RECOMMENDED PRACTICES ON
COAL BED METHANE (CBM) OPERATIONS

Prepared by:
COMMITTEE ON CBM OPERATIONS

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PREAMBLE

Indian petroleum industry is the energy lifeline of the nation and its continuous performance is essential for sovereignty and prosperity of the country. As the industry essentially deals with inherently inflammable substances throughout its value chain – upstream, midstream and downstream – Safety is of paramount importance to this industry as only safe performance at all times can ensure optimum ROI of these national assets and resources including sustainability.

While statutory organizations were in place all along to oversee safety aspects of Indian petroleum industry, Oil Industry Safety Directorate (OISD) was set up in 1986 by the Ministry of Petroleum and Natural Gas, Government of India as a knowledge center for formulation of constantly updated world-scale standards for design, layout and operation of various equipment, facility and activities involved in this industry. Moreover, OISD was also given responsibility of monitoring implementation status of these standards through safety audits.

In more than three decades of its existence, OISD has developed a rigorous, multi-layer, iterative and participative process of development of standards – starting with research by in-house experts and iterating through seeking & validating inputs from all stakeholders – operators, designers, national level knowledge authorities and public at large – with a feedback loop of constant updation based on ground level experience obtained through audits, incident analysis and environment scanning.

The participative process followed in standard formulation has resulted in excellent level of compliance by the industry culminating in a safer environment in the industry. OISD – except in the Upstream Petroleum Sector – is still a regulatory (and not a statutory) body but that has not affected implementation of the OISD standards. It also goes to prove the adage that self-regulation is the best regulation. The quality and relevance of OISD standards had been further endorsed by their adoption in various statutory rules of the land.

Petroleum industry in India is significantly globalized at present in terms of technical content requiring its operation to keep pace with the relevant world scale standards & practices. This matches the OISD philosophy of continuous improvement keeping pace with the global developments in its target environment. To this end, OISD keeps track of changes through participation as member in large number of International and national level Knowledge Organizations – both in the field of standard development and implementation & monitoring in addition to updation of internal knowledge base through continuous research and application surveillance, thereby ensuring that this OISD Standard, along with all other extant ones, remains relevant, updated and effective on a real-time basis in the applicable areas.

Together we strive to achieve NIL incidents in the entire Hydrocarbon Value Chain. This, besides other issues, calls for total engagement from all levels of the stakeholder organizations, which we, at OISD, fervently look forward to.

Jai Hind!!!

Executive Director
Oil Industry Safety Directorate
FOREWORD

The Oil Industry in India is over 100 years old. As such, various practices have been in vogue because of collaboration/ association with different foreign companies and governments. Standardization in design philosophies, operating and maintenance practices remained a grey area. This coupled with feedback from some serious accidents that occurred in the past in India and abroad, emphasized the need for the industry to review the existing state-of-the-art in designing, operating and maintaining of Oil and Gas installations.

With this in view, the Ministry of Petroleum and Natural Gas in 1986 constituted a Safety Council assisted by the Oil Industry Safety Directorate (OISD) staffed from within the industry in formulating and implementing a series of self-regulatory measures aimed at removing obsolescence, standardizing and upgrading the existing standards to ensure safe operations. Accordingly, OISD constituted a number of functional committees of experts nominated from the industry to draw up standards and guidelines on various subjects.

Drilling for coal Bed Methane has been going on for some time in India. CBM exploration and production is a low pressure operation and very much unlike the normal operations at oil and gas wells. Smaller rigs are generally used .Since CBM being an adsorbed gas in the coal seam, unless well is stimulated and water level is brought down sufficiently, such that back pressure on gas producing layer is reduced, the gas would not travel to surface. Water handling and disposal are important considerations in a CBM well. Since there was no specific standard for CBM operations it was thought appropriate to put up a set of recommended practices for Coal Bed Methane Operations with the help of industry.

The document is based on the accumulated knowledge & experience and the various national and international codes & practices. It is hoped that the provision of this document will go a long way to improve safety and reduce accidents in the Oil & Gas Industry.

The figures and annexures used in the document are representative in nature.

We, at OISD, are confident that the provisions of this standard, when implemented in totality, would go a long way in ensuring safe operation of the target group of locations.

Needless to mention, this standard, as always would be reviewed based on field level experience, incident analysis and environment scanning. Suggestions from all stake holders may be forwarded to OISD.
NOTE

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These documents are intended only to supplement and not to replace the prevailing statutory requirements of PESO, DGMS, Factory Inspectorate or any other Government body which must be followed as applicable.

Wherever Acts/ Rules/ Regulation and National/ International Standards are mentioned in the standard, same relates to in-vogue version of such documents.
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**MEMBER COORDINATOR**

Shri Zafar Ali

Oil Industry Safety Directorate, Noida
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1.0 INTRODUCTION:

During the process of formation of coal, or Coalification, when plant materials are progressively converted into coal, large volumes of methane gases are produced. This methane stored in the internal surfaces of coal is known as Coal Bed Methane gas. The term refers to methane adsorbed into the solid matrix of the coal. Methane is held adsorbed in coal seams under pressure. When pressure of coal seams is reduced by dewatering, de-adsorption of methane starts at critical de-adsorption pressure. Methane gas is thus released. CBM has remained a major hazard affecting safety and productivity in coal mines. With the advancement of technology, Coal Bed Methane (CBM) has now become a source of clean energy and is being produced successfully as another form of gas resource. In many technical literatures, CBM is also termed as coal bed gas or Coal Seam Gas.

CBM exploration and production is a low-pressure operation which starts with low gas water ratio (GWR) that increases with time as the water is pumped out from the formation to maximise the gas production. Gases are present in the coal seams either in a free and adsorbed state or only in an adsorbed state. Constituents of CBM gas are mainly methane and traces of ethane, nitrogen, carbon dioxide and few other gases and no natural gas condensate.

2.0 PURPOSE AND SCOPE:

This Recommended Practice (RP) covers the minimum requirement for safety in operation, inspection and maintenance of CBM Onshore fields including drilling of a well, well stimulation and completion, wellhead installation, production and gathering of gas, gas dehydration, gas compression, infield pipeline & gas transportation systems and waste management systems, including produced water handling and disposal.

This recommended practices is divided into four sections. Section - I deals with Drilling and Workover operations, the Section - II deals with Production Operations, Section - III deals with Safety and Environmental aspects and Section –IV deals with Well closure and Abandonment aspect of CBM E&P operations.

3.0 DEFINITION:

3.1. ABSORPTION: 
Absorption is a physical or chemical phenomenon or a process in which atoms, molecules or ions enter some bulk phase – gas, liquid or solid material. Absorption is a condition in which something takes in another substance.

3.2. ACCUMULATOR (BOP CONTROL UNIT):
A pressure vessel charged with nitrogen or other inert gas and used to store hydraulic fluid under pressure for operation of Blowout Preventers and/or diverter system.

3.3. ADSORPTION:
Adsorption is the adhesion of atoms, ions, or molecules from a gas, liquid, or dissolved solid to a surface. This process creates a film of the adsorbate on the surface of the adsorbent. Adsorption is a surface phenomenon.

3.4. ANNULAR PREVENTER:
A device, which can seal around different sizes & shapes object in the wellbore or seal an open hole.

3.5. BLOWOUT:
An uncontrolled sudden violent escape of well fluids and/or formation fluids from the well bore.

3.6. BLOWOUT PREVENTER:
A device attached to the casing head that allows the well to be sealed to confine the well fluids to the wellbore.

3.7. CASING PIPE:
Steel / non-ferrous alloy pipe which is used to provide lining to the drilled hole and to protect the well from formation fluid flow or formation collapse.

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3.8. CHOKE VALVE:
A device specifically intended to control the flow of well fluids being produced. Another purpose that the choke valves serve is to kill the pressure from the reservoir and to regulate the downstream pressure in the flow lines.

3.9. COILED TUBING SERVICES (CTU):
The coiled tubing services are a second-generation workover system employing continuous tubing string to carry out various work over and well maintenance jobs on live wells. The continuous tubing is stored on a ‘reel’ and coiled upon itself.

3.10. COMPETENT PERSON:
In relation to any work or any machinery, plant or equipment means a person who has been duly appointed in writing by the manager as a person competent to supervise or perform that work, or to supervise the operation or maintenance of that machinery, plant or equipment, and who is responsible for the duties assigned to such person.

3.11. COMPRESSOR STATION (CS):
A plant/station where gas is received, liquids separated, and gas is further compressed for onward transmission.

3.12. CONFINED SPACE:
It is an enclosure with known or potential hazards and restricted means of entrance and exit is not normally occupied by people and is usually not well ventilated.

3.13. CUSTODY TRANSFER METER:
A gas measuring device which measures the quantity and/or energy of gas delivered from one agency to another agency for transfer of custody.

3.14. DEW POINT:
The temperature at which vapour begins to condense into a liquid at a particular system pressure. A natural gas stream exhibits both hydrocarbon and water dew points.

3.15. DESORPTION:
Desorption is a phenomenon whereby a substance is released from or through a surface. The process is the opposite of sorption (that is, either adsorption or absorption).

3.16. EARThING:
It is the provision of a safe path of electrical current to ground in order to protect structures, plant and equipment from the effects of stray electrical current and electrostatic discharges.

3.17. EMERGENCY SHUT-OFF VALVE:
A quick action shut off valve, which operates from full open to full close condition in less than one complete turn.

3.18. ELECTROFUSION JOINT:
Electrofusion is a method of joining thermoplastic pipes using special fittings that have built-in electrical heating elements which are used to weld the joint together.

3.19. FRACTURING:
It is the process of pumping of a specially engineered fluid at high pressure and rate into the reservoir interval to be treated, causing a vertical fracture to open. The wings of the fracture extend away from the wellbore in opposing directions according to the natural stresses within the formation. Proppant, such as grains of sand of a particular size, is mixed with the treatment fluid to keep the fracture open when the treatment is complete.

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3.20. FLOW LINES:
Piping which carries well fluid from the wellhead to manifold or first process vessel.

3.21. GAS COLLECTING STATION (GCS):
A production installation where gas is received, liquid separated, gas is dehydrated (if required) and gas is further compressed for onward transmission.

3.22. GAS DEHYDRATION:
Dehydration is the process of removing water vapour from the gas stream.

3.23. INSULATION JOINT:
A fitting having high electric resistance, which can be fitted in a pipeline to insulate one section of pipe from another electrically.

3.24. INTERMEDIATE COMPRESSOR STATION:
An intermediate compressor station is any installation having compressor between originating compressor station and terminal / final/last delivery station on the pipeline for boosting the pressure of the gas so that it reaches to next station.

3.25. INTERMEDIATE PIGGING STATION:
An intermediate pigging station is an installation having facility for receiving and launching of pigs for pipeline pigging operations.

3.26. LATERAL LINES:
Pipelines that transport wet gas from multiple flow lines to trunk lines or Group.

3.27. LEL: LOWER EXPLOSIVE LIMIT:
Air-gas mixtures will only burn or explode within certain limits, known as the flammable (explosive) limits. (LEL) is the minimum percentage of gas mixed with air that will burn or explode. The LEL for natural gas is 5% (50,000 ppm) gas to 95% air.

3.28. MANIFOLD:
An assembly of pipe, valves, and fittings by which fluid from one or more sources is selectively directed to various process systems.

3.29. MAXIMUM ALLOWABLE OPERATING PRESSURE (MAOP):
The maximum pressure at which the pipeline is allowed to operate. MAOP may be equal to the design pressure.

