STANDARD ON LOGGING OPERATIONS

First Edition, June 1999
Revised Edition, October 2013

Prepared by

Functional Committee on “Logging 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 Ministry of Petroleum and Natural Gas, Government of India as a knowledge centre 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 25 years 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 stake-holders – 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 old 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 technology 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 stake holder organizations, which we, at OISD, fervently look forward to.

Jai Hind!!!

Executive Director
Oil Industry Safety Directorate
FOREWORD

The Oil Industry in India is more than 100 years old. Because of various collaboration agreements a variety of international codes and standards have been in vogue. Standardization in design philosophies and operating and maintenance practices at a national level was hardly in existence. This coupled with feedback from some serious accidents that occurred in the recent past in India and abroad, emphasized the need for the industry to review the existing state-of-the-art in designing, operating and maintaining 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 safer operations. Accordingly, OISD constituted a number of committees of experts nominated from the industry to draw up the standards and guidelines on various subjects.

OISD-STD-183 on “Logging Operations” was prepared in 1999. Since then, many new techniques, processes and related safety aspects have evolved in the field of Logging. Thus this standard was taken for revision. This document is based on the accumulated knowledge and experience of industry members and various national and international codes and practices. It is hoped that the provision of this document, if implemented objectively, may go a long way to improve the safety and reduce accidents in logging operations. Suggestions for amendments to this document should be addressed to:

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NOTE

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These documents are intended to supplement rather than replace the prevailing statutory requirements.
Functional committee  
(Second Edition - 2013)

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Inputs on industry practices / comments on standard obtained from:

- Schlumberger Asia Services Limited
- Reliance Industries limited
- Joshi Technologies International Inc.

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1.0 INTRODUCTION

Logging operations involve usage of various kinds of explosives & radioactive sources, heavy & complex downhole tools and surface equipment at base as well as at the drill site, both offshore and onshore on a regular basis.

Explosives and radioactive sources are potentially hazardous materials and the user must know and follow approved safety procedures. It has been found that human error is the principal cause of accidents involving explosives and radioactive materials. Also improper handling of logging tools and equipment can result in unsafe activities and lead to accidents.

The objective of this standard is to provide comprehensive guidance on safety aspects of logging operations. The safety guidelines are based on long field experience or are statutory requirements.

2.0 SCOPE

This standard prescribes the safe practices and procedures to be followed during following operations in onshore as well as offshore areas:

1. Wireline logging operations including Radioactive logging
2. Formation Testing
3. Logging While Drilling /Measurement While Drilling
4. Perforation Operations- both wireline and tubing conveyed
5. Bridge Plug/ Packer /Cement Retainer setting
6. Puncture / cutting / severing of casing, drill pipes & collars, tubing etc.
7. Side wall coring
8. Free point Indicator / String shot
9. Storage, transportation & safe handling of explosives
10. Storage, transportation & safe handling of radioactive materials.
11. Disposal / liquidation of non usable explosives and radioactive materials.

New technologies are being developed in the field of logging to provide better tools and techniques with increased operational efficiencies. These may not be specifically addressed in this standard. For such systems, potential failure modes and their consequences should be identified and controls put in place to ensure safe logging operations.

Security aspects of explosives and radioactive active materials are beyond the scope of this standard.

3.0 DEFINITIONS & ABBREVIATIONS

Arming: The process of mechanically or electromechanically attaching a detonator or initiating device to a loaded explosive device.

Curie: The unit of measurement of radioactivity which is equal to 3.7 x 1\(^{10}\) Becquerel (Becquerel is SI unit which equates to one decay per second).

Minitrion Tube: A minitrion tube is a particle accelerator that yields 14 MeV neutrons when it is operating. The minitrion tube contains Deuterium and Tritium. When a short duration control pulse is applied to a ring magnet surrounding the gases, the gases are ionized. At the same time, a high negative voltage is applied to a target located at the other end of the tube. The positive ions produced by the Deuterium and Tritium bombard the target, generating a nuclear reaction. These tubes are used in Pulsed Neutron type down-hole tools and need recharging after 100 - 120 hours of operation.

Occupational Dose: Includes exposure of an individual to radiation (1) in a restricted area; or (2) in the course of employment in which an individual's duties involve exposure to

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radiation; provided that "occupational dose" shall not be deemed to include any exposure of an individual to radiation for the purpose of medical diagnosis or medical therapy of such individual.

**Primary High explosive:** A very sensitive explosive compound used as the first material in an explosive train that is initiated by the appropriate application of flame, friction, heat, impact or spark.

**Radiation Area:** An area accessible to personnel, in which there exists radiation, originating in whole or in part within licensed material, at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 mRem, or in any 5 consecutive days, a dose in excess of 100 mRem (1 mSv).

**Radiation Safety Officer:** An individual engaged in the practices of providing radiation protection to radiation workers in an organisation. He is the representative appointed by the licensee for liaison with the AERB (Atomic Energy Regulatory Board).

**Radioactivity:** A property of unstable isotopes which undergo spontaneous atomic readjustment with the liberation of energy (e.g. alpha or beta particles, or gamma rays). The loss of energy will result in the decay of transformation of the unstable isotope into a stable isotope; or, transmutation into an isotope of another element.

**Radioactive source:** A radioactive isotope alone or in combination with another element or isotope, hermetically sealed in an encapsulated container used in logging operations to obtain collimated or omni directional radioactivity.

**Roentgen Equivalent Man** (mammal): is a unit of radiation dose that is product of Radiation Absorbed Dose and the quality factor which accounts for the effectiveness of the radiation to cause biological damage. 1 REM = 0.01 Sv.

**Safety Switch:** A keylock safety switch with a properly secured single key, normally inside the logging unit, which isolates all power from the wireline prior to attachment of an explosives device.

**Safety Tube:** A tubular vessel used to contain the detonator during electric arming which is designed to contain the fragments and most of the ballast, should the detonator functions inadvertently.

**Sealed Source:** A by-product material that is encased in a capsule designed to prevent leakage or escape of the by-product material.

**Secondary High explosive:** A high explosive that is less sensitive than a primary explosive to heat and shock.

**Shall:** The word ‘shall’ is used to indicate that the provision is mandatory.

**Should:** The word ‘should’ is used to indicate that the provision is recommendatory as per sound engineering or industry practice.

**Sievert:** is the SI unit of measurement of radioactivity and defined as 1 joule per kilogram. 1 Sievert is equal to 100 Rems.

**Survey Meter:** A portable instrument which measures dose rate of exposure or radiation intensity.

**Thermo Luminescent Dosimeter:** A device that uses electron or hole trapping in organic crystals for recording and integrating radiation dose. Materials exhibiting thermo-luminescence in response to ionizing radiation include but are not limited to Calcium Fluoride, Lithium Fluoride.

**Wipe Test:** A test to determine whether a sealed radioactive source is leaking or not. In this test, a wet or dry swab is used to rub on the suspected clean source housing and its radiation level is measured with a radiation monitoring instrument.

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ABBREVIATIONS:

AERB: Atomic Energy Regulatory Board
BARC: Bhabha Atomic Research Centre
BOP: Blowout Preventer
Bq: Becquerel
Ci: Curie
DGCA: Directorate General of Civil Aviation
ER 2008: Explosives Rule, 2008
H₂S: Hydrogen Sulphide
MeV: Million electron Volt
NACE: National Association of Corrosion Engineers
OEM: Original Equipment Manufacturer
OISD: Oil Industry Safety Directorate
REM: Roentgen Equivalent Man
RPAD: Radiological Physics and Advisory Division of BARC
RSD: Radiological Safety Division of AERB
RSO: Radiation Safety Officer
Sv: Sievert
TLD: Thermo Luminescent Dosimeter

4.0 STATUTORY REQUIREMENTS

In India, use of explosives in oil & gas industry is governed by the Chief Controller of Explosives, Petroleum and Explosives Safety Organisation (PESO), Nagpur and use of radioactive sources is governed by the Atomic Energy Regulatory Board (AERB) & Bhabha Atomic Research Centre (BARC), Mumbai.

In general, all offshore oil and gas activities are governed by the Petroleum and Natural Gas (Safety in Offshore Operations) Rules, 2008 which are regulated by the Oil Industry Safety Directorate.

Occupational health, safety and welfare of employees working in onland oilfields is regulated by Director General Mines Safety, Dhanbad.

5.0 LOGGING OPERATIONS

5.1 Safety Guidelines

The following safety guidelines shall be followed:

1. Use Personal Protective Equipment (PPE) appropriate for the job to avoid injury-
   • Safety glasses for eye protection

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• Ear plugs for hearing protection
• Steel toe shoes for feet protection
• Coveralls for body protection
• Hard hat for head protection
• Gloves for hand protection
• Monitoring badge for radiation
• H₂S monitor (personal detector)

2. Use properly rated equipment (winches, slings, etc.) when lifting logging tools and equipment.
3. Use appropriate stepping, handling and lifting techniques. Do not hesitate to ask for help when moving heavy equipment.
4. Avoid rushing because hazards may get ignored or overlooked while doing so. The time saved is rarely worth the increased risk of accident.
5. If a given task or operation of any equipment is not known, or there are any doubt about the safety aspects involved, the supervisor shall be consulted for help.
6. Keep loose clothing, rags, or any such objects away from moving parts, such as the winch drum, depth counter, and drive chains.
7. Radioactive source shall never be left unattended in the workshop. Always place it in its carrying shield and return it to the storage pit immediately after use.
8. All pressure control equipment shall be periodically tested to their respective working pressure in the designated area which should be provided with baffling (impenetrable) facility to provide protection in case of accidental pressure release.
9. Temperature testing of down hole tools shall be carried out only in recommended oven in a designated area.

10. Only authorized trained persons shall be deployed in handling of radioactive materials.

5.2 Responsibilities of Contractor and Operator

In case an oil & gas operator awards a contract for radiological operations, the contractor shall agree in writing that he has understood the contents of this document i.e. OISD STD-183 on ‘Logging Operations’ as well as the Atomic Energy Act, 1962 and the Explosive Rules 2008 Rules and that he shall abide by the same. This statement shall be made a part of contract so that the contractor is fully aware of the detailed stipulations which have to be followed. The operator awarding the contract and the contractor shall be jointly and separately responsible for the safe handling and security of the radio-active sources, during all phases of oil and gas operations including storage, transport, usage and disposal.

It shall be the responsibility of the contract awarding operator to inform AERB of any change in the contractors, location of the sources and any emergency incident or situation.

5.3 Safety at the Wellsite- Onshore, Offshore

1. Upon arrival at the wellsite –
   • Report immediately to the person in charge. Take an orientation tour of the rig and learn the location of the work areas.
   • Understand all emergency signals, muster stations, escape routes, smoking areas and site safety rules.
   • Ensure that the rig alarms can be heard clearly while inside the logging unit.
   • Attend all rig safety meetings and drills.

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2. Conduct specific Joint Safety Analysis (JSA) meeting prior to operations.
3. Take logging Permit to Work (PTW) before carrying out any logging job.
4. Equipment, cables, air hoses etc. shall not be kept at places where they may block emergency escape routes, walkways, stairs or access to safety appliances.
5. Keep all waste, particularly combustible waste, in containers.
6. Place containers for combustible material away from any combustion source (e.g. welding equipment, electric motors, etc.). Empty such containers daily.
7. Clean up oil and chemical spills immediately with sawdust / detergent as required.
8. Report any accident or anything hazardous affecting safety to the person in charge.
9. Ensure that good communication link with fellow team members and rig personnel is established
10. Logging persons should not go to the rig floor unless required and leave as soon as the work is complete.

For offshore areas

1. A barge, semi submersible or drill ship is in constant motion, which can affect individual’s sense of balance and may cause nausea.
2. Tie down all tools, equipment etc. - anything that can fall or roll due to motion of the barge.
3. Always use hand rails on stairs and ladders.
4. At many off-shore installations, space and hence working area are limited. Never compromise with safety, regardless of unusual rig-ups and cramped working areas.
5. Keep the skid of the unit chained, pinned, or welded down so that it cannot move during operation.
6. Each lifting sling and chain shall be certified to its working load.
7. Ensure proper communication system between logging unit and derrick floor.
8. During usage of explosives, communication must be done through verbal command only. Do not use radio system to avoid potential from electromagnetic field created by radio transmitters.
10. Dispose of dangerous substances by returning them to the base in proper approved containers.

5.4 Electrical set-up

Ensure that all power supplies within the unit are properly grounded to prevent floating voltages or ground loops, which can damage the equipment. The grounding leads shall be connected to the ground of the logging unit, which shall be connected to the rig ground.

Rig electrician shall perform and test the main power supply hookup to the logging unit. Rig personnel may be required to install cables, weld brackets, etc. outside the unit, which shall be done under supervision of the logging engineer.

In case the electrical rig-up work is done by the logging crew, the following must be adhered to:
1. Ensure all power to the panel is off.
2. Use electrical work permit as given in OISD STD 105 on ‘Work Permit’ or equivalent. Lock out and tag out any switches left unattended during work.
3. Verify the incoming power supply voltage and adjust the transformer accordingly.
4. Test the transformer output prior to turning power on or connecting equipment to main supply.
Take following precautions when it is necessary to run some cables across the ground.
1. Logging cables shall be so routed as to protect these from damage and crushing.
2. Minimize trip hazards by covering the cables with cable mats or post signs for awareness and monitor the work area constantly.
3. Secure cables immediately when they are no longer required after rigging down.

5.5 Wireline Logging Unit

5.5.1 Unit Placement

Onshore

1. Logging truck shall be parked on a hard surface. Distance between catwalk and logging truck should be sufficient enough to allow safe handling of logging tools & equipment and proper cable spooling on the drum.
2. Winch drum shall be aligned with centre of the well mouth wherever possible.

Offshore

1. The unit shall be placed on deck having sufficient weight bearing capacity.
2. If the unit location is on or near the drill floor, the oscillatory kit should be installed to improve spooling.
3. Secure the unit before beginning of the operation to prevent it from sliding towards the wellhead while loading the line.

5.5.2 Wireline Unit maintenance

The wireline unit's engine, transmission, brakes, cable drum, etc. are critical for ensuring safety during rig-up and logging operations. The maintenance procedures described in service and maintenance manuals supplied by manufacturer shall be followed.

In particular, check the following items:
- Fluid levels
- Hoist controls, specially neutral positioning
- Drum guards installed
- Unit runs smoothly, with no jerking or surging
- Lights
- Truck chocks or spades
- Any air or hydraulic leaks
- Weight-indicator panel calibration
- Maintenance records are up-to-date

Electric wireline, rope socket, torpedo (cable electrode), bridle, and cable head connections are considered part of the lifting equipment & must be inspected and treated as any other rig-up equipment.

The following shall be ensured before operations:
- Cable is clean (treated with corrosion inhibitor in case of H₂S Environment), properly spooled on the drum and without any kinks. Cable history is available
- Line oiler is used regularly and is in good working condition
- 'Measure Head' is clean, lubricated, and in good condition
- Drum bearings are lubricated as per the maintenance schedule and turn smoothly
- Weight and depth measurement cables are in good condition
- Drum chain and brake bands are properly adjusted
- Line wiper is in good condition
- Ground lines are in good mechanical and electrical condition

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5.6 Rig-up & Rig down for wireline job

Rig-up is referred to the activities prior to actually deploying a logging device to perform service in a well. Similarly rig-down is the post job / service activity. This includes handling of accessories which are critical not only to the safety of logging operation but at times to reservoir / well; and therefore needs certain precautions to ensure smooth functioning of tools / devices and human safety as well.

Rig-up and rig-down equipment & process are job specific. For example 'rig-up for a production logging job on a rig-less well' is quite elaborate than 'rig-up on drilling well being taken-up for open-hole logging job'.

5.6.1 Rig-up equipment

The equipment for rig-up includes, but is not limited to, the following:

1. Upper and lower sheave wheels
2. Tie-down chain (Logging chain)
3. Sheave hanger (spade)
4. Load cell (sensor) & load display module
5. Shackles (clevises)
6. Safety slings
7. T-bar (line clamp)
8. Wireline weak point
9. Pressure Control Equipment
10. Wireline crane / mast for rig-less jobs
11. Working platform of adjustable height
12. Gun Dolly
13. Earthing jacks for units
14. Display boards warning about dangers

The following practices shall be followed:

1. All load-bearing equipment used during wireline rig-up shall be load tested every year, certified and marked appropriately.
2. Visual inspection of all load-bearing items shall be carried out every six months.
3. No equipment shall be used without certification.
4. Each logging base must document the details of all lifting equipment, including certificates, test results, and examination results. This must be available for inspection upon request of an appropriate authority at any time.
5. Do not load rig-up equipment beyond its marked safe-working load.
6. Inspect each rig-up equipment item for cracks and wear before and after each operation. Replace damaged or badly-worn equipment immediately.
7. Clean and grease (and repaint, if appropriate) equipment after each operation to prevent corrosion. Do not paint tie-down chains, sheave hanger etc.
8. No welding on any rig-up equipment shall be done.
9. Calibrate the load cell regularly and mark it with the calibration date. Check the cell electrically and operationally before each operation.
10. Never use a wire sling that has frayed, kinked, or broken wires. Never shorten a safety sling or sling used for hanging the top sheave from the derrick by knotting.
11. Never join chains together with nuts and bolts. Use only certified pins, bolts, and safety pins in shackles.

