold locally.
Sea Fisheries	The main area for sea fisheries lies to the east and west of Kidney Island. Six local fishing boats operate out of Nuaport. They land a catch of over 1000 tons per year worth over $3,000,000 annually. The fish are processed locally providing employment for a staff of 25 employees.
Marine Leisure	There is a marina located in the Nuaport Harbor area, providing berths for over 50 yachts. The area to the south of Nuaport is also a popular area for waterskiing and power boating.
Tourism	The sandy beach at Nuaport is very popular, attracting local and foreign tourists. There is a large hotel located to the west of the town. There is also a quieter beach close to Delta Marshes.
Seabirds	Kidney Island in uninhabited. It is home to various colonies of seabirds and is an important nesting site. A colony of Waders occupy Delta Marshes. This area, along with mudflats and saltmarshes to the east, also hosts large numbers of migratory birds. There is also a colony of birds nesting on the cliffs to the south of the Oil Terminal.
Whales	A pod of whales are regularly seen in the area around grid reference 27AE.

Commercial Resources

Various commercial resources are indicated on the chart. The following table provides some useful extra information:

Power Plant	The power plant is gas-fired and is an important contributor to the national electrical grid. Seawater is used as a coolant, resulting in a 2 - 3 knot current at the intake.
Oil Terminal & Petro-chemical Terminal	The oil terminal is an import and storage point for crude oil for the national refinery located inland. It also imports and stores Gas Oil, Heavy Fuel Oil, and Gasoline. The terminal imports around 200,000 tons of crude every week, delivered by two 100,000 dwt tankers. Product is delivered in smaller parcel sizes by 10,000 dwt tankers. The terminal has a small petro-chemical plant which produces small quantities of chemicals for the agricultural industry locally.

Nuaport Docks	The dock area is used to import a variety of goods, usually delivered by container or general cargo vessels. A substantial amount of wood is exported through the port. An international ferry operates on a daily basis. Container ships of up to 50,000 TEU and general cargo vessels of up to 25,000 DWT regularly use the port. There are some repair facilities, but no dry-docks.

Oil & Hydrocarbon Properties
The table below details the typical characteristics of the oils and hydrocarbons handled at the Oil Terminal and carried as fuel on vessels using the harbour area.

Oil Type	S.G.	API	Pour Point (°C)	Viscosity @ 20 °C (cSt)	% Asphaltene
Gasoline	0.73	62	N/A	0.5	0.0
Naptha	0.70	57	N/A	0.97 (@25°C)	0.0
Gas Oil	0.84	35	N/A	5.5	0.0
Heavy Fuel Oil	0.95	17	-1.0	3000	7.0
Naniun Crude	0.84	37	-15	5.8	0.8
Talang Crude	0.85	33	12	3.7	0.3

Sea Temperature
The sea temperature in the area varies from 5°C during the winter months to 18°C during the summer months.

Currents
The table below shows the current direction and speed at the Tidal Diamonds shown on the chart.

A		B		C		D		E	
Dir.	*Speed*	*Dir.*	*Speed*	*Dir.*	*Speed*	*Dir.*	*Speed*	*Dir.*	*Speed*
180	0.1	225	0.3	120	0.25	270	0.25	045	0.30

⑩ Log Sheet

Page No.	

	Details

⑪ Dangerous Goods Manifest

Name of Ship: Onward Prince
IMO Number: 8478894
Nationality of Ship: Panama
Master's Name: E.Xample

Voyage Reference: 678
Port of Loading:
Port of Discharge:
Shipping Agent: Transfleet

Booking / Reference Number	Marks & Numbers Container ID Nos	Number & Kind of Packages	Proper Shipping Name	Class	UN Number	Packing Group	Subsidiary Risk (s)	Flash point (In ° C,c.c)	Marine Pollutant	Mass (kg) Gross / Net	EmS	Stowage Position on Board
678/ 07856	SUMY308 067P	25 drums	Acetyl Chloride	3	1717	II	8	5		386 Net	F-E, S-C	03/82/06
678/ 05673	ABFG405 781C	20 IBCs	Xanthates	4.2	3342	II				17,326 Net	F-A, S-J	03/84/03
678/ 06568	WERT678 932Q	7 IBCs	Benzyl Chloride	6.1	1738	II	8			5,945 Net	F-A, S-B	05/82/08
678/ 06876	HJKU876 092B	20 IBCs	Ammonium Nitrate	9	2071	III				18,567 Net	F-H, S-Q	05/86/06
678/ 07234	CFTJ768 340N	3 drums	Lead Perchlorate, Solid	5.1	1470	II	6.1		P	963 Net	F-H, S-Q	03/82/09