3.30. PIGGING:
Pigging operations refer to maintenance practice for pipelines using "pipeline pigs", for cleaning or inspection of the pipeline without stopping operation of the pipeline.

3.31. PURGING:
It is the process of replacing the atmospheric air within a container (pipeline, vessels, filters etc.) by an inert substance in such a manner so as to prevent the formation of explosive mixture.

3.32. SETTLING BASIN:
A settling basin or tank is a type of structure, usually a man-made tank or pond that is designed for the purpose of removing sediment and other particulates from water, through the action of gravity.

3.33. SHUTDOWN VALVE:
An automatically operated valve used for isolating a process component or process system.

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3.34. SHALL:
Indicate that provision is mandatory.

3.35. SHOULD:
Indicate that provision is recommendatory as per good engineering practices.

3.36. STIMULATION:
A process undertaken to remove formation damage / enlarge old channels or to create new ones in the producing formation for enhancing the productivity of a well.

3.37. TRUNK/COLLECTOR LINES:
The collector lines are pipelines transporting well fluid from multiple flow lines/ manifolds/ lateral lines to GCS.

3.38. WELL INTEGRITY:
Application of technical, operational and organizational solutions to reduce risk of uncontrolled release of formation fluids throughout the life cycle of a well.
SECTION - I

CBM DRILLING & WORKOVER OPERATIONS

This section deals with a minimum requirement for safety in operations, inspection and maintenance during drilling of a well, well completion, and stimulation and workover operations in a CBM field.

4.0 SAFETY ASPECTS RELATED TO DRILLING OPERATIONS:

Standard operating procedures for drilling of hole of required sizes, lowering of casings and cementing at different stages etc. should be available with each operator. The emphasis should be given to evaluate all associated operational risks and corresponding mitigation measures so as to execute a safe drilling operation without compromising on the integrity of the well being drilled.

4.1. Rig and equipment can cause safety hazards due to dynamic, instantaneous and fatigue loading, wear and tear due to continuous operations at drill site. The safety hazard may also be due to hazardous environment and corrosive fluids.

   i. It is recommended that every drilling rig should have Safe Operating Manual covering all the operations, repair and preventive maintenance including safety checks as per OEM recommendations.

   ii. The SOPs (Safe operating procedures) should be available at the rig before commencement of the operations.

4.2. Rigs of different type and specifications are used depending upon various factors like well depth, loads/tools that are likely to be handled and activities involved. Since the depth of the wells (250m – 1200m) to be drilled in CBM operations is relatively less than the conventional drilling, a smaller capacity rig may be required for such operations.

4.3. For completion and work-over jobs, relatively smaller capacity rigs are used. These “Work over Rigs” should be equipped with power swivel or rotary depending upon job requirement.

4.4. Rig having no monkey board, shall not require emergency escape device. In case of using conventional rig emergency escape device is required.

4.5. A number of activities like dismantling of rig and equipment, their loading/unloading, transportation & erection and commissioning at new site are involved. Following paragraphs provide general guidelines for the users for safe operations in carrying out these activities, keeping in view the associated risks.

4.6. Drilling of a CBM well typically involves following stages:

   i. Determination of well site based on sound geological interpretation of the surface and subsurface data GTO (Geo-Technical Order).

   ii. Civil works for preparation of the drill site, cellar pit of adequate size and approach road

   iii. Placement of conductor casing, which is the first string of casing to be set and cemented in a well for covering top loose soil, typically 2-20 m depending upon the condition of the soil

   iv. To protect freshwater aquifers, surface casing is placed using drilling rig, which usually is set below the expected aquifer level in the area.

   v. Further drilling up to target depth and placing of production casing & cementing, using suitable drilling rig.

   vi. Logging for depth correlation and to have coal seam properties.

   vii. Perforation of the target zone is carried out through Coil Tubing Unit “CTU” using high pressure sand jetting or using explosives

   viii. Hydrofracturing activity is usually carried out in “bottom to top approach”, with the isolation of individual perforated coal seam(s) one after another using suitable methods as the perforation and fracturing progresses upward.

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ix. Sand cleaning, ball and baffle plate assembly milling and scrapper running, are usually done with a workover rig/ CTU.

x. Artificial lifting pump installation for lifting of water.

xi. The well head equipment should be installed either prior to or after the Hydrofracturing (HF). In case it is installed prior to HF the well head should be capable of withstanding the expected highest HF pressure. In case well head is installed after HF, it should be able to withstand the expected maximum formation pressure.

4.7. The following safety precautions during each stage of drilling operations should be taken by operator to ensure safety, reliability and integrity of drilling operations:

4.7.1 Before mobilising drilling / workover rig, a joint visit should be carried out to the well site to access the adequacy of following en route as well as rig site. Adequate measures to be taken to address the shortcomings if any noticed in a safe and timely manner.

i. Width and strength of the road.

ii. Strength of bridges and culverts.

iii. Height of the electrical transmission lines.

iv. Railway crossing and traction lines.

v. Physical condition of well site

vi. Condition of cellar pit and waste pit

vii. Necessary permissions for rig movement from local authorities, as applicable

viii. Condition of approach road for rig movement

ix. Radius of curvature on turnings.

x. Hindrances such as branches of tree, electric cables etc.

4.7.2 During Rig building:

i. Mobilise rig to the well site & start rig building.

ii. Being a light rig, rig building, raising of heavy loads and dismantling can be carried out round the clock. During night hours care shall be taken while raising the mast.

iii. While raising the mast senior personal including tool pusher/DIC shall be present.

iv. The derrick shall be adequately secured to prevent it from overturning.

v. Each derrick or mast should have a nameplate showing the name of manufacturer, year of manufacture and safe working load capacity.

vi. Every hole at the derrick into which persons might accidentally walk should be protected by cover.

vii. Position all the rig equipment as per rig equipment layout plan.

viii. While working in night shift, proper and adequate illumination shall be provided.

ix. There shall not be any hydraulic lines leakage. In case any leakage is observed such hydraulic hoses shall be replaced with new and tested hoses having same specifications as original.

x. All guy ropes shall be properly and equally tensioned.

xi. Rig engine, mud pumps shall be test run before starting the operation.

xii. All electrical equipment at rig site shall be properly earthed and tested prior to commencement of operations and records of such tests shall be maintained.
xiii. Power cables should be protected from any damage by falling object or mechanical injury and also not to cause harm/pose danger to any person.

xiv. All the gauges, safety valves on the rig equipment shall be checked to ensure that these are calibrated and are in working condition.

xv. Tanks shall be filled with water or if required with mud of required gravity.

xvi. Threads shall be cleaned and recommended grease on tubular thread shall be applied

xvii. Appropriate safety signage in adequate numbers should be displayed in English and regional language at drill site.

5.0 CONVENTIONAL OIL AND GAS WELLS vs CBM WELLS

Scope of drilling operations in CBM project differs from conventional exploratory wells. A typical schematic of a CBM well is provided at Fig – 1 A comparison table indicating the difference in the scope of drilling operations between CBM reservoir project and a conventional reservoir is given as under.

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<th>CBM Reservoir</th>
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<td>Mode of occurrence of Hydrocarbon</td>
<td>In the inter-granular pore spaces of rock</td>
<td>In adsorbed state on the surface of coal</td>
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<tr>
<td>02</td>
<td>Depth of Reservoir</td>
<td>Both Shallow and deep to very deep (&lt; 5000 m)</td>
<td>Very Shallow &lt;1000m to ~1500m</td>
</tr>
<tr>
<td>03</td>
<td>Pressure Regime</td>
<td>Mostly more than hydrostatic except in heavy oil loose sand reservoir</td>
<td>Sub-hydrostatic to hydrostatic</td>
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<td>04</td>
<td>Methodology of production</td>
<td>By pressure maintenance</td>
<td>By dewatering and reducing the pressure to allow desorption of gas.</td>
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<tr>
<td>05</td>
<td>Gas &amp; water production</td>
<td>Initially very high gas with little or no water and gradual reversal</td>
<td>Initially low gas and high water, gradual reversal of the trend followed by stable high gas and stable low water</td>
</tr>
<tr>
<td>06</td>
<td>Flow of well fluids</td>
<td>Generally oil and gas production is taken through tubing</td>
<td>Invariably Coal bed Methane Gas is produced from annulus and dewatering done through tubing.</td>
</tr>
</tbody>
</table>

6.0 BLOWOUT PREVENTER (BOP):

Drilling of CBM wells is a low-pressure operation and it differs from the conventional drilling operation. CBM reservoir has no cap rock and gas is found at much shallower depth as compared to the conventional hydrocarbon. Since CBM being an adsorbed gas in the coal seam, unless well is stimulated and water level is brought down sufficiently, such that back pressure on gas producing layer is reduced, and gas does not travel to surface. Normally, 2000-3000 psi working pressure BOP should be considered for use in CBM drilling operations. Refer the Figures 1 & 2.

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6.1 USE OF BLOWOUT PREVENTER (BOP) IN CBM DRILLING OPERATION:

i. During the drilling operation Annular BOP shall be utilised. Alternatively non-rotating Diverter and flow lines from well connected to tank/shale shaker, depending upon elevation difference may be used.

ii. During the work over and completion process, a ram type preventer (equipped with pipe ram and blind ram) shall be used. Alternatively an Annular Type BOP (to close in case multiple size of pipes, can be used.), for closing against drill pipe/tubing.

iii. Perforation: In case of overbalanced perforation with work over rig, ram type BOP should be installed. In case of rig less perforation (overbalanced/underbalanced) pressure tested barrier should be in place.

6.2 CONTROL SYSTEM FOR BOP:

i. All manual controls for mechanically operated blowout preventers shall be located at ground floor level at farthest possible distance as per site layout. Instructions for operating the controls shall be posted prominently near the control unit.

ii. All controls of power operated blowout preventers shall be located within easy reach of the driller on the derrick floor:

iii. All controls for blowout preventers shall be clearly identified with suitable markers.

iv. A minimum of two pump systems are required. Each pump system shall have an independent power source. These pumps shall be connected so that the loss of any one power source does not impair the operation of other pump system.

6.3 TESTING OF BOP ASSEMBLY:

i. Testing of all the blowout preventer assemblies used in CBM operations shall be conducted in accordance with the provision stipulated in OISD-RP–174.

ii. Full particulars of all tests shall be recorded in the daily report and in the case of pressure test, the pressure applied and duration of test shall also be recorded by the persons making the test. A sample BOP test data format based on OISD – RP-174 is provided at Table 1 & 2, as reference.

iii. If during any test, a blowout preventer assembly or any part thereof is found to be defective, such defects shall be rectified before resumption of normal operation of drilling or work over.

7.0 CEMENTING PRACTICES:

Cementing of a CBM well is a precise and highly complex job. It is one of the most critical phases of drilling. Cementing operations are undertaken to seal the annulus after a casing string has been run or to set a plug in an existing well. The cement slurry must exhibit certain hydraulic properties for proper placement in the wellbore while the set cement sheath must possess certain mechanical properties for long-term structural support and zonal isolation. The set cement acts as a barrier to the flow of fluids/gas from formation to other formation or to surface in a successfully drilled well. Wherever, necessary, OISD – STD – 175 “Cementing Operations” should be referred for executing a safe and reliable cementing job. Cement evaluation to be carried out using CBL-VDL tools. After logging operation, if no immediate operations are planned the well shall be suitably secured.

8.0 DRILLING CHALLENGES:

Following challenges may be encountered during drilling of a CBM well.

i. Formation caving

ii. Lost circulation

iii. String Stuck

iv. Logging tool held up
v. Fishing etc.

