CONTENT:

This Section describes certain special practices in the handling of explosives, electric blasting caps, and blasting agents by Geophysical seismic operations. Explosives as used in this Instruction cover the following specific materials:

Dynamite
Water gel and emulsion explosives
Nitro-carbo-nitrate blasting agents
Primer for blasting agent
Booster for blasting agent
Electric Blasting caps
Detonating fuse
Shaped charges

* It is not all-inclusive and is a general guide only. Standard practices in the safe and efficient handling of explosives will be observed at all times. The procedures contained in International Association of Geophysical Contractors (IAGC) Land and Marine Geophysical Operations Safety Manuals (6.3) shall be followed. Reference to relevant sections of IAGC manual in Attachment I to this G.I. In case of conflict between the Special Regulations contained herein and the procedures in the IAGC Safety manuals, then the special Regulations contained herein shall prevail and Saudi ARAMCO Chief Operations Geophysicist shall be immediately notified of such conflict. This text includes:

1. Main Storage Magazine
2. Transportation to Field Magazines
3. Field Storage Magazine
   - 3.1 General Instructions
   - 3.2 Magazine Security and Safety
   - 3.3 Warning Signs
   - 3.4 Storage Containers
   - 3.5 Magazine Location and Arrangement
4. Transport of Explosives from Field Magazine to Work Location
5. Handling of Explosives
   - 5.1 Authorized Personnel
   - 5.2 Explosives Accounting
     - 5.2.1 Field Magazine Withdrawal Record
     - 5.2.2 Loaders Reports (Saudi Aramco Form A-2498)
     - 5.2.3 Detonation Reports (Saudi Aramco Form A-5643)
     - 5.2.4 Explosive Reconciliation
   - 5.3 Responsibility Assignment
   - 5.4 Explosive Supervision - General Instructions
   - 5.5 Shotpoint Procedure
     - 5.5.1 Puffer Drilling
     - 5.5.2 Surface Patterns
     - 5.5.3 Deep Hole Loading
     - 5.5.4 Ammonium Nitrate
     - 5.5.5. Detonation Cord Shooting
   - 5.6 Uphole Shooting
     - 5.6.2 Uphole Shooting Harness
     - 5.6.4 Uphole Shooting Cable
   - 5.7 Clean-up Crew
     - 5.7.3 Clean-up Surface Shooting
     - 5.7.5 Clean-up Drill Patterns
6. References

1.0 MAIN STORAGE MAGAZINE

Seismic explosives will be stored in the main storage magazine until issued to field parties. Refer to General Instruction No. 355.015 for regulations relating to magazine storage of explosives.

2.0 TRANSPORTATION TO FIELD MAGAZINES

Refer to General Instruction No. 1183.215 for regulations relating to movement of explosives from the main magazines to field parties.

3.0 FIELD STORAGE MAGAZINE - A Field Storage Magazine is a portable explosive storage magazine stationed near a seismic field party.

3.1 GENERAL INSTRUCTIONS

3.1.1 All explosives received from the Main Storage Magazines shall be stored in the field storage magazine until they are withdrawn for use.

3.1.2 Containers of explosives will normally not be opened at the storage site.

3.1.3 EXPLOSIVE DETONATORS must be stored separately from all other explosive products.

3.2 MAGAZINE SECURITY AND SAFETY

3.2.1 Watchmen shall provide 24-hour coverage.

3.2.2 Watchmen's tents shall be oriented 70 meters away from and upwind from the explosives storage. The watchmen must be able to view the explosives storage area from inside his tent.

3.2.3 The Amir's representative is to guard the explosives on 24-hour coverage as well as the paid watchmen.

3.2.4 There will be two separate locks on each explosives magazine. One key must be controlled by the camp Party Manager. The second key will be under the control of the Amir's representative. The locks must be arranged so that both keys are required to open the magazine.

* 3.2.5 Approved Fire Extinguishers shall be provided at the Watchmen's tent area, as well as at the Field Storage Magazine site.

* 3.3.5.1 Watchmen shall be trained in the use of Approved Fire Extinguishers.

3.2.6 **NO FIRE ARMS** are permitted in the Watchmen's tent or within 70 meters of the magazine site.

