HAZARD IDENTIFICATION & RISK ASSESSMENT (HIRA)

A Hazard Identification and Risk Assessment (HIRA) assist emergency managers in answering these questions. It is a systematic risk assessment tool that can be used to assess the risks of various hazards.

There are three reasons why a HIRA is useful to the emergency management profession:

- It helps emergency management professionals prepare for the worst and/or most likely risks.
- Allows for the creation of exercises, training programs, and plans based on the most likely scenarios.
- Saves time and resources by isolating hazards that cannot occur in the designated area.

Risk is the unwanted consequence of an event or series of events. Risk occurs when multiple risk causing factors occur at the same time causing an accident manifesting in an event like a fire or explosion. Risk Assessment (RA) is a method that has proven its value as an all-round tool for improving the safety standards prevalent in every hazardous industry. With advancements in in-built and inherent safety systems, accidents rates have come down, but still persist at unacceptable levels for newer technology, new plants and chemical handling facilities. RA is a structured safety assessment tools designed for high hazard industries such as chemical, petrochemical, pesticides, pharmaceuticals, sea ports, etc., supplementing other safety systems tools such as HAZOP, safety audit, and regular incident analysis to identify the potential for incidents (near-misses, unsafe conditions) and to evaluate the necessary control measures.

Objectives of HIRA study:

- Carryout a systematic, critical appraisal of all potential hazards involving personnel, plant, services and operation methods.
- Identify the existing safeguards available to control the risks due to the hazards.
- Suggest additional control measures to reduce the risk to acceptable level.
- Prepare a Risk register that will help in continuously monitoring these risks, detect any changes and ensure the controls are effective.

Steps involved in Hazard identification and risk assessment:

Step 1: Identification of the Hazard

Hazard Identification is a critical step in Risk Analysis. Many aids are available, including experience, engineering codes, checklists, detailed process knowledge, equipment failure experience, hazard index techniques, What-if Analysis, Hazard and Operability (HAZOP) Studies, Failure Mode and Effects Analysis (FMEA), and Preliminary Hazard Analysis (PHA). In this phase all potential incidents are identified and tabulated. Site visit and study of operations and documents like drawings, process write-up etc are used for hazard identification.

Step 2: Assessment of the Risk

Consequence Estimation is the methodology used to determine the potential for damage or injury from specific incidents. A single incident can have many distinct incident outcomes. Likelihood assessment is the methodology used to estimate the frequency or probability of occurrence of an incident. Estimates may be obtained from historical incident data on failure frequencies or from failure sequence models, such as fault trees and event trees. Risks arising from the hazards are evaluated for its tolerability to personnel, the facility and the environment. The acceptability of the estimated risk must then be judged based upon criteria appropriate to the particular situation.

Step 3: Elimination or Reduction of the Risk

This involves identifying opportunities to reduce the likelihood and/or consequence of an accident Where deemed to be necessary. Risk Assessment combines the consequences and likelihood of all incident outcomes from all selected incidents to provide a measure of risk. The risk of all selected incidents are individually estimated and summed to give an overall measure of risk. Risk-reduction measures include those to prevent incidents (i.e. reduce the likelihood of occurrence) to control incidents (i.e. limit the extent and duration of a hazardous event) and to mitigate the effects (i.e. reduce the consequences). Preventive measures, such as using inherently safer designs and ensuring asset integrity, should be used wherever practicable. In many cases, the measures to control and mitigate hazards and risks are simple and obvious and involve modifications to conform to standard practice.

The general hierarchy of risk reducing measures is:

- Prevention (by distance or design)
- Detection (e.g. fire and gas, Leak detection)
- Control (e.g. emergency shutdown and controlled depressurization)
- Mitigation (e.g. fire fighting and passive fire protection)
- Emergency response (in case safety barriers fail)

Components of Risk Assessment:

The normal components of a risk assessment study are:

- Hazard identification and specification
- Risk Review
- Recommendations on mitigation measures

Failure case identification

The first stage in any risk assessment study is to identify the potential accidents that could result in the release of the hazardous material from its normal containment.

