

SURVEY REPORT

of the

SURVEILLANCE AND PROTECTION

SAUDI ARABIAN OIL FIELDS AND INSTALLATIONS

for the

MINISTRY OF INTERIOR

KINGDOM OF SAUDI ARABIA

**OFFICE OF PUBLIC SAFETY
AGENCY FOR INTERNATIONAL DEVELOPMENT
DEPARTMENT OF STATE
WASHINGTON, D.C.**

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TABLE OF CONTENTS

	<i>Page</i>
Summary	1
Terms of Reference	2
Conclusions and Recommendations	3
Saudi Arabia	7
Introduction	13
The Arabian American Oil Co. (ARAMCO)	19
Fire Prevention and Protection	23
The Electric Power Triangle	29
Communications (ARAMCO)	31
Criticality of Installations	33
Dhahran	37
Ras Tanura	45
Abqaiq	53
Safaniya	59
Trans Arabian Pipeline (TAPLINE)	63

LIST OF ATTACHMENTS

<i>Number</i>	<i>Description</i>	<i>Page</i>
1.	Persons Contacted and Interviewed	69
2.	Saudi Arabian Oil Fields and Facilities	73
3.	Aramco Fire Loss Experience, 1965-71	75
4.	Schematic Diagram-Typical Fire Training Area, ARAMCO	77
5.	Schematic Diagram-The Electric Power Triangle, ARAMCO	79
6.	Aerial View, Dhahran Headquarters Installations	81
7.	Aerial View, Rastanura Refinery and Terminal . . .	83
8.	Aerial View, Rastanura Tank Farm and Terminal	85
9.	Sea Island No. 2, Rastanura	87
10.	Abqaiq GOSP No. 1	89
11.	Pipeline Emergency Repair Trailer	91
12.	Pipeline Emergency Repair Tool Van	93

SUMMARY

ARAMCO industrial security responsibility rests with the Auxiliary Services Division, with no professional security coordinator, over-all responsibility nor ready access to management. Expatriate and local personnel, with few exceptions, are surplus employees from other company organizations with no security experience and little training. In contrast, fire protection personnel are outstanding local employees. Few plant protection standards or operations procedures exist, except for the fire protection and prevention program. The identification system is fundamentally sound, but poorly administered in most areas, and the I.D. cards lack control and could be easily counterfeited.

The company should employ a full-time industrial security professional, responsible to management and with company-wide staff responsibility for industrial security and fire protection and prevention. The quality of protection personnel should be upgraded and fully trained. The identification system should be modernized without resorting to electronic gadgetry. Owner company security professionals should be called upon to assist in the development of this program.

No single government security force has the responsibility for surveillance and protection of the petroleum installations. Elements of the National Guard, the Public Security Force and the Coast Guard and Frontier Force share the responsibility, are largely static and located in enclaves near most oil installations. Little training or patrol effort—land, sea or air—was evident. Logically, security responsibilities and tasks outside the Aramco installations should be assigned to and performed by elements of those Saudi Arabian Government (SAG) security forces located in the vicinity of the petroleum installations.

The over-all responsibility for security of the petroleum activities should be vested in a single authority such as the Vice Minister of Interior, the head of the Public Security Force or the head of the Coast Guard/Frontier Force (CG/FF). The individual vested with such responsibility, should be given authority to coordinate plans and operations of those elements of SAG security forces which are assigned security responsibilities and tasks in the petroleum facilities. Development, training and equipping of elements of SAG security forces employed in the petroleum security activities should be expedited. Their principal missions for the security of petroleum activities would be coordinated police, land, sea and air patrol and a well developed emergency response capability in the Eastern and

and Northern Provinces and offshore areas. Government police leadership, at the ministerial and director general level should attend OPS sponsored Executive Orientation Courses.

Twelve commercial security surveillance and protection proposals were submitted to the government. These included electronic gear, air, sea, and underwater patrol equipment, and communications and scanning apparatus. All require human monitoring and response, trained maintenance technicians and an increase in security personnel. All were complex, difficult to maintain, and expensive, with one proposal amounting to US \$180,000,000.

Experience in the petroleum industry reflects that many sophisticated electronic and mechanical security devices have been tested and rejected as impractical. Additionally in Saudi Arabia, it appeared to the study team that ARAMCO has the capability to bypass or replace, within a reasonable time, damaged equipment keeping loss of production and export capability at a minimal level. In view of these factors the study team does not recommend the adoption of sophisticated security equipment and devices. Instead, the study team recommends that existing security, safety equipment and devices are maintained at a high level and effort be concentrated on the training of personnel and the provision of transportation and communications equipment for elements of security forces assigned tasks in the security of petroleum installations.

The commercial proposals were not recommended for consideration.

TERMS OF REFERENCE

1. Examine present surveillance and industrial security provisions of the major petroleum industry installations; i.e. ARAMCO.
2. Assess efficiency and effectiveness of present measures.
3. Develop recommendations for any improvements deemed desirable.
4. Examine, as deemed necessary, surveillance and security proposals previously submitted by various private companies.
5. Examine, to the extent required, capabilities of the Public Security Force (PSF), National Guard (NG) and the Coast Guard and Frontier Force (CG/FF) as presently assigned in petroleum areas, to provide appropriate assistance.
6. Develop recommendations concerning any suggested improvements for protection capabilities for petroleum facilities.

I. CONCLUSIONS AND RECOMMENDATIONS

A. ARAMCO - ORGANIZATION

CONCLUSIONS

1. The industrial security responsibility, as it now exists in ARAMCO is delegated to the Auxiliary Service Division (ASD), nominally a part of the Community Services Department. Staff responsibility does not appear to be centralized as are many other functions of the corporation. Reporting requirements and lines of authority are not uniform for all locations, with the result that each ASD group operates independently. No single coordinator or administrator is responsible for security guidelines and uniform application throughout all installations, nor has easy and direct access been provided to management and to government security leaders.

2. The expatriate supervisory personnel of ASD, with one exception, is drawn from operating or administrative personnel who have no special industrial security training or experience, except as gained from within the limited confines of the company.

3. A substantial percentage of the guards have been drawn from other operational or administrative organizations of the company with little of the normal selective processes used to recruit such personnel. Many of them appear to have been surplus to requirements.

4. Few standard operating procedures or training programs exist for the ASD groups and their personnel.

5. At least one of the owner companies maintains a full time, world wide professional industrial security organization whose mission is to assist affiliates and subsidiary companies in developing plans and programs of this nature. It does not appear that ARAMCO has fully availed itself of this resource.

RECOMMENDATIONS - ORGANIZATION

1. Appropriate structural changes in the company organization should be made to establish an industrial security group, with direct reporting and easy access to top management.
2. This group should have staff responsibility for developing standards for industrial security operations procedures, training programs and security personnel selection criteria for the company. Area organizations would be operationally responsible to local managers.
3. A full time, permanent, experienced, professional industrial security coordinator should be designated to fulfill this staff responsibility. He should be responsible to the company's top operating management. In addition to internal company matters, he would deal directly with government security leaders in operational matters involving industrial security.
4. The industrial security coordinator, in his staff capacity, would develop and coordinate the implementation of the technical aspects of fire protection and fire fighting programs, encompassing the utilization and application of facilities and equipment, and the training and utilization of personnel. He would also coordinate fire protection, prevention and fire fighting matters with the company Chief Fire Protection Engineer and the Chief Loss Prevention (Safety) Engineer. He would have the responsibility, and authority for continuous inspection of all operations, and be required to keep management advised of progress as well as deficiencies.
5. Owner company industrial security professionals should be invited to assist in developing and reorganizing the industrial security program. This assistance should be a continuing arrangement.

B. ARAMCO - PROTECTIVE FORCES

CONCLUSIONS

1. The protective forces have been allowed to degenerate to no more than watchman status. (with little apparent regard for the impact of the company image as it is presently represented to the general public, the government and other company employees.) Training of recruits, who are usually surplus personnel, is limited to on-the-job training. Health and a limited ability to read and understand instructions in English appear to be the principal selection criteria.
2. These employees are furnished a plain khaki uniform consisting of a shirt and trousers with no identifying insignia. A green overseas cap is also issued.

Presumably the company has limited this uniform attire in an effort to avoid allegations that the company has established an internal police force.

3. It is also concluded that protective forces are not per se resented by the other employees or the general public, both of whom are well aware of their functions. Additional training, distinctive insignia designed to motivate pride in performance would result in better protection and an enhanced company image.

RECOMMENDATIONS - PROTECTIVE FORCES

1. The selection criteria, once established, should be used to review the entire protective force and individuals should be replaced as required. This should be coupled with a definition of duties and responsibilities, to maximize their 24-hour effectiveness, such as first aid fire fighting and fire prevention.

2. The protective force uniforms should bear appropriate insignia, indicating their in-plant authority but not infringing upon any government security forces.

3. The protective forces should be given further formal training in the functions of a security guard, patrol methods, the company identification system, gate control, intruders, theft and pilferage control, public and employee relations, first aid fire fighting, fire prevention, industrial safety, first aid and other pertinent subjects.

C. ARAMCO - IDENTIFICATION SYSTEM

CONCLUSIONS

1. ARAMCO has a fundamentally sound identification system which can be improved to meet its needs.

2. The basic documents, i.e., the various identification cards, may be easily counterfeited and such counterfeiting would be difficult to detect. There is also, in some areas, a minimum of control over the blank or unissued documents themselves, and insufficient data to relate the identification to a particular individual.

3. A highly sophisticated identification system involving electronic or mechanical controls, such as closed circuit television or electronically keyed badges, is not required at present in this type of installation. Such a system is costly, difficult to maintain, and must still be monitored by a full time gate guard.

4. The present method of making photographs is satisfactory, inexpensive and provides a film negative for the permanent records. The direct positive photographic is far more costly, without offering significant advantages.

RECOMMENDATIONS — IDENTIFICATION SYSTEM

1. A new basic identification card should be developed. It should incorporate the following data in addition to that already included in the current card:

- a. The employee's signature and thumb print.
- b. The employee's personal data.
- c. It should be printed on counterfeit resistant paper, with adequate safeguards and detection marks incorporated in the design.
- d. The present lamination process appears adequate and should be continued.

2. The color design and wording should be such as to control, as well as permit entry into selected company plants and facilities.

3. Provisions should be made to control the printing of the cards at their source, custody and complete accountability before and after issuance.

D. ARAMCO - FIRE PREVENTION AND PROTECTION

CONCLUSIONS

1. ARAMCO has an outstanding fire prevention and protection system, physically well designed, with inspection, organization and training geared to meet current company requirements in most instances.

2. The company decision to utilize a fire protection advisor and trainer from one of the owner companies is sound. However, since the individual is on loan for two years, it appears that this is a temporary effort to raise the level of in-company fire prevention and protection to a satisfactory level.

3. In addition to the essential role prescribed to the Chief Fire Protection Engineer, continuous professional fire prevention and protection efforts are required at the management advisory level as part of the industrial security effort for some years to come.

RECOMMENDATIONS — FIRE PREVENTION AND PROTECTION

1. The company should continue its efforts of fire prevention and protection in line with existing policies and programs for continuous up grading of capabilities.

2. At the end of the tour of the fire protection advisor and trainer on loan from an owner company, serious consideration should be given to employing or assigning a full time fire protection professional to the central industrial security organization with company-wide responsibility.

I-B: SAUDI ARABIAN GOVERNMENT SECURITY FORCES CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Although it may exist, the Team did not find any directive which delineates the overall responsibility for the security of the oil fields and related petroleum installations to any single security or police force. The National Guard, the Public Security Forces, and the Coast Guard and Frontier Forces apparently operate independently of each other with little coordination. For example, all three forces are operational in the Ras Tanura area with only informal agreements as to the jurisdictions.

2. Individuals from the above forces were observed in position at fixed posts—principally main gates—within the ARAMCO facilities. They appear to be ready to support the ARAMCO protective personnel in the event of need. Most were armed with rifles. The bulk of the forces in the oil fields are static groups stationed in enclaves or encampments with little apparent activity or training effort. Theoretically, they are in a position to act in an emergency and to respond to a call from ARAMCO for assistance in times of difficulty. In one instance, they have responded satisfactorily in practice alerts.

3. There was little indication of coordinated patrol activities by the government police or security forces on land and sea. This was particularly obvious along the coastal area, the Safaniya and other offshore oil fields which are now major producing areas. Some land patrol activity was reported along the Tapline. The security of these offshore areas as well as the extensive on-shore oil processing, producing, and handling facilities is beyond the capability of any industry and should fall within the purview and responsibility of government security forces.

4. Reference is made to the "Survey Report of the Frontier Force, Coast Guard and Ports Department" prepared by the Office of Public Safety, AID, Department of State, in July of 1969, copies of which have been furnished to the Saudi Arabian Government. An excerpt from this report states in substance and summary the following, relative to the activities of the Coast Guard:

"More than 50% of the Coast Guard fleet of 91 boats is out of effective operations and the remainder are badly in need of varying degrees of overhauling and maintenance. About 31 of the 63 forty-five foot patrol boats could be restored to operational status but those boats considered beyond economical repair should be surveyed, salvaged where possible and the hulls sold. Coast Guard does not have the expertise required to maintain, repair and in some cases operate properly its current fleet. The technical requirements to maintain this substantial boat fleet can only be met by competent commercial firms under contractual arrangements."

From the observations made by the Team, the above general situation still applies.

5. A vital factor in the ability to patrol is the capability of the security forces to maintain and operate the motor vehicles, boats or aircraft to be utilized in the effort. Communications equipment maintenance is also imperative if the various patrol units are to coordinate their efforts and to permit a central command to function. It was reported that few maintenance or operating skills in the above categories are available to the government within these security forces. However, there is little doubt that these forces are susceptible to being trained over a period of years in order to perform adequately.

6. Consideration was given in the 1969 Report to utilization of the SAMP military maintenance facilities for the Coast Guard/Frontier Force (CG/FF) equipment. Based on the recent observations by the study team, it was learned that SAMP has now become fully occupied and is incapable of assuming any more responsibilities than now accrue to it. Therefore, the CG/FF should seek other means for equipment maintenance, unless the SAMP maintenance capability can be expanded to accommodate the CG/FF requirements.

~~B. RECOMMENDATIONS -- SAUDI ARABIAN GOVERNMENT SECURITY FORCES~~

1. The overall responsibility for security of petroleum fields, installations and activities should be determined and primary responsibility for this function should be vested in a single authority such as the Vice Minister of Interior, the head of the Public Security Force or the head of the Coast Guard/Frontier Force CG/FF. Additionally, the authority vested with primary responsibility should be charged with coordination authority of the elements of all Saudi Arabian Government security forces involved in the security of petroleum installations, including land, sea and air petroleum security activities.

2. Based on guidance from the coordinating authority, a detailed plan should be developed for employment as appropriate of elements of the various Saudi Arabian

Government security forces in the security of the petroleum fields and installations in the eastern and northern provinces. This plan would encompass organized land, sea and air patrols, closely integrated and controlled by adequate communications. The plan should provide for: (a) daily external assistance as appropriate by trained and adequately equipped personnel and units to the ARAMCO Protective Forces at critical and vulnerable points and installations. (b) An emergency capability to deploy rapid reaction forces to key locations in order to respond to and control riots, demonstrations and other forms of civil disturbance threatening the petroleum installations and activities.

3. The organization, equipment and training of elements of the existing Saudi Arabian Government security forces which may contribute to or become involved in providing security support for petroleum installations should be reviewed and priority given to upgrading their capability to adequately perform the mission.

4. Senior Saudi Arabian government police officials concerned with petroleum installation security should consider attending four weeks individually arranged Police Executive Orientation Programs in the United States, to be programmed by the Office of Public Safety, AID, Department of State. This includes government executives at the ministerial level as well as the director general level of the forces concerned with the protection of the oil field.

5. An agreement should be reached with ARAMCO delineating the company responsibility for security and the respective support which may be expected from government security. Great care should be exercised by government forces in order not to interfere with continuing operations of the company nor to endanger themselves or company personnel and facilities through imperfect coordination with company officials.

6. Greater urgency should be placed on the reformation and development of the Coast Guard and Frontier Force (CG/FF) elements which may be involved in security of the oil industry, in line with Office of Public Safety recommendations previously submitted, and efforts for reorganization, staffing, training and contractor support should be accelerated. This is particularly the case for those elements of the CG/FF who might be assigned responsibility for security of port and off-shore petroleum facilities.

C. CONCLUSIONS AND RECOMMENDATIONS - COMMERCIAL SURVEILLANCE PROPOSALS

CONCLUSIONS

1. Twelve commercial petroleum surveillance and protection systems proposals were submitted by prospective private commercial contractors for security applications in the oil fields and installations. Only seven provided detailed recommendations based on actual surveys. The other five consisted merely of collections of equipment sales brochures. Proposals range up to U.S. \$180,000,000.

2. A review of these proposals divided the recommendations in two general categories: (a) Electronic warning devices; and (b) Air, sea, underwater, and land patrol equipment, communications gear and other area electronics.

