

**GENERAL INSTRUCTION MANUAL**

475.001

**ISSUING ORG.** PROJECT SUPPORT AND CONTROLS DEPARTMENT**ISSUE DATE**  
12/16/2009**REPLACES**  
08/02/2004**SUBJECT** BLASTING NEAR EXISTING FACILITIES**APPROVAL**  
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**1 PURPOSE**

All blasting services required by Saudi Aramco will be carried out by non-Saudi Aramco Contract companies, but will be closely controlled and monitored by Saudi Aramco Blasting Services Group.

This GI sets forth the procedure to be followed when B.S.G. is requested by a Saudi Aramco Contractor liaison division or the Government Affairs Organization, to monitor the blasting activities of Saudi Aramco Contractors or non-Saudi Aramco Contractors for all proposed blasting within 1500 meters of an existing Saudi Aramco facilities i.e. (buildings, pipelines, electrical transmission lines and other facilities) that could be damaged by vibration, flyrock or other factors.

Blasting Services Group reserves the right to refuse any contractor permission to perform any blasting within 1500 meters of any Saudi Aramco facility if any of the standards, as stipulated within this GI, are not met.

**2 REFERENCES**

- GI 2.100 "Work Permit System"
- SAES-B-055 "Plant Layout"
- SAES-B-062 "Onshore Well site Safety"
- SAES-B-064 "Onshore & Near shore Pipeline Safety"

- \*\* American Safety Library Publications
  - "The American Table of Distances" (February 2004)

**3 \*DEFINITIONS**

**B.S.G.:** (Blasting Services Group) under Project Support Services Division of Project Support & Controls Department.

**Benching:** The division of a total cut depth into two or more cuts, such that each subdivided cut depth is treated as a separate blast.

**Blast Area:** The specific area to be blasted into which explosive materials are loaded.

**Blaster (Shotfirer):** The person authorized by Saudi Aramco to use explosive materials at the site for blasting purposes.

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**Blasting Mat:** The man-made cover placed over an explosive charge to contain flyrock. It usually consists of woven-wire chain-link fencing fabric, inter-woven wire-rope cable, used vehicle tires, or wooden timbers secured into a mat form.

**Burden:** The area between a drill hole and the nearest free face.

**Charging holes:** The process of filling drill holes with explosive material.

**Clean Sand:** Dune sand containing only windblown material which meets the gradation shown below and/or soil material meeting the gradation and containing less than three percent by mass of organic material, marl or clay:

Sieve size	Percent passing
1/4 inch	100
No. 10	90 to 100
No. 200	10 or less

\* **Close-proximity Blasting:** A type of blasting performed when fly rock control or vibration control at a distance equal to or less than 60 meters are required.

**Controlled Blasting:** A type of blasting done when the distance from a blast area to a facility is equal to or less than 1,500 meters.

**Deck Loading:** The arrangement of filling explosives in areas of borehole that contain hard rock.

**Delay Cap:** A cap designed not to detonate the instant that an electrical charge is applied but to delay its detonation for a specified period after current is introduced.

**Drill Pattern:** A description of the layout of burden, spacing and hole depths, including sub drill, and their interrelation with each other.

**Project Engineer:** A Saudi Aramco representative responsible for facility site construction activities

**Facility:** Any structure, building, pipeline, well, electric line, item, etc., that may be affected by blasting operations.

**Flyrock:** Rocks or debris thrown into the air from the blast area due to the detonation of charges.

**Free-face:** A near vertical open end in a blast area usually occurring from a previous detonation.

**Misfire:** When un-detonated explosive materials remain in a drill hole after an initial detonation.

**Peak Particle Velocity (PPV):** The maximum time rate of change of displacement for ground particles along one of three mutually perpendicular axes.

**Powder Factor:** The ratio of the mass in kilograms of explosive materials used to the volume in cubic meters of material blasted.

\* **PM:** Project Management

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**Sand Cover:** Natural clean sand used to control flyrock.

**Spacing:** The distance between each drill blast hole in a row of drilled holes.

**Stemming:** Suitable inert incombustible material or device used to confine or separate explosives in a drill hole or to cover explosives in mud-capping.

**Subdrill:** The depth beyond a theoretical blasting bottom.

**Work Permit:** An official written permission authorizing specific construction, maintenance, inspection or repair to be conducted in a Saudi Aramco restricted area.

