RISK MANAGEMENT IN UPSTREAM PETROLEUM OPERATIONS

A STUDY OF TASK RISK ASSESSMENTS PROCESS & REVIEW OF 20 TRA's of PANNA, MUKTA & TAPTI PRODUCTION PLATFORMS OF BGEPIL

Summer Project

By

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In partial fulfilment of the requirements for the degree of

MASTER OF TECHNOLOGY

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CERTIFICATE

This is to certify that **Mr. S. VENKATANARAYANAN**, a student of **M.Tech Health, Safety and Environment**, bearing **H.T. No R-070204004**, at **University of Petroleum and Energy Studies, Dehradun,** has carried out a summer project titled **RISK MANAGEMENT IN PETROLEUM OPERATIONS, REVIEW OF 20 TRA's of PANNA & TAPTI** at **BG EXPLORATION AND PRODUCTION INDIA LIMTED, Mumbai**, during the period **8th June 2005-31st August 2005**. The work is certified as bonafide.

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1. ACTIVITIES CARRIED OUT

1. ACTIVITIES CARRIED OUT BETWEEN 8TH JUNE-31ST AUGUST-2005

- Gap analysis on BGEPIL HSSE MS & HSSE directives
- PST & HUET
- Paper on "Strategy for Prevention, Detection and Protection of Fire and Explosions in Offshore Platforms".
- Booklet on Occupational Health
- Study of TRA, HAZOP, HAZID
- Study of PANNA & TAPTI platforms
- Review of 20 TRA'S OF PANNA & TAPTI platforms

2. ABSTRACT

2. ABSTRACT

Petroleum industry is hazardous in nature. There are various risks encountered in different operations which are carried out. This project studies some of the risks present in PANNA-MUKTA, and TAPTI production platforms of BGEPIL. BGEPIL is the operator of the PANNA-MUKTA and TAPTI contract area with a stake of 30%. The other partners in this contract area are ONGC with a stake of 40% and RIL with 30%.

PANNA-MUKTA facility produces crude oil and associated gas, while TAPTI is a gas producing facility. It is essential that hazards are identified and control measures adopted to minimize the effects of the risk.

A Task Risk Assessment is essentially a procedure of identifying the hazards associated with a particular task assign values of its severity, measure the likelihood of the hazards materializing and measuring the residual risks after control measures are incorporated for the identified risks. The TRA's need to be reviewed and updated periodically to incorporate any new hazards identified and establish any new control measures.

In this project, the hazards in upstream petroleum operations where studied. There are several TRA's which are prepared for various tasks which are hazardous in nature. The production process at PANNA and TAPTI where studied understood and a review of 20 TASK RISK ASSESSMENTS where carried out. The study was carried out over a period of 3 months.

3. CRITICAL REVIEW OF HSSE MS

3. A CRITICAL REVIEW OF BGEPIL HSSE MS

The BGEPIL HSSE Management system is a comprehensive document based on the E&P forum Guidelines for the Development and Application of Health, Safety and Environmental Management Systems. It goes into comprehensive details into various aspects which are mentioned briefly:

1. Purpose, Scope and Structure of BGEPIL HSSE Management System.
2. Policy, Leadership and Commitment.
3. Organisation and Resources.
4. HSSE Documentation.
5. Risk Assessment and Management.
6. Planning.
7. Measurement and Feedback.
8. Audit.
9. Management Review.

HSSE MANAGEMENT SYSTEM MODEL

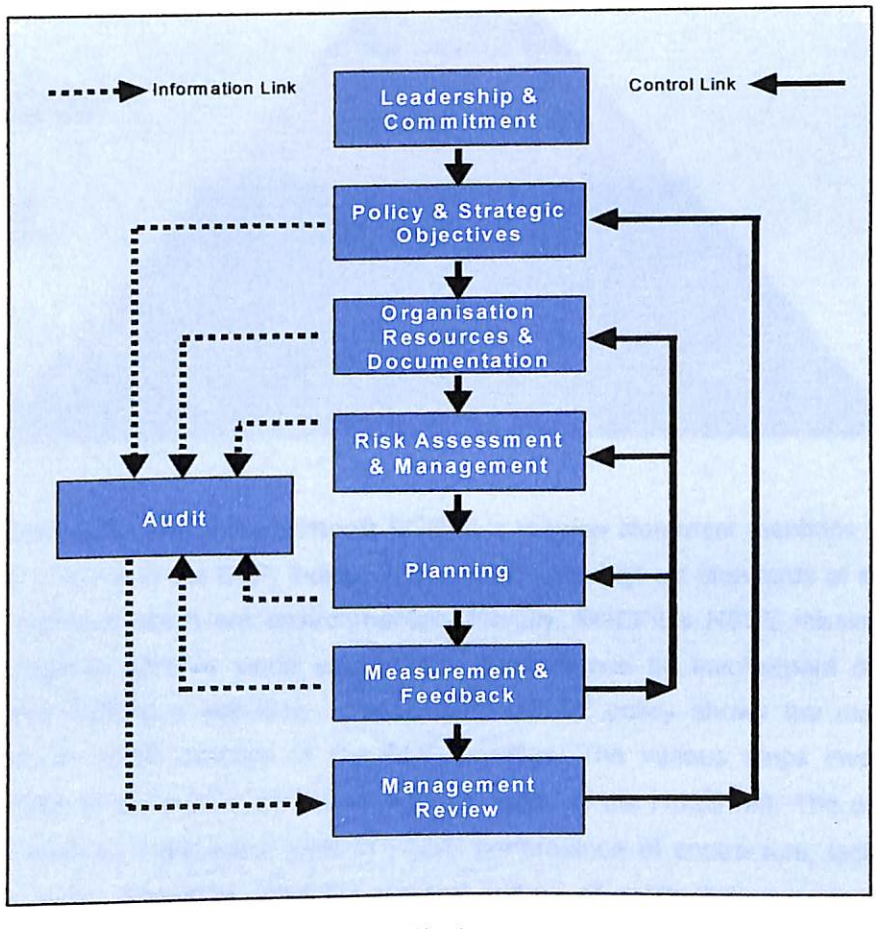
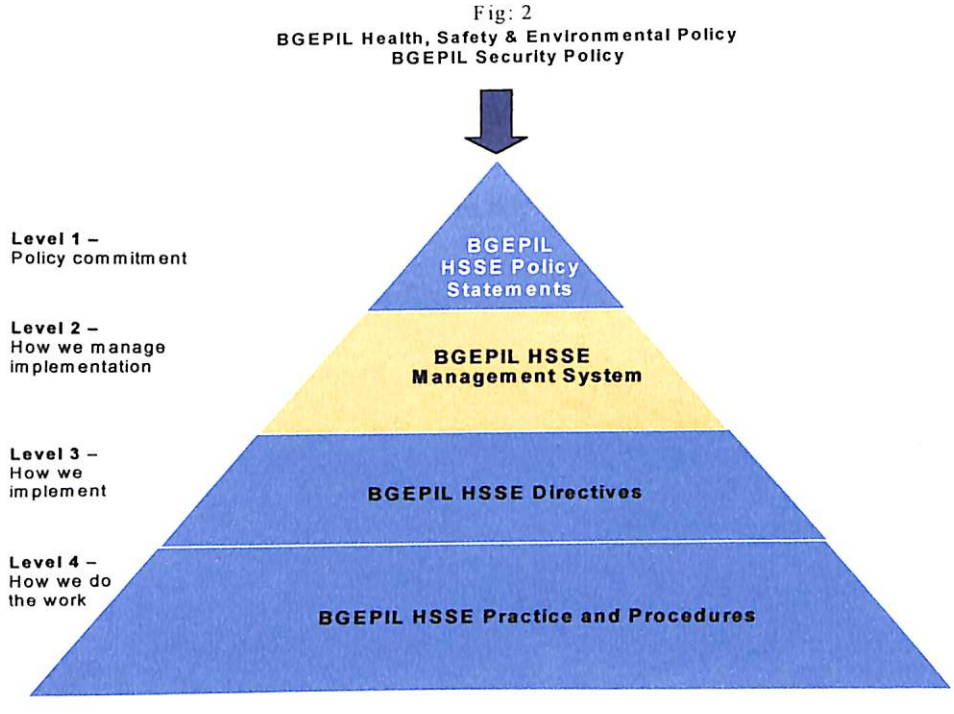


Fig: 1

3.1 BRIEF SUMMARY OF BGEPIL HSSE MS

Purpose, Scope and Structure of BGEPIL HSSE Management System: The purpose of the BGEPIL HSSE MS is to provide the framework and structure for the delivery of the highest level of HSSE performance in lines with the E&P practice. This framework of HSSE MS indicates the manner in which the HSSE MS is to be implemented for best HSSE results. The BGEPIL HSSE MS applies to all the assets of BGEPIL, as well as the contractors involved in the operations of BGEPIL. The HSSE MS is interrelated with the overall BGEPIL business management system. The structure of the MS indicates the flow of activities which lead to best HSSE practice.

Fig: 2



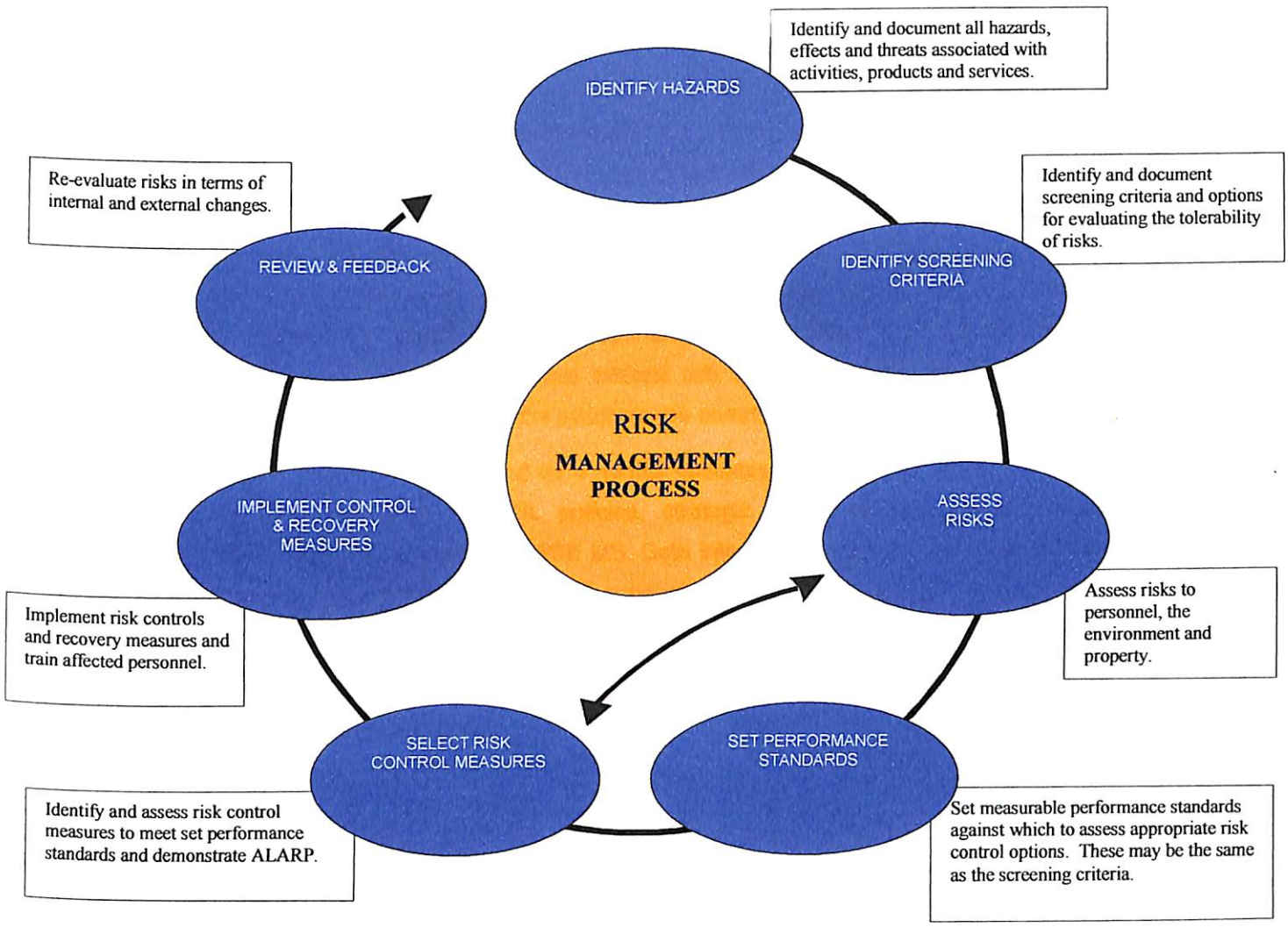
Policy, Leadership and Commitment: BGEPIL's mission statement mentions the need for safe HSSE practice in the E&P, indicating commitment to highest standards of safety and to carry out activities which are environmentally friendly. BGEPIL's HSSE mission statement illustrates how to achieve world class HSSE performance by involvement of all people involved with BGEPIL's activities. The BGEPIL HSSE policy shows the management's commitment to HSSE practice in the E&P activities. The various steps involved in the implementation of the HSSE MS are also incorporated in the HSSE MS. The constraints in HSSE MS such as inadequate level of HSSE performance of contractors, lack of training facilities in some disciplines, and the general culture of safety issues and measures to overcome these issues are discussed in detail in the HSSE MS. The section also discusses the Leadership and Commitment required for the implementation of the HSSE MS at various levels of the organisation specifically through **BELIEF, MOTIVATION, PARTICIPATION, TEAM WORKING, OPENNESS, and PROACTIVENESS.** The HSSE MS also describes in detail the roles and responsibilities (TEAM ROLE, SPECIFIC HSSE RESPONSIBILITIES, &

EMERGENCY RESPONSE RESPONSIBILITIES) of various members of the senior management starting with the MD, Directors, GM's, employees and contractors.

Organisation and Resources: The organisational structure which is required in order to function effectively is important. This section mentions the responsibilities, accountabilities, and authority needed for effective implementation of the HSSE MS.

Documentation: All aspects of HSSE MS have been documented to provide a means of "road mapping" the system that is brief, easily communicated and provides direction (cross-references) to applicable standards, codes of practice, guidelines, procedures and other relevant documentation in the HSSE Management System.

Risk assessment and management: This section illustrates the need to identify hazards, effects, threats associated with BGEPIL's activities, products and services and measures taken to reduce the risks to As Low as Reasonably Practicable. The section illustrates the identification of hazards, screening criteria for tolerability of risks, assessment of risk, performance standards and measures to control the identified risk. The section also mentions the measures to be put in place to respond to any emergency and also the recording of the risk assessment process.


RISK
MANAGEMENT
PROCESS
IDENTIFY HAZARDS
Identify and document all hazards, effects and threats associated with activities, products and services.
IDENTIFY SCREENING CRITERIA
Identify and document screening criteria and options for evaluating the tolerability of risks.
ASSESS RISKS
Assess risks to personnel, the environment and property.
SET PERFORMANCE STANDARDS
Set measurable performance standards against which to assess appropriate risk control options. These may be the same as the screening criteria.
SELECT RISK CONTROL MEASURES
Identify and assess risk control measures to meet set performance standards and demonstrate ALARP.
IMPLEMENT CONTROL & RECOVERY MEASURES
Implement risk controls and recovery measures and train affected personnel.
REVIEW & FEEDBACK
Re-evaluate risks in terms of internal and external changes.

Planning: Plans to be maintained for achieving the Health, Safety, Environmental and Security objectives, the associated activities, risk reduction measures, performance improvement, management of change and preparedness for emergencies are discussed in this section.

Measurement and Feedback: All activities and tasks are carried out as per procedures and work instructions prepared at planning stage or at an earlier stage during the application of the management system. The procedures and work instructions are continuously updated for any deficiencies to improve HSSE performance. Essentially this process ensures that HSSE objectives are met, performance standards met, and control limits are not exceeded. Employees and contractors are educated at all stage regarding any potential hazardous activities. HSSE performance is measured against objectives, targets and performance standards. Monitoring is done on a regular basis and it can be proactive or reactive. Any non-compliance is dealt with and corrective actions are taken. Incidents are reported and investigated and lessons learnt from the incidents are communicated to all.

Audit: Regular audits are carried out as a normal business control to independently assess compliance with legislation, BGEPIL policies, strategic objectives and HSSE planned arrangements, and effectiveness of HSSE MS. Both internal and external audits are carried out and the lessons learnt findings are taken seriously.

Management Review: The HSSE MS is subject to an annual review by senior managers to ensure that it is effective and improvised to take into account any new measures which improves the HSSE performance.

3.2 CRITICAL EVALUATION OF THE HSSE MS

As mentioned in fig: 2 there are four levels in the BGEPIL HSSE MS Manual. Level 1 document contains the BGEPIL HSSE policy, Level 2 explains the BGEPIL HSSE MS, Level 3 contains 17 specific BGEPIL HSSE Directives on various aspects of Health, Safety, Security, and Environment, and Level 4 has the documents pertaining to BGEPIL HSSE practices and procedures. The BGEPIL HSSE Management system is a comprehensive document based on the E&P forum Guidelines for the Development and Application of Health, Safety and Environmental Management Systems. It goes into comprehensive details into various aspects which are mentioned briefly:

1. Purpose, Scope and Structure of BGEPIL HSSE Management System.
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9. Management Review.

BGEPIL's HSSE MS is comprehensive and describes in detail the management aspects of the Health, Safety, Security and Environmental issues. The BGEPIL's HSSE MS is well implemented covering all the assets of BGEPIL. The implementation HSSE MS could be further strengthened by greater involvement of personnel working in the assets of BGEPIL.