3. A variety of mechanical and electronic devices are available commercially to assist in achieving the desired degree of physical protection. The range is from simple sensors, such as rate of rise sprinkler heads to sophisticated barrier intrusion alarm systems, including closed circuit television and entrance/exit X-ray. These are intended to supplement, not replace, manpower. All such devices require trained manpower to monitor and respond. Likewise, an additional increment of highly skilled manpower must be recruited and trained for the maintenance of the equipment, supported by a constant supply of spare parts. All in all, this would require an increase in the security personnel of ARAMCO and Saudi Arabian ranging from ordinary guards to highly skilled technicians along with commensurate equipment.

4. The warning sensor devices are subject to false alarms by animals, mechanical malfunctions, as well as evasion through use of disloyal employees or careless control of individuals. The funds and time required could much better and more economically be used to train the carefully selected human element which, in the final analysis, must monitor the area and can do so with intelligence and judgement factors not available in machinery or electronics. Most of these devices have been studied, and in some cases tried out in the oil industry around the world, and have been rejected as impractical in these situations.

5. The patrol equipment, communications gear and other area electronics proposed by prospective private commercial contractors is found to be more expensive to procure and maintain, too sophisticated for the roles and missions of the security forces and, in some instances, not responsive to requirements. Furthermore, the 1969 Public Safety Report and Survey of the CG/FF lists the required equipment package for this purpose in a more logical and economical T.O. and E.

6. Based on experience in the industry and estimated in-country capabilities of ARAMCO the study team is of the judgement that petroleum industry equipment and

materials that could be damaged through subversive attack or other causes could be usually bypassed and/or expeditiously restored causing a minimal down time of operations and loss of export production. These qualities of resiliency, along with rejection of sophisticated mechanical and electronic devices by the oil industry in circumstances such as those which exist in Saudi Arabia at this time, tend to argue against the acquisition of sophisticated security deterrent alarm and detection materials. In view of these circumstances it appears most logical that the security and safety devices, systems and equipment such as those presently in existence should remain simple but be very highly maintained with appropriate refinements to assure efficient performance.

RECOMMENDATIONS

1. It is recommended that the commercial surveillance proposals submitted to the government be given no further consideration.

2. Existing simple and unsophisticated fencing, lighting, safety and other protective and deterrent materials and equipment such as are presently being employed should be retained, refined as appropriate and maintained at a highly operational level. Effort should be concentrated on the training and equipment of manpower to upgrade techniques and professional skills and capabilities of both the ARAMCO security personnel and elements of the Saudi Arabian Government security forces involved in protection for the petroleum industry.

II. INTRODUCTION

SECURITY CONSIDERATIONS

Industrial operations require physical facilities and employ various processes which are vulnerable to incidents which may result in damage to plants, machinery and products in injuries or death to personnel and in reduction of productive capacity. Such incidents may result from inadequate design or misuse of facilities, carelessness or from deliberate intent by persons or groups whose interests are inimical to those of the production facility.

Industrial security may be simply defined as efforts to prevent any action, intentional or unintentional, which may interfere with the continuity of production. Loss of productive capacity usually results in lowered profits which can be translated into lessened wages, taxes, purchases of raw materials, transportation and similar things and services. Funds generated by production circulate through the merchants, growers, bankers and service operations of an area, as wages are spent for education, clothes, foods, utilities and services.

Hence, loss of production and the possibility of losses of production are a very important concern of employees, management, owners and government. Each has a real self-interest in seeing that productivity may be continued without undue interruption.

Methods for providing the protection required vary with the kinds of operations under consideration, types of facilities and locations, kinds of products and many other factors. Gem cutting and jewelry making require a kind and degree of protection vastly different from that which should be provided for a cotton mill operation. Effective preventive efforts must be planned, based upon careful assessments of requirements to meet existing risks and upon realistic evaluation of vulnerabilities and the degree of protection which is justifiable in the light of the importance of the facility and its products to the well being of the area, the nation and the world.

Applying these criteria to the oil industry of Saudi Arabia clearly demonstrates the need for providing a high degree of protection. The current production rate and the high percentage of the world's oil reserves located in this area highlight the world-wide importance of these facilities. Continued generation of Government

revenues from its oil resources can provide much of the funding for continued development and progress of the nation, regions and areas in which facilities are located.

Effective industrial security includes all of the provisions for safeguarding facilities, operations and products. Planned and built-in factors to preclude or reduce possible unintended interference in processing, storing and shipping, or to prevent, contain and/or extinguish fires, spills, explosions and similar hazards are important parts of a total security effort. Proper use of distance and terrain to attain shielding and drainage, as well as physical separation of portions of operations and rapid replacement or repair capabilities all belong in security considerations. Perimeter barriers, controlled ingress and egress, personnel and vehicle identification, authorizations and controls, adequate mobility and communications are other factors to be examined.

A variety of mechanical and electronic devices are available commercially to assist in achieving the desired degree of physical protection. These range from simple sensors, such as rate of rise sprinkler heads, to highly sophisticated barrier intrusion alarm systems. These may be and should be utilized when and where they can best meet requirements to provide additional needed in-depth protection, in areas where health hazards exist, such as noxious gasses, and to meet special needs. They are intended to supplement trained manpower and may in some instances reduce total manpower requirements. However, they should not be considered as a total replacement for well trained employees. All such devices require varying amounts of monitoring and maintenance by qualified people as well as a readily available supply of spare parts.

Inspections at typical installations of the Arabian American Oil Company clearly demonstrate the Company's program of providing well designed and properly constructed built-in safeguards. Use of separation and distance to limit size of probable incident involvement, selection of sites for construction which provide for drainage away from adjacent facilities, provision of dikeage and firewalls, as well as built-in fire extinguishment capabilities, are noteworthy. Evidence of rapid transport of readily available requirements and capabilities for making quick repairs is convincing. All of these are important parts of effective protection, since explosions, spills, boil-overs and fires constitute ever present dangers in most phases of petroleum operations, and a most important hazard to continuity of production

Provision of complete protection is not possible for such widespread and diversified operations as are found in Saudi Arabian oil operations. Well designed barrier fences around selected installations, properly installed, adequately lighted and frequently patrolled by well trained and equipped personnel, may be expected to keep out persons who might otherwise unintentionally intrude. It will also dis-

courage most intentional intrusions, but cannot alone keep out a determined intruder. It can make such intrusion more difficult and time consuming, so as to greatly enhance the probability of discovery, identification and apprehension.

In most cases, as the degree of physical protection is increased, so are the costs of providing the higher degrees. It becomes quickly possible to discover that increased protection must include installation and maintenance expenses which can be prohibitive in terms of additional protection provided. Protection to be provided should be examined in the same light and detail as is used to justify total fire protection for a community. For a city to provide all of the trained manpower and all of the extinguishment equipment believed necessary to cope with the largest possible conflagration is simply prohibitive in cost. Consequently, provisions are made for a lesser level of protection with emphasis placed upon fire prevention efforts and supplemental trained volunteers.

One of the truisms of the fire prevention professional is, "The fire most easily extinguished is the one which is not permitted to start." In oil operations, even more than in most others, time permitted to burn increases the difficulty of extinguishing. Consequently, rapidity of extinguishment response is an important factor of total extinguishment capability. Awareness of this and provisions for competent rapid response with effective equipment was noted at each installation visited. It is evident that much planning and continuous practical training is contributing beneficially to effective fire prevention and control. It seems equally obvious that risks, required level of effectiveness, and methods to achieve the desired level have been judiciously balanced in existing provisions.

Assignments and activities of members of various Government police and protective forces have been observed throughout this examination of petroleum installations. These opportunities to view some of the operations are valuable in any attempt to assess over-all protective requirements. However, the variety of assignments and the number of Government Forces represented adds to the difficulty of accurate evaluations in the short time span provided for this study.

The physical appearance, posture and alertness of uniformed representatives of government forces viewed ranged from excellent to less than desirable. Generally, the information received concerning availability and conduct of support forces to oil installations was uniformly satisfactory. Relations between police and military forces assigned to particular industrial sites and the local Aramco management of such sites were reported as good. There appeared to be friendly coordination at places where police and Aramco protection personnel were stationed together.

Present command responsibilities for the various government forces seem to be separately channeled, both upward and downward. It is probable that more effective results might be obtained by the establishment of coordinated commands for all government personnel assigned to protective functions at any particular area of the petroleum complex. Multiplicity of command channels and of forces assigned in an identical area frequently complicate and make it more difficult to achieve the best degree of performance for any assigned task.

There exists a generally accepted division of the responsibilities for over-all protection of industrial installations. Total protective efforts begin inside operations and may extend well beyond the perimeter boundaries of any installation. Most establishments must receive raw materials, ship products, be supplied with power and water, maintain many outside communications facilities and utilize highway and road networks, rail systems and such. Management of most industrial plants have neither facilities nor authority to provide controls and protection for such outside facilities. Consequently, protective efforts for any industrial establishment outside its operational boundaries or fences are usually considered as the responsibility of government.

Similarly, government protective forces rarely are trained or equipped to serve the needed protective functions inside plant perimeters. Too much security effort inside a plant or critical area can severely interfere with smooth work flow, impede needed freedom of movement and cause lowering of facility output. These factors have long been recognized and have contributed to the general acceptance of division of security responsibilities, using perimeter boundaries as the dividing line.

Such clearly defined areas of protective responsibility can enhance the effectiveness of total security efforts. Inside plant forces and outside government forces complement each other to accomplish effective total protection. Specific understanding of responsible assignments and joint pre-planning for coordinated operations to control emergency situations, are desirable adjuncts for both Government and Management.

A purpose of the studies made as the basis for this report was to apply the same objectivity to on-site viewing of existing provisions and professional analysis of present requirements for all segments of security. The observations and recommendations offered have the goal of providing effective degrees of protection at reasonable costs in relation to values represented. They should not be expected to completely preclude the possibility of production interruptions and losses. Rather, they are intended to minimize the probability of interruptions and to depend upon rapid response and quick repairs to hold interruptions to those of manageable proportions and within acceptable loss limits.

Effective implementation of recommendations assumes the continued excellent working relations and understanding between the Government of Saudi Arabia and its officials and personnel, and the Management and employees of the Saudi Arabian Oil Company and those of Trans-Arabian Pipeline Company. Close cooperation and joint planning for respective responsibilities for security may be expected to result in maximum effectiveness for necessary expenditures.

III. THE ARABIAN AMERICAN OIL COMPANY (ARAMCO)

AN OVERVIEW

The Arabian American Oil Company (ARAMCO) had its real beginnings in 1933, when a 66-year petroleum concession agreement was signed and ratified by the Saudi Arabian Government and the Standard Oil Company of California, a U. S. corporation. Later in 1933 the concession was assigned to the California Arabian Oil Company (CASOC), a company owned and formed by the Standard of California under the laws of Delaware. The name of this company was changed in 1944 to the present more appropriate title - Arabian American Oil Company (ARAMCO).

By 1936 the production and position of Standard of California in the Middle East and the Netherlands East Indies (now Indonesia) called for additional marketing facilities. On the other hand, marketing facilities which had been developed by the Texas Co. (now Texaco, Inc.) were in need of more accessible production. These two companies combined their interests between Egypt and the Hawaiian Islands and in this way the Texas Co. became half owner of CASOC.

In 1946, after Saudi Arabian petroleum reserves had been proved to be extremely large, calling for great market outlets, and enormous capital investments for their full development, arrangements were made for the Standard Oil Co. (New Jersey) and the Socony-Vacuum Oil Co. (now the Mobil Oil Corp.) also to become owners of Aramco. These arrangements were completed in 1948.

Since that time the shareholders in Aramco have been: Standard of California, 30%; Texaco, 30%; Standard Oil (New Jersey), 30%; and Mobil Oil Corp., 10%.

In its essentials, the original concession grants ARAMCO the exclusive rights within a so-called Exclusive Area, to prospect for, drill for, extract, manufacture, transport, deal with, carry away, and export oil and oil products, and to provide itself with the means and facilities to do so. The Saudi Arabian government received royalties and other payments which for CY 1970 amounted to \$1.2 billion. This was expected to increase in CY 1971 to \$1.7 billion. The government is to receive without cost, on the end of the concession, all of the fixed facilities which the company has installed.

The original concession area covered most of eastern Saudi Arabia, and in 1967 covered five tracts in the east extending 125,000 square miles including acreage in the Arabian Gulf.

Aramco's financial arrangements with the government have undergone change. The company was exempt from taxation under the original Concession Agreement. Beginning in 1950, however, Aramco paid an income tax which, taken together with other payments to the government, equalled fifty per cent of its gross income less operating expenses. There have been some relatively minor modifications in this formula since that time.

Since much of Aramco's oil production is destined for European markets, a pipeline shortcut across Saudi Arabia, Jordan, Syria and Lebanon was decided upon. Accordingly, a U. S. corporation was formed named the Trans-Arabia Pipeline Co. (TAPLINE) to transport crude to the Mediterranean Sea for transshipment by tanker. The pipeline was completed in 1950. Transit fees are paid to the Saudi Arabian and other governments based on crude volumes passing through the line.

There are 14 principal crude oil production fields in the Aramco operation. These fields produced a total average production of 3.5 million bpd during CY 1970, an increase in production of 17% over the previous year. At the time of the inspection, daily crude oil production had reached about 5.2 million bpd. The total Aramco petroleum reserves are variously estimated from 88 billion to 300 billion barrels, and they constitute at least 18% of the world's proven reserves. For the purposes of this study, oil field installations situated principally in the Abqaiq and Safaniya producing fields were selected as typical of the Aramco operations for on-site inspections. (See attachment).

The Ras Tanura facility was inspected. It is located on a peninsula in the Arabian Gulf about 72 kilometers by paved highway north of Dhahran and is the major refining, terminating, and shipping facility of Aramco. Crude shipments for November 1971 amounted to 3.9 million bpd (including 190,000 bpd through the underwater pipeline from Ras Tanura to Bahrain). The refinery throughput for this month was 462 thousand bpd, which coupled with a crude shipment of 415 thousand bpd through TAPLINE, totalled 4.7 million bpd of crude and products for the company during November of 1971.

Dhahran, located 18 kms. inland from the principal Arabian Gulf port and capital of the Eastern Province, Dammam, is the site of the Aramco headquarters administrative office, and was also inspected. Also located here are electric power plants, large closed and open material storage areas, motor vehicle and aircraft maintenance shops.

The TAPLINE is a 30"-31" pipeline extending 1207 kms. from Qaisumah, Saudi Arabia, its eastern terminus where it connects with the gathering systems of Aramco, the Sidon, Lebanon, on the Mediterranean. It operated in CY 1970 at a rate of 491 thousand bpd until May 3 when damage inside Syria halted operations. This interruption lasted until January 1971, when an agreement with the government of

Syria resulted in the reopening of the line. However, even though Saudi Arabia lost substantial transit revenues during the period of closure, Aramco managed to shift all of TAPLINE's normal Sidon offtake to the marine terminal at Ras Tanura. In November 1971 TAPLINE transported 415 thousand bpd of crude and 490 thousand bpd was forecast for December. TAPLINE itself was not inspected but a typical mainline pump station was visited and pipelines viewed from the air.

During CY 1970 Aramco continued its policy of reducing its total labor force, while at the same time increasing the percentage of Saudi Arabian employees. The following brief table shows the statistics concerning employees and their nationalities for CY 1969 and 1970.

ARAMCO WORK FORCE

I. <u>Saudi Arabia</u>	1970		1969	
	Number	Percent	Number	Percent
Saudi Arab	8,630	83.3	9,015	82.9
American	886	8.6	985	9.1
Other Arab (34 Palestinians)	256	2.5	275	2.5
Other Nationals (290 Indians) (212 Pakistanis)	584	5.6	593	5.5
Totals	10,356	100.0	10,868	100.0
II. Overseas Staffing				
A. United States (all American)			1970	1969
1. New York Office			168	168
2. Washington Office			4	4
Totals			172	172
III. ARAMCO Overseas Corp. (AOC) ¹				
The Hague			209	207
Beirut			13	14
Sydney			3	3
Dhahran			3	3
Totals			228	227
IV. Total ARAMCO Work Force				
TOTALS			10,756	11,267

In CY 1971 Saudi Arabia became the third leading oil producer in the world, after the United States and Russia and ahead of Iran and Venezuela. Most, but not all of this is attributable to Aramco. Saudi Arabia shares the ownership and income from the fields in the Neutral Zone, controlled by Kuwait, which contributes to this total. Two companies, the Getty Oil Co., American, and the Arabian Oil, Japanese, produced and average total of 359 thousand bpd in CY 1970. These installations are outside the purview of this study. Petroleum played the dominant role in the Saudi Arabian economy, contributing about 53.8% of the GNP in 1970.

The major contemporary internal security problem involving Aramco occurred in early June of 1967 when tensions over the Middle East conflict generated demonstrations against the company at its principal installations. Operations were shut down in the affected areas on 7 June but by the morning of 10 June, most employees of Aramco were back at work and operations resumed.

Note: The AOC is a wholly owned purchasing and design subsidiary of ARAMCO.

