

CHAPTER 5

OPERATIONAL PRACTICES

I. SAFE OPERATION OF COMPANY VEHICLES

A. Employees' Responsibilities - You are responsible for the safety inspection of the vehicle you are operating. You must operate it safely. You must be alert and avoid any hazardous situation which appears either on the job or on the highway.

You, your equipment and your driving create a public image. Your company relies upon you for cooperation. All practices apply to company-owned, rented or leased vehicles.

Each driver will operate his vehicle in a courteous manner at all times.

1. Business Use Of Company Vehicles - Company vehicles will be driven only by the employees to whom the vehicle has been assigned or by an employee who has been authorized to operate the particular vehicle.

2. Personal Use Of Company Vehicles - Personal use of company vehicles is prohibited. A mileage entry under personal mileage must be entered into your mileage log when a company vehicle is used for commuting. Use of company vehicles for vacations by employees is prohibited.

3. Vehicle Documentation - Vehicle documents such as registration papers, insurance certificate and accident reporting forms are to be carried in the glove compartment or document pouch at all times.

4. Accident Reporting - Drivers will make prompt, factual and complete reports of all vehicle accidents which result in personal injury and / or property damage. Refer to Chapter I - Section III for more information on accident procedures. See Chapter 10 "Reports and Forms" for accident procedures and reports.

5. Vehicle Maintenance - Each driver is responsible for maintaining his company vehicle in an efficient and safe operating condition.

B. Licensing And Qualifications - You must have on driver's license from the state in which you live and must be licensed to drive equipment you operate. You, as a vehicle operator, must study and know all local and state traffic regulations.

Drivers of company-owned and/or operated vehicles shall meet the following standards:

1. Have no record of license suspension or revocation in any state during the preceding 36 months.

2. Have no record of conviction for drunk driving, driving while intoxicated, impaired driving due to drugs or alcohol, or any related offense during the preceding 36 months.
3. Have no record of conviction for more than three moving traffic violations during the preceding 12 months.
4. Have no record of involvement as a driver in more than two chargeable motor vehicle accidents during the preceding 12 months.
5. Have attended a Defensive Driving course within the preceding 36 months.
6. Additionally, drivers who operate trucks of a size and class regulated by the U.S. Department of Transportation (DOT) shall:
 - a. Be at least 21 years of age.
 - b. Be qualified as a driver by the U.S. Federal Motor Carrier Safety Regulations or as required by government regulation.
 - c. Have obtained and be in possession of a current Medical Examiner's Certificate as required by the U.S. Federal Motor Carrier Safety Regulations or other governmental regulation.
7. Each approved driver's supervisor must review the employee's motor vehicle record (MVR) and driving to determine whether that driver meets minimum requirements for safe driving.
8. Failure to meet one or more of these standards shall disqualify a driver from operating a vehicle on behalf of the Company.

C. CDL Qualifications - In addition to the above Company standards the following **Commercial Motor Vehicle Safety Act** rules will apply to all CDL drivers and will therefore, be a part of Company policy. Those rules are as follows:

1. Notify the Company within 30 days of a conviction for any traffic violation (except parking). This is true no matter what type of vehicle you were driving.
2. Notify the motor vehicle licensing agency within 30 days if you are convicted in any other state of any traffic violation (except parking). This is true no matter what type of vehicle you were driving.
3. Notify the Company if your license is suspended, revoked, cancelled or if you are disqualified from driving.
4. Give the Company information on all driving jobs you have held for the past 10 years. You must do this when you apply for a commercial driving job.

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5. No one can drive a Commercial Motor Vehicle after April 1, 1992 without a CDL. A court may fine you up to \$5000 or put you in jail for breaking this rule.

6. The Company will not let you drive a Commercial Motor Vehicle if you have more than one license or if your CDL is suspended or revoked.

7. A driver will lose his CDL for at least one year for a first offense:

- if he drives a Commercial Motor Vehicle (CMV) under the influence of alcohol or a controlled substance (for example, illegal drugs).
- if he leaves the scene of an accident involving a CMV he was driving.
- if he used a CMV to commit a felony.

If the offense occurs while he is operating a CMV that is placarded for hazardous materials, he will lose his CDL for at least 3 years. He will lose his CDL for life for a second offense. He will also lose his CDL for life if he uses a CMV to commit a felony involving controlled substances.

8. A driver will lose his CDL:

- for at least 60 days if he has committed 2 serious traffic violations within a 3 year period involving a CMV.
- for at least 120 days for 3 serious traffic violations within a 3 year period.

"Serious traffic violations" are excessive speeding, reckless driving, and traffic offenses committed in a CMV in connection with fatal traffic accidents.

9. If a driver drives when his blood alcohol concentration is 0.04 percent or more, he is driving under the influence of alcohol. He will lose his CDL for one year for his first offense. He will lose it for life for a second offense. If his blood alcohol concentration is less than 0.04 percent but he has any detectable amount, he will be put out-of-service for 24 hours.

Although some of the above rules are as stringent as Company Policy stated in this manual, the more stringent rule will apply and violation will be cause for termination.

D. Vehicle Operation

1. Speed Limits - The maximum speed limit for all Company trucks is 55 mph (88 km/h). For over-the-road DOT equipment, 65 mph (90 km/h) is permitted where legal. Your safe driving speed should be adjusted downward for adverse weather, road, load or hazardous conditions. In certain geographical locations, speed limits may be adjusted downward at the discretion of the supervisor. Truck drivers traveling on the highway must not tailgate, but should observe the 3-second rule.

Maximum speed limits for automobiles and pickups half-ton or less are designated by national, state or provincial laws. For safety, these should be reduced for adverse weather, road or hazardous conditions.

Automobiles must keep a safe distance from the vehicle ahead at all times. The minimum distance is at least one vehicle length for each 10 (26 km/h) miles per hour of speed. Defensive driving, weather or road conditions may require greater distance.

When you must back a vehicle, be certain the area is clear. Before backing a truck, get a guide, if one is available. If not, get out of the vehicle to see whether the sides and backing area are clear. Do not back a vehicle at the facility or on the work location without a guide.

When descending steep hills, shift to a lower gear. Downshift before going down a steep grade.

Always drive on the right hand side of the road except when passing. Never pass on the right except on multilane or marked roads.

Reduce your driving speed on unpaved, unimproved roads. Keep your vehicle under full control.

To drive defensively is to drive safely and lawfully. Be alert. Look out for other cars, bicycles, pedestrians, and animals. Slow down or stop, if necessary.

Disabled Company rolling equipment must be towed by towing equipment designed for that purpose. Towed vehicles must have brakes and tail lights in full operation. When towing another vehicle, under normal conditions, your maximum speed limit is 35 mph (60 km/h). Reduce speed for adverse road, weather or other unsafe conditions.

It is better to yield the right-of-way even if you are right rather than to risk your safety.

Loose, heavy items or materials must not be carried in the passenger compartments of any Company vehicle.

2. Defensive Driving - Each driver is expected to understand and practice the concept of defensive driving. All drivers of company vehicles must attend a defensive driving course. In the case of DOT vehicles, the Professional Truck Drivers (PTD) course may be substituted. Completion of these courses will be required as follows:

- a. Upon employment.
- b. Every 3 years as a refresher course in defensive driving.
- c. As determined by management.
- d. When a need for a refresher course is indicated by a driver's license investigation, customer complaints or observation of the driver.

Each driver will operate his vehicle in a courteous manner at all times.

3. Fatigue - No driver will operate a company vehicle when he is fatigued. Fatigue is not considered a valid excuse for an accident. The driver will accept full responsibility for any accident due to fatigue. However, if a supervisor knowingly dispatches an employee who is excessively fatigued, the supervisor will be additionally responsible should an accident occur due to the fatigue of that driver.

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4. Intoxicants and Drugs - No driver will operate any vehicle (company-owned, leased or rented) while under the influence of alcohol, narcotics or other drugs (including prescription or over-the-counter drugs) which might affect the driver's skill and alertness. Violation of this policy will subject the employee to severe disciplinary action up to and including immediate discharge from employment.

5. Seat Belts -

- a. All company road vehicles, automobiles, vans, pickups and trucks will be equipped with functional seat belts for the driver's seat and passenger seats.
- b. Drivers and passengers will wear seat belts and shoulder straps, if available.
- c. Seat belts and shoulder straps are to be in place and in working order. Periodic inspections will be made to guarantee this.
- d. The passenger capacity of a vehicle is determined by the number of permanently installed seat belts.