3.2.7 The magazine site selected is to be free of, and to be kept clear of empty cases, debris, and grass and shrubs.

3.2.8 **SMOKING, FIRE, or OPEN FLAME ARE NOT** permitted within 70 meters of the field storage magazine site.

** 3.2.9 Approved Lightening Protection (Conductors) shall be erected above or near all storage magazines.

3.3 WARNING SIGNS - IN ENGLISH AND ARABIC

3.3.1 Four standard explosive signs shall be placed north, south, east, and west of each storage site - 70 meters from the closest explosives.

3.3.2 Four "KEEP AWAY - DO NOT APPROACH" warning signs are to be placed 70 meters from each magazine.

3.3.3 Four "NO SMOKING and NO BUILDING OF CAMP FIRES" signs are to be placed 70 meters from each magazine area.

** 3.3.4 Usage of CELLULAR PHONES or VHF RADIOS is not permitted within a 250 meter perimeter of the Magazine storage site. ALL CELLULAR PHONES & VHF RADIOS must be turned off when operating within the magazine perimeter area. Proper warning signs indicating NO USAGE of CELLULAR PHONES & VHF RADIOS must be posted at all entrances to Magazine site at the 250 meter boundary.

3.4 STORAGE CONTAINERS

3.4.1 For large quantities of explosives, the vehicle or the trailer used to transport the explosives from the Main Magazine to the field camp can act as the field storage magazine.

3.4.2 Explosive transport trailers and trucks, when used as storage magazines on field parties, will have tarpaulin covers to provide shade. The tarpaulin will be draped over the top of the vehicle or trailer and the overhang will be pulled away from the side of the vehicle and secured to the ground by ropes forming a tent-fashion shade and maximum ventilation.

3.4.3 Cap boxes and booster boxes will be made of 1/8" steel plate with inside lining of wood 3/8" thick. No steel or iron screws or nails will be used to fasten the wood lining in place. ONLY non-spark copper and brass fasteners may be used.

3.4.4 Cap box and booster box magazines will have series of one (1) cm holes 15 cm apart on 2 sides for ventilation. The holes will be covered with screen wire fine enough to prevent the entry of cigarette butts.

3.5 MAGAZINE LOCATION AND ARRANGEMENT

** 3.5.1 The field storage Magazine shall be located at minimum of One Kilometer from the main camp or any built up area. The Magazines shall be of steel construction, wood lining, adequate ventilation with security mesh, and constructed using non-sparking fasteners.

3.5.2 If possible, high terrain should be between the field camp and the storage magazine.

** 3.5.3 Wooden blocks or Lath (Minimum thickness 2,54 centimeters) are to be placed under Detonator and Booster boxes to provide adequate ventilation during storage.

3.5.4 The cap storage area and the explosives storage area are to be at least 200 meters apart.

4.0 TRANSPORT OF EXPLOSIVES FROM FIELD MAGAZINE TO WORK LOCATION

* 4.1 All vehicles used to transport explosives shall be Diesel and shall be serviced with fuel and oil before explosives are loaded.

4.2 Caps and explosives may be carried on the same vehicle if it is impractical to use separate vehicles and if suitable separate magazines are provided.

4.3 Magazines shall be separated sufficiently to protect the explosives from possible electric blasting cap explosion.

4.4 Vehicle magazines shall be of sheet metal construction. The explosives magazine shall have a wooden lining at least 3/8" thick with no exposed metal fastenings. The electric blasting cap magazine shall have either a wood or celotex lining at least 3/8" thick with no exposed metal fastenings.

4.5 The magazines used for explosives shall be used exclusively for explosives.

* 4.6 A vehicle containing explosives shall not be left unattended. The Driver must turn off engine and remove key from ignition before exiting.

4.7 A vehicle containing explosives shall not be taken closer than 100 meters to a gasoline or diesel tanker.

4.8 Trucks carrying explosives shall proceed directly to the work location. NO DETOURS.

4.9 Vehicle magazines shall remain locked at all times when not in use.

4.10 All explosives shall be returned to the main field magazine at the close of the work day. The only exception is aircraft supported spike camp/ operations where explosives may be stored in a guarded remote location overnight.