IV. FIRE PREVENTION AND PROTECTION

The Chief Fire Protection Engineer for Aramco is located at company headquarters in Dhahran. He is responsible to the Chief Engineer of the company. He also has frequent and direct contact and coordination with the operations Vice Presidents, the operations General Manager, and as required with the President of the company.

As part of the company's coordination procedures, the Chief Fire Prevention Engineers meet every two weeks with the Vice President of Oil Processing and Movements whose functions include the refining, terminalling and pipeline operations and the General Manager of Producing and Exploration. Also involved are any operations, safety or other personnel who may have an interest in any of the subjects being discussed at these bi-weekly meetings.

The Chief Fire Protection Engineer has functional responsibility for all fire protection activities of the company. He is also responsible for fire protection review of all engineering project proposals for all new company facilities or alterations of existing plants. It is significant that this review takes place in the design stage rather than *ex post facto*. He continually reviews existing installations for which designs were less adequate than are present standards, as part of the effort to upgrade all "as-built" protection. These fire prevention engineering reviews encompass plant layout, drainage and run-off channeling, work space and spacing of equipment in reference to separation of potential hazards.

A number of criteria have been developed by the company. Basic fire prevention criteria are derived from the standards of the American Petroleum Institute (API) and the National Fire Protection Association (NEPA), both of whom set standards for U. S. operations. Aramco considers these standards as minimums and makes add-ons to meet the requirements of their isolated situation, inasmuch as there presently is no mutual aid or backup assistance outside their own installations.

One of the criteria is that no drainage design is made which will result in dumping oil into the sea from terminals or tank farms. For example, a single risk area will contain the volume of the largest tank in the area. A single risk area is surrounded by dikeage and/or drainage sufficient to handle the maximum expected spillage or boil-over and is provided with canals to direct such flow away from other products. This is accomplished in most areas by selecting terrain with the proper

grade or mechanically grading for the purpose. Spacing required is 175 feet from shell to shell exceeding the U. S. standards which call for a minimum distance of 150 feet between shells. All production tanks are floating roof except for the non-flammable products such as fuel oil. None of the floating roof tanks have foam installation.

An example is the tankage protection criteria developed for the new Juaymah project. This will begin as a one million bpd deep water terminal and may expand to more than two million bpd capacity. The location is about seven miles north of Ras Tanura. The fire protection engineering review of the project aims at built-in fire prevention as well as the need for extinguishing capability. It is also noted that Juaymah will have lines and terminaling facilities separate and apart from Ras Tanura thus further isolating the tanks using distance as protection.

FIRE PREVENTION

Fire prevention is geared into top management through the utilization of a safety and fire prevention committee. This management level committee, known as the General Safety Committee, includes as members the Vice President of Oil Processing and Movements, the General Manager of Producing and Exploration, the Chief Fire Prevention Engineer, the Chief Safety Engineer and the Chief Inspection Engineer. Management personnel responsible for the area to be inspected are also included. Conditions viewed are discussed with local personnel and a written report is prepared reflecting problem areas encountered. A follow-up system ensures that remedial actions are taken.

Each year the month of February is declared fire prevention month for all Aramco facilities. Four inspections are conducted by this General Safety Committee covering all installations during each February.

~~Each principal facility has a local fire and safety committee.~~ The Area Manager serves as Chairman and members are drawn from the senior staff group of the area and include the manager or superintendent of the combined operations, foreman of the area, operations supervisor, fire chief and safety engineer. The committee meets weekly to review all fires, all industry disabling injuries, all motor vehicle accidents, explosions and all other incidents. The operations supervisor makes safety and fire inspections covering one-third of the area each month, hence providing a complete inspection of his installation each quarter.

All fires must be reported and those in excess of \$100 damage must also be reported to the Saudi Arabian government. (See Attachment Number 3, "Aramco Fire Loss Experience, 1965-71".)

The local safety and fire prevention committee decides when a disaster drill should be held. These drills are based upon a hypothetical situation and designed as a preplanning device. These are held quarterly and activate the disaster control headquarters established at each major Aramco installation. The Chief Fire Protection Engineer is also the Coordinator for the Aramco Oil Spills Task Force, which, in addition to fire and safety considerations, is concerned with environmental protection.

FIRE PREVENTION AND PROTECTION TRAINING

Fire prevention and protection training is based upon full time presence of a minimum number of professional fire extinguishment personnel, supported by well trained volunteer employees for immediate, joint response to all alarms.

All plant operators whether they are involved in oil processing or movements, regardless of nationality, are required to take a basic 60-hour training course in fire prevention and protection. This training not only encompasses the theory of fire protection, but also active fire fighting on practice burn grounds constructed at each major facility for that purpose (See Attachment No. 4 "Fire Training Area".) This gives the operators actual experience in facing a fire with its dangers so that they learn to operate the equipment and fight the fire under simulated times of stress. Also, the operators are taught fire prevention in terms of housekeeping and safety precautions, use of preventive devices such as air masks and similar equipments. As a follow-up, each operator receives four hours each year of refresher training in the actual use of various extinguishing agents at the extinguishment practice range. These operators form the bulk of the fire fighting force and compose the volunteer fire fighting organization at each locality.

In addition to the operators, in each major facility there are paid firemen who drive the mobile equipment, maintain it and furnish the operating instructions. They conduct required daily equipment inspections and identify replacements and repairs required in various plant areas. The composition of fire extinguishment forces is dealt with under the various location descriptions.

Generally there are three types of volunteer fire fighting groups at each major Aramco installation. The Laboratory Brigade provides an immediate response and manning of the mobile equipment. At Abaiq and Ras Tanura the Laboratory is located opposite the fire station. The usual maximum response time is less than four minutes. The Maintenance and Shop Brigade is a second force drawn from these areas. The largest group is the regular Fire Brigade consisting of general company employees. All of these are used as required on an "as-available" basis, with expected response from the Volunteer Brigades during off-duty hours reported as

about 35%. These forces are structured to provide adequate protection with this known turn-out figure.

FIRE LOSS RECORD

The Aramco fire loss experience from 1965 through the first eleven months of 1971 compares favorably with those reported in the API annual world-wide fire loss reports. (See Attachment 3.) It should be noted that 1970 was an exceptionally high loss year around the world because of a number of major fire disasters which occurred during that period.

Although Aramco established in 1970 a new record low of 50 fires, the total losses for 1970 amounted to \$640,000. A major loss and the greatest in the history of the company involving an oil installation happened five miles northwest of Ras Tanura. This incident occurred in June, 1970, at a point about 1,000 yards southeast of the checkpoint along the highway paralleling three crude pipelines, when a motor vehicle driven at high speed went out of control and ran into a line. The impact ruptured a line spilling the crude which immediately ignited. This line was immediately shut off but flows were deliberately continued in two adjacent lines as an effort to keep them cool to prevent ruptures. The attempt was not successful and in about 20 minutes after ignition the other two lines collapsed from the heat and were in turn shut off. The fire was diked and allowed to burn itself out which took about 30 hours. Six days and nights of work around the clock were required to repair and replace the some thousand feet of line lost in each of the three pipelines. The crude production loss during this period was approximately 3.5 million barrels of crude oil.

FIRE EXTINGUISHMENT MATERIALS

In 1969 Aramco began conversion to combination dry chemical and light water foam systems. Prior to this, all mobile equipment and fixed installations had been supplied with mechanical foam. Dry chemical is not new to the industry but a later type of powder is utilized to provide increased extinguishing capacity.

Light water, as it is called in the industry, is a fluorinated hydrocarbon foam which, when mixed with water changes the surface tension of the fire water so that the resulting mix will float on oil instead of vice versa. The fire fighting process, combining dry chemical and light water enables the firemen to knock down the fire with a dry chemical nozzle and simultaneously blanket the fire area to cut off oxygen with the light water foam nozzle. Mobile fire trucks carry 200 to 500 gallons of light water for nozzle mixing. Each unit is equipped with twin, 360

degree turret nozzles which can be triggered singly or simultaneously to apply the dual purpose extinguishment agents.

A 6% light water mix for use with sea water is a recent development which provides an effective extinguishing agent.

Two trucks respond to every fire call in all of the locations visited. If both are not needed, one returns to the Station. In addition, a dry chemical/light water trailer is stationed as stand-by at all hot-work jobs. In the plant, refinery, and terminal areas, the response of the mobile fire equipment is estimated to be from one to five minutes. Operators are trained to make an immediate shutdown of any operations which might contribute fuel to the fire. There is a gratifying awareness of the need for rapid response for extinguishment and available records indicate success in this field. Rapid response permits much easier extinguishment since elapsed time from ignition to extinguishment is related to difficulty of extinguishment. Increasing temperatures of the oil and structures rapidly accelerate flash-back potential making control measures more difficult and time consuming at the same time that rising heat in adjacent risks require increasing cooling and protection and as fire expansion potential quickly rises.

In order to further upgrade the fire prevention and protection activities, the company has decided to retain a former Fire Protection Supervisor from the Petro Chemical Division, Mobil Chemical Co., Beaumont, Texas. He will be on a two-year loan basis and is scheduled to arrive in Saudi Arabia on 15 December 1971. He will make a review of these company operations, in each area, as follows:

1. Fire Fighting Organization
2. Fire Equipment
3. Existing and Previous Fire Fighting Training Programs
4. Identify fire fighting training requirements for:
 - (a) Full time firemen
 - (b) Laboratory, Maintenance, Industrial Services, Utilities, and Operations fire brigades
 - (c) Volunteer fire brigades
 - (d) Apprentices and Operator Trainees
 - (e) Refresher Training, Operations and Maintenance personnel
5. Develop broad outline of training programs for each group outlined in 4 above
6. Develop integrated training schedule for all areas based on time required to formulate specific training program content and conducting of the program for each group outlined in 4 above.

V. THE ELECTRIC POWER TRIANGLE

Electric power generation is a key element in the continued and successful operation of the Saudi Arabian oil fields and facilities. Accordingly, Aramco has over the years developed what is generally referred to as the "Electric Power Triangle" (See Attachment No. 5.).

The principal power generation sources are located at Dhahran, Ras Tanura and Abqaiq, with smaller plants for local consumption in offshore Safaniya and 'Aid Dar.

It is reported that with any of the above power sources down for any reason, operational curtailments will be required. A shutdown - depending on its magnitude - could also reduce the capability to produce and ship oil. This would be particularly critical at a time when maximum power from all is needed, which situation existed at the time of the study. There are many variables in the electrical power load requirements, which in itself varies with seasonal requirements of certain crude, the overall production requirements as well as such matters as tanker availability.

The power grid is such that in the event of interruption power may be re-scheduled along alternate transmission lines to maximize facility operations. Transmission lines, while vulnerable to attack, are easily and quickly repaired with a minimum of down time. Consequently, lines are not considered a critical security problem.

The power generating equipment - motors and generators - and related control equipment - switch gear and transformer banks - are critical, expensive and require long lead times to replace. Major damage to these kinds of power equipment could seriously jeopardize over a long period the company's ability to produce, process and ship oil. However, probable periods of lost productivity from this exposure are greatly reduced by company capabilities to rapidly replace or repair such facilities.

Generally, the power plants are within separately fenced areas located within an overall fenced enclave such as an industrial area, providing a multiplicity of security deterrents. The plants are operator attended 24 hours a day and passes are required for entrance.

Of greater important is the stocking of replacement units, i.e., generators, motors, transformers, and switching gear. Some stocking is done now. However, to further

insure rapid return to power generation after shutdown, the company is planning further spares procurement. This is being accomplished through "advanced spending" or procurement in advance of planned expansion, for these long-lead time, critical spares.

Another assist in maintaining productive capacity in the event of failure, is the ability to "shed" loads. There are numerous ways in which "shedding" may be accomplished, but one example will suffice, the "shedding" of the electric power load for the 'Ain Dar Gas Injection Plant.

As explained in the section covering Abqaiq, a gas injection plant returns surplus gas to the underground oil structure, repressurizing the field which results in a longer and more productive life. Operation of the plant requires eight megawatts of power. The injection plant could be closed down temporarily for a number of days, or even weeks without materially affecting the long rang goals of repressurization of the oil structures. Therefore, these "shedded" megawatts could then be rescheduled and retransmitted to critical facilities as an assist in maintaining production.

The "power triangle," while probably not designed with the existing system redundancy for security purposes, has a positive impact on maintaining security of this vital resource.

VI. COMMUNICATIONS -- ARAMCO

The main telecommunications network called the "Backbone Communications Net" is an internal company system operating on a multi-channel microwave. The main bases are Dhahran, Ras Tanura and Safaniya with auxiliary links into all of the remote areas of operations. The bulk of the system is tied into the regular internal telephone networks at each of the principal areas. There is a single channel VHF system which serves as a backup from Dhahran to Abqaiq and Ras Tanura. A third alternate is the capability of talking from VHF mobile sets at Ras Tanura and Abqaiq directly to the phone system at Dhahran.

A high frequency radio system is also operated out of the communications control center at Dhahran. An emergency control center separate and apart from the principal center is also located there. The Dhahran control center serves the purpose of: (1) Air to ground communications; (2) Direct communications with exploration camps and remote drilling rigs; and (3) CW communications to marine tankers preparing to approach Ras Tanura. This latter capability actually amounts to the offshore CW for Saudi Arabia.

The external communications links include a leased teletype circuit to The Hague and to the New York office. This operates through the Saudi Arabian government system to the Bahrain satellite. The standby or alternate communications center at Dhahran can also communicate by VHF and HF teletype to ships at sea and aircraft in the area.

An emergency "call-out" system with small portable units for firemen and doctors is installed at Abqaiq. This is also in effect at Dhahran for the medical employees only. Fireman's telephone alert systems are installed at Dhahran, Abqaiq and Ras Tanura. A key management personnel alert system can be used for emergencies at Dhahran.

In terms of equipment, the company has some 500 VHF mobile units, 500 portables and 75 base stations. Most of these are operational links working on a day-to-day basis. However, the entire communications system furnishes in reality an excellent security network whose day-to-day operation virtually insures communications during an emergency. Each site communications installations has its emergency electric power generators and these are checked and operated weekly to insure availability if required.

VII. CRITICALITY OF INSTALLATIONS

Assessments of criticality should systematically and continuously examine and evaluate for installations, areas, or parts of either, a number of significant factors. One such factor is vulnerability or susceptibility to damage; another is the importance of the subject of the study to continued operations and the total costs damage might entail.

Vulnerability must, by definition, include those hazards which are inherent in the particular operations and processes; interference which may ensue from human error or carelessness; and any intentional damaging attempt from within or without installation boundaries. The overall security of any installation is only as strong as its weakest point. At any place where protection fails to fully meet safeguarding requirements, the facility is vulnerable.

Susceptibility to damage which can interrupt production varies widely through the components of an industrial complex. Particularly is this true in the many phases of petroleum extraction, processing and transporting. At numerous stages within such operations spills, explosions, fires or release of dangerous vapors are potential, inherent hazards.

Degrees of hazards may be greatly reduced in many areas by adequately designed and carefully built-in safeguards as parts of processing or handling. Some such systems are based upon reduction of fire potentials; others use the principle of directing potential hazards into channels, areas, and conditions where they may be dissipated, destroyed or rendered harmless. Controlled burning to destroy unwanted gas through flares, thus reducing or negating potential danger, is one example.

Use of closed systems for transporting and processing offers another type of built-in safeguard. These are based upon isolating one of the essential elements for burning by separation of combustible materials from a supply of oxygen. Others may be designed to reduce and/or maintain temperatures well below ignition points of materials handled. Most such designs for reducing fire potentials utilize the principle of isolating one of the three elements which are essential to any blaze; fuel to burn, ignition temperature to start, the fire, and oxygen to sustain burning.

Recognizing that situations or conditions may occur which over-ride or negate the built-in safety devices, a second line of defense is usually included in design and construction. These are the "fail safe" features to provide automatic or

manual immediate shutdown of all or parts of an operation under conditions in which continued operation might be hazardous. Permanently installed fire extinguishment systems such as sprinklers or foam flooding which are built in to control fire in a specific location or area and which are activated either automatically or manually belong in this category.

A third line of defense includes such items as portable fire extinguishers and hoses, fire pumpers, foam trailers, etc., together with personnel trained in effective use of such equipment. Also included must be provision of alternate facilities like backup generators, alternative transport facilities, and the capability to repair, replace and to reactivate promptly.

Additional provisions such as separation of similar facilities to reduce extent of damage, provision of reserve or dual capacity and like features must be considered as vital parts of protecting continuity of production. Perimeter fencing and lighting, control of movements into, within and out from an installation are used for the identical purpose - to reduce possible interruptions of production.

Criticality studies are made to determine the importance of a particular installation and its components to overall operations, including the probable impact of damage to, or loss of it, to employee morale, to the economic structures of the area and the nation and its possible effects on the prevailing political and social climate. When a process is the only one in the area such as an only water plant or electric power plant, without availability of alternate suppliers, the facility must be given a high criticality rating.

