International Oil and Gas Operational Safety

Unit IOG1 Management of International Oil and Gas Operational Safety

Sample pages from

Shift handover should be:

1) Conducted face-to-face (for example, in control room).
2) Two-way, with both participants taking joint responsibility (for example, relaying information; seeking clarification).
3) Done using both verbal and written communication (for example, log books).
4) Based on an analysis of the information needs of incoming staff (for example, after prolonged absence; experience of incoming operator).
5) Given as much time and resource as necessary (for example, dependent on state of the process; amount of maintenance work on previous shift).

Key operational issues to be covered at shift handover, include:

- Operational status of the process.
- Changes of operation required during the forthcoming shift.
- Emergencies or abnormal events that occurred during the shift.
- Completed maintenance activities.
- Maintenance activities started but not completed (plant out of service).
- Details of any overrides that have been put in place.
- Permit-to-work status.
- Any forthcoming preparation work that will be required.
- Any routine operational task for the forthcoming shift (for example, fire deluge checks).
- Emergency drills planned for the forthcoming shift.

2.5 - Plant operations and maintenance

Asset integrity

Asset integrity can be defined as the ability of an asset to perform its required function effectively and efficiently whilst protecting health, safety and the environment. Asset integrity management is the means of ensuring that the people, systems, processes and resources that deliver integrity are in place, in use and will perform when required over the whole lifecycle of the asset. Essential for the integrity of any installation are the safety-critical elements (SCEs). These are the parts of an installation and its plant (including computer programmes) whose purpose is to prevent, control or mitigate major accident hazards (MAHs) and the failure of which could cause or contribute substantially to a major accident. These include temporary refuge (HVAC systems); fire pumps; deluge systems and Emergency Shutdown Devices (ESD's).

BARRIERS

The SCEs represent the ***barriers*** which prevent, control or mitigate the major accident scenarios. The maintenance management strategy must be developed to provide assurance that they will be available when required, they will operate with the required reliability and they be able, as necessary, to survive incidents against which they are designed to protect. In the Swiss Cheese Model ***(see figure ref 2-6)***, an organisation's defences against failure are modelled as a series of ***barriers***, represented as slices of Swiss cheese.

