NEBOSH International Technical Certificate in Oil and Gas Operational Safety

Unit IOG1

MANAGEMENT OF INTERNATIONAL OIL AND GAS OPERATIONAL SAFETY

ELEMENT 5: LOGISTICS AND TRANSPORT OPERATIONS

SAMPLE MATERIAL

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Marine Transport

Key Information

- The oil and gas industry uses an array of marine vessels and structures, such as FPSO, FSU, FSO and LNG FSRU.
- Marine hazards include extremes of weather, accelerated corrosion, the proximity of other vessels, hazardous substances, cargo and personnel transfer operations, and piracy.
- Loading and unloading of vessels at marine terminals needs to be strictly controlled; the vessel must be securely moored; cargo transfer must be planned; and precautions against fire and explosion must be observed.
- Vessels and crew are subject to regulatory controls, commonly known as 'flagging'.
- The crew of a vessel has a strict command structure – the Master (or captain) has ultimate authority and responsibility for the safety of the vessel and crew.
- Personnel transfers can be achieved using methods such as bridges, baskets and rope ladders.
- Required PPE is task-dependent but typically includes hard hats, hi-viz jackets, boiler suits and gloves.
- Diving operations must be carefully planned and executed; they make use of the permit-to-work system.

Hazards of Vessels and Working Over Water

The off-shore oil industry uses a vast array of marine vessels and structures, ranging from the large (floating oil rigs and oil tankers) to the small (survival craft).

Jargon Buster

FSO

Floating storage and offloading unit – a floating hull fitted with oil storage tanks and a facility to transfer oil to tankers. Many FSOs are old, converted supertankers.

FSU

Floating storage unit – can either be the same as an FSO or, more commonly, transfer the oil by pipeline to a land-based facility.

FPSO

Floating production, storage and offloading unit – for receiving crude oil from wells, processing it (separation of oil, gas and water), storing and offloading.

LNG FSRU

Liquefied natural gas floating storage and regasification unit – receives LNG from other vessels, 'regasifies' it (i.e. converts the liquid back into gas) and distributes it via pipelines to onshore facilities.

As well as the intrinsic dangers associated with planned operations on board and beneath such vessels, there are the specific issues of:

- Extreme environmental conditions (weather, waves, sea currents/temperature, ice, etc.).
- Accelerated wear and corrosion – the stress of constant movement/buffeting and aggressive salt spray means that structures and equipment can quickly fail if maintenance is neglected. We looked at this in an earlier element.
- Collisions with other vessels and structures (including running aground and damage from icebergs) – these may also result in environmental damage (oil spills). An inadequate/defective mooring, combined with extreme weather may contribute to this. We will look at control of vessel design and marine operations later.
- The intrinsic hazards of the substances – we looked at the hazards of the main substances in Element 1, e.g. LNG, hydrogen sulphide and drilling fluids ('mud'). We also looked at the potential for fire and the different methods of fire and explosion protection in earlier elements.
- Oil/LNG transfer operations – which, again, could result in environmental damage (oil spills). We will look at loading/unloading operations later.
- Personnel transfer operations – see later in this element.
- Drilling rig hazards (other than those already mentioned, such as fire and substances in use) – working at height, manual handling.
- Lone working (we will look at diving operations later).
- Personnel falling overboard (through tripping, slipping), with the risk of cold shock (from icy water), extreme fatigue (the effort to stay afloat with water-logged clothing), hypothermia (if not rescued immediately) and drowning. We looked at recovery and rescue in the last element.
- Piracy (a specific problem around East Africa/Somalia). We will look at some aspects of vessel safety/security later.

More...

Guidelines for Managing Marine Risks Associated with FPSOs (OGP (International Association of Oil & Gas Producers) Report No. 377)

Loading and Unloading of Vessels at Marine Terminals

A marine oil and gas terminal is a dock where ships/tankers moor to transfer crude oil (and derived products) and gas (LNG, LPG) to, or from, storage facilities. Some terminals are on-shore and some are off-shore. You will notice that F(P)SO/FSU can be regarded as off-shore terminals in this respect, though transfer will only be from the storage unit to the ship/tanker. Activities at terminals would include escorting (by use of tug boat) to safely berth/moor the ship and offloading/loading (using hoses, pipelines or loading arms). Some tankers ('supertankers') may be too large to moor at the terminal itself. In these cases, ship-to-ship transfers are the usual solution, whereby liquid from the larger ship is transferred by hose to a smaller, lighter vessel, which can then moor at the terminal. This process is called 'lightering'.