Responsibilities and Accountabilities for ensuring successful implementation of the BGEPIL HSSE MS lies with the top management of BGEPIL comprising the MD, and the senior management team. All Managers are responsible for endorsing and promoting the HSSE Management System, Policies and Strategic Objectives through the allocation of appropriate resources, and through their personal involvement in encouraging awareness and responsibility of staff and contractors on HSSE issues. This commitment cascades down through BGEPIL for the resourcing, promotion and monitoring of the HSSE Management System. A mention of Responsibilities and Accountabilities of employees, direct reports and contractors working in BGEPIL assets could be done in the HSSE MS which will indicate that all those working in BGEPIL assets are responsible and accountable for the implementation of the HSSE MS.

The E&P forum guidelines have a separate section on Implementation and Monitoring which comprises

- Activities and Tasks
- Monitoring
- Records
- Non-Compliance and Corrective action
- Incident reporting

- Incident follow-up.

The above sections are addressed in next level of HSSE management system, which is level 4. An elaboration of each of these topics could be mentioned in the BGEPIL HSSE management system as it would explain the practices followed in these tasks.

The section titled, **Compliance Assessment** could be elaborated in the HSSE MS. This elaboration would mention the ways to reduce conflicts with respect to policies and procedures and to verify that policies and procedures are complied with.

BGEPIL has a comprehensive Safety Case for both its PANNA and TAPTI production facilities. The *Safety Case* provides living documentary evidence for facilities and activities where hazards with the potential to cause a major incident are present. An outline of the safety case with a brief mention of the following topics could be mentioned in the BGEPIL HSSE Management system.

- **Hazard identification techniques,**
- **Assessment of hazards using qualitative analysis,**
- **Consequence analysis, QRA's etc.,**
- **Methods to control Hazards with focus on system design and maintenance,**
- **Layout of facilities, facilities and process safeguarding.**

The HSSE MS could also incorporate a section on the different drills conducted in the offshore installation, their requirements and periodicity.

BGEPIL has a Level 3 document titled Health Management the purpose of which is to ensure that all health hazards arising from the business are identified, assessed and managed to reduce the risks of persons developing occupational illness, and to ensure that appropriate means are taken to assist the return to work of those disabled by disease or injury. The following topics are a part of Health Risk Assurance a Level 4 document of BGEPIL and could be outlined briefly in the Level 3 of HSSE MS as details of Health Risk Assurance.

- Pre-employment Medical Examination
- Regular Medical Examination
- Special Medical Examination
- Malaria Prevention
- Vaccinations
- Noise
- Personal Medical Record
- Emergency Medical Response Plan
- Personal Hygiene
- Offshore Medic

The Safety Management aspects given below are discussed in detail in the Level 4 documents of BGEPIL HSSE MS. A brief outline of these could be mentioned in the Level 3 of HSSE Management system.

- To Personnel. (Facial Hair, Medical care, Safety training for new employees)
- Detailed Section on Fire and Gas. (Detection System, Fire protection system, Devices, H_2S, Storage and use of combustibles).
- PPE
- Electrical Safety, Pressure Lines, Pressure vessels and fittings, Manual and Mechanical Fittings.
- Hazardous conditions and operations including confined spaces, restricted entry etc.
- Automotive Safety
- General and Miscellaneous including jewellery, drugs and alcohols etc.

BGEPIL adheres to ISO 14001 Environmental Management System and Environmental norms. The following areas are adhered to strictly as part of BGEPIL's environmental protection measures. A brief mention of these activities could be incorporated in the Level 3 of HSSE MS as it would show that these measures are taken to ensure that all activities are performed in an environmentally friendly manner.

- Environmental Protection
- Periodic Environmental Assessment
- Site Abandonment Survey.
- Environmental Emergency response plan
- Performance Measurement
- Business Transaction Environmental Measurement.
- ISO 14001

The above if included either as part of the HSSE MS or as a separate section in the HSSE MS more comprehensive as it would incorporate key aspects of Health, Safety and Environment and measures to be taken in the event of an unforeseen event.

4. PANNA-MUKTA, TAPTI

4. OVERVIEW OF BGEPIL'S PANNA, MUKTA, TAPTI PLATFORM OPERATIONS

4.1 THE PANNA-MUKTA, TAPTI JOINT-VENTURE PARTNERS: The Panna-Mukta, Tapti Contract Area was awarded by the Government of India to a joint venture comprised of Enron Oil and Gas India, Ltd. (30%, Operator), Reliance Industries (30%), and Oil and Natural Gas Corporation, Ltd. (40%), following the 1992 bid round for small and medium sized oil and gas Fields. A Production Sharing Contract and Joint Operating Agreement were approved and signed on December 22, 1994.

The Fields are presently being operated by a Joint Venture (JV) consortium of ONGC (Oil and Natural Gas Corporation Limited), BG and RIL (Reliance Industries Limited). Working interests of the participating companies are 40% for ONGC, 30% for BG and 30% for RIL.

4.2 FIELD LOCATION AND GEOLOGY:

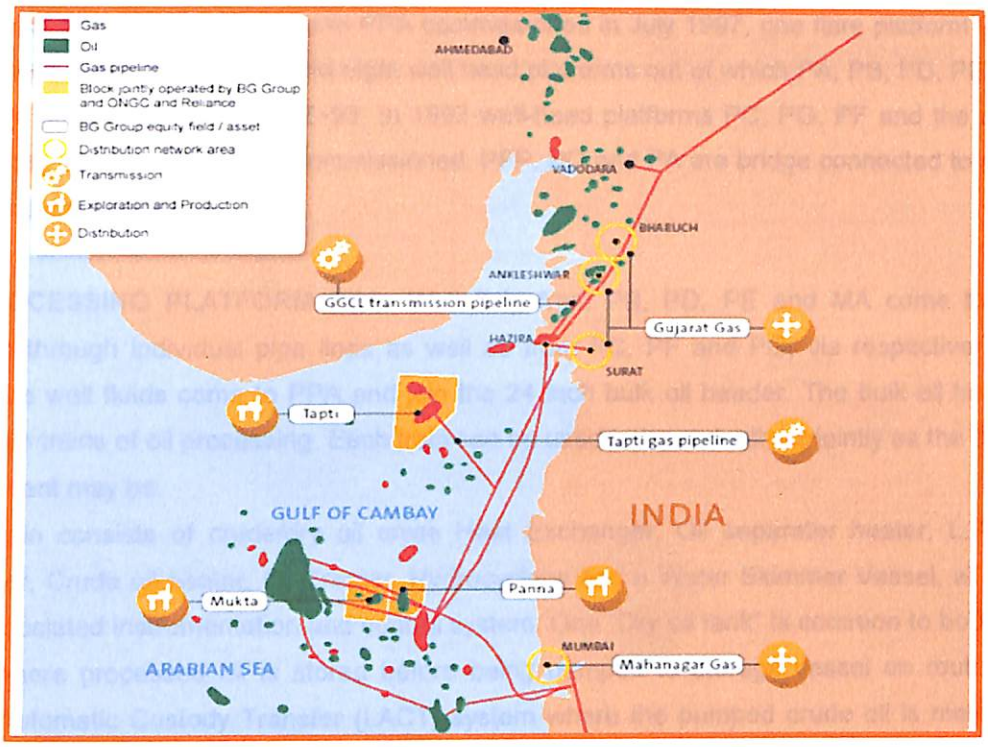
PANNA-MUKTA: Panna-Mukta oil is exported via tanker, gas and condensate are exported through an 18 inch pipeline to join ONGC pipeline from Bassein field to Hazira. PANNA oil and gas processing facility consists of one processing platform PPA, one flare platform PFP, one living quarter platform PQ and eight well head platforms PA, PB, PC, PD, PE,PF, PG and MA. PQ and PA are bridge connected to main process platform PPA.

The PANNA field is located 50 km (31 miles) east of the giant Bombay High field and 95 km (59 miles) NW of the city of Bombay. The field is 70 km (43 miles) from the nearest shoreline. It lies immediately to the north of the Bassein gas field, separated by a shallow NE-SW trending syncline. The PANNA block comprises approximately 430 km^2 (106,000 acres). The water depth varies from 36 m to 67 m (120 feet to 220 feet) and the average water depth is 45 m (150 feet).

TAPTI: The 363,500-acre (1471 km^2) Tapti Block is located offshore, 100 miles (160 kilometres) north-northwest of the city of Bombay and 50 km (31 miles) from the nearest shore; the northern edge of the Tapti mid field is, only 18km (11 miles) from the nearest shoreline. It lies in approximately 20 meters (65 feet) of water on the northeast flank of the Surat Depression, Offshore Bombay Basin.

The block contains two fields South Tapti and Mid Tapti, which occur in two large structural culminations. The two fields have tested natural gas and condensate from porous and permeable Early Miocene-Oligocene age shallow marine and deltaic sand reservoirs.

The location of the Panna-Mukta, Tapti development is shown in the Figure below:



4.3 HYDROCARBON RESERVES:

PANNA: The initial in place volumes in the two main reservoirs, Bassein A and B Zones, are estimated to be about 1 billion barrels of oil and 1.8 tcf of gas.

TAPTI: The original gas in place (OGIP) volumes in the two main reservoirs, south Tapti and mid Tapti, are estimated to be about 2.776 tcf of which 2.055 tcf is recoverable till 2019.

4.4 PRODUCTION PROFILE:

The **PANNA** fields are producing at an average rate of 32000 BOPD of oil and 125 MMSCFGD of gas.

The **TAPTI** fields are producing at average producing at an average rate of 225 MMSCFGD of gas.

THERE ARE A TOTAL OF 93 WELLS IN PANNA AND 17 WELLS IN TAPTI.

4.5 OVERVIEW OF EXISTING PANNA FACILITIES: PANNA oil and gas processing facility consists of one processing platform PPA commissioned in July 1997, one flare platform PFP, one living quarter platform PQ and eight well head platforms out of which PA, PB, PD, PE and MA were commissioned in 1992~93. In 1997 well-head platforms PC, PG, PF and the main processing platform PPA were commissioned. PFP, PQ and PA are bridge connected to main process platform PPA.

4.6 PROCESSING PLATFORM PPA: Well fluid from PB, PD, PE and MA come to PA platform through individual pipe lines as well as from PC, PF and PG, via respective pipe lines. The well fluids come to PPA and join the 24 inch bulk oil header. The bulk oil header feeds two trains of oil processing. Each train can be used independently or jointly as the case/ requirement may be.

Each train consists of crude/dry oil cross Heat Exchanger, Oil separator heater, L.P. oil separator, Crude oil heater, Oil Treater, Hydrocyclone and a Water Skimmer Vessel, all with their associated instrumentation and control system. One "Dry oil tank" is common to both the trains where processed oil is stored before being pumped to storage vessel en route the Lease Automatic Custody Transfer (LACT) system where the pumped crude oil is metered. One ""Wet oil tank" also is common to both the trains. In this Wet Oil Tank the crude oil is diverted to, if the water content in the discharged crude is more than a preset value. This oil, stored in the wet oil tank is pumped back in the bulk oil header and undergoes processing once again along with the well fluid.

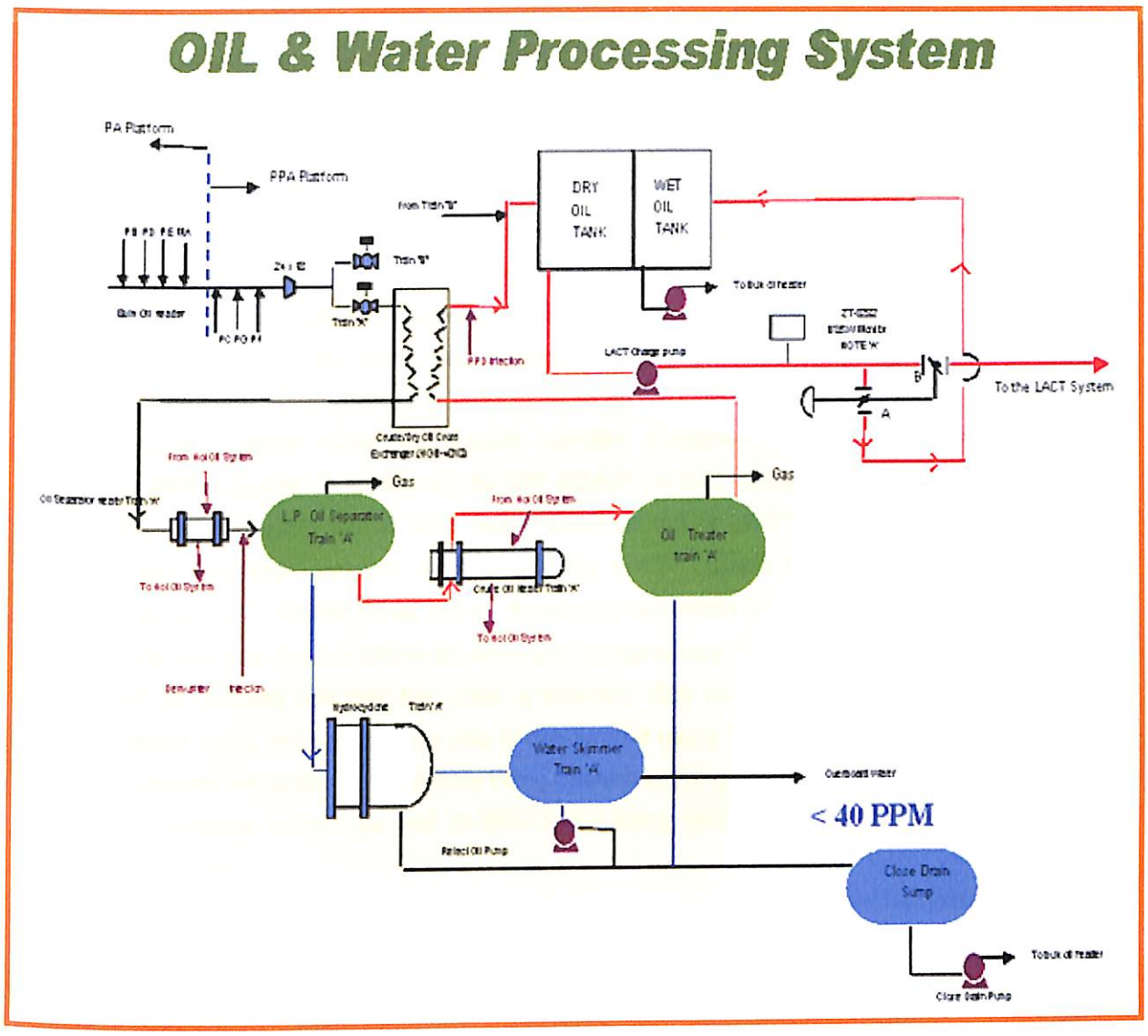
Oil Separator heater is a plate type Heat exchanger and is designed to heat up the incoming fluid. Heat transfer takes place between the well fluid and processed fluid from oil treater before it goes to dry oil tank.

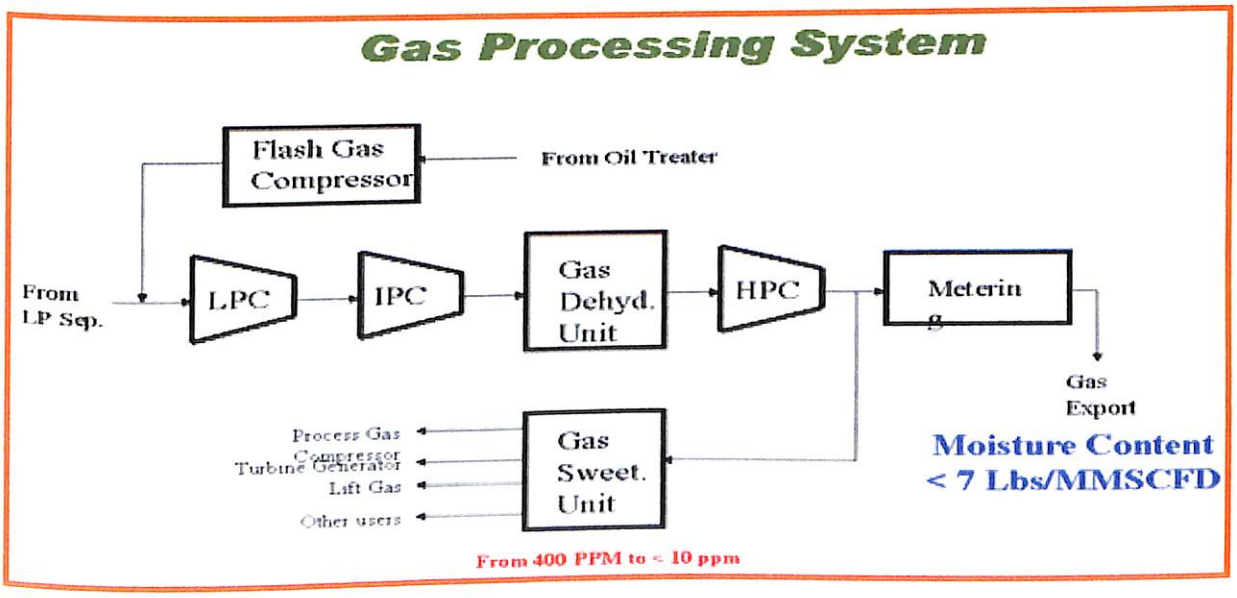
Well fluid is heated up once again in oil separator heater before it goes in L.P. oil separator. Heating medium used in the "oil separator heater" is Therminol. First stage of separation takes place in L.P. oil separator where majority of water is separated and sent to hydrocyclone & downstream skimmer vessel for further processing and recovery of oil. Demulsifier, which is injected upstream of L.P.Oil separator at a recommended rate, helps this separation. Each L.P. Separator has been checked for handling 18,000 BOPD, 25,000 BWPD and 70 MMSCFD of gas.

Oil coming out of L.P. Oil Separator is sent to "Oil treater" after being heated in "crude oil heater". Therminol is used in "crude oil heater" as heating medium. Small amount of water which is separated in the oil treater with the help of electrostatic field is sent to close drain vessel. Oil from the treater is sent to dry oil tank via crude/dry oil cross exchanger.