SOP manual shall include procedures and practices to overcome these challenges in a safe and effective manner.

9.0 HERMETICAL TESTING OF WELL:

All CBM wells after cementing operation and prior to perforation casing shall be hermetically tested to maximum anticipated surface pressure or at a pressure at least seventy per cent of casing burst pressure in case of single string or burst pressure of minimum grade & type of casing in case multiple grade strings are used or pressure rating of the Wellhead installed. Hold the pressure for 15 min. if the pressure stabilises after maximum drop of pressure up to 10% of the test pressure, the casing is tested hermetically. Bleed off the pressure in stages of 500 psi once the test is successfully completed. The safe practices are:

i. The valves should be tested to working pressure.

ii. Pressure gauges with suitable valves should be installed for release of pressure during the test.

iii. Well head assembly should be provided with suitable arrangement for recording Tubing and annulus pressure.

iv. All safe practices for operation of drilling/workover rig to be followed.

10.0 WORK OVER PRACTICES

Work over operations are carried out on wells during life of well for purpose of maintaining, restoring or increasing the productivity of well and also for the abandonment of well. Work over operations in CBM field includes:

i. Repairing/replacing down hole completion equipment

ii. Repairing liner/casing

iii. Coiled tubing assisted operations

iv. Hydraulic fracturing

v. Well clean out

vi. Installing/change of artificial lift

vii. Milling

viii. Fishing

ix. Well activation/ well testing

x. Well abandonment.

xi. Work over operations may be done with a rig or by rig less operations like slick line, wire line, e-line or coil tubing.

11.0 PRECAUTIONS DURING DRILLING, COMPLETION & WORK OVER AND OTHER OPERATIONS:

11.1 DRILLING AND WORKOVER OPERATIONS:

i. Every derrick shall be carefully examined by a competent person before it is used for drilling / well servicing operations. The derrick shall be adequately secured to prevent it from overturning.

ii. At the beginning of every shift the instruments and controls at the driller's stand, draw-works, mud pumps, casing line, cat line and blowout preventer assembly shall be examined by the driller and he shall satisfy himself that these are in good working order.

iii. The driller shall see that no person remains in a position of danger at or near the rotary table before the rotary table is set in motion.

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iv. Tools or other materials shall not be carried up or down a ladder unless properly secured to the body leaving both hands free for climbing.

v. The casing line shall not be in direct contact with any derrick member or foul with any material in the derrick excepting the crown block and any travelling block sheaves, a line spooler, all line stabilizer or weight indicator.

vi. All slings, wire ropes, D-shackle and lifting tools and tackles shall be tested at least once in a year in line with stipulation laid down in OISD-STD-187 and records shall be maintained.

vii. While cementing, no person shall be allowed on the rig floor near the wellhead or near the cementing line and equipment except those actually engaged in the operation.

viii. All high-pressure pipes fitted with flexible joints shall be suitably anchored and pressure tested before the commencement of operations.

ix. An Inside BOP/Full opening Safety Valve (FOSV) and tubing hanger shall be pre-assembled and kept readily available at the well site for immediate use in case the well kicks during pulling out or running in the tubing.

x. No well servicing operation shall be carried out at any live well unless proper blowout preventer assembly is securely installed and maintained.

xi. Before commencement of well servicing operation, the blowout preventer assembly shall be pressure and function tested.

xii. No tubing shall be pulled out of any well unless the well is properly subdued.

xiii. In case of any work over job requirement, in a producing CBM well, killing of well would require injection of large amount of water in formation. To avoid this, Stripper rubber should be fitted on top of the well head and workover operations is carried out in a low pressure live well.

xiv. Every person who works above 1.8 meter shall use shall be provided with approved type of safety belts with full body safety harness and the same unless he is otherwise protected against the danger of falling from height.

 xv. Safety line shall be of proper thickness with sufficient numbers of U-clamps in same orientation.

11.2 PERFORATION OPERATIONS:

i. Well-perforation operation using explosives shall be carried out under the direct personal supervision of an officer duly authorised for the purpose.

ii. Before commencement of perforation operation, the official shall ensure that:

a. The well is adequately filled with water/mud so as to keep the bottom hole pressure under control;

b. All well head equipment including the blowout preventer assembly is pressure and function tested and the results of the test are recorded.

c. All equipment including drilling rig, pipe rack and cable used for perforation are efficiently earthed;

d. Electrical bonding is established between equipment and well-head before connecting up explosive charges.

e. Persons not directly connected with perforation job should remain at safe distance. Area within 30m of the well should be demarcated as a danger zone.

f. At well site all operations not directly connected with perforation should be suspended.

iii. While charging of perforation guns, care shall be taken to avoid risks arising due to stray current and static electricity. For more details refer OISD-STD-183.

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iv. Well-perforation shall not be carried out under conditions of lightning, thunder, high winds and heavy rain.

v. Preferably work to be carried out during daylight time. Provision of adequate lighting to be available if the work gets extended beyond daylight time. For more details refer OISD-STD-191

vi. If perforation is carried out using CTU and sand jetting, the operations can be done round the clock.

vii. Adequate firefighting equipment shall be kept readily available at site for the whole period while well perforation operations are in progress.

11.3 WELL TESTING AND ACTIVATION OPERATIONS:

i. Before commencement of testing or activation of well, the Christmas tree and flow lines including the associated fittings shall be subjected to the maximum pressure that are likely to be encountered.

ii. Well testing shall be done under the direct personal supervision of the authorised person, he shall see that:
   a. No operation to activate the well is done during night hours;
   b. Flow lines are firmly anchored to the ground;
   c. The separator safety valve is in good working order and properly adjusted;
   d. Adequate fire-fighting equipment is readily available for immediate use; and
   e. Gas and water flow rate is tested utilising suitable gas and water flow meter.
   f. Adequate facilities are provided to safely collect the liquid well products in tanks or suitably lined pits

iii. During well testing, in the event of any gas show, immediate steps shall be taken to bring the well under control.

11.4 FRACTURING OPERATIONS:

i. Fracturing operations at a well shall be carried out under the direct personal supervision of an official authorised for the purpose.

ii. Conduct a pre-job inspection to identify and to eliminate or correct hazardous work conditions.

iii. Prior to fracturing operations, discharge pipeline up to the last valve on the wellhead shall be tested to a pressure ten per cent higher than the expected fracturing pressure.

iv. A non-return valve shall be installed in each discharge line as close to the wellhead as practicable.

v. All discharge and bleed-off lines from the well shall be securely anchored. Bleed off lines shall discharge into open tanks or to a pit with proper precautions.

vi. During fracturing operation, the official shall see that within vicinity of well
   a. No person other than those required for fracturing operation remains;
   b. No naked light or other source of ignition is permitted;
   c. Adequate fire fighting equipment is available for immediate use.

vii. The pumping units shall be located cross-wind at safe distance from the wellhead.

viii. While carrying out hydrofracturing high-pressure Frac head shall be used.

11.5 HANDLING OF CASING AND TUBINGPIPES:

Casing pipe and tubing are lowered in the well from surface to provide lining to well and to produce well fluids or to inject fluids in the well respectively. These pipes play vital role in the completion of CBM wells and its

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performance is the key factor in successful completion of the well. Any failure in inspection & handling would lead to complications in the well and in few cases even to the extent of loss of well and human life. Therefore proper field inspection & handling practice is required to eliminate any such mishap.

11.5.1 PRECAUTIONS BEFORE LOWERING OF TUBING IN CASED HOLE:
   i. The actual length of tubing string under tension should be obtained, giving due consideration to factor of elongation because of temperature and pressure.
   ii. Tubing shall be gauged before lowering into the well.
   iii. Tubing shall be tightened by giving appropriate torque.

11.5.2 PRECAUTIONS DURING PULLING OUT OF TUBING:
   i. When tubing is pulled in to the derrick, care should be taken that the tubing is not bent or couplings or protectors bumped.
   ii. Tubing set back in the rack should be properly supported in the middle to prevent undue bending.

11.5.3 SAFETY PRECAUTIONS DURING HOT WORK, WELDING & FLAME CUTTING:
Following precautions should be taken before taking up the welding job on casing pipes and tubing.
   i. Field welding may have adverse effects on various types of steels used in all grades of casing pipes and tubing unless due precautions are taken.
   ii. Welding on high strength steel should be avoided, as the heat from welding may affect the mechanical properties of high strength steel.
   iii. Welding is not recommended on critical portions of the string or sub where tension, burst or collapse strength properties are important.
   iv. Welding of Float Shoe / collar with joint shall be done only with extreme caution.
   v. Prior to taking up the welding job, the authorized person should ascertain the welder’s qualification.
   vi. Provisions of OISD-STD-105 shall be followed for all work permits.
   vii. The area to be welded should be dry and brushed or wiped, free of any excess paint, grease, scale, rust or dirt.
   viii. During welding operation, keep suitable portable fire extinguishers in the vicinity. A person shall be designated as a fire watch.
   ix. Welded joint should be put to use, after normal cooling only.
   x. During welding operation adequate precaution shall be taken to prevent fire being started by spark, slag or hot metal.

11.5.4 PRECAUTIONS AGAINST FIRE:
   i. Dead leaves or dry vegetation shall not be allowed to accumulate and combustible materials other than materials required for use shall not be stored within a distance of 15 metres from any gas well or fuel tank storage area.
   ii. Where an internal combustion engine is located within 30 metres of any well, separator, storage tank -
      a. Its exhaust pipe shall be insulated or sufficiently cooled and the end of the exhaust pipe shall be directed away from the well head; and
      b. Its exhaust manifold shall be shielded to prevent its contact with liquids or gases which might otherwise fall on it.

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c. All Vehicles/ IC engines entering into 30 mtrs of radius of well /facility shall have approved type of spark arrestors fitted on the vehicle.

iii. All plant, machinery and derricks shall be effectively earthed for dissipation of any static electric charge.

12.0 ELECTRICAL SAFETY AT RIG SITE:

i. Rig generators on land locations and all electrical equipment should be placed according to hazardous area classification.

ii. All generators should have an overload / short circuit protection device that will provide protection from shorting and burnout.

iii. Also the system to have sufficient protection against electric shock during normal operations.

iv. All electrical equipment including electric motors, generators and panels shall be properly earthed.

v. All electrical wires shall be properly secured, insulated and plugs shall be in good condition. Joints, if any, shall be placed in a safe area and be located such that it does not pose hazard due to accidental contact.

vi. All lights should be properly protected and adequate illumination should be ensured.

vii. Rig lighting and fixtures shall conform to corresponding area electrical classification.

viii. Lock out/tag out with appropriate work permit shall be issued before taking up any electrical equipment repair job. The repair job shall be performed after taking electrical isolation from the power source.

ix. Electric shock treatment chart shall be displayed in generator/electrical control room.

x. Emergency lighting system shall be available.

xi. A competent person shall be designated to be responsible for the electrical system of the installation. For more details refer OISD-STD-216

13.0 FIRE PROTECTION SYSTEM AT RIG SITE:

i. The fire protection facilities at drilling rig; work over rig shall be designed to initiate an immediate firefighting operation so as to prevent escalation into a major emergency.

ii. Suitable manual and electrical fire alarm system shall be provided and clearly marked.

iii. Firefighting equipment and accessories shall be handled with utmost care during transportation. A box/container should be provided with brackets to store hoses, nozzles, fire extinguishers to minimize possibility of damage during transportation.

iv. Water storage and pumping facility shall be sufficient to initiate firefighting for minimum 30 minutes with a portable water monitor at 1750 lpm in line with OISD-STD-189.