More...

International Safety Guide for Oil Tankers and Terminals (ISGOTT)

In general:

- The ship should be securely moored.
- The responsible people in charge of the terminal and the tanker, respectively, should agree a loading/off-loading plan (exchanging information about the cargo, transfer rates, venting, quantities, communications/signals, etc.). A checklist is used for this purpose. For tanker loading operations, this may involve the inspection of tanks and verification of the previous load and tank cleanliness.
- The ship's doors, ports, windows, etc. which open onto the tank deck, should be kept closed (to avoid ingress of flammable vapours and the risk of explosion in accommodation areas). Ventilation systems may also have to be adjusted or disconnected so that they do not suck in flammable vapours or act as an ignition source. Cargo tank vents should be protected by flame arresters.
- Ship to terminal connections (such as via directly connecting hose or marine loading arms (also known as metal cargo arms)) can be fitted with an emergency release.
- Liquid loading lines and vapour emission control lines (vapour recovery) should be clearly distinguished, to avoid misconnection (this would typically be by unique connection design, so that they cannot be inadvertently connected to the wrong line).

- Hoses should be inspected for defects before use (they should be subject to periodic pressure testing). Hoses located under water will require periodic inspection by divers.

- The position of the hoses/loading arms should be adjusted (or take account of the rising and falling of the ship) so as not to place undue strain on the components (the hoses themselves, ship's manifold connection, etc.). Wind loading can be a particular issue for marine loading arms, and can place additional strain on connections.
- The weather should be monitored before and during the operation, with the operation being suspended in cases where high winds or electrical storms are expected.
- Crews should keep watch for leaks during the operation, and be prepared to stop if leaks are detected.

- Precautions against electrical discharge need to be observed. For electrical discharge between ship and terminal, this is most likely to arise during terminal hose/arm connection to the ship manifold, so the connection to the ship either uses an insulating (i.e. non-conductive) flange or a length of insulating hose - the ship-side and terminal-side are then electrically isolated from each other. It has been found that the previous practice of earth bonding the ship to the terminal is ineffective (and in fact dangerous in some cases) and so is not generally recommended (see Topic Focus). In addition, precautions against static electrical discharge (ship–side or terminal-side) should be observed. Many petroleum-based products (though not crude oil) accumulate static because they are poor electrical conductors. Precautions during the loading of tankers include inerting, control of the initial liquid flow rate when charging tanks, and allowing liquids to rest for at least 30 minutes after loading before any metallic equipment (for sampling, etc.) is introduced (and only then if it is earth-bonded to the ship).

Topic Focus

Ship-to-Terminal Electric Currents, Earthing and Bonding

Ships are not generally earth bonded to on-shore terminals during off-loading/loading operations. This sounds counter to what you may have heard. This is because the electrical current flow from ship to marine terminal is largely not electrostatic in origin; rather it arises from galvanic potential differences between them as well as installed cathodic protection devices (to protect against corrosion). A shore-side marine loading arm (all metal construction) obviously conducts electricity well and is very likely to cause a discharge spark on connection/disconnection to the ship.

More...

For more information, see Chapter 20 of *International Safety Guide for Oil Tankers and Terminals*

- Co-ordinate activities (or take precautions), e.g. if hazardous activities are being undertaken in adjacent tanker berths. Do not allow tugs, helicopters, etc. to approach too close during the operation (or suspend operations if they must).

There should be joint formal agreement between the master of the vessel and the terminal authority on readiness to load/unload cargo. No transfer should take place before this. Both sides should monitor the operation and communicate throughout.

Control of Marine Operations, Certification of Vessels, Inspection and Approvals

You will already be familiar with one form of control of oil and gas marine/offshore installations – that of the safety case regime. This runs in parallel with other regulatory controls on vessels.