All types of risks to which the operations and installation may be exposed must be evaluated. The social, political and financial climates of the area deserve study. Relations between employer and employees, the presence or absence of tensions in such relations, and the existing degree of unemployment are pertinent items. The level of general peacefulness or unrest in the community and past adherence to good order must be weighed. Quality of available law enforcement and support agencies, capabilities of the agencies and the competency of members, and the level of respect for laws and regulations exhibited by the people of the area should be carefully examined and weighed.

The presence or absence of agitators in the area and the responsiveness of local people to logical or emotional stimuli may be influencing factors. The general tenor of community life, the concern of community members for their interrelations and common welfare, and their desires and concern for peace and good order all have important bearings on protective requirements and evaluation of criticality.

It should be obvious that many of these same factors must be of concern to the government forces which supply protection outside the perimeter of

the installation. To achieve maximum possible protection for efforts applied, a continual or frequent exchange of pertinent information is helpful. Plant management has daily contacts with employees and are in position to evaluate demeanor and attitudes on a regular basis. Changes are more readily apparent to them than can be detected by others with less frequent contacts.

On the other hand representatives of government forces have access to sources of information which are not available to others, and have regular contacts with citizens of nearby and outlying areas. They are in the best position to assess local situations and to be sensitive to, and aware of, any change of local behavior and customs.

Such alertness to changing reactions is also a measure of the risks at that location at that time. Stated in other words, this awareness constitutes another part of the continuous evaluation of the criticality of an installation.

Patterns and intensities of world tensions may affect criticality. Rapid change, particularly accelerations, can increase the risk assessment in many areas. Government may be expected to quickly be alerted to such changes and to be in a position to evaluate information received and sources from which it has been passed.

Locations, such as Qatif Junction where many pipelines come together or Zero Anchor in the Ras Tanura Area, are examples of points which must be constantly and critically evaluated for protection requirements. Qatif Junction is remotely located from other installations and is situated almost due west from the Ras Tanura facility. Pipelines lead from Qatff Junction directly across the flats and Tarut Bay 27 kilometers to Ras Tanura. At this crossing five large crude oil lines and two LPG lines are in close proximity to each other, hence could be vulnerable to extensive damage.

A complete knockout or damage to all of the facilities at Qatif Junction could require 72 or more hours to cap off and shunt lines to put the system back into full operation. The burn-out time for any escaped fuels must be added to total down time. Closing block valves at various locations should be able to hold losses down but as much as one quarter million barrels might be lost by such shutdown, and productive capacity could be affected.

Formerly a 1600 horsepower pump utilized this location as a booster station, but this capacity is presently not in use. Since the pumps are not presently used, there are no pressing power requirements at the Junction. Aramco does not provide an attendant at the fenced area, but there is one member of the Government Public Safety Force assigned at all times and Aramco's pipeline riders make frequent checks.

Another example of a vulnerable point is Zero Anchor, the terminal point for crude oil lines and manifolding for Ras Tanura. As much as 4½ million bpd flow through here plus 50,000 bpd of liquid petroleum gas plus 40,000 bpd naptha oil or 12,000 bpd of natural gasoline if naptha is not being forwarded. Company management is limited in the kinds and degrees of protection it can provide at such locations which must extend outside the company perimeters. This exterior security is properly a function of government and its protective forces. The responsibility may be best met by continually utilizing information from both company and government sources as a method of evaluating current requirements.

It is difficult to achieve a high level of protection for some areas outside company boundaries. For example, pipelines are buried below grade in some levels or evaluated above grade in others. In some places they pass under water. Regular patrolling does provide a deterrent to intended damage but distances involved in the vast oil areas of Saudi Arabia preclude patrol coverage on a high frequency basis. Theoretically, it might be possible to increase the level of protection by stationing men on both sides of such lines at arm's length apart, but the cost would be prohibitive and the idea is impractical. Even this could not guarantee against intentional damage from an aircraft or of the type which might originate at a distance such as a projectile. As a matter of fact, even where the lines are buried below grade, they are clearly visible to low flying aircraft and most times to surface view.

It follows that company management is in the best position to identify critical points in operations, to study their vulnerabilities and to assess protection requirements on a continuing basis. Government representatives can more readily assess developing situations outside the company boundaries and are endowed with the needed authority to take remedial action, authority which is not granted to management of private enterprises.

The constant exchange of relevant information enables the company contact to alert government forces to any estimated change in supporting actions required. Similarly, information received by company management from official government sources can enable better meeting of needs inside perimeter fencing, and consequently enhancing exterior efforts of government forces.

VIII. DHAHRAN

A. GENERAL DESCRIPTION

Dhahran, where the company's headquarters is situated and which serves as the base for overall operations, includes administrative facilities, maintenance facilities, and process areas. (See Attachment No. 6 "Aerial View of Dhahran headquarters") Inside the overall fenced area are provisions for housing employees in several locations. Included are the usual accommodations and recreational facilities plus a hospital-health center. Entry is through a main gate which is continuously manned by company Identification Control Officers. Present nearby are two detachments of Public Security Forces numbering 20-25 men each. Passes and/or badges are not consistently checked at the time of entry or exit.

B. PHYSICAL SECURITY

Fencing is generally well maintained although there are exceptions. Usually the type A fence, eight feet high, twist wire mesh, is mounted on 2½" pipe rail frames with "A" frame inner supports. These utilize a "Y" or single arm top extension carrying barbed wire.

Gates are generally of light construction and manually operated. At the main gate, two 12 feet wide, heavy gauge, twist wire mesh gates are provided on either side of the guard station island. These are mounted on 8 inch diameter metal posts by circular strip hinging about three inches high at top and bottom. Framing is of two inch pipe with a vertical two inch pipe center and one-half inch solid metal rounds forming an "X" on either side of the vertical divider. There is one pedestrian gate, backed up by a pipe maze, on either side composed of two 6 feet wide double gates. Two company Identification Control employees man the main gate 24 hours daily, and one or two plain clothes soldiers from the forces of the Amir of the Eastern Province are permanent duty, either at the gate or in a small structure located some 60 feet distant.

Interior fences are provided for various installations. At the storage yard and radio repair shop twist wire mesh fencing is 8 feet high and is surmounted by "Y" top extensions equipped with 8 strands of barbed wire. Framing for the fence is of 2½" pipe and gates are kept closed and locked when not in use.

At the maintenance and shop building a similar fence is provided but gates are unattended and left open 24 hours daily. This area provides storage for grading and heavy equipment as well as a gas oil separation plant. Fencing uses single arm extensions with three strands of barbed wire and at one location is replaced by a solid corrugated metal fence.

At the transportation department, which houses the paint and carpenter shop, some fencing on the south side is only five feet high and some portions are without top extensions. The gate is left open during working hours, closed at other times. Located within this enclosure is one of the emergency water pumping facilities and wells to assure continued water supply.

The transportation wire fence parallels the perimeter fence, separated by some 20 to 25 feet. A vehicle gate for this area is closed at the end of the day work shift, restricting the pedestrian walk-way to an outer gate which is kept locked when not attended. This gate and others are equipped with lock shields of the cylindrical type fabricated of heavy metal. It is reported that at time gate guards spot check outgoing packages but do not check incoming parcels. Private cars are permitted to park inside the transportation area during normal work hours.

At the fenced bus terminal the gate is unmanned and left open.

The housing area for intermediate employees is completely enclosed by fence. One main vehicular gate is open 24 hours daily and attended by a company Identification Control Officer. Two pedestrian gates are open at shift change time and attended; kept closed at other times. One attendant at the camp site pedestrian gate also serves to keep watch over the gate to the intermediate area located on the opposite side of a busy street.

C. POWER SUPPLY

The main power house located in the plant area is separately fenced and is provided with a double vehicular gate which is constantly locked and controlled by the on-duty operator. Patrols are provided at average time intervals of one hour and must dismount here to clock in at a key-clock station.

Entry into the plant area is through a single gate attended by a company Identification Control Employee who checks proper badging before permitting entry. The perimeter boundary at the entrance is delineated by metal posts perforated to afford mounting of a single, continuous chain through each.

A single, attended gate must be entered to go into the plant area. Here a company Identification Control employee checks passes and requires signing-in and signing-out. A special pass for this area is required.

The number two electrical substation is located off the road to the plant area just north of the Dhahran terminus of the government railroad. The turnoff intersection has police barracks housing 20 to 25 members of the Public Security Force. The 66 kv station is entirely fenced with one vehicular gate which is kept closed and one pedestrian gate which is left open and unattended. A vehicular patrolman must leave his car and go on foot around this area to clock in at three clock stations upon an irregular hourly basis, 24 hours per day.

The utility group and water demineralization tank areas are each provided with separate interior fencing and vehicular gates controlled by on-duty operators.

The tank farm for Petromin, the Saudi Arabian Government marketing company, has eight tanks some of which store gasoline. The fencing in this area is inadequate. Two National Guard Commandos, who occupy a small wooden structure nearby, provide surveillance.

Tank farm number two includes two crude oil storage tanks and is provided with a lighted, standard perimeter fence with the single gate kept locked. Two armed commandos occupy a small, nearby guard station.

The water treatment plant has fencing only in front of the building and is unattended. This, coupled with the glass windows and light wood doors in the building, effectively negate the protection afforded by fencing.

The pump house, from which oil is shipped to Bahrain, is enclosed with a separate fence. Two vehicular gates are locked and controlled by the on-duty operator. A buzzer, activated outside the gate, sounds at his work location, signals him to unlock the chain-secured gate for admittance.

A VHF transmitter tower and receiver are located on top of the Long Jabal hill serve the long-lines communications net. The chain link fence with single top extension at this location has deteriorated. The single gate was locked. A second VHF communications system is located within the camp area and is presently in service.

Near Long Jabal the main water storage supply for Dhahran is located providing two tanks for supplies of raw and sweet water. Water flows by gravity from here to the area through 16" and 6" pipelines. The location is checked by mobile patrols controlled by a watch clock system 24 hours a day.

Clock stations are located in such positions that the patrolman must dismount from the vehicle and walk around to check the back of the installation. The water storage area is completely fenced with one double gate which is kept locked. It is opened as needed by utilities personnel who carry keys.

D. AVIATION DEPARTMENT

Aramco hangars, located near the airport, are enclosed in a lighted, perimeter fence. A double fence in front is composed of standard twist wire mesh with a single upward extension mounting four strands of barbed wire. The gate is attended and entrance is granted only by special pass.

At the rear of the fencing and out of view of the gate attendant a small building is located, inside and adjacent to the fence. Another small structure is close to and outside the fence which could provide easy access over the barrier into the property.

The team was not equipped to measure intensity levels of protective lighting but it is suggested that this be done for the lights installed around the perimeter fence at the Aviation Department. They seemed of such spacing and type that the adequacy of illumination must be questioned. Minimum standards are 0.04 foot candles on a horizontal plane at ground level for perimeter fences with light increased to at least 1.0 foot candles measured in the same manner at vehicle gates, and 2.0 foot candles where pedestrian identification is required.

E. COMPANY IDENTIFICATION CONTROL FORCE (GUARD FORCE) DHAHRAN

Under the Auxiliary Services Division 140 personnel serve as gate attendants or make patrols, both foot and vehicular. These employees work an 8-hour day with a schedule of 7 work days on, two off, two on, 7 off, 7 on, and 3 off, average a total of 42 hours per week. The average shift strength is about 30 with a minimum on duty at any given time of 25. Shifts rotate each three weeks and shift hours are 7:00 A.M. to 3:00 P.M., 3:00 P.M. to 11:00 P.M., and 11:00 P.M. to 7:00 A.M. Personnel are uniformed by the company and are not armed. Their uniforms carry no insignia. However, they wear green overseas caps. The average age is reported as about 45 years. A maximum/minimum hiring age has not been established since all new assignments during the past 15 years have come from transfers from other parts of company operations. Retirement age is 60.

Character investigations for employment are not possible nor is a police fingerprinting check made, although company employee records are reviewed. Fingerprints

are taken of all company employees and filed. Training of the force is limited to on-the-job instruction with no formal class hours.

A total of 17 fixed post locations are manned at the Dhahran facility by company personnel. At each location a shelter of some type is provided, many of the one-man variety. Construction ranges from cement block at gate houses to small metal trailers at remote locations. Sixteen are equipped with telephones while one uses two-way radio. None of the fixed locations are equipped with search lights, although flood light systems are employed at two gates. There are no guard towers.

Two vehicle patrols plus a patrolling supervisor, also in a vehicle, are employed around the clock. The vehicles are each equipped with two-radios and patrols cover a given area hourly on an irregular basis. The plant area foot patrolmen cover some 40 clock locations on a 60-minute schedule. Fixed post guards are required to report at 60-minute intervals and failure to do so brings an immediate check by another patrol or the ship supervisor.

There are no automatic alarm systems.

No joint plans have been developed with police. However, fixed posts are backed by government members of several police forces. Each guard shift reports to a supervisor of Auxiliary Services Division, who in turn makes a log inspected daily at 0700 hours by the Advisor, Auxiliary Services. No guard dogs are employed. It is of interest to note that during the 1967 crisis, all guards at Dhahran reported for work and carried out their duties as usual.

F. IDENTIFICATION SYSTEM DHAHRAN

The principal identification document is the employee 2¼ x 3¼ inch ID card. Each displays a photograph, the employee's name and permanent number. One card is issued to each expatriate and includes additional information in Arabic on the reverse side as is required by the government, which states he has a passport which is held by the provincial authorities. The second is issued to national employees and does not include the back printing. A third card of the same type requires an additional stamp for admittance into the data processing operations. Similar size cards are used for various other groups. All are of the same general type and employ the same kind and amount of information.

The cards are color coded to a degree. Pink is for expatriates at the foreman level, whereas blue is issued to supervision and management level employees. Salmon cards are provided for certain employees to enter the company movies. Green cards serve as a temporary identification pass while a yellow card is used for personal

servants. A 3" x 5" peach colored card, without a photograph is issued as a gardener's gate pass and permits access from 6:00 A.M. to 5:00 P.M. on company work days. Contractor identification cards are printed black on white and employ a slightly different format restricting bearers to certain construction areas.

For entry to southern and northern area plant facilities, a 2½" x 2¼" diagonally pink and white striped, clip badge is provided. The same information is provided on the face as is included in the regular ID cards. A separate yellow clip badge of the same dimensions is required for entry into the Aviation Division.

None of the badges include special management marks, inks, color-coding for multiple area entry, signature or thumb prints. They are laminated in a satisfactory manner.

Records are maintained for badges issued. A lost badge requires the recommendation of a supervisor for re-issue. Request for replacement of a lost badge must be accompanied by a penalty payment of 20 Saudi Riyals, about U.S. \$4.40. Designs of all badges were last changed a little more than one year ago.

All twelve of the basic badge documents are illustrated in attachment number

G. FIRE PREVENTION AND EXTINGUISHMENT - DHAHRAN

The Fire Chief at Dhahran reports to the Auxiliary Services Division. A single, central fire station responds to all calls. Available are 30 full time paid firemen plus 40 trained volunteers. Volunteers are composed of 24 company employees from the senior staff housing area plus 16 volunteers from the intermediate housing area. Normally 12 full time firemen per shift can be supplemented by trained volunteers if required.

A dispatcher at fire headquarters receives all alarms by telephone. Average response time in Dhahran is reported to be three to four minutes. Log recordings are kept to show time of receipt of alarm, of arrival at the fire, the time the fire is reported under control and when the company reports back into service. The dispatcher's office is equipped with four radios, a hot line telephone to the main gate, one emergency phone, two incoming telephones and one outgoing telephone, one ADT intrusion system central reporting station covering certain offices in the main administration building and a tape recorder used as part of the volunteer call-out system. The incoming calls during non-working hours are tape recorded and used to respond to the volunteer alarm system in the homes of a number of the volunteers. Upon receipt of the alarm, they receive the taped message giving details by calling

the proper number by telephone, leaving the dispatcher free to handle his other duties. During working hours the alarm is given by a siren control led by the dispatcher's office when volunteers are to be alerted. On-duty firemen are alerted by a buzzer system at headquarters.

Fire drills for the 40 volunteers are conducted each seven days. The volunteers are divided into two groups for such training which includes instructional motion pictures, classroom instruction and actual extinguishment of fires at the Dhahran fire extinguishment practice field.

Upon receipt of an alarm two fire pumpers normally respond with the second returning promptly if it is not required. The first unit is manned by a captain, an operator and two firemen while the second unit carries an operator and one additional fireman.

The two fire pumpers are rated at 1200 gpm. The older unit is equipped for off road travel and each pumper carries 500 gallons of 6% pre-mix light wetting agent. The new fire pumper is equipped with 500 gallons of regular foam and controls for a 3-6% mix through twin turret nozzles. Preconnected reeled hose with fog nozzles are mounted on each. Additionally, two pickup trucks are provided for spare equipment and transportation for additional fire fighters. The fire chief drives an emergency carryall equipped with resuscitation and forcible entry equipment.