4.11 Fire extinguishers will be provided on every vehicle carrying explosives.

4.12 A vehicle containing explosives including electric blasting caps shall not be brought closer than one-half kilometer to a camp trailer or tent. Explosives watchman's tent is excepted.

* 4.13 All vehicles carrying and transporting explosives shall be equipped with an earth chain to ground.

5.0 HANDLING OF EXPLOSIVES

* 5.1 **AUTHORIZED PERSONNEL**. All persons entering the restricted area at and around the storage magazines shall notify the person in charge of the explosive handling before entering the site. Only the following personnel are permitted at seismic field magazines sites or in the vicinity of a seismic field operation where explosives are being used. At all times the number of personnel near a magazine or loading operation shall be kept to the minimum necessary.

* 5.1.1 Geophysical Service Personnel

5.1.2 Saudi ARAMCO Management and Supervisory Personnel.

5.1.3 Loss Prevention and Service Organization Safety Engineers.

* 5.1.4 Other Company and/or Saudi Arab Government officials whose presence is approved by the Chief Geophysicist of Geophysical Data Acquisition Department.

5.1.5 Company or geophysical service organization employees engaged in explosives transport from the main magazines to the field magazines.

5.1.6 If, at any time, persons other than those mentioned above are present while explosives are being handled, the operation shall be suspended by the man in charge until the person or persons have left the area.

5.2 EXPLOSIVES ACCOUNTING

5.2.1 **FIELD MAGAZINE WITHDRAWAL RECORD.** An inventory book shall be maintained to list all withdrawals and returns. Each entry shall be dated and signed by the individual making the entry. This inventory book must be maintained at the field storage site, with a duplicate set of records at the main camp office.

5.2.2 **LOADERS REPORTS (Saudi ARAMCO Form A-2498).** Explosives loaded into the ground for subsequent detonation shall be recorded on Loaders Report (A-2498) which shall be completed daily. If more than one Seismic Line is worked on in any given day, then a separate Loaders Report shall be completed for each line. Drill Supervisors will normally oversee the loading operation and sign the Loaders Report.

5.2.3 **DETONATION REPORTS (Saudi ARAMCO Form A-5643).** Detonations shall be recorded daily on Detonation Report (A-5643) by line number. These are for subsequent reporting to Saudi Arab Government.

* 5.2.4 **EXPLOSIVES RECONCILIATION.** The Crew Manager or his delegate shall reconcile the Detonation Reports daily against the Loaders and Blasting Reports to insure that all explosives and detonators are accounted for. A journal must be maintained for this purpose.

5.3 RESPONSIBILITY ASSIGNMENT

5.3.1 The Seismic Party Manager has prime responsibility for care of explosives in the field magazine. He will make a physical inventory of all items in the magazine at least once each month and certify its correctness by signing the explosives inventory statement at the bottom of Saudi ARAMCO Form A-5472-2, Seismograph Statistics.

5.3.2 The Seismic Party Manager will designate one Shooter or Driller to be responsible for maintaining a daily balance of explosives withdrawn, used, returned, and in storage.

5.3.3 The Instrument Engineer is in overall charge of the recording and shooting crew and it shall be his responsibility to see that all rules and regulations given in this Section are carried out. In the situation where the only explosives are used by Uphole Drillers, the Drillers have overall safety authority and responsibility.

5.3.4 The Shooter and/or Drill Supervisors shall cooperate with the Instrument Engineer in all safety procedures and shall perform any additional safety measures which the Instrument Engineer may deem necessary, but only insofar as these do not conflict with the rules of this instruction, or with directives from the Seismic Party Manager.

5.3.5 The Shooter and/or the Drill Supervisors are charged with the responsibility for the safe handling of explosives at the shot point. This includes all transport of priming and charging of explosives.

5.3.6 Two Shot point Headmen will be employed on all field parties using explosives as their seismic energy source.

One Shot point Headman will be assigned to the Shot point Driller and issue explosives to Drill Units as explosives are required. The Shot point Headman will keep track of all explosives issued to Drill Units and assist in Explosives Accounting.

The second Shot point Headman will be assigned to the Shooter and be responsible for clean up crews as described in Section 5.7.