All vessels undergoing international voyages (like tankers) are subject to a system known as **flagging**, i.e. it must be registered to a country and abide by its maritime regulations. As an example, a UK registered vessel ("UK Flagged") must comply with the requirements of the UK's Maritime and Coastguard Agency (MCA). These requirements derive from those of the International Maritime Organisation (IMO). Typically this would mean:

- **Certification/Approval**

  Depending on the vessel it would need certificates of:

  - Safety construction (i.e. it is safely designed and constructed).
  - Oil pollution prevention (i.e. that it complies with the MARPOL (marine pollution) convention requirements).
  - Loadline (to help guard against overloading and the vessel sitting too low in the water).
  - Tonnage (ships must pay a tax on entering ports and this is levied based on their tonnage).
  - Mobile offshore drilling unit (MODU) safety (i.e. compliance with the IMO requirements for the safety of MODUs).
  - Shipboard safety management (i.e. the ship operates to a documented, effective safety management system).
  - Class (i.e. it conforms to established rules on design, build, inspection and maintenance for that class of vessel) – these certificates would normally be issued by independent verifiers called 'Classification Societies'.

  The operator would also need certificates for certain on-board equipment such as cranes (and other lifting equipment) and, of course, the master and crew must be certified as competent (e.g. qualifications such as a master marine certificate) and fit. Some state flag regimes will have specific additional requirements and there are the usual insurance certification requirements.

- **Inspection**

  To maintain Class certification, ships must undergo periodic inspection by the classification society. This would mean routine annual surveys together with a five-yearly 'special' survey to maintain the certification/approval.

Jargon Buster

Loadline

This is marked on the side of a ship's hull to indicate the maximum load. It depends on water density (affected by temperature, salinity).

Approval

An acknowledgment given by an approver (such as a regulator, classification society or insurer) indicating satisfactory compliance with requirements and sanctioning the vessel for that approved use/purpose. A certificate may be issued as documentary evidence of approval.

Roles and Responsibilities of Marine Co-ordinators, Masters and Crews

A **Marine Co-ordinator** co-ordinates all the activities related to a vessel's arrival, mooring, cargo loading/discharge, and departure. This is the marine equivalent of a logistics co-ordinator. Liaison with other functions will also be involved, e.g. when vessels require annual/special independent inspections.

A **Ship's Master** (i.e. captain) has ultimate authority and responsibility aboard ship. In particular, he is responsible to the flag state, classification society and operator for the continued seaworthiness and safety of the vessel and will have the authority to do whatever is needed to maintain compliance. He is responsible for the safe navigation of the ship and the continued safety of his crew and the cargo (including from threats such as pirates). In case of incidents (such as collisions, pollution) the master must keep accurate records/logs and provide these to (and co-operate with) investigators. Whilst, in practice, the master will delegate many tasks (such as piloting), he cannot delegate the legal responsibility laid down in international maritime law.

The crew is everyone else. There are many different ranks and departments.

Deck crew, consist of:

- **Chief Officer/First Officer** (second in command after the master) – responsibilities include maintenance of the ship (the integrity of the hull, as well as equipment such as for fire-fighting), supervision and training of the deck crew and anything to do with the cargo (charging/discharging and cleaning tanks).
- **Second Officer** – mainly responsible for vessel navigation (course charting, etc.) but may also assist the chief officer in their duties.
- **Third Officer** – usually responsible for safety, so in

charge of the safety equipment.

- **Deck Cadet** – essentially a trainee officer.
- **Able Seaman** – duties include watchman and maintaining a steady heading at the helm (as directed).
- **Ordinary Seaman** – general duties include painting, cleaning and helping with cargo operations.

Engineering crew consist of:

- **Chief Engineer** – responsible for supervising the engine room operations and other engineering equipment. There is a whole range of lower ranking engineers (second, third, fourth) who are responsible for maintenance.

Steward's crew consist of:

- **Chief Steward** – in charge of the food and cleaning services. The Chief Cook will report to this rank.

Personnel Transfers and Boarding Arrangements

Typical methods for personnel transfer and boarding include:

- Helicopter, but this depends on weather, location and whether the vessel is fitted with a helideck.
- Transfer basket (there are numerous designs, e.g. a personnel transfer capsule) but essentially this consists of a frame (of rope or rigid construction) inside which (or onto which) several personnel sit or hold. The basket is transferred from ship-to-ship using the ship's crane. There have been a number of accidents with this type of transfer and so it is not generally recommended if alternatives are available. Since this is a lifting operation using lifting equipment and greatly affected by weather conditions, etc. it will be subject to the usual lift planning and equipment inspection, testing and marking (SWL – safe working load).