A new emergency supply van has been locally designed and is presently being fitted out by the fire unit. This will be committed as required for backup or special uses. It will carry two entry and two proximity suits, five Scott air packs with six bottles of air, two water driven, high exchange foam generators and one electric driven unit of the same type, a roof piercing nozzle, an 1800 watt generator supplying pre-mounted and portable lights, a portable multi-purpose saw, one smoke ejector, extra protective clothing, boots and helmets, spare hoses, tarpaulins, small tools, supplies of needed fuels, one 30 pound dry chemical portable extinguisher and one 10 pound CO² portable extinguisher, reflecting suits and emergency flares. This unit should prove valuable in salvage work.

A number of automatic alarms are installed to report to the telephone exchange which in turn calls fire headquarters as required. These cover the main administration building, two schools, the hospital and hospital pharmacy, the recreation area, radio shop, radio transmitter building and the mortuary. Additionally, sprinkler systems as well as the alarms are installed at the records center, the bowling alley and the hospital pharmacy. Single sprinkler heads are installed in the waste storage area at the commissary and the furniture warehouse.

In the plant area all pumps in the pump house are equipped with manually controlled water curtains. A CO² flooding system is installed for each generator in the

power house and each is supplied with five, 50 pound cylinders. Another manually operated CO² flooding system at the pump house protects the facilities directing oil to the Nariya area and is provided with seven 50 pound cylinders.

Throughout the non-residential areas fixed hoses equipped with fog nozzles are available, plus portable first aid extinguishers ranging from 30 pound hand extinguishers to 350 pound wheeled units. A number of the CO² extinguishers ranging from 2½ to 15 pounds and 30 pound dry chemical extinguishers are distributed. All first aid extinguishing equipment is checked quarterly by fire department personnel and pressure cylinders are hydrostatically checked each two years.

The night foreman serves as supervisor of fire operations when the fire chief is off duty. Operational response to outlying areas is provided as far as 130 kms. distant to near Safaniya, about 3 hours driving time. The total areas are defined and added to Aramco fire installations at various locations as additional protective factors to maximize response. However, the Fire Chief at Dhahran reports that during his 15 months tenure he has not had to respond to any such distant calls.

Positive actions to prevent accidents are apparent throughout the Dharan installation. The Chief Safety Engineer occupies a staff position and reports to the Vice President of Industrial Relations. A concept of loss prevention both on-job and off-job is well understood and continuous reminders urging safe actions are posted.

Statistics have been recorded since 1938. Presently reports are received of mishaps from the hospital, including all off the job injuries. The laws of Saudi Arabia provide compensation to an employee beginning on the day following any injury. A disabling injury accident rate for 1971 is (following U.S. standards) expected to be in the vicinity of 2.4 per million man hours which is well below average. Additionally, the year should end with an off-job frequency of about 3.7, also low.

As is done by the Fire Prevention Engineer, the Loss Prevention Engineer reviews all new projects to assure proper attention to loss prevention aspects. This office prepares instructions for use of the operating supervisors who issue hot work permits, cold work permits in closed space, and permits for the release of flammable or injurious gasses. A senior Loss Prevention Engineer devotes much of his time to monitoring and safeguarding radiological sources, employed in various controls.

As part of the on-job and off-job loss prevention program, some 3,000 employees have completed the National Safety Council's motor vehicle defensive driving course. Materials for this have been made available to the government of Saudi Arabia in Arabic and are presently reported as being well used.

IX. RAS TANURA FACILITIES - TERMINAL AND REFINERY

A. GENERAL DESCRIPTION

Installations at Ras Tanura are situated on a curving spit of sandy terrain some 72 kms. north of Dhahran by road, although airline distance is much less. Approaches near the entrance of the facilities, except for the company constructed and maintained black-topped roadway, are through salt marshes. It is possible for a person on foot to traverse these, but one would probably sink ankle deep into the muck. The consistency will not sustain a wheeled vehicle, nor is there sufficient water coverage to afford access by ordinary boat unless water levels are raised by heavy rains. The perimeter from the land side is fenced, lighted, patrolled and access to refinery and processing areas is limited by two attended gates.

A 5,000 foot airstrip is provided north of the installation and helicopter pads are located inside the perimeter boundary and at one pier. Access road and interior roads and streets are maintained by the company. Water approaches are fenced, lighted and provided with interior patrol roads. Government security assistance for the piers and exterior waters are the responsibility of the Saudi Arabian Coast Guard and Frontier Forces (CC/FF).

Despite the large area covered by the facilities, continuous expansions have reached the level at which limitations on further additions are imposed for some activities. The town of Rahimah, a community of about 2,000 dwelling units, located outside the company fencing has developed to accommodate approximately 10,000 persons. Included are employees with their families, tradesmen and the usual community service people. The company has encouraged such development and continues to assist employees to provide improved housing and services.

A senior housing area accommodates key employees and their families, numbering about 900 persons. Usual social, recreational, medical and commercial services are available at the site. Interior fencing separates all housing and service areas from refinery processing, storage, loading operations and power plant. Pipeline-manifolding and other potentially hazardous areas are separated by additional interior fence lines. Terminal facilities are completely enclosed by separate fencing. (See Attachment No. 7., "Aerial Pier, Ras Tanura Refinery and Terminal," and No. 8 "Aerial View, Ras Tanura Tanks Farm and Terminal," and No. 9, "Sea Island.")

B. PHYSICAL SECURITY MEASURES

A standard, wire twist-mesh fencing with rigidly fixed bottoms, open top mesh and a single or "Y" are extension with multiple barbed wire strands is backed by high type, interior boundary lighting located inside the fence. Interior perimeter patrol roads parallel the fence lines.

Two constantly attended gates control all access and exits into and out of the refinery, process areas and terminal. Each is attended by a company identification control employee who checks badges at each passage. Official Saudi Arabian Government protection is apparent here by the presence of a uniformed and armed policeman at each gate. Vehicle drivers and passengers were scanned and, on two occasions, the officer required that the vehicle trunk be opened for inspection.

The two piers, North and South, can accommodate a total of ten tankers concurrently. The Sea Island structures can at the same time provide loading for six vessels of larger capacities and greater draught. Present on-site capacity is in excess of five million barrels daily.

Access to the Sea Island facilities is limited to travel by boat from the south pier, to which entry is controlled. Crew changes are accomplished by work boat schedules from this pier.

Boundary fencing is undergoing a renewal program at this time - with some areas showing loose and damaged mesh due to deterioration from salt air and other weather conditions. In other areas heavy gauge mesh covered with a plastic protective coat, is well stretched and new in appearance. Extension arms and barbed wire (also plastic protected in new areas) are in excellent condition in new or renewed lines, but sagging and rusted in some others. Some stretches of perimeter fence are strengthened by interior, steel pipe "A" supports, but interior fencing is supported by knee braces.

Electrical, hydraulic and manually operated switching banks, and substations within the process areas are not separately fenced, but power generating units are so protected. Construction areas are separated from all others by fencing and especially badged access limits construction workers to such areas.

C. GUARD SERVICES - COMPANY

A total of 70 men comprise the Identification Control Force. The Company prefers use of this terminology to avoid confusion with the guard services provided by the Government of Saudi Arabia. Identification Control personnel are

transferred in from other company employment, rather than sought through new-hire channels. They are selected for ability to read, write and speak some English and for general good health and appearance. These employees work five eight-hour days each week, are provided with uniforms without insignia and on-the-job training in their gate and/or patrol duties by the company. There is no formalized training for the group.

All members of each shift report to the Supervising Identification Controller, who in turn is responsible to the General Supervisor, Auxiliary Services Division. This Division reports to the Manager, Ras Tanura Refinery. Shift strengths range from a minimum of 14 members to a maximum of 16. Three mobile patrol units during daylight hours are increased to four during usual hours of darkness. Each gate control unit is provided with either two-way radio or telephone to the Main Gate and mobile patrols are equipped with single channel transceivers. Patrols are conducted on irregular schedules with point checking frequencies varying from 15 minutes to 8 hours depending upon criticality and vulnerability assessments. Failure to report at expected intervals results in immediate on-scene checks. Clock-check stations are not used in the area.

D. IDENTIFICATION SYSTEM

The Ras Tanura Identification System is administered under the General Supervisor Auxiliary Services Division, and is applicable only at Ras Tanura. It is enforced at the various gates and entrances by the company guard force or identification personnel.

The basic document is a 2¼" x 3¼" identification card, encased in non-sensitized plastic and equipped with a pin or a clip and which becomes the permanent employee badge. Company rules do not require that the badge be displayed at all times in operating areas, but that it be presented at entrances and on demand. The card is printed on plain, unwatermarked paper, with no visible cross threads, but with diagonal, colored, printed stripes. Special or fluorescent inks are not used. It contains an employee number and a photograph, but no signature nor thumbprint. A special badge for the refinery, the terminal area or both is issued, since the basic badge is not color coded for entrance to multiple critical areas.

The Visitor's Badge is distinctive, serially numbered and issuance is limited to one work day. It does not include a photograph of the bearer.

Contractor's construction badges are issued as a work unit for the particular job being performed and restricted to that area only. The time limit is for the duration of the construction job. Badges are issued daily at the entrance gates to the contractor foreman or lead man for the number of workers on the job.

There is no separate record maintained of all badges issued nor dates of issuance. However, lost and returned badges and clearance status changes are recorded.

No pre-determined time for changing badges has been established, but they are changed when it appears reasonable to do so. The last change was about three years ago. The printing of the basic identification card is not controlled and basic forms could be easily copied.

E. FIRE PREVENTION AND PROTECTION

Most buildings in the area are of the cement block-stucco or masonry type and thus provide some degree of fire resistance. A few, small wooden structures are scattered through the installation, but are well separated.

A water distribution and fire hydrant system is reported as exceeding American Petroleum Institute (API)-standards. CO² and dry chemical portable extinguishers are placed in convenient locations. Extinguishers are required to be inspected and tested twice yearly. Usual types of extinguishment equipment are strategically placed in work areas, including the Sea Island loading facilities. Processing, pumping, terminalling and storage facilities are equipped with manually operated water containment and cooling systems. An automatic sprinkler system located in the crude topping plant employs 42 rate-of-rise sprinkler heads.

Fire alarms are received via telephone or radio. Automatic alarm systems are not centrally supervised and there are no central stations pull-box installations.

Fire losses are reported as low. Only one loss slightly exceeding \$1,000.00 is reported for the most recent six months period. (See the discussion of fire losses under the general section "Fire Prevention and Protection", No. IV.) The Fire Department averages about fifty responses per year, according to information provided. ~~Most required responses are within acceptable time limits.~~ No other fire-fighting organizations are located in the area with whom mutual aid or backup agreements might be developed, except Dhahran - Aramco. The units do respond to requirements outside their primary responsibility on an available-at-the-time basis, particularly to the nearby community.

Full time fire protection personnel number 22, and operate under the supervision of the Auxiliary Services Division. A two-man complement is constantly assigned to the headquarters station and one other man is in constant attendance at Station #2. Other on-duty personnel are engaged in fire prevention inspection duties. Constant training is provided by weekly two-hour practice sessions which regularly include hook-ups and use of fog, foam and light water/dry chemical patterns.

Backup personnel participate in training sessions and include 42 company employee-volunteers, normally assigned to other regular duties. A normal response of about 50% is expected. First response to an alarm includes four men from the Laboratory Brigade, situated opposite fire headquarters who quickly man the fire trucks. Second response is by a 10-man unit of the Volunteer Fire Brigade, and a third response can call eight members of the Maintenance and Shop Brigade. In-plant supervisors know where and how to cut power and utilities as required or the Fire Chief may decide to call out Utilities personnel.

Four radio equipped, motorized pumpers are available. Three are equipped with foam capabilities; one is a straight water pump. Two are equipped with foam booster units and dry chemical. A trailer unit is also stationed at headquarters. Normal manning is for two of the three headquarter's trucks and one at the process area station. Two trucks respond to every alarm. Departure from the station signals an immediate manning of the backup truck and such in-service readiness is maintained until others are reported back in-service. The rated 1,000 gpm fire pumpers appear to be well maintained and personnel protective equipment for extinguishment seems adequate.

Fire drills are conducted on an 180-day frequency within the separate work areas and an area-wide disaster type drill is required once each year. Surprise alarms are not used for calling drills.

Accident prevention is constantly and forcefully conducted. Reminders are posted throughout the areas and competition between units is encouraged. The awards program in use for an extended period was suspended about two years ago when it became counter-productive since awards had become an end in themselves and were affording questionable merit in promoting prevention of accidents. The topic is presently under study.

The company directs its efforts into off-job as well as on-duty safety activities. Ballpoint pens bearing the inscription "I wear my seat belt" were handed out at gates at unannounced intervals to persons wearing the equipment. Those failing to utilize the provided seat belts are admonished by the Identification Controllers at gates to do so.

The Company Fire and Safety Committees are composed of five management and supervisory members, and are supplemented by relevant operating personnel. These committees inspect all premises quarterly and report findings through regular company channels.

A total of eleven disabling accidents were reported for industrial operations during the most recent eleven months. Principal contributing factors were slipping, falls, and improper use of motor vehicles. The latest fatality noted for the

approximately 2,400 employees occurred on November 2, 1971. It involved a non-company (contractor) vehicle driver preparing to off-load pipe, who backed into a company employee and impaled him on the pipe. The last previous fatality recorded this area was also motor vehicle related and was dated July 9, 1966.

RAS TANURA TERMINALING FIRE PROTECTION

The north and south piers at Ras Tanura have foam flooding systems located underneath the piers to protect against spills on the water. Manual controls may be activated locally or remotely, to start a 3,000 gpm diesel pump. When the diesel pump reaches 3,000 gpm delivery capacity, the foam pump delivery system supplies mixed foam through the system and out onto the water through fixed nozzles for rapid smothering action. Foam dispersal or flooding is selective for each pier area. In addition, each pier has two Roman chariot foam dispensers to supplement fixed systems and to serve first aid extinguishment requirements. The system has a 5,000 gallon, 30 minute delivery capacity.

There are relatively frequent overflows of one to five barrels caused by spillage during coupling and uncoupling at the loading facility. Up to 50 barrel overflows are caused by tanker overfills while loading. The only time the foam system is activated is when the overflow reaches underneath the piers. It is estimated that this happens no more frequently than once every two or three months. Three interconnected Sea Islands, which are simply offshore loading piers, are mounted on metal pilings with oil loading gear similar to that found on the fixed shore line piers. These facilities are constructed of flexibly mounted metal-grating platforms to respond to wave action, hence offer minimum structural combustibility potential. The housekeeping on the Sea Islands was poor.

Each of the three islands has its own foam system for dispersal underneath the piers to protect against oil spills. Each island has a 2,000 gallon foam tank with two electric pumps, totaling 1,200 gpm capacity each. All three islands have interconnected fire water systems for mutual support and these will be connected with the new island, number 4, soon to be constructed and which will be an extension of island number 3. Number 4 will have 4,000 gallons of foam storage. The increase is required because the largest tankers will be berthed at this newer island.

F. GOVERNMENT PROTECTION

Three Saudi Arabian Government police forces participate in armed surveillance and protection at the Ras Tanura installations. Armed police of the Public Security Force are present at all but one of the gates to supplement the Company Identification Controllers as may be required. One gate at Terminal controls access to

launch passengers to and from the Sea Islands and is manned by members of the Coast Guard and Frontier Forces (CG/FF) in addition to company guards. The CG/FF is also responsible for off-shore patrolling. Such patrols were not in evidence at the times the Survey Team was in the area.

A third protective unit of the National Guard consists of about 300 members permanently stationed near the site. This unit is self-contained and, according to company officials, remains ready for call. When summoned, on-scene response requires only seven to eight minutes, is in force and ready for effective action.

All members of Saudi Arabian Police forces in the area are quartered outside the installation and do not normally perform functions inside the perimeter boundaries.

X. ABQAIQ

A. GENERAL DESCRIPTION

Abqaiq is the operating headquarters for producing operations in the Abqaiq, Ghawar and Khurais oil fields. This headquarters is located about 70 kms. by paved highway southwest of Dhahran. The combined production of these fields is at present in excess of 3 million bpd. The crude in these three fields passes through Abqaiq and surrounding installations for separation and stabilizations, as well as for pumpint to processing and shipping facilities, principally in Ras Tanura, but also in Dhahran and Bahrain.

Gas-Oil Separator Plants (GOSP's) – The reservoir fluid that emerges from a well is not crude oil alone, but a mixture of oil and gas. As the reservoir mixture flows up the well bore and through the flowline, pressure on the fluid decreases and gas starts to separate from the oil. This action is similar to that of a bottle of warm carbonated beverage which is shaken, then opened. The mixture of oil and gas is delivered to a series of vessels, or traps, of a gas-oil separator plant where the two are physically separated. Each succeeding vessel in a GOSP is operated at a lower pressure, to separate the gas from the oil in steps, which progressively reduces the amount and pressure of the gas in the mixture. (See Attachment No. 10 "Abqaiq GOSP")

In the Abqaiq field and the 'Ain Dar-Shedgum areas of the Ghawar field, gas that comes from the first-stage separator vessels is compressed and reinjected into the reservoir to maintain the underground pressures, thus extending the life of the field. This high pressure gas fraction constitutes 70-80 per cent of the total gas produced in these areas.