II. LOADING VEHICLES FOR SERVICE JOBS

- A. Lifting - Utilize proper lifting techniques at all times; get help when needed; avoid strain.
- B. Hoists - Use a hoist whenever a tool or instrument is too heavy or bulky for safe, easy lifting.
- C. Good Footing - keep back end of trucks and pickups free of oil and mud. Use a "floor dry" substance if necessary.
- D. Balance Your Load - Load auxiliary trucks with weight evenly distributed to avoid unbalance.
- E. Truck Loads - Avoid overloading back end of auxiliary trucks beyond the rated capacity of the truck or to such a degree that the headlights will blind oncoming drivers.
- F. Placement of Load - Carry regular equipment in its proper place, not thrown loosely on the truck floor. Avoid the possibility of articles falling out when the bin doors are opened.
- G. Articles In Truck Cab - Pieces of equipment normally carried in the truck cab should be secured to prevent movement in case of accident. Such articles as clipboards, water cans, tool boxes, spare parts, etc., can be missiles unless a means of holding them in place is devised.
- H. Securing Loads - Racks or tubes for tubular instruments must be equipped with positive latches, clamps, boomers or air bags. All equipment carried in them must be securely fastened for hauling. The best items for securing loads are cargo straps, which are as strong as chains but last longer and are easier to tighten, and are less likely to loosen during transport.

By regulation and Company policy all sources of radiation, sealed sources and tracer material, must be locked and secured from movement or tipping and the possibility of loss during transport.

I. Carbon Monoxide - Never let a vehicle's motor run in enclosed areas while loading.

J. Backing - Always have a "ground guide" to direct you when backing. Before backing be sure to walk behind the vehicle to ensure there are no obstacles.

K. Air Brakes - If the truck is equipped with air brakes move the truck only after the air pressure has reached the established minimum limit. Test brakes prior to driving.

L. Carrying External Loads - Cars with a carrying rack installed on the side for hauling instruments or other long tubular equipment must be loaded and driven with special precautions. Securely fasten the item being carried to prevent sliding or falling off. Ensure proper weight distribution and avoid letting the equipment protrude fore and aft. A heavy instrument on the outer portion of a car will cause serious imbalance of the vehicle and increase the probability of losing control.

M. Loading Pickup Trucks - Pickup trucks with carrying racks on both sides of the bed and over the cab should be loaded to balance as nearly as possible. Never load two tools on one side, if this is the total load. Carry one on each side. Distribute all articles in the pickup bed to equalize weight from side to side and always place articles as far forward as practical.

N. Carrying Radioactive Materials - Tools containing radioactive materials are never to be carried in racks outside a vehicle.

III. SAFETY TO AND FROM THE JOB

A. Pre-Trip Inspection - Before leaving for the job use the Driver's Vehicle Inspection Report to inspect the truck to ensure that it is mechanically ready to be put on the road. By following the outline on this report you will be checking the main safety items that could cause a mechanical breakdown or even an accident. (Refer to report form located in Chapter 10)

B. Drive Defensively And Safely - Observe traffic rules and speed limits. Develop courteous driving habits. Drive defensively at all times. If roads are wet or covered with ice or snow - SLOW DOWN. Any speed is too fast if you cannot control your vehicle. Prepare yourself against drowsiness; get enough sleep before going on the job to prevent yourself from getting sleepy. Fatigue is not an excuse for having an accident. You are authorized to stop and rest or stretch as required for safety.

C. Parking - When it is necessary to park the truck while traveling to or from a job, you must take positive steps to prevent it from moving while unattended.

1. Park where the surface is level - whenever this is possible. If on a down grade, turn the wheels into the curb or parking stop, making sure the obstruction is sufficient to hold the weight of a heavy vehicle.

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2. Leave the truck in gear - set the hand brake.
3. Parallel Parking - if parking parallel to a curb where the road is sloping, cut the front wheels into the curb in the direction of the slope.
4. Chock blocks - are to be used whenever a heavy truck is parked.
5. Stay out of the way - park the truck where it will not have to be moved until you are ready to move it.
6. Lock doors - do not allow any unauthorized personnel to operate or drive the Company vehicle.

D. Radioactive Materials - If a vehicle transporting these materials is involved in an accident, steps must be taken to prevent human exposure. The material should be removed from the vehicle if there is a danger to the material. Only remove the material if it is safe to do so and supervision of the material by competent personnel is available. Keep in mind the safety formula of time, distance and shielding when warning emergency personnel of the potential danger. DOT approved transport containers are designed to withstand severe treatment and in most cases will come through the accident intact. Liquid tracer material is subject to being scattered by an accident and proper measures must be taken to reduce or eliminate contamination.

NOTE: ADDITIONAL INFORMATION CONCERNING THE HANDLING OF MOTOR VEHICLE ACCIDENTS INVOLVING THESE MATERIALS IS AVAILABLE IN THE CARDINAL SURVEYS COMPANY RADIATION SAFETY AND PROCEDURES MANUAL. REFER TO THESE DOCUMENTS FOR DETAILED INSTRUCTIONS.

IF AN ACCIDENT INVOLVING THESE MATERIALS OCCURS IT IS VERY IMPORTANT THAT THE DISTRICT MANAGER BE NOTIFIED AS SOON AS POSSIBLE AND THAT THE DISTRICT MANAGER NOTIFY THE PRESIDENT IMMEDIATELY.

IV. SAFETY ON SERVICE JOBS

A. Safety Performance; Its Importance - We must develop and practice workable accident prevention procedures while on customer premises. To be leaders in our industry, we must also be leaders in safety. Customers will favor a company which demonstrates a sincere desire to do a job safely without delays due to accidents and without exposing their people or equipment to unnecessary risk.

1. Know how to do the job safely - it is mandatory that all employees have knowledge of Cardinal Surveys safety procedures before being allowed to perform the respective jobs. It is the District Manager's responsibility to fulfill this requirement. Complete and proper training of all employees is vital.
2. Clothing and protective equipment - all personnel will wear approved hard hats, eye protection and safety footwear while on customer property. Company monogrammed uniforms will also be worn where available.

3. Locating equipment at the well site - upon arrival at the well site, park where our personnel and equipment will be least likely to interfere with the customer's normal work traffic. Stay clear of areas where there is a danger of falling objects, rolling pipe, etc., until ready to unload.

4. Tailgate (pre-job) meeting - once our equipment is in place and prior to rigging up, the Company's designated person-in-charge of safety is to conduct a tailgate safety meeting which would encompass safety issues dealing with the performance of our work.

5. Smoking - never smoke on a customer's premises until you are sure you are in an approved area for smoking. If there is gas escaping from the well, there is probably no area approved for smoking.

6. Lubricators - must be kept in good working condition, ready for use at all times. When preparing to log where pressures are a possibility, a lubricator must be installed. It is considered basic that an approved type bleeder outlet be built into all lubricators for bleeding pressure and providing a pumping intake connection. A 2" heavy-duty collar with 8-round thread is standard. A heavy-duty valve must be installed.

When rigging up lubricator equipment, special measures must be taken to prevent injury to back. Make sure area is free of obstructions. Keep hoses and wireline neatly coiled and properly placed. Make sure line and hoses are not crossed or twisted.

B. Safety At The Location After The Job

1. Preparing to leave the wellsite - back the truck or pickup to the most convenient place for loading near the rig floor or catwalk. Avoid lifting heavy equipment unnecessarily. Use caution. If gas is being emitted into the atmosphere near the wellhead do not take the truck near it for fire precaution reasons.

2. Presence of gas - vehicle motors should be shut down if gas pressure has been created and is leaking from the lubricator or blowing from wellhead until such time as our operator and the customer can agree that it is safe to resume operations.

3. Pressurized tools - logging tools and instruments will occasionally return to the surface with pressure confined. When a tool reaches the surface it should be determined immediately if there is a likelihood that pressure is confined. The pressurized tool should be handled very carefully from the time it is pulled from the wellhead or lubricator, during the laying down procedure and while removing the cablehead. The greatest danger is to the eyes and skin because of the possibility of pressure being released through a port or from an o-ring seal with considerable force. Logical protection here would be to wear safety goggles, shield the skin and stand out of the way.

C. Safety Upon Arriving At The District Shop After A Job

1. Fatigue - upon returning to the shop extra effort is required to off-set fatigue which may cause laxity of observance of careful working standard.