**\*\* Work Permit (HOT WORK):** is any work that develops sparks, flames, or heat sufficient to cause ignition. This Saudi Aramco work permit will apply to the use of spark or flame producing tools and equipment, including the use of internal combustion engines in restricted areas. This Saudi Aramco work permit is also required for open flames, welding or torch cutting within 30 m (100 ft.) of a pipeline or facility containing hydrocarbons in non-restricted areas. Use Saudi Aramco form 924-2 (RED - white form with red text and border).

**4 BLASTER'S QUALIFICATIONS**

**\*\*** The Contractor Liaison Office shall submit to B.S.G. information regarding the proposed blaster:

- 4.1 A current resume of the blaster, including a copy of his license issued by the Ministry of Interior.
- 4.2 The blaster must have an oral/or written test interview arranged with the B.S.G. supervising blasting specialist to determine whether the blaster is acceptable. This submission and interview must not be performed prior to design review.
- 4.3 The blaster shall be at least 21 years of age and shall be qualified and experienced in the controlled application of explosive materials to a standard acceptable to Saudi Aramco.
- 4.4 The blaster must possess a valid Saudi Arab Blasting License based on having completed Technical Examinations as well as a Medical Examination to ensure that he does not suffer from any physical disability or mental disorder that may affect the safe execution of his duties. All blasting license documentation is held by the relevant Government Department.

**5 WORK PERMIT**

- 5.1 All procedures as stated in GI 2.100, "WORK PERMIT SYSTEM" will be strictly adhered to.
- 5.2 The work-permit issuer shall issue a permit only if he is satisfied that nothing under his operation will be affected.
- 5.3 The contractor must possess a valid Work Permit Receiver certificate.

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**6 RESPONSIBILITIES**

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**6.1 BLASTING CONTRACTOR**

- 6.1.1 The blaster shall comply with all stipulations and safety precautions as defined in the Blasting Services Manual.
- 6.1.2 The Contractor Liaison Office shall submit to B.S.G. a proposal plan for the proposed planned blasting operation. The proposal package must include:
- Scope of the blast project
  - Location and site plan
- 6.1.3 Blast design, including but not limited to:
- Burden and spacing
  - Quantity, depth and diameter of holes
  - Types of explosive material and initiation method
  - Type of stemming material
  - Maximum charge per delay
  - Maximum number of holes per delay
  - Number of delay periods available
  - Number of delay periods used in a typical blast design
  - Powder factor
  - Proposed flyrock control method (when required by the blast)
- 6.1.4 Anticipated theoretical peak particle velocity (PPV) imposed upon the facility.
- 6.1.5 Substrata information, if available, shall be submitted as part of the proposal package.
- 6.1.6 A minimum period of two weeks shall be given to B.S.G. to review and either approve or reject the contractors proposed blasting plan design submittal in writing.
- 6.1.7 The project contractor must make sure that all cover material, equipment, labor and Saudi Aramco work permits required by the blaster for the operation are on-site prior to any holes being charged with explosive material.
- 6.1.8 The blaster and a representative from B.S.G. must visit the proposed blast site a minimum of one day prior to a scheduled blast to ensure that the holes have been drilled properly.
- 6.1.9 In all built-up areas or areas where a Saudi Aramco work permit is required, the Contractor Liaison must, at least 24 hours prior to the blast taking place, notify the individuals below in writing:
- Area Loss Prevention Division Head;
  - Area Security Division Head;
  - Area Fire Protection Fire Marshal;
  - Area Government Affairs Office;
  - Proponent Department Head of facilities that could be affected;
  - Supervisor of each organization working on the site.

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- 6.1.10 The Contractor Liaison must inform B.S.G. whenever drilling operations occurs within 15 meters of any Saudi Aramco facilities.
- 6.1.11 Contractor Liaison shall make sure that the contractor cooperates with B.S.G. in all phases of the blast inspection and shall make sure that the contractor provides B.S.G. with copies of all blasting data in connection with the project.
- 6.1.12 B.S.G. shall supervise all drilling operations taking place within 15 meters of a facility.
- 6.1.13 The contractor must possess a valid Saudi Aramco Work Permit Receivers Certificate.
- 6.1.14 Once the Saudi Aramco work permit has been issued and the holes charged with explosive material, the blast must take place before sunset. This instruction shall be on each Saudi Aramco work permit issued and overseen by B.S.G.
- 6.1.15 The blaster, following the advice of the B.S.G. Representative, if required, shall be the only person to give work instructions regarding blasting operations, such as but not limited to: loading explosive materials; cleaning blocked holes; determining and laying flyrock cover; clearing a site of personnel, equipment, etc., prior to the blast, and handling misfires.
- 6.1.16 The blaster, after having informed the B.S.G. Representative, shall fire the shot only when he is entirely satisfied that all safety precautions have been taken.
- 6.1.17 Should an emergency arise in a restricted area where holes have been charged, then the B.S.G. Representative must immediately instruct the blaster to withdraw the Saudi Aramco work permit and then notify the area Government Affairs Office, Security Office and Police escort that he has canceled the permit and that explosive material is still in the area.
- 6.1.18 All blasted material shall be excavated immediately after it has been blasted. This will minimize exposure to the hazards associated with a possible misfire that could not have been detected at the time of the blast.

