Escape, Evacuation and Rescue Analysis at an Offshore Platform

S. N. Vaez¹, S. Mirseraji, F. Nourai
Aftab Imen Parto Consulting Engineers, Tehran, Iran

Abstract: In an emergency situation, beyond those immediate risks posed by the particular initiating hazard, additional risks to personnel can arise from the process of Escape, Evacuation and Rescue (EER) itself. Therefore, reviewing the more probable scenarios which may lead to any problem in case of emergency for escape, evacuation and rescue process and setting proper strategies, especially in design phase of projects, is essential. In the present paper, an escape, evacuation and rescue study is reported that was undertaken on an offshore platform in South Pars area. The methodology employed was that first, eight reasonable goals of escape, evacuation and rescue were defined; Then, provisions for escape, evacuation and rescue as well as EER strategy were studied. To determine if each of the EER goals is met, various fire, explosion and toxic release scenarios were developed and the consequences of these potential accidents were simulated. Besides, the maximum estimated time to get to muster area was also calculated. The results assure that sufficient EER facilities have been considered for the platform to meet the 8 EER goals.

Key words: EERA, escape routes, muster area, offshore facilities

1. Introduction

South Pars Gas Field is one of the most extensive gas reserves of Iran, supplying a large portion of the total natural gas consumption of the country through offshore (wellhead/production) platforms, subsea pipelines, and onshore facilities. This study has been undertaken for Wellhead platforms SPD15 and SPD16. These five-deck wellhead platforms are unmanned with a small facility on upper deck for crew which may happen to spend the night. Process equipment is located on lower and upper decks. Power generation is by two generating sets. Fiber optic sub-sea cable takes the control signals to the nearby phases 9/10 platforms. From there it is routed to phase 15 and 16 Onshore Plant and also to SPQ1 central control room. Besides, standby vessel is to be usually present near the platform.

EERA is a technique to evaluate the performance of the emergency response facilities and procedures. It consists of a structured review of the performance of the escape, evacuation and rescue facilities and procedures in representative scenarios. The objective of this study is to assess the adequacy of the facilities provided for the South Pars Gas Field Development of phases 15 and 16 to meet the Escape, Evacuation and Rescue goals.

This study has been performed based on a goal-oriented method, while there are some other methods, for example, United Kingdom Health and Safety Executive organization has developed a methodology for hazard identification on EER assessment [1], furthermore, EER performance-based standards have been released by Canada Transportation development center [2], also Norwegian Technology Centre has provided a NORSOK standard for risk and emergency preparedness analysis and a guide for calculating human resistance against thermal explosion, toxic effects and obstruction of vision [3].

Furthermore, some studies have been focused on the procedure of escape, evacuation and rescue specifically as such is the United Kingdom Health and Safety Executives which has provided a report about good practices in offshore rescue. Attempts have been made in this study to use the most important as well as relevant information from the references to have a comprehensive EER study.

¹ Corresponding author: info@imen-parto.com
Tel: 021-22583114
Facilities addressed in this study include detectors and alarm system, escape routes, mustering facilities in refuge, evacuation facilities including helicopter and helideck operation, life boats, liferafts and rescue arrangements such as ERRV. An effective assessment of EER provisions needs to address each of those components and interactions between them for each foreseeable hazardous event.

The success of EER from offshore installations depends upon a number of factors:

- Hazard prevention, control and mitigation.
- Appropriate installation Physical design. (e.g. escape routes, muster area)
- The performance of equipment in an emergency (e.g. alarm systems, firefighting equipment, Helicopters, TEMPSC, etc.).
- The actions of the personnel concerned (offshore emergency response teams and general POB)

2. Objectives and Scope

A list of eight goals has been provided to see if necessary measures have been taken in to consider in case of any possible accidents. The aim of the study is also to see if additional EER facilities or measures have been provided in case of any impairment or facility malfunction in an unwanted situation. In order to achieve the stated objectives, the scope of the study is as follows:

- The study addressed the EER process from the sounding of an alarm through to rescue to a place of safety.
- Account was taken of all factors relevant to EER including the physical layout of facilities, equipment, availability of necessary resources (e.g. helicopters, liferafts, etc.).
- The study is limited to assessment of the EER arrangements on the installation itself, up to the interfaces with the standby vessel (SBV).

3. Methodology

To conduct the EERA study firstly, the goals of the escape, evacuation and rescue shall be defined. Secondly, the provisions for escape, evacuation and rescue shall be analyzed, thirdly, escape, evacuation and rescue strategy shall be defined, in the next step, the accident events for which the escape, evacuation and rescue facilities may be impaired by, shall be identified. This is done by a series of a Fire, Explosion and toxic gas simulations and some supporting studies, and finally an EERA has to ensure that all escape, evacuation and rescue goals are met.