2. Report unsafe equipment - report trucks or other equipment that are in an unsafe

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condition to the District Manager.

3. Report injuries - report any injuries or accidents of any type to the Manager.

V. SAFETY ON HIGH PRESSURE WELLS

A. General - Performing work on wells under pressure can be extremely dangerous if personnel are not properly trained and do not follow safety procedures. Lubricator equipment is now in service that has a working pressure of 10,000 psi and test pressure of 15,000 psi. It is possible to go into wells and perform completion services with wellhead pressures up to 10,000 psi. Contained pressure is very dangerous and should be treated with respect.

1. Use proper connection for the pressure - threaded joints are not considered safe for working at pressures above 5,000 psi. Flanged wellhead connections and specially fabricated lubricator sections should be used on wells where the pressure is expected to exceed 5,000 psi.

2. Pressurized lubricators - never climb a lubricator when there is pressure confined. Any horizontal movement will place additional stress on the lubricator threads and may cause it to be blown off.

3. Hydraulically operated control heads and blow-out preventers - are required safety equipment on high-pressure completion units.

4. Check for pressure - always check to be sure there is no pressure on a wellhead or lubricator before attempting to work on it. A wellhead, lubricator, flow line, or any closed system may contain high internal pressure and must be checked by opening a bleed-off valve. Always make it a practice to check the wellhead for pressure before rigging up. After the tools are pulled into the lubricator, close the master valve and bleed the lubricator before releasing packing gland or grease-head grease seal.

5. Trapped pressure - when backing off a connection or union be alert for trapped pressure. Threaded connections and threaded unions (Bowen) are difficult to back off when they are under pressure and provide a warning of pressure in the system. Unibolt unions can usually be broken by one blow with a hammer, regardless of the amount of pressure on them. The bolt on the unbolt union should be loosened but never taken out or not completely removed until the union is broken. If there is pressure the blast will be deflected downward and the lubricator held in position.

6. Multiple connection wellheads - employ extreme caution when working on a multiple completion wellhead. The multiple completion wellhead is two, three, or four wellheads built into on assembly. This increases the chances of error in opening or closing the wrong valve. Always stop and study the wellhead before closing a valve or breaking a connection.

7. Swages and unions - inspect the inside of swages and unions for wear.

8. Wing valves - never open a wing valve while the tools are in the tubing if the well has pressure on it. This would usually result in the tools being blown up the tubing past the cable. The wing valve should be kept closed at all times, even if the well has no pressure on it.
9. Flow hose - must be securely tied down. A high volume of flow through the flow hose can cause it to swing back and forth around the wellhead creating a serious hazard. Flow hoses should be terminated with a needle valve.
10. Safe working position - never place any part of the body in the path of high velocity fluids or gases. This will cause serious damage to the skin.
11. Do not touch frozen parts - do not touch any part of the control head or flow hose that is frozen due to the rapid expansion of gases. Frostbite may result even if the hands are exposed for only a short period of time.
12. Use high pressure lines - use high pressure Chiksan steel pipe instead of rubber flow hose on wells with extremely high pressure.
13. Frozen flow hose - never flex or knock ice from a frozen flow hose. This may cause the rubber in the flow hose to break.
14. Length of the flow line - sufficient flow hose or pipe should be used to discharge oil or gas in a safe area on the down-wind side of the rig.
15. Smoking - never smoke near a wellhead or discharge line.
16. Spot truck upwind - always spot the truck on the upwind side of the location.
17. Starting motors - never start a motor near a wellhead if gas is present.
18. Equipment under pressure must be attended - the wellhead and pressure control equipment should never be left unattended while operating under pressure.
19. Working near pressurized equipment - stay clear of pressurized lubricator, flow lines, and the wellhead except when required.
20. Bleeding off pressure - bleed off pressure from lubricator before loosening pressure packing gland or releasing grease-head grease seal.
21. Well site meetings - safety meetings should take place on location prior to the job. These meetings must include all Cardinal Surveys personnel on the job and should include customer personnel and other service personnel whenever possible.

B. High Pressure Safety And Lubricator Operations

1. Equipment Description - We must satisfy ourselves and our clients that we are operating the safest and most reliable equipment available. To do this, all pressure components must be standardized and periodically certified. Selection of each item used in pressure control work is based on thorough field testing and experience. Do not substitute, add or subtract from the recommended equipment or procedures.

2. Wellhead And Lubricator

a. CHANGEOVER ADAPTERS - the changeover adapter (swages) connects our wellhead equipment to the well. Since there are numerous configurations of wellhead fittings that may be encountered, a proper adapter is required.

These connections are subjected to the full wellhead pressure whenever the well is open. We must have control over the maintenance and reliability of these connections. In any event, the "on-the-job" test procedures, which will be described later, will provide an indication of the integrity of the Cardinal furnished or rented part.

Special adapters must be used in operations involving greater than 2% H₂S.

b. BLOWOUT PREVENTERS - immediately above the tree adapter is the blowout preventer. This device has rubber faced rams which may be closed against the cable to contain the well while the tool is in the hole. The rams are closed either manually or by means of a hydraulic cylinder actuated by hand or a pneumatically actuated pump when encountering pressures in excess of 5,000 psi.

Special preventers must be used in operations involving greater than 2% H₂S.

c. TOOL TRAP - the tool trap is installed above the blow out preventer. It contains a mechanical flapper assembly that allows tool string passage upward through the lubricator riser, but prevents tool string loss in the event that the cable head becomes disengaged from the cable. The lubricator riser must allow enough room for the entire length of the tools.

d. PUMPING TEE - the pumping tee resides above the tool trap, and provides a means of bleeding off the lubricator and pumping in of well kill fluids. The normal tee is a two inch with a ball valve.

e. LUBRICATOR RISER - the lubricator riser pipe along with the blowout preventer, tool trap and pumping tee form an extension of the well above the master valve. Enough riser pipe plus three feet must be used so that the entire downhole tool string may be contained above the top master valve, and in particular, above the tool trap. The riser pipe normally comes in five (5) and eight (8) foot lengths. Most Company trucks also have a 20 foot lubricator attached to the logging truck mast. Special risers must be used in operations with greater than 2% H₂S.

f. GREASE SEAL EQUIPMENT - to seal the annular space around the cable, a viscous oil is pumped into a close fitting tube ("grease tube") around the cable. The oil must be injected at a pressure greater than the wellhead pressure and is allowed to flow out the top and bottom of the tube. Above and below the grease tube is one or more flow tubes. This equipment is known as the grease injection control head or "grease-head".

Some grease-head assemblies are equipped with an alternate form of tool trap. In the bottom of the grease-head is a tool trap which will catch a string of tools and hold them suspended in the riser if the tools are accidentally run into the top of the riser and the rope socket breaks. This tool trap consists of an overshot with a basket grapple which is completely contained in the lubricator. This means that there are no external shafts that must be sealed. A protective shear screw guards against the trap catching the tool string if it is bumped against the top. Approximately 650 pounds is required to shear this screw before the tool can engage the trap.

Located at the top of the grease-head is a hydraulic pack-off gland. This is essentially a rubber sleeve which is compressed around the cable by means of a hydraulically operated piston. A hand pump is used to close the pack-off.

3. Accessory Equipment - consists of the grease pump, the hoses and the grease.

a. GREASE PUMP - there are two grease pumps available. One for operating under pressures up to 5,000 psi and the other for pressures up to 10,000 psi.

i. The 5,000 psi pump is an ALEMITE pump. It is an air operated pump with a 75 to 1 pressure ratio. Up to 14 cubic feet of air at 100 psi is required for operation at 5,000 psi. This pump is usually installed on a reservoir tank and operated from the truck air supply. In the event that a truck air supply is not available or is insufficient, a separate supply should be used. Rig air may also be used.

ii. The 10,000 psi pump is a hydraulically powered Mac-Farland pump. Pressure to operate the pump comes from a diesel engine driven hydraulic pump. The weight of the unit is approximately 2,200 pounds. The skid includes a grease tank.

iii. High pressure grease hoses are also provided. Their pressure ratings correspond to the pump with which they are used.

4. Operating Instructions - pressure jobs must be completely planned prior to the field operation. Customer cooperation is essential in planning, preparing and making the job. One unknown well condition or emergency procedure may result in an unsafe operation, or at least an embarrassment on our part. Ask questions, show interest in well problems and record any information gathered about the well. Select and prepare the equipment and crew in accordance with the job to be done. Plan each step of the operation and assign emergency procedures to each crew member.