Personnel transfer capsule

- Gangways, bridges and accommodation ladders – the usual means of transfer between ship and shore where a ship is moored at port. They may also be used for transfer between offshore installations and ships. Bridges can be lifted at short notice if, for example, the weather conditions deteriorate.
- Rope ladder (for pilot transfer) - before docking at a terminal, local pilots may be transferred to the ship to aid navigation (they will be considerably more familiar with local waters). These personnel are usually transferred out at sea from a small pilot boat to the ship via a rope ladder hung over the side of the ship (this is a very common method for any ship-ship transfer at sea in the absence of a helicopter). This can be somewhat hazardous so standards have been developed for the ladders and the transfer procedure itself.

More...

More detailed information on personnel transfer and boarding can be found at:

Guidance on the Transfer of Personnel to and from Offshore Vessels

(http://www.imca-int.com/documents/core/sel/docs/IMCASEL025.pdf)

Guidance For Oil Terminal Operators On The IMO International Ship And Port Facility Security Code

Shipping Industry Guidance on the Rigging of Ladders for Pilot Transfer

(http://www.impahq.org/downloads.cfm)

Security

One additional consideration is security. Vessels and terminals used by the oil and gas industry are hazardous but also obvious targets for terrorists and pirates. Personnel transfers are therefore restricted to authorised personnel only. The level of security will depend on an assessment of the perceived threat at any time and protocols agreed between vessel and terminal and between vessels (for ship-to-ship transfers). There are three levels of security assessment, Level 1 being the lowest and Level 3 the highest.

In general, a terminal will develop a **port facility security plan** (PFSP) to cover port-ship transfers. Amongst other things, it will include measures to:

- Prevent unauthorised access to the port (and specific restricted areas).

- Allow shore leave.
- Rotate the crew.
- Allow visitors on board.

This may typically be by some form of identification, e.g. visitor badge/access card system together with enforcement by security guards. Port terminals request information about the ship, ship's personnel and cargo prior to entry to the port. They communicate and formally agree the specific security protocol for transfers.

Personnel Protective Equipment Suitability

The nature of the task and its associated risk will determine the selection, suitability and appropriateness of the PPE to be worn. Typical protection worn on board ship would include safety boots, boiler suits/overalls and gloves (cotton riggers gloves for general work but also specialist gloves such as for welding or working with chemicals/oils) and high-visibility jackets. Depending on the job, personnel might also require goggles, hearing protection (engine rooms), harness and lanyard (for maintenance work at heights), respirators, breathing apparatus (including emergency escape BA), visors/face shields (for chemicals and those used for welding), and anti-static/spark-proof clothing/zips.

As an example, for ship transfers by basket, personnel might be wearing safety helmets, inflatable life jackets (with light and whistle) and survival suits (in cold seas).

Diver Operations

Diving operations may be required for purposes of inspection (e.g. of moorings, pipelines, anchor), maintenance, repair and also decommissioning.

Diving can be categorised into several different types.

- **Surface supplied diving** - where divers have their air supplied via hose (called an 'umbilical') from a diving support vessel or installation on the surface.
- **Self-contained underwater breathing apparatus** (SCUBA) - where the diver carries their own air supply in tanks on their back. This gives more freedom to the diver but has a more limited air supply (amongst other drawbacks).
- **A hybrid system** (sometimes called mobile (or portable) surface supplied diving) - a mobile system which adds some of the greater flexibility inherent in SCUBA, but the air is actually surface supplied.

Atmospheric diving suits and habitats may also be employed in diving operations.

Inspection is increasingly being done by remote operated vehicles (ROV – essentially a robotic underwater CCTV camera) rather than divers.

Installations would normally maintain a Site Information Dossier (SID) which would assess the likely mutual impacts and act as a source of information to diving/ROV contractors.

OGP Report 411 breaks the diving operation management process down into four steps:

- **Compliance**
  - All parties should comply with all applicable national, international, industry and company/contractor requirements for the diving operation. The most stringent requirements should be followed where there is conflict between those requirements.
- **Planning**

  The diving operation should be properly planned, including coverage of such activities as:
  - Agreeing communications, roles and responsibilities.
  - Agreeing the scope of the job to be done.
  - Identifying likely hazards and assessing risks:
    - Typically utilising thorough, detailed systematic techniques such as HAZID and FMEA to help identify potential domino effects.
    - OGP Report 411 breaks subsea risk assessment down into three stages:

      Stage 1 - onshore risk assessment (during the onshore planning stage).

      Stage 2 - onsite risk assessment (actually onsite and by those supervising the work – this will be more specific than the onshore assessment).

      Stage 3 - toolbox talk – a communications and review event shortly before the work actually begins involving everyone who is part of the job.