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12. The following sheave-wheel features shall be ensured:
   - Size is correct for the wireline in use
   - Wireline grooves are within permissible limits.
   - Free movement of sheave
   - Protection panels are installed on the sheaves
   - Sheave guards are in place

5.6.2 Winch Operation
1. Ensure that the winch drum is fitted with appropriate guard.
2. A tool box meeting shall be held before every winch operation.
3. Assign only one person to give signal to the winch operator. Be sure that the operator understands winch operation signals.
4. Always keep tension on the cable when reeling cable in or out.
5. The wireline shall not be loaded more than its rated strength.
6. Keep the winch in gear when lowering a tool.
7. No personnel other than the operator shall stand or work near the winch while it is moving. Entire path of the cable movement shall be made out of bounds.

5.6.3 Lifting Rig-Up Equipment to the Rig Floor
1. Use winch or crane to shift equipment to the rig floor. If equipment is carried manually, use proper posture and be careful to avoid slippery surfaces and obstacles.
2. Logging personnel shall not operate rig winch / crane.
3. Stand clear of loads during lifting and keep all non-essential personnel away from the lifting area. Never walk or stand under a lifted load.
4. Never try to restrain a lifted load by hand.
5. Assign only one person to signal the crane operator, but the operator should comply with a stop signal given by any person.

5.6.4 Drill-Floor Safety
Hazards are always present on the drill floor. With many people doing various tasks simultaneously in little space, the logging crew should be alert and attentive at the rig floor.
1. Never use the drill floor as a shortcut from one well site area to another.
2. Do not interfere during drilling operations.
3. Observe restrictions on the use of electrical equipment (radiation monitors, electrical-circuit checkers, etc.) on the drill-floor or other hazardous areas. Do not troubleshoot or repair logging equipment, including cable heads, in a hazardous area.
4. While on the rig floor, be careful of hazards such as:
   - **Falling objects:** Always wear hard hat. Keep an eye out for falling tools, mud, and other objects. Be aware of personnel working above the drill floor.
   - **Rig Floor Operations:** Do not come in the way of personnel using tools on the derrick floor.
   - **Slippery surfaces:** Ensure that the drill floor is clear of mud, oil and grease before starting operations.
   - **Unguarded Openings / V-door:** Safety chains removed for any reason shall be placed as soon as possible. Be extremely cautious while working near the V-door specially on floaters.

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• Unguarded Floor Openings: Open mouse-holes, inspection holes etc on the rig floor shall be kept covered.

• Rotating Sheave Wheels: Stay clear of rotating parts, even with guards in place. Never touch or bring objects such as rags near the sheave while it rotates.

• Hazardous area: Observe all precautions for rig floor as zone-I hazardous area. (Zone 1: An area in which a hazardous atmosphere is likely to occur under normal operating condition.)

• H2S gas environment: Refer section 10 on the subject.

• Wave-Motion Compensator (offshore): Never touch during operation.

• Wireline Pressure Control Equipment: Stay clear during operation to avoid high pressure hazards.

• Trapped Well Pressure: Keep clear of the borehole as the blind rams open. Any pressure in the well can be hazardous.

5.6.5 Wireline rig up / rig down operations

5.6.5.1 Safety Guidelines

1. Ensure that the rig floor is clean and drilling equipment & tools are removed from the work area before rig-up.

2. Hold a brief safety meeting before rig-up involving the rig crew. Ensure to inform both rig and wireline crews of wireline operation hazards, such as moving wireline, rotating sheave wheels, high tension cables etc.

3. Ensure that the borehole is always covered. Use wireline pressure-control equipment or a special slotted cover (C-plate) or a line-wiper base plate that can accommodate the wireline.

4. Rotary table should be locked before lowering wireline equipment and it is to kept locked during the entire operation. Exception: Rotation during a free-point indicator or pipe back-off operation. Omit in the event of Active Wave Compensation availability in Ultradeepwater Rigs.

5. Use a suitable line wiper when raising wireline equipment to avoid bringing mud up onto the drill floor. Never attempt to clean a moving wireline by hand. Even safety gloves are no protection from a moving broken strand of armor wire.

6. Logging personnel are not permitted to operate any rig equipment, including cranes, air winches, tuggers, or catlines. Stand clear when any such equipment is in use.

7. Ensure that rig floor activities can always be clearly seen from the unit. During night operations, sufficient lighting should be ensured. Ensure that the lower sheave and well mouth are clearly visible from the logging unit.

8. Notify the Driller before going under the rig floor.

9. When performing vertical make-up, always ensure good communication between the unit and the rig floor.

5.6.5.2 Lower-Sheave Installation

1. Secure the lower sheave to the rig with the tie-down chain or an equivalent device.

2. Attach the tie-down chain’s shackle end to the lower sheave eye nut. Never attach the tie-down chain to the sheave handle (the unrated end of the hanger weldment).

3. Wrap the tie-down chain’s hook end around a principal member of the rig superstructure and tie it with a double knot. Secure the hook to the chain (leave the chain loose between the double knot and the hook, so that all the tension will be held by the double knot. The chain shall not be attached to a secondary structure or to a potential weak point.

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4. The chain shall not be attached to the rig with both ends of the chain, such that the sheave wheel is suspended at the middle of the chain. Any angle formed by the chain will reduce its strength.

5. Never double the tie-down chain to shorten it. Tie extra knots, if necessary.

6. Locate the tie-down chain anchor point as closely as possible in line between the logging unit and the borehole centerline. This will keep the upper and lower sheaves and the logging cable drum center in the same vertical plane to minimize any lateral component of tension in cable.

7. The length of chain between the anchor point and the lower sheave should allow some lower sheave side-to-side movement. The closer the logging unit is to the wellhead, the more important this movement is.

8. The lower-sheave position, with tension applied to the logging cable, should be such that the cable between the upper and lower sheaves is close to vertical to minimize any cable-tension horizontal component on the upper sheave. Adjust the chain as necessary.

9. Ensure that ample space exists between the racked drill pipe and the lower sheave to work safely. Extra caution should be taken while moving tools through this space.

10. Keep a safety line (usually the line from an air tugger) permanently attached to the lower sheave handle. This line must go slack as tension is applied to the logging cable. The safety line supports the lower sheave when tension from the logging cable is removed and restrains the lower sheave if the logging chain becomes loose or breaks.

11. If the logging unit is far from the drill floor, or if a restriction exists on the height of the upper sheave, the load cell can be installed between the lower sheave and the tie-down chain. The tension meter reading should be corrected for the angle formed by the cable. The load-cell cable should be positioned carefully to avoid damaging it while picking up and laying down equipment.

12. After threading the logging head and cable, position the cable guides to prevent the cable jumping the sheave. Tighten the T-nut securely to prevent guide movement. Ensure that the cable will not rub against the guides during operation.

13. Secure all shackles with locking clips to prevent loosening of pins caused by shock or vibration.

5.6.5.3 Upper Sheave Installation (Fixed Platform or Rig)

1. Suspend the upper sheave from the elevator by the sheave hanger. Normal installation is with the load cell between the sheave hanger and the upper sheave.

2. Ensure that the elevator is of proper size so that the sheave hanger's larger end is supported on both shoulders.

3. Ensure that the travelling block swivel is locked.

4. After sheave-hanger installation, thread a wire rope through the elevator handles and tie it to prevent accidental opening. Also thread a safety sling through the sheave-hanger eye & bail, and secure it with a shackle. This sling must be strong enough to support the full weight of the cable if the elevator opens accidentally.

5. Always suspend the upper sheave by the clevis and not by the sheave handle (since that is the hanger weldment's unrated end). Check for smooth rotation about the pivot.

6. After threading the logging head and cable, position the cable guides to prevent the cable from jumping the sheave. Tighten the T-nut securely to prevent guide movement. If the cable rubs against the guides, reposition the guide.

7. Secure all shackles with locking clips to prevent loosening of pin caused by shock or vibration.

8. The logging engineer shall make a final check of upper sheave configuration and other rig-up arrangement before raising the sheave up the derrick.

9. Clear all personnel away from lower sheave and logging cable before starting to raise the upper sheave.

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10. Position the upper sheave as high as possible in the derrick to keep a safety margin while pulling long tool strings out of the well.

5.6.5.4 Upper Sheave Installation (Floating Rig in off-shore area)
1. Suspend the upper sheave from the elevator with the wireline compensation device. This device comprises of compensator sheave over which the compensator line passes, with suitable arrangement for suspending the device in the elevator. Normally the load cell is installed between the compensation device and the upper sheave. This installation does not use a sheave hanger.

2. As with a fixed platform or rig installation, the upper-sheave support must be well secured in the elevator. Pass a safety sling through the eye of the support structure & the bails and secure it with a shackle. Thread a wire rope through the elevator handles and tie it to prevent accidental opening.

3. The compensator line shall have a suitably-rated shear-pin assembly and safety cable to protect personnel and equipment from whiplash if that line breaks because of excessive wave motion. Normally, the rig crew installs the line and safety cable.

4. Pick up and lay down logging equipment with the compensator switched off. Drilling crew should be alerted of the logging tool’s relative motion while adjusting the tool at zero level.

5.6.5.5 Picking Up and Laying Down Tools
1. Ensure the winch operator and wireline operator can communicate effectively. Assign only one person to give signals to the winch operator.
2. Protect the cable and cablehead with a gooseneck.
3. Use a snubbing / restraining rope, to ensure smooth movement of logging tools over the V-door.
4. When raising tools, especially on the first trip, be alert for jerks as the tie-down chain gets strained.

5.6.5.6 Rigging Down
1. Before rigging down, clear the drill floor of all non-essential personnel.
2. To prevent damage to logging and load-cell cables, reel them in as the upper sheave is lowered.
3. As the upper sheave is lowered, secure the logging cable head to the drill floor or hold it firmly to prevent it from being pulled into the derrick. Ensure that the winchman and Driller can communicate easily.
4. Use winch to rig down material from derrick floor to cat walk.

5.7 Wireline Operations
5.7.1 Safety Guidelines
Proper planning, efficient communication and well maintained tools are vital elements of safe wireline operations. The following safety guidelines shall be followed:

1. While running in or pulling out a wireline device, ensure that the hole is filled with well fluid up to the correct level to ensure primary well control.
2. During logging operations at a drilling rig, the Driller shall be responsible for overall safety on the rig, for monitoring well-fluid gains or losses and for maintaining primary pressure control of the well.
3. During logging operations involving mast / crane and equipment on an unmanned well site, the logging engineer shall be responsible for the overall safety of the wellsite.
4. During logging operations, ensure that the number of drilling crew members on the rig floor is kept to a minimum.
5. The blind rams should be closed before and after each wireline run, when the wireline device is confirmed out of the hole. This prevents tools or logging equipment from being inadvertently lost in the hole. (This may not always be possible for long tool strings

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requiring vertical make-up. In these cases, be sure to coordinate closely with the Driller to ensure that the rams are not closed on a sonde suspended by the vertical make-up plate.)

6. During rig floor crew changes, ensure that incoming crew members are fully briefed on the present operation and next plan.

5.7.2 Surface equipment

1. High voltage and current are present in many surface panels. Closely observe all precautions as specified in relevant operations/technical manuals, when handling, operating, repairing, and testing the panels. In some panels, power is present the moment power cord is plugged in, even though the panel is not turned on.

2. Disconnect power to the rack and panel before attempting to check, service, or connect/disconnect cables and fuses.

3. Disconnect the power cord when working on surface panels. Be extremely careful when work on the panel must be performed with the power on.

4. Before debugging an energized system for fault finding, insulate live switches.

5. Many of the circuit cards in the panels are sensitive to static electricity. Handle the cards by the edges and avoid touching the edge connectors or circuitry. The components and circuits of panels are sensitive to voltage shorting and are easily destroyed by mishandling or carelessness.

6. Disconnect power before changing printed circuit boards, to prevent shorting circuits or integrated circuit components.

7. Some panels have an open frame design which increases the possibility of personal injury and/or equipment damage. When the panel is not mounted in an equipment rack, use caution to avoid contacting energized circuits or components, and shorting of internal parts by dropping hand tools, wire or other objects in the panel.

8. Be sure that panel rack-mount screws and face plate captive screws are secured when traveling to or from the site.

9. The corners and front doors of some panels are sharp. Be careful while working around the system panels, especially with the front door open.

10. Ensure that panels are securely mounted in the rack during operation.

11. Before removing a panel from the rack, ensure that all interconnection cables are released and properly secured.

12. Many panels are quite heavy and are difficult for one person to handle safely. Use front and rear handles, if provided, for lifting and carrying.

5.7.3 Downhole Tools

1. Avoid dropping or rough handling of downhole equipment.

2. Specified operating limits of a tool shall not be exceeded. Closely monitor pressure, temperature, electrical current and other limiting conditions crucial to safe and effective operation.

3. Most logging tools use electrical power and involve high voltage. Avoid electrical shock by following these precautions:
   - Disconnect power to the tool before servicing.
   - Work in a protected & clean area.
   - Do not work on a wet floor or wet ground.
   - Do not touch the tool during testing.
   - If it becomes necessary to work on the tool with the power ON (testing electrical circuits etc.), power distribution in the tool shall be clearly understood and necessary care shall be exercised while troubleshooting high voltage boards.

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4. Specific instructions as given in the tool manual by the OEM shall be followed for operation and maintenance of downhole tools.

5.8 Safety during sampling and transportation of formation fluid samples

Section 9 on ‘Safety’ and Section 8.1 on ‘Shipping reservoir fluid samples’ of API RP 44 on ‘Sampling Petroleum Reservoir Fluids’ (Second edition, April, 2003) should be followed. Also, internal guidelines of the logging contractor/operator on the subject should be developed if required and followed.

5.9 Safety during Wireline Fishing Operations

Wireline fishing operations are complex and hazardous. A meeting of logging and fishing crew shall be held to decide the method of fishing (cable snapping or cut & thread) depending upon the down-hole tools condition. The information regarding cable/cable head/bridle history and well history shall be gathered before taking up the fishing operation.

The following safety precautions shall be adhered to during fishing operation:

1. Upper and lower sheave shall be re-checked from safety viewpoint.
2. There shall be proper communication between derrick floor and logging unit through a radio set.
3. All pad sections of tools shall be closed and tool power switched off.
4. Cable tension shall be monitored continuously during cable snapping and cut & thread procedure.
5. When a tool along with radioactive source gets stuck, all out efforts shall be made to fish out the tool along with the source. If it is not possible to fish out, the abandonment procedure detailed in section 7.10 on radioactive materials shall be followed.
6. In case winch power is insufficient to snap the cable, rig power can be used for snapping at weak point. An additional tie back chain shall be used at the lower sheave.

6.0 EXPLOSIVES SAFETY IN LOGGING

Requirement of the Explosives Rules, 2008 relevant to the use of explosives in logging operations shall be clearly known to logging personnel and followed in addition to the international regulations and guidelines. Petroleum and Explosives Safety Organisation (PESO) under Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, Government of India, is the statutory body entrusted with the administration of the Explosives Rules, 2008.

Safety precautions given in this section are applicable to the following services that use tools containing electrically fired detonators, such as:

- Perforating guns/strips
- Side wall core guns
- Bridge plugs and packers
- Chemical/Jet cutters
- Dump bailers
- Back-off shots
- Pipe severing tools
- Junk shots etc.

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Only trained and authorized persons shall be allowed to handle explosives and record of authorized persons shall be maintained.

6.1 Safety guidelines

1. Explosives, even in their safest state, are potentially hazardous. Persons who use explosives on a regular basis over a long period of time must guard against becoming complacent and taking short cuts in the required procedures.
2. Operations involving use of explosives shall be undertaken only during daylight hours.
3. The detonating cord should not be lubricated prior to loading. Lubricants can desensitize booster powder and cause misfires of perforating charges.
4. While charging, enough care shall be taken so that the prima cord is not twisted.
5. The prima cord shall never be cut by metal to metal contact.
6. Never join two incompatible prima cords, for example, RDX with HMX. As the detonating velocities and pressures are different, it may lead to an improper detonation.
7. Handle loaded guns as smoothly as possible to avoid shocks. This is particularly important when dealing with guns that have misfired and contain explosives that have been subjected to high temperature for an extended period of time.
8. Loaded guns shall be stored and transported with plastic vent plugs. This allows degassing of explosives in the event of fire, while still providing moisture protection during transportation or storage.
9. Charges and detonating cord exposed to well environment for more than one hour shall not be re-used.
10. In case of water entry inside the gun, the charges shall be discarded and not re-used.

Many of the explosives used in oilfield may be of interest to those with criminal intentions. The operator shall take adequate security measures for safety of explosives as per requirements in the area of operation.

6.2 Gun loading at shop

Shop shall have a specified well lit gun loading area and designated storage of associated explosives with suitable security arrangements. In-charge logging Operations – Base / Location shall ensure that the loading area meets all local, state, national and international statutory requirements. "EXPLOSIVES" and "NO SMOKING AREA" signs shall be displayed prominently in local, Hindi and English languages. International symbols can also be used.