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**6.2 BLASTING SERVICES GROUP**

- 6.2.1 The extent of field inspection extended by B.S.G. shall be determined by the intricacy of the particular project, the type of blasting and the proximity to a Saudi Aramco facility as defined in 6.1.2 and 6.1.3.
- 6.2.2 Distance blasting
- a) B.S.G. shall monitor the initial blast using an appropriate blast monitoring device, which shall be furnished by the contractor.
  - b) Any necessary correction in the permissible amount of explosive material detonated per delay period, as determined initially by a theoretical formula or otherwise proposed can be made by the contractor with the concurrence of B.S.G.
  - c) Subsequent monitoring shall be performed by random inspection at the project site.

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**6.2.3 Close Proximity blasting**

- a) The initial blast shall be monitored, as described in 6.2.1, except that the B.S.G. inspector shall continuously inspect and monitor all of the blasting operations.

**6.2.4** After B.S.G. approve the contractor blaster qualifications and the project blast design in writing, the project blasting contractor will notify B.S.G. one week in advance of the proposed start date of the blasting operation.

**6.2.5** B.S.G. must make sure that Saudi Aramco work permits for blasting are obtained from each organization whose facilities may be affected.

**6.2.6** The records of field inspection shall be maintained by B.S.G. and made available to Contractor Liaison, as requested.

\*

**6.3 PROJECT ENGINEER**

**6.3.1** The project engineer from Project Management is responsible to notify B.S.G. whenever blasting may be necessary so that B.S.G. can assign a representative to the project.

**6.3.2** The project engineer must make sure that B.S.G. is invited to attend any meeting regarding proposed blasting operations.

**6.3.3** The project engineer must inform B.S.G. and the Project Blasting Contractor in writing of the location of any underground service installation that could affect the blasting operation.

**6.3.4** The project engineer must ensure that B.S.G. and the Project Blasting Contractor are advised in writing of known geological irregularities in the strata to be blasted, including cavities, soft-soil strata thicknesses and depth from the top of the hole, water table, etc.

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**6.3.5** The project engineer must ensure that the drilling contractor adheres to the drill pattern established and approved by B.S.G.

**6.3.6** Site Engineer; IF UNDETONATED EXPLOSIVE MATERIALS are discovered during an excavation of a blast area, then the site engineer must immediately stop all excavation and inform B.S.G. that undetonated explosive materials have been found. B.S.G. shall then take action using recognized approved procedures, as defined in the Blasting Manual, Section 1.1

**6.3.7** Project Management shall identify facilities located within 1,500 meters of the blasting site and inform the authorized representative of the department responsible for the facility, then inform B.S.G. well in advance of the scheduled blast day.

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\* **6.4 GOVERNMENT AFFAIRS DEPARTMENT**

6.4.1 Whenever B.S.G. monitor a non Saudi Aramco blasting contractor, a representative from Contractor Liaison Affairs Division, Government Affairs Department, shall submit the service request to Saudi Aramco Government Affairs Department, in accordance with the requirements as stipulated in this G.I.

6.4.2 The Government Affairs Department local representative shall notify any Government authority concerned of a pending blast that could affect persons or property outside Saudi Aramco facilities.

6.4.3 Upon receiving information from the blaster in a restricted area that a blasting operation has been withdrawn due to an emergency, the local representative shall immediately notify the Saudi Arab Police and obtain any assistance necessary.

**7 BLASTING PROCEDURES**\* **7.1 TRANSPORTATION/HANDLING**

ALL transportation/handling and distribution of explosives on Saudi Aramco property or within 1500 meters of any Saudi Aramco facility will be in accordance with the Saudi Government Public Security Instructions. Once the explosives are on site the Police Escort will take over the responsibility.