The following are the steps necessary to plan and perform a pressure operation.

a. PRE-JOB - planning is a vital part of high pressure work. Some of the information necessary can be obtained from the client during the first call. A trip to the well site or client's office by an experienced employee may save time

b. TAKING THE CALL

i. Use a diagram to show well components on job sheet.

ii. Obtain client's name and phone number.

5. Equipment Selection

a. CABLE - check for length and temperature rating.

b. DOWNHOLE TOOLS - select size and type.

c. SINKER BARS - determine from chart necessary line weight. Tool weight is found on the chart. Calculate number of sinker bars necessary and add to find tool length. Thirty pounds of weight are required for each 1,000 psi plus 20% if possible (3/16" cable).

d. RISER LENGTH - allow two (2) feet between cable head and grease head and one (1) foot between the tool and tool trap. Tool length plus (3) feet equals riser length. Total riser length is limited to working space in the mast derrick.

f. BLOWOUT PREVENTERS - blowout preventers are required for all pressure work.

g. HYDRAULIC CONTROL HEAD - a minimum of three (3) flow tubes are recommended for all pressure work.

h. GREASE INJECTION SYSTEM - pressures below 5,000 psi use the ALEMITE. Above 5,000 psi, use the grease skid unit.

i. MAST TRUCK OR CRANE - 104 foot derrick. If pressure requires extra riser the 104 foot derrick (with boom) is to be used. Crane truck may be used with logging truck when necessary.

6. Equipment Preparation (Office and Shop) - High pressure operations demand first class equipment in first class condition. Prior to each job the equipment must be checked and prepared for the coming operation. All maintenance should be performed in the location shop so that only a minimum amount of cleaning and rigging up is required at the well site. However, threads and "O" ring seats on the lubricator must be cleaned and inspected just prior to rigging up.

Exxon Company U.S.A. Offshore Division's Workover Operations Manual requires that lubricator equipment be shop tested at six (6) month intervals to 1.5 times the working pressure of the equipment. Specifically the Exxon procedures state, "A shop pressure test of lubricator assemblies must be made by the wireline service company every six months. The lubricator is to be assembled with control head, blowout preventer, riser sections and tree connection and tested to 1.5 times working pressure. A record of this test giving the date, test pressure, results and wireline company's supervisor's signature must be maintained with the equipment for the information of the Workover Supervisor's hiring the unit." Other client's may have similar requirements. In addition to maintaining the test records with the equipment, documentation of these tests must be kept on file at the district.

The following are preparations necessary for a successful high pressure operation.

- a. BLOWOUT PREVENTER - test as prescribed, clean and visibly check. Dismantle and check ram condition and install new "O" rings. Ensure by-pass valve is working. Clean and install thread protectors (see Bowen manual).
- b. RISERS AND TOOL-TRAP - test as prescribed, clean and visibly check. Clean and install thread protectors. Check tool-trap "O" rings.
- c. HIGH PRESSURE HOSES AND HYDRAULIC LINES - test as prescribed. Look for kinks, abrasions and bruises. Clean and protect unions and connections.
- d. HYDRAULIC CONTROL HEAD - test as prescribed. Install close tolerance grease injection tube and flow tubes. If a worn or larger flow tube must be used, install above new or smaller flow tube. Use a good, tight fitting set of rubbers in pack-off.
- e. CABLE AND DOWNHOLE TOOLS - check insulation and continuity. Be sure correct amount of weight is available. Post maximum cable diameter on truck.
- f. HYDRAULIC PUMPS - fill with oil and check their operation.
- g. VALVES, NIPPLES AND GAUGES - check all valves for operation and pressure rating. Gauges must be clean and operative. Only specified valves, fittings and nipples may be used.
- h. MAST OR CRANE TRUCK - check cat lines and winch lines for wear. Make sure tanks are full. Make sure all necessary equipment is loaded.
- i. GREASE - have sufficient supply of grease seal oil, clean and free of water.

7. Equipment Preparation (On Location) - Rigging up is the most critical aspect of the pressure job. Pre-job preparations leave only the setting up, cleaning and connecting to be done. The following sequence of events lead to a safe and successful pressure operation.

a. RIGGING UP (GENERAL)

- i. Hold pre-job safety meeting.
- ii. Spot hoist unit cross wind where possible. If not, upwind.
- iii. Raise mast extension and extend outriggers.
- iv. Outriggers must be in place before mast is raised. Use wide, thick boards for support on infirm ground. Carry these boards on the mast / crane truck at all times.
- v. Install wireline on upper sheave, clear all lines and cables, then raise the mast (LOOK FOR OVERHEAD POWER LINES, stay clear).

b. RIGGING UP (WELLHEAD)

- i. Prepare christmas tree by first closing upper most swab valve and wing valve. Only the top master valve is to be used unless otherwise directed by the customer's representative.
- ii. Close the gauge valve and remove the customer's gauge carefully.
- iii. Open the gauge valve and bleed off pressure (needle valve could be plugged).
- iv. Remove wellhead cap.
- v. Beware of trapped pressure if connection is difficult to break.
- vi. Attach the Cardinal wellhead connection. Clean and teflon tape the threads. Clean and lightly oil the flange and ring. Hammer all flange bolts up tight (never hammer on connections with pressure on them).
- vii. Place preventer on christmas tree connector with cat line. Clean and lightly oil seals or unions just before connecting.

8. Rigging Up (Lubricator)

- a. The pressure head and riser may be assembled on the ground or vertically as conditions dictate. Longer risers are more safely made up vertically. Lateral strains on the mast reach the safety limit far below the breaking strength of the cat line.

- b. Keep cable head at bottom of the riser while assembling the riser assembly, or attach weight bars.
 - c. Allow sufficient riser length for three (3) feet of working room between tool trap and control head.
 - d. Attach the grease and flow hoses and pack-off hydraulic line. Have grease and flow lines laid parallel to riser assembly and secured at approximately ten (10) foot intervals with tape before raising control head. Do not pull on hoses or allow hose to become caught on anything.

9. Rigging Up (Tool String)

- a. Suspend bottom of riser six (6) feet above ground level to make up tool(s).
- b. Attach tools, pulling tool string up as more length is attached.
- c. Check cable insulation and continuity before attaching each tool.
- d. Observe all safety rules while attaching tools.
- e. Pull tool string into riser. If tools are made up in riser while in the horizontal position, bottom of riser should have a bull plug inserted before picking up. NEVER ATTEMPT TO PICK UP WITH ONLY THE PACKOFF OR TOOL TRAP HOLDING THE TOOLS.
- f. Lift lubricator and tool string to just above the preventer. Take up all cable slack on winch (remove bull plug if used).
- g. Lower tool string into preventer to act as a guide.
- h. Clean seals and lower lubricator onto the preventer. Make up connection. Do not over-tighten or use excessive force.

10. Rigging Up (Pressure and Hydraulic Lines)

- a. Connect hydraulic lines to preventers and hand pumps. Position hand pumps for ready access in case of emergency (upwind or cross wind if possible).
- b. Secure high pressure flowhose downwind. Secure with chain and boomer or tie chain and tape the hook. Attach flowhose to pit flowline with swage and nipple if available.
- c. Connect pressure gauge.
- d. Connect grease hose to high pressure pump.

11. Rigging Up (Check All Valves & Connections)

- a. High pressure flowhose valve - maximum open.
- b. Grease hose - connect to grease pump.
- c. Lubricator - straight, wireline free and untwisted.
- d. Lower sheave - check for proper wireline placement.
- e. Bypass valves on preventers - closed.

12. On The Job Tests

- a. TEST SPECIFICATIONS - Prior to opening the well for the first trip in, the entire wellhead assembly may need to be hydrostatically tested to 1.2 times the expected maximum wellhead pressure. If the client does not want his christmas tree subjected to this pressure, then the test pressure shall be equal to the expected wellhead pressure or to the maximum specified by the client, whichever is greater.

The offshore division of Exxon Company U.S.A. has very specific procedures that are to be followed when conducting on-the-job tests of this equipment. The offshore division's Workover Operations Manual specifies two specific tests that are to be conducted. The first test outlined in this manual is the "Blowout Preventer Operational Test." The manual states, "the rams of the wireline blowout preventer will be tested for closing and opening operation each time they are rigged up on a well. The condition of the ram rubbers should be visually inspected at the same time."