The following safety precautions shall be followed:

1. The IME (Institute of Makers of Explosives), USA recommends that all explosives be stored in anti theft magazines. All magazines shall be kept locked. An accurate count of all explosives and loaded guns shall be kept.
2. Explosives should not be subjected to jerks (shock), heat or confining pressure.
3. Primary and secondary high explosives shall be stored separately.
4. Load the gun with as few people around as possible.
5. Detonators shall not be installed in gun loading area. These are the last things to be installed just before lowering the gun in the well.
6. Check gun wiring continuity and insulation, with an approved Blasting Galvanometer / Multimeter only.
7. Do not attach gun firing head to guns stored in the racks.
8. Store loaded guns neatly on racks at a safe distance from the arming area. Direct the charge path towards the least inhabited area.

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9. The loading area shall be cleaned up immediately after the loading / unloading operations are completed.

10. Separate containers shall be used for ordinary trash and explosives remnants.

11. Put excess or junk explosives in the appropriate shipping containers. Keep these boxes closed and locked.

6.3 Field operations

6.3.1 Pre-departure Checks

1. All equipment / carrying cases that contain explosives shall be properly labeled with appropriate warnings on them. Ensure that Mechanical safety Switch (if required), Safety Tube, Explosives Remnant Box, Casing to Rig Voltage Monitor, Safety meter for testing detonators and Safety grounding device of Truck / Unit with “C”-Clamp are loaded in the truck before departure to the field. Checklist given at Annexure-I should be used.

2. Following warning sign boards in Hindi, English and Regional language shall be taken for display at the site- 
   - “DANGER ZONE, EXPLOSIVES IN USE”
   - “TURN OFF ALL RADIOS AND MOBILE PHONES”
   - “TURN OFF ALL GENERATORS”
   - “TURN OFF ALL WELDING MACHINES”

6.3.2 Arrival at the Well site

Incharge logging at Wellsite shall establish a safe, controlled working environment for explosives operations in consultation with the operator, tool pusher and any other responsible personnel involved.

1. Hold Safety meeting with Drilling Incharge / Site Supervisor / Production Engineer / Offshore Installation Manager.

2. Check and make ready all safety equipment.

3. Display warning signs in Hindi, Local Language and English. One at the site and one at each entrance to the site.

4. If there is a possibility of a thunder storm / sand storm, suspend operations till it subsides.

5. Look out for hazards in or around well site / mast and correct them. All open fires shall be put off.

6. Check for BOP testing, working of winch and clear parking / working place in front of Rig / Mast.

7. Ensure that the hole is completely filled with fluid except in cases of under balance perforations.

8. Get all the arc / gas welding machines and cathodic protection equipment off.

9. Get radio transmitters / receivers, mobile phones turned off within 300 metres of work area well before arming the explosives device. These shall remain switched off till the device is 100 meters down inside the well.

10. If there is high tension line running over or underground within 30 metres of the work area, power has to be disconnected.

11. Electrical power connection to Sucker Rod Pumps (SRP) within 30 meters from wellhead shall be switched off.

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12. For recommended distances of transmitters ‘Safety guide for the prevention of radio frequency radiation hazards in the use of common electric detonators’ of Institute of Makers of Explosives (www.ime.org) should be followed.

13. If conditions at steps 9, 10 or 11 are not met, Rig Environment Detonators (RED) or equivalent shall be used. In such case, rig to casing voltage shall not exceed 2 volts

14. Checklist for Joint safety/ tool box meeting before taking up explosives job at wellsite is placed at Annexure-II. This checklist shall form part of Work Permit.

6.3.3 Rigging-up

1. Any exposed electrical wiring at site near work area or inside unit shall be removed before connecting the gun head to cable.

2. Ensure grounding of wireline to equipment. Following shall be ensured:
   - Logging computer or panel rack shall be properly grounded to unit chassis.
   - Auxiliary generator, if used, shall be grounded to unit chassis with suitable cable.
   - Offshore logging unit shall be properly grounded to rig or barge.
   - All metallic structure that might touch logging cable shall be grounded together to the logging unit.

3. Remove any rig wiring, guide-lines etc. that could touch the logging cable.

4. Install ‘casing to rig’ voltage monitor. Check for any stray voltage between rig, casing and cable armor. If voltage exceeds 0.25 volt, investigate the cause and rectify before proceeding further. The voltage shall be less than 0.25 volt.

5. When residual voltage is less than 0.25 volt, install safety grounding cable between unit / truck to rig and casings. Leave the voltage monitor connected between rig and casing. Watch the meter during whole operation.

6. Check cable insulation and continuity with approved meters only. Discharge the cable after insulation check.

7. The engineer performing hot check and CCL check shall have clear full view of the gun assembly.

8. Once again ensure that welding transformer, cathodic protection equipment, high tension lines, radio, T.V. transmitter and mobile phones are turned off in and around the work area.

9. After confirming the above checks, turn off A/C generators. Engage safety switch on the Shooting Panel to ‘SAFE’ mode and remove the key. The key shall be in personal custody of In-charge logging Unit at site.

10. All safety measures inside the unit at this juncture shall be rechecked.

11. Clear every one out of the unit. No one shall be allowed to enter the logging unit till the explosives device is lowered in the well.

12. Reconfirm that the voltage in casing to rig voltage monitor is less than 0.25 volt.

13. Clear all non essential personnel. Bring the explosives device / charged gun at cat walk. Keep everyone else out of line of fire.


15. Attach the explosives device to the cable head.

6.3.4 Arming the Device

1. Only In-charge logging Unit at site shall arm or disarm any explosives device.

2. The device shall not be armed when helicopter / boat is approaching / departing or during a thunder storm. Arming shall not be commenced if such circumstances are expected to arise before the arming operation can be completed and the gun lowered into the well to a minimum depth of 100 m below ground level or the sea floor.

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3. Reconfirm that the safety key is outside the wireline unit.
4. Connect gun to the cable.
5. Remove the detonator from its storage box, verify that it is shunted, insert it in Safety tube and carry to the arming area. Detonators shall not carried loose in the pocket or tool box.
6. Test the detonator in Safety Tube with approved safety meter after removing shunt.
7. With detonator in Safety tube, arm the gun electrically. First connect the ground wire then connect central conductor of logging cable to the lead wire from detonator and insulate them.
8. Take out detonator from Safety Tube. Cut excess detonating cord using wooden block and sharp edged cutter.
9. Attach the detonator to the detonating cord until it seats nicely and crimp it to detonating cord if required, using appropriate approved crimping pliers only. Fix the detonator at proper place in the explosives device.
10. Use hermetrical sealing sleeve on exposed detonators. Ensure that no pull on detonator lead wires is applied while putting hermetrical sealing sleeve.

6.3.5 Perforating / explosives jobs at shallow depths

If the zone of perforation is less than 100 metres, following additional precautions shall be taken:

1. The job is carried out under positive head.
2. Special detonators like SAFE/ RED should be used.
3. In case steps 1 and 2 above can not be followed, perforation should be carried out through tubing with pressure control equipment.
4. Misfired guns should be treated with extra caution. Section 6.3.9 on misfired guns shall be strictly followed. (Depth restriction of 100 metres is not applicable in this case).
5. Carbon-monoxide (CO), a well characterized toxin, is byproduct of perforation operations. There is a risk of CO coming to surface during perforation at shallow depths and a likelihood that a combination of events could lead to release of CO in breathing space of rig crew, may be in small quantities. Appropriate measures should be taken in shallow depth perforations to address the CO hazard, when gun is brought to surface.

6.3.6 Deploying the device to depth

1. Lift the explosives device and lower it into well carefully.
2. Run the device in the well slowly at least 100 meter below ground level or sea bed. Turn on safety switch & restore AC power. Insert the cable jack to collar locator socket for depth tie-up.
3. Proceed in the hole at a controlled rate checking CCL. Go at least 5 meter below the zone of interest if possible.
4. Pull about 100 m with CCL record.
5. Drop back down below the zone to be perforated. Pull up & position the gun or device at desired depth and shoot.
6. When operating in deep water offshore, power may be restored at 100 m below sea level, rather than below sea floor / mud line, provided the consequences of an unintended detonation at that depth have been properly investigated on a case to case basis and shown to present an acceptable level of risk.

6.3.7 Retrieval to Surface

1. The device shall be retrieved at a rate not exceeding the limit recommended by the manufacturer.

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2. During pulling out when the gun is at a depth of 100 metre below ground level or sea bed, the cable circuit shall be kept in safe mode: safety key shall be removed and shall remain out side the unit until the explosive device has been retrieved from the well and disarmed.
3. All safety precautions as given in previous section shall be followed while retrieving the device.

For rigging-up, arming and pulling out check list given in Annexure-III should be used.

6.3.8 Disarming the Device when fired

An explosives device shall be treated as armed until firing has been visually confirmed.

1. Explosive device shall not be disarmed when helicopter/boat is approaching/departing or during a thunder storm. Disarming shall not be commenced if such circumstances are expected to arise before the disarming operation can be completed. The device shall be kept in the well at a minimum depth of 100 m below ground level or the sea floor until it can be safety removed or disarmed.
2. Bring the device out of hole. Bring the gun to cat walk and look for any charge that did not detonate.
3. Disconnect the device. Beware of trapped pressure in gun.
4. When the operation is complete, rig down using standard safe operating procedures.
5. Clean the area for any detonating cord scraps, loose charges, trash etc. Put them at proper locations and prepare equipment for departure.

6.3.9 Disarming the Device with suspected misfire of armed Device pulled out due to hold up

1. Cable position on the perforation panel shall be in 'SAFE' mode.
2. Pull the device slowly up to 100 metres below the ground level so that the gun remains in the well for minimum 30 minutes after firing.
3. Switch off generators and apply circuit breakers.
4. Re-confirm closure of Rig generators, Radio / T.V. transmitter etc.
5. The misfire shall be treated as an unplanned event and therefore the state of explosives inside the gun is considered unknown.
6. Verify the casing to rig voltage monitor connection and ensure its reading less than 0.25 volt. If a helicopter is approaching keep the device in the well till it departs.
7. Misfired gun shall not be pulled out of the well before lapse of 30 minutes since firing.
8. While keeping the top of gun assembly at well mouth establish gun temperature less than 100 deg C by remote temperature monitoring device or by spraying water test (Sprinkle water by a hose from a distance to see if water evaporation takes place which is indication that the temperature is above 100 Deg C). If temperature is above 100 Deg C, immediately drop back down to 100 meters. Wait for 2 hours. After 2 hours, pull the top of gun assembly up to well mouth. Measure Temperature again, if it is less than 100 deg.C pull the gun up & lay down on catwalk. If not then, process shall be repeated till temperature is less than 100 deg.C.
9. Once temperature is less than 100 deg C, pull the device out of well, activate mechanical safety switch (if attached) & bring the device to cat walk. Follow safety procedures as per type of charge / device used. There shall not be any one inside unit cabin at this moment.
10. Inspect the device for any hole in port plug / scallops (in case explosives device is a gun). Disarming of the device shall be done by a competent person preferably by the same person who has armed it.

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11. Check carefully for trapped pressure inside the port plug / scallop gun while disassembling the device.
12. Remove detonating cord from detonator by cutting it. Put the detonator inside safety tube.
13. Disconnect central wire (live) of cable from detonator first.
14. Disconnect ground connection of cable from detonator.
15. Short both wires of detonator.
16. Remove safety tube from cat walk. Take out detonator and put in detonator remnants box.
17. Disconnect gun from quick change assembly and check gun for any water entry.
18. Check cable continuity and insulation.
19. Ascertain reasons of misfire, eliminate these and proceed for a fresh run.

6.3.10 Safety during Tubing Conveyed Perforation

Tubing conveyed perforating system consists of a perforating gun run into the well at the bottom of a production tubing string or drill pipe. A 10 feet long safety spacer shall be inserted between gun assembly and firing head to position the loaded portion at a safe distance below the rig floor during arming and disarming operations. A safety spacer may not be required when running a bottom-up firing system. Perforating guns of any length and shot density can be connected with choice of selecting various sizes of guns for their effective use in different kind of operations.

1. All the national, international and local explosives safety rules employed during conventional perforations are also applicable to TCP operations.
2. The rig crew has to be involved in assembly and disassembly of the guns being attached to tubing / drill pipes. Hence, for the reasons of explosives safety the rig crew shall work under the guidance and supervision of In-charge logging at site.
3. Number of personnel handling equipment containing explosives shall be kept to a minimum.
4. All non-essential personnel shall remain at safe distance from gun assembly area.
5. No one including rig crew shall be allowed to work on the rig floor at the time of arming the guns.
6. Any activity below rig floor shall be suspended till the armed guns reach below ground level.

6.4 Explosives Storage Facilities and Containers

6.4.1 Onshore

1. Magazines and containers storage facilities for explosives shall meet all local and national regulations and specific terms of permit(s) issued by the statutory agencies. ‘Specifications of magazine other than of fireworks’ given under Schedule VII of Explosives Rules 2008 shall be followed.
3. Unauthorized personnel shall not be allowed to enter Magazine.
4. Magazines shall be made to specifications for ‘ZZ’ (missile) class of explosives.
5. Magazine premises shall be kept neat and clean for easy approach in case of any emergency.
6. Appropriate fire fighting facilities like water filled pit, fire extinguisher etc. shall be made available in the magazine premises.
7. The type and quantity of explosives shall determine the container or facility type. All the containers or outside packaging carrying such containers shall be marked with required information including hazard warning labels.

8. Primary high explosives (detonators, some boosters) shall be stored separately from secondary high explosives, low explosives and flammable solids (power charges). The separate storage can be separate containers or separate compartments. This above storage requirement also applies for faulty or junked explosives which shall be clearly marked with label "NOT SUITABLE FOR OIL FIELD USE".

9. The building for storage of explosives on land should be completely separated from living and work areas. It shall be constructed away from radioactive source storage.

10. The construction of temporary magazine (type B or C metal cases) can be done to handle the explosives in small quantities for efficient job execution at short notices.

11. Explosives storage facilities shall be clearly marked with weather resistant signs in the local, Hindi and English languages:
   
   DANGER
   EXPLOSIVES
   NO SMOKING
   USE OF FIRE OR IGNITING DEVICES PROHIBITED
   SWITCH OFF TWO WAY RADIOS AND MOBILES

12. Record keeping is mandatory as per Explosive Rules (ER) 2008. The procedure is reproduced below for easy reference-
   
   - Account of receipt of explosives shall be maintained at each magazine as per Form RE 3 of ER 2008.
   - Account of explosives used shall be maintained as per Form RE 5 of ER 2008.
   - Record of explosives transported by road shall be maintained on Form RE 6 of ER 2008.
   - Return of explosives shall be maintained as per Form RE 7 of ER 2008
   - Indent of Explosives shall be filled on RE 11 of ER 2008.

6.4.2 Offshore

1. Offshore storage magazines should be constructed in accordance with specifications for type 'B' Magazine detailed in Schedule VII of ER 2008 duly approved by the Chief Controller of Explosives.

2. Magazines containing explosives on offshore rigs shall have lock and appropriate sealing system. One key of the magazine shall be in the custody of tool pusher / barge engineer and other with logging crew / department for better safety and control.

3. Offshore storage containers shall be placed on quick release bracket so that it can be quickly released and dropped overboard in case of fire. These shall be located as far as possible, away from all activity, open flames and heat sources, inflammable items, hazardous materials and electrical sources.

4. The explosives magazines shall not be located in hazardous area of an offshore rig and shall be away from radioactive source storage.

6.5 Explosives Transport

6.5.1 Safety Guidelines

1. All local / National / International statutory rules shall be followed while transporting explosives.

2. Primary and secondary high explosives shall not be transported in the same container or in divided compartments of a single container. However primary and secondary high explosives may be transported in the same Van but in separate containers, kept at least 1.5 meter apart. Use of original packaging is most safe for transport.

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3. Loose charges, detonating cord or detonators shall be kept in their designated containers and shall be locked. End of detonating cord must be taped to avoid spillage of powder.
4. All containers shall be properly secured to prevent movement during transport.
5. No smoking shall be allowed near the explosives van during loading / unloading or explosives.
6. Explosives shall be delivered only to authorized consignee and removed from shipping containers / vehicle as soon as it reaches destination.
7. Explosives shall be the last item to load and the very first item to unload.