5.3.7 The Shot point Headmen are charged with the responsibility of familiarizing all personnel including watchmen, laborers, loading personnel, Shooter's helpers, and drivers of proper Explosive Safety Regulations.

5.4 EXPLOSIVE SUPERVISION - General Instructions

5.4.1 Any explosives which, in the opinion of the Shooter, show signs of deterioration shall be destroyed by loading into a shot hole and detonating with a charge of good explosives.

5.4.2 Explosives shall not be used for any other purpose than that designated in regular seismic work.

5.4.3 Explosives shall not be burned.

5.4.4 Explosives may not be sold, given, nor loaned to anyone for any purpose.

* 5.4.5 VHF Mobile radio transmitters with output power of 100 watts or less may NOT be used within 250 meters of detonators unless all detonators are enclosed and shunted in a steel storage magazine.

5.4.6 All circuit continuity testing shall be done with a cap tester galvanometer with an approved low voltage power source, NOT with an ohmmeter.

The ohmmeter can potentially deliver a large enough electrical charge to detonate a cap and as such is unsuitable for circuitry testing.

5.4.7 No shotpoint pattern shall be checked with the firing line connected to the blaster.

The firing line must be disconnected and shunted before personnel enter the pattern for any reason.

5.4.8 Under no circumstances should the meter in the blaster be used to check an open circuit in the pattern when personnel are within or near the shot point area.

5.4.9 Wires at both ends of the firing line should be shunted and the blaster end of the firing line grounded.

When ready for firing the Shooter shall ascertain that the shot point area has been evacuated of personnel. Then he shall connect the firing line to the pattern. He may then connect the firing line to the blaster, provided he can visually be certain the shot point area remains evacuated of personnel.

5.4.10 The Shooter shall be the only man to fire the charge except when the Instrument Engineer is acting as both Shooter and Instrument Engineer.

5.4.11 Immediately after firing the charge, the Shooter shall remove the firing line from the blaster, short the conductors, and place the end some distance away.

5.4.12 The handling of explosives at the shot point will be suspended when the wind is strong enough to move sand regularly across the surface, and also during electrical storms. Shooter or Driller has the responsibility to shut down operations if unsafe conditions exist.

5.4.13 Blasting equipment must be grounded to the vehicle and the vehicle must be equipped with a grounding chain. The system should be checked monthly especially for corrosion which might interrupt the continuity to ground.

5.4.14 Only non-spark metals or wooden objects shall be used for making detonator holes in explosives.

5.4.15 All pattern shots will be wired in complete series.

5.4.16 A charge shall not be pulled back to the surface after it has been loaded.

5.4.17 At no time shall direct tension be applied between a detonator and its electrical lead.

5.5 SHOTPOINT PROCEDURE

5.5.1 PUFFER DRILLING

5.5.1.1 Drill Supervisors will act as Shooter and have all authority and responsibility assigned to Shooter.

5.5.1.2 Only the Shooter, Drill Supervisor, and the Shot point Headman are authorized to remove explosives from Vehicle Magazine.

5.5.1.3 Locally hired preloading crews are authorized for puffer drill loading.

5.5.1.4 On each drill unit a safe storage location will be constructed to contain small amounts of explosives and detonators. The storage location will be designed to accept one box of explosives (generally 50 lbs.) and small amounts of detonators. Explosives will be carried only in these designed locations.

5.5.1.5 Charges shall not be capped until they are ready to be dropped into the puffer pipe.

5.5.1.6 Only the Shooter, Drill Supervisor, and preloading personnel shall handle the caps including the unwinding of the leads, the placing of the cap into the charge, the removing of the shunt, and the tying of the leads to the firing line.

5.5.2 SURFACE PATTERNS

5.5.2.1 Vehicles should never be within 20 meters of the surface pattern when personnel are deploying or wiring the pattern.

5.5.2.2 In deploying surface patterns, the cap lead should be unwound and placed on the ground with the shunt intact before placing the cap into the charge.

5.5.2.3 Only the Shooter, Drill Supervisor, and preloading personnel shall handle the caps including the unwinding of the leads, the placing of the cap into the charge, the removing of the shunt, and the tying of the leads to the firing line.

5.5.2.4 Tying of the adjacent cap leads in the Surface Pattern should be done near the ground level. DO NOT HOLD cap lead wires any higher from the ground than necessary.