![Figure 1- The steps of this EER Analysis Methodology](image-url)
4. Description of EER process

In order to identify the hazards associated with a process, it is obviously necessary to define the process itself. The level of accuracy and detail of the process definition will determine whether or not all hazards can be identified. For this reason, a fairly detailed model of the EER process was developed in the study based on the following description of the EER process on an offshore installation.

The terms evacuation, escape and rescue are defined in the Cullen Report on the Piper Alpha Disaster Inquiry [1] as follows:

Evacuation refers to the planned method of leaving the installation without directly entering the sea, while escape refers to the process of leaving an offshore installation in the event on part or all of the evacuation system falling, whereby personnel on board make their way in to the sea by various means or by jumping. Rescue is the process by which escapees and man overboard (MOB) casualties are retrieved to a safe place where medical assistance is available.

Figure 1 gives an overview of the EER process.

An important thing that should be taken into consideration is that since the 15 and 16 wellhead platforms are normally unmanned, only one muster point has been considered as a place for assembly and in case of any damage to that, personnel will follow the escape and evacuation procedure without mustering. [1]
5. Escape, Muster, Evacuation and Rescue Goals

Using the same starting point of a similar study for another platform [6], the goals of the EER plan were defined as:

Goal 1: Detecting the incident and raising the alarm

Goal 2: Escape and reach the safe areas and facilities

Goal 3: Provision of muster points

Goal 4: Incident management
6. Description of Escape, Evacuation and Rescue Facilities

The wellhead platforms under study are equipped with fire and gas detection systems, alarms as well as various fixed and portable fire fighting systems which are located in various locations on the platform. Each Deck is provided with at least two escape routes (primary width of 1200 mm and secondary width of 800 mm) situated along the outboard edge of the platform making it easy to reach the muster station.

The muster area is adjacent to the life boat sited on the Southwest side of the platform at the Upper Deck (i.e. safe area). Helideck is another alternative for evacuation and located above the upper deck which is the safe area so it is far enough from the hazardous areas and therefore it is safe for evacuation. Different evacuation systems are designed for safe evacuation, such as Life Boat, Liferafts, Life Buoys, Life Jackets, and Work Vests which are located in strategic places on the platform. [7]

7. Escape, Evacuation and Rescue Strategy

In an emergency, personnel shall be able to escape to the safe place; this would include the muster area on the upper deck and the protected rooms like a technical room. From these places communication and monitoring the situation will become possible. They should then escape via lifeboat located beside muster point.

If the incident escalates and impairs the escape routes personnel shall be able to evacuate the platform by liferafts situated on the cellar and lower decks.

In most cases the situation will be detected, communicated and become under control automatically from the SPQ1 platform or from the offshore complex but manual call points and extinguishers should be provided throughout the WHP in the case of small and controllable scenarios.

Rescue is the final stage of the EER process whereby personnel should be transferred directly or indirectly to safe locations such as standby vessel (SBV), passing vessel, land, or a nearby installation.

8. Supporting Studies

The adequacy of EER facilities was reviewed by a series of studies including hydrocarbon gas release, toxic gas release, explosion overpressure and jet fire radiation studies. For each study several scenarios were identified and a series of assumptions were made.

The scenarios basically originate from the wellhead platform facilities such as the riser, the process equipment and the wellheads; in each scenario the impact of accidental release from these facilities on the monitor points (EER provisions) has been studied.

Modeling of accidental release scenarios is done using PHAST, ver. 6.51, an engineering software capable of modeling and predicting the consequences of a release, its outcomes and its impacts.

For the study assumptions, various leak sizes were assumed to represent small, medium and large leaks for each scenario. Then, different wind velocities were assumed for different times of the year at each direction according to local meteorological data², also the Pasquill stability class was assumed to be the worst case F, i.e. the most stable

² www.weather.ir
atmospheric condition. (According to the basic considerations that are dependent on the volume of the discharged gas, for other weather situations the result is the same.)

9. Demonstration of Meeting EER Goals

The last step of EERA is to show the EER Goals are met. This is done by taking advantage of the results of Modeling and other supporting studies. The requirements of each goal and the provisions to meet them are described below.

9.1. Goal 1 - Detecting the incident and raising the Alarm

To ensure that all on board personnel and the onshore main control room are made aware that an incident has occurred, the whole platform facilities are provided with an integrated ESD and F&G detection system and manual alarm call points. Alarm signals will be transmitted to onshore main control room. Besides, each detection situation will initiate a special class of shutdown.