6.6.2 Explosives Transport by Road
1. Transportation of explosives shall be done in a licensed / permitted vehicle / van as per the specifications given in schedule VII of the Explosives Rule 2008.
2. The driver of the vehicle carrying the explosives shall have clear instructions regarding the steps to be taken in case of an emergency like road accident or fire during transport and shall carry the TREMCARD containing relevant instructions. The TREMCARD is given in the Annexure-IV.
3. The van shall carry at least two reflective explosives warning signs in front and rear.
4. The van shall have important emergency contact numbers boldly written in the driver’s cabin.
5. Following shall be ensured to protect the explosives :
   - No fuel leak
   - No exhaust system leak
   - No exposed electrical wires.
   - No oil / grease on exposed surfaces
   - Clean interiors
6. The van shall not carry any other hazardous cargo, extra fuel or flammable liquid with explosives.
7. Van engine shall not be running during loading / unloading of explosives or while filling fuel in a loaded vehicle.
8. Explosives shall never be carried in driver’s cabin / passenger area.
9. Only optimum number of detonators shall be taken to work site (Not more than 2 detonators/run).
10. Unarmed loaded guns shall be carried only on racks or in tubes designed for the purpose after they are properly secured / tied with racks / tubes.
11. Loaded guns shall not extend out of the transporting vehicle body.
12. The explosives van shall never be used to tow any other vehicle and vice versa.
13. Explosives van shall not be stopped at places where security may be endangered.
14. If the explosives van is to be parked overnight due to reasons beyond control the parking place shall be
   - Away from open flame, High tension line, radio / T.V. tower etc.
   - Away from habitation or any godown containing articles of flammable / hazardous goods.

   In such cases, nearest police station shall be informed about the location of vehicle parking.
15. Routes passing through dense habitation shall be avoided as far as possible.
16. At any unmanned railway crossing or high way crossing the explosives van shall be stopped till safe clearance is available.
17. The copy of license shall be kept in the van all the times.
18. The van shall have four wheel brakes.

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19. If fire occurs on the explosives van, the driver shall take steps to stop other vehicles / traffic at least 300 m away on all sides of road and that all the persons will be warned of the danger.

20. In case explosives van is involved in accident or fire or other mishap the following shall be followed:
   - Comply with all legal requirements relating to road accident.
   - Place warning signs for moving traffic at safe distance.
   - Inform local police.
   - Inform Licensee who in turn shall inform Chief Controller of Explosives giving full details of accident.
   - Arrange for safety and security of explosives till inspection by the Chief Controller of Explosives (if needed) is done.
   - Stay with the vehicle (if it is not a fire case).
   - If the explosives van is on fire use your judgment as to whether to try to extinguish it or to get to a safe distance.

21. In case of explosives to be transported by wireline truck:
   - Prior permission from PESO shall be obtained.
   - Follow all the guidelines of transport by explosives van and general transport rules (precautions mentioned in this section).

6.5.3 Explosives transport by Rail

For transport of explosives by rail Part 4 under schedule VI on ‘Safety provisions for transport of explosives by rail’ of ER 2008 shall be followed.

6.5.4 Explosives Transport by Sea

For transport of explosives by ship Part 3 under schedule VI on ‘Safety provisions for transport of explosives by water’ of ER 2008 shall be followed. Also Regulations contained in the Merchant Shipping (Carriage of dangerous goods) Rules 1978 shall be followed.

6.5.5 Explosives transport by Air

1. Air transportation of explosives is severely restricted and is governed by many national / international organizations.

2. DGCA Permit for air transport and NOC from PESO, Nagpur is essential for explosives import by air.

3. Explosives which are to be imported shall fulfill standards set by IATA (International Air Transport Association), ICAO (International Civil Aviation Organization). In addition to above, The Aircraft (Carriage of Dangerous Goods) Rules, 2003 shall be followed.

6.6 Liquidation and Disposal

1. The unusable explosives shall be segregated (charges, primacord and defective detonators).

2. Defective / remnants of primary high explosives and secondary high explosives should be stored in separate containers designated for each type of explosives in Magazine at a predefined location away from good / usable explosives storage area. These explosives shall be properly packed and marked "NOT SUITABLE FOR USE". The area of disposable explosives shall be marked "DISPOSABLE EXPLOSIVES AREA."

3. A proper record of disposable explosives shall be maintained at magazine.

4. A flat, clear and open field far away from inhabited area and buildings, highways and railway tracks shall be chosen for burning or open detonation.

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5. No high tension line should be crossing over the selected site. It must be grass free preferably sandy soil.
6. Approval from local police and regional Controller of Explosives shall be taken for disposal activity.
7. All disposal activities shall be well documented and archived.
8. Representative from the office of PESO (Chief Controller of Explosives) may be present during disposal operation.

Following methods of disposal should be followed as per requirement.

6.6.1 Burning

1. Burning pit of dimensions 1.5 meter length, 1.5 meter breadth and 1.5 meter depth shall be used for disposal of secondary high explosives. An expanded metal cover shall be placed over the pit to avoid any projectiles.
2. A steel tray of dimensions 1 meter length, 1 meter breadth and 0.15 meter depth with 3 to 4 mm plate thickness and having legs 20 cm high shall be used.
3. Put steel tray in the pit
4. Metal liners of the shaped charges should be separated from their rubber jackets, wherever possible. In cases, where separation is not feasible, the shaped charges are to be burnt as it is.
5. In general 50 charges each of 22 gm of grain load can be burnt in one batch.
6. Soak the explosives in kerosene or diesel for a minimum period of half an hour.
7. A thin layer of dry wood, paper, straw or cotton waste should be put at bottom of tray.
8. Soaked explosives shall be spread over entire tray. Ignite the explosives by electric igniter from a distance of minimum 100 meters.
9. The explosives / charges will burn with a roaring fire. Check for any unburnt charges after two hours of cessation of fire to avoid any danger.
10. For disposal of Primacord - remnants or misfired, it shall be cut into small pieces of 6" to 8" and doused with kerosene for minimum half an hour. Burn the doused prima cord in steel tray repeating sl 7, 8 and 9 above.
11. Damaged power charges used in side wall core gun and bridge plug setting tool shall be liquidated just as shaped charges or Primacord. It is mandatory to liquidate shaped charges, prima cord and power charges separately.

6.6.2 Open Detonation on ground

1. It is always not possible to liquidate the explosives by burning. In such cases open detonation can be used effectively to liquidate the explosives.
2. Dig a trench of minimum 0.6 meter depth.
3. String the charges with the primacord at one foot distance. Garland of such charges shall be placed inside the trench with all the charges facing downwards. One end of primacord, shall be attached with detonator which in turn should be connected with long electrical wires shorted at other end.
4. Top up the trench with soil. Cover it with a metallic cover to avoid splinters/ projectiles.
5. Move away all the personnel from trench to a distance of minimum 200 meter.
6. Detonate the charges electrically from a distance of minimum 100 meters.
7. Any charges that did not detonate in this process shall be burnt in subsequent operation.

6.6.3 Liquidation of Detonators / Boosters

1. Collect all the bad detonators along with booster cap if any.
2. Bundle detonators / booster around a small section of primacord with adhesive tape.

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3. Put the bundle inside a 0.6 meter deep pit. Fill the pit with soil after attaching the bundle with a good detonator connected with long wires shorted at other end.
4. Move away all the personnel from the pit to a distance of minimum 200 meters.
5. Fire the detonators from a distance of 100 meters electrically.

6.6.4 Liquidation in an Abandoned Well

6.6.4.1 Well is in continuity with formation

1. Identify an abandoned well which might never be opened in future. Specific gravity of the well fluid shall be less than 1.2.
2. Dump the damaged explosives in the well, using rigid containers.
3. The depth range in which the explosives were dumped should be in hydraulic continuity with the formation through perforations. The basic idea behind this is to expose the dumped explosives to the formation temperature and pressure, wherein, the explosives will be degraded as per the temperature versus time chart over a period of time.
4. Plug the well with bridge plug followed by cement plug.
5. Note the event in Well Completion report / Well History regarding dumping of explosives, its depth and depth of cement plug.

6.6.4.2 Well is isolated from the formation (Downhole bunker)

In this method, liquidation procedure is the same as in 5.6.4.1 above, except that the borehole is not perforated and is isolated from the formation. The unusable explosives are considered to be in deep underground storage forever within the casing. Since the well will not be opened in future, the explosives would degrade with time. A schematic of Downhole Bunker is given in Annexure--V.

6.6.5 Liquidation by Other Agencies

In areas where suitable sites are not available for liquidation of the explosives or any other problem is encountered, Chief Controller of Explosives, Nagpur shall be consulted for alternate solutions.

6.7 Emergency Procedures

Refer section 11 on Emergency Response Plan.

6.8 Training

The operator shall ensure that persons using and handling explosives are adequately trained.

7.0 RADIOLGICAL SAFETY ASPECTS IN WELL LOGGING

Radiological safety aspects including those of logging operations are governed by the Atomic Energy Act, 1962 and Atomic Energy (Radiation Protection) Rules, 2004 made thereunder. These are available at www.indiacode.nic.in and www.aerb.gov.in respectively. Radioactive Sources for Well logging applications are called, “Nucleonic Gauges” and statutory guidelines and forms pertaining to nucleonic gauges can be downloaded from the AERB website.

7.1 Radiological Safety Officer

Every institution (oil & gas operator) handling radioactive sources shall designate one of their qualified employees as Radiological Safety Officer (RSO) and seek approval from AERB in prescribed application form (available at AERB website) for his appointment. Qualification of the RSO shall be minimum graduation in science with physics as one of the subjects or a diploma holder in engineering and shall have adequate training in radiation protection as specified by AERB.

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It shall be the responsibility of the contract awarding oil and gas operator to inform AERB of any change the RSO of the contractor.

7.2 Procurement of Source and Logging Device

Before procuring Radioactive Sources (Nucleonic Guages) for well logging applications, AERB pre-requisites / guidelines (AERB/RSD/NLG/PREREQ/ 2001 or its amendments) shall be strictly complied with. These guidelines can be downloaded from www.aerb.gov.in.

1. The sealed source shall be so designed so as to withstand the tests of temperature, external pressure, impact, vibration, and puncture.
   
   AERB safety standard no. AERB/SS-3 (Rev-1) or ISO 2919(1997) on Testing and Classification of sealed radioactive Sources shall be followed for testing details.

2. Sources should be procured along with lockable and transportable containers for carrying them to the well sites.

3. For procuring the radioactive sources, application in the prescribed format (AERB/RSD/NGU-1) is to be submitted to AERB for obtaining NOC along with relevant details of the radioactive materials and the purpose for which they are being procured. For air shipment, landing permit from DGCA is required.

4. Check for any update on the prevailing instruction by AERB that stipulates a clause in the purchase order by negotiation with the supplier manufacturer that mandates the supplier/manufacturer to take the source back after it becomes unusable.

5. In case of import of devices (logging tools with inbuilt sources), the following additional information shall be furnished to AERB:
   
   Maximum external radiation level at 5 cm and at the surface of the logging tool containing the source.

7.3 Storage

7.3.1 At Base

1. All radioactive sources shall be stored in properly shielded and appropriately labeled containers indicating the source activity etc.

2. Storage facility shall be in non-residential area.

3. The sources shall be stored in under ground pits or in an above ground radioactive source magazine as per the AERB regulations and site plan approved by AERB / BARC. However in no case, the radioactivity strength shall exceed 50 Ci/pit and radiation level at the fence shall be limited to 20 mSv (2 mRem/hr). Proper water proofing shall be ensured in under ground storage.

4. Neutron sources with low gamma intensities shall be stored in designated container made of paraffin wax or polyethylene, so that the requirements as stated above are met. The paraffin and polyethylene in turn should be confined in the mild steel outer containers. Sources with sufficient gamma hazards shall first be placed in lead containers of suitable thickness and then surrounded by a hydrogenous material. Storage of the radioactive sources in their original transportable shielded containers (received from the supplier) is recommended when the sources are not in use or being transported.

5. The source container shall be kept under double locking system. One set of keys of the room shall be kept in the custody of responsible person or In-charge logging Operations to prevent unauthorized removal, theft or exposure to the radiation. Second set of keys may be kept with the security agency or any other competent person as per company policy so that both parties are required to access the radioactive sources.

6. The radiation sources shall be stored in a manner which will minimize the danger from explosion or fire.

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7. The Area, where all sources and radiation material are stored, shall carry the sign "CAUTION - RADIATION AREA". AERB Safety directive no 02/2011 on 'The Specifications on Radiation Symbol and Warning Signs' shall be followed in this regard.

8. Calibration sources having extremely low radiation levels can be stored in a lockable storage cabinet provided the cabinet is dry and the radiation level at the cabinet surface does not exceed 6.0 μSv/hr (0.6 mRem/hr).

9. Pre-departure checklist for radioactive sources to be filled at base is placed at Annexure-VI.

10. Post arrival checklist for radioactive sources to be filled at base is placed at Annexure-VII.

7.3.2 At Work Site

Radioactive sources may be stored at well drilling sites onshore and offshore. Strict physical security shall be ensured and radioactive sources shall be stored as far away as possible from living quarters, inflammables, explosives etc. Prior clearance shall be obtained from AERB giving details of proposed layouts, minimum safety distances maintained etc.

7.3.2.1 At Offshore Rigs, Platforms

1. The boxes containing radioactive sources shall always remain locked, and one key will be with logging Engineer and one with OIM / Tool Pusher.

2. Offshore storage containers with buoy and beacon shall be placed on quick release bracket so that it can be quickly released and dropped overboard in case of emergencies.

3. These shall be located as far as possible, away from all activity, open flames and heat sources, inflammable items, hazardous materials and electrical sources.

4. The radioactive boxes shall not be kept under a crane or where mechanical damage can occur.

5. The Radioactive boxes should be minimum 20 feet away from working area, escape boat, muster point and explosives magazine.

7.3.2.2 On Barge / vessel

1. The radioactive boxes shall be chained directly to the deck and placed at least 10 feet away from living quarters.

2. The radioactive boxes should be as far away as possible from the stern and as close as possible to the centre line of the barge / vessel.

3. The radioactive boxes shall be resting directly on the deck (not on top of pipes, casing, mud chemicals).

7.4 Inventory Management

1. Physical checks of serial numbers of shield and source shall be conducted at regular intervals.

2. Photograph of every radioactive source housing (not the container) clearly showing the source serial number should be taken and stored. A hard copy is to be filed in the source dossier. Normally the source serial numbers are punched or permanently scribed on the source indelibly.

3. Proper records shall be maintained at the base for the inventory of the radioactive materials and their movement. The inventory records may be clubbed with Wipe test results (Refer Para 6.6.4 below). Wipe test failed sources shall be marked as LEAKY Sources, isolated for disposal and recorded accordingly.

4. Inventory reports are required to be reported to AERB in their prescribed proforma (RSD/ NG- STATUS/ PROFORMA (G)), in the 1st week of January and July every year as per AERB requirement.
7.5 Transportation

For ensuring security of radioactive material during transport AERB SAFETY GUIDE NO. AERB/NRF-TS/SG-10 shall be followed. Sources shall be transported from the main storage area to sites of use in their original designated independent shielded and approved transport containers with labels displayed in accordance with the AERB Transport Regulations. The label shall clearly indicate the following:

1. Assay label which displays the isotope symbol (e.g. Cs-137, Am-Be), the source activity in Bq and the manufacturing date.

2. Package type label which displays Type A (UN class 7 and the UN Number) or Type B (Unilateral approval or Multi-lateral approval) package.

3. Transport category label as specified by International Atomic Energy Agency (IAEA) Safety Series No.6 and as required by International Air Transport Association (IATA), International Maritime Organisation (IMO), International Civil Aviation Organisation (ICAO) for transport of radio-active materials.

7.5.1 Safety Guidelines

1. The transport container shall be made an integral part of the logging unit (bolted /fixed firmly by suitable means in the unit).

2. If transported in a separate vehicle other than the logging unit, the container shall be chained and locked to an integral part of the vehicle until the source is removed for use at the well site or for storage at the location.

3. The source shall be kept locked in its shielded container when not in use.

4. Radiation warning symbols shall be prominently displayed on the vehicle carrying the radioactive sources.

5. Explosives, corrosive and inflammable material should not be transported with radioactive sources.

6. Radioactive sources shall always be the last items to be loaded in the vehicle (just prior to departure from the main storage area) and the first items to be unloaded from the vehicle (immediately upon arrival back at the base).

7. The driver of the vehicle carrying the sources shall have clear instructions regarding the steps to be taken in case of an emergency like road accident or fire during transport and shall carry the TREMCARD containing relevant instructions. The TREMCARD is given in the Annexure-VIII and also can be downloaded from www.aerb.gov.in.

8. For Air transportation of radioactive materials, the latest guidelines / regulations of AERB, DGCA and Dangerous Goods Regulations (DGR) of IATA shall be strictly complied with.

7.5.2 Offshore Transport by Vessel

1. A copy of the dangerous goods manifest (clearly recording the radioactive materials) shall accompany the shipment at all times.

2. Logging sources and associated calibrators shall be transported in the approved offshore carrier boxes. The box shall remain locked at all times.

3. The box shall be adequately secured to an integral part of the vessel. Chain and binders, nylon slings, or wire rope of adequate strength should be used.

4. In rough weather, if anticipated, additional precautions shall be taken to secure the radioactive source carrier boxes on the deck.