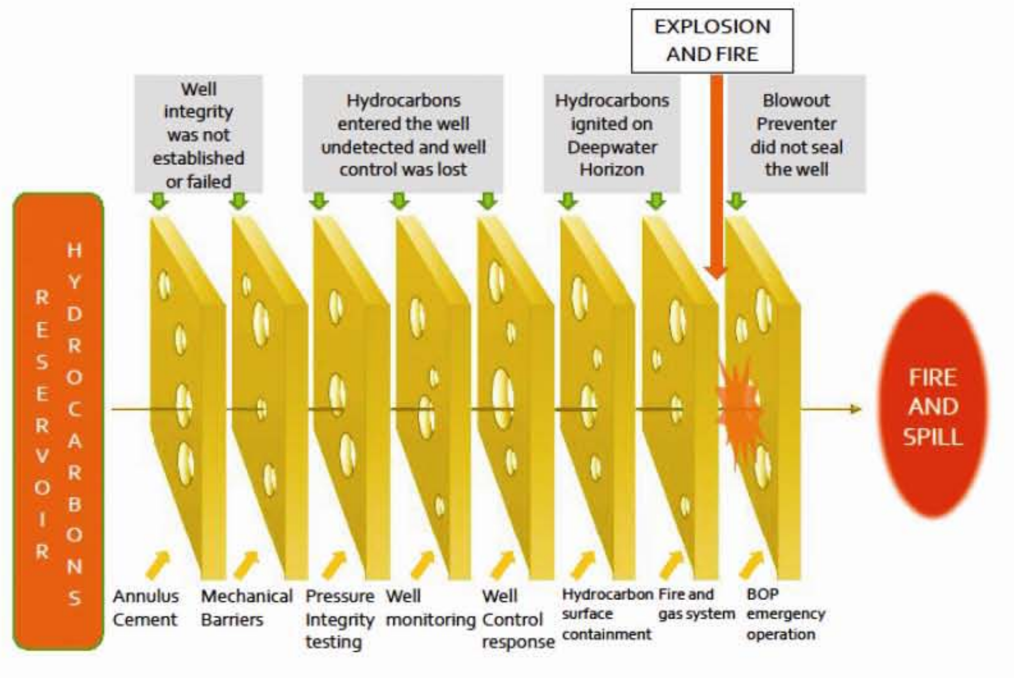

Figure 2-6: Swiss cheese model. Source: *The Bly Report.*

Emergency shutdown systems

Emergency shutdown systems (ESD's) are intended to minimise the consequences of emergency situations, for example, the uncontrolled release/loss of containment of hydrocarbons, or the outbreak of fire in hydrocarbon areas. Generally designed with a high safety integrity level (SIL) typical actions of an ESD include:

- Shutdown of a system, or part of a system.
- Isolate hydrocarbon inventories.
- Stop hydrocarbon flow.
- Prevent escalation of an incident.
- Depressure/blowdown.

For shutdown valves used in safety instrumented systems it is essential to know that the valve is capable of providing the required level of safety performance and that the valve will operate on demand.

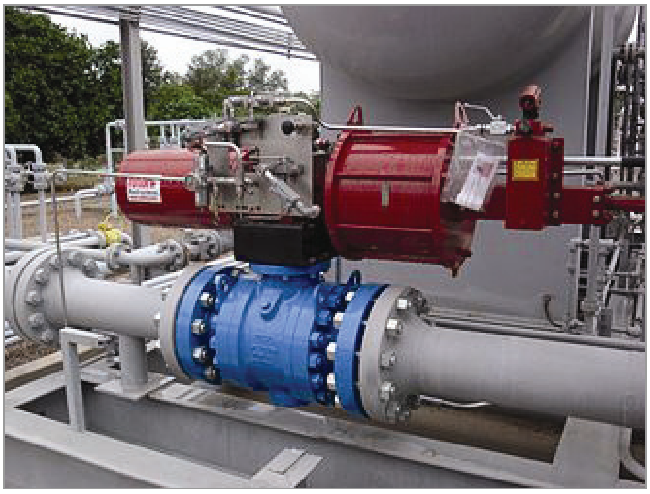

Figure 3-8: Emergency shut down valve. *Source: Wikimedia.*

The required level of performance is dictated by the safety integrity level (SIL). In order to adhere to this level of performance it is necessary to test the valve. There are two types of testing methods available:

A proof test: a manual test that will determine whether the valve is "as good as new", by testing for all possible failure modes. This may require a system shutdown (unless by pass facilities are provided).

A diagnostic test: An "online" test that will detect some of the possible failure modes of the valve (for example, a partial stroke test).

Procedures for bypassing ESD's

Occasionally, ESD's will need to be bypassed or overridden (for example, for emergency maintenance work). These operations must be very closely controlled, and subject to a written procedure (this may be included in the management of change procedures, as a temporary change).

Authorised by a competent person (often a Plant Manager), and subject to justification and risk assessment, alternative means of control in the event of an emergency should be considered.

The bypass arrangement should be applied for the shortest possible period of time.

The details of bypass arrangements should be entered into a logbook and communicated to all relevant parties (for example, operations, maintenance staff and supervision). This is critically important should the bypass be in place during a shift hand over.

FIRE AND GAS CONTROLS

Oil and Gas installations should be designed to be safe. However there will always be residual risks. Layers of protection need to be designed in, to detect any anomalies that the process control system hasn't taken care of. These additional layers should make the process safe. The fire and gas detection system provides an extra layer of protection to mitigate the consequences when the other safeguarding layers have not been sufficient.

The gas detection system can detect a discharge of combustible or toxic gas and take action to minimise the leak and prevent it turning into a fire or explosion. If a fire should result, systems can be attached to extinguish the fire and protect other areas from the actions of the fire. The same system, usually with different detectors and principles, can be used to detect toxic gases, give warning to personnel and provide the possibility of taking automatic shutdown actions.