AGENT'S SIGNATURE: ______________________________

MASTER'S SIGNATURE: ____________________________

PLACE AND DATE: _____________________________

PLACE AND DATE: ____________________________

- Equipment Availability Sheet

Running Tabletop Exercise

1) First Step
- Appoint On-Scene Commander.
- Assign roles and responsibilities (stick to your roles during the exercise)

2) Radio Message Received from Onward Prince
Time: 0635hrs
From: MV Onward Prince
To: Nuaport Coast Guard

This is MV Onward Prince inbound for Nuaport for repairs.

Our present position is AE8-283, ETA Pilot Station 30 minutes.

We have a number of crew who have fallen ill. Can we proceed straight to the repair berth in Nuaport?

3) Radio Message
Time: 0637hrs
From: Nuaport Coast Guard
To: Duty Manager

Container vessel Onward Prince inbound to Nuaport repair berth. Reports a number of ill crew.

Present position AE8-283. ETA Pilot Station 30 minutes.

They are requesting permission to berth. How should we proceed?

4) Radio Message
Time: 0639hrs
From: Nuaport Coast Guard
To: MV Onward Prince

Rendezvous with pilot launch at AK-267. Stand-by for further instructions.

5) Weather report
Time: 0640hrs

Wind Direction:	1200
Wind Speed:	10 knots
Air Temperature:	130C
Sea Temperature:	110C
Sea State:	Slight
First Light:	0730hrs

6) Question to a Trainee
Time: 0645hrs

What are your initial reactions?

What questions will you ask the vessel?

The vessel has asked permission to proceed to the repair Berth. Will you grant permission for this?

7) Telephone Message
Time: 0705hrs
From: Nuaport Coast Guard
To: Response Team Leader

Suspected incident onboard MV Onward Prince. Container vessel inbound to repair berth Nuaport.

Number of sick crew reported.

Respond appropriately.

8) Question to a Trainee 2nd time
Time: 0706hrs

What are your initial reactions?

What will be your initial response?

When can you start responding?

What information do you need?

9) Weather Forecast
Time: 0715hrs

Weather Forecast for next 12 hours

Wind Direction: 1200 backing 1800 by 1300hrs
Wind Speed: 10 knots increasing 15 knots by 1300hrs

Air Temperature: 130C Sea Temperature: 110C
Sea State: Slight becoming moderate
Sunset: 1946hrs

10) Radio Message
Time: 0720hrs
From: MV Onward Prince
To: Nuaport Coast Guard

In position AK5-271 awaiting further instructions. Pilot launch standing by.

11) Radio Message
Time: 0745hrs
From: Nuaport Coast Guard
To: Response Team

Overflight of vessel reports nothing seen coming from or around vessel. Aircraft now returning to airport and available on 10 minutes notice.

12) Question to a Trainee 3rd time
Time: 0749hrs

What is is your response strategy?

What are your response objectives?

What response assets and equipment will you use?

What information do you need?

13) Task 1.
Time: 0805hrs

Prepare a Site Safety Plan and demarcate any work areas.

Prepare a site de-contamination plan to include your personnel and equipment.

14) Task 2.
Time: 0815hrs

Prepare a detailed report of your activities so far, and your response plans.

Prepare a press release describing the incident and your response plans.

15) Task 3. Question to a Trainee 4th time
Time: 0830hrs

Do you have enough appropriate equipment for a prolonged operation?

Where can you access back-up equipment?

When can this equipment be on-site?

16) Task 4.
Time: 0845hrs

Describe how you will gain access to the vessel?

What is your emergency cover?

What is your escape plan?

17) End of Exercise and Debrief

RECOMMENDATUIN to Trainees

By finishing this lesson of tabletop exercise, trainees that complete this manual are deemed to have gained knowledge and skills required for the possible first responder in the HNS incident.
To reinforce the skills, it is highly recommended that trainees periodically attend the training course at least once every other year.

-- End of Lessons --

NOWPAP MERRAC

Northwest Pacific Action Plan
Marine Environmental Emergency Preparedness and Response
Regional Activity Centre

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