5.5.2.5 When a pattern has an open circuit and cannot be fired, ALL FIRING LINES SHALL BE REMOVED FROM THE BLASTER. After all firing lines have been removed from the blaster and re-shunted and re-grounded, only one individual will enter the pattern to search for the defective wiring or cap.

5.5.3 DEEP HOLE LOADING

* 5.5.3.1 Both explosives and electric blasting caps shall be kept in approved locked magazines on the carrying vehicle until actually being assembled for loading into the hole.

5.5.3.2 A charge shall not be capped until the charge is ready to be placed into the shot hole. It shall be capped only at the shot hole.

5.5.3.3 Only the Shooter, Drill Supervisors, and preloading personnel shall handle the caps including the unwinding of the cap leads, the placing of the cap into the charge, the removing of the shunt, and the tying of the leads to the firing line.

5.5.3.4 Seismic shot holes shall be loaded by methods in general use in the industry including the use of wooden loading poles with brass connectors.

5.5.3.4.1 Aluminum loading poles are not permitted.

5.5.3.4.2 Violent churning of the loading poles, while attempting to load a charge, is prohibited.

5.5.3.5 Only one firing line shall be used.

5.5.3.6 Under NO circumstances shall more than one charge be capped at one time. The caps for the next charge shall not be taken from a cap magazine until the capped charge has been lowered to the designated depth in the hole or fired.

5.5.3.7 In a loaded hole, the cap lead shall be concealed by covering with sand or placing it into the upper part of the shot hole.

5.5.3.8 The firing line shall not be tied into cap leads unless the charge has been dropped the full length of the cap wires or to the bottom of the shot hole. The shunt shall not be removed until the charge has reached this depth.

5.5.3.9 When a charge cannot be fired by a repeated application of the firing current, the charge shall NOT be pulled from the hole.

5.5.3.9.1 A second charge of sufficient size shall be loaded on the top of the misfire after allowing sufficient time for evidence of a burning charge to reach the surface.

5.5.3.9.2 If the charge is burning as indicted by gases reaching the surface of the hole, NO attempt shall be made to load another charge until the gases are no longer seen coming from the hole and adequate time has elapsed for the hole to cool.

** 5.5.3.10 Prior to firing, the shot hole shall be properly tamped by using either the cuttings from the hole or by bentonite plugs

** 5.5.3.11 Prior to firing the shot hole the shooter shall sound a clearly audible warning signal.

5.5.3.12 After the shot has been fired, the Shooter shall watch for signs of burning explosives.

5.5.3.12.1 If it is believed that the charge did not completely detonate, sufficient time should be allowed for a possible subsequent explosion due to the burning of the explosive before returning to the shot hole.

5.5.3.12.2 The Shooter shall decide when it is safe to return to the shot point.

5.5.4 AMMONIUM NITRATE

5.5.4.1 Fertilizer grade prilled Ammonium Nitrate is an oxidizing agent and is not to be transported with any combustible or flammable material.

5.5.4.2 Ammonium Nitrate will be stored in the field magazine not less than 100 meters from the explosives and 200 meters from electric blasting caps.

5.5.4.3 During transport to, and storage in the field magazine, the Ammonium Nitrate will be covered by flameproof and waterproof tarpaulin.

5.5.4.4 Sensitizing Ammonium Nitrate.

5.5.4.4.1 The mixing of fuel or diesel oil and Ammonium Nitrate will be performed at the shot point or at the field magazine area not less than 100 meters from the explosives, and in such a manner as not to contaminate the unsensitized Ammonium Nitrate remaining in storage.

5.5.4.5 Only that mount of Ammonium Nitrate expected to be detonated the same day or the following day will be sensitized.

5.5.4.6 Sensitized Ammonium Nitrate will not be stored within 35 meters of explosives, nor will it be placed with untreated Ammonium Nitrate.

5.5.4.7 All regulations controlling storage, transporting and use of explosives will apply to Ammonium Nitrate during and after the addition of any carbon agent (petroleum or petroleum derivative, coal dust, vegetable matter etc.).