5. Radio-active sources shall always be the last items loaded on to the vessel and first items to be unloaded.

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7.6 Safe Handling

7.6.1 Safety Guidelines

1. When a source is out of storage facility, it shall remain inside a locked container.
2. All calibrators shall be locked in the truck when not in use.
3. When a source is removed from the shield (container) for loading into the tool, the following procedure shall be followed:
   - The hole shall be covered.
   - All non-essential personnel shall be cleared from the rig floor area.
   - Appropriate signs and barriers shall be provided in the controlled work areas if a 20 μSv (2 mRem) possible exposure is expected during a 40 Hr week. For higher levels, ropes, fences or even barricades with controlled check-in and check-out should be utilized.
   - The source housing of the tool and all equipment necessary for the transfer shall be checked beforehand to eliminate delay.
   - The sources shall always be handled with the manufacturers’ recommended and approved remote handling tools.
   - The transfer of the source from the storage container with the help of the source holder to the logging tool shall be done in minimum possible time. Person transferring a radioactive source shall never be panicky and run with the source.
   - For all collimated (directional) sources the radiation shall be directed away from the person transferring the source and also from other persons present.
   - After inserting the source into the tool, all locking mechanisms of the source holder in the tools shall be thoroughly activated and re-checked using approved locking pin wrench, wherever applicable.
   - After the source is fixed in the housing of the tool, the personnel shall keep a distance of at least 1 metre from source.
   - Once the logging tool is loaded with the source, it shall be lowered in the well as soon as possible.
   - Under no circumstances, the tool with a source in place shall be handled directly with hands.
4. The logging tool and the section of the well site in the vicinity of the operating area shall be surveyed when logging tools are removed from the hole and after the source has been removed from the logging tool, to ensure that the source is back in its container.
5. Checklist for Joint safety/ tool box meeting at rig for safe handling of radioactive sources is placed at Annexure-IX.
6. Checklist for safety precautions during logging operations is placed at Annexure-X.

7.6.2 Radiation Monitoring

1. Gamma radiation monitors shall be used to measure dose due to gamma rays.
2. To determine the radiation level when using an Am-241-Be neutron source, a correction factor of 1.9 shall be applied to the dose rate measure using a gamma survey meter.
   Example: Gamma Dose Rate = 8 μSv/Hr (0.8 mR/hr)
   Total Radiation Dose Rate = 8 x 1.9 μSv = 15.2 μSv/Hr (1.52 mRem/hr)
   This “corrected” value shall be used when determining restricted, radiation and high radiation areas for storage/use location containing neutron sources.
3. There shall be at least one radiation monitoring equipment for each type of radiation in good working order. These monitors are to be calibrated periodically as per AERB guidelines.

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7.6.3 Area Monitoring

Area monitoring devices capable of monitoring radiation levels from 2 µSv/Hr (0.2 mRem/Hr) to 50 µSv/Hr (5 mRem) shall be used to assess radiation level at occupied areas and for general radiation survey around installations.

7.6.4 Leakage

Although all encapsulated radioactive sources used in well logging are built to stringent specifications and subjected to various performance tests to ensure non-dispersal from the capsules, leakage in the sources may occur due to their physical abuse or exposure to the hostile down-hole pressure and temperature

1. Every source should be treated as a potential leaky source.
2. Physical inspection for checking cracks, O-ring damage etc. on the source capsule is mandatory before every down-hole run of the source.
3. Contamination monitors shall be used to perform the Wipe test once in every six months. Also, after use in hostile logging conditions the sources shall be subjected to wipe test. (Refer Annexure –XI for detailed procedure of Wipe test).
4. If the Wipe test results show 0.005 µCi (185 Bq) or more, the Source is considered to be leaky. A source found leaky in the Wipe test shall be withdrawn immediately.
5. The leaky source shall be marked as unusable and shall be kept separately for disposal by the supplier or as per instructions of AERB

7.7 Medical Surveillance of Radiation Personnel

1. Pre-employment medical examination is mandatory for fresh appointees likely to be posted in well logging discipline.
2. All the radiation personnel shall wear the appropriate radiation monitoring badges [Thermo Luminescent Dosimeter (TLD) / pocket dosimeter/ (Fast Neutron Monitoring (FNM))] and these badges shall be checked periodically as recommended by BARC and any follow up suggested by BARC shall be complied with.
3. AERB safety directive no. CH/AERB/ ITSD/125/2011/1507 dated April 27, 2011 on 'The Dose Limits for Exposures from Ionising Radiations for workers and the members of the public' shall be followed for maximum permissible dose of radiation exposure.
4. Every radiation personnel, prior to commencing radiation work, and subsequently at intervals not exceeding three years or at any other frequency specified by AERB shall be subjected to routine medical examination and any other examination.
5. Medical records of all radiation workers shall be maintained at each operational base which shall include medical and radiation exposure history, details of accidental exposure if any and their periodic dose evaluation results. These records shall be maintained for a time period specified in Atomic Energy (Radiation Protection) Rules, 2004 and its updates or revisions, if any.

7.8 Emergency Procedures

Refer section 11 on Emergency Response Plan.

7.9 Disposal

A source may have to be disposed off when it is no longer needed or it has outlived its useful life or when it shows higher than permissible levels of contamination in "wipe test". All imported sources should be sent back for disposal to the supplier or BARC Mumbai or any other agency authorized by AERB.

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7.10 Abandonment of Logging Tools with Radioactive Sources lost in the Well

If a tool containing a source is lost in a well, all efforts shall be made to fish it out. If the source is irretrievable, it shall be sealed with a plug of high density cement slurry in line with guidelines of AERB and a report shall be submitted to with the following details:

1. Date of occurrence.
2. A description of the irretrievable well logging source involved including the radio-nuclide and its activity.
3. Identification of the well.
4. Depth of the source.
5. Depth of the top of cement plug.
6. Brief description of the attempted recovery effort.
7. Warning signs/plaques placed on the well.

Sources abandoned in the well shall be covered with a 50 metre long color dyed (red iron oxide) cement plug on top of which a whipstock or other approved deflection device shall be set. The idea is to alert the re-entry operator prior to encountering the source.

For cementation & abandonment, OISD-STD-175 on ‘Cementing Operations’ shall be followed.

7.11 Training

Persons responsible for use of radio-active sources shall be trained in training courses conducted or approved by AERB.

7.12 Safety Precautions for Unsealed Radioactive Tracers

1. Radioactive isotopes with long half life shall not be used, since these can contaminate the well through absorption around the well bore and prevent future tracer surveys.
2. While mixing or handling tracer material, all bottles of concentrated tracers shall be opened only by trained, experienced and authorized personnel.
3. Personnel Protective Equipment (PPE) viz., Rubber gloves, Plastic face shields and disposable protective clothing, such as overalls, shall be worn. The bottles shall never be handled directly.
4. Use of tongs and other remote handling equipment is mandatory when volatile material is used. It shall be opened only in a well ventilated area with all personnel up-wind to avoid inhalation.
5. Careful handling and pouring are necessary to prevent splashing and dropping radio-isotope solutions. Initially the person should first practice all field procedures without radioactive materials using plain water in deactivated isotope containers.
6. A closed container with a disposable plastic liner shall be provided for tongs, gloves and other similar items which may become contaminated. These items shall be checked for radioactivity after every use.
7. No eatables shall be touched or eaten and there shall be no smoking while using radioactive material. No food shall be placed on or near anything suspected of contamination.
8. Keep all unauthorized personnel at a sufficient distance from the tools, wellhead, pumping equipment etc. that may contain radioactive material.
9. After the completion of job, survey of the areas and all equipment which may have been contaminated shall be done. A reading of three times the back ground radiation indicates significant contamination. De-contaminate if necessary.

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8.0 RIGLESS JOBS

8.1 Safety Guidelines

Potential safety hazards always exist during any operation performed in the well. Well trained personnel and well maintained equipment are fundamental requirements for a safe control job.

1. All personnel shall wear adequate safety kit viz. safety goggles, gloves, safety boot, hardhat, overalls and H2S gear if required.
2. Pressure Control Equipment (PCE) or any of its part shall not be heated, welded or modified.
3. Equipment which is subjected to pressure shall not be tempered.
4. Hose reels having pressure shall not be bent.
5. While replacing pressure fittings, quality and rating shall be ensured.
6. Part of PCE not having required Working Pressure Rating shall not be used.
7. Lubricators (riser pipes) shall not be filled or or pressure tested with diesel. Air in the lubricator will be compressed which mixed with diesel vapour can cause an explosion.
8. Hydraulic /grease hoses should not be used to align the PCE, while mounting over Christmas tree. Separate ropes shall be used for this purpose.
9. Hoses should not be cleaned with diesel. Repeated exposure to diesel will weaken the hoses.
10. All the hoses shall be inspected before and after an under-balanced pressure job.
11. All O rings shall be changed after every job.
12. Rubber-seals of BOP rams shall be changed after every usage / closure on wireline cable.

8.2 Planning for Rig-less Job

Proper planning is pre-requisite to success of any rig-less job. In cases where the information about the well may not be accurately available, it is always better to have safety margin on higher side during planning stage. Planning for rig-less job includes information about the well, service required & its purpose, devising the Pressure Control Equipment assembly, re-heading cable head for appropriate weak point on wireline and designing the tool string weight to compensate the upward thrust due to wellhead pressure, arrangement for a crane or mast and a working platform to be used as substitute of rig-floor etc.

The following information about the well inter alia shall be available before the job:

1. Well name / number and location along with road map
2. Status of well - Producing / Injection
3. Wellhead pressure, average reservoir pressure (SBHP)
4. Temperature - surface and bottom hole
5. Production / injection details: details of fluids being produced or injected.
6. Well completion details:
   - Cellar-pit size
   - Christmas tree height
   - Wellhead crossover connection details
   - Tubing size & its drift ID
   - Depth of tubing shoe / WLEG (Wireline entry guide)
   - Depth of Packer(s)

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8.3 Rig-up for Rig-less / Through Tubing Jobs

Rig less logging jobs like production logging, through tubing perforation, tubing puncture, through tubing plug setting, chemical stimulation / frac jobs etc are usually carried out either with certain wellhead pressure or when well is under-balanced. The wireline intervention in this situation requires usage of Pressure Control Equipment to prevent the well-bore fluids to escape out which may be potentially dangerous. To substitute the rig, either a crane or a mast is needed to hoist the top sheave and Pressure Control Equipment.

As the job is normally carried out either in active or likely to become active wells, following safety precautions are of paramount importance to prevent any accident.

1. Identify parking places for logging truck, crane / mast and other vehicles.
2. Place the logging unit as per recommended guidelines.
3. Place the crane such that the working area is clearly visible. Use its outriggers to stabilize the placement.
4. Assemble the working platform. Adjust its height as per Christmas tree of the well. Harness the platform to ensure its stability.
5. Cut and clean the wireline with a diesel soaked rag to remove any dirt.
6. Feed through line wiper and stuffing box, ball check-valve, tool catcher and then through the required number of flow tubes of Grease Injection Control Head (GIH).
7. Once the wireline has been fed through the GIH, make the cable head with the correct weak point.
8. Connect the GIH and two lengths of riser-pipes and pass the cable-head with a weight bar through risers. Make sure not to damage the wireline.
9. Fit a set of dolly wheels to the bottom of the lubricator to aid in the rig up.
10. Fit the riser-pipe clamp to the top of the uppermost riser pipe. Put certified slings on both ends of riser-pipe clamp.
11. Add lengths of riser-pipes as required to accommodate the tool length. Pull the cable-head & weight-bar inside the riser assembly so that cable-head is caught by tool catcher.
12. Connect hydraulic lines of sufficient length as required to operate line-wiper, pack-off, and tool-catcher and harness them properly at a distance not less than 50 feet from wellhead.
13. Tie a rope on the bottom of lowest riser-pipe to assist in lifting / hoisting this assembly over BOP.
14. Connect grease injector and return lines (hoses) with GIH and Grease pump. The length of grease lines must be sufficient enough to operate from at least 50 feet distance from wellhead.
15. Fix the Wellhead Adaptor on the Flange over Christmas tree.
16. Connect the Pump-in-Sub over the wellhead adopter.
17. Connect the BOPs over Pump-in-Sub after checking that the rams can be opened and closed smoothly.

18. Connect Tool-trap above the BOP and check for its flap lifting either mechanically or hydraulically & falling on its own.

19. Loop wireline on to upper sheave wheel and fix the sheave on the hook, if provided, at the top of mast / crane. Raise the sheave up to the necessary height needed for the operation.

20. Pick up whole GIH & lubricators / riser-pipes and lift up very slowly to a height just above the BOPs. Take care to prevent severe bending of the GIH-lubricators assembly.

21. Use Christmas tree as anchor for the certified chain and fix the lower sheave with this chain. Loop the cable over the sheave and put the sheave vertical on floor sheave stand.

22. Pick up excess slack in the wireline using winch. Take care not to pull the weak point.

23. Release the cable-head and weight bar from the tool catcher. Lower them down to a height at which the tools can be connected.

24. When the tools are all made up, lower down lubricator and make sure whole tool string has been covered inside lubricator. Always ensure there is sufficient distance between the head and tool catcher, otherwise a cable head pull out may occur.

25. Connect the lubricator on to the tool-trap. After connection, lubricators should be straight and vertical.

26. It is best to pull the down-hole tool in to the catcher before pressure testing. This prevents the tool from being pushed up during pressure testing and eliminates the chance of the wireline being kinked.

27. Start the grease injection at desired pressure and check for its return through return line.

28. Conduct pressure test.

29. Open the crown valve of Christmas tree and close flow-line valve, if required, to facilitate the tool descent.

30. Release the tool from catcher, open the tool-trap and start lowering the tool.

8.4 Pressure Control Equipment (PCE)

Pressure Control Equipment often referred to as wellhead equipment (WHE) provides safe means of entering and exiting a producing well with wireline tool while remaining in control of the well pressures. Generally a complete PCE comprises Wellhead Adapter / Crossover, Pump-in-Sub, Wireline BOP, Tool Trap, Lubricators (Riser Pipes), Head / Tool Catcher, Ball Check valve, Grease Injection Head, Pack-off, Line wiper, Grease Injection Pump with Grease hoses, Air Compressor & Hydraulic Pumps or Integrated Pressure Unit having Hydraulic pumps with Hydraulic lines.

Wireline pressure control can be divided into two categories:

- **Non grease type equipment** (Stuffing Box) is used for low pressure cased-hole jobs or as a precautionary pressure control in openhole jobs.

- **Grease injection type equipment** is used for all high pressure cased-hole jobs, especially in gas wells.

PCE normally has working pressure ratings of 5000 psi, 10000 psi or 15000 psi. If there is presence of H2S, equipment made up of special alloys is required. Separate arrangements of injecting glycol etc are necessary to deal with gas hydrates.

**Identifying PCE configuration**

1. Pressure rating of PCE shall be selected so that it is more than or equal to 1.2 times of anticipated pressure at wellhead.

2. If fluid being produced / injected is gas, then wireline BOP having 2 rams shall be used.

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3. In case of H₂S, special PCE shall be used. H₂S detectors with alarm shall be placed near the wellhead. Gas masks & breathing apparatus shall be available at the well-site.

4. Grease Injection Head (GIH) should have optimum number of flow-tubes of appropriate ID. Additionally it is recommended to keep one flow-tube below the grease injection collar. The following guideline may be used in making GIH:

<table>
<thead>
<tr>
<th>Well Pressure</th>
<th>Fluid Type</th>
<th>No of Flow-Tubes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5000 psi</td>
<td>Liquid</td>
<td>4</td>
</tr>
<tr>
<td>Up to 5000 psi</td>
<td>Gas</td>
<td>5</td>
</tr>
<tr>
<td>5000-10000 psi</td>
<td>Liquid</td>
<td>6</td>
</tr>
<tr>
<td>5000-10000 psi</td>
<td>Gas</td>
<td>7</td>
</tr>
</tbody>
</table>

5. Decide the number of lubricators required based on upward thrust caused by 1.2 times of the reported wellhead pressure. (20% being the safety margin for wellhead pressure). Additional weights should be added to tool string to overcome frictional forces due to line-wiper, pack-off rubbers and centralizers, if any, on the tool string. Thus, the total length of tool string and weight-bars will decide the number of lubricators needed to make PCE for any particular job.

6. Entire equipment including adapters, shall be rated to minimum 5000 psi working pressure. In case of high pressure wells / extreme overbalanced / underbalanced perforations, availability of appropriate pressure rated equipment shall be ensured.

7. Check the cable for kinks and broken strands while running in.

8. Correct size adapter flange shall be used to install wellhead pressure control equipment on the wellhead / X-mass tree.

9. Grease injection equipment must be deployed if well is flowing or flow is expected.

10. For grease injection jobs, a sufficient volume of approved grease for entire operation shall be available at the site.

11. Pressure control equipment is never to be used above the rating of the lowest rated item in the complete string.

12. Do not use old tubing in place of riser pipes.

13. Length of lubricator pipes shall be minimum 1 meter more than length of the tool string.

14. A safety check union (automatic pressure shut-off valve / ball check valve designed for use with lubricator pipes) shall be used on high pressure wells and when H₂S is anticipated.

15. In case air pressure is planned to be availed from the rig, ensure that it has sufficient air in the tank so that pumping grease continues unhindered throughout the operation.

16. Rubber elements of the pack-off and rams of BOP shall be inspected thoroughly and pressure tested. While checking BOP at base, it is recommended to use a bar equivalent to the cable size. Armored cable leaks through its strands creating doubt on the sealing by the BOP rams. BOP rams are to be closed around the bar and fluid is to be pumped from the bottom to test the BOP.