The second on-the-job test outlined in the Exxon Manual is the "Thru-Tubing Lubricator Test." The manual states, "the lubricator and pressure control equipment must be pressure tested while rigging up on the well. On Class II operations, defined by Exxon as less than 5,000 psi maximum anticipated shut-in surface pressure, test the entire assembly to 1.5 times the maximum anticipated surface shut-in pressure or 1,000 psi, whichever is greater.

On Class I operations, defined by Exxon as 5,000 psi or highest maximum anticipated shut-in surface pressure, test the rams to 1,000 psi and test the entire assembly to the rated WP of the tree. The service company will be required to furnish the necessary pump, power, and fluid to test their equipment.

Other clients may have specific on-the-job testing procedures that they require that we follow. It is important that this information be available prior to going on the job.

b. TESTING PROCEDURES

- i. Assemble the well head equipment for starting into the hole, but do not open the wellhead master valve.
- ii. Connect the 30 foot pressure testing line to the lubricator tee. Open the tee valve.
- iii. Connect the other end to the testing pump.
- iv. Insert the pump into a supply of colored water if desired. Food coloring added to the water helps in determining where small leaks occur during rain.
- v. Connect an air supply to the pump.
- vi. Start the pump and pump the lubricator completely full of water. NOTE: If a grease seal has been established, it will be necessary to break the seal until the riser is full.
- vii. Close the testing line.
- viii. Start the grease pump and establish a grease seal in the grease head.
- ix. Open the testing line valve and pressure up the riser to the appropriate test pressure.
- x. Hold test pressure for three minutes checking for leaks.
- xi. Bleed pressure in lubricator down to wellhead pressure.

13. Operation Procedures (General) - Only after the hydrostatic pre-job test has proven the lubricator pressure tight, should the well be opened and the operation begun.

14. Operation Procedures (Grease Injection) - Grease injection pressure must be maintained 20% above well pressure. Cable movement and pressure changes will affect the seal.

- a. Adjust air pressure on the grease pump to control pressure, or
- b. Adjust by-pass regulator valve on Diesel Skid unit for pressure control.
- c. Pump rate should be low and the pressure stable before proceeding.

15. Operation Procedures (Opening Master Valve)

- a. Slowly open master valve counting turns needed to fully open. Avoid any pressure surge by opening the master valve just enough to equalize the pressure then open it completely.
- b. Record number of turns to fully open master valve on a green tag. Attach the tag to the valve handle for use in case of emergency.

16. Operation Procedures (Cable Movement)

- a. Check bight (cable between drum and lower sheave) of line to ensure tools have not been blown into the control head. The weight of the tools will pull the cable taut.
- b. If the tools are free, slack off the cable. Do not let the cable touch the ground. Cable movement is very slow for the first few hundred feet.
- c. A quick jerk on the bight of the line and then slacking off will normally start the tools moving.
- d. CLEAN THE CABLE THAT TOUCHED THE GROUND DURING RIGGING UP WITH A KEROSENE SOAKED RAG. Dirt and grit abrade the flow tubes.
- e. If the cable will not move, check the following:
 - i. Tool trap.
 - ii. Pack-off rubbers too tight.
 - iii. Not enough weight to overcome pressure.
 - iv. Release pressure on hydraulic pack-off.
- f. Cable speed going in will be slow. Do not force the cable, let the tools pull it in.
- g. Caliper cable while going in once every thousand feet. Record in truck cab for reference when selecting flow tubes.
- h. Cable speed coming out depends on grease volume and clearance between grease tube and cable, 300 FPM maximum is recommended. Release all hydraulic pressures from packoff before starting job. Use packoff to wipe grease off cable. Apply adequate amounts of wire-line corrosion inhibitor.
- i. Pull tools into lubricator very slowly. Hold bight to line down to feel when the head hits the top. Have operator hold down and "walk" the bight of the cable in for the last 100 feet.
- j. Close master valve while tools are held by the tool trap. Count turns to make sure

valve is closed. Remove tag.

17. Operation Procedures (Rigging Down)

- a. Stop grease injection and corrosion inhibitor flow.
- b. Bleed off pressure trapped in the lubricator by opening bleed off valves. Discharged fluid should be assumed to be contaminated and therefore contained until testing can prove otherwise.
- c. Remove gauges and hydraulic lines.
- d. Disconnect union and lift riser out of the preventer. Watch for trapped pressure and fluid.
- e. Dismantle tool string.
- f. Dismantle lubricator.
- g. Install thread protectors and remove preventer using catline.

18. Operating Hints (Getting Stuck and Getting Out) - These situations happen in pressure operations, too. But they can be handled. If the downhole tools are pulled off near the bottom of the hole for some reason, the cable will be blown out of the hole as the end of the cable nears the surface. To eliminate this the hydraulic packoff must be pumped down to create drag on the cable to replace or simulate the weight of the downhole tools. Extreme care must be taken not to exert too much pressure or drag on the cable as it will cause bunching or bird caging of the armor on the cable.

When the weak point is pulled out of the head, kinks or bird cages often begin to appear on the cable about 1,000 feet from the end of the cable. The speed at which the cable is drawn from the well should be reduced to eliminate pulling the cable in two if the kinks will not go through the grease tube. If a kink cannot be worked through the grease tube with a reasonable amount of effort, the blowout preventer must be closed and the pressure bled off of the lubricator. Disconnect the union at the top of the blowout preventer and raise the lubricator about one (1) foot.

The cable can then be pulled back down through the lubricator and cut in two at the damaged place. At this point of the operation, the decision must be made whether to lay down a portion of the lubricator and thread the undamaged cable back through the pressure head or cut the cable off near the wellhead and tie the drum end of the cable back in it after the kinked portion has been removed. This latter method will only allow portions of cable to be removed from the wellbore in lengths equivalent to the lubricator length. It is not recommended that the cable be moved in the BOP rams unless the lubricator is in place and holding well pressure.

19. Operating Hints (Regaining Seal) - In the event the seal is lost and there is a blowby in the control head, an effort should be made to regain the seal. This is done in the following manner:

- a. Stop cable.
- b. Close packoff.
- c. Close high pressure flow hose valve.
- d. Watch grease pressure for increase. Pressure should build back to sufficient value. Check grease pot or drum for sufficient oil. Pump rate will increase when seal is lost.

If seal is regained, correct the cause and proceed with the operation. If there is a small blowby, it may be permissible to come out of the hole without regaining the seal. Don't proceed with the operation if there is considerable blowby or if the blowby poses a danger.

VI. SAFE OPERATION OF MOBILE CRANE

A. Introduction - Before placing the crane in service, all operators and persons working around the crane must thoroughly read and understand the contents of the crane Owner's Manual pertaining to Safety, Operation and Maintenance. Before moving a vehicle equipped with the crane, information relating to transporting the vehicle must also be read and observed. Failure to read the Owner's Manual is a misuse of the equipment. All operators must follow the Manufacturer's rated load capacities and recommended operating speeds as posted on the equipment.

B. Authorized Operators - Crane operation shall be limited to personnel with the following minimum qualifications:

1. An employee of the Company
2. Designated, competent and experienced persons.
3. Trainees or untrained persons under the direct supervision of qualified persons.
4. Maintenance and test personnel, only in so far as it is necessary for the performance of their duties
5. Supervisor with a designated experienced person present.

C. Operator Qualifications - Crane operators shall meet all of the following qualifications:

1. Demonstrate the ability to read, comprehend and interpret all placards, operator's manuals, safety codes and other information pertinent to correct, safe crane operation.
2. Possess knowledge of emergency procedures and implementation of same.

3. An operator shall demonstrate to the employer the ability to operate the specific type of equipment or provide satisfactory evidence of qualifications and experience to do so.
4. Be familiar with all relevant safety standard codes and applicable governmental regulations.
5. Recognize and be responsible for all maintenance requirements of the crane operated by him or trainees under his supervision.
6. Be thoroughly familiar with the crane being operated and its control functions.
7. Have read and fully comprehends the operating procedures as outlined in this manual.