  Stages 2 and 3 are generally included as part of the Execution step (later).

  Divers and ROVs are obviously at risk from operations undertaken on board vessels and installations, but the reverse is also true (e.g. a diver may accidentally sever or damage an oil pipeline or block a firewater intake).

  The risks to divers include: drowning; becoming trapped (e.g. by their own airlines or by moorings or stuck in a soft seabed); problems with their breathing apparatus (e.g. faulty valves, incorrect gas mixture, loss of gas); developing illness during the dive; blackouts; developing decompression sickness ('the bends'); developing nitrogen narcosis (a state similar to alcohol intoxication); developing oxygen poisoning; miscommunications (leading to errors); collisions (e.g. if a vessel escapes from its mooring or from an ROV also being used); the effects of extreme environment (changeable weather, cold).

- Identifying required competence (and how that will delivered (training, etc.) and assessed (qualifications, experience validation)).
- Checking that systems, equipment and vessels are in satisfactory condition and good working order (such as through inspection or audit and validation of certificates).
- Planning for emergency situations that might arise (e.g. injured diver, decompression sickness, hyperbaric evacuation) and notification of accidents to regulators (as required by law).
- Management of change (authorisation).

- **Execution**
  - Site rules must be followed/developed.
  - Risk assessment (Stages 2 and 3 as discussed earlier – onsite risk assessment and toolbox talk).
  - Safety briefings (inductions, expectations, etc.).
  - Use of formal permit-to-work/permit-to-dive system to control the dive - to ensure joint planning, risk assessment, management and communication between all parties.
- **Measuring and Improving**
  - Review of the operation and any incidents and what lessons can be learned.

More...

To view the full *Diving Recommended Practice*, OGP Report 411, go to:

http://www.ogp.org.uk/pubs/411.pdf

Revision Questions

1. Outline what is meant by the term 'flagging', when applied to vessels.
2. Outline the options for personnel transfer and boarding methods.
3. Outline the four steps of the diving operation management process.

(Suggested Answers are at the end of Unit IOG1.)

Land Transport

Key Information

- Oil and gas products such as petrol are classified as dangerous goods.
- Transport of dangerous goods is regulated by national laws and international agreements, the rules depending on the mode of transport. The rules are generally aligned with recommendations issued by the United Nations (UN).
- The UN system assigns a class, a description and a four-digit number to dangerous goods.
- Dangerous goods carried in road tankers need to be marked and placarded with a system of hazard diamonds, orange plates, UN number and hazard codes.
- Precautions must be observed when loading and unloading dangerous goods from tankers, e.g. against ignition sources.
- Road vehicle movements need to be controlled and thought given to traffic routes on-site and the protection of vulnerable vessels and bunds.
- Tankers represent an attractive target for terrorists; security measures such as varying the route (but the route being planned) are sensible precautions.
- Rail transport of dangerous goods has similar provisions to those for road transport.

Road Tankers

Jargon Buster

Tankers

Sometimes referred to as 'fixed tanks' or road tank vehicles; the tank is permanently fixed to the vehicle chassis. Tank containers (sometimes called 'ISO tanks' or 'portable tanks'), are held in boxed-steel framework. The framework is locked to the vehicle chassis but can be unloaded from the vehicle – this is particularly suited to transfer of tanks between, say, road vehicle and train, or road vehicle and ship.

UN Classification and Transport of Hazardous Materials (Transport of Dangerous Goods)

Carrying goods by road involves the risk of traffic accidents. If the goods carried are dangerous, there is also the risk that the dangerous goods may escape due to collisions (with vehicles, storage vessels), or spillage of the goods (including during transfer), leading to effects such as fire, explosion, injury/death, ill-health and environmental pollution.

Transportation of dangerous goods has long been subject to (or at least influenced by) international agreements. The current rules derive from a system of model regulations developed by the United Nations (UN). These are published as the UN Recommendations on the Transport of Dangerous Goods – Model Regulations (often referred to as the **Orange Book**, because of the colour of the cover). It is supported by the Manual of Tests and Criteria.

In the main, these recommendations have been adopted wholesale into legally binding international agreements. There are modal variations (published separately) for road, rail, air, sea and inland waterway (necessitated by the operational differences). There are also some negotiated national and regional variations in their application (usually leading to more stringent requirements).