17. A tool trap just above the wireline BOP shall be used in all pressure jobs as it gives clear cut indication of the tool entering the lubricator pipe while pulling out.

18. Suitable number of sinker bars shall be used depending upon the cable diameter and expected well pressure.

19. No smoking shall be permitted around the well.

20. All spark / heat generating equipment shall be parked minimum 15 meter upwind from the well mouth.

21. In H₂S environment, the crew members must be equipped with detectors and gas masks.

22. For perforation jobs, a fire tender shall be deployed to be kept on standby.

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8.5 Crane / Mast

For wireline / logging jobs to be carried on rig-less wells, a crane or mast is used as a substitute of rig for hoisting the upper sheave, lifting and fixing the PCE over the wellhead.

8.5.1 Wireline Operations with Crane.
1. The boom length / height shall be sufficient enough to accommodate the height of PCE configured as above.
2. It should preferably have a separate hook of appropriate load capacity for fixing the top sheave.
3. It should preferably have a separate cat-line with an attachable cage able to accommodate 2 persons. This may become necessary to free the cable entangled / entwined at or above GIH.
4. The crane shall be equipped with a support system e.g. outriggers for uneven surface.
5. The crane shall be equipped with load chart & real time display of height & length of boom, load and alarm system.

8.5.2 Wireline Operations with Portable Mast
1. The mast unit shall be installed, operated, and maintained according to the manufacturer's procedure.
2. Must have the following information about the mast unit:
   - Manufacturer's name
   - Unit serial number
   - Total height
   - Maximum load rating
   - Maximum wind-velocity rating at maximum load
   - Distance from mast base to well centerline.
3. Inspect the mast and its raising mechanism according to the manufacturer's procedures before raising it.
4. Guy lines shall be inspected before each rig-up and must be replaced if:
   - Any of the strands are found broken or if the wire rope has any permanent bend /deformity.
   - Rust, corrosion, or heat damage anywhere on the line is seen.
   - Splices in the wire's load-carrying portion are seen.
5. The load-carrying part of any guy line should not be spliced except in an emergency. The spliced wire rope must be replaced as soon as possible.
6. Booms must be equipped with handle safety latches to prevent accidental closing. All such devices must be visually inspected before each use.
7. Spot the mast truck or mast skid such that the distance of the mast base from the wellbore is as specified by the manufacturer, with the mast top centered on the wellhead, directly in line with the logging unit and wellhead.
8. Ensure that the parking brakes of the truck are set.
9. On land, stake the steel cables supplied as guy lines to support the raised mast, and drive those stakes into the ground (after obtaining an excavation permit, if locally required).
10. Lay out guy lines as close to 90 degrees apart as possible, but be sure they will not foul other equipment as the mast rises.

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11. Check that the wireline is carefully threaded through the sheaves and laid out, ensuring that the wireline will not foul other equipment as the mast rises.

12. Before raising the mast from the cradle, ensure that the jacks under the rear end have a solid footing, then tighten and level them. After raising, retighten and re-level. Inspect jacks and footing frequently during operation.

13. Inspect and lubricate pulleys used for telescoping upper-mast sections according to manufacturer’s instructions before telescoping.

14. Check and lubricate all locating and locking pins before raising or lowering the mast.

15. Guy lines must be clear of overhead electric lines by at least 5 meters.

16. Keep all unnecessary personnel clear when raising, lowering, or telescoping the mast.

17. It shall be ensured that everyone understands the signaling procedure before raising the mast.

18. Be very careful during mast raising until the guy wires are secured. Stop if the mast shows any tendency to sway or lean. In high winds, guy lines may need to be staked and secured before raising the boom. Position the unit in line with the wind if possible.

19. Verify proper pawl seating in the pawl rest assembly before applying any load to a telescoping mast. The locking mechanism must be engaged.

20. Hold tension on the winch line to avoid losing line. The winch line must be spooled evenly to prevent jerking when telescoping up or down.

21. With the mast raised, secure it against the stop plate by attaching the safety chains at the rear of the unit to the hooks at the rear of the mast.

22. If, after raising the mast, it is observed that the unit is spotted incorrectly, lower the mast and place it in a horizontal position before moving it.

23. Never move a unit with the mast in its vertical position unless the mast was designed to be so moved. Always follow the manufacturer’s procedures when doing so.

24. Masts must be properly positioned, leveled and then guyed after reaching the proper height. Do not use guy wire tension to position or level the mast.

25. Masts must have all guy lines in service during the entire operation, except during the interval required to replace a damaged wire.

26. Visually inspect the guy lines, leg screws and anchors of any unit left unattended for any length of time before resuming work.

27. Ensure that the ladder is secured before anyone climbs the mast.

28. Use a safety harness when on the ladder or the mast. Do not try to go from one level to another without using the ladder, except in an emergency.

29. Visually inspect all anchors and guy lines after pulls greater than 75% of the rated hook-load capacity or after exposure to winds greater than 35 knots. Be sure to document this inspection on the job report.

30. Follow the manufacturer’s procedure for lowering the mast.

**FOR OFF-SHORE AREA**

1. Control room shall be kept informed about all operations being carried out on unmanned platforms.

2. No operation shall be carried out on unmanned platform during night.

3. No overnight stay back should be allowed on unmanned platform except under emergency situations.

4. Ensure possession of a VHF set before proceeding for job on unmanned platform.

5. Make sure that there is enough space to off load all equipment on unmanned platform.

6. Inspect the mast and its telescoping mechanism before raising it.
7. Size the mast footing to carry mast weight during raising and carry the maximum mast gross weight under maximum load conditions.
8. Off-shore guying depends upon the availability of space; however, the mast shall always be guyed.
9. Guy lines should be anchored to pad eyes welded or otherwise suitably attached to the main platform structure or deck.
10. Position all equipment in such a way that they do not block the escape routes in case of emergency.
11. Always rig up mast under favourable weather conditions.

8.5.3 Working Platform

This is a substitute of rig floor and is required to stand upon for mounting and dismounting the Pressure Control Equipment on wellhead, to handle the well pressure during lowering in and pulling the tool assembly out of the well-bore. It is a necessary arrangement to work safely on rig-less wells. Working platform shall have:

1. Adjustable height to be used with different sizes of Christmas trees.
2. It must be able to withstand a weight of app 500 Kg.
3. It must be stable enough to stand upon and work on it. It shall have an arrangement to be harnessed with well structure.
4. It shall have a ladder harnessed to climb up & down.

8.6 Rigging up and Rigging Down

Refer section 5.6.5 on “Wireline Rig up / Rig down operations”

Trapped pressure may still exist in the equipment even after it has been laid down and apparently bled off. A sure sign of trapped pressure is an unusually tight union connection or a stiff hose.

8.7 Execution of Job

Special attention shall be paid towards flowing condition of the well. Sometimes change may occur in the flow pattern / wellhead pressure of the well during the job. This is more expected after an additional perforation or some stimulation jobs like propellant stimulation or simply by swabbing action caused due to tool movement in smaller ID tubing. Few suggestions listed may be helpful

1. Perfect coordination among the crew is necessary for a successful job.
2. Well serviced equipment like tool-trap, ball check valve, tool catcher etc is very handy in averting major disasters.
3. Never forget to bleed off the pressure trapped inside PCE before opening a joint, usually top of tool trap, to change tool string or to wind-up the job.
4. The pressure bleed-off line must be secured enough to withstand the wellhead pressure.

9.0 LOGGING WHILE DRILLING (LWD) / MEASUREMENT WHILE DRILLING (MWD)

9.1 Well Site Equipment

The M/LWD units shall be serviced at regular intervals and the maintenance activities shall be recorded. The units and containers shall be properly grounded. All containers and tool baskets shall be corrosion free, compliant with HSE standards, well painted with proper logos and markings to indicate serial number, SWL and foot print. The interiors of the units and containers shall be kept clean.

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All drilling tools, lifting subs and other tubulars shall be properly painted, marked, thread protectors installed, torqued or loose connections properly indicated, and serial numbers shall be readable.

Storage of drilling equipment and tools shall be done in a safe manner protecting the personnel from injury. Shipment to and from the base shall comply with the applicable shipping regulations. Shipping details shall include specifics on MWD/LWD tools, DD tools, motors, jars subs and stabilizers, support equipment (i.e. radioactive source containers, shields, sleeve breakers, support containers), and logging cabins.

Rig floor monitors shall be operated in a method compliant with hazardous zone operating requirements

9.2 Signal pressure transducers

Signal Pressure Transducer (SPT) rig-up requires the assistance of the rig crew.

1. Do not install an SPT or associated equipment on the standpipe when it is under pressure or contains fluid. Ensure the standpipe is drained of fluid with the Driller’s assistance before installing SPTs.

2. SPTs must be housed inside a secure protective cover to prevent injuries in case of SPT blowing under pressure.

3. SPT covers and other SPT associated equipment, installed above head height in the derrick, must be chained to a permanent part of the rig structure to prevent them from falling from the derrick.

All pressure equipment and fittings used shall be compatible in pressure rating to the associated equipment in the hydraulic system to which they are introduced. The pressure rating shall be clearly marked on all equipment. No component of a lower pressure rating than the overall system pressure rating may be employed in any system. Correct fittings of the original type supplied by the manufacturer shall be used during all servicing and for all replacement parts.

9.3 Trapped pressure

Take precautions against trapped pressure when working with the tool that has just come out of the hole. If trapped pressure is suspected, make sure that all non-M/LWD personnel are clear of the area before proceeding. If the tool was subject to mud invasion downhole, trapped pressure can be present once on surface. Furthermore, if the surface removable plugs are very difficult to turn while unscrewing, this could be an indication of trapped pressure.

9.4 Job Execution

Safe job execution at the well site will be achieved by following the guidelines inter alia given below:

1. Equipment shall be rechecked, tested and inventoried after arrival at the rig site as soon as possible.

2. Fishing diagrams shall be prepared for all M/LWD equipment prior to running in hole.

3. M/LWD crew shall be present on the rig floor when picking up or laying down M/LWD equipment (even for drilling tools such as non-magnetic drill collars and stabilizers).

4. Surface Tests of tools shall be conducted and recorded.

5. Surface sensor calibrations shall be performed regularly and documented.

6. Battery usage shall be tracked and recorded for any MWD or LWD tools using batteries.

7. Radioactive source transfers and required shield surveys shall be documented
9.5 Lithium batteries

9.5.1 Safety Information

Lithium batteries that are commonly used in LWD tools contain cells which have anodes of Lithium or Lithium-magnesium metal and graphite cathodes with a chloride electrolyte. All of these chemicals are contained in stainless steel hermetically sealed cans. The cell cans are electrically connected together and potted into a modular unit called battery. Safety aspects given below shall be known to the personnel using these:

1. Lithium metal has a melting point of 179 degC (355 degF). Above this temperature, Lithium batteries may rupture, vent or explode. The temperature inside a battery is the sum of the ambient temperature of the battery and the induced temperature rise caused by current drawn from the battery through the battery resistance (or worse, a reverse current forced through a cell by a higher voltage than the cell’s own).
2. Lithium metal reacts explosively with water.
3. The chloride electrolyte is both toxic and corrosive. It can immediately decompose on exposure to humid air, giving off toxic and corrosive fumes.
4. While Lithium cells and batteries are hermetically sealed, they are not designed to withstand downhole pressures. If subjected to such pressures, they will most likely be crushed, causing internal short circuits which could cause a sufficient temperature increase to induce rupture or explosion of the cell.

Hence, the most significant risks are rupture, venting and explosion of the cell or pack. These events release the Lithium and chloride ingredients to the outside environment and may result if the battery is over-depleted. This is called forced-over discharge and results when a live cell drives a current through a dead series connected cell. Some features of this safety hazard are:
- May occur at the end or past normal battery operation.
- Is worse if the battery has always been used at ambient surface conditions.
- Battery is rendered safe by disconnection from tool (assure complete load stoppage).

9.5.2 Precautions with Lithium batteries

The characteristics noted above require a number of standard precautions:

1. Battery spill kit shall always be available with the unit during Lithium Battery operations.
2. Do not short circuit Lithium batteries or the individual Lithium cells. Always protect the battery terminals from accidental short circuits by insulating them with tape when not in use.
3. Do not attempt to charge Lithium cells or batteries. Never connect any Lithium battery or cell to a source of voltage.
4. Do not crush, puncture, cut into or otherwise try to open a Lithium battery or cell.
5. Do not throw Lithium cells or batteries into a fire (like mercury or alkaline cells).
6. Subject Lithium batteries to rated temperatures only - the melting point of Lithium is 179 degC (355 degF).
7. Do not attempt to load or unload Lithium batteries in the rain.
8. Do not dispose off Lithium batteries in public landfills or bodies of water.
9. Always store Lithium batteries in a cool, dry place.
10. Be careful when opening a battery housing after use. If there is any sign of gas or pressure, stop and take precautions (including use of a PPE kit).
11. Do not over-deplete Lithium batteries.
12. The preferred method of disposal is to use an approved agency. Disposal contractors will dispose of the batteries without requiring full depletion. Contact the QHSE person for recommendations.

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13. Never leave a battery unattended in tool. Short checkouts are OK but make sure that the battery does not get depleted during shop tests.

14. Never store a battery with a connected resistor or load.

15. Lithium batteries are considered dangerous and hazardous goods; therefore, strict international regulations dictate transportation and shipment of these batteries.

16. The original individual packaging and shipping containers sent from Manufacturers are approved for international shipping under IATA, hence, it is recommended that all locations retain this packaging for use when shipping batteries for disposal or from location to location. A completed HazMat form and the relevant MSDS must accompany the shipment and be available at all times during transportation.

17. Lithium batteries can only be flown in non-passenger aircraft (i.e. cargo aircraft ONLY). Helicopters flying to offshore installations are considered passenger aircraft only when carrying passengers.

18. Emergency Response Plan for Lithium batteries shall be in place and readily available / displayed in the unit.

Apart from above safety precautions, Battery (Management and Handling) Rules, 2001 shall be followed.

10.0 HYDROGEN SULPHIDE (H₂S) WELLS LOGGING SAFETY

The presence of Hydrogen Sulphide gas in a well imposes several limitations on wireline logging services. There are three main areas of utmost importance while working in H₂S environment.

1. Safety of personnel
2. Safety of wireline equipment

10.1 Characteristics of H₂S

H₂S has the following characteristics:

1. It is extremely toxic.
2. It is heavier than air with a specific gravity of 1.192 at 77°F. Vapours may travel considerable distance to a source of ignition and flash back.
3. In small quantities, it has an odor similar to the rotten eggs.
4. It is colourless.
5. It burns with a blue flame and produces Sulphur Dioxide (SO₂) gas, which is very irritating to the eyes.
6. It forms an explosive mixture with air, between 4.3% and 43% by volume. This mixture has an auto-ignition level of 500°F.
7. It is soluble in both water and liquid hydrocarbons.
8. It is corrosive to all electrochemical metals. It also reacts with plastics, human tissues and nerves.
9. It produces irritation to the eyes, throat and respiratory system. It affects major nerves within the human nervous system.
H₂S TOXICITY TABLE

<table>
<thead>
<tr>
<th>Concentration</th>
<th>PHYSICAL EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>00.001% or 10 ppm</td>
<td>Obvious unpleasant odor. Threshold limit. Safe for 8 hr. of exposure</td>
</tr>
<tr>
<td>00.0015% or 15 ppm</td>
<td>Short threshold limit. Safe for 15 minutes exposure</td>
</tr>
<tr>
<td>00.002% or 20 ppm</td>
<td>Kills sense of smell in 3 to 15 minutes, may sting eyes &amp; throat</td>
</tr>
<tr>
<td>00.01% or 100 ppm</td>
<td>Kills sense of smell immediately and stings eyes &amp; throat</td>
</tr>
<tr>
<td>00.02% or 200 ppm</td>
<td>Dizziness, breathing ceases in a few minutes</td>
</tr>
<tr>
<td>00.05% or 500 ppm</td>
<td>Loss of consciousness occurs quickly. Death soon follows.</td>
</tr>
<tr>
<td>00.07% or 700 ppm</td>
<td>Immediate loss of consciousness followed by death within minutes.</td>
</tr>
<tr>
<td>0.10% or 1000 ppm</td>
<td></td>
</tr>
</tbody>
</table>

10.2 Safety in wireline equipment

Special care must be taken in selecting and preparing surface pressure control equipment (BOP, riser, flow tubes, grease heads etc.). Film forming inhibitors can retard the corrosion and embrittlement caused by H₂S. Inhibitors chosen shall be soluble, dispensable under controlled conditions and have a protective film that is self-healing when broken.

10.2.1 Pressure Control Equipment

Standard BOP and lubricators for use with logging cable are subject to quick failure in H₂S environment. In H₂S environment, equipment for sour service as per NACE shall be used where partial pressure of H₂S is above the threshold value.

10.2.2 Cables

Logging cables may fail after brief exposure to even low concentrations of H₂S because it attacks the steel armor wires, causing hydrogen embrittlement. Special H₂S resistant logging cables must be used for H₂S concentration greater than the threshold value.