For fire presence along with the manual and automatic alarms and RED ESD, manual activation of deluge system from the safe area on the cellar deck or technical room will be possible.

After hearing the alarm it would be up to the individuals to make their own decision on the most appropriate actions to take, whether to get to the muster point or to get to safe areas like technical room and evacuate the platform with life rafts or life boat.

9.2. Goal 2- Escape and Reach the Safe Areas and Facilities

Since the main means of escape is escape route, each deck should be provided with primary and secondary escape routes, so if one escape route is impaired then the alternative route should be available.

The muster station should be in a safe area. The muster station is provided with a life boat for evacuation.

The incidents that could impair escape routes and in which equipment may obstruct the escape routes and make escape difficult, are jet fire, explosion, smoke and toxic gas dispersion. Their effects on escape routes and escape equipment are evaluated in supporting studies. According to jet fire modeling, by one escape facility being impaired by jet fire radiation, other ones will be available to escape from hazardous situation. To make the escape easier, AC and DC UPS systems are provided for the emergency power generation of the safety/emergency lighting.

The explosion modeling shows that for credible explosion events, the overpressure will not exceed 0.2 bar and thus escape routes (or liferafts) will not be impaired.

Smoke and Toxic gas dispersion were studied separately based on smoke obstruction visibility criteria and fatality criteria for Hydrogen Sulfide. It was shown that smoke and toxic gas dispersion cannot effectively impair escape route, because of prevailing wind direction and the presence of an F&G system. [5, 6]

9.3. Goal 3 - Provision of Muster Station

The muster station is adjacent to the life boat sited on the non-process area which is provided a safe place for evacuation the Platform in an emergency situation. Enough clear space per person in muster station is considered. Also, Technical Room can be used as a Temporary Refuge for minor incidents. Technical room is separated from process zone via J60 firewall in order to protect it against fire, explosion and overpressures. To prevent from smoke and toxic gas ingress, Technical Room HVAC system is equipped with airlock and smoke detector.
9.4. **Goal 4 - Incident Management**

Essential process control and communication facilities are provided in Technical Room to use in emergency conditions to satisfy the requirements for incident control.

9.5. **Goal 5 - Evacuation Facilities**

The evacuation facilities are the lifeboat and the life rafts. The lifeboat is located on the safe area of the platform, in the emergency situations personnel will muster at life boat embarkation area and don available life jackets then evacuate the place.

On the situation that the lifeboat is unavailable, the life rafts provided in other decks can be used.

**Impairment scenarios:**

**Impaired by smoke or toxic gas:**

If the lifeboat area is impaired by smoke or toxic gas, SCBA3 sets have been provided near the Muster Area for the number of persons on the platform. The lifeboat will also have its own air supply.

**Impaired by process fire:**

As the lifeboat is located at non-process deck, it is protected from any process events on the adjacent platforms.

9.6. **Goal 6- Contingency against Unforeseen Incidents**

When the personnel cannot escape to the muster area to abandon the platform via lifeboat or unable to access the life rafts in each deck, they will escape to sea. They should don lifejackets or use life buoys that located all around the deck.

Personnel should access the boat landing or drain deck via the stairs. From there they can decide to await rescue or jump to the sea as a last resort.

9.7. **Goal 7- Abandonment**

An Abandon platform alarm will be available during presence of personnel. The system will permit acoustic alarm as well as voice communication to a number of loudspeakers on the platform. These loudspeakers are located as strategic locations on different levels of the platform.

Blue strobe lights shall be installed at strategic locations on the platform to alert the personnel to proceed to the muster station prior to abandoning the platform.

9.8. **Goal 8- Rescue**

The dedicated platform EERVs4 or the ones of nearby platforms can be used to rescue personnel that have abandoned the platform and transport them to shore.

10. **Conclusion**

The study has reviewed the escape, evacuation and rescue provisions and determined they are sufficient to meet the 8 Goals EER process. In summery it has been demonstrated that the goals have been met by the provision of Means of

---

3. Self-Contained Breathing Apparatus
4. Escape, Evacuation and Rescue Vessels
detection the accident event and raising the alarm, two escape routes, muster station in a non-process deck, Life Boat and Liferaft for evacuation, and sufficient equipment for safe escape and evacuation. The platform is provided by one means of refuge (technical room with J60 firewall) and a muster station with a life boat and two life rafts as means of escape.

The availability of EER facilities in case of emergency and the vulnerability of them in case of impair was reviewed in three supporting studies which are Fire and Smoke Study, Explosion Overpressure Study and Emergency Systems Vulnerability Study. Having these studies carried out, they provide us enough evidence to prove the EER goals are met.

11. References