D. Setting up at the job site - One of the most important prerequisites to proper setting up on job site is to thoroughly plan the lift before positioning the vehicle. The following items must be considered:

1. Vehicle should be positioned in an area free from overhead obstructions to allow performance of the entire task without repositioning. Check the capacity chart for areas of reduced capacity and position vehicle accordingly.
2. The vehicle should be positioned so it is impossible for any portion of the equipment to come within the minimum required safe distance to any energized power line. You must maintain a clearance of at least ten (10) feet between any part of the crane, loadline or load and any electrical line or apparatus carrying up to 50,000 volts. One foot additional clearance is required for every additional 30,000 volts or less. Remember power lines and loadlines deflect in winds and additional clearances must be allowed. If you do not know the voltage of the electrical line and therefore the minimum required safe distance, you shall request the electrical utility to advise you of the line's voltage. Death or serious injury will result from contact or arcing due to inadequate clearance. All overhead wires should be considered energized until the electrical utility authorities verify they are not and the wires are visibly grounded.
3. Anytime the task requires setup in the vicinity of energized power lines, a qualified signal person shall be assigned at a vantage point where he can accurately monitor the distance from the equipment to the power lines and give warning before approaching the minimum safety distance. If the task requires any portion of the crane or its optional equipment to operate at less than the minimum required safe distance, the appropriate electric utility shall be notified to de-energize the power line before any work is performed with the crane.
4. The vehicle shall be located on a firm and level surface that will provide adequate support for the outrigger loading. Use caution when setting up near overhanging banks or excavations.
5. The vehicle park brake shall be set and drive axle disengaged.

6. All outriggers shall be extended fully to a firm surface. Use outriggers as necessary to level the truck side to side, then stabilizers to level the truck front to back. A level indicator is provided at the operator's control station. If the outriggers are not visible at the operator's station, a signal person should be used to be sure the outriggers are set safely.

E. Safety Tips

This section of the safety manual is designed to present some of the daily work problems which may be encountered by the operator, service and other personnel.

1. Operator Safety Tips - Winch Equipped Cranes

- a. Do not pull the load block up against the boom tip.
- b. Payout loadline before or during boom extension to avoid two-blocking.
- c. Do not allow personnel to ride the loadline, hook, load or any device attached to loadline. Use only approved baskets.
- d. Do not allow anyone to ride the loadline, hook or load.
- e. Keep at least three full wraps of wire rope on the winch drum at all times.
- f. Check the winch brake for proper operation before handling the load.
- g. Use proper multi-part reeving for the load to be lifted.
- h. When using multi-part reeving, be sure cable is properly routed.
- i. Know the lifting capacities of both the winch and boom. They will have different capacities. The weight of the load must not exceed the lesser capacity.
- j. Do not drag loads with winch or boom.
- k. If using Burst of Speed winch, actuate switch before valve lever to smoothly control load.

2. Operator Safety Tips - Cranes

- a. Control lever movement should be slow and smooth to meter oil flow for safe operation. Jerky or sudden movement of the controls should be avoided.
- b. Do not use stability to determine loads.
- c. Be constantly aware of the boom(s) position when operating the controls.
- d. Make certain the boom tip is centered directly over the load before lifting.

- e. Dragging the load from any position shall be avoided.
- f. Do not attempt to lift fixed loads.
- g. Do not load boom in sideward direction.
- h. Know the weight and radius of your load to avoid overloading the crane.
- i. Deduct the weight of the load handling equipment from the maximum load rating to determine how much weight can be lifted.
- j. Take care when lifting with jibs so as not to exceed jib capacities even if main boom is retracted.
- k. Make certain the jib is properly stowed and secured before operating the boom.
- l. Do not rotate or extend a load over anyone.
- m. Keep the load close to the ground whenever possible.
- n. Use non-conductive tag lines.
- o. Do not permit loose objects on booms or on loads. Remove before operating the crane.
- p. When operator is out of sight of the load, a qualified signal person shall be used. Signals shall be in accordance with the standard U.S.A. Hand Signals for Controlling Crane Operation (see chart at end of chapter).
- q. Obey a signal to stop from anyone.
- r. Do not operate the crane during electrical storms, when high wind conditions exist, or in poorly lighted conditions.
- s. Do not perform any work on the crane unless authorized to do so. Modifications or additions which may affect the safe operation of the crane can only be made with the manufacturer's written approval.
- t. Do not attempt service or repair while the crane is operating.
- u. Do not push down with the boom.
- v. Stay clear of outriggers while operating.
- w. Do not operate the crane with oily or greasy hands.
- x. Keep operator platform clear of tools, cans, etc.
- y. The operator shall read all Danger and Caution decals on the equipment and

understand their meaning.

z. Keep children and others clear of equipment.

aa. Do not disconnect hydraulic leaks as high pressure and hot hydraulic fluid can cause serious injury.

bb. Stay clear of hydraulic leaks as high pressure and hot hydraulic fluid can cause serious injury.

cc. Do not allow unauthorized personnel or equipment to enter within ten (10) feet of crane operating reach.

dd. Do not attempt to clean, oil or service a crane while the PTO is engaged.

ee. Stow the boom in its support when not in use.

ff. Do not leave crane unattended with suspended load.

gg. When rotating boom from an area supported by outriggers / stabilizers to an area supported by springs and tires, care should be taken because a change in the machine's stability characteristics may occur. This change, if sudden, may cause swinging or oscillation of the load potentially causing overload or instability.

hh. When operating in areas supported by vehicle tires and not outriggers, care should be taken because of the spongy effect of springs and tires.

3. Operation Training - All members of the crew must be thoroughly familiar with the operation of controls, the correct operating procedures, standard hand signals for cranes (see chart at end of chapter) maximum lifting capacities and safety precautions before operating the crane. Operator training is essential. Always be prepared for an emergency. It is essential that the operator review and know the material in the Owner's Manual.

The health, safety and well-being of each member of the crew is of primary importance. Consequently, each member has an obligation to himself and to his fellow workers, to make sure safe operating procedures are followed. All operating regulations recommended by the manufacturer, the Company and by municipal, state and federal agencies must be observed.

The operator must become familiar with all equipment checks. The operator should make daily equipment inspections and be able to spot any abnormality or malfunctions before beginning a job, while working and after completing the job. An operator should never take another's word, but always thoroughly check the equipment himself.

4. Operating Procedures - A crane is a complex piece of equipment and can be overloaded in many ways. Carefully follow the operating procedures outlined below.

a. Perform the following checks prior to placing the unit in operation:

- i. Inspect for any unusual conditions such as pools of hydraulic fluid or

lubricating oil under the chassis, any outrigger which may have crept down or up and any signs of damage or improper maintenance.

- ii. Check that the tires are inflated to the proper pressure.

- iii. Check the level of the hydraulic reservoir.

- iv. Check the operation of the "kill" and horn circuits.

- v. Check for loose bolts.

- vi. Check for damaged structural members.

- vii. Check all rope guides and cable keeper.

- viii. Check all sheaves for free turning.

- ix. Check the loadline cable for kinks, broken strands or other damage in accordance with instructions in the Owner's Manual.

- x. Check to see that the hydraulic hoses and fittings are in good condition and show no signs of leaking. The hoses should be free from cuts and abrasions and there should be no evidence of binding. Any damage or leakage should be repaired immediately.

5. Wellsite Procedure (Rigging Up) - Always seek the best possible work site when parking the crane. The best location at a wellsite is firm, level, dry ground located fourteen (14) feet from the wellhead. Location should be selected such that outriggers can be fully extended and leg comes down on firm level surface.

- a. Before leaving the cab:

- i. Set the truck brake securely. Wheel chocks may be required under certain conditions.

- ii. With the gear shift in neutral, depress clutch and engage the power take-off by pulling out the shifting knob.

- iii. Bring the hydraulic system up to operating temperature by allowing the system to operate with all controls at neutral.

- b. Set the outriggers.

- c. Determine the weight of the load and load handling equipment. Refer to Capacity Chart for crane and determine that load and radius of lifting are within

capacity of crane.

d. Always operate the winch control to payout the loadline while extending the boom.

Keeping the hooks at eye level while extending the boom up will help prevent a problem.

e. Do not pull load block into boom tip.

f. Make certain the winch cable is not twisted or kinked and that cable is properly seated on the drum and in the sheaves.

g. Before lifting a load, always make certain three full wraps of rope will remain on the drum at all times throughout the lift.

h. Do not drag loads in any direction with the winch.

i. Maintain tension on the loadline at all times to prevent the cable from becoming twisted, kinked or improperly seated on the winch drum or sheaves.

j. Rotate, extend or move boom up or down until boom tip is directly over the load.

k. During operations, the controls should always be metered when beginning or terminating movement to prevent sudden starting or stopping, which imposes undue hock loads on the equipment.

l. Lower loadline and attach load.

m. Hoist load, rotate and lower onto wellhead for attachment.