Water from L.P. Oil Separator is routed to hydrocyclone. Each hydrocyclone is capable of handling 55,000 BWPD. Overflow from hydrocyclone which contains oil is routed to close drain vessel. Underflow from hydrocyclone which contains water having oil less that 40 ppm is routed to water skimmer vessel. Oil recovered in the water skimmer vessel is pumped into close drain vessel and water is sent overboard.

PROCESS FLOW DIAGRAM OF PANNA PROCESS PLATFORM





Oil from both the trains gets accumulated in dry oil tank. Capacity of dry oil tank is 960 barrels. At a preset level, LACT Charge pump starts automatically and pumps the treated crude oil to the tanker through LACT metering system. PPD is injected in the sales oil prior to dispatch to the tanker to maintain the pour point of the crude oil at 70^0F.

The BS&W probe installed in the discharge of LACT charge pump continuously monitors the BS&W of the crude oil and diverts the oil flow to wet oil tank if the BS&W value exceeds a preset limit. When liquid level in the Wet oil tank reaches a preset value, wet oil pump starts automatically and pumps the fluid in the bulk oil header where it is processed along with the incoming well fluid. Capacity of wet oil tank is 1920 barrels.

Liquid accumulated in the close drain vessel also is pumped in the bulk oil header with the help of close drain pump where it is processed along with the incoming well fluid.

LACT system (Lease automatic custody transfer) consists of two positive displacement meters, each capable of measuring 50,000 BOPD, product sampling system and a prover loop to prove the accuracy of each meter. Downstream of LACT unit is a control valve to control the discharge pressure of LACT charge pump. Signals from instruments of LACT system go to LACT control Panel and oil dispatch is calculated automatically.

There are two gas turbine driven process gas compressors of capacity 90 MMSCFD each. One unit is normally run and the other is standby. Gas coming out of L.P. Separators is compressed using the compressor and is dehydrated using Tri-ethylene Glycol process to a pre-established acceptable limit before being pushed in the gas Export pipe line. Sales gas is metered for sales volume as well as BTU value using online gas chromatograph and gas metering station.

Electrical power generation is done by Gas Turbine Generators. There are two generators of capacity 3500 kW each as 1 + 1 standby basis. In addition to this, there is one diesel engine driven emergency generator of 750 kW capacities to meet the emergency power requirements.

4.7 PQ PLATFORM: PQ platform is the living quarters and the utilities unit of Panna-Mukta complex, bridge connected to PPA process platform. The building Module is designed for 60 beds housed in two and four bedded rooms on three floors. The Helideck and the Radio Room are located on the main deck of this platform.

The Two gas turbine generators of 3500 KW each and the 750 KW Emergency Generator as described earlier are located on PQ along with control and switchgear rooms. The Fire Water Pumps are located on PQ platform, the controls of which are integrated with PPA and PA.

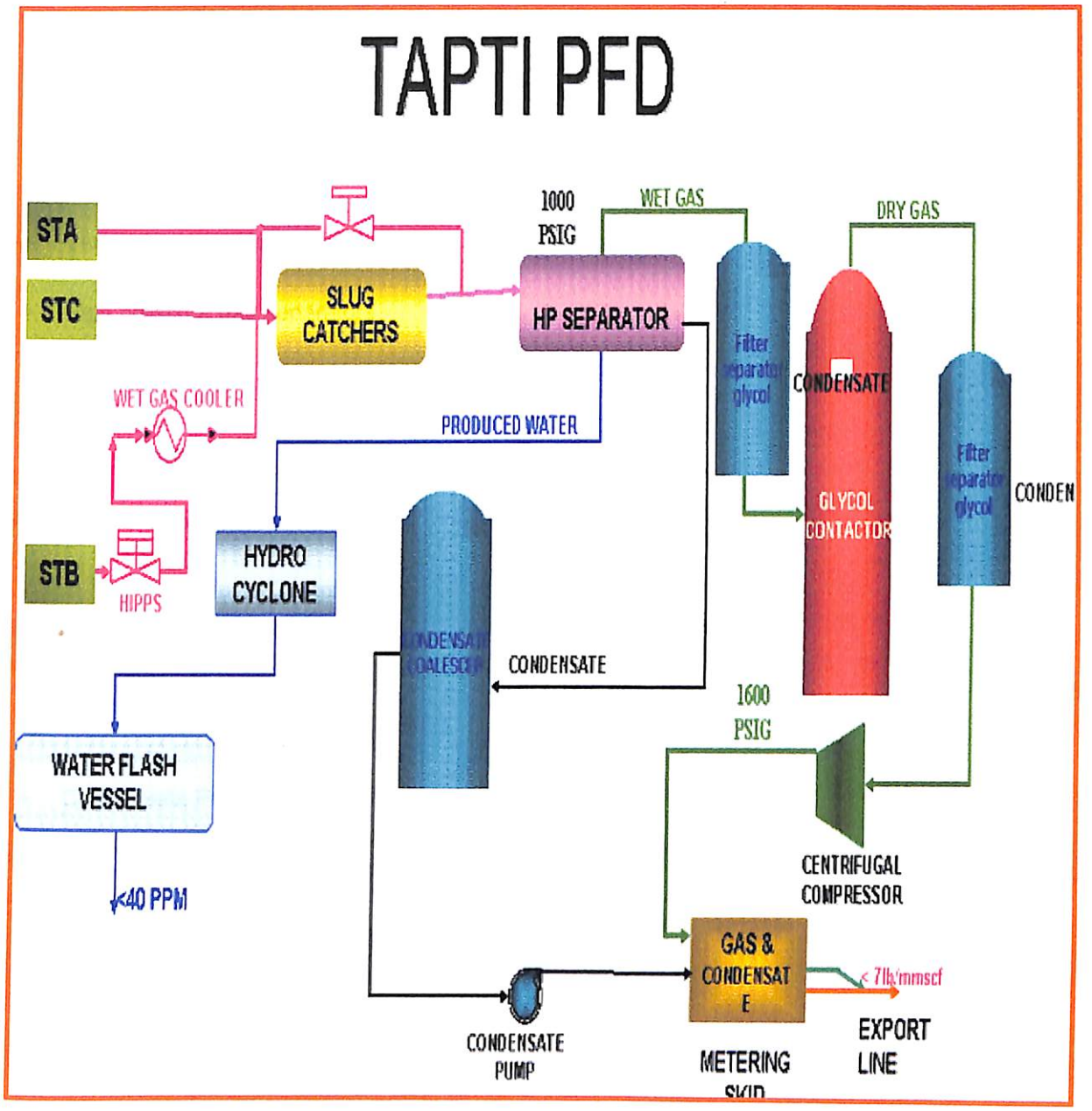
The PQ platform also has Diesel treatment and storage facility as well as fresh water generator, storage and supply system. It has an 80 men sewage treatment facility for treating grey water from the living quarters.

4.8 EXPORT PIPELINE & SINGLE BUOY MOORING (SBM): The stabilized crude oil from PANNA platform is first metered in the LACT unit and then checked for BS&W on PA

platform. From PA, the processed crude oil is then sent to the field tanker via a 12", 2.7 Km export line to the PLEM. The export line goes to the tanker via a Pipe Line End Manifold system (PLEM) and then on to the SBM. The SBM is 12.5 meter diameter, 4.57 meter height, IMODCO make, and floating structure capable of diverting crude oil from PA platform to the tanker through a system of incoming submersible hoses and outgoing floating and semi-submersible hoses. It is designed to handle a Tanker of 115 KDWT (Kilo Dead Weight Tonnage). This is a new SBM, which was installed in 2001 replacing the earlier SBM, which was in operation since 1992-93. This SBM is capable of simultaneous loading of Crude Oil and Condensate. It has a floatation chamber and balancing arm and is moored to the sea-bed with anchor chains. The 12" pipe line coming from PA is connected to this SBM via the PLEM. PA is hard piped to the PLEM and the PLEM is connected to the SBM.

4.9 OVERVIEW OF EXISTING TAPTI FIELD FACILITIES: The central gas processing facility (TPP) is equipped with separation facilities, dehydration facilities, a quarters building and all necessary utilities to process the enhanced nominal design gas throughput of 250 MM SCFD (upgraded from 180 MMCFD). The platform is a 6 pile structure adjacent and bridge-connected to the first wellhead platform (STB) and a flare platform (TFP). Other satellite wellhead platforms are connected to TPP via sub-sea flow lines.

PROCESS FLOW DIAGRAM OF TAPTI PROCESS PLATFORM



PROCESSING PLATFORM TPP: The following facilities are located on TPP

Quarters building (50 person) with associated utilities

- Two gas turbine electrical generators and one diesel generator for start up operations.
- MCC and switch gear.
- Pig launchers and receivers.
- Slug catchers (Kept inventory free)
- High pressure gas separators
- Gas dehydration system, including glycol re-boiler
- Gas compression system
    - Suction scrubbers
    - Centrifugal Compressors
    - After coolers
    - Fuel gas conditioning system
- Condensate Processing System
    - Condensate coalescers
    - Condensate Booster pumps
- Produced water clean up system
- Warehouse/shop
- Firewater system with two pumps located one each at TPP and STB.
- Two cranes
- Escape capsule.
- Chemical injection and distribution system 93
- HP/LP vent scrubber.

- Two bridge landings.
- Helideck
- Boat landings
- Gas metering
- Condensate metering

The TPP platform has dimensions of approximately 42m x 26 m. There are two primary decks with the cellar deck at elevation 22.3 m and the main deck at elevation 31.4 above mean sea level (MSL).

The cellar deck contains the pig receivers and launchers, slug catchers, centrifugal compressors and fuel gas conditioning system, PCR building(switch gear/controls for compressors), LP and HP relief scrubbers, water flash vessel and lower sections of the contactor towers. Sub-cellar deck houses the condensate booster pumps and slop oil tank. Bridges to the flare platform (TFP) and wellhead platform (STB) are accessed from the cellar deck.

The main deck houses the living quarters module with one 36 men and one 50 men lifeboats located behind it as well as the turbine generators, MCC/switchgear room, gas separation equipment, glycol regeneration skids, condensate coalescers, process gas coolers, compressor suction scrubbers and the upper sections of the contactor towers.

A flare platform (TFP) is installed adjacent to TPP to allow the gas to be temporarily flared in case of an emergency/blow down. The flare/vent system on TPP is designed to accommodate the full relief of the production without jeopardizing the facilities or personnel working on the facilities. The TFP platform is connected to the TPP platform by a 60 m bridge.

Wellhead platform STB

Three 8 – slot wellhead platforms are installed. The equipments located on a typical wellhead platform include:

- Up to eight wellheads.
- Eight slot production manifold with a high pressure log and a test log.
- Test separator capable of testing individual wells.
- Vent system including a vent boom and vent scrubber (only on STA/STC).

- Instrument gas skid (only on STA/STC).
- Deck drain system.
- Chemical injection skid.
- Helideck (only on STA/STC)
- Crane
- Pig Launchers (only on STA/STC)
- Boat Landing.
- Wet gas cooler (only at STB)
- HIPPS (High integrity Pressure Protection System, only on STB)

The wellhead platforms each have dimensions of 15 m x 15 m. The cellar decks are at elevation 22.3 m and the main decks at elevation 29.9 m above MSL. All process equipment is located on the cellar decks of the wellhead platforms (except wet gas cooler, which is on main deck at STB). There is also a dog house located on the main deck of each platform. On STB, the bridge to TPP is accessed via the cellar deck.

5. HAZARDS OF OFFSHORE OIL&GAS PRODUCTION

5. MAJOR HAZARDS OF OFFSHORE OIL AND GAS PRODUCTION

Offshore oil and gas production systems present a unique combination of equipment and conditions not observed in any other industry. Although there are few aspects of the industry which are completely new or novel, their application in an offshore environment can result in new potential hazards which must be identified and controlled.

Much of the oil and gas processing equipment which is utilized on offshore facilities is similar to the equipment used onshore for oil production activities or in chemical process plants. Therefore, many of the hazards associated with the process equipment are well known. However, the inherent space constraints on offshore structures have resulted in the application of some new process equipment, and, more importantly, make it difficult to mitigate hazards by separating equipment, personnel and hazardous materials. Due to the facilities' remote locations, personnel who operate or service offshore facilities typically live and work offshore for extended periods of time. In many ways, these aspects of offshore operations are similar to those found in the shipping industry. However, the operations that take place on offshore oil and gas production are different than those which take place on trading ships.

Another difference between offshore and onshore oil and gas production is the relative complexity of drilling and construction activities, which contribute significantly to the risk picture. Due to the remoteness of most offshore facilities and the challenges presented by a marine environment, drilling and construction projects are typically major undertakings which require the use of large and expensive marine vessels (drill ships, derrick barges, supply vessels, diver-support vessels, etc.).

These non-routine operations dramatically increase the number of persons onboard a facility and the level of marine activity, material handling and other support activities over more routine production activities.

Transportation of personnel and materials to and from the offshore locations present a significant risk element: helicopter transport, marine transport and loading and unloading operations are a routine part of offshore life.

The design of offshore facilities – multi-deck platforms above the water or floating systems, can expose personnel to falling and drowning hazards which are not encountered onshore.

In addition to the factors described above, the fact that offshore facilities typically have higher concentrations of manpower, higher operating costs and revenues, and higher initial capital investments than their onshore counterparts makes them an obvious place to apply risk assessment and risk reduction measures. The hazards associated with offshore production facilities can be categorized in different ways, but are often grouped by operation. This grouping mirrors the way the supporting engineers, operators and support personnel are grouped within the organization, since these organizational entities are responsible for

identifying and understanding potential hazards and addressing them during design, construction and operation of the facilities.

Some of the major potential hazards associated with offshore operations are listed below.

5.1 PRODUCTION OPERATIONS:

Topside Production Facilities and Pipelines

1 Equipment-related Hazards:

i) Rotating equipment hazards

ii) Electrical equipment hazards

iii) Lifting equipment hazards

iv) Defective equipment

v) Impact by foreign objects

2 Process-related Hazards:

i) High pressure liquids and gas

ii) Hydrocarbons under pressure

iii) Temperature (High or very low)

iv) Hydrocarbons and other flammable materials

v) Toxic substances

vi) Storage of flammable or hazardous materials

vii) Internal erosion/corrosion

viii) Seal or containment failures

ix) Production upsets or deviations

x) Vent and flare conditions

xi) Ignition sources

xii) Process control failures

xiii) Operator error

xiv) Safety system failures

xv) Pyrophoric materials

3 Well-related Hazards:

i) Pressure containment

ii) Unexpected fluid characteristics (sand, etc.)

iii) Well-servicing activities

iv) Proximity of wells to other wells and facilities

4 Environmental Hazards:

i) Corrosive atmosphere

ii) Sea conditions

iii) Severe Weather (storms, hurricanes, etc.)

iv) Earthquakes or other natural disaster

5.2 LIVING QUARTERS

1 External Hazards:

i) Gas releases

ii) Fires

iii) Dropped objects

2 Internal Hazards:

i) Flammable materials/internal fires

ii) Toxic construction materials

iii) Inadequate escape routes and lifesaving equipment

iv) Emergency system failures

v) Bacterial hazards

vi) Drinking water supply

vii) Food preparation and delivery

viii) Living conditions

ix) Waste disposal

x) Security hazards

5.3 MARINE TRANSPORT

i) Vessel traffic and mooring

ii) Sea conditions

iii) Vessel failures

iv) Diving operations

5.4 MATERIALS AND EQUIPMENT HANDLING

i) Crane and lifting operations

ii) Elevated objects

iii) Storage of equipment and supplies

iv) Chemical/flammable storage

v) Static electricity

vi) Radioactive sources

vii) Respiratory hazards (exhaust, chemicals, confined spaces, etc.)

viii) Active or stored energy sources (electrical and mechanical)

5.5 SIMULTANEOUS ACTIVITIES

i) Release of flammable hydrocarbons

ii) Hot work (Welding, grinding, cutting)

iii) Proximity of other operations

5.6 DRILLING OPERATIONS

1 Rig Operations

i) Well control

ii) Tubular handling

iii) Lifting operations

2 Air and Marine Transport

i) Vessel approach and docking or mooring procedures

ii) Sea and atmosphere conditions

iii) Severe weather

iv) Vessel failures

v) Diving operations

3 Materials Handling

i) Rig transfers

ii) Crane operations

iii) Storage of drilling equipment and supplies

iv) Chemical/flammable storage

v) Radioactive sources

vi) Explosives

5.7 PERSONNEL SAFETY

i) Inadequate personnel protective equipment

ii) Improper use of equipment

iii) Slipping and tripping hazards

iv) Working at heights

v) Friction, sparks or flames

vi) Drugs and alcohol

vii) Exposure to weather

viii) Fatigue

ix) Housekeeping

x) Living conditions (see Quarters, above)

xi) Waste disposal

This listing of hazards is not meant to be all-inclusive, but is provided to give an understanding of the types of hazards encountered offshore. Listings such as this or more specific and detailed listings can be used in hazard identification exercises.