(a) In case HSD is required to be stored at site and is contained in a receptacle not exceeding one thousand litres in capacity, an adequate number of portable dry chemical powder or any other fire extinguisher capable of extinguishing oil fires shall always be kept in every storage shed at strategic points and all persons employed at such locations shall be conversant with the use of such fire extinguishers.

(b) In case HSD is required to be stored at site and is contained in a receptacle exceeding one thousand litres, additionally one water cum foam monitor with sufficient quantity of foam concentrate shall be kept at site in line with the requirement stipulated in OISD-STD-189.

v. Fire water system shall be designed for a minimum residual pressure of 7 kgf/cm² at the most hydraulically remotest point of application.

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vi. Being low pressure, oil free, gas environment at CBM well site, foam firefighting system and appliances are not required. In case HSD is required to be stored at site additionally one water cum foam monitor with sufficient quantity of foam concentrate shall be kept at site subject to conditions stipulated at clause no. 10(iv), above.

vii. Skid mounted or trailer type centrifugal pump of suitable capacity to deliver minimum 7 kgf/cm² pressure at remotest point for firefighting complete with accessories and suction hose shall be provided and permanently hooked up with the water tank and fire water line/hose.

viii. A skid mounted water tank(s) of minimum 53KL effective capacity shall be provided at a suitable location within the drill site, with easy accessibility to fire tenders. Suitable connection shall be provided on the tank for connecting fire tender in case of emergency.

ix. If water storage effective capacity is less than 53KL, shortfall shall be made up by water from water pit/tank. In this case it will be ensured that pumping arrangement to transfer water to the fire water tank and required quantity of water (to be transferred to fire water tank) is always available.

x. Fire water tank(s) and water tank provided for preparation of mud fluid shall be located at a safe place and always kept full of water.

xi. In case accommodation for the drilling/work over rig crew is provided at the site itself, the following provisions shall be made:

a. Accommodation area should be located in a non-hazardous area, near to exit of the drill site, generally in upwind direction.

b. DCP fire extinguishers shall be provided to adequately cover the living areas, kitchen areas and utilities areas.

c. Alarm system, to warn off-duty personnel, in an emergency.

d. In the rig emergency response plan action(s) required to be taken by off-duty personnel (like mustering at the designated locations) shall be clearly spelt out.

xii. The following firefighting accessories shall be readily available at site:

i. Fire delivery hose – 2 Nos.

ii. Additionally Fire hose – 2 Nos.

iii. Multipurpose nozzle – 2 Nos.

iv. For foam system, in case, it is used.

a) Inline foam eductor- 2 Nos.

b) Foam branch pipe – 2 Nos.

c) Foam compound – minimum 200 lts.

v. Weather-proof facility for storing above items.

xiii. A windsock shall be provided at appropriately elevated structure so as to avoid any blind spot.

xiv. Portable Fire Extinguishers shall be provided as per OISD-STD-189

**14.0 HANDING OVER TAKING OVER (HOTO) OF A CBM WELL:**

Check list shall be followed while handing over and taking over of any CBM well after drilling / work over operations. A typical HOTO format is attached at Table – 3.
SECTION – II

CBM PRODUCTION OPERATIONS

This section outlines the minimum requirement for safety in design, construction, inspection, testing, commissioning, operation, maintenance, modifications, abandonment, corrosion protection, of onshore facilities viz. well sites/ pads, well head installation, flow lines, lateral lines, gas collecting stations, compression & dehydration facilities and installations of a CBM gas field.

1.0 GENERAL

CBM wells are known to produce gas at low pressure. A number of wells have been drilled for exploiting the reservoir to a commercial level. Wells drilled to develop a CBM field on commercial basis may be vertical, inclined or horizontal. These wells are connected to GCS, for supplying gas, either through the lateral lines, collector lines or directly through the flow lines. Gas at GCS is treated for removal of water and other contaminants, (if required) like sand, coal fines etc. and is compressed before being put into gas transportation network. Produced water from individual wells flows through a separate pipeline network for further handling and treatment, if required, before routing it for final disposal.

2.0 DESIGN CONSIDERATIONS:

For the purpose of ensuring the safety of an installation, no operator shall use the installation unless the equipment on the installation is arranged in accordance with applicable regulations to:

i. Provide for the safety of personnel;

ii. Minimize damage to the environment; and

iii. Enable easy access to the equipment for inspection and maintenance.

iv. The specific facility design should be based on field requirement, availability of technology and industry practices.

v. Every installation and every component of an installation shall be designed in accordance with good engineering practices, taking into account:

a. The nature of the activities in and around the installation;

b. The type and magnitude of functional loads, environmental loads, and foreseeable accidental loads;

c. Operating and ambient temperatures;

d. Corrosion conditions that may be encountered during the construction, operation and maintenance of the installation;

e. Soil conditions.

vi. Safety, economy, operability and ease of maintenance should be considered in locating each item within the unit. Adequate spacing between equipment will help in minimizing the spread of fire. Consideration should be given to access for firefighting.

vii. The layout diagram is prepared and the inter-distance of various equipment is based on OISD-STD- 118.

viii. Equipment should be arranged in logical process sequence for optimum piping runs and operational and maintenance ease. Spacing between equipment shall be adequate for undertaking maintenance and repairs jobs. In case of any deviation Risk Assessment to be carried out and mitigation measures should be in place.

ix. Process design information should include, as appropriate, a simplified process flow diagram and acceptable upper and lower limits, where applicable for items such as temperature, pressure, flow and composition.

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x. Mechanical design information should include, as appropriate, piping and instrument diagrams, electrical area classifications, equipment arrangement drawings, design basis of the relief system, description of alarm, shutdown, and interlock systems, description of well control systems, and design basis for passive and active fire protection features and systems and emergency evacuation procedures.

xi. Process control generally refers to automatic manipulation of the process variables in order to meet the process objectives. The process control and shutdown philosophy for any CBM project should be developed keeping in mind the following objectives:
   a. All critical parameters for field operations should be possible to be controlled and monitored from the process control room.
   b. Process control system of CBM facilities shall be classified as:
      i) Regulatory control (keep process variables at steady point of operation).
      ii) Safeguarding control (brings the process to safe state when a potential hazard is detected)

xii. As per field production profile, both equipment and gathering systems will be subjected to different flow rates and pressures over the life of the well. The design should be flexible enough to operate during all phases of well life.

xiii. At a late life stage of field when the reservoir pressure depletes; provisions should be considered for installation of booster compressors, at appropriate locations.

xiv. Consideration shall be given in designing the process facilities so that the quality of gas being delivered at custody point, meets the quality specification as laid down for pipeline transportation by PNGRB.(Petroleum and Natural Gas Regulatory Board)

xv. Turndown factor: As a general philosophy, the surface production facilities should have turndown flexibility in the design, so that the equipment / instrument operability is not compromised even at the lowest flow rates that may prevail at end of the field life.

3.0 FACILITIES FOR INSPECTION AND MAINTENANCE:

i. An installation shall be designed and equipped in such a manner as to allow for the monitoring, maintenance and periodic inspection of the installation, including
   a. Clear marking and identification of the areas to be inspected;
   b. Provision for safe access to and adequate inspection space for the areas to be inspected;

ii. The equipment used in an installation are fabricated as per the relevant API/ASME/BIS requirement. The design of electrical equipment is based on the area classification in accordance to OISD- STD-113.

iii. The facilities and pipelines shall be designed in a manner that ensures adequate public safety under all conditions likely to be encountered during operating conditions.
   a. All materials and equipment shall be selected to ensure safety and suitability for the condition of use.
   b. The initial integrity of the facilities and pipelines is established through proper design, material selection and sound construction practices.
   c. After the facility has been commissioned and is in operation, a programme of condition monitoring and maintenance should be undertaken to ensure integrity is maintained.
   d. A design life shall be considered by the operator for designing various facilities and pipelines beyond which such system(s) can be considered for abandonment.

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iv. The selection of design for production facility and pipeline system shall be based on the evaluation of the properties and required flow rate of the fluid to be handled/processed/transported, together with the environment in which the facilities/pipeline is to be installed.

4.0 PRODUCTION FACILITIES

CBM gas from the field shall undergo a series of processes in order to achieve the dry gas quality as acceptable for pipeline transportation, before it is sent to the delivery pipeline. The main components of processes are:

i. Extraction from the field – Well head facility.

ii. Separation of free liquids from gas.

iii. Compression of gas for processing / delivery.

iv. Processing to pipeline specifications.

v. Gas custody transfer metering and delivery.

vi. Produced water and effluent handling facility.

vii. In addition, several utilities are also required viz. potable water, fuel gas, flare, instrument/plant air, fire water, power etc.

Following section deals with individual units of a CBM Production facility:

4.1 WELL HEAD FACILITY:

i. Each well site shall be designed for continuous operation. There should be following major equipment per well site:

a. Down hole de-watering pump

b. Separator skid

ii. Well head shut in pressure (WHSIP) should be considered for designing the well site facilities located immediately downstream of the well head.

iii. Gas is produced through the well annulus and leaves the well through a choke assembly.

a. The choke valve should be used to control the gas pressure primarily during the initial period of well flow.

b. During normal operation, the choke valve may not be necessary.

iv. The down hole Dewatering Pump (SRP/PCP/ESP) delivers produced water through the tubing string.

v. Capacity of the installed dewatering pump should be varied by varying the speed of the pump manually from the well site.

a. The dewatering pump discharge pressure shall be made sufficient to transport the water from the wellheads to gathering station.

vi. Wellhead back pressure permitted in the water gathering network shall be set below the MAOP of pipeline in water service. A safe margin of 15% should be considered on the MAOP to allow operating margin for high pressure due to gas pockets, surge effects and in order to account for elevation changes.

vii. Gas from the well head should be routed through a separator to knockoff the entrained water from the produced gas. For recovery of entrained gas in produced water, separator should be considered.

viii. A suitable gas measuring device should be installed in order to measure the gas flow rate and to evaluate the individual well performance.

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4.2 GAS GATHERING PIPELINE NETWORK:

Gas gathering pipeline network floats on the respective GCS compressor suction pressure.

i. Route selection for flow lines / pipelines should address the related issues like, topography, right of way/use maintenance, and possible land erosion, location of existing roads and likelihood of excavation & construction work near right of way/use in future.

ii. All pipelines connected to the facility should be protected against corrosion. Methods of providing such protection should be documented.

iii. Carbon steel and plastic pipelines should be tested hydraulically before they are put into operation. Pressure tests, profile surveys, and other health checks should be carried out to meet operating safety requirements for carbon steel pipelines.

iv. Check valves should be installed at each well site to prevent back flow of gas from flow line/lateral/trunk line.

v. Condensed water collected in the gas collecting network should be periodically removed through low point drains, if any, provided at critical locations and / or through pigging at regular interval in line with stipulation laid down in OISD-STD-233.

vi. A programme for periodical removal of water from the gas collecting network, excluding flow lines or lateral, through pigging operation shall be developed and implemented.

vii. Pipeline network may be either non-metallic or metallic depending upon the operating conditions requirement.

4.3 WATER GATHERING PIPELINE NETWORK:

Produced water from the wells is gathered through water gathering pipeline networks.

i. A negligible quantity of gas is expected to be separated and is vented locally above the produced water degasser.

ii. To release gas locally accumulated at high points in the water gathering networks, manual/automatic release valves shall be provided at strategic locations.

iii. Pipeline network may be either non-metallic or metallic depending upon the operating conditions requirement.