10.2.3 Tools and Guns

There is no downhole equipment designed specifically for H₂S operations. Extra efforts should be made to clean up the tools and guns before and after H₂S jobs. Also, an inhibitor shall be used.

10.2.4 O-rings and Seals

Close attention must be given to the proper selection of O-rings when working in H₂S. Use Viton O-rings and rebuild the logging head after three to four downhole trips.

10.3 Operations and limitations

The following procedures apply when working in a H₂S environment. Items preceded with (*) apply only when standard non H₂S certified equipment is used.

1. Ensure all personnel assigned to the job have undergone H₂S training.
2. Pressure check all pressure equipment to 1.2 times the expected well pressure.
3. (*) Bathe all internal parts of the blow out preventors, riser, wellhead adapters and stuffing boxes with a solution of inhibitor.
4. Use H₂S grade O-rings and seals when making up tools and guns.
5. Mix proper amount of inhibitor with injector grease and line oiler.

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6. Verify status of H₂S monitors and respiratory equipment.
7. Ensure bleed off lines are securely chained.
8. After opening the well, feed a continuous stream of inhibited grease into the pressure control equipment to replace any loss during the operation.
9. When bleeding off pressure, ensure the operator remains upwind with respiratory equipment donned.
10. Open all tools/guns parts or seals slowly to relieve any trapped pressure. Back off only enough to break the seal.
11. (*) Non-proofed equipment shall not be used again for several days to allow the atomic hydrogen to diffuse out. Failure to do this can cause premature failure of equipment.
12. (*) Check cables for possible H₂S damage. If damage is indicated, the only safe action is to use another cable until the damaged cable has been properly checked for strength and H₂S damage.

10.4 Safety of personnel

All personnel likely to be involved with H₂S environment operations, must be specially trained in the following:

1. H₂S Characteristics and hazards to personnel and equipment.
2. Use of H₂S detectors and their limitations.
3. Use of protective (respiratory) equipment and emergency procedures.
4. Selection, preparation and use of equipment for H₂S environment.
5. Special Operating procedures in H₂S environment.

10.4.1 Detection of H₂S

1. H₂S detection cannot be relied upon smell only.
2. Existing H₂S detectors may be fixed-location monitors or attached to the clothing of personnel.
3. Monitors may be qualitative or quantitative and may use chemical or electronic sensors.
4. Proper detector positioning is critical. Place fixed monitors in low areas where H₂S accumulates. Wear the personal detector at waist height.

10.4.2 H₂S Emergencies

1. If H₂S gas concentration exceeds 10 ppm in air, stop work and don approved respiratory equipment.
2. Leave the area if are not working.
3. If H₂S gas concentration exceeds 50 ppm in air, all personnel shall leave the area immediately except those whose assigned job is to contain the emergency. Staying personnel must wear appropriate respiratory equipment.
4. In the event of a sudden release of H₂S gas, or on hearing H₂S gas release warning signals.
   - Hold your breath to avoid breathing the gas.
   - Put on protective equipment.
   - Help any person in distress.
   - Leave the area and gather for muster and a safety briefing.
   - Re-enter the area with protective equipment for repairs or to continue operations as appropriate.

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5. Emergency priorities MUST be:
   - Personal safety
   - Safety of others
   - Containment of emergency
   - Completion of operation

10.4.3 Rescue and treatment of H2S victims

10.4.3.1 Rescuing the victim

1. Ensure your own safety first. Use respiratory equipment.
2. Check upwind safe area for sufficient air supply before moving victim.
3. Check your mask seal before entering a contaminated area.
4. Two people can rescue better than one person.
5. Use all available aids such as stretches, ropes, slings etc.
6. Remove the victim to non H2S location as quickly as possible. Every second is vital after H2S inhalation. If the victim has inhaled a lethal amount of H2S, he may have only moments to live, unless adequate first-aid is applied.

10.4.3.2 Treatment of the victim

1. Clear the air passage.
2. If the victim is breathing, administer oxygen through a mask.
3. If the victim is not breathing, begin mouth to mouth resuscitation immediately.
4. Irrigate eyes with normal saline, or if not available, by clean water.
5. Keep victim warm with feet elevated.
6. Follow first aid procedure for other associated conditions such as:
   a. If there is no pulse and no heart sounds are audible when ear is applied to victim’s chest, begin Cardio- pulmonary (CPR) resuscitation.
   b. In case of bleeding, secure it by appropriate method- direct pressure, tourniquet.
7. Get medical help as soon as possible.
8. H2S exposure victim should return for duty only after getting clearance from his treating doctor.

11.0 EMERGENCY RESPONSE PLAN

Various emergency situations can arise at logging Base or well site during logging operations and during movement of logging units/trucks. Certain standardized response procedures need to be adopted to cope up with these situations.

Often, contractual logging services are also being availed by E & P companies through various contracts for wireline logging, perforating and LWD services. A comprehensive Emergency Response Plan (ERP) providing guidance for actions to be taken under various types of emergency conditions that are likely to occur in logging operations shall be prepared in line with OISD-GDN-227 on ‘Emergency Response Preparedness in E&P Industry’.

The following emergency conditions inter alia be covered in the ERP:

1. Fire
2. Blow out during logging operations
3. Emergencies involving Explosives
4. Emergencies involving radioactive material

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5. Logging tool stuck up during operations
6. Accident involving logging units/vans

11.1 Fire
Occurrence
1. In logging Base complex
2. In logging units during logging operations
3. At the well site/Rig

Action
1. In case of fire in logging Base Complex, the person who first notices the fire will shout ‘fire’, ‘fire’ and ring the fire bell. He or another person will call the fire station and inform about the emergency specifically and clearly mentioning the address and the type of fire. If the fire is of small magnitude, he will take the nearest appropriate portable fire extinguisher and try to put it off.

2. In case of fire in logging unit during logging, the portable fire extinguisher kept in the unit shall be used. If the radio active sources and Explosives are loaded in the unit, an attempt shall be made to take them out without risking personal safety.

3. In case of fire on on-land rig, attempt should be made to retrieve the equipment to safe distance from the well site. RA and explosives material are to be retrieved first.
   In offshore Rig, Explosives and RA material shall be dumped into the sea immediately. A buoy & beacon system installed is to be used for tracking RA sources. Head Logging and Logistics shall be informed.

11.2 Blowout during Logging Operations
Occurrence:
Blow out may occur during open hole logging or cased hole/production logging operations.

Action:
1. In case of a blow out situation during logging operation at a well where there is a Rig, the In-charge of Rig will take command of the situation. Immediate shifting of the logging equipment particularly the explosives and radioactive sources shall be carried out.

2. In case of a blow out situation during logging operation at a well where there is no Rig, the In-charge, logging at site will take command of situation. He will flash the message to key personnel at base office including Crisis Management Team with the help of Incharge of any nearby Installation or Rig.
   - Try controlling the blowout by grease injection at maximum rate while keeping the tool stationary.
   - Close master valve of Christmas tree to the extent possible.
   - Move the logging equipment away.

3. In-charge of Drilling / Work over Rig/ Installation concerned, as the case may be, will report immediately on receipt of message & assume charge at site soon after arrival. All personnel and, if possible, equipment should be moved to safe distance from the area.

11.3 Emergencies involving Explosives
Occurrence
1. In storage facilities
2. During transportation
3. At well site

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Action

1. In storage facilities
   In the event of an explosion in the storage facility, there is no way to control it, except to wait and watch and warn the surrounding people not to approach the site. Besides the logging Base, Civil authorities and Controller of Explosives shall be informed.

2. During transportation
   In case a vehicle transporting explosives is involved in an accident, fire or any other occurrence, the driver shall take all practical steps to ensure that
   1. All other traffic is stopped at least 300 meters from the vehicle and that all persons in the vicinity are warned of the danger.
   2. Inform the licensee who shall inform the Chief controller of Explosives and the Controller of Explosives in whose jurisdiction the accident has taken place giving the full details of explosives carried and the accident.
   3. Inform nearest police station and comply with all requirements of the law relating to road accidents.
   4. Arrange for safe storage and custody of explosives till an examination by the Controller of Explosives, if required, and then arrange transport to the destination or place designated by the Controller of Explosives.
   5. Where major repairs are required in the van, the explosives must be shifted to another van or removed from the vehicle and stored under proper security and kept at a safe distance from the highway and habitations.
   6. Loaded explosives van shall not be towed with another vehicle in case of breakdown.
   7. No welding jobs shall be carried out with explosives in the van.

3. At well site
   In the event of explosives firing etc. at surface, logging crew chief shall inform DIC, who will assume charge of the situation in consultation with In-charge logging. Information shall also be given to Dy CCE / DGMS of the area in consultation with I/C HSE. For offshore areas intimation shall be given to OISD within 24 hours of the incident of firing of explosives in line with Rule 11 of the Petroleum and Natural Gas (Safety in Offshore Operations) Rules, 2008.

Addresses of persons to be contacted in such cases are given in Annexure IV TREM Card- Explosives carriage).

11.4 Emergencies involving Radioactive Material

Occurrence:
1. In storage facilities
2. During transport.
3. At Well site
4. Leakage or rupture of the radioactive source.

Action:
In any of the above emergency situations, procedures as advised by AERB/ BARC shall be strictly followed.

1. During Storage

Radioactive sources, when not in use are stored at logging base in suitable constructed storage room, which is approved by AERB. In case of rupture, theft, or damage to the radioactive sources by extremists/ anti social elements, district authorities and AERB shall be informed by the logging base In-charge.
2. During transportation

The sources are transported in specified containers to the well site. If any damage occurs to the sources/containers during the transit, the following steps shall be taken-

- Cordon off the Area.
- Demarcate the area of excessive radiation by Radio activity survey.
- Note down the Names and Addresses of the persons who might have been exposed to the radiations.
- Inform logging base and the Civil Authorities.
- Inform RSD, AERB, Mumbai.

Addresses of persons to be contacted in such cases are given in Annexure- VIII (TREM Card-Radioactive Sources carriage).

3. At Well Site

Logging tool carrying radiation source may get stuck in the well during operation. In the event of failure to fish out the same from the well, the following details shall be submitted to AERB and their guidelines shall be followed:

- Date of occurrence
- A description of the irretrievable well logging source involved including the radio-nuclide and its activity
- Identification of the well (Well Name, Area)
- Depth of the source
- Depth of the top of cement plug
- Brief description of the attempted recovery effort

RESPONSIBILITY AND AUTHORITY

Head logging services is identified as the Chief Emergency Coordinator to develop and administer the overall emergency preparedness. In-charge, Logging Operations and logging safety officers will act as the coordinators in case of any emergency. Head-HSE of Project to be kept informed.

In case of any accident in offshore operations which involves explosives or radioactive materials, in addition to above, OISD shall be intimated by telephone or by fax in line with Rule 11 on ‘Notice of accident’ of the Petroleum and Natural Gas (Safety in Offshore Operations) Rules, 2008.
REFERENCES:

1. Manuals on Safety in Well Logging of Schlumberger and Halliburton.


4. The Explosives Act, 1884 along with the Explosives Rules, 2008. (available at www.peso.gov.in)


6. Corporate Disaster Management Plan of ONGC

7. Code of Safe Practices of ONGC
PRE DEPARTURE CHECK LIST FOR EXPLOSIVES SAFETY EQUIPMENT
(to be filled at base)

The logging truck shall leave base only after all the answers in the check list are ‘yes’, and a signed copy should be left with base incharge.

Unit No. ___________  PREPARATION DATE ______
TO PROCEED TO WELL NO ______________

A. Has the following items been loaded on the truck?

<table>
<thead>
<tr>
<th>Item</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Safety tube</td>
<td>Yes / No</td>
</tr>
<tr>
<td>2. Detonator carrying box with proper lock and key</td>
<td>Yes / No</td>
</tr>
<tr>
<td>3. Explosives Remnant Box with proper lock and key</td>
<td>Yes / No</td>
</tr>
<tr>
<td>4. Casing to rig voltage monitor</td>
<td>Yes / No</td>
</tr>
<tr>
<td>5. Safety meter for testing detonators</td>
<td>Yes / No</td>
</tr>
<tr>
<td>6. Safety grounding device of truck / unit with spool and C clamps</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

B. Has the explosives field check list been taken?  Yes / No

C. Has the following sign boards in Hindi, English and Regional Language taken?

<table>
<thead>
<tr>
<th>Sign Board</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A) DANGER ZONE, EXPLOSIVE IN USE, TURN OFF ALL RADIOS.</td>
<td>Yes / No</td>
</tr>
<tr>
<td>B) DANGER ZONE, EXPLOSIVE IN USE, TURN OFF ALL GENERATORS.</td>
<td>Yes / No</td>
</tr>
<tr>
<td>C) DANGER ZONE, EXPLOSIVE IN USE, TURN OFF ALL WELDING MACHINES</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

Countersign

Logging Crew Chief  Logging Engineer
Date  Place  Date  Place

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## CHECK LIST FOR EXPLOSIVES SAFETY PROCEDURES
*(AT SITE- Joint Safety / Tool Box Meeting)*

<table>
<thead>
<tr>
<th>WELL NO.</th>
<th>UNIT No</th>
<th>DATE</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Have the following sign boards in Hindi, English and local Language been displayed at appropriate places in the well site area?
   - A) **DANGER ZONE, EXPLOSIVE IN USE, TURN OFF ALL RADIOS**
   - B) **DANGER ZONE, EXPLOSIVE IN USE, TURN OFF ALL GENERATORS.**
   - C) **DANGER ZONE, EXPLOSIVE IN USE, TURN OFF ALL WELDING MACHINES**

2. Have all the arc / gas welding machine been turned off? Yes / No

3. Have the Radio Transmitters / Receiver Phone within 300 m been turned off? Yes / No

4. Is there a large radio / television station within 4 km. (If yes, contact the head Logging base for instructions ) Yes / No

5. Have all generators been turned off Yes / No

6. Has the cathodic protection system been turned off? Yes / No

7. Any State Electricity Board power connection to SRP within 30 m from wellhead has been switched off and ends connection insulated? Yes / No

8. Confirm that there is no high tension line (over ground and underground) in the vicinity of perforation job site. If it exists, has it been disconnected and ends insulated? Yes / No

9. Has the defective rig wiring, if any, been removed? Yes / No

10. Is there any warning for sand storm / thunder storm? In case of any storm suspend operations till the storm subsides. Yes / No

Contd…

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Contd. from pre-page:

11. Have all open fires, if any, in the vicinity of well site been removed?  
   Answer: Yes / No

12. Has the WLS safety officer visited the site and his recommendation complied with?  
   Answer: Yes / No

13. Has the Mobile Phones been switched off?  
   Answer: Yes / No

14. Is the well site free from obstacles and slippery areas? (specially catwalk, logging unit parking place etc)  
   Answer: Yes / No

15. Is the well scrapped thoroughly after last cementation / squeeze perforation job?  
   Answer: Yes / No

16. Is the well circulated thoroughly?  
   Answer: Yes / No

17. Is the well filled with the fluid?  
   Answer: Yes / No

18. Is the BOP tested?  
   Answer: Yes / No

19. Whether pressure control equipment is used  
   a. Are lubricators and hydraulic pack offs function tested?  
   b. Wireline BOP is function tested?  
   Answer: Yes / No

20. Are there any other hazards coming up in the way of the safe working practices?  
   Answer: Yes / No

21. Has the logging unit been parked at a safe distance? (to be confirmed by Logging Crew Chief)  
   Answer: Yes / No

In case of No appearing in 3rd column above, reasons for same and compensating measures in place to be given.

Above checks have been made and site conditions are appropriate for commencing operations involving explosives.

(Signature of Logging Crew Chief)  
(Signature of Drilling In-charge)  
Hired Rigs - Company man  
Owned Rigs - Onland - Tool Pusher  
Offshore - OIM

Date  
Place  
Date  
Place

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Annexure-III

CHECK LIST FOR EXPLOSIVES FIELD OPERATIONS

<table>
<thead>
<tr>
<th>WELL NO.</th>
<th>UNIT No</th>
<th>DATE</th>
<th>Rigging up:</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1. Remove any rig wiring that might contact the cable while rigging up cable</td>
<td>Yes / No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2. Install the Casing- to Rig Voltage Monitor. Check for residual voltage. Do not proceed with operations if the value exceeds 0.25 V. Investigate the cause and reduce the level to 0.25 V.</td>
<td>Yes / No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3. If the residual voltage is less than 0.25 V AC-DC, install safety grounding cable between unit, rig and wellhead. Leave the voltage monitor connected between the rig and the casing.</td>
<td>Yes / No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4. Turn off the AC Generator of Truck / Unit.</td>
<td>Yes / No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5. Engage the Safety Switch to SAFE mode and remove the key. The key shall be in the personal custody of Incharge Logging</td>
<td>Yes / No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6. Prior to attaching any explosives device to the cable, check the following: 6.1 Does the Casing to Rig voltage monitor reads less than 0.25 V DC-AC?</td>
<td>Yes / No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.2 Clear all personnel from the line of fire.</td>
<td>Yes / No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.3 Attach the explosives device to the cable. At this time, the Safety key must be in the possession of the Incharge Logging and till the time the tool / perforator is at least 100 m below ground level.</td>
<td>Yes / No</td>
</tr>
</tbody>
</table>

Arming

|          |         |      | 7. Only the Logging Crew Chief is authorized to arm the gun and shall follow the sequence below: 7.1 Attach the cable to the gun before arming the gun. 7.2 Keeping the detonator in Safety Tube, test it with a Safety Meter. 7.3. With the detonator in safety tube arm the gun electrically. i) First connect the ground lead. ii) then connect the central lead. 7.4 Arm the gun ballistically last by crimping the detonator to the detonating cord. | Yes / No |

Contd....