\* **7.2 VIBRATION CONTROL**

7.2.1 All blasts within 1500 meters of a Saudi Aramco facility shall be monitored by B.S.G.

7.2.2 Blasts over 1500 meters of a Saudi Aramco facility shall be monitored by B.S.G. on a random basis.

7.2.3 The monitoring of blasts shall be done by vibration recording equipment that produces a permanent record of the PPV imposed upon the involved facility.

7.2.4 The formula used for vibration control in designing an initial blast is:

$$W = (D/SD)^2$$

Where: **W** is the mass in kilograms of explosive materials allowable per delay period;

**D** is the distance in meters from the blast area to the affected facility,

**SD** is the scale distance factor, which is based on the designed PPV.



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7.2.5 To control vibration in close-proximity blasting, as set forth in Section 7.2, deck loading or benching of shots shall be required. An immediate change in the initial drill pattern also could be required. These factors will be evaluated by a B.S.G. representative after the initial blast and possible succeeding blasts.

7.2.6 The initial blast shall be located, at the farthest point possible from the most affected facility, as determined by B.S.G.

7.2.7 After the initial blast, the maximum kilograms of explosive material per delay in subsequent blasts shall be adjusted over the amount as determined in 7.2.4, provided the PPV determined in 6.1.4 (Blast design) is not exceeded.

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**7.3 FLYROCK CONTROL**

7.3.1 The requirements regarding cover protection for blasts close to a facility that could be damaged by flyrock must be established by the blaster as stipulated in the proposed blasting operation plan.

7.3.2 Permission to blast must not be given until the cover protection requirements have been approved by B.S.G. and complied with.

7.3.3 Powder factor, ground surface conditions, site geological conditions and the facility to be protected shall govern the final requirements for type and quantity of cover protection.

- a) The depth of sand cover, if required, shall be 1 meter unless directed otherwise by B.S.G.
- b) Where glass breakage, fragile materials, and items of a sensitive nature or when a blast is 30 meters or closer to an exposed facility, a blasting mat may be placed over the blast area, along with sand cover as specified in 7.3.3 a), otherwise a solid type blast mat that will contain all flyrock shall be used.
- c) Clean sand used to cover a blast must be somewhat free of foreign matter. It shall on a random basis, uniformly contain 4 to 11 percent moisture by mass. The full depth of sand cover shall be placed over the blast area and on an adjoining strip on all sides of the blast area that is equal to the burden distance/spacing of the blast holes. Reclaimable sand from a previous blast that meets the above requirements may be used in covering successive blasts.
- d) When a blast mat is required, the total depth of the sand cover shall be as specified in 7.3.3 a). An initial 12 to 15 centimeter depth of clean, dry sand shall be placed over the blast area to protect the blast initiation system. The blast mat shall cover the same area as specified for the full depth of sand cover as specified in 7.3.3 c). The remaining required depth of sand is then to be placed over the blast area.
- e) For a Saudi Aramco project, all materials, equipment, supplies and labor for the placement of flyrock cover protection shall be furnished by the Blasting Contractor. The blaster shall direct the placement of the cover material.



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**7.4 DISTANCE CRITERIA:**

7.4.1 A Saudi Aramco work permit shall be obtained by the project contractor from the authorized representative of the department responsible for the affected facility when blasting is to be accomplished within the restricted areas specified in SAES-B-55 for onshore and offshore plants, SAES-B-62 for onshore well sites and SAES-B-64 onshore and near shore pipelines.

7.4.2 When blasting at distances of 30 meters or less from a facility, it is advisable to shoot away from the facility from a free face and progress toward the facility, maintaining the free face at all times. This reduces resistance in the direction away from the facility and reduces vibration experienced at the facility. Excavation of previously blasted material is required to maintain the necessary free face.

7.4.3 Unless directed otherwise by the facility's proponent or the blaster, blasting shall not encroach at distances of less than the following:

- a) Buried facilities 4 meters
- b) Exposed facilities 2 meters
- c) Buried oil-filled electric cable 5 meters
- d) No blasting shall occur directly under overhead electrical lines with a clearance of less than 6 meters

SAUDI ARABIAN OIL COMPANY (Saudi Aramco)

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### \* 8 APPROVAL AUTHORITY

Approved By: \_\_\_\_\_  
Motaz A. Al-Mashouk, Manager  
Project Support & Controls Department

Date: \_\_\_\_\_

\* CHANGE

\*\* ADDITION

NEW INSTRUCTION ☐

COMPLETE REVISION ☐