Chemical hazards are generally considered to be of three types:

- Flammable
- Reactive
- Toxic

Where there is the potential for confined gas releases, there is also the potential for explosions. These often produce overpressures which can cause fatalities, both through direct action on the body or through building damage. Potential accidents associated with any plant, section of a terminal/plant or pipeline can be divided into two categories:

- There is a possibility of failure associated with each, mechanical component of the facility/terminal (vessels, pipes, pumps or compressors). There are generic failures and can be caused by such mechanisms as corrosion, vibration or external impact (mechanical or overpressure). A small event (such as a leak) may escalate to a bigger event, by itself causing a larger failure.
- There is also a likelihood of failures caused by specific operating

circumstances. The prime example of this is human error, however it can also include other accidents due, for example, to reaction runaway or the possibility of ignition of leaking tank gases due to hot work.

Classification of Major Hazard Units:

- Damage of oil storage tanks and oil leaks into the sea
- In case of fire explosion
- In case of emergency during ship maneuvering
- In case of vessel or boat collision

Hazard Identification

Identification of hazards in the proposed jetty is of primary significance in the analysis, quantification and cost effective control of accidents and process. Definition of hazard states that, hazard is in fact the characteristic of system/process that presents potential for an accident. Hence, all the components of a system need to be thoroughly examined to assess their potential for initiating or propagating an unplanned event/sequence of events, which can be termed as an accident. The following two methods for hazard identification have been employed in the proposed Jetty Study:

Hazards during Construction Phase

- Mechanical Hazards
- Transportation Hazards
- Physical Hazards
- Storage and Handling of Hazardous Materials

Hazards during Operation Phase

- Material Hazards
- Handling Hazards

Hazards due to Natural Calamities

- Earthquake
- Tsunami
- Cyclone/Flood

Hazards during Construction Phase

Potential hazards during the construction phase of the project could be due to the mechanical hazards, navigation/ transportation hazards, physical hazards and storage and handling of hazardous materials.

Mechanical Hazards: Mechanical hazards during the construction phase arise due to the moving parts in the machinery, especially the belts and bolts of the construction equipment, which are heavy and pose a threat to the work personnel. Other hazards include falling (during working at heights), falling objects like hand held tools, etc; failure of slips and traps created for scaffolding; and due to faulting of electrical equipment.

Navigation/ transportation Hazards: Planning of access/egress to construction site also plays significant role in minimizing the associated hazards such as vehicles/ barges collision.

Physical Hazards: The noise and vibrations generated during construction phase may affect the workers health, hinder effective communication. In addition to noise and vibration, hot works also pose a considerable hazard to the workers.

Hazards during Operational phase

Material Hazards: During operation, Liquid Cargo will be handled at the proposed facility. The Liquid cargo hazard classification can be made based on its Characteristics such as Flammability, explosiveness, toxicity or corrosivity etc.

Handling Hazards: Proposed jetty involves handling of Liquid Cargo. The hazards related to edible oil transport and unloading may be due to accidents, breaking of unloading arms, failure in mechanical components, etc. The handling hazards include:

- Insufficient knowledge on hazardous nature of Liquid Cargo in use leading to inappropriate handling of the Liquid Cargo.
- Failure to use appropriate control measures and Personal Protective Equipment (PPE)
- Use of expired/worn Personal Protective Equipment’s (PPE’s)

- Failure of liquid delivery tools.
- Possible hazards during ship movements at the port are collision, grounding, etc.
- Likely hazards during loading and unloading of Liquid Cargo.
- During ship unloading operations, the possible hazard may arise due to collision by another vessel and others.

Cargo handling: A fully mechanized ship loading/unloading system (Pipelines) is planned at the berths. The major components of the mechanized ship loading/unloading system are Pumps and Pipelines.

Ship movements/Navigation Hazards: The navigation hazards during operation phase are grounding and collision of vessels. However, these would be controlled by suitable vessel traffic management.

Ship unloading: During ship unloading operations, possible hazard may arise due to collision by another vessel and others.