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Contd. from pre-page:

|   |   |  
|---|---|---|
| 8. | Lift the gun and lower it into the well safely and quickly. | Yes/No |
| 9. | After the gun string is at least 100 m below the ground level, turn on the power generators etc. | Yes/No |
| 10 | Disengage the safety lock; insert the cable jack to the collar locator socket for depth tie up. | Yes/No |
| 11 | Tie in, position gun and shoot | Yes/No |

**Pulling out**

|   |   |  
|---|---|---|
| 12 | Switch off the shooting circuit and bring back the cable jack to collar socket and pull up the gun. | Yes/No |
| 13 | While pulling out of the hole, stop at least 100m below the ground level and return cable jack to SAFE mode and remove the key and keep with In-charge Logging | Yes/No |
| 14 | After any shooting, successful or not and when the gun is at around 30m below ground /sea level proceed the same way as the before running in. | Yes/No |
| 15 | On surface, all gun shall be safely relieved of any trapped pressures/gasses. | Yes/ No |
| 16 | If misfired, ensure temp of gun below 100 °C and disarm the gun by disconnecting the detonator  
   a) First cut the prima cord from the detonator with a sharp blade  
   b) Disconnect the central lead and disconnect the ground lead. | Yes/No |
| 17 | Police the area for detonator cord remnants, unused/damaged charges etc. and store then in the explosives remnant box and lock | Yes/No |
| 18 | Store all unused detonators in the detonator carrying case and lock. | Yes/No |

In case of No appearing in 3rd column above, reasons for same and compensating measures in place to be given.

(Signature)  
Logging crew Chief

(Signature)  
Logging Engineer

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### Annexure IV

**TREM CARD – EXPLOSIVES CARRIAGES (TRANSPORT EMERGENCY CARD)**

<table>
<thead>
<tr>
<th>Cargo</th>
<th>Explosive Material</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nature of Hazard</strong></td>
<td>Explosive Material—may explode on catching fire</td>
</tr>
<tr>
<td><strong>Emergency Action</strong></td>
<td><strong>In case of Breakdown</strong>&lt;br&gt;- Inform Logging Party Chief/Head Logging&lt;br&gt;- Inform Nearest Police Station in case night halt is necessary. <strong>In Case of Fire</strong>&lt;br&gt;- Keep everybody at safe distance. Divert traffic, if required.&lt;br&gt;- Inform Logging Party Chief/Head Logging and nearest Police Station.</td>
</tr>
</tbody>
</table>

**Contact Persons/ Nos. for advice and assistance**

<table>
<thead>
<tr>
<th>Immediate</th>
<th>In-charge Logging Location</th>
<th>Phone / Fax / e-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For areas in Gujarat, Maharashtra, Daman &amp; Diu</strong></td>
<td>Joint Chief Controller of Explosives (West Circle), A-1/A-2 Wing, 5th Floor, CGO Complex, CBD Belapur, Navi Mumbai-400 614</td>
<td>022-27564941, 27575946, 2757881</td>
</tr>
<tr>
<td><strong>For areas in Rajasthan, Delhi, Punjab, Haryana, Himachal Pradesh, Chandigarh and Jammu &amp; Kashmir</strong></td>
<td>Joint Chief Controller of Explosives (North Circle), Hall no 502 &amp; 507, Level 5, Block B, Old CGO Complex, NH-IV, Faridabad-121001, Haryana</td>
<td>0129- 2410730, 2410731, 2410732, / 2410734</td>
</tr>
<tr>
<td><strong>For areas in Uttar Pradesh, Uttarakhand, Madhya Pradesh, Chattisgarh</strong></td>
<td>Joint Chief Controller of Explosives (Central Circle), 63/A, A wing, 2nd floor, Kenrayala CGO</td>
<td>0562-2523266 /2523244</td>
</tr>
<tr>
<td><strong>For areas in Karnataka, Andhra Pradesh, Tamil Nadu, Kerala, Lakshwadeep Islands</strong></td>
<td>Joint Chief Controller of Explosives (South Circle), No.140, Rukmini Laxmipathi Road, Marshalls Road, Egmore, Chennai-600008</td>
<td>Phone: 044-28419529</td>
</tr>
<tr>
<td><strong>For areas in Bihar, Jharkhand, West Bengal, Orissa, North East States</strong></td>
<td>Joint Chief Controller of Explosives(East Circle), 1st floor, 8, Esplanade East, Kolkata-700089</td>
<td>033-22480427, 22489524, 22486600 /22420686</td>
</tr>
</tbody>
</table>

**Head Office**<br>Chief Controller of Explosives, Department of Explosives (PESO), A Block, 5th Floor, CGO Complex, Seminary Hills, Nagpur-440006 | 0712-2510248 / 2510579 |

* This information is to be updated by the company at periodic intervals

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Annexure V

DOWNHOLE BUNKER – SKETCH SHOWING DISPOSAL OF UNUSABLE OIL WELL EXPLOSIVES IN AN ABANDONED WELL

(Not to scale)

300 m Cement Plug up to surface

100 m Cement Plug

Bridge Plug

Casing shoe

Fluid of sp gravity < 1.2

Unusable explosives loaded in combination of 3” & 4” Perforated Plastic pipes

Cement Plug 100 m

Bridge Plug

Casing shoe

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Annexure-VI

PRE DEPARTURE CHECK LIST FOR RADIOACTIVE SAFETY (TO BE FILLED AT BASE)

The Logging Truck shall leave base only after all the answers in the check list are yes and a signed copy should be left with Base In charge/In charge Logging Operations.

Unit No ___________ Date ___________

To Proceed to Well No. ___________ Rig. ________________

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Proper Remote source handling rods available?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>2</td>
<td>Source storage containers in the logging unit clean?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>3</td>
<td>Radiation warning symbols displayed on the vehicle carrying radioactive sources</td>
<td>Yes/No</td>
</tr>
<tr>
<td>4</td>
<td>All tools are loaded in logging unit before loading RA Sources</td>
<td>Yes/No</td>
</tr>
<tr>
<td>5</td>
<td>Is TREMCARD displayed in the unit?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>6</td>
<td>All persons handling RA sources wearing TLD / FNM badges</td>
<td>Yes/No</td>
</tr>
<tr>
<td>7</td>
<td>Is Source room under double lock?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>8</td>
<td>Is radiation level in the vicinity of source room within limit(≤2 mR/Hr)</td>
<td>Yes/No</td>
</tr>
<tr>
<td>9</td>
<td>Underground pits/Containers where the radioactive source stored is appropriately labeled</td>
<td>Yes/No</td>
</tr>
<tr>
<td>10</td>
<td>Sources are loaded in the Logging Unit</td>
<td>Yes/No</td>
</tr>
<tr>
<td>11</td>
<td>Source handling rods are loaded in the Logging Unit</td>
<td>Yes/No</td>
</tr>
<tr>
<td>12</td>
<td>Source room double locked after loading RA sources in truck</td>
<td>Yes/No</td>
</tr>
<tr>
<td>13</td>
<td>Source container in the Logging Unit locked</td>
<td>Yes/No</td>
</tr>
<tr>
<td>14</td>
<td>Storage box containing RA Sources in the Logging Unit locked</td>
<td>Yes/No</td>
</tr>
<tr>
<td>15</td>
<td>Entry made in the RA Source Movement Register</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

In case of No appearing in 3rd column above, reasons for same and compensating measures in place to be given.

Counter sign
Logging Crew Chief ____________________ Logging Engineer ____________________
Date ___________ Place ___________ Date ___________ Place ___________
Annexure-VII

POST ARRIVAL CHECK LIST FOR RADIOACTIVE SAFETY
(TO BE FILLED AT BASE)

Immediately after return to Base, check list is to be filled and a signed copy should be left with Base In charge/ In-charge Operations.

<table>
<thead>
<tr>
<th>Unit No</th>
<th>Date</th>
<th>Returned from Well No.</th>
<th>Rig No</th>
<th>Remarks</th>
</tr>
</thead>
</table>

1. Storage box containing RA Sources in the Logging Unit locked? Yes/No
2. Source container in the Logging Unit locked? Yes/No
3. Is the Source room locked Yes/No
4. Unlock the Source room Yes/No
5. Transfer RA Sources source room from Logging Unit Yes/No
6. Is Source container in source room locked Yes/No
7. Have Source handling rods put back in source room? Yes/No
8. Entry made in the RA Source movement register Yes/No
9. Is Source room double locked after transferring RA sources to Source room Yes/No
10. All Keys put back in safe place? Yes/No

In case of No appearing in 3rd column above, reasons for same and compensating measures in place to be given.

Counter sign
Logging Crew Chief Logging Engineer

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## Annexure VIII

### TREM CARD – RA SOURCES CARRIAGE (TRANSPORT EMERGENCY CARD)

<table>
<thead>
<tr>
<th>Cargo</th>
<th>In-dispersible Radioactive Material (Nucleonic gauges)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nature of Hazard</strong></td>
<td>Radioactive Material- Potential external exposure</td>
</tr>
<tr>
<td><strong>Emergency Action</strong></td>
<td></td>
</tr>
</tbody>
</table>
  - Keep everybody at safe distance. Divert traffic, if required.  
  - In case of fire, fight from a distance.  
  - Inform Logging Party Chief/ Head Logging and nearest Police Station.  
  - Note down names and addresses of persons who might have been exposed to radiation and convey particulars to Head Radiological Safety Division (RSD), AERB and Head, Radiological Physics and Advisory Division (RPAD), BARC, Mumbai |

### Contact Persons/ Nos. for advice and assistance *

<table>
<thead>
<tr>
<th>Immediate</th>
<th>In-Charge - Logging Location</th>
<th>Phone / Fax</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAE Emergency Control Room Chairman, Crisis Management Group, DAE, Mumbai-400001</td>
<td>022-22023978, 22830441 / 022-22830441</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>By Fax/ Phone</th>
<th>Head Radiological Safety Division (RSD) AERB, Niyamak Bhavan, Anushakti Nagar, Mumbai-400094</th>
<th>022-25990655, 25574287 / 022-25990650, 25562344</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Head Radiological Physics &amp; Advisory Division (RPAD), BARC, CT &amp; CRS Building, Anushakti Nagar, Mumbai-400094</td>
<td>022-25519209 / 022-25519209</td>
</tr>
</tbody>
</table>

* This information is to be updated by the company at periodic intervals.
**Annexure-IX**

**CHECK LIST FOR RADIOACTIVE SAFETY PROCEDURES**
*(AT SITE- Joint Safety / Tool Box Meeting)*

<table>
<thead>
<tr>
<th>Well No.</th>
<th>Unit No.</th>
<th>Rig</th>
<th>Date</th>
<th>Remarks</th>
</tr>
</thead>
</table>

|   |   | 1. Is the well site free from obstacles and slippery areas? (specially catwalk, logging unit parking place etc) |   | Yes/No |
|   |   | 2. Is the well conditioned thoroughly? |   | Yes/No |
|   |   | 3. Are there any other hazards coming up in the way of safe working practices? |   | Yes/No |
|   |   | 4. Has the logging unit been parked at a safe distance from wellhead? |   | Yes/No |
|   |   | 5. Appropriate sign boards displayed and barriers provided for safe usage of RA Sources |   | Yes/No |
|   |   | 6. All non-essential personnel are cleared from the Rig floor/ Catwalk area |   | Yes/No |

Above checks have been made and site conditions are appropriate for commencing operations involving radioactive materials.

(Signature of Logging Crew Chief)  
Hired Rigs -Company man  
Owned Rigs- Onland -Tool Pusher  
Offshore- OIM  

Date  
Place

(Signature of Drilling In-charge)  

Date  
Place

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Annexure-X

CHECK LIST FOR RADIOACTIVE FIELD OPERATIONS
(AT SITE- During Logging Operation)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All persons handling RA sources are wearing TLD/FNM badges?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>2</td>
<td>All other logging personnel are cleared from rig floor area?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>3</td>
<td>All equipments necessary for source transfer are checked?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>4</td>
<td>Source housing of the tool OK?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>5</td>
<td>Physical inspection of the source OK?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>6</td>
<td>Condition of O-ring in RA Source OK?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>7</td>
<td>Direction of radiation in collimated source away from body?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>8</td>
<td>Source inserted in tool source holder properly</td>
<td>Yes/No</td>
</tr>
<tr>
<td>9</td>
<td>Source is properly locked in the tool</td>
<td>Yes/No</td>
</tr>
<tr>
<td>10</td>
<td>Source screws are tightened properly</td>
<td>Yes/No</td>
</tr>
<tr>
<td>11</td>
<td>Personnel lowering tool at safe distance from the source</td>
<td>Yes/No</td>
</tr>
<tr>
<td>12</td>
<td>Tool thoroughly cleaned after logging</td>
<td>Yes/No</td>
</tr>
<tr>
<td>13</td>
<td>Source removed from the tool &amp; transferred to container in logging unit</td>
<td>Yes/No</td>
</tr>
<tr>
<td>14</td>
<td>Source transfer is shared by more than one person</td>
<td>Yes/No</td>
</tr>
<tr>
<td>15</td>
<td>Source container locked after transferring source?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>16</td>
<td>Source storage box locked</td>
<td>Yes/No</td>
</tr>
<tr>
<td>17</td>
<td>Source handling equipments kept at designated places</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

In case of No appearing in 3rd column above, reasons for same and compensating measures in place to be given.

Counter signed by-
Logging Crew Chief Logging Engineer

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Annexure XI

WIPE TEST PROCEDURE FOR SEALED RADIOACTIVE SOURCES

Material required for a Wipe test

- Wipe medium e.g. filter paper, cotton wool or any other material of high wet strength and absorbent capacity.
- Water or methylated spirit or any other liquid which will not attack or react with the material of the source housing.
- Surgical/Disposable gloves
- Forceps or tongs.
- Small plastic bags.
- Radiation measuring instrument.
- Identification labels / marking pen.

Procedure

The source need to be cleaned (decontaminated) before a wipe test. A wet or dry wipe test is carried out depending upon the situation. Normal wipe test is a wet wipe test.

- **Wet Wipe Test**

  All external surfaces of the sealed source shall be wiped thoroughly with a swab of filter paper, or other suitable material of high absorbent capacity, moistened with a liquid which will not chemically attack the material of external surface of the sealed source and which, under conditions of the test, has been demonstrated to be effective in removing any radioactive material present. The activity of the swab shall be measured.

- **Dry Wipe Test**

  This test can be used in situations where it may not be appropriate to use a wet swab, for example, for high activity Cobalt-60 sources or in some recurrent inspections. To carry out the test, all external surfaces of sealed source shall be thoroughly rubbed with a dry swab of filter paper and the activity of the swab shall be measured using a radiation measuring instrument.

  After the wipe, each wipe medium used must be placed in an individual plastic bag which is then sealed together with an identification label. Alternatively, one could write a description and identification (type of radionuclide and serial number of the source) on the bag.

  The wipe must be done by a competent and qualified person.

Approval Criteria

If the activity detected does not exceed 85 Bq, the sealed source is considered to be leak-tight.

**Note:** In case of a suspected leak, further leak confirmation tests shall be done with high precision instruments under the guidance of AERB / BARC.

Precautions

- Surgical / disposable gloves shall be worn to protect the hands from possible radioactive contamination.
- Forceps or tongs shall be used to minimize radiation exposure of the hand.

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The sealed plastic bag containing the wipe medium shall not be opened prior to measurement of the radioactivity of the sample.

**Measurement of Radioactive Contamination**

The wipe medium is brought to the measurement facility and checked for radioactivity to determine whether any significant contamination is present. The contamination monitoring equipment used depends on the type and energy of the ionising radiation emitted from the radioactive sealed source tested. In general, for beta emitters, a GM counter is used and for gamma emitters, a scintillation counter is used. These are connected to a single channel analyser and calibrated for the particular radionuclide before the wipe medium is counted. A report will be generated and test results are recorded in a register.

Wipe tests should, wherever possible, be checked immediately on basic contamination measuring equipment, for example, a Geiger counter, to establish whether there is any gross contamination prior to final measurement on more sophisticated equipment.

If the source is found to be leaking, it shall be dismantled and put into a leak-proof container. It shall not be brought into use until all necessary repairs have been affected. The areas affected by the leakage shall be decontaminated with information to or under the supervision of AERB / BARC. More information on leakage tests of sealed radioactive sources can be found in the AERB SAFETY STANDARD NO. AERB/SS/3 (Rev.1), 2001.