In Europe, international road transportation of dangerous goods, such as petroleum products in road tankers, is governed by a set of rules called the European Agreement Concerning the International Carriage of Dangerous Goods by Road (known as ADR, which derives from its French title). This is a modal (i.e. just for roads in this case) implementation of the generic UN Recommendations. National implementations by European states for purely domestic transport essentially reference ADR, but with small variations (called derogations). For example, the UK's domestic regulations are the **Carriage of Dangerous Goods**

and Use of Transportable Pressure Equipment Regulations 2009 and these allow use of modified marking and placarding of road tankers (see later).

More...

The current copies of the UN Recommendations (Orange Book), the Manual of Tests and Criteria and ADR can be viewed and downloaded free from the legal instruments and recommendations area of the UN's Dangerous Goods web pages: http://www.unece.org/trans/danger/danger.htm

Dangerous goods are substances (and articles containing them) that have been tested and assessed against agreed criteria and found to be potentially dangerous (hazardous) when carried. They are placed in recognised categories or classes; this process is called **classification**.

Dangerous goods are assigned to the following different UN classes depending on their predominant hazard:

1.	Explosive substances and articles.
2.	Gases.
3.	Flammable liquids.
4.1	Flammable solids, self-reactive substances and solid desensitised explosives.
4.2	Substances liable to spontaneous combustion.
4.3	Substances which, in contact with water, emit flammable gases.
5.1	Oxidising substances.
5.2	Organic peroxides.
6.1	Toxic substances.
6.2	Infectious substances.
7.	Radioactive material.
8.	Corrosive substances.
9.	Miscellaneous dangerous substances and articles.

You will note that petrol is assigned to Class 3 (flammable liquids).

Taking ADR as a typical example of UN requirements for road transport of dangerous goods, it covers the following basic areas:

- General provisions – covering, for example, definitions, general training, safety obligations, appointment of safety advisers (specifically to advise on dangerous goods transportation), security.
- Classification (the allocation of dangerous goods to a class and assigning a UN number, description and packing group based on its properties).
- Dangerous goods list – effectively a very large lookup table consisting of a tabulated list of dangerous goods, together with their classes, UN number, packing and tank provisions (i.e. allowable packaging and whether it can be transported in tanks), labelling, exemptions, quantity and other restrictions and so on. The table uses codes to refer the reader to other chapters of the rules (such as packing and tank provisions) to find the detailed requirements.
- Consignment procedures – marking and labelling of packages, marking and placarding of vehicles and tanks, documentation (dangerous goods transport document, container packing certificate and "instructions in writing" in case of emergency).

Jargon Buster

UN number

A four digit short code assigned to each entry in the list of dangerous goods (which is usually organised in UN numerical order), e.g. petrol (gasoline or motor spirit) is assigned UN number 1203. The numbers have no systematic meaning in themselves, except that anything starting with a zero is in Class 1 (explosives).

Packing group

An attempt to categorise substances into degrees of danger. There are three such groups and each is conventionally written in roman numerals. Packing group I is high danger, II is medium danger, and III is low danger. Different UN classes have different criteria for this assignment. Petrol (UN 1203) is assigned packing group II.

Hazard Identification Number (HIN)

A two or three digit code which attempts to communicate the nature and intensity of the hazard class. For example, UN 1203 (petrol) is associated with a HIN of 33 (note that this system is related to the UN hazard class – petrol is in Class 3).

Emergency Action Code (EAC)

A code used in the UK instead of the HIN. It communicates emergency information to fire-fighters.

Placarding

The display of large hazard warning diamonds (which contain graphics communicating the hazardous nature of the load, related to the UN hazard class(es) into which the dangerous goods fall).

Marking

When used in relation to vehicles and tanks, is the display of orange reflectorised rectangular plates. The exact nature of these depends on the type of vehicle and the type/amount of the load.

- Construction and testing of packaging, tanks, etc.
- Conditions of carriage, loading, unloading and handling, e.g. prohibition of smoking, precautions against electrostatic discharge.
- Vehicle crew, equipment, operation and documentation, e.g. specific training of crew, supervision of vehicles.
- Construction and approval of vehicles (such as tankers).

Road tankers carrying dangerous goods have to be marked and placarded. They must also display other information such as the UN number and the Hazard Identification Number (HIN) relating to the dangerous goods being carried. For UK domestic transport (rather than international) it is permissible to use an emergency action code (EAC) instead of the HIN. All this information may be displayed in a special panel, commonly called a "HazChem" panel. Here's an example of such information on a petrol tanker.