The potential hazards described in this section, if not properly controlled, can lead to undesirable and hazardous events. The most severe consequences of these events could include:

i) Personnel injury

ii) Loss of life

iii) Impact on public

iv) Environmental impact

v) Loss of facilities and equipment damage

vi) Loss of production

vii) Impact on associated operations

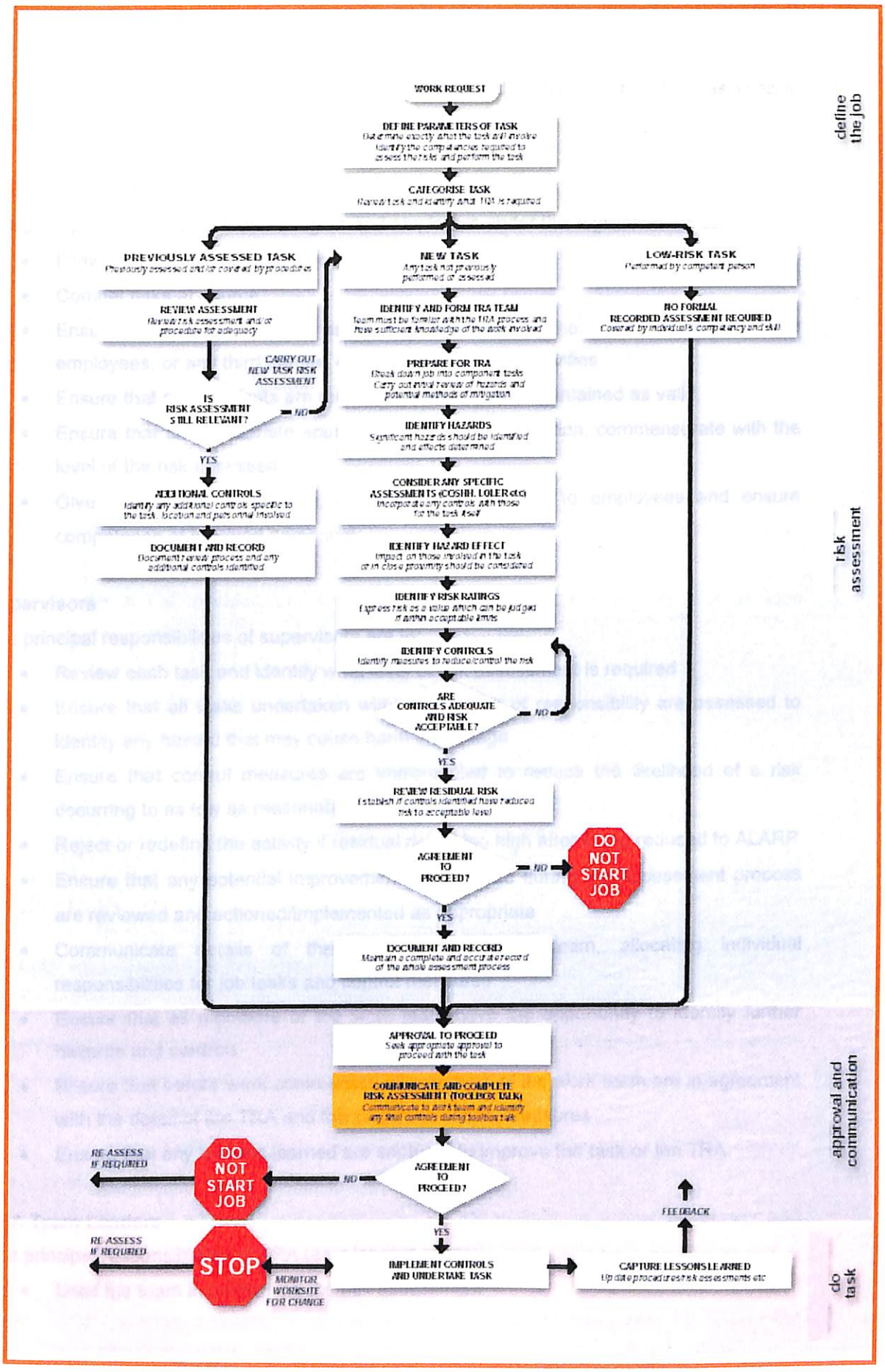
viii) Impact on corporate reputation

It is to prevent these types of consequences that regulations have been developed and corporations have established internal standards and controls. Through the application of risk assessment approaches, the risks associated with offshore hazards can be better understood and regulations and controls can be continuously improved.

6. TASK RISK ASSESSMENTS

6. TASK RISK ASSESSMENTS

6.1 INTRODUCTION: It is a requirement of legislation, good company practice and common sense, that all work tasks should be subject to an assessment of their risks. This is in order to identify the hazards present, assess the risks involved, and identify the controls and precautions necessary to undertake the work safely. When a task is identified, the first action is to establish what it will involve. This initial appraisal should identify the need for any special safety studies or assessments and identify at the outset if it is clearly obvious that the task cannot be carried out safely. If the likely hazards cannot be reconciled at this stage, then the task should be rejected or redefined. The next stage represents the heart of the TRA process. It involves identifying the hazards associated with the task, assessing the risks and identifying the controls/precautions required to mitigate those risks. Where a task comprises a number of separate activities, these should be broken down into individual tasks and assessed separately. The extent of the controls identified will depend upon the level of risk associated with the task. THE HIGHER THE RISK, GREATER IS THE DEGREE OF CONTROL. A new risk assessment will not be required for every task. Where a task has previously been risk assessed, or is covered by a procedure, it may not need a new risk assessment. Where this is the case, the previous assessment or procedure should be reviewed to ensure that the hazards and controls are still relevant and that any site or job specific controls are identified. For low-risk tasks performed by competent people, no formal recorded risk assessment is required as the individual's competency and skill cover this. Prior to undertaking the task, the appropriate approval should be sought and a pre-task talk or toolbox talk should be held. At this point it is essential to communicate the hazards, controls and individual responsibilities to the rest of the work team and engage everyone involved in the final stage of the risk assessment process. The latter is an important opportunity for the whole work team to identify any additional hazards and controls, especially those specific to the site and the local conditions. Once the task commences, it is important to monitor the worksite for any change in conditions that might alter the hazards and controls in place. If there is any concern, stop the work, re-assess the controls and, if necessary, re-plan and re-assess the task. On completion of the task, it is important to capture any lessons learned and make improvements for next time.


define the job
risk assessment
approval and communication
do task
WORK REQUEST
DEFINE PARAMETERS OF TASK
Determine exactly what the task will involve
Identify the competencies required to assess the risks and perform the task
CATEGORISE TASK
Review task and identify what TRA is required
PREVIOUSLY ASSESSED TASK
Previously assessed and for control by procedure
REVIEW ASSESSMENT
Review risk assessment and or procedure for adequacy
CARRY OUT NEW TASK RISK ASSESSMENT
IS RISK ASSESSMENT STILL RELEVANT?
NO
YES
ADDITIONAL CONTROLS
Identify any additional controls specific to the task location and persons involved
DOCUMENT AND RECORD
Document review process and any additional controls identified
NEW TASK
Any task not previously performed or assessed
IDENTIFY AND FORM TRA TEAM
Team must be familiar with the TRA process and have sufficient knowledge of the work involved
PREPARE FOR TRA
Break down job into component tasks
Carry out initial review of hazards and potential methods of mitigation
IDENTIFY HAZARDS
Significant hazards should be identified and effects determined
CONSIDER ANY SPECIFIC ASSESSMENTS (COSHH, LOLER etc)
Incorporate any controls with those for the task itself
IDENTIFY HAZARD EFFECT
Impact on those involved in the task or in close proximity should be considered
IDENTIFY RISK RATINGS
Express risk as a value which can be judged against acceptable limits
IDENTIFY CONTROLS
Identify measures to reduce/control the risk
ARE CONTROLS ADEQUATE AND RISK ACCEPTABLE?
NO
YES
REVIEW RESIDUAL RISK
Establish if controls identified have reduced risk to acceptable level
AGREEMENT TO PROCEED?
NO
DO NOT START JOB
YES
DOCUMENT AND RECORD
Maintain a complete and accurate record of the whole assessment process
LOW-RISK TASK
Performed by competent person
NO FORMAL RECORDED ASSESSMENT REQUIRED
Covered by individuals competency and skill
APPROVAL TO PROCEED
Seek appropriate approval to proceed with the task
COMMUNICATE AND COMPLETE RISK ASSESSMENT (TOOLBOX TALK)
Communicate to task team and identify any final controls during toolbox talk
AGREEMENT TO PROCEED?
NO
DO NOT START JOB
RE-ASSESS IF REQUIRED
YES
IMPLEMENT CONTROLS AND UNDERTAKE TASK
STOP
RE-ASSESS IF REQUIRED
MONITOR WORKSITE FOR CHANGE
CAPTURE LESSONS LEARNED
Update procedures risk assessments etc
FEEDBACK

6.2 ROLES AND RESPONSIBILITIES: Everyone involved in the TRA process has specific responsibilities. These are defined in the following paragraphs.

Employers and Managers

The principal responsibilities of managers and employers under this legislation are to:

- Eliminate and reduce risks wherever practicable
- Combat risks at source
- Ensure suitable and sufficient assessment of all risks to the health and safety of their employees, or any third parties, caused by their work activities
- Ensure that assessments are recorded, reviewed and maintained as valid,
- Ensure that an appropriate approval process is in operation, commensurate with the level of the risk assessed,
- Give appropriate information, instruction and training to employees and ensure competence of involved personnel.

Supervisors

The principal responsibilities of supervisors are to:

- Review each task and identify what level of risk assessment is required
- Ensure that all tasks undertaken within their area of responsibility are assessed to identify any hazard that may cause harm or damage
- Ensure that control measures are implemented to reduce the likelihood of a risk occurring to as low as reasonably practicable (ALARP)
- Reject or redefine the activity if residual risk is too high after being reduced to ALARP
- Ensure that any potential improvements highlighted during the assessment process are reviewed and actioned/implemented as appropriate
- Communicate details of the TRA to the work team, allocating individual responsibilities for job tasks and control measures
- Ensure that all members of the work team have the opportunity to identify further hazards and controls
- Ensure that before work commences all members of the work team are in agreement with the detail of the TRA and the proposed control measures
- Ensure that any lessons learned are captured to improve the task or the TRA

TRA Team Leaders

The principal responsibilities of TRA team leaders are to:

- Lead the team in performing the risk assessment

- Ensure that the team understands the assessment process and what it is trying to achieve
- Take responsibility for the quality of the TRA
- Ensure that the assessment team includes personnel with all the necessary knowledge and competence for the task involved
- Ensure that the team is guided systematically through the assessment process and kept on track
- Ensure that the TRA includes a worksite visit where possible
- Ensure that the detail of the assessment is agreed by the assessment team
- Ensure that the detail of the assessment is recorded and that records are updated as appropriate

Individual TRA Team Members

The principal responsibilities of individual team members are to:

- Actively participate in any TRA related to the work activity
- Help identify hazard(s) and control measures to reduce the likelihood of an incident/accident occurring
- Assist in the identification of any deficiencies in the work process and possible improvements

People Carrying Out the Work

Have a crucial part to play in the TRA process through:

- Understanding the hazards and control measures associated with the task
- Actively monitoring their worksites and surroundings for changes
- Stopping the work at any time they are concerned about safety
- Sharing knowledge and contributing towards the pre-task talk or toolbox talk
- Identifying any lessons learned from the job

6.3 RISK ASSESSMENT PROCESS:

Define Parameters of Task: When a work request is received, the first part of the process is to define the parameters of the task. This is the responsibility of the supervisor, i.e. the person responsible for seeing that the work is carried out. An examination should be made to determine exactly what the task will involve. It should consider:

- The need for any special safety studies or assessments (e.g. COSHH, manual handling, etc)
- Whether it is immediately obvious that the task cannot be carried out safely and should be immediately discarded. If the likely hazards cannot be reconciled at this stage then the task should be rejected or redefined
- What personal competency requirements are needed of those who will assess the risks and perform the task?

Categorise Task: Once this initial examination is complete, the supervisor should determine into which of the following categories the task fits:

• **New Task**

Any task not previously performed or assessed. New tasks should be subject to a TRA before commencement, unless categorised as a 'low-risk activity performed by a competent person' (see below). A new risk assessment is performed whereby all risks are identified and assessed in detail and controls identified to reduce the risk to ALARP. Other reasons for a new assessment may be that it is physically impossible to comply fully with all recognised standards or when previously used controls are not sufficient or practicable.

• **Task Previously Risk Assessed and/or Covered by Existing Procedures**

Tasks that have been previously assessed and/or are covered by procedures may not require a new risk assessment. Previous assessments or procedures should be reviewed for accuracy and current applicability to see if they remain valid and to identify any additional job specific controls.

• **Low-risk Task**

Where a task is low risk and is performed by a competent person, a worksite assessment will still be necessary; however, no formal recorded risk assessment will be required. Once the category of the task has been determined, the applicable process detailed in the following paragraphs should be followed.

The risk assessment process consists of five essential steps. Each step of the assessment process should be completed before going onto the next.

Step 1 - Look for the Hazards

Look for what could reasonably be expected to cause harm. Ignore the trivial and concentrate only on significant hazards, which could result in serious harm or affect several people by considering the equipment and materials being used and the environment where the work is being carried out. Manufacturer instructions or material data sheets can also help you stop hazards and put risks in their true perspective.

Step 2 - Decide who may be harmed and how

Think about people who may not be at the work place at the time, e.g. cleaner, visitors, contractors, and members of the public, etc. Is there any chance that they might be harmed by your activities.

Step 3 - Evaluate the risks arising from the hazards and decide whether existing precautions are adequate or more should be done

Risks can be reduced by using the following hierarchy:

- Eliminate the hazard to remove the risk; e.g. use of intrinsically safe electrical equipment in a classified area (elimination of sparks, which are ignition sources).

- Reduce or substitute the hazard with an alternative; e.g. use of sodium hypochlorite solution instead of free chlorine gas for disinfection purposes.

- Isolate the hazard from people; e.g. fencing of excavations.

- Control the hazard by introducing suitable measures; e.g. Permit-to-Work system.

- Personal protective equipment; e.g. use of safety harness when working at height.

- Discipline - personal discipline that is competence based (e.g. well-trained staff) and organisational discipline which is rule based (e.g. adherence to work procedures).

Step 4 - Record

Record the findings, write down the more significant hazards e.g. above ground power cables.

Step 5 - Monitor and Review

Review your assessment from time to time and revise if necessary. If there is any significant change, you should add to the assessment to take account of the new hazards.

6.4 CONDUCTING A RISK ASSESSMENT:

Stage (i): Define Tasks, Activities

This is the starting point for the risk assessment and requires consideration of all the tasks that are likely to be carried out and the workplace area. In order to adequately assess the risk associated with the task, a manageable level of detail is required and this may require the task to be broken down into discrete steps or component tasks. Each of these tasks is then defined in terms of activities, use of plant and equipment, use of materials/substances, workplace and procedures used.

The method proposed for identifying the tasks is to categorise the tasks according to the lead job trade/discipline involved in carrying out the work. This should help to build up (over time) an inventory of tasks that the lead discipline get involved in and the type of work carried out in the different workplace areas.

Once all the tasks have been identified, an inventory should be drawn up which lists all the lead disciplines and the tasks carried out in each workplace area. These tasks can be considered as being routine or generic and these should be fed forward for risk assessment.

Stage (ii): Identify Hazards

In order to improve consistency in identification of hazards and to ensure that no hazards are omitted at this stage, it is usual practice that personnel engaged in risk assessment use the hazard identification checklist tables.

The checklists used are not exhaustive and are updated each time a new hazard is identified. The checklists can be used as a guide to ensure that personnel involved in the risk assessment are not side-tracked into identifying things as hazards that are not in fact hazards.

The checklist tables provide examples of hazards within the following categories: -

i) Plant and Equipment
ii) Materials and Substances
iii) Place of Work
iv) Working Environment
v) Methods of Work

Other methods that can aid hazard identification include the use of accident / incident statistics, toolbox talks, and reference to HSSE Documents, etc.

Stage (iii): Identify Hazard Effects

Having identified the hazards, the next step is to identify the hazard effects on people, equipment, asset and the environment.

People

Identification of hazard effect on People is the most important aspect of risk assessment. Identify all the people who are at risk from each hazard and its effect(s) on them. In most cases those affected will be the persons involved in the tasks. In other cases it may be other personnel not directly involved with the task e.g. cleaners, neighbours, visitors etc.

Equipment / Asset

Identify all the relevant equipment / asset involved in the task and any effect on these. Could the task damage any of the equipment / asset involved in the task.

Environment

Identify all the hazard effect on the environment. Will it cause any damage to environment? Will the task generate waste and appropriate means of disposal available?

Stage (iv): Estimate Consequence (Severity) Rating

The judgement about the consequence (severity) rating of the hazard, with or without any control measures in place, should be entered on the Risk Assessment form as a number using the following scale shown in Table 1 for Injury.

The consequence ratings for environment and asset damage are shown for completeness and may not be relevant as far as risk assessment for personnel.

Table 1 - Consequence (Severity) Rating Guidance

Hazard Outcome Consequence (Severity)			Severity Rating
Injury	**Asset Damage**	**Environmental Damage**	
Multiple fatalities e.g. release of high toxic gas.	Extensive damage. Shut-down. Substantial loss of plant. e.g. gas explosion.	Massive leak/spill. Major public concern. Major clean up. e.g. well blowout.	5
Single fatality or permanent disability e.g. release of carcinogenic substance.	Major damage. Partial shutdown of part of plant or facility. e.g. condensate fire.	Massive leak/spill. Non-conformance with regulations. E.g. diesel dumped overboard supply vessel.	4
Major injury, Lost time incident >1 day e.g. falling from height.	Localised damage. Partial shutdown of part of plant or facility. e.g. glycol blow-by.	Localised leak/spill. Non-conformance with regulations. E.g. discharge of process water into rain water drain.	3
Minor/serious injury. e.g. burn with caustic, back or limb strain.	Minor damage. Parts replacement. e.g. pump or compressor failure.	Minor leak/spill. Public concern. No lasting effect. e.g. condensate leak from road tanker.	2
Slight injury. First Aid Case. e.g. finger cut.	Slight damage to equipment. Minimal cost. No down-time. e.g. Gasket failure.	Slight leak. Spill minimal. Effect contained locally. e.g. leak from a chemical drum.	1

The use of numbers for consequence rating from the above scale does not make the risk assessment quantitative. The use of numbers from the scale, merely, provides a shorthand way of recording the judgement of consequence (severity) and their priority for control measures.