SAFETY INTEGRITY LEVELS FOR INSTRUMENTATION

Safety integrity level (SIL) is a statistical representation of the reliability of safety instrument systems. There are four categories, namely SILs 1, 2, 3 and 4, SIL 1 being the least dependable and SIL 4 being the most dependable. It is defined as the probability of the safety instrument system (SIS) to fail on demand (PFD). A process demand occurs whenever the process reaches the trip condition and causes the SIS to take action.

Consider a tank filling with a process fluid. If the tank is full, the SIS comes into play as the trip conditions are reached. The SIS prevents the tank from overflowing. The number of times this occurs is known as the incident frequency.

Consider an SIL 1 installation, which has a maximum probability level of 1 in 10. This means for every 10 times the SIS is activated as a result of a high tank level trip, the safety function (for example, the dump valve opens lowering the level) could be expected to work nine times. The other one time the safety function would not work and the tank would overflow.

SPRINKLER SYSTEMS

Automatic sprinkler systems are used more than any other fixed fire protection system. The purpose of an automatic sprinkler system is to detect the fire, extinguish or control the fire and to raise the alarm.

The structure/area to be protected is covered by a grid of pipes with sprinkler heads fitted into them at regular intervals. Pumped water (from a source such as a tank or seawater) fills the pipes.

Each sprinkler head will open when it reaches a specific temperature and spray water on to a fire. The hot gases from a fire are usually enough to make it operate.

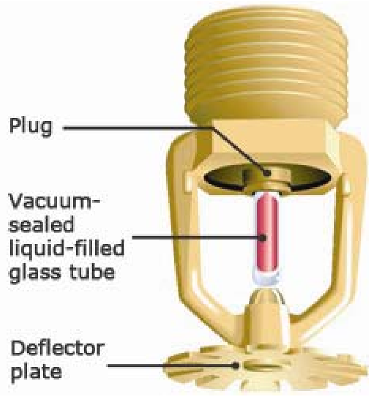

Figure 4-9: Sprinkler head with frangible bulb. *Source: J.Hind.*

Only the sprinklers over the fire open. The others remain closed. This limits any damage to areas where there is no fire and reduces the amount of water needed.

At the point where the water enters the sprinkler system there is a valve. This can be used to shut off the system for maintenance. For safety reasons it is kept locked open and only authorised persons should be able to close it.

DELUGE SYSTEMS

Deluge water spray systems are similar to sprinkler systems, except all nozzles are open and will discharge together when the system is activated.

These systems are used where rapid fire spread is a concern, as they provide a simultaneous application of water over the entire hazard. Water is not present in the piping until the system operates. To prevent the water supply pressure from forcing water into the piping, a deluge valve is used in the water supply connection, which is a mechanically latched valve. It is a non-resetting valve, and stays open once tripped.

Figure 4-10: Deluge water spray system. *Source: J.Hind.*

The deluge valve must be opened as signalled by a fire alarm system. The type of fire alarm initiating device is selected mainly based on the hazard. The initiation device signals the fire alarm panel, which in turn signals the deluge valve to open. Activation can also be manual.

Deluge systems can provide rapid cooling, reducing available oxygen. In addition, there is also a reduction in the amount of radiant heat that may be transmitted to nearby structures or vessels.

WATER MIST SYSTEMS

Water mist is a fine spray with 99 percent of water volume contained in water droplets less than one millimetre (1,000 microns) in diameter.

Water divided into very fine droplets creates a greater surface area than standard droplets emitted from sprinkler system heads.

Water mist system droplets can be 20 times smaller and have a surface area 400 times greater than sprinkler system water droplets. This enhanced area allows more of the water to absorb the heat from the fire. Steam generated during the cooling process, provides an inert blanket, which has the effect of also excluding oxygen from the fire.

Figure 4-11: Water mist sprinkler head. *Source: J.Hind.*

The mist is created by discharging water through special nozzles at very high pressure. Nitrogen cylinders used in conjunction with water cylinders, or pump systems are used to deliver water to the nozzles. The mist acts similar to gaseous extinguishing systems in that the mist can extinguish fires in shielded, obstructed locations which would not be reached by other directional water jets/droplets type systems.