Crude Oil Stabilization – Crude oil leaving all of the Aramco GOSP's, with the exception of those at Safaniya, is sour crude; that is, it contains toxic hydrogen sulfide (H_2S). Sour crude can be shipped by pipeline and used as refinery feed, but is undesirable for tanker transport. Because the major portion of crude from this area is shipped by tanker to world markets, sour crude must be sweetened, or stabilized, prior to shipment.

The Abqaiq Stabilizer Plant sweetens the major portion of the crude oil produced in the Abqaiq and Ghawar fields. Stabilization is accomplished by the simple process of boiling off the hydrogen sulfide.

Sour crude containing 300-700 parts per million of hydrogen sulfide is fed at a controlled rate to the top of a stabilizing column, sometimes referred to as a weathering column, and flows downward in the column over a series of trays. Oil from the bottom tray enters the reboiler section where it is heated by steam. The heated oil spills back into a compartment in the base of the column, from which bottom pumps deliver the sweetened crude through coolers to Abqaiq Tank Farm No. 2. Dissolved gasses liberated by the heat rise through the column, stripping the H₂S and other volatile components from the sour oil flowing down through the trays. These gasses pass from the top of the column and are routed to the Abqaiq LPG Plants to be compressed, liquefied and fractionated.

Sour crude also can be sent to Ras Tanura for refinery feed stock, delivered to Bahrain Petroleum Company (Bapco), or stabilized in the stabilizers at the Ras Tanura refinery. Another stabilizer column located at Abu Hadriya stabilizes sour crude from the Abu Hadriya and Fadhili GOSP's and the sweetened crude is pumped directly into the pipeline carrying oil to the Qaisumah Tank Farm.

Liquefied Petroleum Gas (LPG) – To meet increased demand for liquefied petroleum gasses for both foreign and local sales, the LPG compressor and processing plants were constructed in Abqaiq.

Gasses from several GOSP's and the Abqaiq Stabilizer columns are delivered to the compression plants, compressed to more than 400 psig in two stages, then cooled and liquefied as a raw LPG. In the processing plants the raw LPG is fractionated to produce a mixture of propanes and butanes and a smaller quantity of light naphtha. The LPG and naphtha streams are shipped by pipelines to Ras Tanura for further treatment and loading aboard tankers. Any liquids in excess of sales requirement can be injected in either the Abqaiq or ~~Ain-Dar~~ reservoirs for pressure maintenance purposes.

Pipelines: Letter designations normally are used to identify pipeline locations. Thus SRT refers to the Safaniya-to-Ras Tanura pipeline. Because several lines may run parallel to each other, a number is used to differentiate them. Often two or more pipe diameters go into a single pipeline, a method first used in Saudi Arabia when the Trans-Arabia Pipe Line (Tapline) was constructed in 1948-50. Tapline was built with 30- and 31-inch pipe for the shipboard journey to Saudi Arabia.

Among the important Aramco pipelines are the UA and AA lines, which deliver sour pressure crude from the Ghawar field to Abqaiq; the AD lines, which carry oil from Abqaiq to Dhahran for transshipment to Bapco, the QA and QRT lines, which

take sour crude from Abqaiq through Qatif Junction and on to Ras Tanura; and the pipelines between Safaniya and Ras Tanura. Major additions to the pipeline system are completed every year.

Pump Stations: Pump stations are located at most GOSP's and other gathering and dispersal points throughout the company's pipeline system. Typical of the arrangement used in moving crude oil long distances are the pump stations handling Safaniya oil. Four 600-horsepower electric motors, seven 950 hp combustion gas turbines and two 4,000 hp electric motors drive the pumps which start the Safaniya oil on its 131-mile (211-kilometer) journey to Ras Tanura. At high production rates, the Khursaniyah pump station, 66 miles (106 kilometers) downstream from Safaniya, gives the Safaniya oil a boost, then 40 miles (64 kilometers) farther down, at the al-Wusta pump station, a final boost is administered.

Pressure Maintenance: The natural energy that makes Aramco oil wells free-flowing includes both gas dissolved in oil and water underlying the oil. Gas in the oil forces reservoir fluid to the surface and water moves from below into the space vacated by produced gas and oil and, in effect, helps displace the reservoir fluid. If it is decided that crude oil production should proceed with little drop in reservoir pressure, then the withdrawal rate must be restricted.

To permit increased withdrawal rates from the Ghawar and Abqaiq fields while abiding by the "no pressure decline" principle, reservoir pressure maintenance plants were installed. Injection of gas, gas liquids and non-potable water are the three methods of pressure maintenance used by Aramco. In gas injection, high pressure gas separated from oil in GOSP's is compressed and injected into the top of the oil reservoir. In water injection, large quantities of water are introduced at the edges of the reservoir to supplement the influx of water from below the oil. To increase the efficiency of gas injection, low pressure gasses are collected and liquefied in an LPG Plant in Abqaiq and LPG components which are surplus to sales requirements are injected along with compressed gas into the 'Ain Dar area of the Ghawar field or into the Abqaiq reservoir.

Reservoir characteristics differ, but using the Abqaiq field as an example, studies show the injection of one million cubic feet of gas into the reservoir will displace approximately 800 barrels of oil. Also, each barrel of water injected into the Abqaiq reservoir will displace approximately six-tenths of a barrel of oil. Gas injection also conserves large quantities of gas that can be reproduced as needed in the future.

Aramco's two gas injection plants — one for the Abqaiq field, one for the northern area of the Ghawar field — together have injected more than one trillion standard cubic feet of gas.

The Abqaiq Gas Injection Plant receives 400-500 psig gas and compresses it in three stages to about 2,500 psig for delivery to injection wells on the crest of the south dome of the Abqaiq reservoir. At the 'Ain Dar Gas Injection Plant, gas is compressed in five stages to about 1,800 psig for reservoir injection.

The chief means of pressure maintenance in the Abqaiq and Ghawar fields is non-potable water injected through wells surrounding the field. In most of the injection wells non-potable water flows from an aquifer by gravity to the oil-bearing formation below. A few wells use pumps to inject the water. The source of this non-potable water for the Abqaiq field is the prolific Wasia aquifer. The water is very saline and unsuitable for agriculture.

Utilities:

Steam: Steam generating equipment in the Abqaiq Power Plant provides high pressure steam (625 psig) for the generation of electric power, pumps at Abqaiq Pump Stations Nos. 1, 4 and 5, centrifugal compressors at the Abqaiq Gas Injection Plant and refrigeration compressors at the LPG Plant. In addition, a lower pressure steam system (60 psig) is maintained for stabilizing oil, heating reboilers at the LPG Plant, producing distilled water, heating feedwater, sweetening gas and for a number of other heating and cleaning operations. About 95 per cent of all steam generated in the boilers and distributed to facilities in the area is returned to the power plant as condensate or exhaust steam.

Electricity: In addition to the steam-driven turbogenerators in the Abqaiq Power Plant, combustion gas turbogenerating units are also used. Electricity generated at 13,800 volts is distributed through primary sub-stations that feed a 2,400-volt secondary system.

Abqaiq's electric power generating plant is interconnected to the Aramco generating plants in Ras Tanura, Dhahran and 'Ain Dar by 66,000-volt transmission lines. The Abqaiq and Ras Tanura plants are linked with a 115,000-volt transmission system to provide adequate power transfer capability to the Northern Area. Outlying oil-handling facilities along the transmission lines receive electrical power from this network.

Air and Water Plant: This plant softens raw water to provide feed for the Evaporator Plant and various cooling towers, distills softened water to produce high purity condensate for boilers and drinking water and compresses air for the two systems serving the Abqaiq industrial area.

Others: Three central air conditioning plants and a chilled water system serve the Abqaiq industrial-residential area. Two major raw water systems supply the water requirements. Ice making facilities and dispensing services are available.

B. PHYSICAL SECURITY AND GUARD FORCE

The plant area is separately fenced with a twisted mesh wire fence and ingress and egress is controlled through a single gate. The total strength of the guard force is 47 and there is a maximum of 11 guards per shift and a minimum of nine. The guards work eight hours a day for a 40-hour week and the service is performed 24 hours a day. All guards are direct hire employees, unarmed and uniformed by the company. The average age of the guards is about 40 years and there is no maximum hiring age. As in the other Aramco installations, the retirement age is 60 and all new guards are drawn from surplus personnel in other areas. Other qualifications are similar to that found in the balance of the Aramco guards and there are no formal classes with only on-the-job training provided. There are six fixed post locations with one-man concrete block or frame shelters at each. Two-way radio control is maintained at the main gate and telephone lines run to two of the fixed posts.

There is a 24-hour vehicular patrol equipped with a radio transceiver as well as a walkie-talkie. Six key-clock stations are located in the plant with a minimum checking frequency of once every 60 minutes. There is no automatic alarm system. An automatic auxiliary power plant provides electricity for communications. The guard force is supervised on each shift by a shift supervisor who in turn is accountable to an identification supervisor. The guard units are under the General Supervisor of Auxiliary Services who is responsible to the plant manager at Abqaiq.

The identification system at Abqaiq is similar to that in Ras Tanura.

C. FIRE PREVENTION AND PROTECTION

The Abqaiq fire department is headed up by a Fire Chief supported by a full time fire training and maintenance crew of 24 members. Fire fighting is done by a 48-man volunteer fire organization drawn from company maintenance and operational personnel.

The volunteer fire group receives a minimum 30-hour basic course, and regular drills are held twice a week either in the plant or residence areas. These drills consist of hose laying as well as actual fire extinguishment in the training area.

The plant is looped by a constant pressure fire water main at about 150-160 psi, with NFPA hydrant spacing. Fire water at about 1,000 gpm maximum is available at the hydrants. The power house, gas and water injection plants are equipped with automatic CO² flooding installations.

The Fire Chief is responsible to the General Supervisor of Auxiliary Services at Abqaiq, who in turn reports to the Manager, Plants and Pipeline Department, Abqaiq.

XI. SAFANIYA

A. GENERAL DESCRIPTION

The Safaniya oil field is the largest offshore field in the world. In addition to three producing wells on shore, there are some 90 offshore wells with about 60 of them presently producing. The Zuluf field lies adjacent to Safaniya to the east about 40 miles out from shore and still further east is the Marjan field 60 miles out from shore, both in development stages. These are both high pressure and high yield areas. The Khafji field operated by Arabian Oil Company (Japanese) is actually an extension of the Safaniya field but is situated north of the Neutral Zone line separating Saudi Arabia and Kuwait in an area outside of Saudi Arabian operations.

A heavy grade of crude is produced for which demand at present is less than the lighter oils from some of the other fields. Consequently, the production demands fluctuate widely from time to time.

About 200 persons are provided with feeding and housing at Safaniya which serves as the dormitory community for the Nariya pump station and other nearby installations. About 90 of the persons domiciled in Safaniya are engaged in operations there. Included are the maintenance group for servicing offshore requirements. Some of the resident employees report to department or division heads other than the Safaniya management.

B. PHYSICAL SECURITY

Standard twist wire mesh fencing with barbed wire mounted top extension provides perimeter protection at Safaniya, but fences end on the beach at points leading to the piers, short of the desired degree of protection. The pier area is not fenced.

A single gate provides access to the facility and this is kept locked as a part of normal protective procedure. The gate is opened by the company guard to allow entry to properly identified persons. Standard perimeter incandescent lighting fixtures are installed inside the fence line.

C. GUARD SERVICES

One full time post is manned at the main gate by a company identification employee, who reports to the Supervisor of the Community Services Division in Safaniya. A total of four such employees are resident in Safaniya. A uniformed, armed National Guardsman is assigned to the gate, affording 24-hour coverage.

Government security forces consist of a nearby detachment approximating 100 members of the National Guard. Only about one-half of these are normally present to serve Safaniya. The other half are normally distributed to other installations with 20 at Abu Hadriya, 20 at Manifa and 10 at Fadhili, all of which are Aramco GOSP installations.

A Coast Guard Contingent consisting of 15-20 men is also assigned to Safaniya. They have one, 14-foot outboard powered boat for marine patrol. This group formerly conducted regular beach patrols until recently when they are reported as having changed to occasional or irregular patrols. Local surveillance by government protection forces is reported as being tightened or relaxed at various times according to the estimate of the situation by commanders of the forces so employed.

D. FIRE PREVENTION AND PROTECTION

A 1,000 gpm fire pumper is permanently stationed at Safaniya. This carries dry chemical foam and light water. The Fire Station is manned by one full time Fire Captain who also operates and maintains the pumper truck. Operational responsibility for fire extinguishment and prevention comes under the Community Services Division at Dhahran.

The volunteer fire brigade numbers 110 members, or more than half of the resident population at Safaniya. All employees are encouraged to participate in the volunteer fire brigade training given two hours weekly. The entire group is split into two for training. These weekly training sessions include practice hose lays, extinguishment of pit blazes of burning mixed kerosene and crude oil, using foam and other extinguishment equipment and patterns.

First aid fire extinguishment equipment consists of 30 pound dry chemical or CO² hand extinguishers stationed throughout hazardous areas at 50-foot intervals. These are supplemented by standard hose reels with spray nozzles and pressurized fire hydrants throughout the plant area. Each piece of equipment checked revealed that it had been inspected and approved within the last 60 days.

Actual fires are followed by a detailed post mortem critique to ascertain factors contributing to the ignition and to seek improvements in the installations and means of meeting fire problems.

Other fire protection and prevention measures are designed and built into the installation. Crude oil pumping capacity, for example, is well separated into two increments, each capable of pumping 600,000 bpd. One-half is electrically-motor driven, and these are housed in a separate building with a manually operated water spray curtain installed above them. The second group of pumps are gas turbine driven and are separated from the other by sufficient distance to reduce hazard. A possible bottleneck is in the event of breakdown reported as the spheroid capacity but this area is well diked and drained so that any burning oil is directed away from other fuel sources.

E. THE NARIYA MAIN LINE PUMP STATION

The Nariya main line pump station, although in the Aramco complex, is typical of Tapline operations. This station, located at kilometer 185 northeast of the Qatif station, which is designated as kilometer zero, pumps from this location directly to Qaisumah. This station must lift the crude from 164 feet above sea level to more than 1,164 feet of elevation with an additional boost at Wariah located at kilometer 298 on the pipeline. The pumps are driven by six crude oil burning diesel engines and two gas turbine booster pumps, with a maximum capacity of about 500,000 bpd. Three 800 kilowatt generators produce electric power for local requirements.

Also located on the premises are one 90,000 barrel and one 180,000 barrel floating roof surge tanks to control the flow of crude through the pipelines.

This station is permanently manned although there are no resident operators at the pump station. All commute daily from Safaniya. There is a basic operating force of three men on a shift, 24 hours a day plus two daytime operators and seven multicraft mechanics for a total of 25 persons.

No guards are stationed here. The area is completely enclosed by standard twist mesh wire fencing. The main gate, the only entrance, is locked and is opened by the operators on demand. The gate is now being rigged for an electric lock located at and to be operated from the control station. Standard perimeter incandescent lighting is in place.

Fire fighting equipment consists of a light water foam/dry chemical trailer and first aid extinguishment equipment consists of 32 30-pound dry chemical extinguishers and ten CO² bottles. Fire water ringing the principal installations is under constant

pressure and available through well spaced fire hydrants around the plant. Fire water storage is in a single 200,000 gallon capacity tank and pressure can be raised to 150 psi.

No fires were reported at Nariya. The housekeeping here was poor.

It was reported that a light foam generator is to be installed in the pump building. This system forces a light detergent foam through nylon mesh to produce continuous large bubbles with sufficient capacity to fill the pump house in a matter of minutes, blanketing and cooling any spill or spillfire which may be expected.

XII. TRANS ARABIAN PIPELINE (TAPLINE)

A. GENERAL DESCRIPTION

The Trans Arabian Pipeline Company (TAPLINE) is a wholly owned United States corporation whose function is to transport crude petroleum by pipeline from the Aramco fields in Saudi Arabia to the Mediterranean Sea for tanker shipment.

The 30 to 31-inch line extending from the southern terminus of Qaisumah, Saudi Arabia, the end of the Aramco gathering system, to Sidon, Lebanon, the port on the Mediterranean, passes through Jordan and Syria. In addition to the TAPLINE there are 315 miles of Aramco related gathering pipeline systems terminating at Qaisumah. At the Mediterranean end of the TAPLINE, a 400 million barrel tank farm is located with terminal facilities.

In the Saudi Arabian portion of the line, four manned, main line pump stations are located. Each pump station is complete with operator personnel and supporting staff. The average pump station is manned by two United States supervisors, five other operational and tank farm personnel and includes approximately 100 Saudi Arabian nationals. In addition, there are seven medical personnel and two doctors in a clinic located at each main line station with the exception of Badanah which has a hospital. One similar main line station is located in Qaryatain in Jordan.

Three non-manned auxiliary pump units (APU's) are installed at intervals between the main line stations. With the additional pumping capacity and other technical improvements in line operation, it has been possible to increase the capacity of the pipeline from 320,000 barrels per day (bpd) to about 500,000 bpd. During calendar year 1970 the average for the TAPLINE was 490,000 bpd and the December 1971 forecast is for the same amount.