Transfer operation: The transfer operation involves transfer of liquid cargo from ships through pipelines. During this operation there is a possibility of mal-operation / non-synchronization / misalignment leading to liquid cargo spillage.

Slip and Trip Hazards: Workers performing cleaning operations are exposed to slippery working surfaces and tripping hazards. This places workers at risk of:

- Slipping off oily and greasy ladders
- Slipping and falling on oily decks
- Tripping over equipment, hoses and vessel structures

Hazard due to Natural Calamities:

Cyclone, Tsunami and Storm surge are the most destructive forces among the natural devastations. It causes instant disaster and burial of lives and destruction to entire coastal properties. The damage and loss can be minimized if appropriate preparedness plan is formulated. The following statutory guidelines are recommended by National

Disaster Management Authority (NDMA) to minimize the impact due to Cyclone, Tsunami and storm.

Types of Disasters	Risk incurred	Mitigation steps
Earthquake	Highest vulnerability towards earthquake occurrence (based on past history) resulting into massive destruction.	Structure proposed should comply as per relevant IS Codes for Earthquake resistant structures for adequate factor of safety.
Tsunami	Kandla region had been affected by Tsunami in past with a ht. of 12m in 1945. Thus, it is also one of the major risks applied to the SIPC locations.	Land use planning should be as per the zoning maps by Gujarat State Disaster Management Authority (GSDMA)
Cyclone	Gujarat falls in the region of tropical cyclone and is highly vulnerable to associated hazards such as floods, storm surges etc. Kandla falls in the belt in which the wind speed ranges between 45-47m/sec. Over 120 cyclones originated within Arabian Sea in past 100 years. Damage to property and life is huge.	Structure proposed should comply as per relevant IS Codes for cyclone resistant structures for adequate factor of safety.
Drought	Kandla is a drought prone area with less rainfall Drought vulnerability increases the groundwater exploitation	Rain water harvesting should be mandatory
Epidemics	Outbreak of Epidemics such as swine flu has been seen in past	Necessary steps should be undertaken to have hygienic conditions and medical assistance within the location to cater to any epidemic

A Risk Analysis should therefore, be seen as an important component of any or all on-going preventive actions aimed at minimizing and thus hopefully, avoiding accidents. Re-assessments should therefore follow at regular intervals, and/or after any changes that could alter the hazard, so contributing to the overall prevention programme and disaster management plan of the project.

PRELIMINARY HAZARD ANALYSIS (PHA):

Preliminary Hazards Analysis (PHA) is a broad based study carried out to identify potential hazards associated with various process operations, types of chemicals, and associated activities carried out at any facility. The objective of Preliminary Hazards Analysis is to further direct greater depth of analysis and suggest remedial measures for hazard potential areas. The PHA is always better done in the early stages of the project so that requisite time is available to implement recommendations and it is economical to implement in the beginning rather than modifying the system subsequently after commissioning the facility.

The areas identified for carrying out PHA are given below:

- Areas where large quantities of hazardous chemicals are stored or processed.
- Areas where operating temperatures and pressures could be particularly high.
- Areas where flammable inventories exist. At times the flammable inventories may not be hazardous in itself but even a minor fire in the vicinity may be sufficient to cause knock-.on effect resulting in release of hazardous chemicals.
- Specific operations associated with the high probability of failure.
- Areas where destructive and dangerous chemical reactions could take place resulting in major heat evolution, release of toxic products in reaction, polymerization, etc.
- Areas where potentially corrosive material is stored and handled and where pipeline or tank failure due to corrosion would result in major release of the corrosive or toxic chemical.
- Areas where passive or active safety systems are associated with a generally high failure rate.

RISK ANALYSIS

A hazard is generally realized as a loss of containment of a hazardous material. The routes for such loss of containment can include release from pipe fittings containing liquid or gas, releases from vents/relief and releases.

The objective of hazard identification is to identify and evaluate the hazards and the unintended events, which could cause an accident. The first task usually is to identify the hazards that are inherent to the process and/or plant and then focus on the evaluation of the events, which could be associated with hazards. In hazard identification and quantification of probability of occurrence it is assumed that the plant will perform as designed in the absence of unintended events (component and material failures, human errors, external event, process unknown), which may affect the plant/process behavior.