Some water mist systems have an additive injection component to introduce Class A or Class B foam concentrate into the piping. A small amount of foam concentrate added to the water supply can significantly improve the water mist system's performance when suppressing buried ordinary combustibles and liquid fuel spill fires. The resulting thin layer of foam solution blanketing the fuel spill reduces the amount of vaporization and inhibits the amount of radiant heat energy absorbed by the fuel.

5.2 - Land transport

Tankers

UN 'CLASSIFICATION' AND TRANSPORT OF HAZARDOUS MATERIALS

In the UK and Europe, the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations (CDGUTPER) 2009 and the European agreement ("Accord européen relatif au transport international des marchandises dangereuses par route") (known as ADR), regulate the carriage of dangerous goods by road.

The classes of dangerous goods according to ADR are:

UN Class	***Dangerous Goods***	***Classification***
1	Explosives	Explosive
2	Gases	Flammable gas
		Non-flammable, non-toxic gas
		Toxic gas
3	Flammable liquid	Flammable liquid
4	Flammable solids	Flammable solid
		Spontaneously combustible substance
		Substance which in contact with water emits flammable gas
5	Oxidising substances	Oxidising substance
		Organic peroxide
6	Toxic substances	Toxic substance
		Infectious substance
7	Radioactive material	Radioactive material
8	Corrosive substances	Corrosive substance
9	Miscellaneous dangerous goods	Miscellaneous dangerous goods

Figure 5-16: Classes of dangerous goods. *Source: ADR.*

Consignors must identify the hazardous substance that they are transporting. To assist in emergency the driver is responsible for ensuring that the correct paperwork for the load is to hand.

For dangerous goods a Dangerous Goods Note should detail:

- Nature and quantity of dangerous goods.
- UN number or identification number.
- Proper shipping name.
- Class or division (subsidiary risk).
- Packing group (if required).
- All other required information.

This has usually been accomplished through special marking and labelling to indicate the hazards of the consignment on the vehicle and inclusion of relevant information in the transport documents and also by the pleading and labelling displayed on the transport unit.

Warning signs are used to alert emergency services and other road users that a vehicle is carrying dangerous goods which pose a greater risk to people, property and the environment than ordinary loads.

Additional safety precautions will be needed to handle any incident involving the vehicle.

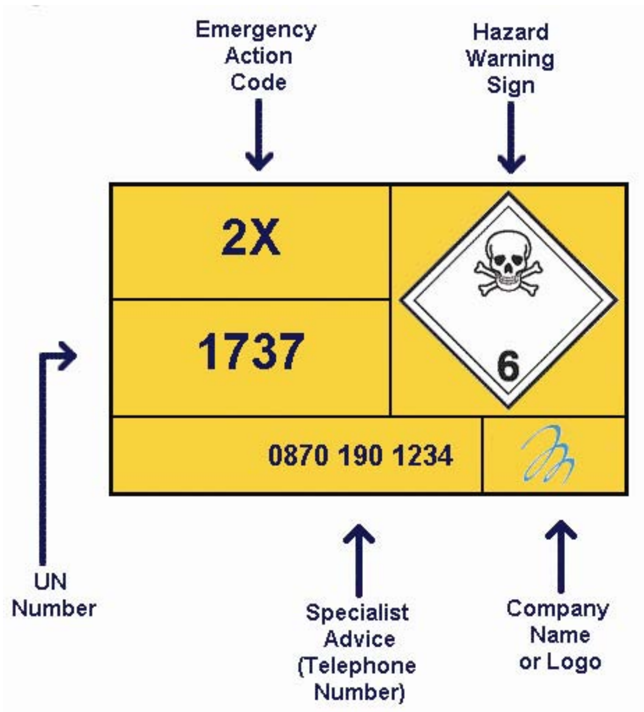

Figure 5-17: Dangerous Goods Note. *Source: NCEC.*