6. Wellsite Procedure (Rigging Down) -

a. Detach load from wellhead, rotate and lower load.

b. Completely retract boom and place securely in boom rack.

c. Secure loadline block so it cannot swing freely.

d. Retract all outriggers / stabilizers.

e. Secure any loads, tools or lifting devices on truck bed or body.

f. Disengage power take off (PTO).

g. Release park brake before moving truck.

VII. CRANE SAFETY INSPECTION AND MAINTENANCE

A. The single most important factor in the prevention of equipment failures and accidents is a positive attitude towards safety. The habit of anticipating possible problems normally prevents many accidents from occurring. Inspection checks are not to be overlooked. Below are listed several important inspections that should be performed before and during operation of the unit.

1. Chassis - check the oil level, battery, lights and brakes.
2. Tires - check for proper inflation, cuts, loose wheel nuts.
3. Safety accessories - check for proper function, oil level, leaks, etc.
4. Hydraulic oil reservoir - check for proper oil level, leaks.
5. Structurals - visually inspect complete crane for damage especially for cracks in weldments.
6. Fasteners - check all pins, sheaves, retainers, bolts and nuts. Check for presence and proper tightness.
7. Sheaves - check for rope wear, cracks and bearing condition.
8. Hose / fittings - check for leaks, abrasion and loose clamps.
9. Lifting rope / slings - check rope and slings for frayed edges, broken strands, kinks, flat spots and end attachments for unsafe conditions.
10. Crane hooks - check hook for safety catch, twist and opening of hook throat.
11. Covers and guards - check for proper installation.
12. Operating placards and safety signs - check for missing, illegible, defaced signs and placards.
13. Confirm that rated load capacities, recommended operating speeds, special hazard warnings and all other instructions or warnings are visible to the operator while he is at the control station. The crane rated load capacities and speed recommended by the manufacturer must be posted on all equipment and must be followed.
14. Horn and kill switch - check for proper operation.
15. Make necessary repairs and replacements prior to operating the truck or crane.

This safety checklist does not eliminate prescribed detailed maintenance covered in the Owner's Operation and Maintenance Manual for the crane being utilized.

Government regulations require the Company to perform daily and monthly inspections and maintain results of these inspections for each crane, and that a thorough annual inspection of the crane shall be made by a competent person, or by a government or private agency recognized by the U.S. Department of Labor. The Company shall maintain a record of the dates and results of the inspections for each crane and its optional equipment.

All crawler, truck, or locomotive cranes in use shall meet the applicable requirements for design, inspection, construction, testing, maintenance and operation as prescribed in the ANSI B30.5-1968.

Cardinal Surveys company maintains an Annual Inspection Certificate which includes the date the crane items were inspected, the signature of the person who inspected the crane items, and the serial number for the crane inspected in accordance with 29CFR 1926.1550.

VIII. SAFE VEHICLE (CRANE) TRANSPORTATION

- A. Before transporting:
 - 1. Be sure outriggers are stowed properly.
 - 2. Secure the loadline hook.
 - 3. Secure boom properly.
 - 4. Secure all loose items to the truck bed.
 - 5. Disengage PTO.
 - 6. Release park brake
- B. Do not travel with load on the hook.
- C. Be sure tires are properly inflated.
- D. Make sure there is enough overhead clearance before entering any underpass.
- E. Do not allow any persons to ride on the equipment when it is being transported.
- F. A signal man may be required when moving or backing unit in areas where visibility is limited.

IX. TAGMASTER[®] AND STIMULATION JOB RELATED SAFETY

Refer to sections I - IV. The pumping service company field supervisor is in charge of the general location of equipment and safety practices while on location. Our goal is to cooperate with the pumping service company as much as possible for the purpose of providing a safe and efficient service. Customer

and pumping service company safety rules apply where they do not conflict with Cardinal's rules. However, we will not compromise good safety practice for any reason. If you are not satisfied with the situation on location, you are expressly authorized to refuse to rig up Cardinal's equipment.

A. Parking service unit on location.

1. Always locate the unit as far away from other personnel and equipment as practical. The purpose is to minimize exposure of other personnel to radiation, as well as to limit our exposure to hazardous chemicals and equipment.
2. The following guidelines will be followed:
 - a. Outside well service unit guy-wires.
 - b. Outside the radius of the high-pressure treatment line. This radius is determined with possibility of the line parting at either the pump end or the well-head end. This area is known as the "control area".
 - c. Never park within a 60 ft. radius of the wellhead.
 - d. Survey the location for radiation prior to unloading equipment. Complete the wellhead survey form.
 - e. Locate the unit up wind of the wellhead.

B. Unloading of equipment and rig-up.

1. Place the tagging tee as close to the wellhead as practical, preferable down-stream of the pumping service company's bleed line and densitometer.
2. Caution pumping service company personnel concerning exposure to radiation. Do not permit anyone to handle the hose or tee, except as required to make the connections in the treatment line. Make sure that hammers do not contact the tee brace or valve.
3. Check the tee valve and fittings with a torque wrench. Make sure all connections are properly torqued. Check o-rings for size and wear. Inspect hammer-union seal rings. Inspect the interior of the tee or plug for erosion wear. Make sure the unions are clean and lightly oiled.
4. Locate portable radiation safety placards over the hose and at the rear of the unit.
5. Connect the hose to the pump. Make sure block valves are in the proper position.
6. Locate hose away from personnel and equipment. Do not allow anyone to drive over the hose.
7. Leave sufficient slack in the hose. Coil excess hose neatly, and away from high traffic areas. Do not stand near hose or coils during the treatment phase.

C. Pre-job safety policy.

1. Attend the pre-job ("tail-gate") safety meeting. Know the agreed upon escape route and meeting place.
2. Obtain a copy of the treatment schedule. Know the maximum treatment pressure and anticipated rates and pressures limits.
4. Agree upon the method of communication. Obtain a radio and head-set if possible. Know who will specify the start and end of the tagging operation.
3. Determine the location of fire extinguisher and other safety equipment.
4. Always assume that there is H₂S gas present.
5. If smoking is permitted, determine the designated safe smoking area.
6. Inspect the treatment company for proper rig-up.
 - a. The treatment line should be of sufficient length to safely position the pumping equipment away from the wellhead. A minimum of three joints is required.
 - b. Each swing should include a minimum of two Chiksan connections. Double Chiksans should be used coming off the well-head and trucks.
 - c. A properly anchored stimulation line will be staked or restrained every 15 to 20 ft. A line is anchored securely when it cannot move while being used.
 - d. Make sure the tagging tee or plug will not interfere with the pumping company's equipment.
7. Verify that the proposed treatment schedule will be compatible with the size of treatment line, recommended sand slurry concentrations and pumping rates. Exceeding these recommended rates will cause rapid erosion of treating connections, including the Tagmaster[®] tee. These rates are based on 45 ft/sec velocity which is considered the maximum rate at which erosion is not excessive when pumping ungelled sand slurries.

Treating		Pipe	Maximum	Maximum
<u>O.D.</u>	<u>I.D.</u>		<u>Pressure</u>	<u>Rate</u>
			Working	(BPM)
2"		1.3"	20,000	4.5
2"		1.8"	15,000	8.5
2.5"		2.51"	4,000	16.5
3"		2.75"	15,000	20.0
4"		3.83"	6,000	40.0

7. Pressure test the tee and hose in conjunction with the pumping service company pressure test. Verify the operation of block and check valves.
8. Follow Company policy and procedures with regard to handling radioactive materials. Follow the ALARA standard with regard to time, distance and shielding. Always use proper equipment (tongs, lead-apron, gloves). Tag and seal waste.

D. Safety during the pumping operation.

1. Monitor your equipment. Watch for excessive pressure, pulsation and vibration. Watch for leaks, and be prepared to block-in and shut-down equipment.
2. Maintain communication with the pumping service company supervisor.
3. Be prepared to discontinue tagging operations at the first sign of any problem with the job. Prevention of contamination and spills is far more important than providing the service.
4. In the event of a malfunction with the tagging equipment, never disassemble any of the high-pressure fittings unless the hose and tee can be safely blocked in and pressure bled off. When in doubt, discontinue the service operation until after pressure can be relieved from the treatment line.
5. Never walk across or near pressurized iron. Remain clear of control area around treatment line.