Edible oil is less hazardous in nature but even edible oil storage and handling may result in various incidences during cleaning and maintenance of the line and storage vessel.

The proposed project has risk potential of toxic and flammable chemicals. For Hazard identification, Maximum Credible Accident (MCA) scenarios have been assessed. The maximum credible accident has been characterized as an accident with a maximum damage potential and the occurrence of which is most probable.

PREAMBLE

During the burning of edible oil, the maximum threat zone (Lethal & 2nd degree burn) extends to a distance of 100m. Information available in the literature regarding exposure versus damages is given below:-

Incident Radiation intensity, KW/m^2	Type of damage	Damage to human
37.5	Damages the process Equipments	100 % Lethality in one minute, 0.1% in 10 seconds
25.0	Minimum energy to ignite wood up on indefinitely long exposure	100% lethality in 1 minute, Significant injury in 10 seconds Via
12.5	Minimum energy to ignite the combustion materials	1 minute: First degree burns in 10 seconds.
9.5	--	Pain threshold reached after 10 seconds: II degree burns after 20 seconds.
4.0	--	Causes pain if duration is longer than 20 seconds: But

Incident Radiation intensity, KW/m^2	Type of damage	Damage to human
		blisters Unlikely.
1.6	--	Causes no Discomfort

CAUSES OF FIRE

a) Fuel and Storage Tanks

Ferry terminal / jetty contain materials like edible oil and are the material of focus in our project as they can pose hazardous actions in the jetty. Individual ferrys have hydrocarbons on board, and the proposed jetty will also have docks for dispensing fuel to the ferries coming at the jetty, which requires that they have fuel storage tanks. These tanks need to safely contain the hazardous materials, and the dispensing equipment must be used properly and maintained to ensure that the materials will not leak or spill into the water or onto the pier, which can cause fire. As improper usage or faulty equipment can result in spills and other emergencies, fuelling docks and fuel storage tanks are some of the most incident-prone locations and items in the jetty.

b) Ferry Fire

Ferry fires are one of the most common ways that jetty fires can begin. These fires can spread to the rest of the jetty and to other ferries. The most common causes of ferry fires are electrical malfunctions, unattended portable heaters, smoking, and poor housekeeping. Smoking is a common cause of fires, whether on a ferry or in the jetty. Electrical fires are also common, and can occur whether the jetty is or is not in use. Exposed wiring can arc to outside materials, or it can cause short circuit. Wiring on ferries can become exposed due to the constant movement of the ferry in the water as well as the corrosive properties of the damp sea air. Improperly sized fuses or circuit breakers can also cause wiring to arc to another material. Overloading electrical sockets and accidents with light bulbs may also cause electrical fires on ferries.

c) Fire in public area

Smoking also causes fire in public area like the restaurants, waiting room, common toilets, parking lot and public parks. Electrical fires are common in restaurants due to short circuit or exposed wiring.

d) Other causes - calamity

Fires in the jetty are potentially calamitous. Fires may cause the spread of hazardous materials, especially hydrocarbons from ferrys and storage tanks. The types of ferry passing through the jetty can be hazardous and may be in danger of spilling during a fire or another incident. Fires may also ignite when the ferrys are not being operated or even supervised.

e) Operation and Maintenance

Other sources of fires in ferrys and jettys include those caused during maintenance and operation, including fuel transfer, welding, and cargo stowage. If the fuel tanks are overfilled, the overflow could ignite inside the terminal if the fuel begins to leak on the shoreline, it could spread on the pier or light the actual fuel storage tank and cause a fire.