4.4 SLUG CATCHER (SC)/WATER KNOCK OUT DRUM (WKOD):

During the transportation of wet gas through the gas network, the temperature of wet gas drops and water condenses from the gas. The condensed water settles in the pipe line. The water accumulated in the pipeline needs to be periodically removed by pigging of the trunk lines.

i. The design intent of the SC/WKOD is to accommodate the water slugs during pigging and to remove the water carried along with the gas during normal operation.

ii. Dedicated pumps to transfer produced water from SC/WKOD to settling basin should be considered for installation to cater to late life operation of field when the pressure depletes.

4.5 GAS COMPRESSION:

Gas is compressed to a pressure suitable for dehydration, transportation and delivery requirements.

i. The compressor system may be screw/ reciprocating /centrifugal type.

ii. The gas compressor shall be designed and installed as per the requirements of relevant national and international standards and applicable rules and regulations.

iii. Centrifugal compressor units shall be provided with shut down and depressurisation in the event of failure of seals.

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iv. All gas compressor sheds/stations should be provided with suitable gas and smoke detectors at all strategic locations as per OMR 2017.

v. Equipment should be maintained as per the requirements of Original Equipment manufacturer (OEM) and recommended practices / standards.

4.6 GAS DEHYDRATION:

Dehydration of CBM gas is the removal of the water that is associated with gases in vapour form. Unless gases are dehydrated, water vapour may condense in pipelines and accumulate at low points along the line, reducing its flow capacity and causing corrosion problems. Water is primarily removed to meet water dew point requirement of a sales gas contract. The design intent of the gas dehydration unit is to bring down the moisture content in the dry gas suitable to meet the gas transportation specification requirement.

4.7 CUSTODY TRANSFER METERING (CTM):

Custody transfer is defined as a metering point (location) where the gas is being measured for sale from one party to another.

i. Custody transfer metering systems must meet requirements set by applicable industry bodies such as AGA, API, or ISO, and national metrology standards.

ii. CTM should be of Ultra Sonic Meter type or as permitted and approved by the regulatory authority.

iii. Meters should meet the appropriate accuracy and specified performance criteria for custody transfer or field operations management.

iv. Sampling systems should be as per OISD-STD-109. Preferably, online gas chromatograph should be provided for verification of gas composition and computation of calorific value.

4.8 INSTRUMENT & PLANT AIR SYSTEM:

Following is the philosophy that should be adopted in plant air and instrument air system.

i. The air compressor system may be screw/ reciprocating /centrifugal type

ii. Drying of compressed air is essential to meet dew point requirement of instrument air.

iii. Dew point analyser with an alarm should be installed at the dryer outlet to monitor the dew point of instrument air.

iv. Plant and Instrument Air System should have sufficient redundancy to meet any safety / process eventualities

4.9 FUEL GAS SYSTEM:

Following is the philosophy that should be adopted in Fuel Gas System.

i. The fuel gas shall meet the requirements specified by Original Equipment Manufacturer before its use in gas turbines or gas engines or other consumers. If required, the fuel gas conditioning should be provided.

ii. Adequate redundancy should be available in fuel gas supply source.

4.10 PRODUCED WATER HANDLING SYSTEM:

The water produced from CBM wells can vary in quality from field to field. Periodic water quality monitoring should be carried out.

i. In areas where the produced water quality is suitable for direct use, following options may be considered:

a. Direct discharge, storage in impoundments,

b. Livestock watering, irrigation, and dust control.

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c. Injection wells/abandoned coal mines may be utilised to dispose CBM produced water, with proper authorisation from regulatory authority.

ii. In areas where the water quality is not suitable for direct use, treatment prior to discharge shall be considered to meet the conditions stipulated by CPCB and Environmental Clearance (EC) as applicable.

4.11 OILY WATER HANDLING AND TREATMENT SYSTEM:
The configuration of system should be evaluated considering maximum oil content expected to be at the inlet, as received through oily water sewerage system e.g. compressors lube oil system etc.

i. Oil content in the treated water at the outlet of treatment system shall not be more than 10 ppm or shall be in compliance with pollution control board norms.

ii. Periodical sampling will be done of the treated water to monitor the quality of the treated water. Treated water from treatment system shall meet the specification as prescribed by the respective state pollution control board. For more details refer OISD-STD-109.

4.12 LABORATORIES:
Recommended practices for laboratories as per OISD-GDN-211 Safety in petroleum laboratory should be followed.

4.13 ELECTRICAL SYSTEM:
The GCS/compressor station shall have either captive power generation system or an alternate power supply system. Power supply to individual well pad / well sites shall be provided either by means of following:

i. Dedicated Diesel Generator sets / Gas Generator sets of adequate capacity

ii. Power distribution network from captive generation/State electricity grid.

iii. Alternate energy source.

iv. In addition, minimum one diesel generator shall be provided to meet the emergency power requirement in case of failure of normal power supply system at GCS/compressor stations.

v. These equipment should be maintained as per the requirements of Original Equipment manufacturer (OEM).

vi. Electrical equipment shall be selected based on hazardous area classification and shall comply with applicable IS, DGMS circular.

vii. Electrical motor terminal box which may be either air insulated or compound filled shall be certified by competent authority for use in applicable hazardous area.

viii. Electrical installation in well site area shall be placed by taking into consideration the hazardous area classification. Non-Ex rated electrical equipment shall be placed outside the classified hazardous area.

ix. Hazardous area classification shall be carried out in accordance with applicable DGMS Circular, CEA Regulations, IS standard, OISD-STD– 113 & OMR 2017.

5.0 GAS RELEASE & BLOW DOWN PHILOSOPHY

i. Gas release system means a system for releasing gas and combustible liquid from an installation, and includes a flare system, pressure relief system, depressurizing system and a vent system.

ii. Various credible over pressure scenarios should be analysed within GCS in such a way to ensure that, safety valves installed in the plant should be capable of handling any over pressure scenarios expected to occur during the entire plant life.

iii. Every gas release system shall be designed and located, taking into account the amount of combustibles to be released, the prevailing winds, the location of other equipment and facilities,
including rigs, the dependent personnel accommodation/offices, the air intake system, embarkation points, muster areas.

iv. Every gas release system shall be designed and installed in accordance with
   a. API-RP-520, Recommended Practice for the Design and Installation of Pressure-Relieving Systems in Refineries;
   b. OISD-STD-106: Pressure Relief & Disposal System

v. Operational and accidental emission to air should be eliminated or minimized through design.

vi. The use of the flare is considered to represent best practice for emergency release and is recommended at the GCS’s. System which cannot be connected to flare (e.g. compressor seal vents, well casing venting, analyser systems etc.) due to back pressure limitations and/or remoteness should be vented to atmosphere at a safe height.

vii. Safety valve discharge at well site can be vented at safe height. The vent of relief valve shall discharge at a minimum elevation of 3 meters above grade or the tallest structure, within a radius of 15 meters, whichever is higher.

viii. Flare stack height should be sized based on either heat radiation or dispersion plots in the event of emergency relief and shall meet regulatory requirement. However, during test production, flare-line shall terminate with the vertical rise of at least 9 metres at distance more than 30 meter from wellhead.

ix. The heat radiation limit shall be as per API- 521.

x. Every gas release system shall be designed and constructed to ensure that oxygen cannot enter the system during normal operation.
   a. Fuel gas / nitrogen will be used for purging the flare header to prevent air ingress.
   b. Suitable system should be installed and used for flare pilots operation.
   c. To ensure ignition of flare gases, continuous pilots with a means of remote ignition are recommended for all flares. The igniter panel shall be sufficiently away from flare stack and shall be provided with a canopy to protect men and equipment from liquid spill or thermal radiation.
   d. Every gas release system shall be designed to limit to the acceptable levels permitted by the respective State Pollution control board regulations the noise that may occur as the gas expands.
   e. Any vent that is used to release gas to the atmosphere without combustion shall be located and designed to minimize the risk of accidental ignition of the gas.

xi. It is further recommended that start-up and shutdown plans be developed to minimize operational emission as much as possible.

xii. Every blow down system both for gaseous or liquid stream shall be designed and installed in accordance with respective provisions of OISD-STD-106/ 109.

xiii. An updated list should be kept for all isolation valves located in relief piping system which could isolate relief valves. Documentation of the required position and reason for the lock or seal should be provided. Periodic inspection of isolation valves located in relief piping should be made.

6.0 ISOLATION PHILOSOPHY:

i. Sufficient means will be provided to ensure that positive isolation of plant facilities and well head facilities are possible where the balance of the facility can continue to operate or remain pressurized.

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ii. If spare equipment is to be isolated, the reminder of the unit must be capable of continuing to operate normally.

iii. Large complexes have many units feeding to a common flare system. Since units must be isolated from rest of the complex for maintenance, isolation valves with blinds at the battery limits of units shall be provided.

iv. The type of isolation required should identify systems where intervention during operation may be required. This determination should be based on:
   a. The need for maintenance during operation
   b. Fluid category (level of hazard involved, e.g. flammability, toxicity).
   c. Operating pressure and temperature.
   d. Frequency and duration of isolation

7.0 EMERGENCY SHUTDOWN SYSTEM:

i. Emergency shutdown system should be capable of shutting down equipment and isolate source of flammable liquids or gases. Emergency shutdown system should be designed for unit level and/or plant shutdown.

ii. An emergency shutdown system shall be designed and installed so that when activated, an audible and visual signal that provides the cause of its activation and the identity of the equipment that has been shut down and isolated is available in the appropriate operator control station.

iii. At least one of the controls of the emergency shutdown system shall be located outside hazardous areas.

iv. After an emergency shutdown, the emergency shutdown system shall stay in a locked-out condition until it is manually reset.

v. The emergency shutdown system shall be connected to a source of power in such a way that, in the event of a failure of the primary source of power, there is automatic changeover to an emergency source of power.

8.0 PIPELINES SYSTEM

8.1 PIPELINE:

i. Materials for use in the pipeline system shall comply with the design requirements and be suitable for the intended fabrication and / or construction methods.

ii. Piping shall be designed with sufficient flexibility to absorb any excessive stresses. Anchors, stops or guides shall be used to direct thermal expansion away from pumps and compressors etc.

iii. The life of facilities/ pipeline can be extended beyond the design life subject to satisfying the comprehensive integrity test.

iv. A significant factor contributing to the failure of a pipeline is the damage caused to the pipeline by activities along the route of the pipeline associated with human dwellings and commercial/industrial installations. Pipelines and its associated facilities shall be designed to meet the requirements of location Class.

v. The design of pressure piping shall comply with the ASME B31.3, 31.4, 31.8 and OISD-STD-141 and are to be maintained as per OISD- GDN-233.

8.2 ADDITIONAL ENHANCED PROTECTIVE MEASURES:

While designing the pipeline system, the design engineer shall provide reasonable protection to prevent damage to the pipeline from unusual external conditions. Some of the protective measures which the design engineer may provide are:

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i. Encasing the carrier pipe with steel casing pipe of larger diameter;
ii. Adding concrete protective coating;
iii. Increasing the wall thickness of the pipe;
iv. Lowering the pipeline to a greater depth and/or
v. Indicating the presence of the pipeline with additional warning signs/markers.

9.0 CORROSION PROTECTION:

All structural elements that are part of an installation and the failure of which as a result of corrosion would cause a safety hazard shall be protected or constructed with extra material so as to prevent the degree of corrosion that may cause that structural element to fail and shall be protected against corrosion.

i. Corrosion protection systems for installations shall be designed, installed and maintained in accordance with applicable codes

ii. All corrosion protection systems on an installation shall be designed so that adjustment, repair or replacement can be done on site, except where the corrosion protection system is a cathodic protection system that has a design life exceeding that of the installation.

iii. The pipelines shall also be protected against stray DC or AC current induced corrosion by providing metallic bonds, increased cathodic protection, supplementary protective coatings, insulating flanges or such other methods as technically required.