The person(s) carrying out the risk assessment should not become too obsessed with the figures; part of the purpose of the risk assessment is to identify the control measures that need to be implemented and these figures are designed to assist with the prioritisation of such measures. The objective of this process is not to arrive at a certain number but to provide a systematic method of ensuring that consequence and likelihood ratings are analysed carefully and a record made of the analysis for future reference and review.

Stage (v): Estimate Likelihood Rating

The judgement regarding the likelihood of the hazard actually causing harm is more difficult than deciding on the consequence of the hazard. Typical factors affecting the analysis of likelihood are:-

a) The number of times the situation occurs;

b) Duration of exposure;

c) Quantities of materials involved;

d) Environmental conditions;

e) Competence of people involved;

f) Condition of equipment;

g) Lighting;

h) Distractions.

The other important factors to take into account are the control measures already provided or to be provided. In analysing the likelihood of harm, the risk assessor(s) must take into account the possibility of control measures not being implemented due to human error, lack of maintenance, difficulty in compliance, complexity of instructions, etc.

It is essential to discover how the task is actually carried out and base the assessment on this, rather than assessing the likelihood on how the task is supposed to be carried out. When all factors have been considered and a decision made on the likelihood of the hazard actually causing harm, a number can be entered in the *Likelihood* column on the risk assessment form using the scale shown in Table 2.

Table 2 - Likelihood Rating Guidance

Description	Likelihood Rating
Certain or Imminent Harm from a hazard is certain or imminent if no control measures are provided at all and/or if one or more of the following factors also apply:- a) the hazard is a cause of large numbers of injuries or ill health in national or location statistics e.g. cholera epidemic; b) people are exposed to the hazard continuously e.g. noise level above 85 dB; c) the hazard is difficult to see e.g. H2S gas; d) safety is not considered high priority by those involved including manager and supervisors. E.g. non adherence to PTW system.	5
Very Likely Harm is very likely if the control measures provided depend on an individual using them on every occasion (e.g. personal protective equipment, PTW system) or if training and supervision are minimal, and/or if one or more of the above factors are present.	4
Likely Harm is likely if the control measures provided depend on an individual using them or adjusting them on every occasion (e.g. portable gas detectors, safe working procedures), or if training is provided and work supervised, and/or if any of the factors given for certain or imminent harm also apply.	3
May Happen Harm may happen if control measures include measures that do not depend on the operator but can break down or be removed or defeated (e.g. pressure safety valve), or if there is no defined system of maintenance or supervision of the control measures. Other factors include hazards, which are a significant cause of injury or ill health, or those to which a number of people are often exposed.	2
Unlikely The circumstances under which harm may happen will reduce to harm being unlikely if there is a defined system of supervision and maintenance, or if training is provided and repeated regularly. Other factors making harm unlikely include hazards, which are a cause of few injuries or cases of ill health, or those to which a few people are occasionally exposed.	1

Stage (vi): Analyse Risk Rating

Risk Rating Without Any Control Measures

The next stage is to multiply the consequence number by the *likelihood* number to arrive at a risk rating (or ranking) for each hazard. This produces a number on a scale of 1 to 25. This number should be entered in the *Risk* column on the Risk Assessment Form. The numbers in the *Risk* column provide an indication of priority and of the extent of the risk without any specific control measures.

Control Measures

The next step is to consider the preventative and/or protective control measures needed to reduce or minimise the risk for each identified hazard. The preferred hierarchy for the control measures should be as follows:-

a) Elimination or minimisation of hazard;

b) Engineering design;

c) Suitable systems of working - procedures, competency, training etc;

d) Provision of suitable personal protective equipment.

The control measures may address the consequence, the likelihood or both. The required control measures for each hazard should be recorded alongside each hazard on the Risk Assessment Form. Appendix B provides guidance on the type of control measures that can be employed for the various hazards.

Residual Risk

To assess the Residual Risk that remains with the control measures in place, the consequence and likelihood ratings are again selected from the scales shown in Tables 1 and 2, respectively. The product of these two ratings provides a measure of the Residual Risk and completes the risk analysis stage.

The information provided in the Residual Risk box is used in the next stage of the Risk Assessment to evaluate whether the risk is adequately controlled or not.

Stage (vii): Risk Evaluation

This is the final step in the risk assessment process and will require the assessor(s) to decide if the hazards identified have been controlled to a suitable level. The risk analysis stage took into account the control measures currently applied to the hazard and, therefore, the result of the analysis indicates the amount of risk that remains, or the *residual risk*. The system used in this section will use this analysis to decide if the residual risk of each hazard is:-

a) Trivial;

b) Adequately controlled;

c) Moderately controlled;

d) Intolerable.

These results are recorded in the final column of the task risk assessment form.

Table 3 - The Severity/Likelihood Matrix shows the result of the risk analysis of severity and likelihood and gives a rough guide to the size of the risk. The number in each box is the *risk*

rating number entered on the risk assessment form and arrived at by multiplying together the severity and likelihood numbers. The higher the number the higher the risk. This will assist later in deciding priorities for action and in deciding the authorisation levels for the work commensurate with the risk.

In general, high risks may require the provision of considerable additional resources involving special equipment, training, high levels of supervision, and consideration of the most effective methods of eliminating or controlling hazards. Lower level risks may be considered as acceptable but actions should still be taken to try to reduce these risks further if possible within reasonable limits.

Table 3 - Severity/Likelihood Matrix

		Severity				
Likelihood		**Slight Injury First Aid**	**Minor/Serious Injury**	**Major Injury Lost Time > 1 day**	**Single Fatality/ Permanent Disability**	**Multiple Fatalities**
		1	2	3	4	5
Certain	5	5	10	15	20	25
Very Likely	4	4	8	12	16	20
Likely	3	3	6	9	12	15
May Happen	2	2	4	6	8	10
Unlikely	1	1	2	3	4	5

1 to 2	Trivial Risk - No further improvements necessary provided control measures are maintained.
3 to 6	*Adequately Controlled Risk* - Risk is tolerable when control measures identified are implemented.
8 to 12	Moderately Controlled Risk. Further Risk Reduction Measures should be considered.
15 to 25	**Intolerable Risk** - Seek specialist advice/support.

For the purposes of evaluation, the matrix shown in Table 3 can be used to provide an initial breakdown of the hazards into categories, as follows:-

a) Those hazards with residual risk ratings of 1 to 2 can usually be considered as *trivial risk*. No further improvements necessary provided control measures are maintained;

b) Hazards with residual risk ratings greater than 2 but equal or less than 6 can be considered as *adequately controlled risk*. Risk is tolerable when control measures identified are implemented.

c) Hazards with residual risk ratings greater than 6 but equal or less than 12 must be considered as *moderately controlled risk*. Further risk reduction measures should be considered;

d) Hazards with residual risk ratings greater than 12 must be considered as *intolerable and not adequately* controlled.

Further control measures or alternative ways of carrying out the task must be identified and implemented. This may require specialist expertise/advice.

Approval to Proceed: On completion of the risk assessment and prior to executing the task, the appropriate level of approval should be obtained. Approval to proceed should not be seen as a formality. Approval should ensure that a suitable and sufficient risk assessment has been performed and that adequate controls have been identified to reduce the risks to an acceptable level and ALARP. The level of approval must be commensurate with the level of risk, i.e. higher risks require more senior management approval.

Communicate and Complete Risk Assessment: The success of a TRA will depend upon how effectively it has been communicated. The value of the risk assessment will be wasted if the people carrying out the task are not fully aware of, or do not thoroughly understand, the hazards and the precautions put in place. Open two-way dialogue should take place at a predominantly informal meeting prior to starting the activity. In this guide, we refer to these meetings as toolbox talks.

The toolbox talk should fulfil four functions:

1. Give everyone involved in the task a thorough understanding of:

- The detail of the activities involved in carrying out the work; both their own activity and that of others
- The potential hazards identified for each stage of the task
- The control measures in place or to be put in place to mitigate the hazards
- Individual actions and responsibilities at various stages of the task

2. Provide the opportunity for those involved in the task, either wholly or partly, to identify further hazards and control measures which may have been overlooked in the initial assessment. This is especially useful for identifying hazards at the worksite which may not have come to anyone's attention in the earlier stages.
3. Reach agreement of the whole work team on whether or not to proceed with the activity. If agreement cannot be reached, DO NOT START THE JOB.
4. Make clear to all involved that should conditions or personnel change or assumptions made when planning the activity prove false, they should re-assess the situation and, if in any doubt, STOP THE JOB.

For these reasons, a successful toolbox talk should be held at or near the worksite. It should include all people involved in the work or those who may be affected by it such as subcontractors, vendors and base crew. A copy of the TRA should be used during the toolbox talk to lead the team systematically through each step of the task ahead.

The structure of the toolbox talk should provide mechanisms for:

- Confirming the general understanding of the task and TRA detail,
- Identifying further hazards and control measures,
- Recording the communication and toolbox talk process,
- Collecting feedback on the effectiveness of the risk assessment process to facilitate update of the TRA or procedures,

The Toolbox Talk Risk Identification Card (TRIC) is a suitable tool to guide this process. The card is designed to lead the discussion through the necessary elements to be covered. It is not the only means of ensuring that the TRA has been effectively communicated and opportunity provided for further input. However, whatever system is used, it should cover the same elements. When new work team members join the team, the same communication must be given to them.

Capture Lessons Learned: On completion of work it is important that any lessons learned are captured and incorporated into the process. This may be in the form of changes/revisions to:

- Procedures used
- Risk assessment records
- The TRA process itself

This is an important feedback loop in the TRA process. Wherever possible, a post-TRA review should take place in order to establish any deficiencies or weaknesses within the risk assessment process. This will provide feedback into the management of a safe system of work.

Equally, where improvements to working practices can be identified, they should also be fed back into existing procedures. In the event of an accident, incident or near miss taking place, it is critical that the TRA is reviewed. The findings from incident investigations, near miss reporting and procedural review are good sources of lessons learned that can be applied to the TRA process.

Training and Monitoring: Good, effective training of individuals involved in leading or participating in TRA is essential to achieve quality and consistency of results. Training provides the foundation for effective risk assessments and supports competence. The fundamental TRA process is covered through a vast range of procedures and varying organisational approaches across the industry. TRA is not a complex process but requires continual usage and practise to reinforce the risk awareness levels of the workforce and enhance safety performance.

Training should be viewed as the start of the process with the inclusion of all personnel in TRA as the goal. The ability to share training across and between organisations is possible through a common approach, and will drive the acceptance and implementation of best practice for TRA. No matter how thorough the TRA procedure has been, its ultimate success depends on the awareness of the people carrying out the activity. If they do not have a sound

7. BENEFITS OF TRA

understanding of the TRA findings, what it means to them and what their responsibilities are, it will have a limited effect on preventing accidents.

7. BENEFITS OF RISK ASSESSMENT APPLICATIONS

Risk assessment techniques can be applied in almost all areas of the offshore oil and gas and marine industries. Corporations know that to be successful they must have a good understanding of their risks and how the risks impact the people associated with their operations, their financial performance and corporate reputation. More and more, regulators are striving to use risk-based approaches in formulating new regulations. The ability to conduct meaningful risk assessments continues to improve as more and better data are collected, and computer applications become more accessible.

The four key areas where risk assessment has been seen to be useful are:

i) Identifying hazards and protecting against them

ii) Improving operations

iii) Efficient use of resources

iv) Developing or complying with rules and regulations

Identifying Hazards and Protecting against Them: The primary goal of many risk assessments is to identify the hazards that are involved in a particular process or system and to develop adequate safeguards to prevent or reduce negative consequences from the related hazardous events. As previously discussed, the first step in performing a risk assessment is hazard identification. Whether done in an explicit or implicit form, this step provides an understanding of the basic hazards (e.g., high temperatures, toxic chemicals, and rotating machinery) that are involved in a process or operation. Because of the negative consequences that can occur if these hazards are not controlled, the hazard identification step is key in developing an understanding of the contributors to the risk of operating a particular system or process. Once these hazards are identified and the potential undesirable events involving these hazards are described, risk assessment techniques can allow personnel to identify the safeguards, or risk-reducing measures, that are currently in place and to make recommendations for additional safeguards that would further reduce the risk. These safeguards can either prevent an event from occurring, or reduce (mitigate) the consequences if an event does occur.

Improving Operations through Better Understanding: In addition to the identification of hazards and safeguards, the value of the knowledge and understanding gained from the performance of risk assessments should not be under estimated. This increased understanding can often result in improved operations, design, maintenance, and emergency response. Risk assessments frequently yield recommendations to system hardware,

software, training, and procedures that result in more efficient or improved operations, along with increased safety.

Many of the techniques used in performing risk assessments involve a detailed, systematic review of the process or system being evaluated. During a review, a variety of information sources, such as process drawings, operating and emergency procedures, incident reports and operators' experiences, are typically examined in detail to allow an understanding of the hazards, potential events or mishaps and the safeguards that exist to minimize the frequency or consequence of these events. In addition, many reviews involve a multidisciplinary team representing various organizations (e.g., operations, engineering, instrumentation, or industrial hygiene), each member of which has detailed knowledge on particular aspects of the system. This thorough review and sharing of information typically benefits all personnel involved in the risk assessment by increasing their knowledge of the design and operation of their facility.

7.1 REVIEW OF 20 TASK RISK ASSESSMENTS OF PANNA & TAPTI: BGEPIL has TRA's done for many permit to Work Tasks. These TRA's were classified under the following headings.

1) Generic TRA's
2) Mechanical TRA's
3) Process TRA's
4) Instrumentation TRA's
5) Electrical TRA's
6) Well Engineering TRA's
7) Specific TRA's

The TRA's where incorporated in work permits and all the people doing the job where made aware of the risks associated with the task and the control measures incorporated and to be followed by them.

As part of the project a review of a few TRA's was carried out. This looked at the following at the following aspects in the TRA.

1) Description of jobs inside a task.
2) Description of Hazard
3) The population at risk
4) The scores assigned to the severity and likelihood as part of risk analysis without controls.
5) Adequacy of control measures.
6) The scores assigned to the severity and likelihood as part of risk analysis after controls where incorporated.
7) The evaluation of risks as to whether they could be brought down taking into account the factor of Cost Benefit Analysis.
8) Some of the TRA's of PANNA-MUKTA and TAPTI where different though for the same task. During the review of 17 TRA's where merged with some new inputs, 2

new TRA's where made, and one TRA specific to PANNA was revised. This is common to both PANNA and TAPTI platforms.

7.2 THE FOLLOWING TRA'S WHERE REVIEWED:

1) Fumigation/Pest control in living quarters.
2) Diving Job.
3) Diving at SPM for inspection and maintenance.
4) Wireline operations
5) Diving job being carried out with simultaneous slick line operations.
6) Continuous stay in satellite platform.
7) Photography in platform.
8) Heavy load lifting from boat and vice versa.
9) Work at height at satellite and living quarters.
10) Work at height PPA/TPP
11) Hot work in cellar/spider deck.
12) Use of Heat Gun/Temperature bath for fire checks, Therma detectors/switches of TG, PGC, and EG.
13) Ladder safety
14) Working in confined spaces.
15) Work at height above water
16) Use of electric power tools
17) Inboard scaffolding
18) Working in galley
19) Fortnightly cleaning of galley
20) Installation/Removal of scaffolding above water.

8. Conclusion

8. CONCLUSION

1) The study of the HSSE Management system helped in understanding the management challenges in the area of Health, Safety, Security and Environment.
2) The visit to both PANNA & TAPTI offshore installation gave an insight into how an offshore oil and gas production facility works.
3) The study helped in knowing the various safety measures in the platform to counter an emergency.
4) The study helped in familiarising with the fire and gas detection, protection, and, measures to fight any emergency.
5) The review of 20 Task Risk Assessments of Panna & Tapti gave an insight into what a TRA is, how it's made and implemented.
6) TRA has a major role in any Permit to Work activity. It indicates both the risks associated with a particular task and the control measures needed to mitigate the same.
7) The study found that TRA's for similar activities of PANNA and TAPTI platforms where different.
8) The study achieved consistency of 20 TRA's of PANNA and TAPTI platforms by incorporating all known hazards and control measures.