f) Prevention for Jetty fire

- Fire fighting system to be set up and the Jetty shall have its own independent fire fighting arrangements. Shall maintain the fire main pressure at 7 kg/cm^2.
- Identify smoking zone areas on the jetty and public area to avoid fire due to smoking.
- Enforcing an inspection program of all electrical equipment at regular intervals can prevent some fires from occurring. This can be done by either the jetty management or the fire department themselves.
- Ensuring that the fuelling pumps and pipes are safely installed is also important in minimizing fires due to fuels.
- Another prevention strategy is to require that fire extinguishers be located within certain distances of each other, or to keep other means of fire protection equipment in specific locations of the jetty and public area.
- Fire tenders to be located at each berth.
- Signage to be provide notification to the public and staff of restrictions that apply to certain areas or facilities within the jetty and public area. Signage should be present at specific locations, such as fuelling procedures at fuelling

stations, as well as throughout jetty and terminal. Signage including ‘No Smoking’ signs, fire safety signs, hazardous materials storage signs, and evacuation route signs will be present at the jetty.

- A manually activated electric fire alarm and an automatic fire alarm that is audible through the jetty and public area is distinguishable from any other signal will be provided.

VESSEL / BOAT COLLISION

- This section provides data on vessel / boat collision risks. Offshore traffic may be divided into two groups:
- Passing vessels: Ship traffic which is not related to the installation being considered, including merchant vessels, fishing vessels, naval vessels and also offshore related traffic going to and from other installations than that being considered.
- Field related: Offshore related traffic which is there to serve the installation being considered, e.g. supply vessels, oil tankers, work vessels.
- For passing vessels, collision risk is highly location dependent due to variation in offshore traffic from one location to another. The Offshore traffic volume and pattern at the specific location should hence be considered with considerable care.
- Field related offshore traffic refers to those vessels which are specifically visiting the installation, and is therefore considered to be less dependent of the location of the installation. The frequency of infield vessel impacts will depend on the durations that vessels are alongside, the installation layout, environmental conditions, and procedures,
- Collisions can be divided into two groups:
- Powered collisions (vessel moving under power towards the installation)
- Drifting collisions (vessel drifting towards the installation)
- Powered collisions include navigational/maneuvering errors (human/technical failures), watch keeping failure, and bad visibility/ineffective radar use. A drifting vessel is a vessel that has lost its propulsion or steerage, or has

experienced a progressive failure of anchor lines or towline and is drifting only under the influence of environmental forces.

IMPACTS OF OIL SPILLS:

When the oil spills in large quantity, it temporarily affects the air-sea interaction, thus preventing the entry of oxygen from the atmosphere. The first set of organisms affected is the primary producers like phytoplankton, which are the basis of the marine food chain. The other free-swimming organisms such as fish larvae and fish also get affected. Further, when the oil sinks during the course of time, it affects the benthic organisms. Oil spills can also have a serious economic impact on coastal activities and resources of the sea.

Spills close to the shoreline tend to have the greatest immediate impact because more diverse forms of life may come into contact with the oil. In addition to ecological concerns, shoreline spills can affect the air quality, due to the hydrocarbon gases and sulphur compounds present in the oil, and are also a potential fire hazard. They will also depress recreational areas, harbours, industries, commercial fishing grounds.

PILING

Piling activities generate significant noise in the marine environment and can result in adverse behavioral and auditory impacts among biota up to tens of kilometres away.

A slow start-up to piling activities should be employed at the beginning of each construction period to allow mobile animals to remove themselves from the unpleasant stimuli before it reaches maximum strength.