10.0 OPERATIONS AND MAINTENANCE:

The following basic principles should be considered for developing the overall operating and maintenance philosophy for the field:

i. Simplicity in operation and maintenance

ii. Unmanned facility at production wells. Basic dewatering pump controls to be provided with local control facility.

iii. GCS facilities should be developed as centralised monitoring and control facility with manning level commensurate with operational activity level.

iv. Equipment appurtenances, protection devices associated with the CBM system as incorporated in the design shall be tested, maintained, repaired and replaced as recommended by the manufacturer.

v. Preventive maintenance schedules shall be drawn for all equipment in accordance with manufacturer’s recommendations and established mandatory / recommendatory standards. Records of all preventive maintenance undertaken shall be maintained and updated from time-to-time.

vi. Calibration of meters/ gauges etc. shall be carried out, documented and records kept.

vii. The Functional Test of Active/ Monitor Regulator, shutdown logic/ Valve and Pressure Relief Valve for their proper operation shall be carried out as per codes and applicable regulatory requirement.

11.0 MANUAL, PLANS AND PROGRAMS FOR INSTALLATION:

Every operator shall prepare, adhere to and maintain, in respect of every installation, an operations manual that contains the following data:

i. A written facility operating procedures designed to enhance efficient, safe, and environmentally sound operations.

ii. Operating procedures, with suitable operational controls based on formal hazard identification & risk assessment.

iii. Emergency response procedures.

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iv. Limitations on the operation of the installation and its equipment, if any.
v. Information as to environmental conditions at the site where the installation is situated and/or will be installed and the effect of those conditions on the installation,
vi. Details of colour coding system used on the installation for the safety of personnel;
vii. Information on corrosion protection systems used and any requirements for the safety and maintenance of the systems;
viii. Special arrangements or facilities for the inspection and maintenance of the installation, any equipment or plant, and any POL storage facilities on or in the installation;
ix. Special precautions or instructions to be followed when repairs or alterations to the installation are to be carried out;
x. Locations of escape routes, fixed fire- extinguishing systems and life-saving appliances,
i xi. Fire divisions and the location of associated equipment,
 x ii. Location of the hazardous areas on the installation,
 x iii. Brief particulars of all the equipment on the installation, including flow sheets and instructions for the installation, operation and maintenance of the equipment;
xiv. Procedure for preparing, and the description and format for, periodic reports concerning the integrity of the installation; and
 xv. Procedure for notifying to the authorities, any incident / situation.
xvi. Every operator of an installation shall operate at all times the installation in accordance with limitations imposed by the certificate of fitness and by these Regulations and in accordance with the operations manual.
xvii. Every operator of an installation shall develop and implement an inspection and monitoring, maintenance and an integrity management program.
xviii. To update and modify the manuals/plans from time to time as experience dictates and changes in operating conditions.

12.0 TRAINING:
The management shall establish and implement training programs so that all employees including the contract workers engaged in the CBM operations are trained to work safely. The objective of training is to provide good understanding of all the facets of CBM activities including operations, procedures, maintenance and hazards and the risks associated with its handling.

i. Training shall ensure that the jobs are performed in accordance with the laid down procedures and practices.
ii. Possibility of multitasking / multi skilling of field teams should be explored for safe and efficient management of field works through proper classroom as well as on the job training. Care need to be taken such that, no statutory requirements are overlooked.
iii. Training shall be imparted to all personnel at the time of induction, which is to be followed up by periodic refresher courses.
iv. Proper records for the training and refresher courses shall be maintained.

13.0 RECORDS AND REPORTING:
The Operator shall maintain records / documents prescribed in OISD check list.

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SECTION – III

ENVIRONMENT MANAGEMENT AND SAFETY MANAGEMENT SYSTEM

1.0 ENVIRONMENT MANAGEMENT:

The recommended practices for environment management of CBM E & P operations are as follows:

i. All applicable documents related to environment protection, in the form of acts, regulations, notifications, standards, industry practices and organizational requirements should be identified, listed and applied during design, operation, maintenance and disposal stages of facilities.

ii. Functional requirements to be met as per applicable regulations and the related guidelines should be adopted by the organisation. In addition to the regulatory requirements, focus should be to reduce emissions/discharges by process design and through energy optimisation.

iii. Each CBM facility should set targets for continual reduction in use of natural resources, energy and generation of waste.

iv. Responsibilities for implementation and day to day monitoring of environment management related activities should be assigned to designated person(s).

v. Employees and contractors' workers should be trained on procedures for monitoring, controlling functions and operations that are associated with environmental aspects.

vi. The Operator shall maintain documents related to compliance to statutory obligations and should be able to demonstrate the same.

2.0 ELEMENTS OF ENVIRONMENT MANAGEMENT:

Various elements of environment management in CBM activities are given below:

2.1 EMISSION MONITORING AND CONTROL

i. Relevant emission data should be monitored at various CBM Installations.

ii. The Generator sets shall conform to Central Pollution Control Board (CPCB) standards for discharge of gaseous emissions.

iii. Flare stacks and generator exhausts shall have height conforming to CPCB guidelines.

2.2 NOISE CONTROL

i. Ambient noise levels of engines, machinery and processes shall be maintained as per The Noise Pollution (Regulation and Control) Rules, 2000 and subsequent amendments under The Environment (Protection) Rules, 1986.

ii. Exposure of personnel to noise levels in the operational areas shall be controlled in line with OMR-2017 and OISD-GDN-166.

2.3 HAZARDOUS SUBSTANCE MANAGEMENT:

i. Hazardous materials shall be stored, labelled, and disposed of as per applicable regulatory requirements “Manufacture, Storage, and Import of Hazardous Chemicals (MSIHC) Rules, 1989” and subsequent amendments under the Environment (Protection) Act, 1986. 


iii. Material safety data sheet (MSDS) shall be available for the chemicals being used. Besides properties of a particular substance, MSDS should also contain information on procedures for handling.

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iv. The relevant portion of MSDS in bilingual form shall be prominently displayed in the working areas.

v. Use of appropriate PPE should be ensured.

vi. Hazardous waste materials should not be mixed with non-hazardous wastes. If so, the entire mixture should be considered hazardous and should meet hazardous waste disposal requirements.

2.4 EFFLUENT MANAGEMENT:

i. Drilling fluid selection should be made following an environmental risk evaluation combined with operational and technical requirements under The Environment (Protection) Rules, 1986

ii. Drilling fluid, oil, waste, chemical substances or refuse from a well or facility should not be permitted:
   a. To create hazard to public health and safety;
   b. To run into or contaminate any freshwater structure or body of water or to remain in a place from where it might contaminate any freshwater or body of water; and
   c. To run over or damage any land, highway.

iii. Spill containment system should be implemented at all the operation site of the organization.

iv. Drill Cuttings (DC) separated from Water Base Mud (WBM) should be properly washed and unusable drilling fluids (DF) such as WBM should be disposed-off in a well-designed pit lined with impervious liner; located off-site or on-site. Suitable disposal methods should be employed including disposal by solar evaporation

v. Washed drill cutting may be used as filling material for levelling of site or the approach road.

vi. For on-shore disposal, the effluent shall meet the permissible limits of Oil Drilling and Gas extraction Sector specific CPCB Standard to protect the recipient environment.

vii. Produced water generated during CBM production operations should be collected in concrete water gathering ponds/basins or lined Water gathering ponds connected with single well or a cluster of wells for settling of debris and cooling.

viii. Quality of water shall be checked regularly before discharging on the surface or nearby streams, rivers to ensure that it is meeting the surface discharge criteria of CPCB and respective State Pollution control board (SPCB).

ix. In case the produced water quality fails to meet the discharge standards, suitable treatment facility shall be installed for treatment of water before discharge.

3.0 SAFETY MANAGEMENT SYSTEM:

The organization shall develop an effective Safety Management System to prevent hazardous incidents and eliminate or mitigate their consequences, emphasizing the application of management controls for tackling the risks associated with handling / working with or near to hazardous substances in CBM Exploration, production and transportation.

3.1 AS A PART OF SAFETY MANAGEMENT SYSTEM FOLLOWING SHOULD BE COMPLIED WITH:

i. All CBM operations shall be carried out under the supervision of an authorised person(s).

ii. Adequate training shall be imparted to the operators; service engineers etc. and records thereof shall be maintained.

iii. Operating personnel shall possess adequate knowledge and experience to ensure functioning of the CBM facility/ system in a safe and efficient manner.

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iv. System of periodic inspection and maintenance of CBM facilities shall be established as an integral part of operations.

v. Action in the event of emergency shall be clearly established and understood by all concerned and displayed prominently.

vi. Important operational activities shall be logged and records of such activities shall be maintained.

vii. Limits of operating parameters including level, pressure and any other condition as set for sound and safe operations shall not be exceeded. In case any abnormal operating conditions are encountered, the same shall be recorded, causes shall be investigated and corrective actions taken.

viii. The operating staff shall maintain vigilance for detection and control of any leakage.

ix. Safety audit of the CBM system shall be done once in a year as per OISD-GDN-145.

x. Certificate of fitness, declaring integrity with respect to equipment, facilities, operations & safety procedures, shall be maintained.

xi. All recommendations of the safety audit/ inspections shall be compiled in a time-bound manner and record maintained thereof.

xii. Disassembly or removal of the facilities and components of equipment whilst any part of the system is under pressure is hazardous and shall not be undertaken unless the system is depressurised, gas freed and certified.

3.2 HAZARD IDENTIFICATION, RISK ASSESSMENT AND RISK CONTROL:

i. The hazard identification, risk assessment and risk control process should be documented and should include the following elements:

   a. Identification of hazards;

   b. Evaluation of risks with existing (or proposed) control measures in place (taking into account exposure to specific hazards, the likelihood of failure of the control measures, and the potential severity of consequences of injury or damage);

   c. Evaluation of the tolerability of residual risk;

   d. Identification of any additional risk control measure needed.

ii. The operator should identify sources of risk, areas of impacts, events (including changes in circumstances) and their causes and their potential consequences.

iii. The organization should apply risk identification tools and techniques that are suited to its objectives and capabilities, and to the risks faced.

iv. Identified Risks should be ranked as per risk assessment matrix. Based on the outcome, risks should be endorsed and prioritised.

v. Quantitative Risk Assessment (QRA) study should also be considered to determine the Individual and Societal risks. For details, refer OISD-GDN-227 “Emergency Response and preparedness in E&P Industry”

3.3 PERMIT TO WORK AND CONTROL OF WORK

i. The system of permit to work shall be established for non-routine works in line with OISD-STD-105 and such works shall be undertaken with full knowledge and approval by an authorised person.

ii. No maintenance/inspection work shall be carried out without following the OISD Standard 105 on “Work Permit System” and Section 4 of OISD-STD-137 for electrical maintenance purpose.

iii. Based on the nature of work to be performed, the following minimum type of work permits shall be used:

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a. Cold Work Permit
b. Hot Work Permit
c. Confined Space Entry
iv. Electrical isolation and energisation procedure shall be established with proper authorisation matrix.
v. Self-verification process should be implemented to ensure that process of control of work is well understood at all levels and is implemented.
vi. Work permits for critical jobs shall be issued subsequent to Job safety analysis (JSA) of the individual work coupled with Tool Box talks at individual work sites.