5.5.5 DETONATION CORD SHOOTING

5.5.5.1 Locally hired personnel are authorized to assist in charge preparation.

5.5.5.2 In Marine Operations, cord charges will be knotted behind the business end of the detonator especially when the cap lead is used to stream the charge.

5.5.5.3 In Marine Operations, only one charge shall be capped at any one time.

5.5.5.4 Storage areas must be cleaned regularly especially when charges are cut to length in vicinity of magazine. Avoid build-up of cord explosives on the floor of storage area.

5.5.5.5 When detonation cord must be cut to size, only non-spark knives shall be used. Pliers, wire-cutters, or any pinching device shall not be used.

5.5.5.6 In land operations wherever possible detonation cord will be plowed in or buried. When hard surfaces are encountered, cord may be shot on the surface. All surface shooting safety procedures will apply.

5.5.5.7 Cord charges will be plowed in completely and cut from supply reel before being capped and will be capped by the same crew doing the plowing. Only one crew will operate on any single strand of detonating cord at any one time.

5.5.5.8 When plow blades are mounted in front of the rear tire, caution should be taken to insure that rear wheels do not spin over detonation cord.

5.5.5.9 Plows will be constructed strong enough to withstand a detonation in the feeder mechanism.

5.5.5.10 Detonators shall be fixed to the detonation cord with standard explosive crimps or taped securely with PVC electrical type tape (NOT FRICTION TAPE) with the business end of the detonator pointing in the direction of the loaded cord.

5.6 UPHOLE SHOOTING

5.6.2 Uphole Driller will normally act as Shooter and will have all authority and responsibility therewith.

5.6.3 UPHOLE SHOOTING HARNESS - Shooting harnesses will be made up at the shot point. (Wire harnesses with no explosives may be made up in camp).

5.6.4 The fixing of explosives to an Uphole harness will be done by the Drill Supervisor.

5.6.5 UPHOLE SHOOTING CABLE - Cable recorded upholes require surface or near-surface charges. All surface shooting regulations will apply for cable recorded upholes.

5.7 CLEAN-UP CREW

5.7.1 The Shot point Headman, supervised by the Shooter, is in charge of all clean-up activities.

5.7.2 The clean-up crew shall follow the seismic shooting for the following purposes:

5.7.2.1 Pick up and burn all discarded boxes.

5.7.2.2 Clip-off at the surface and gather all cap wire.

5.7.2.3 Fill all shot hole craters so that the area is left in an undisturbed condition.

5.7.2.4 Recover any explosives and/or blasting caps which may inadvertently be lost and turn them in to the Drill Supervisor.

5.7.3 CLEAN-UP - SURFACE SHOOTING: When an unexploded surface charge is encountered:

5.7.3.1 De-cap the charge and insert the defective cap into the ground.

5.7.3.2 Remove the explosive to the storage for use in a subsequent shot.

5.7.3.3 Shunt the cap leads and this cap is to be placed into a special storage box which is marked for defective caps.

5.7.4 Defective caps shall be destroyed by inserting them into a charge of dynamite and detonating.

5.7.5 CLEAN-UP - DRILL PATTERNS

The headman will examine the shot point for evidence of undetonated charges. If he suspects a charge did not fire, he will flag the cap wire. A second attempt will be made to fire this charge. If a second firing attempt is unsuccessful - DO NOT ATTEMPT to pull the charge to the surface. The cap wire shall be clipped off at the surface.

6.0 REFERENCES

6.1 Part of the information in this Section has been excerpted from the "Field Safety Manual" of Geophysical Services, Inc.

6.2 Other instructions pertaining to explosives are:

Responsible Department	General Instruction No.	Title
Loss Prevention	7.016	Transportation of Dangerous Articles Aboard Saudi ARAMCO Aircraft
MS&T	355.015	Handling Explosives
Construction	475.003	Use of Explosives
Transportation	1183.215	Transporting Explosives

Land Geophysical Operations Safety Manual, International Association of Geophysical Contractors Marine Geophysical Operations Safety Manual, International Association of Geophysical Contractors.

APPROVED: Manager, Exploration Operations Department

c.c. ALL Party Managers
Saudi ARAMCO Crew Supervisors
Servorg Managers
Servorg Supervisors
(In addition to regular distribution.)