CONTINGENCY PLANNING

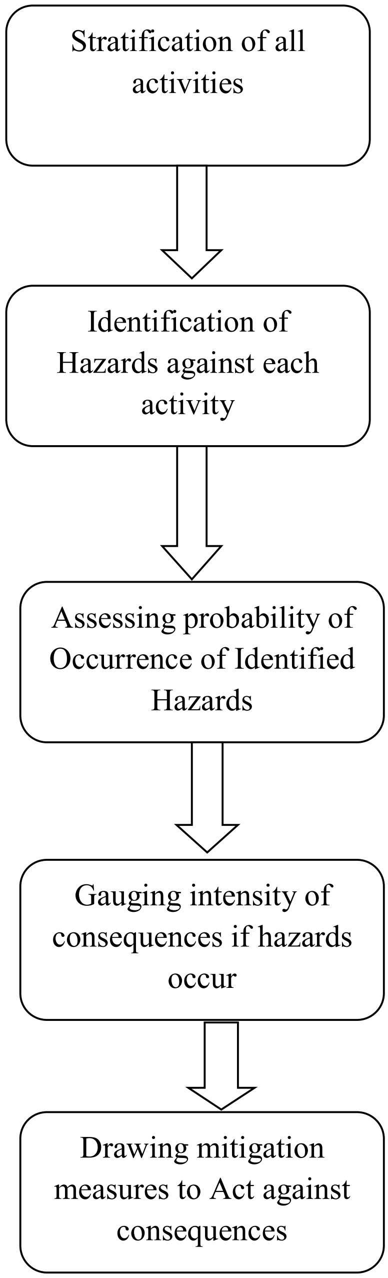
The risks of the tank and pipeline failing as a structure are remote. The terminals that exist in the Port Area have been there during pre-independence and their performance have been satisfactory. Mechanical failures in terms of rupture and weld failures have not been recorded so far and the risks are negligible. However, should this arise for some reasons that could be beyond the control of everybody, then the oil would be contained within a reinforced concrete bund wall. The risks of all tanks failing at the same time could be safely ignored unless they are subject to an attack or raid or an earthquake of significant magnitude impacting the locus. This scenario is quite very remote.

Most of the calamities occur in sea. Records from statistical data have demonstrated that spillage of oil is frequent. However, since no sea-based activities would be carried out, spillage of oil is unlikely to arise for the proposed undertaking.

RISK ASSESSMENT REPORT ON IMPACTS OF PROPOSED PROJECT ON THE SURROUNDING ENVIRONMENT

Risk Evaluation

The evaluation of the risks associated with the above identified hazards in the facility is done using the QRA (Qualitative Risk Assessment) method involving the risk matrix. The qualitative approach is a structured and documented approach in which observations to several strategic indicative activities are retrieved and the likelihood and consequences determined based on technical knowhow, professional judgement and experience. Observations to the following indicative activities are sought.



The evaluation of risk probability (P) is given a rating of 1 to 5 i.e. rare to almost certain and the intensity of consequence is rated from 1 to 5 i.e. insignificant to catastrophic. From this the level of risk or a score is evaluated as,

$$\text{Risk} = \text{Probability (P)} \times \text{Consequence (C)}$$

Table: Risk Level and Mitigation measures for during Operations

S.No	Hazardous Activity	Risk Level	Mitigation/control Measure
1	Chemical Hazard	**Moderate Level Risk**: Tolerable with immediate action	• Regular maintenance of all connections and monitoring of the same. • Strict supervision of all activities involving the use of hazardous substances is very important. • Provision for on-site medical facility and first aid for medical emergencies before further treatment, like Medical support and ambulance • Material Safety Data Sheets (MSDS) of all hazardous substances to be well distributed and displayed for awareness and knowledge in handling such substances • SoPs for handling of chemicals • Mandatory use of personal protective equipment (PPE).
2	Mechanical/Operational Hazard	**High Level Risk**: Unacceptable & to be eliminated.	• All installations will be safely designed, built, maintained, modified and operated • Integrated warning system including public address system to ensure working personnel are

			timely alerted before testing and after testing. • Remote operations to make sure personnel are at a safe distance from winches, bollards, capstans while operating machineries. • Soft stop or variable buffer safeguard options will be considered to cut down on risks to personnel from cranes. • Cranes and suspended loads to be grounded. • Regular monitoring of site and coordinated supervision is very instrumental in eliminating all probable risks. • Efficient control and civil teams will be deployed for overall monitoring and coordination through CCTVs and other technology. • Provision for on-site medical facility and first aid to aid to medical emergencies before further treatment. Availability of 24x7 medical officer and ambulance is a must. • Timely training to all workers and staff in their specific work

			areas. • Mandatory use of personal protective equipment (PPE).
3	Electrical Hazard	**Low Level Risk:** Acceptable with immediate action.	• Substations will be sealed. • Regular maintenance of the sub-stations, wiring and monitoring of the same • Strict supervision of all day-to-day activities is very important to prevent any untoward incident. • Proper earthing to discharge static electric charge.
4	Fire/Explosion Hazard	**High Level Risk:** Unacceptable & to be eliminated.	• The comprehensive fire fighting system of the facility will be as per CFEES for effective in eliminating any consequential risk.
5	Hazard from Natural Calamities	**Moderate Level Risk:** Tolerable with immediate action	• All installations will be safely designed, built, maintained, modified and operated in accordance with applicable standards.