3.4 GENERAL OPERATIONAL SAFETY:

3.4.1 PERSONAL PROTECTIVE EQUIPMENT (PPE)
i. The operation area should be assessed to evaluate the types of hazards present at the operations.
ii. Personal protective equipment for hearing, eyes, face, head, extremities, protective clothing, respiratory protection and fall protection shall be considered for use to protect personnel.

3.4.2 HOUSEKEEPING
i. Work areas should be maintained clean and free of debris and tripping hazards.
ii. Leaks or spills should be promptly cleaned up to eliminate personnel slipping and fire hazards.
iii. If personnel are required to work in a pit, it should be kept reasonably clear of water or oil accumulation. No loose equipment or materials should be in the cellar except those in use or about to be used.
iv. Escape routes shall be marked and free from any obstruction.
v. Tools and equipment should be securely placed and stored in a position or manner so they will not fall.
vi. Clear access to control devices, emergency shutdown, emergency equipment, etc., shall be maintained.

3.4.3 WORKING AT HEIGHT:
i. While working at a height of more than 1.8 meters, ISI approved full body safety harness shall be used.
ii. While working at a height of more than 1.8 meters, permit should be issued by competent person before commencement of the job.
iii. Workers should be well trained on usage of full-body safety harness including its proper usage at the time of ascending/descending.
iv. All tools should be carried in toolkits to avoid their falling.
v. If the job is on fragile/sloping roof, roof walk ladders shall be used.
vi. Lifeline shall be provided wherever required.

vi. Additional safety measures like providing Fall Arrestor type Safety belt, safety net should be provided depending upon site conditions, job requirements, steps of the ladder.

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viii. Elevated workplaces including roofs should be provided with safe means of access and egress such as stairs, ramps or ladders. For more details refer OISD-GDN-192.

3.4.4 LOAD LIFTING:
Following precautions should be taken before taking up any lifting job:

i. The manufacturer’s rated load capacity shall not be exceeded on cranes or other load lifting devices.

ii. Equipment should be operated and maintained in accordance with manufacturers’ recommendations.

iii. Tag lines should be used to guide and steady all loads being lifted.

iv. Use proper lifting means.

v. Hoist slowly to limit equipment momentum.

vi. Seek assistance when moving irregular shaped and heavy loads.

vii. Use mechanical lifting aids, proper lifting techniques and team lifting where appropriate.

viii. Use proper hand and body positioning.

ix. It shall be ensured that personnel do not come under suspended load.

x. Hook used for lifting should be equipped with a safety latch.

xi. Webbing strap slings’ use and maintenance should be as per manufacturer’s recommendations.

xii. Wire rope slings should be used and maintained as per OISD-STD-187 on ‘Care and Use of Wire Rope’

3.4.5 LOCKOUT / TAG OUT:
A lockout/tag out program shall be established to control hazardous energy as follows:

i. Locks and/or tags should be placed to clearly identify the equipment or circuits being worked on. Systems locked or tagged should include the identity or job title of person installing the lock or tag.

ii. Personnel should be trained and disciplined in the use of this system to prevent unexpected operation of any equipment that stores any type of energy that might inflict injury to personnel.

iii. The lock or tag should be removed by the person who installed it. In the event the individual is not available, the lock or tag may be removed by the supervisor after ensuring that no hazard will be created by energizing the locked or tagged equipment or circuit(s).

3.4.6 CONFINED SPACE AND HAZARDOUS ENVIRONMENTS:
Confined space hazards should be identified for all facilities in the workplace and safe work practices should be established for working in the confined spaces.

i. When preparing the confined space for entry ensures positive isolation, precautions must be in place to ensure space remains safe during the entire period of work. This may include forced air ventilation, equipment isolation or other measures.

ii. For equipment isolation, consideration should be given to blinding, double block and bleed, or other equipment and energy isolation controls.

iii. A confined space entry permit is required for the protection of personnel entering a confined space such as vessels, boilers, storage tanks, large diameter piping etc. against hazards such as oxygen deficiency, toxic and flammable materials, falling objects, power-driven equipment etc.

iv. Lifeline shall be provided wherever required.

3.4.7 WORK IN PROXIMITY TO EXPOSED ENERGIZED POWER SOURCES:

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i. Neither equipment nor machines on rigs (includes guy lines) shall be operated closer to power lines than the recommended minimum clearances, except when such lines have been de-energized and visibly grounded or when barriers are present to prevent physical contact with the lines.

ii. An individual should be designated to observe equipment clearance. The operator should notify the observer if he is having any difficulty in determining the clearance. The observer should sound a warning at any time the clearance is not maintained.

iii. Overhead wires should be considered energized (live) unless either the electrical system owner reports them to be non-energized, or a qualified electrical person tests and finds them to be non-energized.

3.4.8 ELECTRICAL HAZARDS:

i. The following is a list of a common electrical hazards:
   a. Improper grounding
   b. Static electricity
   c. Exposed electrical parts
   d. Inadequate wiring
   e. Overhead power lines
   f. Damaged insulation
   g. Overloaded circuits
   h. Wet conditions
   i. Damaged tools and equipment

ii. The recommended practice require that certain approved testing organizations test and certify electrical equipment before use in the workplace to ensure it is safe.
   a. Electrical equipment used in hazardous locations should be designed for such locations, and tested or approved by a nationally recognized testing laboratory.
   b. All wiring components and electrical equipment should be installed and maintained in accordance with the applicable standards/codes and manufacturer’s recommendation.
   c. Hazardous Area Classification and selection of electrical equipment shall be in accordance with latest applicable DGMS Circulars, OMR 2017, CEA 2010 and OISD 113.
   d. Electrical installations in hazardous locations which are to remain in operation during emergency shall be designed to conform to Zone 1 hazardous area classification
   e. All generators should have an overload and short circuit protection
   f. Wherever temporary lights need to be provided it should be in compliance with hazardous area classification.
   g. Repairs to electrical equipment shall be performed by authorised person after ensuring the power source has been isolated as per isolation procedures.

4.0 EMERGENCY ELECTRICAL POWER SOURCE:

i. Every installation shall have an emergency source of electrical power that is independent of the primary source of electrical power and that is capable of supplying electrical power sufficient to operate, the following equipment:
   a. All lights referred to in subsection (ii);
   b. All gas detection and alarm systems;

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c. All fire detection and alarm systems;
d. All firefighting systems except any fire pump that is driven by a liquid fuelled combustion engine;
e. The general alarm system and all internal communication systems;
f. The emergency shutdown system referred to in section 7;
g. All radio communication equipment necessary to comply with the contingency plans.

ii. Every installation shall be equipped with lights supplied by the emergency source of power described in subsection (i), in the following locations:
   a. Every escape route and area containing escape route markings;
   b. The control room;
   c. All spaces from which the drilling and production operations are controlled and at which controls of machinery essential for the performance of those operations and devices for the emergency shut-down of the power plant are located;
   d. the stowage positions for firefighting equipment;
   e. Each fire pump
   f. The radio room.

iii. Where the emergency source of electrical power required by subsection (i) is a mechanically driven generator, the installation shall be provided with:
   a. a transitional source of electrical power,
   b. a self-contained battery system designed to supply sufficient power, automatically on failure or shutdown of both the primary and the emergency sources of electrical power, to operate, the equipment described:
      i) the lights located in every control room
      ii) the internal communication system and the general alarm system, and
   c. The battery system referred to in paragraph (b) above shall be capable of returning to the trickle charge state on the restoration of the primary or emergency source of electrical power.
   d. The emergency source of electrical power required by subsection (i), shall be designed to supply electrical power automatically, on the failure of the primary source of electrical power, to a switchboard that is designed to direct the power to the equipment listed in that subsection.

5.0 COMMUNICATION SYSTEMS:
Every installation shall be equipped with a communication that includes:
   i. The communication systems shall be operational at all times.
   ii. The operator of an installation shall ensure that the radio communication systems comply with the relevant applicable rules and Radio Regulations.
   iii. All intermediate stations along the pipeline route including IP stations / Repeater station shall be provided with the proven communication system.
   iv. Security at the unmanned stations should be trained to deal with communication and emergency handling.

6.0 GAS DETECTION SYSTEMS AND ALARM PANELS:
Every installation shall be equipped with a fire or gas detection system in accordance with OISD-STD-189, OISD-STD-173.

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i. The system shall be capable of detecting, in every part of the installation in which any type of hydrocarbon gas may accumulate, the presence of those gases that includes:
   a. one or more fire and gas detector indicator panels located at the control station, which
      i) indicate the source of fire and gas by means of a visual signal,
      ii) are capable of being functionally tested, and
      iii) are fitted with equipment for resetting the fire and gas detection systems; and
   b. An audible and visual fire and gas alarm that has a characteristic tone and colour that distinguishes it from the alarms associated with machinery, safety and control system faults or any other alarm system.

ii. Every installation shall be equipped with
   a. At least two portable gas detectors capable of
      i) measuring the concentration of oxygen, and
      ii) detecting any type of hydrocarbon gas
   b. A means of testing the portable gas detectors described in paragraph (i) above or it shall be ensured that the portable gas detectors are calibrated and labelled at the defined interval.

7.0 FIRE FIGHTING AND SHUTDOWN SYSTEM:

For the protection of the human life, equipment and the safety of the surrounding areas, the Operator shall install necessary fire protection arrangement in the operational area of CBM exploration, production and distribution. While making the system, due consideration should be given to the nearby facilities as well as fire services.

i. Design criteria of any firefighting system would depend upon the type of installation involved.

ii. Isolatable sections should be identified in the installations and Consequence Analysis should be carried out to identify the damage distances / vulnerable areas in case of Jet Fire, Flash Fire, Pool Fire and Explosion.

iii. The fire protection system shall be designed based on single fire scenario.

iv. The basic design criteria for a fire protection system should be such that to initiate the firefighting operation before the mobile fire tenders reach at the site to provide backup service.

v. Fixed Fire Protection system including fire water storage, pumping arrangements, header pressure, hydrants and monitors should be provided in accordance with OISD – 189, it should be ensured that all the critical areas are covered.

vi. All the areas within the installation facility shall be accessible to the fire tender.

vii. Detection of confirmed fire should lead to unit and/or plant shutdown and blowdown of the trapped gas to flare.

viii. Automatic fire Sprinkler System with Deluge valve might be considered for the compressor area / any other critical locations.

ix. Automatic fire Suppression System using clean agents/aerosol based extinguishing media might be considered for the enclosures.

8.0 GENERAL ALARM SYSTEM:

i. Every installation shall be equipped with a general alarm system that is capable of alerting personnel to any hazardous conditions other than fire or gas that might;
   a. endanger the personnel;

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b. endanger the installation; or

c. Be harmful to the environment.

ii. Every general alarm system referred to in subsection (i) shall be

a. operational and in operation at all times other than when the system is being inspected, maintained or repaired;

b. Designed in such a manner as to prevent tampering.

iii. Where a general alarm system for an installation is being inspected, maintained or repaired, the operator of the installation shall ensure these functions can be operated manually also if required.

9.0 EMERGENCY RESPONSE AND CONTROL PLAN:

Every Operator shall frame an Emergency response and control plan. It should provide clear written procedures for expected actions including operational and procedural requirements during various anticipated emergency scenarios and are ready for immediate implementation. The emergency plan shall contain:

i. The appropriate emergency response team composition clearly stating the line of command and the responsibilities of each person involved in case of emergency situations;

ii. Equipment plan clearly stipulating the equipment’s make and type, capacity, location, correct operation and field of operation;

iii. Action plan clearly stipulating –

a. alarm and communication system,

b. system of notifying the authorities,

c. the duties and responsibilities of each key personnel including measures to be adopted to avert or minimise the consequences of the emergency,

d. when and how the equipment shall be used and when and how the action shall be carried out, and help or information that would be available from associated and external agencies including government agencies,

e. guidelines for terminating the action; and

iv. Plan for training of personnel and for mock-drills.

v. Emergency drills and exercises. An analysis and critique of each drill and exercise have to be documented to identify and correct weaknesses.

vi. The emergency response plan shall be reviewed and revised as appropriate in line with the findings from drills and exercises.