E. Pumping of Gaseous Fluids (N₂ / CO₂).

1. Liquid CO₂ and N₂ behave differently than any other treating fluids and must be properly handled to prevent trouble. Never shut-in a line filled with liquid cryogenic fluid without immediately venting it.
2. Dry ice in CO₂ lines must always be suspected when pressure has been bled from lines while they contained liquid CO₂. Always be careful of sudden release of blocks of dry ice when inspecting connections.
3. N₂ pumpers use open flame burners. Stay clear of these service units.
4. Liquid nitrogen and CO₂ on the skin or in the eyes produces a freeze effect similar to a severe burn. Frost-bite may result from exposure to cryogenic materials.
5. Cryogenic temperatures can cause metal failure. Never hammer a cold union. Allow the metal to warm up first.
6. Safety goggles should always be worn on jobs using CO₂ or N₂ cryogenic fluids.
7. Displacement of air. Since CO₂ and nitrogen may collect in low lying areas, never enter a fog. Remain up wind of cryogenic equipment and iron.
8. Be extremely careful when looking for leaks. A small, high pressure leak can damage an eye or cut or sever a body extremity.

F. Flammable Fluids.

1. Smoking is not allowed during well treatments using flammable fluids (live lease oil, diesel, etc.)
2. All engines, electricity, heaters or other equipment not necessary to the job shall be shut down.
3. Position mobile equipment so that it may be quickly shut down and removed from the work area with minimal delay.
4. Do not locate equipment down slope from flammable liquid storage vessels. Do not locate in natural drainage areas.
5. Locate upwind of all pumping equipment.
6. Hammering or tightening of unions or connections under pressure is prohibited.
7. Any spilled flammable or combustible fluid is to be absorbed or covered over with an inert material as soon as practicable.
8. First aid. In case of contact, wash contacted skin with copious amounts of fresh water. Remove contaminated clothing and shoes. Never continue to work with hydrocarbon saturated clothing or shoes.

G. Acid.

1. First aid. Wash contacted areas with copious amounts of fresh water. Remove contaminated clothing.
2. Do not locate near pumping equipment.
3. Remain upwind of pumping equipment. Be aware that acid fumes are very hazardous.
4. Check for acid in tee and hose after pumping.
5. Avoid skin contact. Wear safety goggles.

H. Post job safety.

1. Never attempt to remove equipment from the treatment line until you have verified that all pressure has been relieved.
2. Do not allow any other personnel to handle the tee and hose, except to break the hammer unions. Stow all radioactive equipment on the service unit as soon as practicable.
3. Survey the well head and location for contamination. Check treating company lines and treesavers if applicable. Give a copy of the well head survey to the job supervisor.
4. Check tee for erosion damage. Clean and oil connections prior to stowing. Check o-rings for damage and swelling from fluid contact.

5. Monitor flow back for contamination. Follow Company policy with regard to any contamination found. Be cautious of chemicals and fumes.
6. Follow safety guidelines when lifting and moving heavy loads.

X. ELECTRICAL SAFETY (Non-Qualified)

Non-Qualified Person – Persons who operate electrically powered equipment, but are not trained to perform any operation or maintenance on or near any exposed energized parts. **Note:** The term “work on” energized equipment includes the testing of live electrical circuits.

1. Electrical Safety Rules

- a. Only qualified employees shall repair, install, troubleshoot or work on electrical circuits. All electrical circuits should be de-energized whenever possible before an employee works on or near the electrical equipment.
- b. All employees are to be trained in the hazards of working on or near electrical equipment.
- c. All electrical circuits are to be considered energized, until the absence of electrical current is verified.
- d. Work performed on live circuits will be done as the exception and not the rule.
- e. Uninsulated metallic items, such as rings, neck chains, watches, eyewear, etc. are not to be worn while working on or near exposed energized electrical circuits.
- f. Blown fuses shall be replaced with equal type and interrupting rating using the appropriate tool.
- g. Use non-conductive ladders when working on or near electrical equipment.
- h. Electrical equipment and extension cords are to be inspected prior to each use and immediately removed from service if found to be unsafe.
- i. Space heaters are to be turned off if left unattended.

j. Secure extension cords to prevent tripping hazard.

2. Power Lines

a. All power lines shall be considered energized.

b. When power lines are de-energized, they shall have safety grounds attached.

c. No part of a crane, boom, mast, gin poles or machinery shall be permitted within 50 ft. of power lines rated at kV or below.

XI. CONFINED SPACE AWARENESS

This standard establishes procedures necessary for preparation, entry and restoration of a confined space to be entered by personnel. Examples of confined space may include, but are not limited to, tanks, vessels, underground meter boxes, pig launchers/receivers, engine crankcases, open pits or turbine packages.

1. Confined Space

a. Is large enough and so configured that personnel can bodily enter and perform assigned work.

b. Has limited or restricted means for entry or exit.

c. Is not designed for continuous personnel occupancy.

2. Guidelines for entry

a. **Cardinal Surveys Company employees are prohibited to enter confined spaces,** i.e. Tanks, Vessels, Open Pits or Well Head Cellars.

XII. MANAGEMENT OF CHANGE (MOC)

MOC provides a check to ensure that personnel have been notified/trained and the appropriate risk analyses have been performed. This provides greater certainty that changes will improve operations and not negatively affect safety, health, or the environment.

1. Intended application – The MOC process is intended to cover changes that may increase the level of risk or lead to operations outside the normal operating mode. It is important that operating personnel have the flexibility to maintain the continuity of operations within established safe limits.

2. Definition of change:

- a. Deviations from established processes, guidelines, or standards, or other design and operating standards.
- b. Changes to approved procedures that significantly increase job risk or change job scope.
- c. Replacement of materials/equipment with materials/equipment that do not meet the original design specifications

3. Guidelines for Change:

- a. Replacement of materials/equipment must be approved by management before any change is performed.
- b. Deviations from established procedures must be evaluated and approved by management.

XIII. THE SAFE OPERATING PROCEDURE (SOP)

1. The purpose of a Safe Operating Procedure is to provide written guidance for a particular task such that any qualified person can successfully and safely complete the task. An SOP consists of:

- a. List of required personal protective equipment (PPE)
- b. A written step by step procedure for a specific task
- c. A description of possible hazards and conditions
- d. Hazard control steps
- e. Qualifications required for the operation

XIV. JOB SAFETY ANALYSIS (JSA)

1. Pre-Job Hazard Assessment - A JSA must be completed for each job. The JSA must assess each aspect of the task and identify items that could result in injury to personnel, damage to equipment or threaten the environment. Any time that the procedure changes or a new task needs to be done, a new JSA is required. Basic steps for conducting a JSA:

a. Break the job down into steps – The major reason for doing a job step breakdown is so each step of the job can be examined for hazards and potential accidents.

b. Identify the hazards or potential accidents - The idea is to identify all hazards, whether they are of the employee's own doing or part of the job's surroundings. All hazards are recorded as potential accidents, that is, accidents that might occur when an employee does the job step.

2. Develop solutions for the potential hazards or accidents - Procedure solutions, environmental

solutions, radical solutions, and reduced frequency solutions for specific potential accident problems are given below:

a. A job procedure solution - This kind of solution is one that spells out exactly what employee should or should not do to avoid a specific potential accident.

b. A job environment solution - This kind of solution changes some aspect of the job environment in order to avoid accidents. The changes may concern such things as tools, equipment, machines, materials, work-area layouts, illumination, and atmospheric conditions-in short, anything that is part of the employee's physical surroundings.

c. A radical solution - This type of solution is usually a combination of procedure and an environment solution that changes the way a job is done. I

d. A reduced frequency solution - This type of solution is so-called because it reduces the number of times a repair or service job must be done in a given period of time. No JSA on a regularly reoccurring repair or service job should ever be completed without asking, "Can the frequency of this job be reduced in any way?"

XV. BEHAVIOR BASED SAFETY PROGRAM (BBSP)

1. BBSP is a process where employees conduct observations and provides feedback on safety practices within their assigned work areas. These observations provide data that is used as the basis for problem solving and continuous improvement.

2. The BBSP is intended to cover at-risk behaviors and be noted on observation forms so that unsafe acts can be tracked and trends identified. As trends are identified Cardinal Surveys Company will address these issues, provide additional training, and develop plans to address the at-risk behavior.