RISK CALCULATION PROCESS

Risk assessment is performed according to the process shown in below Figure. First, the shortest stopping distance and turning stopping distance are calculated. The risk based area for a ship is then calculated using the two stopping distances, and that for a jetty is calculated considering the relevant conditions. Second, the overlap between the risk based areas of the ship and jetty is calculated. Finally, collisions between the ship and jetty are predicted by assessing the size of the overlapping risk based area.

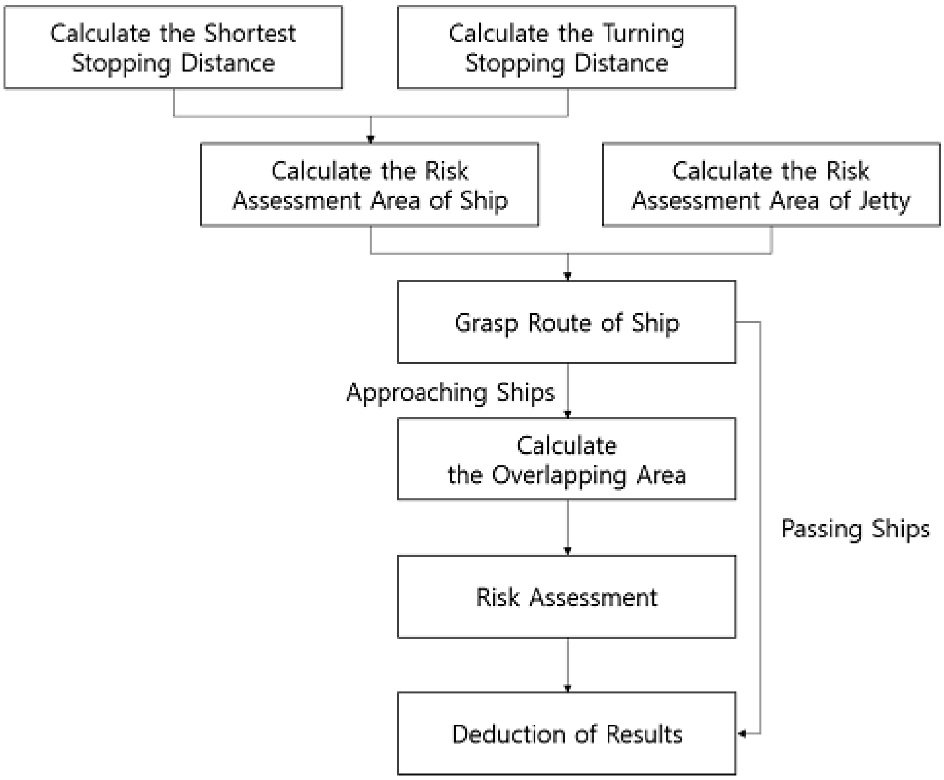


Fig: Risk Calculation Process

OCCUPATIONAL HEALTH AND SAFETY:

Occupational health and safety issues during the construction of Jetty are common to those of most large infrastructure and industrial facilities and their prevention and control. These issues include, among others, exposure to dust and hazardous materials that may be present in construction materials, hazardous materials in other building components (e.g. mercury in electrical equipment), and physical hazards associated with the use of heavy equipment, or the use of explosives.