10.0 MEDICAL FACILITIES:

i. A well-defined and documented company policy should be in place to address the issues pertaining to medical requirements, facilities and emergency medical care including Evacuation procedure. For further details OISD-GDN-204 “Medical Requirements, Emergency Evacuation and Facilities (for Upstream)” is to be followed.

ii. Medical aspects at rig site: Drilling/work over jobs is frequently done at remote locations/areas where medical aid is not readily available. In view of the above,

a. It is strongly recommended that all employees undergo training in first aid. At least one person who is trained and certified in first aid and basic rescue techniques shall be available in each shift.

b. The information and location of first aid kit should be known to all personnel.

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c. An adequate and approved first aid kit shall be provided on each rig and should be conspicuously located. The first aid kit should have all medicines, as recommended.

d. Posters demonstrating techniques (like cardiopulmonary resuscitation, stopping bleeding) and first aid should be displayed at workplace.

e. Emergency vehicle at the site shall have the provision to shift injured person on a stretcher to nearby medical centre or alternatively an ambulance should be available.

f. Well stimulation team shall be equipped with necessary first aid kit and trained personnel, to take care of eventualities when it is working on a stand-alone basis at sites.

11.0 MISCELLANEOUS:

11.1 WINDSOCK:

Windsock shall be provided on an appropriately elevated structure like the control room / fire-water pump house in such a manner so as to avoid blind areas.

11.2 PIPELINE MARKERS:

i. Route markers shall be placed on the entire pipeline at a distance such that two such markers shall be visible from any point along the route.

ii. Additional sign/ markers shall be installed to indicate the presence of a pipeline at bends, road, highway, railroad, stream crossings and locations where there is a probability of damage or interference.

iii. A marker shall be marked in easily readable local language with at least the following:
   a. Name of company
   b. Contact telephone number(s) in emergency.
   c. Location code
   d. Warning- “High-Pressure Gas Line” etc.

11.3 SAFETY WARNING SIGNS:

i. The Safe Work Instructions (in bilingual) should be displayed at various strategic locations within the installation.

ii. “No Mobile phone”, “No smoking sign”, “No lighter / matches” signboard shall be displayed prominently in the operational area.

iii. Do’s and Don’ts, safety precautions, emergency telephone nos. shall be displayed at relevant locations.

iv. Storage area and containers of toxic, corrosive, flammable, poisonous and radioactive material shall be properly labelled and appropriately stored according to content.

v. Warning signs shall be posted to denote any hazardous situation.

vi. Warning signs shall be posted in areas where the use of personal protective equipment is required.

vii. Identification signs shall be conspicuously posted to locate emergency equipment and directions of escape route.

viii. Pipelines carrying steam or fluid at high pressure shall be conspicuously identified.

11.4 FENCINGS:

i. The well site facility including Christmas tree provided on a well on land shall be kept securely fenced with access gates securely locked.

ii. The protected area surrounding every drilling or workover installation, Production installation shall be provided with fence of not less than 1.8 metres in height.

iii. Precautions shall be taken to prevent any unauthorised person from having access to any place which has been duly fenced.

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SECTION - IV
WELL CLOSURE & ABANDONMENT

Abandonment and site restoration (ASR) is one of the activities in the Oil & Gas life cycle project which is the final phase of closure activities. The primary activity of ASR is the implementation of well plugging and abandonment as well as decommissioning facilities including pipelines and restoration of the site.

1.0 TEMPORARY CLOSURE OF WELL:

i. When it is intended to temporarily close any producing well for a period exceeding 30 days, the valves of the Christmas tree/tubing head assembly shall be completely closed and wheels shall be removed.

ii. The Christmas tree/tubing head assembly shall be examined for leakage once in 30 days by a competent person authorised for the purpose. In case any leakage is detected during such examination the competent person shall take immediate steps to stop it.

iii. A report of every such examination shall be recorded for the purpose and shall be signed and dated by the person making the examination.

2.0 ABANDONMENT OF WELL:

When it is intended to abandon a well, OISD-STD-175 & OISD–RP-238 is to be followed.

3.0 SITE RESTORATION:

Petroleum sharing contract provides for the site restoration after cessation of petroleum operations where proper abandonment of wells or other facilities, removal of equipment, structure and debris, replacement of top soil, re-vegetation, slope stabilisation, infilling of excavation or any other appropriate actions in the circumstances are to be carried out by the Operator. In this regard, the applicable guidelines, as issued by MoEF, Govt. of India and DGH site may be referred.
ABBREVIATIONS:

API : American Petroleum Institute
BIS : Bureau of Indian Standards
CBM : Coal Bed Methane
CEA : Central Electricity Authority
CTM : Custody Transfer Meter
ISO : International Organization for Standardization
KO Drum/KOD: Knock Out Drum
MoEF : Ministry of Environment and Forest
OISD : Oil Industry Safety Directorate
OEM : Original Equipment Manufacturer
OMR : Oil Mines Regulations

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References:
1. Oil Mines Regulations, 2017
2. OISD-STD-105 – Work Permit System
3. OISD- STD-106 Pressure Relief and Disposal system
5. OISD-STD-113 – Classification of Areas for Electrical Installations at Hydrocarbon Processing and Handling Facilities
6. OISD-STD-141 – Design and construction requirements for cross country liquid hydrocarbon pipeline
7. OISD-STD-118 - Layouts for Oil and Gas Installations
8. OISD-STD-191 – Oil Field Explosive Safety
9. OISD-STD-173 - Fire Protection System for Electrical Installations
10. OISD-STD-187 – Care and use of wire rope
11. OISD-STD-189- Standard on Firefighting Equipment for Drilling Rigs, work over Rigs and Production Installations
12. OISD-RP-238 - Well Integrity
14. OISD-GDN-211 – Safety in Petroleum Laboratories
15. OISD-GDN-192 – Safety Practices During Construction
16. OISD-RP-174 - Well Control
17. OISD-STD-154- Safety aspects in functional training
18. OISD-STD-176 – Safety Health & Environment Training for Exploration & Production (Upstream) Personnel
19. OISD-GDN-166 - Guidelines for occupational Health Monitoring in Oil and Gas Industry
20. OISD-STD-114- Safe handling of Hazardous Chemicals
22. OISD-GDN-227 – Emergency Response and preparedness in E&P Industry
23. OISD-STD-216 – Electrical Safety In onshore Drilling and Work over Rigs
24. OISD-STD-175- Cementing Operations
25. OISD-GDN-204 – Medical Requirements, Emergency Evacuation and Facilities
26. OISD-STD-137 – Inspection of Electrical Equipment
27. OISD-GDN-233 - Guidelines on Inspection of Non Piggable Pipeline
28. PNGRB: Petroleum and Gas Regulatory board
32. ASME-B31.8 - Gas Transmission and Distribution Piping Systems 2010
Figures and Tables

Fig - 1 Simplified schematic of a CBM well

"OISD hereby expressly disclaims any liability or responsibility for loss or damage resulting from the use of OISD Standards/Guidelines."
Fig - 2 Typical Schematic- Annular BOP set up for drilling
Fig - 3 Arrangements for 2000 psi Surface BOP Stack (Source: OISD-RP- 174), if Ram type BOPs is used in CBM workover operation.
TABLE - 1
BOP FUNCTION TEST REPORT AND ACCUMULATOR DRILL
(As per OISD-RP-174)

RIG: ___________________________ DATE: ___________________________
WELL: ___________________________
BOP STACK DETAIL (as applicable):
1. Annular BOP -
2. Single / double / triple ram type BOP -
3. Upper pipe ram size -
4. Lower pipe ram size -

<table>
<thead>
<tr>
<th>S. NO</th>
<th>DESCRIPTION</th>
<th>FUNCTION CLOSED /OPEN</th>
<th>TIME (SECONDS)</th>
<th>ACCUMULATOR INITIAL PRESSURE - psi</th>
<th>ACCUMULATOR FINAL PRESSURE - psi</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>Annular Preventer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02.</td>
<td>Lower pipe ram</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>03.</td>
<td>Upper pipe ram</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>04.</td>
<td>Blind / shear ram</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>05.</td>
<td>Hyd. Valve on choke line</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>06.</td>
<td>Hyd. Valve on kill line</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N.B.
01. Conduct BOP function test/accumulator drill once in a week
02. Follow.  
   a) Record initial accumulator pressure  
   b) Turn off both electric and pneumatic pumps  
   c) Close annular and pipe rams one by one and record time to close each preventer  
   d) Open the hydraulic Valve on choke line and kill line  
   e) Open pipe ram to compensate for blind ram close  
   f) Record the final accumulator pressure after each operation  
   g) Turn on electrical/ pneumatic pump and open all the preventer. Record the opening time.
03. Carry out function test alternatively from rig floor panel/auxiliary panel/main control unit.
04. Final accumulator pressure should be not less than 1200 psi or 200 psi above pre charge pressure of accumulator bottles.
05. Special attention needed to address the following:

SIGNATURE: ___________________________ SIGNATURE: ___________________________
NAME: ___________________________ NAME: ___________________________
SHIFT INCHARGE/ DRILLER: ___________________________ DIC/TOOL PUSHER: ___________________________

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### Table – 2

**BOP PRESSURE TEST REPORT**

(As per OISD – RP- 174)

<table>
<thead>
<tr>
<th>RIG:</th>
<th>WELL NO.:</th>
<th>DATE:</th>
<th>TEST FLUID:</th>
<th>TESTING EQUIPMENT-</th>
<th>TEST PUMP/CEMENTING UNIT:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>TYPE OF BOP</th>
<th>TEST PRESSURE &amp; DURATION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LOW PRESSURE psi</td>
<td>DURATION minutes</td>
<td>HIGH PRESSURE psi</td>
</tr>
<tr>
<td>1</td>
<td>Annular BOP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Upper pipe ram (size.....)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Lower pipe ram (size.....)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Blind ram/shear ram</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Choke manifold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Kill manifold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Hyd. Valve on choke line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Hyd. Valve on kill line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>HP valves on choke &amp; kill manifold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Upper Kelly cock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Lower Kelly cock</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>FOSV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Inside BOP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**N.B.**

01. Keep annulus valve open on wellhead when test plug is used during test & check for any Leakage during BOP testing.
02. Testing line should be flushed with clean water before pressurisation.
03. Special attention needed to address the following:

**SIGNATURE:**
**NAME:**
**SHIFT INCHARGE/ DRILLER:**

**SIGNATURE:**
**NAME:**
**IC/ TOOL PUSHER:**

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## Table - 3
Well Handing over Taking over Format

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>DESCRIPTION</th>
<th>DETAILS GIVEN BY DIC</th>
<th>REMARKS BY DIC</th>
<th>DIC / IM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cleared well depth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pump details</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>NTT Setting depth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>PID Setting Depth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Float Collar Depth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Float Shoe Depth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>BHA Details and schematic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Well Head pressure test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Tubing tally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Sucker rod tally</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Sucker rod guide &amp; Sleeve</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Pump start date and Time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Test run parameters</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Rig release date and time</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Site cleared on</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:**

Drilling Engineer

Production Engineer

DIC

IM

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