9. TRA'S REVIEWED

REVIEW OF TRA'S

1. Fumigation in living quarters /Pest Control in Living Quarters

Job Step Description	HAZARDS		RISK ANALYSIS (No Controls)			Control Measures	RISK ANALYSIS (With Controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Covering of air inlets/exhausts to prevent smoke escape	Working at height	Performing authority	4	2	8	Adhere to working at height, wear face mask.	4	1	4	Adequately controlled risk.
Use of responser SC025.	Irritation to skin if in direct contact.	Personnel involved in task	4	5	20	Use gloves, face mask	4	1	4	Adequately controlled risk
During Fumigation	Can cause severe injury when it comes into contact with Skin/eye.	Personnel involved in task	3	3	9	Wear cotton coveralls, buttoned to the neck and wrist and a washable hat. Wear elbow length PVC or nitrile gloves. Wear face mask. Keep area well ventilated. MSDS of chemical should be available at site.	3	1	3	Adequately controlled risk.
Use of pyrethrum Chemical	Contact with skin/swallowing,	Personnel	3	4	12	Induce vomiting if swallowed, wash skin with running water and soap on skin contact, flush eyes with water for 15min.	3	1	3	Adequately controlled risk

2. Diving Job

Job Step Description	HAZARDS		RISK ANALYSIS (No Controls)			Control Measures	RISK ANALYSIS (With Controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all control s required	Severit	Likeliho od	Rati ng	T/A/M/I
Diving	Shark Attack	Divers	3	3	9	Terminate the dive prematurely and exit the water. Shark billys should be carried if sharks are expected to be encountered. Care should also be taken if diving takes place in toxic phytoplankton blooms	3	1	3	Adequately Controlled Risk.
Diver under water	Communication failure between Diver & Diving control	Diver	5	3	15	Manual Signals using umbilical chord. Operation should be aborted. All divers using SSDE must be familiar with the *Single Lifeline Code of Signals* for use in an emergency.	5	1	5	Adequately controlled risk
Diver under water	Supply vessels in the vicinity may injure the divers	Diver	4	2	8	No OSV to be within 200 m of divers. Radio room to be informed of diving.	4	1	4	Adequately controlled risk
Diver under water	Diver near sea water/FWP pumps vicinity may adversely affect the diver	Diver	4	3	12	Pumps to be offline and electrically locked out and tagged out.	4	1	4	Adequately controlled risk

Diver under water	Weather Conditions may adversely affect the weather	Diver	4	3	12	Confirm weather conditions favourable for dive swell above 2m, current-1.5 knots. Diving to be aborted in rough seas. Have contingency plan. Continuously monitor conditions prior to and during dive. Diver recall system in place. Abort dive if necessary.	4	1	4	Adequately Controlled Risk
Diver under water	Chemical Spillage & falling objects	Diver	3	3	9	Spillage to be avoided (Control room)	3	2	6	Adequately controlled risk.
Breathing air	Gas intrusion in Breathing air will harm the diver due to asphyxiation	Diver	4	3	12	No local venting of gas is permitted near breathing air compressor, breathing air compressor to be located in ventilated area. Diving control to check area using portable gas detectors. Ensure air compressors are properly secured to prevent movement. Periodically drain the moisture cock on dive compressors and visually inspect the fittings and connections to ensure these connections are secure. When using the buddy system, ensure that both divers leave the water at the same time. Dive tenders and dive supervisors must know the location of every diver at all times	4	1	4	

Diving Equipment failure	Injury/fatality to diver	Diver	4	2	8	General checks to be carried out before dive & discard faulty equipment. Two emergency reserves of breathing gas for use in the event of a supply failure must be immediately available, one on the surface and one with the diver. Throughout the dive allowance must be made for the possibility of zero visibility. Diving Supervisor must always carry a set of tables, and back up instrumentation, in case of mechanical or electrical failure.	4	1	4	Adequately controlled risk.
Diver returning to surface	Diver will suffer decompression sickness if proper decompression is not given	Diver	4	2	8	Proper decompression tables to be followed. Keep proper account for bottom time, If decompression is not provided in water, decompression chamber should be used.	4	1	4	Adequately controlled risk.

3. Diving at SPM for inspection and maintenance

Job Step Description	HAZARDS		RISK ANALYSIS (No Controls)			Control Measures	RISK ANALYSIS (With Controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likeli.	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Diving	Strong current	Divers	5	2	10	Dive in slack tides only.	5	1	5	Adequately controlled risk.
Diving	Poor Visibility	Divers	3	3	9	Diver has fixed head light. Attendant to feel diver by umbilical.	3	1	3	Adequately controlled Risk.
Diving	SPM Emergency Viz. Crude spillage. Tanker hitting SPM, work boats around tanker.	Divers	5	2	10	Spillage to be avoided from tanker. Keep continuous watch at SPM. Control room to monitor SPM. Diving supervisor and tanker pull back vessel, tanker captain to remain in contact. Tanker captain to inform diving supervisor in case tanker drifts towards SPM. OSV to pull back tanker. No OSV movement around SPM vicinity. Work around favourable tides.	5	1	5	Adequately Controlled Risk.
Diving	Fishing Nets	Divers	3	4	12	Knife available with divers. Standby diver ready to assist. Two separate communication channel with two divers, Tag line available.	3	1	3	Adequately controlled risk
Diving	Faulty life saving equipments	Divers	4	2	8	Test certificate available. Operation to be checked before diving	4	1	4	Adequately controlled risk
Diving	Loss of communication	Divers	5	3	15	Two sets of communication available. Test the units before each dive. Tag lines available. Manual signals using umbilical code	5	1	5	Adequately controlled risk
Diving	Cutting of air supply to diver will cause respiratory	Divers	4	2	8	Diver to immediately switch over to bail out bottle. Supervisor to open up back up air supply. Diver to be recalled to surface.	4	1	4	Adequately controlled risk.

	problem									
Diving	Adverse weather conditions	Divers	4	3	12	Confirm weather conditions. Abort diving if swell is above 2mts and current more than 1.5mts.	4	1	4	Adequately controlled risk.
Diving	Chemical/Crude spillage from SPM/Tanker	Divers	5	3	15	A dry suit with attached gloves connected to a positive pressure (free flow) helmet. Full-face mask for contaminated water diving.	5	1	5	Adequately controlled risk.
Chipping and painting	Spark generation on SPM	Divers	4	3	12	Use brass chippers only, keep FiFi equipment.	4	1	4	Adequately controlled risk.
Zodiac Traveling	Failure of OBM	Divers	5	2	10	Check up zodiac before start. Paddles to be present in the zodiac. Zodiac must have adequate fuel.	5	1	5	Adequately controlled risk
Inspection of void compartments and thickness measurements of walls.	Suffocation/Asphyxiation of personnel	Divers	5	4	20	Confined space entry permit required. SCBA to be worn. Compartments on SPM are to be fully ventilated before entering in compartment and check for any foul gas with gas/oxy detector.	5	1	5	Adequately controlled risk
Chain inspection, Diving on chains on SPM	Diver gets stuck in trench	Divers	5	2	10	Standby vessel/Zodiac available followed by all other safety precautions. Pile to be located by using the bridal chain.	5	1	5	Adequately controlled risk.
Chipping and painting	Diver slips on deck and fallen in water	Divers	4	3	12	Diver to work with life jacket. Zodiac stand by and aware of movement of turn table.	4	1	4	Adequately controlled risk.

4. Wire Line Operations

Job Step Description	HAZARDS		RISK ANALYSIS (No Controls)			Control Measures	RISK ANALYSIS (With Controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Well Manhole opening	Personnel Injury	Personnel at work	3	3	9	Half moon Ring to be placed on the opening.	3	1	3	Adequately Controlled Risk.
Equipment Load Lifting	Swinging load hitting pipeline	Asset working personnel near by	4	3	12	Unloading area should be clear before load lifting. Crane boom should be away from the pipeline. Competent crane operator.	4	1	4	Adequately controlled risk.
Installation of lubricator on well	Release of gas	Personnel working near by	5	2	10	Confirm well is secured properly	5	1	5	Adequately controlled risk.
Strong wind speed or no wind	Personnel injury	All personnel	4	2	8	Review weather forecast before starting job, wind speed shouldn't exceed 30 Knots.	4	1	4	Adequately controlled Task
Release of trapped pressure from Xmas tree or Lubricator	Personnel falling down or getting injured. Exposure to hydrocarbons	Personnel working nearby.	3	2	6	Check for H2S periodically. Keep a standby fire extinguisher. Follow standard instructions for opening tree cap. Check pressure on lubricator.	3	1	3	Adequately controlled risk
Riser/Lubricator fall down while rig up	Personnel injury or equipment damage	Personnel working nearby	5	3	15	Secure the lubricator firmly and avoid multiple tasks. Follow standard instructions and proper signals. Keep personnel clear of load. Keep personnel of well head area while rig up and rig down. Cordon off area.	5	1	5	Adequately controlled risk
BOP not sealing	Exposure to hydrocarbons and uncontrolled release of well fluid in case of well fluid in case of upper lubricator	Personnel working nearby.	3	2	6	Follow standard wireline instructions and periodic BOP/ Upper lubricator O-ring/Stuffing box checks to be done.	3	1	3	Adequately controlled risk

	O-ring or stuffing box failure.									
Make up lubricator section, stuffing box and make wire for rope socket	Hand cut and back injury	Personnel working on equipment	3	2	6	Follow standard wireline instructions and safety instructions. Cordon off area	3	1	3	Adequately controlled risk
Wire break while retrieving DHSV	Personnel injury/Equipment Damaged	Personnel working nearby	3	3	9	Cordon off area. Good quality, high strength wires must be used at the start of wireline operations. Follow wireline instructions.	3	2	6	Adequately controlled Risk
Installation of lubricator on well	Personnel injury/ Equipment damage	Personnel working nearby	3	2	6	Cordon off area while rigging up and down. Secure well head hatch with anchor bolts before starting the job	3	1	3	Adequately controlled risk.
Leak during pressure test of surface equipments	Personnel injury and exposure to hydrocarbons	Personnel working nearby	3	2	6	Pressure up system slowly and perform a low pressure test followed by high pressure test. Keep personnel off from pressurized equipments	3	1	3	Adequately controlled risk
Slippage of tools while replacing tools from tool string	Personnel injury/Equipment Damage	Personnel working nearby	4	2	8	Cordon off are while replacing tools from tool string and donot allow unauthorized persons to enter while replacing tools below well head area. Always two persons to replace tools from tool string. Ensure to lay a tarpaulin on the deck while carrying out the wire line activities to avoid tools or equipments falling through the grating.	4	1	4	Adequately controlled Risk.
Close master valve/ Crown valve and bleed down pressure	Tool Stuck in X mas tree and can not close the tree valve fully	Personnel at work	3	2	6	Count number of turns of the valve before opening and closing	3	1	3	Adequately controlled risk.
While making rope socket or redressal of tool in container put tarpaulin in front of the container	Chances to fall Small tools like screw driver, Allen keys, screw while making rope sockets or redressing tools through the grating	Personnel working at cellar deck	3	2	6	Put tarpaulin in front of the Tool Box(container)	3	1	3	Adequately controlled risk
Personnel working on main deck.	Chances of personnel working on STB main deck touching the hot equipment on STB main deck.	Personnel working on STB main deck.	2	4	8	Stickers mentioning hot surface pasted on the equipment.	2	1	2	Trivial

5. Diving Job being carried out with simultaneous slickline operations

Job Step Description	HAZARDS		RISK ANALYSIS (No Controls)			Control Measures	RISK ANALYSIS (With Controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Diver under water below 'D' level	Dive time is reduced with increase in depth and for any emergency.	Diver	4	2	8	Slickline job should be suspended in case of emergency for crane to recover the diver. Communication should be frequent and operations should be well coordinated through walkie-talkie. Zodiac to be stand by in emergency so that it can send the diver to decompression chamber at the earliest.	4	1	4	Adequately controlled Risk
Diving	Platform emergencies	Diver in water	4	2	8	No heavy load lifting to be carried out during the dive. No OSV operations within 200 m of the vicinity. No simultaneous activity during the job with high hazard potential.	4	1	4	Adequately controlled risk.
Diving	Platform emergencies	Diver in water	4	2	8	Diving to be abandoned on sounding of emergency alarm. Supervisor to ensure safety of diver in the water. As far as possible, avoid simultaneous operations.	4	1	4	Adequately controlled risk

6. Continuous Stay in Satellite platform.

Job Step Description	HAZARDS		RISK ANALYSIS (No Controls)			Control Measures	RISK ANALYSIS (With Controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Continuous stay in satellite platform.	Unhygienic conditions	Personnel	3	3	9	Proper toilet bunk to be provided. Water connection to be given. Clean clothes to be used, with soiled clothes being given to PQ for washing. Accommodation area and surroundings must be kept clean.	3	2	6	Adequately controlled risk
Continuous stay in satellite platform.	Standby boat not available for rescue.	Personnel	3	3	9	Carry Hand Set radio communication. Check the condition of the EG and Battery Charger.	3	2	6	Adequately controlled risk
Continuous stay in satellite	Bad weather forces chopper to be grounded.	Personnel	3	3	9	One crane operator must be present in satellite platform to lift food from boat. Emergency rations to be used.	3	1	3	Adequately controlled risk
Continuous stay in satellite platform.	Standby boat not available for delivering food on days when choppers are grounded.	Personnel	2	4	8	Live on emergency food, food can be delivered by Zodiac if weather permits. Emergency food to be stored clean and checked periodically for their expiry dates.	2	2	4	Adequately controlled risk
Platform emergency during day light.	Gas Leaks, fire, Chemical Spillage	Personnel	5	2	10	Regular weekly drills at satellite platform. OSC and MC to be fixed. Muster location would be main deck South. Familiarity with use of safety equipment. Abandonment procedure to be familiarized to POB. PPE's must be used.	5	1	5	Adequately controlled risk

						Communication with control room and with standby boat. Standby boat should be informed of the number of personnel on board for the day/night days. Equipments for painting etc should be kept away from compressors.				
Platform Emergency in night	Gas leaks, Fire, Chemical spillage	Personnel	5	3	15	Sufficient torches 4 numbers to be available at all times. Back up lighting to be known to all personnel	5	1	5	Adequately controlled risk
Scope of work will be completed in around three months period	Fatigues, stress, strain.	Personnel	5	3	15	Regular rotation of personnel must take place strictly.	5	1	5	Adequately controlled risk
Continuous stay in satellite platform.	Injuries due to use of chemicals and equipments	Personnel	4	3	12	Familiarity with use of First Aid kit and availability. Regular refurbishment of first aid kit.	4	1	4	Adequately controlled risk
Abandonment of platform	Sufficient number of PPE not available	Personnel	5	3	15	Sufficient number of life jackets, SCBA's need to be available at all times. Access to safety equipment to be available at all times.	5	1	5	Adequately controlled risk.
Continuous stay in platform.	Emergency food contaminated or exhausted	Personnel	3	3	9	Emergency food should be sufficient and must be checked for quality and check for expiry dates.	3	1	3	Adequately controlled risk.

7. Photography in PLATFORM

Job Step Description	HAZARDS		RISK ANALYSIS (No Controls)			Control Measures	RISK ANALYSIS (With Controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Use of digital camera in hazardous area	Electrical spark generation causing fire/explosion of hydrocarbon gas atmosphere	Personnel at the platform	5	4	20	Monitor LEL at regular intervals and note down the readings. Stop the work if LEL is above 10%. All the work to be controlled under permit to work system of hot work.	5	1	5	Adequately controlled risk.
Use of digital camera in hazardous area	Fire/ explosion	Performing authority All the personnel on board	5	4	20	Monitor LEL and commence the job only if the LEL is below 10%.	5	1	5	Adequately controlled risk.

8. Heavy load lifting from Boat Vice versa

Job Step Description	HAZARDS		RISK ANALYSIS (No Controls)			Control Measures	RISK ANALYSIS (With Controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Heavy load lifting by crane	Heavy Load can damage man and machinery	Deck crew & Crane operator	5	2	10	Precautions to be taken as per BGEPIL-HSSE-MS- WHM-406-021 for heavy load lifting	5	1	5	Adequately Controlled risk.
Rigging of loads by deck personnel	Heavy Load can damage man and machinery	deck crew	4	3	12	Lifting plan to be discussed and agreed upon by the crane operator, the RO before hand in a tool box talk .Loads to be pre-slung. Crane operator and Deck crew to be competent. OSV to be standby if required. Other loads on the deck to be kept properly lashed.	4	1	4	Adequately controlled risk
Rigging of loads by deck personnel	Crane hook getting entangled with the platform structure. Severe damage to the crane, crane toppling	Crane operator, mechanical engineer	5	2	10	Crane operator & Deck Crew to be competent. Check the weather condition. Mechanical engineer to be standby on the crane deck during lifting operation.	5	1	5	Adequately controlled risk.
Swinging the load on to the deck	Load hitting unprotected plant and machinery.	Platform Personnel	5	2	10	Adhere to lifting and lay down plans and procedure as far as possible. Competent crane operator and banksman. Tool box talk to cover lifting techniques. Follow designated trajectory. Long taglines to be attached with the load.	5	1	5	Adequately controlled risk

Swinging the load on to the deck	Deck crew being injured by getting caught between or struck by loads	Deck rigging crew	5	3	15	Competent banksmen and slinger men. Radio communication between the designated coordinator for the lift and the crane operator and RO. Lay down plan to be discussed in the toolbox talk. Long tagline to be attached with the load. Visual and radio contact between the Crane Op and the banksman.	5	1	5	Adequately controlled risk
Lifting of the load from the deck	Crane or the lifting gears overloaded	Deck crew, crane operator, mechanical engineer	5	4	20	Check the correct weight of the load. Radius of the boom to be maintained allowing adequate Safety factor from the SWL of the crane. Check the load cell meter availability and accuracy. All the limit switch to be in working condition. Mechanical engineer to be present on the crane deck at the time of lifting	5	1	5	Adequately controlled risk
Load Lift	Slings/Web belts may give way	Deck crew	4	4	16	Web belts record checks. Combined capacity of lifting gear to be verified. Check rigging arrangements. Same capacity belts used in the past. Main blocks to be used. Hooks certified, Four way sling tested. D shackle new, Certification check, check the load stability at low height from the deck. Keep personnel clear of hoisting area.	4	1	4	Adequately controlled risk
Load Lift	Free fall	Deck crew	4	3	12	Lifting gears should be having higher capacity than the load. Deck crew should not stand below the load. Captain to be informed and implementation checked continuously. Particular care should be taken during rough seas.	4	1	4	Adequately controlled risk
Load lift	Crane stuck in the middle	Crane operator	3	3	9	Emergency lowering mechanism available. Check all accessories are in place. Cranes to be checked before hoisting.	3	2	6	Adequately controlled risk

Load lift	Load hitting against the lift on the swinging of load.	Boat crew	4	3	12	Deck cleared of load in vicinity. Load lifting to be done in good weather condition. Centre of gravity of load is directly below the main hook.	4	1	4	Adequately controlled risk
Load lifting from boat deck and placing on platform deck	Boat looses control and drifts.	Platform personnel	5	2	10	Check weather condition; confirm with boat captain; preferably prevailing current direction should make it drift away from platform. Boat should be with the platform during comfortable tides.	5	1	5	Adequately controlled risk.
Manual handling of slings and load if required.	Slippage of load or person getting injured of not following proper ergonomical practices.	Deck rigging crew.	3	5	15	Take help of other person if required and follow proper ergonomcal practices.	3	2	6	Adequately controlled risk
Critical material handling	Falling of load on process area.	Personnel at platform and deck	5	3	15	1) Lifeboat to be on standby. 2) Trajectory of load should be away from process area. 3) Proper lifting gears should be used having higher capacity.	5	1	5	Adequately controlled risk.