The telephone number is for specialist advice. Note the UN Class 3 (flammable liquid) placard and the additional environmentally hazardous substance pictogram (dead tree and fish). This is required if the product meets certain criteria as a pollutant.

Protection of Plant Against Vehicles Striking Plant

Vulnerable plant and equipment, such as bulk storage tanks, should be protected from vehicle collision damage. This may typically be achieved either by position (the storage tank is isolated from the tanker off-loading point) or by barriers (e.g. Armco metal barriers, as routinely used on motorways/highways). A bund wall should not be used as collision protection – the bund wall itself should be further protected with a barrier if necessary.

Driver Training

ADR requires drivers of tankers carrying dangerous goods to attend a vocational course of instruction (theory and practice) and sit an externally assessed examination - for the classes of goods being carried. This gives them a certificate of competency, which has to be updated at specific intervals.

The course covers some general aspects of dangerous goods transportation but, for tanker drivers, will also cover tanker-specific issues, such as:

- Vehicle behaviour (e.g. load movement/surge).
- Specific vehicle requirements.
- Filling and discharge.
- Specific rules (approval certificates, marking, placarding, etc.).

Loading and Unloading Arrangements

Drivers of tankers must be fully informed of the dangers of the materials carried and the emergency action that needs to be taken. ADR requires drivers to carry 'instructions in writing', more commonly known as the TRansport EMergency card (TREM card). This is a four-page instruction which, amongst other things, describes the nature of the hazardous load and action to be taken in an emergency. The TREM card must be kept in the vehicle cab so that it can be easily located by the emergency services in the event of an accident. The driver and the recipient of materials should have written procedures that set out the precautions that need to be taken during loading and unloading. Fire extinguishers should be carried on all vehicles. If substances are flammable or explosive, earth connections should be used during loading and unloading to prevent the possibility of a static spark, and no other sources of ignition, such as smoking materials, should be allowed in the vicinity.

Where bulk storage tanks are used for different substances, there is always the possibility of cross contamination, i.e. a substance being unloaded from a tanker into the wrong bulk tank at an installation. This can be prevented by strict operating procedures and the use of couplings of a different design for each substance. It is also important to ensure that tanks to be filled have enough space so as to prevent spillage through overfilling.

Traffic Management

On Site

The principles for on site management of traffic include:

- Minimise bends/junctions, steep gradients and the need for reversing.
- Pedestrian and vehicle segregation – clearly designate areas for pedestrian walkways and crossing points.
- Clear signage (which, as far as possible, reflects standard road signage) – warning of speed limits, obstructions, allowable width/height, etc.
- Well lit (if necessary) during hours of darkness.
- Wide enough for the vehicles and, if not, consider one-way systems.
- Enforce speed limits.
- Protect vulnerable plant with barriers.
- Designed with plenty of space for off-loading (demountable tanks).
- Dedicated tanker off-loading points (with emergency facilities and environmental protection built in).
- Security access gate/sign in (so you know who is on site and control who enters the site).

Routes

It goes without saying that not all routes are suitable for vehicles, such as tankers, transporting petroleum products, e.g. narrow roads, weak bridges. There is also the issue of the security threat (terrorism, theft) to the valuable load being carried and its possible use as a terrorist weapon. Consideration of the security of dangerous goods is a specific requirement of the UN Recommendations and, therefore, ADR.

Routes should be planned to minimise such threats (and obstructions). It is not generally considered a good idea to use the same route each time (predictability). However, although the route should be varied, it should be planned each time, the advantage being that if the vehicle goes off route, it can be detected (especially with the more commonly available vehicle tracking systems).

Rail

Rail transportation of petroleum products will involve tank cars and tank containers. Modal rules on transport of dangerous goods derive from the UN Recommendations and rail is no exception. In Europe, the implementation is called the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID).

Earlier we discussed the ADR requirements for road transport of dangerous goods in tankers; there are very similar risks for rail. As a result, the requirements are very similar, the general layout and thrust of the two modal regulatory texts being alike. There are some obvious operational differences and there are greater restrictions than for road and especially when transporting dangerous goods through long tunnels (such as the Channel Tunnel).

Revision Questions

4. List the 9 UN classes.
5. Outline the general requirements for dangerous goods tanker driver training.
6. Outline why it might be important to plan the route of a road tanker carrying dangerous goods.

(Suggested Answers are at the end of Unit IOG1.)