The entire line is controlled from Qaisumah where any interruption would be immediately noted and the line automatically shut down.

B. PHYSICAL SECURITY MEASURES

All stations, including APU's, are fenced with twist wire mesh fencing with a single entry gate. At the main line stations an industrial area, including the tank

farm, the main line pumps, and the maintenance shops, is separately fenced. The living quarters are separated from the industrial area by additional standard fencing.

At the main exterior gate a 24-hour guard control is maintained. Entrance is permitted only by a company badge or a government badge. Visitors are checked by telephone with the person to be visited and allowed entrance as required. Gates are closed at 9:00 P.M. and the guards go on patrol (see section C, Guard Service). No one not assigned there is permitted in the industrial area without a reason. All visitors are similarly controlled.

C. GUARD SERVICE

At each of the main line stations there is a total guard force strength of 19. A maximum of two guards per shift are employed, principally in the nighttime hours. One man is stationed at the main gate during the daytime as well as a supervisor for control purposes. The guards work an 8-hour shift, five days a week, and there is 24-hour coverage. Guard towers are not used. All guards are direct-hire employees and are uniformed by the company. Guards are not armed.

The average age of the guards is about 45 years with mandatory retirement at age 60. Minimum qualifications required are a minimum age of 20 years, with six years of primary school, and the ability to read and write instructions in English, and signs used to control personnel. The character investigation is the same as conducted by TAPLINE for all its personnel. No police checks are made nor are they possible but a check is made of TAPLINE employees who know the individual. A full set of finger prints is taken by the company.

At present, since the guard force has been in business some years, the training consists of seminars held monthly by the plant protection supervisor who is resident at Turaif. New employees are given training by supervisors and OJT.

Fixed post locations are at the main gates and where in each instance there is a concrete gate house. Each gate house is equipped with a two-way radio to control mobile and foot patrols, and there is an interior and exterior telephone system plus an intercom. There are no search lights and lighting depends on the fixed flood lights.

Patrols are inaugurated during the nighttime hours after the main gate is closed. The guard at the main gate makes a foot patrol within the inside of the perimeter fence. A vehicle is used for the exterior perimeter patrol. The entire station area is covered each two hours. Recording watch clocks are used and each area has about 15 key stations. The patrols are irregular and the lead gate man sets the schedule daily. No automatic alarm systems are installed.

The responsibility for the guard organization and operations are under each station superintendent. However, there is a Plant and Fire Protection Supervisor who has staff responsibility for the entire TAPLINE operation, and is a full time employee of TAPLINE. He was formerly Assistant Chief of the Hong Kong Colonial Police.

D. IDENTIFICATION SYSTEM

The TAPLINE has had an identification system for a number of years. Personnel identification consists of a non-sensitized laminated plastic card, 2¼" x 3¼". The badge insert is a special watermarked paper with background printing. It has a serial number but no special marks or fluorescent inks. It is coded for type of clearance as well as critical area entry. It contains the employee's photograph but no signature or thumb print. The badge has a clip and must be displayed at all times the person is in an industrial area.

A temporary distinctive construction worker badge is issued. The privilege under this badge is time and construction area limited. Construction workers are not permitted in the industrial area without an escort. This limitation is clearly indicated on the badges. Guards check badges at all entries either during regular working hours or otherwise. A sign in-and-out register is used for all off-hour movements.

Permanent records are maintained for all badges made, issued, lost and returned. These records include the date of issuance, authorized access area, and upon departure, the date the badge was returned. Lost badges must be reported to the gate man who then reports the matter to the plant superintendent as soon as possible. The last time the badge system was changed was in 1959.

One possible and relatively easy entrance by intruders would be through the clinics or the hospital. The clinics and the hospital are well located at the fence line with an entrance outside of the enclosed area. However, even though a nurse is on duty 24-hours a day, it would appear relatively simple to evade a nurse once inside the hospital or clinic.

E. FIRE PROTECTION

In full realization of the volatility of crude oils, the company has made a special effort for fire safety and training and provides redundancy in protective systems.

In addition to the crude carried in the pipeline, each tank farm contains one each 90,000 and 180,000 barrel surge storage tanks with floating roofs. Industrial combustibles, such as paint thinner and gasoline, are located in the industrial area,

a distance from the tanks and the pump stations are housed in separate buildings so that they do not present a fire hazard to the main operations. All pump rooms and oil handling facilities are equipped with automatic water spray cooling systems activated by temperature-rate-of-rise sprinkler heads. Hand started, foam generators are built in and have a capacity to flood the pump house from the floor to the ceiling in about five minutes. This high-expansion foam is for internal building use only. A petro-chemical foam base for use through mixing nozzles is provided in five and 50 pound cans. Fire mains are equipped with 600 gpm electrical and diesel driven fuel pumps to provide reserve pumping capacity in the event of failure. A fire trailer truck with a built-in pumping system gives a 300 gpm mobile and backup fighting system. The fixed installations can be used to pressurize the whole residential fire water system in case of necessity.

At Turaif, smoke detectors and combustible gas detectors have been installed to protect the gas turbines which are installed at that locality only. Automatic alarm and shutdown devices are also installed at Turaif. The other pump stations utilize diesel driven pumps.

Portable extinguishers range from CO² five pound, hand carried to 250 pound wheeled bottles. Dry chemical extinguishers are also on hand. These extinguishers are inspected annually.

Fire extinguishment training is provided to all employees periodically by actual extinguishment of practice fires. Supervisory and certain key employees are provided initial fire training at the Civil Aviation Institute in Beirut and are rotated through special two-week annual refresher courses. Fire drills are conducted each 30 days on a regular schedule. Top management stages unannounced, on-site fire drills quarterly.

The fire department is composed entirely of company employee volunteers. The volunteer fire chief and truck trailer driver are resident at the camp. No mutual aid is available. A Fire Safety committee has been established whose chairman is the Vice-President of Operations and is composed of the Manager of Industrial Relations, Government Relations and a representative of Engineering. They meet quarterly at each station, make inspections and call fire drills without pre-announcement. Fire safety is promoted by incentive awards such as alarm clocks, pen and pencil sets, Swiss knives and similar gifts.

F. GENERAL

The general industrial protection philosophy of the company is to establish a presence of well-trained guards coupled with adequate fences and lighting as a deterrent. In the history of the TAPLINE there have been no attempts at sabotage within the pumping stations themselves. Within Saudi Arabia two instances of

pipeline sabotage attempts occurred prior to 1965, the only happenings of their kind. In each instance an explosive device, probably dynamite, was placed on top of the line, once near Shibah and once near Badanah. The explosions caused no damage. On occasion truck drivers have cracked the line through carelessness, but such ruptures have been repaired quickly with a minimum loss of through-put. Interruptions of the types reported as occurring in Syria and Jordan have not been encountered within the boundaries of Saudi Arabia. Those reported outside such boundaries are not within the scope of this inquiry.

Basic philosophy of the TAPLINE is that prompt and rapid pipeline repairs are an essential part of industrial protection. Capability to quickly move all requirements is designed so that repairs can be accomplished within 24 to 72 hours after a break, plus the time it takes for any resulting fire to burn itself out. See Attachments 10 & 11 "Pipeline Emergency Repair Equipment." Spills are controlled immediately by shutdown at the pump stations.

Sabotage within a station would be very difficult because of the constant presence of personnel and guards. Damage probably could only be accomplished by a concerted and well-organized group of determined guerrillas. Even if a station should be damaged and the pumps put out of operation, the station itself could be by-passed and the only additional damage might be some loss of crude flow. If the line were entirely shut down, the flow could be reversed and sent back out through Ras Tanura terminal, which was done during 1970 when the line was interrupted in Syria.

**ATTACHMENT NO. 1
PERSONS CONTACTED & INTERVIEWED**

SAUDI ARABIAN GOVERNMENT

H.R.H. Prince NAYIF BINABD-AL-AZIZ, Vice Minister of Interior	Riyadh
LT. GEN. MUHAMED TAYEB TUNISI Director General, Public Security Force	Riyadh
BRIG. GEN. AHMED JAWAD ALAMDAR, Deputy Director General, Public Security Force	Riyadh
H.R.H. Prince ABDUL MUSIN binABDULLAH binJILUWI Amir of the Eastern Province	Damman
SHAIK IBRAHIM AL JINDAN Chief of Protocol, Amir, Eastern Province	Damman
BRIG. GEN. MUHAMMAD al-HALLALI Director, Public Security Force	Damman
AMIR TURKI AL-UTAISHAN Amir of Ras Tanura	Damman
MAHMOUD MALHAS, Administrative Assistant, Minister of Interior	Riyadh

ARABIAN AMERICAN OIL CO (ARAMCO) – U.S.

MICHAEL M. AMEEN, Director, Washington Office	Washington, D.C.
H.T. FOGELQUIST, Assistant General Manager, New York Office	New York, N.Y.
ROBERT HENRY, TAPLINE Representative	New York, N.Y.

STANDARD OIL CO. (N.J.)

LEE H. KOSTORA, Assistant Industrial Security Administrator	New York, N.Y.
D.D. McCONNELL, ESSO Representative for Middle East	New York, N.Y.

ARAMCO - SAUDI ARABIA

FRANK JUNGERS, President	Dhahran
D.R. FATE, Vice President Operations & Oil Movements	Dhahran
J.D. EHL, Manager, Refinery & Terminal	Ras Tanura
HARRY McDONALD, General Manager, Government Relations	Dhahran
WILLIAM E. MULLIGAN, Government Relations Office	Dhahran
THOMAS G. GODDARD, Company Representative, Eastern Province	Dhahran
G.W. STOCKWELL, Manager, Oil Supply, Planning and Scheduling	Dhahran
HOHN HELBERER, Vice President, TAPLINE (Beirut)	Dhahran
R.H. GARDNER, Petroleum & Terminal & Planning Representative	Ras Tanura
C.S. KORYUS, General Supervisor, Auxiliary Services	Ras Tanura
F.A. ASLAN, Supervisor, Refinery & Planning	Ras Tanura
B.W. CHANCY Acting Fire Chief	Ras Tanura
H.M. al-RAFAI, Area Safety Advisor	Ras Tanura

H.A. STREAKER, Manager, Plants & Pipeline	Abqaiq
L.R. TANNER, Superintendent, Plants Division	Abqaiq
W.H. LYLE, Assistant Superintendent, Utilities Division	Abqaiq
R.M. HOLLINGSHEAD, General Superintendent, Auxiliary Service Division	Abqaiq
A.M. AZMAN, Fire Chief	Abqaiq
MUHAMMAD BOUBSHAIT, Deputy Fire Chief	Abqaiq
HAROLD KRAPP, Foreman	'Ain Dar
WILLIAM K. BUTLER, Chief Fire Protection Engineer	Dhahran
R.S. LEHMAN, Acting Supervisor, Auxiliary Services Division	Dhahran
MUHAMMAD SABAHEY, Advisor, Auxiliary Services Division	Dhahran
ISHTIAQ CHISTY, Supervisor, Investigations, Identification and Admin. Services	Dhahran
A.M. SHIHADDEH, Assistant to Company Representative	Dhahran
CHARLES HOMEWOOD, Chief Safety Engineer	Dhahran
OTHMAN KHOWAITER, Producing Foreman	Safaniya
MUHAMMAD NAJIYA, Operating Foreman	Nariyah
WILLIAM GARNER, Senior Loss Prevention Engineer	Dhahran
COLLINS B. BROOKS, Superintendent, Safaniya Producing Division	Dhahran
FRED E. ABOTT, JR., Producing Manager	Abqaiq

M.M. ORSETH,
Manager Communications

Dhahran

U.S. GOVERNMENT

HON. NICHOLAS G. THATCHER,
Ambassador

Jiddah

HON. LEE DINSMORE,
Consul General

Dhahran

DAVID NEWTON,
Embassy Political Officer

Jiddah

RAYMOND H. CLOSE,
Assistant Political Officer

Jiddah

RICHARD H. IMUS,
Economic & Petroleum Officer

Dhahran

PHILLIP GRIFFIN,
Deputy Principal Officer

Dhahran

WILLIAM H. TWADDELL,
Consular Assistant

Dhahran

CHARLES NESBITT,
Chief Public Safety Advisor

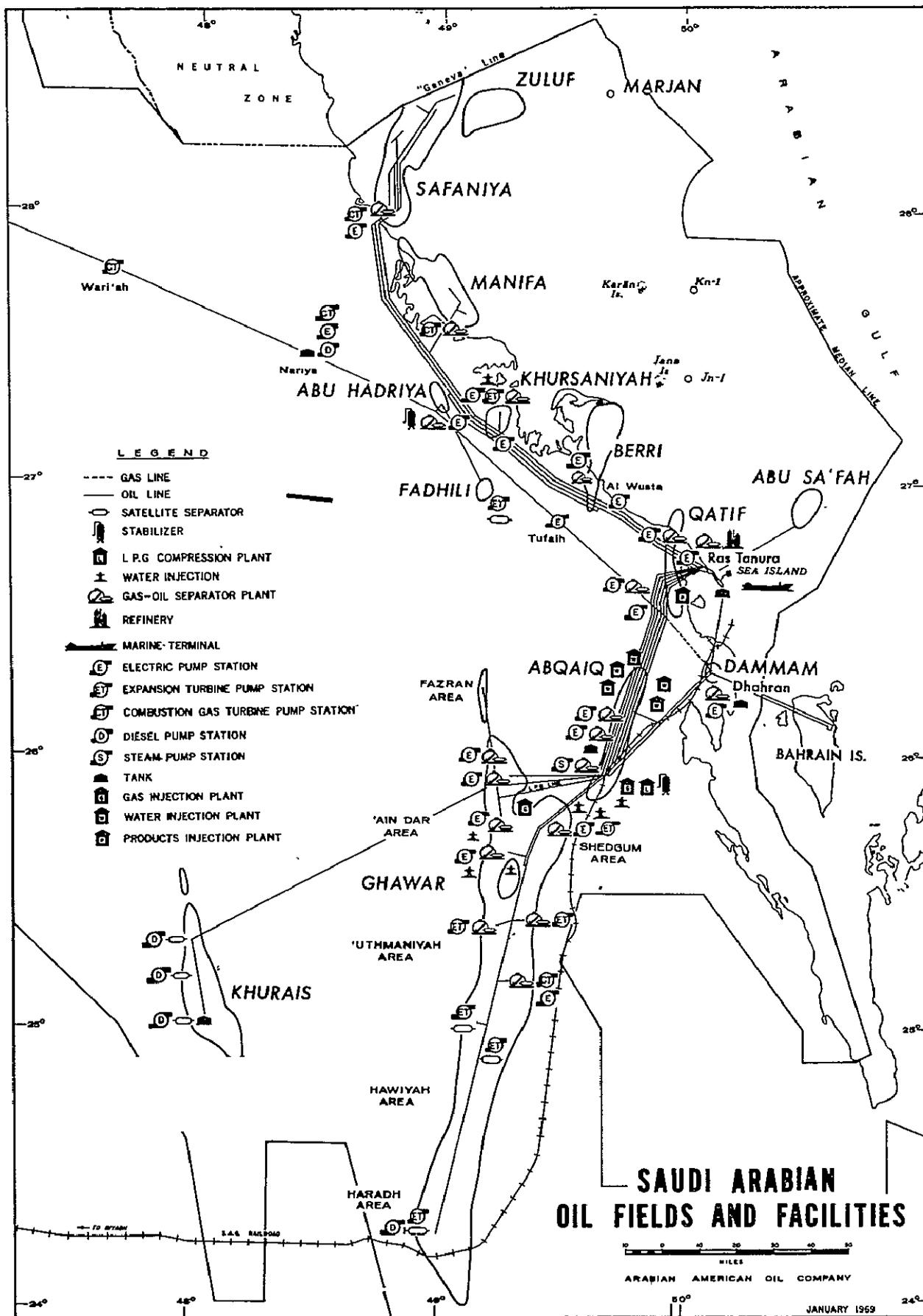
Riyadh

WALTER P. NEYLAND,
Public Safety Advisor

Riyadh

JOHN C. ZEIGLER,
Public Safety Officer

Riyadh



SAUDI ARABIAN OIL FIELDS AND FACILITIES

ATTACHMENT 3.