9. Work at Height at Satellite, LQ.

Job Step Description	HAZARDS		RISK ANALYSIS (No Controls)			Control Measures	RISK ANALYSIS (With Controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Working at height	Slip/fall of personnel	Personnel	3	3	9	Safety Harness with energy absorbing double lanyard system for easy movement. Roll gliss rescue system will be used for rescuing person. Employees trained in fall arrest systems should undertake any work at height.	3	2	6	Adequately controlled risk.
Use of safety harness	Slip/Fall of personnel	Personnel	4	2	8	Check condition of safety harness before use. Tighten the straps of harness properly. Lock the harness rope properly to fix support.	4	1	4	Adequately controlled risk
Work at height	Failure to rescue person if he slips.	Personnel performing.	4	2	8	1 Provide rescue mechanism with the harness. 2 Standby person is available and alternative person designated in absence of the stand by person.	4	1	4	Adequately controlled risk.
Use of Safety Harness	Fall causing injuries to personnel	Personnel	3	3	9	Buddy system should be in place. In case of an emergency, suspension time should be less than 5 minutes. Rope/cable tenders must make *certain* the harness user is conscious at all times. Tie-off lanyards should be anchored as high and tight as work permits.	3	1	3	Adequately controlled risk
Approaching to the location at height.	Slip/Fall of personnel	Personnel	3	2	6	Use ladder for climbing up at the elevated location. Adhere to ladder safety. Wear a fall arrest system if there is likelihood of a free fall.	3	1	3	Adequately controlled risk

Use of tools	*Falling of tools from height*	*Personnel and equipment*	3	2	6	*Tie the tools as required during use at elevated location. Barricade the area, and donot allow unauthorised personnel.*	3	1	3	Adequately controlled risk
Working at height	Strong winds causing equipment/tooling to be blown from worksite, resulting in injury to personnel.	Personnel adjacent to worksite	3	3	9	Monitor wind speeds and stop work if wind speed exceeds 30 knots Prohibit working in strong winds. Secure all equipment and materials.	3	1	3	Adequately controlled risk
Gas leakage emergency during working at height	Exposure to the toxic gas	Personnel	4	2	8	Carry cartridge type face mask during working at height. Carry H2S detector and LEL detector.	4	1	4	Adequately controlled risk.
Work at height	Escape route obstructed and barricaded	Personnel working near work area	5	3	15	Inform the control room & personal working in the area. Demarcate alternate emergency route, which is to be familiar with all.	5	1	5	Adequately controlled Risk.

10. Working at height-PPA/TPP

Job Step Description	HAZARDS		RISK ANALYSIS (No Controls)			Control Measures	RISK ANALYSIS (With Controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Working over beam below PGC deck	Slip/fall of personnel	Personnel	3	3	9	Safety harness with energy absorbing system. Rollgliss rescue system will be used for rescuing person	3	2	6	Adequately controlled risk
Working over beam below PGC deck	Load falling from height	Personnel and asset	4	3	12	Load should be secured by rope and personnel to be away from load	4	1	4	Adequately controlled risk
Use of tools	Falling of tools from height	Personnel and equipment	3	2	6	Tie the tools as required during use at elevated location. Use tool belt to keep tools. Barricade area and donot allow unauthorised personnel.	3	1	3	Adequately controlled risk
Working at height	Strong winds causing equipment/tooling to be blown from worksite, resulting in injury to personnel.	Personnel adjacent to worksite	3	3	9	Monitor wind speeds and stop work if wind speed exceeds 30 knots Prohibit working in strong winds. Secure all equipment and materials.	3	1	3	Adequately controlled risk
Gas leakage emergency during working at height	Exposure to the toxic gas	Personnel	4	2	8	Carry cartridge type face mask during working at height. Carry H2S detector.	4	1	4	Adequately controlled risk.
Work at height	Escape route obstructed and barricaded	Personnel working near work area	5	3	15	Inform the control room & personal working in the area.	5	1	5	Adequately controlled Risk.

11. Hot work in Cellar/Spider deck

Job Step Description	HAZARDS		RISK ANALYSIS (No Controls)			Control Measures	RISK ANALYSIS (With Controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Gas Cutting/ Welding operation	Fire Hazard	Personnel and asset	4	2	8	Adhere to PTW strictly. Blanketing to be done as much as possible. Area to be wetted with potable water before carrying out gas cutting or similar operation. Well testing and sampling activities must be stopped. GDS should not be bypassed. Familiarize with FIFI equipment. Stand by person should be alert. Portable extinguishers to be kept nearby. Fire water pumps to be kept in auto. Fire watch to be assigned. Life rings/ Nylon ropes or any flammable materials to be covered with asbestos clothing at spider deck near the area below the hot work. Check the condition of the M/C, cutting set and ensure no leakage. Fire watch to be kept monitored at least half an hour after completion of the job. Use proper PPE. Fire watch to be in Radio contact with Control Room. LEL to be monitored. Ensure hot slag doesn't fall below cellar deck.	4	1	4	Adequately controlled risk.
Gas cutting/ Welding operation	Fire hazard	Personnel and asset	4	2	8	Inspect welding and cutting area and equipment before use (arc or gas welding/burning). Ensure adequate ventilation from toxic welding and cutting fumes. Store cylinders in a dry, well-ventilated location.	4	1	4	Adequately controlled risk
Grinding operation	Impact of high velocity particles.	Personnel	3	2	6	Use proper PPE. Use chuck key to tighten grinding head. Ensure grinding wheel is in good condition and guard fixed properly. Before carrying out operation ensure grinding particles doesn't fly towards nearby persons.	3	1	3	Adequately controlled risk.
Grinding operation	Electric shock	Personnel	4	2	8	Use proper PPE. Check the integrity of grinding machine before operation. Use ELCB extension boards. Never carry a grinder by the cord or hose. Never yank a cord or hose to disconnect it from the receptacle. Keep cords away from heat, oil and sharp edges. Disconnect tools when not in use, before servicing and cleaning, and when changing accessories.	4	1	4	Adequately controlled risk

Welding, Burning and Grinding	*Fire / Explosion* *Injury to Personnel*	*Performing Authorities* *All Personnel*	*5*	*4*	*20*	*Work scope in hazardous areas only when Process mechanically isolated/depressurised and Nitrogen purged if required. Welding hand should not be wet as this can create electrocution.*	5	2	10	Moderately controlled risk
Welding, Burning	*Fire / Explosion* Injury to Personnel	Performing Authorities All Personnel	5	4	20	All Personnel to be given Toolbox Talk and made aware of hazards surrounding work scope. All Personnel to be made aware of all safety appliances available in area.	5	2	10	Moderately controlled risk
Welding, Burning	Fire / Explosion Injury to Personnel	Performing Authorities All Personnel	5	4	20	Correct PPE for Task to be worn. Only certified equipment to be used. Area to be barriered off and signs erected, Control Room to inform all personnel to be aware of work scope and requirement to obey above signs and barriers. Regular liaison between Performing Authority and Area Authority to ensure no changes to work scope or surroundings has occurred.	5	2	10	Moderately controlled risk
Cylinder storage	Falling or rolling injuries from improper gas cylinder storage	Personnel and Asset	3	3	9	Ensure cylinders are properly stored in an upright position and chained. Store full and empty cylinders separately. Cylinders should be isolated.	3	1	3	Adequately controlled risk
Cylinder storage	Valve opening or break off, exposing workers to toxic fumes and flammable gas, caused by improper gas cylinder storage	Personnel	4	2	8	Store cylinder properly. Always remove gauges and regulators, and install protective valve caps before transporting.	4	1	4	Adequately Controlled risk
Use of power saw & drilling machines in process/ well bay areas.	Fire / Explosion Injury to Personnel	Performing Authorities All Personnel	5	4	20	Continuous Gas Monitoring during work scope, Area to be clear of combustibles. Fire & Gas detection in the area to be live.	5	2	10	Moderately controlled risk.
Shifting of material and tools to the location	Slipping of material in case of manual handling is involved	Performing authorities	5	2	10	Ask for additional help if the material to be shifted is too heavy for handling	5	1	5	Adequately controlled Risk

Welding, Burning and Grinding	*Disposal or spraying of some water from the rig side*	*Performing authorities*	*5*	*2*	*10*	*Inform the rig regarding the hot job and the duration for which it will be carried out.*	*5*	*1*	*5*	Adequately controlled risk.
Welding, Burning and Grinding	*Spurious alarm from the F&G panel*	*All the personnel*	*5*	*3*	*15*	By pass UV/IR detection system. Keep gas detection normalised.	5	1	5	Adequately controlled risk
Welding, Burning and Grinding	Sheen on the water. The sheen can catch fire.	Performing authorities All the personnel	5	2	10	Run Skim pile pumps and empty out the condensate from the skim pile. Spray fire water on the sheen to dispose off the sheen.	5	1	5	Adequately Controlled risk

12. Use of Heat Gun/Temperature bath for fire checks, Therma detectors/switches of TG, PGC, and EG.

Job Step Description	HAZARDS		RISK ANALYSIS (No Controls)			Control Measures	RISK ANALYSIS (With Controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Heat Gun/Temperature bath use for thermal Detectors	Can cause hand injury as Gun Tip/temperature bath is hot	Personnel	4	4	16	Use proper PPE and adhere to PTW. Never touch the hot metal nozzle with clothing or skin. Do not place the nozzle next to anything whilst it is hot. Allow the tool to cool before storing it. Always switch the tool off before putting it down on any surface. Use the sign board to alert the nature of the job.	4	1	4	Adequately controlled risk
Input fire loop to FGP#1	General alarm will be sounded & shut down sequence will be initiated.	Staff personnel	2	4	8	Disconnect fire signal cable to F& G panel	2	1	2	Trivial Risk
Fire fighting equipments for TG	CO2 release in TG	Personnel at work	3	4	12	CO2 cylinder heads to be disconnected.	3	1	3	Adequately controlled risk
UV detection system	CO2 release in TG & shut down of engine	Personnel at work	3	4	12	1. By pass UV detection system 2. CO2 cylinder heads to be disconnected.	3	1	3	Adequately controlled risk
fire fighting system	CO2 release in TG & shut down of engine	Personnel at work	3	4	12	1. By pass fire fighting system 2. CO2 cylinder heads to be disconnected.	3	1	3	Adequately controlled risk
Thermal detector checks	CO2 release in TG & shut down of engine	Personnel at work	3	4	12	1. By pass fire fighting system 2. CO2 cylinder heads to be disconnected.	3	1	3	Adequately controlled risk
Heat Gun/Temperature bath use for Thermal Detectors	Spark generation during on/off of the unit	Personnel	4	4	16	Do not use a heat gun near inflammable materials. Do not look down the nozzle while the gun is turned on. Wear proper PPE.	4	1	4	Adequately controlled risk
Use of Temperature Bath	Slip Hazard because of extension cable used to power the gun/bath	Asset and personnel	3	2	6	Completely unwind the extension lead. Barricade the area where the cables pass through. Wear proper PPE and keep fire extinguisher ready. Have a standby person.	3	1	3	Adequately controlled risk

Use of tools	*Falling tools can cause injury to legs.*	*Personnel*	*3*	*3*	*9*	*Stack the tools properly.*	3	1	3	Adequately controlled risk.
Heat Gun/Temperature bath use for Thermal Detectors	Fire Hazard	Personnel and Asset	3	3	9	Never obstruct or cover the air inlet grills. Never operate the heat gun with the outlet nozzle hard up against a surface. Do not insert anything down the nozzle with the gun	3	1	3	Adequately Controlled Risk

13. Ladder Safety

Job Step Description	Hazards		Risk Analysis (NO Controls)			Control Measures	Risk Analysis (With Controls)			Evaluation.
	Hazard Description	Population at risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Selection of proper ladder	Improper ladder selection may cause injury and damage to equipments	Personnel and Equipment	3	2	6	Proper selection of ladder required for specific job to be taken	3	1	3	Adequately controlled risk.
Fixing the ladder	Improper angle of fixing the ladder	Personnel and equipment	3	2	6	The base should be spaced 1 foot away for every 4 feet it reaches up	3	1	3	Adequately controlled risk
Non-skid feet or spurs may prevent a ladder from slipping on a hard smooth surface.	Fall and slip	Personnel and Equipment	3	2	6	1. Step ladders should be securely spread open. Never use a folding step ladder in an unfolded position. 2. Do not carry loads on a ladder. 3. Ladder should be properly secured with rope at the bottom and top.	3	1	3	Adequately controlled risk
Lifting Ladders	Back injuries.	Personnel	3	4	12	Lift objects properly, ladder should be carried by two persons. Avoid bending over, Squat before the objects to be lifted, Get a good grip and good footing, bend the knees and lift with the leg muscles.	3	2	6	Adequately controlled risk.

Working with ladders	*Fall and Slips*	*Personnel*	*3*	*3*	*9*	*Ladder to be in serviceable condition. Personnel to wear harness attached by lanyard to suitable anchor point if working on height. Secure all hand tools & work at all times. Barricade off area below worksite.*	3	1	3	Adequately controlled Risk.
Working on Ladder	Strong winds causing injury to personnel by equipment/tools being blown from worksite	Personnel	3	3	9	Monitor wind speeds and comply with restriction in adverse weather procedure.	3	1	3	Adequately controlled risk.
Working with ladder	Escape route obstructed & Barricaded.	Personnel	3	3	9	Inform the control room & Personnel in the work area, and Demarcate alternate emergency route, which is to be familiar with all.	3	1	3	Adequately controlled risk

14. WORKING ON CONFINED SPACES

Job Step Description	Hazards		Risk Analysis (NO Controls)			Control Measures	Risk Analysis (With Controls)			Evaluation.
	Hazard Description	Population at risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Working in confined spaces	Asphyxiation or loss of breathing due to inadequate oxygen or presence of poisonous gasses.	Personnel within confined space	4	4	16	Work under PTW system. Check oxygen, LEL, & H2S (where applicable) before entering the vessel. Sufficient ventilation to be provided. Use SCBA's or masks if needed. Donot stay inside for too long. Work in turns of 15 minutes each.	4	2	8	Moderately controlled risk
Working in confined spaces	Hazardous atmospheres-Flammable, Toxic, Irritant/Corrosive	Personnel within confined space	5	4	20	Confined space must be cleared before entering it. Supervisor must be present through out and the persons for carrying out the job must be competent. Mechanical and electrical isolation of equipment is essentially. Physical isolation of pipe work must be done. Check should be made to ensure that isolation is effective.	5	2	10	Moderately Controlled Risk
Working in confined spaces	Hazardous atmosphere.	Personnel within confined space.	4	4	16	Check if person can enter with all equipments. Breathing apparatus to be provided.	4	1	4	Adequately controlled risk
Working in confined spaces	Hazardous atmosphere	Personnel within confined space	4	4	16	Emergency equipment s must be provided. Lifelines attached to harness must run to a point outside the confined space. Contingency plan and rescue team must be on standby.	4	1	4	Adequately controlled risk
Working in confined spaces	forced ventilation	Personnel within confined space	5	4	20	Information such as restricted areas within the confined space, voids, the nature of the contaminants present, the size of the space, the type of work to be performed, and the number of people involved should be considered. The ventilation air from Air blower/ventillator should not create an additional hazard due to recirculation of contaminants, improper arrangement of the inlet duct, or by the substitution of anything other than fresh (normal) air	5	2	10	Moderately controlled risk.

Working in confined spaces	*Poor visibility, injury to personnel*	*Personnel within confined space*	3	4	12	*Ensure confined space is well lit and is provided with non-sparking tools.*	3	1	3	Adequately controlled risk
Working in confined spaces	Lack of communication, unable to rescue personnel	Personnel within confined space	5	4	20	Dedicated standby watch to be in radio contact with control room. Control room to be made aware of entry status at all times. Safe access & egress to be maintained at all times.	5	1	5	Adequately controlled risk
Working in confined spaces	Personnel not familiar with equipment / entry procedures resulting in injury to personnel	Personnel within confined space	4	4	16	Personnel to be made aware of Entry to Confined Space precautions. Toolbox talks to be conducted.	4	1	4	Adequately controlled risk
Use of tools in confined spaces	Personnel getting injured due to slippage of tools in confined spaces.	Personnel working with in confined spaces	5	3	15	All tools to be used in confined spaces should be secured to avoid slippage of tools in confined spaces.	5	1	5	Adequately controlled risk.