Specific occupational health and safety issues relevant to Jetty operations primarily include the following:

- Physical hazards
- Chemical hazards
- Confined spaces

Physical Hazards

- The main sources of physical hazards at jetties are associated with Jetty operation and use of associated machinery and vehicles. Separation of people from vehicles and making vehicle passageways one-way, to the extent practical
- Locating means of access to ensure suspended loads do not pass overhead, to the extent practical
- Constructing the surface of Jetty areas to be: of adequate strength to support the heaviest expected loads; level, or with only a slight slope; free from holes, cracks, depressions, unnecessary curbs, or other raised objects; continuous; and skid resistant
- Providing safe access arrangements suitable for the sizes and types of vessels calling at their facilities. These access arrangements should include guard rails and / or properly secured safety nets to prevent workers from falling into the water between the ship's side and the adjacent quay
- Avoiding placing cargo on, or allowing passage of vehicles over, any hatch cover that is not of adequate strength for that purpose
- As far as is reasonably practicable, preventing workers from working in the part of a hold where a trimming machine or grab is operational o Inspecting and approving all slings before use
- Equipping lifting appliances with means of emergency escape from the driver's cabin and a safe means for the removal of an injured or ill driver. Risk of free fall of materials should be minimized by installing telescoping arm loaders and conveyors;
- Materials handling operations should follow a simple, linear layout to reduce the

need for multiple transfer points.

Chemical Hazards

Jetty workers may be exposed to chemical hazards especially if their work entails direct contact with fuels or chemicals, or depending on the nature of jetty activities. Work with fuels may present a risk of exposure to volatile organic compounds (VOC) via inhalation or skin contact during normal use or in the case of spills.

Noise

Noise sources in Jetties may include DG operations, including vehicular traffic, and boats. In order to evaluate the impacts of proposed project on the health of workers, baseline health studies will be carried out on every worker before joining their duties.

RISK REDUCTION MEASURES:

Safety Measures to be implemented during construction phase

- The contractor shall adhere to safe construction practice, guard against hazardous and unsafe working conditions and follow all safety precautions for prevention of injury or accidents and safeguarding life and property.
- The contractor shall further comply with any instruction issued by the Safety Officials in regards to safety which may relate to temporary, enabling or permanent works, working of tools, plants, machineries, equipments, means of access or any other aspect. The contractor shall provide PPE's (Personal Protective Equipments) as well as job specific PPE's, all as per requirement and as directed by the Engineer.
- All safety rules shall be strictly followed while working on live electrical systems or installations as stipulated in the relevant safety codes.
- All mechanical hoisting and hauling devices and equipment required for execution of the work, including their attachments, construction tools, machineries and equipments shall be of adequate capacity and shall comply with relevant safety codes. All the components shall be in good working condition and shall be checked frequently to ensure that no defect/breakage has

developed.

- During work on Jetty project location, the areas of work must be clearly marked with red flags and prominent red lamps (at night) to prevent any danger to workmen engaged at site or to ships berthing at the Jetties.
- During work at night, the Contractor shall deploy halogen lamps/ other electrical lamps at the required spots to ensure there is adequate illumination for hazard-free work.
- The Contractor shall also surround vulnerable areas of on-going works with old rubber tyres as a precaution against accidental collision and damage.
- High quality well-sheathed cables shall be used for all temporary electrical work. All electrical installations shall be grounded and well protected.
- All accessories such as welding leads, electrode holders, welding gloves and helmets, etc. must be of high quality and should be well maintained and checked.
- The contractor shall adopt all the above safety measures at his own cost.
- The contractor shall adhere to safe construction practice, guard against hazardous and unsafe working conditions and follow all safety precautions for prevention of injury or accidents and safeguarding life and property. In case any accident/untoward incident occurs during execution of the work, the Contractor shall be solely responsible for such incident.
- At all times during execution of the project, the contractor shall provide and maintain at site all necessary first aid measures including oxygen cylinder and mask in proper condition.
- Marine Environmental Risk, No damage is caused to plants and vegetations unless the same is required for execution of the project proper.
- The work shall not pollute any source of water / land / air surrounding the work site so as to affect adversely the quality or appearance thereof or cause injury or death to Marine Eco system Flora & Fauna, animal and plant life.
- Labour camp/ Shift room etc, shall be maintained in a clean and hygienic

condition throughout the period of their use and different effluents of the labour hutment shall have to be disposed off suitably.

- Stringent work permit system to be implemented for safety of workman