15. Working at height above water

Job Step Description	Hazards		Risk Analysis (NO Controls)			Control Measures	Risk Analysis (With Controls)			Evaluation.
	Hazard Description	Population at risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Personnel Working at Height and above water (outside of platform deck)	Person falling in water, drowning, hypothermia.	Personnel	4	3	12	Safety Harness with energy absorbing lanyard to be worn by personnel. Safety equipment must be checked and have a current test certificate. Safety Harness to be hooked to fall arrestor. Work vest to be worn by personnel. Roll gliss rescue system should be available. PTW should be used strictly Standby boat to be made available. Standby person should be available at all time. Use inertia reel.	4	2	8	Moderately controlled risk
Over side working – injury by falling into water. Retrieval mechanism not in place.	Worksite personnel	Personnel	4	4	16	Worksite personnel to dawn work vest. Standby watch in radio contact with Control Room and Standby vessel. No work until permission received from Control Room. Deploy rescue rocket in case of emergency. Confirm weather conditions with Standby vessel. STOP ALL WORK IF WIND SPEED IS CLOSE TO 30KNOTS.	4	1	4	Adequately controlled risk
Material Dropping	Injury to personnel and damage to structure	Personnel	3	3	9	Correct manual handling technique must be used. Competent persons to work.	3	2	6	Adequately controlled risk
Working at height	Slip/Fall of personnel	Personnel	3	3	9	Safety harness with two lanyard lines, and inertia reel with energy absorbing system. Roll gliss system will be used for rescuing person. Standby boat to be informed and to be standby at the location. Job to be taken up in favorable weather. Secure tools & equipment. Access to area below work scope to be limited. Use lifting aids, correct manual Handling techniques. No overboard work above Diving or vessel operations	3	2	6	Adequately controlled risk
Working at height above water	Secondary drowning	Personnel	3	3	9	All precautions shall be implemented for work near or over deep water. All personnel who have been exposed to cold water or has swallowed water during exposure, shall be spent to hospital immediately.	3	1	3	Adequately controlled risk

16. Use of electric power tools

Job Step Description	Hazards		Risk Analysis (NO Controls)			Control Measures	Risk Analysis (With Controls)			Evaluation.
	Hazard Description	Population at risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Switch power on to tool	Tool damaged causing risk of electrocution or fire	Person using tool	4	4	16	Tool must be suitable for application for the particular task. All portable electrical equipment to be on portable equipment/ temporary equipment register. User to inspect tools for frayed cords, loose or broken switches, and other obvious problems prior to use. All leads to be in good condition. Tool to be powered via ELCB. Inspect the cord for the proper type. Electric-powered tools must either have a three-wire cord with ground or be double insulated. Never use a plug that has its ground prong removed. Do not use electric-powered tools in damp or wet locations. Verify that it bears an electrical test label to indicate it successfully passed inspection and tests for electrical safety within the previous six months. Know the application, limitation, and potential hazards of the tool. Operate according to the manufacturer's instructions.	4	2	8	Moderately controlled risk
Change of tool e.g. drill, grinding disc etc.	Tool switches on during tool change causing injury	Person using tool	3	4	12	Power to be isolated when changing tools. Unplug the tool from the socket,	3	2	6	Adequately controlled risk
Use of electric drill	Drill chuck insufficiently tightened causing drill to slip in chuck & possibly snaps, electric shock and mechanical cutting.	Person using tool	2	4	8	Chuck key to be used to tighten chuck. Chuck key to be fastened to drill power cable. Have good electrical connections; pay great attention when using it.	2	2	4	Adequately controlled risk
Use of electric power tools	Power tool cable causes tripping hazard	Person using tool	3	4	12	Power cable to be as short as possible. Power cable not to cross walkways. Barriers to be erected. Observers should remain a safe distance away from the work area. Be sure to keep good footing and maintain good balance.	3	2	6	Adequately controlled risk
Use of electric power tools	Power tool inadvertently operated by third party causing injury	Persons in work area	3	3	9	Power to be isolated when tools are left unattended. Observers should remain a safe distance away from the work area. Only trained and authorised person must use the equipment.	3	2	6	Adequately controlled risk

Use of electric power tools	*Rotating equipment* *Injury to personnel*	*Person using tool*	4	3	12	*Equipment to have approved guards / fencing in place. Mechanical / Electrical isolations to be in place prior to guards being removed. Safety guards must never be removed when the tool is being used. Safety switches must be kept in working order and must not be modified. If you feel it necessary to modify a safety switch for a job you're doing, use another tool. Do not wear loose clothing, ties, or jewellery when operating tools.*	4	2	8	Moderately controlled risk
Use of electric power tools	Noise in work area causing deafness	Persons in work area	3	4	12	Obey Hearing Protection Warning Signs in Area. Wear approved hearing protection in designated areas or when using power tools.	3	1	3	Adequately controlled risk
Use of electric power tools	Flying particles causing eye injuries	Persons in work area	3	5	15	Use of eye protection / correct PPE.	3	2	6	Adequately controlled risk
Use of electric power tools	Manual handling – sprains and strains	Person using tool	3	4	12	Observe manual handling procedures and use lifting aids.	3	2	6	Adequately controlled risk
Use of electric power tools in hazardous areas	Ignition of flammable atmosphere	Persons in work area	4	4	16	Continuous atmosphere monitoring to be carried out. Work to be carried out under control of a hot work permit.	4	2	8	Moderately controlled risk
Use of electric power tools	Improper precautions during servicing and storing tools	Person working with the tools	3	3	9	Never modify a tool to use for a job it's not intended to do. Disconnect power tools while servicing or storing. Do not wrap the cord around the tool for storage. Store tools in a dry place.	3	1	3	Adequately controlled risk
Working on ladder	Injury to personnel	Personnel working with tools	3	3	9	Standby person should be present and should be aware of location of ELCB. Wires should be entangled.	3	1	3	Adequately controlled risk.

17. Inboard Scaffolding

Job Step Description	Hazards		Risk Analysis (NO Controls)			Control Measures	Risk Analysis (With Controls)			Evaluation.
	Hazard Description	Population at risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Inboard Scaffolding	1 - Work at height - injury to personnel by fall from height	Worksite personnel	4	4	16	Adhere to Work permit system & inform control room. Area to be barricaded. Competent Personnel to be involved. When working above 2 meters, inertia reel to be hooked up when double lanyard is not present, including transfer. All equipment to be certified i.e. Inertia Reels, harness & safety line. Double lanyard must be used always. Scaffolds must be capable of supporting at least four times the maximum intended load. Stop work if wind speeds exceed 30 knots.	4	1	4	Adequately controlled risk
Inboard Scaffolding	2 - Work at height - injury to personnel by fall from height	Worksite personnel	4	4	16	Minimum of 2 persons on location. Ladders to be secured. Process plant & equipment not to be used for hand holds. Working in winds prohibited. Ensure 3 point contact at all times when using ladders. Ensure ladder is secure. Emergency Roll Gliss rescue mechanism must be in the area. Supervisor should carry walkie-talkie with him during erecting/dismantling of scaffolds. Contingency plan must be in place. Ladders must be used for getting up and down. Ladders must be secured. Guardrails, toe boards and similar barriers should be provided whenever someone could fall 2 metres or more.	4	1	4	Adequately controlled risk

Inboard scaffolding	*3- Work at height - injury to personnel by fall from height*	*Worksite personnel*	*4*	*4*	*16*	*Scaffolds and components should not be overloaded. Movement of scaffolds should be prohibited during the job. Prohibit scaffold use during high winds and poor weather. Protect suspension ropes from contact with sources of heat, and from acids and other corrosive substances. Remove debris and unnecessary materials while working on scaffolds.*	4	1	4	Adequately controlled risk.
Inboard Scaffolding	Dropped objects-injury to personnel and damage to plant.	Worksite personnel	4	3	12	Scaffold Platform must be free of loose materials. Tools and equipment to be secured. Lifting aids to be utilized. Correct manual handling techniques to be used. A way of preventing materials or other objects rolling or being kicked off platform edges should be provided, e.g. toe boards, solid barriers at open edges. Area below to be barriered off and proper warning signs posted. Tube caps to be provided to prevent insertion of foreign objects.	4	1	4	Adequately controlled risk.
Inboard Scaffolding	1- Inadvertent damage to Process Equipment - Uncontrolled release of hydrocarbons	All platform personnel	5	4	20	Personnel to be aware of Process Systems and inventories, pressures and temperatures at each location. Tubes should be lifted sequentially. Particular care to be taken when handling tubes, especially when working in areas with instrument tapings and fittings. Continuous supervision necessary. Supervisor to have walkie-talkie.	5	1	5	Adequately controlled risk
Inboard Scaffolding	2- Inadvertent damage to Process Equipment - Uncontrolled release of hydrocarbons	All platform personnel	5	4	20	Good liaison with control room regards location, and any abnormal activity such as leaks, damages etc. should be reported. Examination of work scope and detailed discussion between Issuing and Performing Authority prior to each task commencing. Unauthorized persons should not be allowed. Coordination must be there are multiple activities going on side by side. Use a tag line when hoisting equipment onto a scaffold.	5	1	5	Adequately controlled risk
Inboard Scaffolding	Tripping hazards - injury to personnel.	Worksite personnel	3	5	15	All equipment to be stored in approved racks when not in use Good housekeeping through out the job. Wear appropriate PPE. Boots must be checked for greases and must be cleaned before use to avoid slips.	3	2	6	Adequately controlled risk

Inboard Scaffolding	*Manual handling - injury to personnel*	*Worksite personnel*	*3*	*4*	*12*	*Application of good manual handling techniques* *Lifting aids to be used. Work position should have characteristics appropriate to the nature of the job.* *Utilize mechanical aids for material mobilization to worksite* Effective planning by Supervisor & Operations, ensuring lifting of loads should be done by minimum of two persons.	3	2	6	Adequately controlled risk
Inboard Scaffold	Working on incomplete scaffold	Worksite Personnel	4	5	20	Access to incomplete or unattended scaffolding structures to be barriered off & DO NOT Use Scaff Tags posted on site. Approved Scaff Tags to be posted on all completed scaffolding. Remove all decking and ladders. Scaffolds must be checked once in 7 days. Edge protection to working platform must be there-Handrail, mid-rail etc.	4	1	4	Adequately controlled risk
Inboard Scaffold	External heat sources - personal injury, damage to scaffold boards or fire	Worksite Personnel	4	4	16	Scaffold boards to be protected at all times from heat sources e.g. exhaust & sparks from hot work. Close liaison with Issue Authority regards potential hazards in area. In the presence of flame or heat, wire rope lifelines should be used with lanyards containing shock absorbers. Keep safe distances from heat source. Protect suspension ropes from contact with sources of heat (welding, cutting, etc.) and from acids and other corrosive substances.	4	1	4	Adequately controlled risk
Inboard Scaffolding	Removal of grating causing possibility of personnel falling	Platform personnel	4	4	16	No grating to be removed without permission of Shift Supervisor. Scaffold barrier to be erected prior to removing grating. Temporary scaffold handrails should be erected.	4	2	8	Moderately controlled risk
Emergency Response access / egress locations	Restricted casualty handling from erected scaffold	Personnel using scaffold	4	4	16	Access & egress locations to be wide enough to facilitate the removal of a basket stretcher in the horizontal position. Access & egress locations should be clear at all times. Suitable approved lifting point to be fitted at access & egress locations	4	2	8	Moderately controlled risk
Inboard Scaffolding	Escape route restricted & barricaded	Personnel working near work area	5	3	15	Inform control room & personnel working in the area. Demarcate alternate escape route and make it familiar to personnel on site.	5	1	5	Adequately controlled risk

Job Description	Hazards		Risk Analysis (No controls)			Control Measures	Risk Analysis (With controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Cooking appliances to be clean	Contamination, food poisoning	All personnel	3	3	9	Ensure cooking appliances, tools and equipment is clean at all times. Use gloves at all times. Never wipe hot surfaces with wet or damp cloth.	3	1	3	Adequately controlled risk
Cooking appliances to be clean	Contamination, food poisoning	All personnel	3	4	12	Ensure food is never stored below 5°C or above 65°C at all times. Use of contaminated and expired goods not allowed. Cool room temperatures must never go below 5°C, and freezer temperature must never go above minus 18°C.	3	1	3	Adequately controlled risk
Cooking appliances	Burns, fire, electrocution,	Galley crew	3	5	15	Never overfill containers. Appliances should be turned off immediately after use. Warn others that the surface and appliances are hot. Donot leave utensils hanging from appliances. Fire extinguisher and blanket must be there in good condition. Suppression system to be activated in case of fire over hot plate	3	2	6	Adequately controlled risk
Cooking appliances	Burns, fire, Cuts	Galley crew	3	5	15	First aid box should be available. Long tong must be used. Be away when frying food. Contact Doctor for any injuries. Vegetables must be cut carefully. High temperature gloves must be used. Gloves must be used during cutting of meat etc.	3	1	3	Adequately controlled risk,
Cooking	Falling hairs, loose clothes, slips etc.	Galley crew	3	3	12	All catering staff must wear company uniform which must be clean at all times, comprising of the aprons, safety footwear and caps. Food handling gloves must be used when handling raw and processed foods, excepting where handling raw meats, vegetables and pastries.	3	1	3	Adequately controlled risk
Galley area	Cockroaches and bugs	All personnel	3	4	12	Periodic fumigation of galley to be done. Cockroach monitor to be used.	3	2	6	Adequately controlled risk
Galley area	Slip/Trip/falls	Galley crew, Personnel	4	3	12	Housekeeping should be good. Caution signs indicating wet floor must be displayed.	4	1	4	Adequately controlled risk
Galley area	Hygiene	All personnel	3	4	12	Daily cleaning must be carried twice a day. Wastes should be disposed in respective bins; waste bins should be emptied periodically. Tables to be cleaned periodically. Personnel to keep their plates, tumblers, cups after eating in washing area. Thorough fortnightly cleaning of galley must be undertaken.	3	1	3	Adequately controlled risk.
Galley	Hygiene	All personnel	3	4	12	Chiller, Freezer, Storage area must have high housekeeping. Fruits, vegetables, meat etc should be kept in chiller.	3	2	6	Adequately controlled risk
Galley	Manual handling	Galley crew	3	4	12	Follow correct lifting techniques. Trolley to be used for moving heavy items. Loads above 16 Kgs should be lifted by more than one person.	3	1	3	Adequately controlled risk.

19. Fortnightly cleaning of Galley

Job Description	Hazards		Risk Analysis (No controls)			Control Measures	Risk Analysis (With controls)			Evaluation
	Hazard Description	Population at Risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Floor cleaning	Slips and falls	Galley crew	3	5	15	Caution sign indicating WET FLOOR must be present. No personnel should be allowed to enter galley for duration of wet floor. Galley crew must be careful and avoid skidding.	3	2	6	Adequately controlled risk
Floor cleaning	Back strain, Equipment damage	Galley crew	3	3	9	No twisting or bending of knees constantly. Hot soapy water to be used and distributed by metal bucket, without splashing. Hard broom must be used. Dry floor as much as possible.	3	1	3	Adequately controlled risk
Use of chemicals like Bleaching powder, Phenyl etc	Splashes, skin contact, burns, inhalation.	Galley crew	3	4	12	Use proper PPE. MSDS of chemicals must be available. Food items in stores should be stacked at a distance and in a safe manner to avoid contact and contamination. Food stuff must not get in contact with chemicals and become contaminated.	3	1	3	Adequately controlled risk
Stacking of Dining tables and chairs	Improper arrangement leading to falls of chairs or tables.	Personnel	3	3	9	Tables must be positioned in a corner with chairs firmly kept over them to avoid risk of falling. No personnel should be allowed when cleaning is going on.	3	1	3	Adequately controlled risk
Serving food	Un hygienic	Personnel	3	3	9	Food should be served away from the cleaning area either prior to or after cleaning of galley takes place. This reduces risk of falls, contaminated food.	3	1	3	Adequately controlled risk.

20. Installation/ Removal of scaffolding above water

Job Step Description	Hazards		Risk Analysis (NO Controls)			Control Measures	Risk Analysis (With Controls)			Evaluation.
	Hazard Description	Population at risk	Severity	Likelihood	Risk Rating	List all controls required	Severity	Likelihood	Rating	T/A/M/I
Working over water	Personnel falling in water	Personnel	4	3	12	Safety harness with energy absorbing lanyard to be worn by personnel. Work vest to be worn by personnel. Rollgliss system to be kept available. Radio communication with radio room/Control room. Standby person should be available at site. Standby boat to be made available. Adhere to Work permit system & inform control room. Competent Personnel to be involved. When working above water, inertia reel to be hooked up at all times, including transfer. Adhere to Permit to Work precautions. All equipment to be certified i.e. Inertia Reels, harness & safety line.	4	2	8	Moderately controlled risk
Working over water	Scaffolding collapse and personnel falling in water	Personnel	4	3	12	Scaffolding to be inspected before starting the job. Adhere to Permit to Work precautions. All equipment to be certified i.e. Inertia Reels, harness & safety line. Scafftag to be certified for the loading allowed. Scaffold should not be overloaded.	4	2	8	Moderately controlled risk
Removal of scaffolding	Collapse of scaffolding	Personnel	5	4	20	Adhere to Permit to Work precautions. Assess the weather conditions before dismantling. Proper sequence to be followed when dismantling. Use proper PPE. Area below should be barricaded, and it must be ensured that there is no critical equipment which will be damaged. Inspection of scaffolding to be carried out in case of start of job after high wind condition and after every seven days during the job.	5	2	10	Moderately controlled risk.
Overboard Scaffolding	Dropped objects - injury to personnel and damage to plant	Worksite personnel	4	5	20	Tools and equipment to be secured. Lifting aids to be utilized. Correct manual handling techniques to be used. Area below to be barriered off and warning signs posted. Tube caps to be provided to prevent insertion of foreign objects.	4	1	4	Adequately controlled risk

Overboard Scaffolding	*Inadvertent damage to Process Equipment - Uncontrolled release of hydrocarbons*	*All platform personnel*	*5*	*4*	*20*	*Personnel to be aware of Process Systems and inventories, pressures and temperatures at each location. Particular care to be taken when handling tubes, especially when working in areas with instrument tapings and fittings. Good liaison with control room regards location, and any abnormal activity such as leaks, damages etc.*	5	1	5	Adequately controlled risk
Overboard Scaffolding	*Manual handling - injury to personnel*	*Worksite personnel*	*4*	*4*	16	Application of good manual handling techniques. Lifting aids to be used. Work position should have characteristics appropriate to the nature of the job. Utilize mechanical aids for material mobilization to worksite. Effective planning by Supervisor & Operations.	4	1	4	Adequately controlled risk
Overboard Scaffolding	Working on incomplete scaffold	Worksite Personnel	5	4	20	Access to incomplete or unattended scaffolding structures to be barriered off & DO NOT Use Scaff Tags posted on site. Approved Scaff Tags to be posted on all completed scaffolding. Remove all decking and ladders. Scaffolds must be checked once in 7 days. Edge protection to working platform must be there-Handrail, mid-rail etc.	5	1	5	Adequately controlled risk
Overboard Scaffolding	Falling from scaffoldings due to high winds	Personnel working on scaffolding	5	4	20	Monitor wind speeds and sea conditions. Keep stand-by vessel close to the platform at all times. Stop work and get down the scaffolding if the wind speed increases to 30knots.	5	1	5	Adequately controlled risk.