Dhahran
December 1971

ARAMCO FIRE LOSS EXPERIENCE
1965-1971

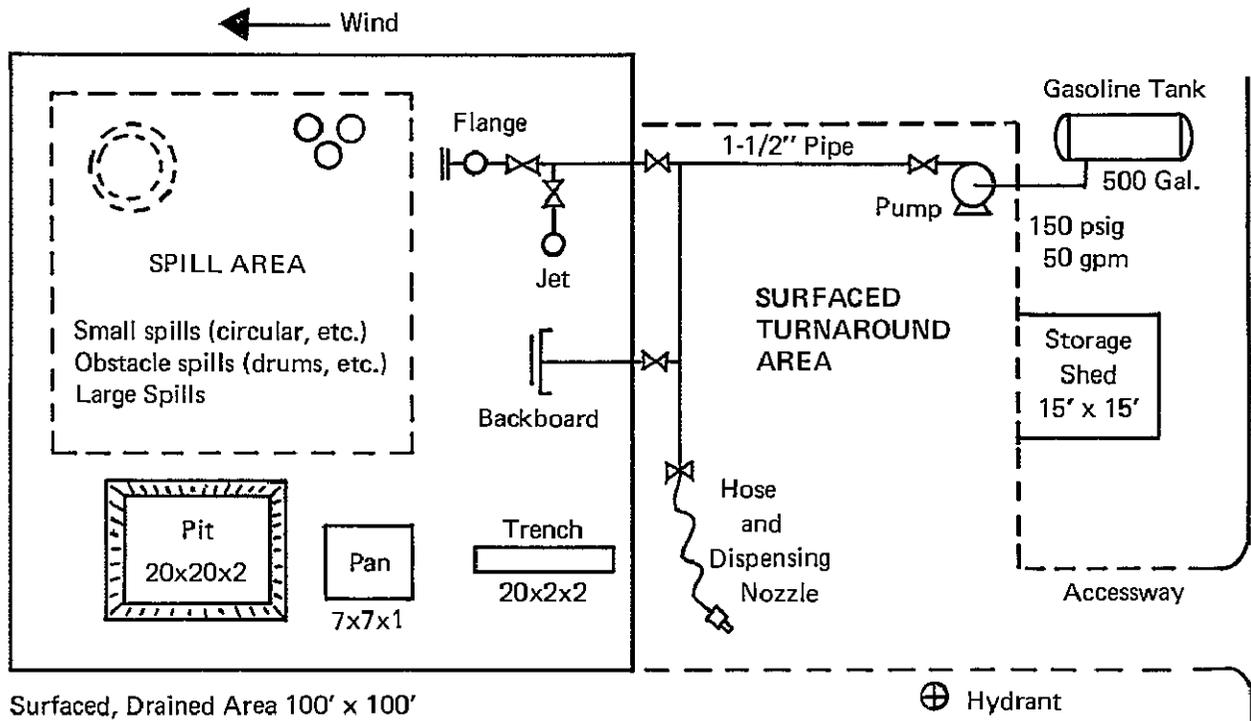
(CY)	\$ Loss	No. of Fires	Loss/\$100 of Insured Value	
			ARAMCO	API *
1965-	178,462	75	.024	.068
1966-	53,630	67	.007	.081
1967-	77,462	61	.009	.116
1968-	229,684	71	.024	.069
1969-	48,659	69	.005	.081
1970-	639,714	50	.065	.309
1971-	EST. 154,000	<u>±</u> 58	<u>±</u> .015	- -

Average API Loss .085
previous 5 years.

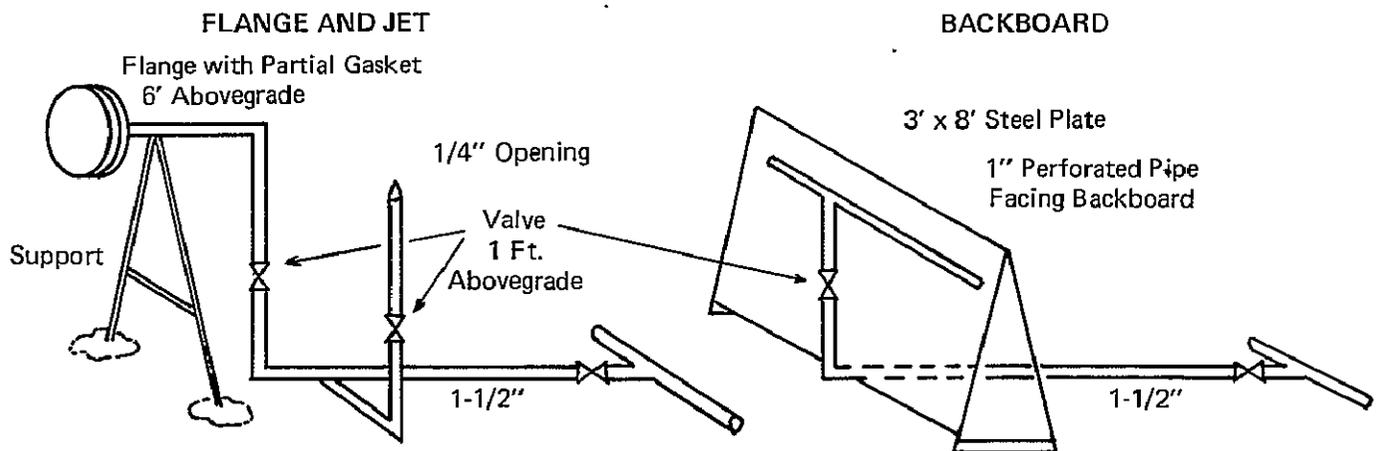
W.K. BUTLER
Chief Fire Prevention Engineer

* API — American Petroleum Institute.

TYPICAL FIRE TRAINING AREA

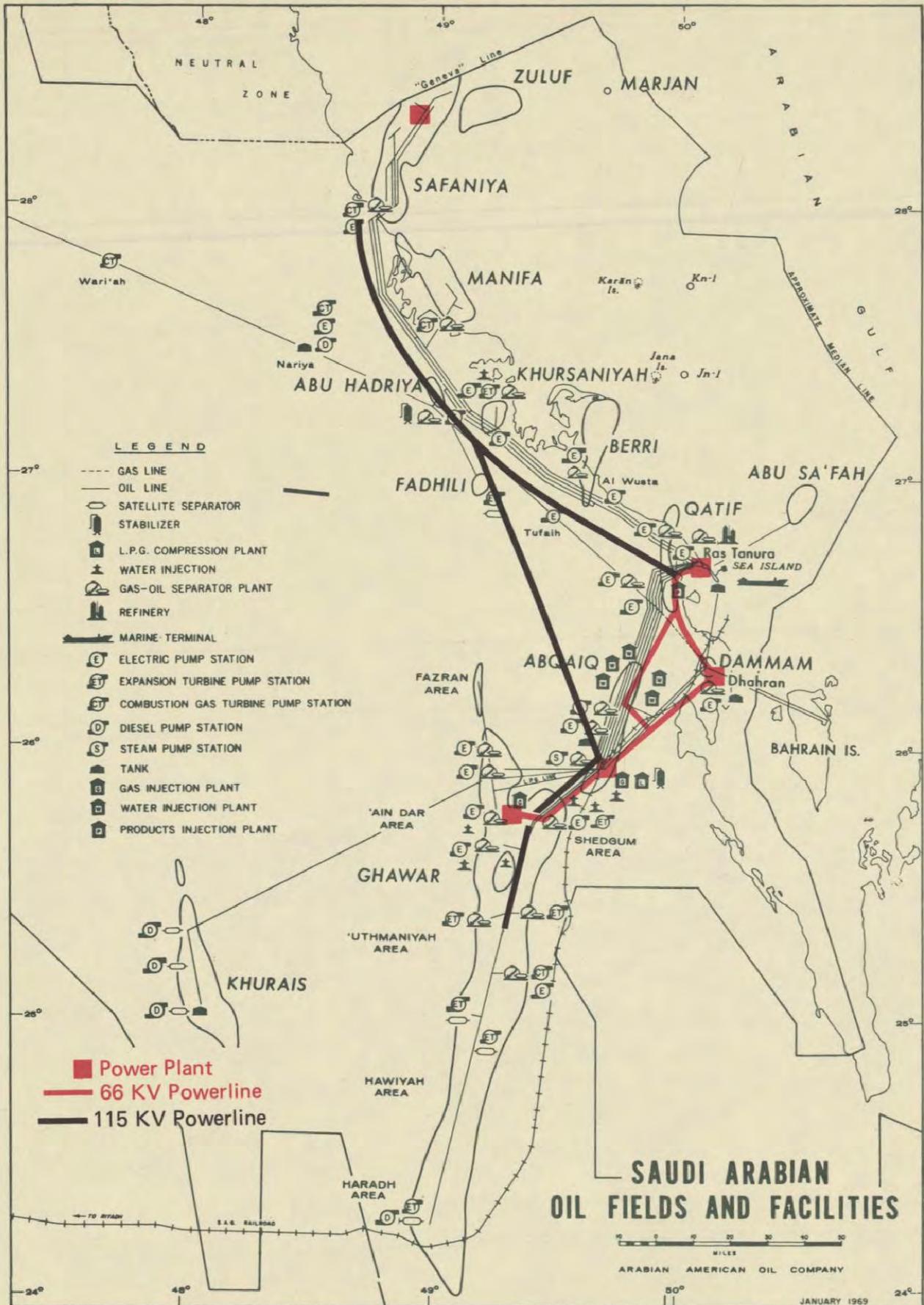


DETAILS OF FIRE SIMULATIONS



SCHEMATIC DIAGRAM – TYPICAL FIRE TRAINING AREA, ARAMCO

ATTACHMENT 5.



SCHMATIC DIAGRAM The Electric Power Triangle, ARAMCO

ATTACHMENT 6.



AERIAL VIEW DHARAN HEADQUARTERS INSTALLATIONS

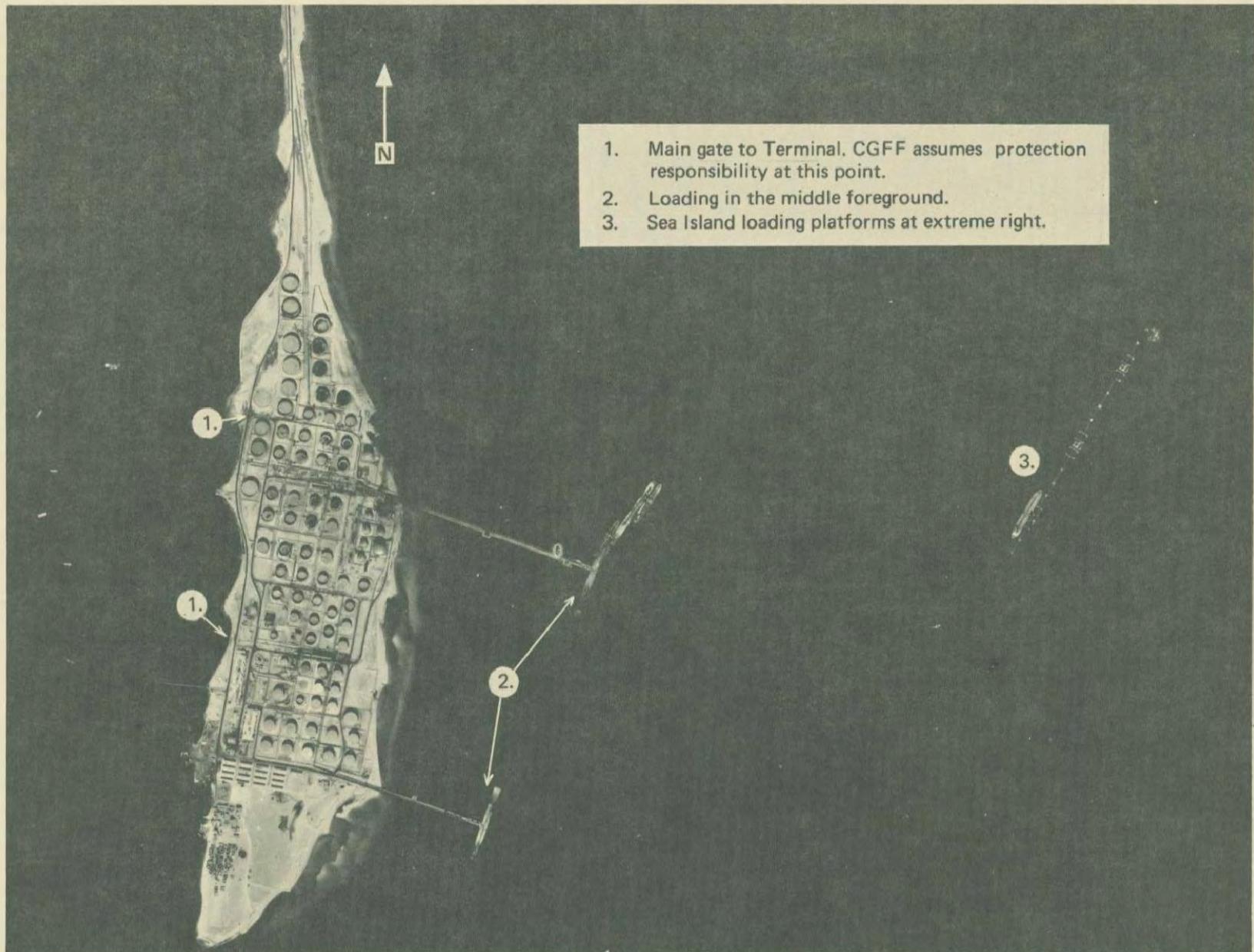
1. Power Plant
2. Main Gate to industrial and residential areas
3. Material storage area

ATTACHMENT 7.

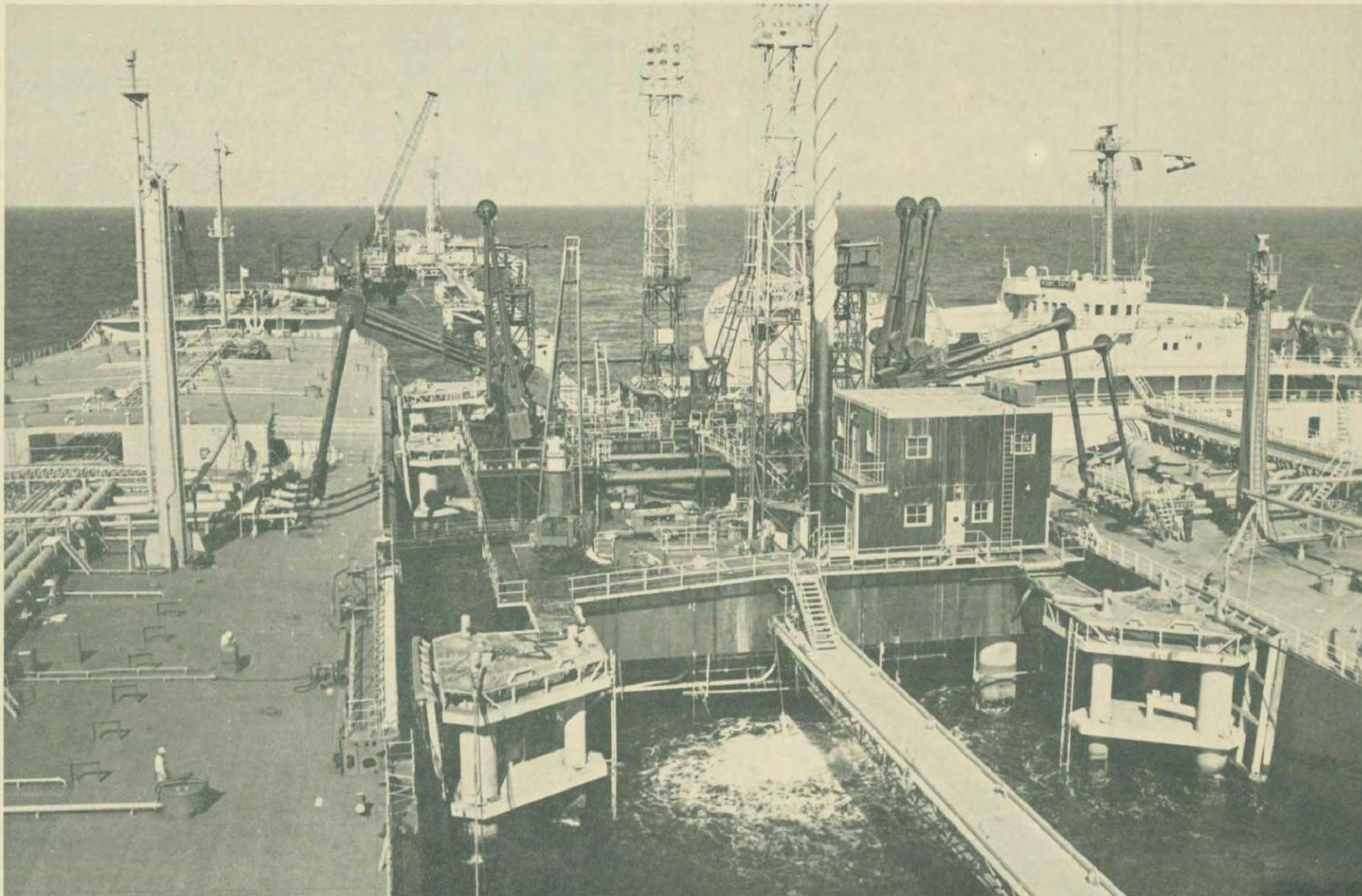


AERIAL VIEW – RAS TANURA REFINERY AND TERMINAL

1. The Refinery
2. The Power Plant
3. Main Gate to the Refinery, Fire Station and Laboratory
4. Zero Anchor



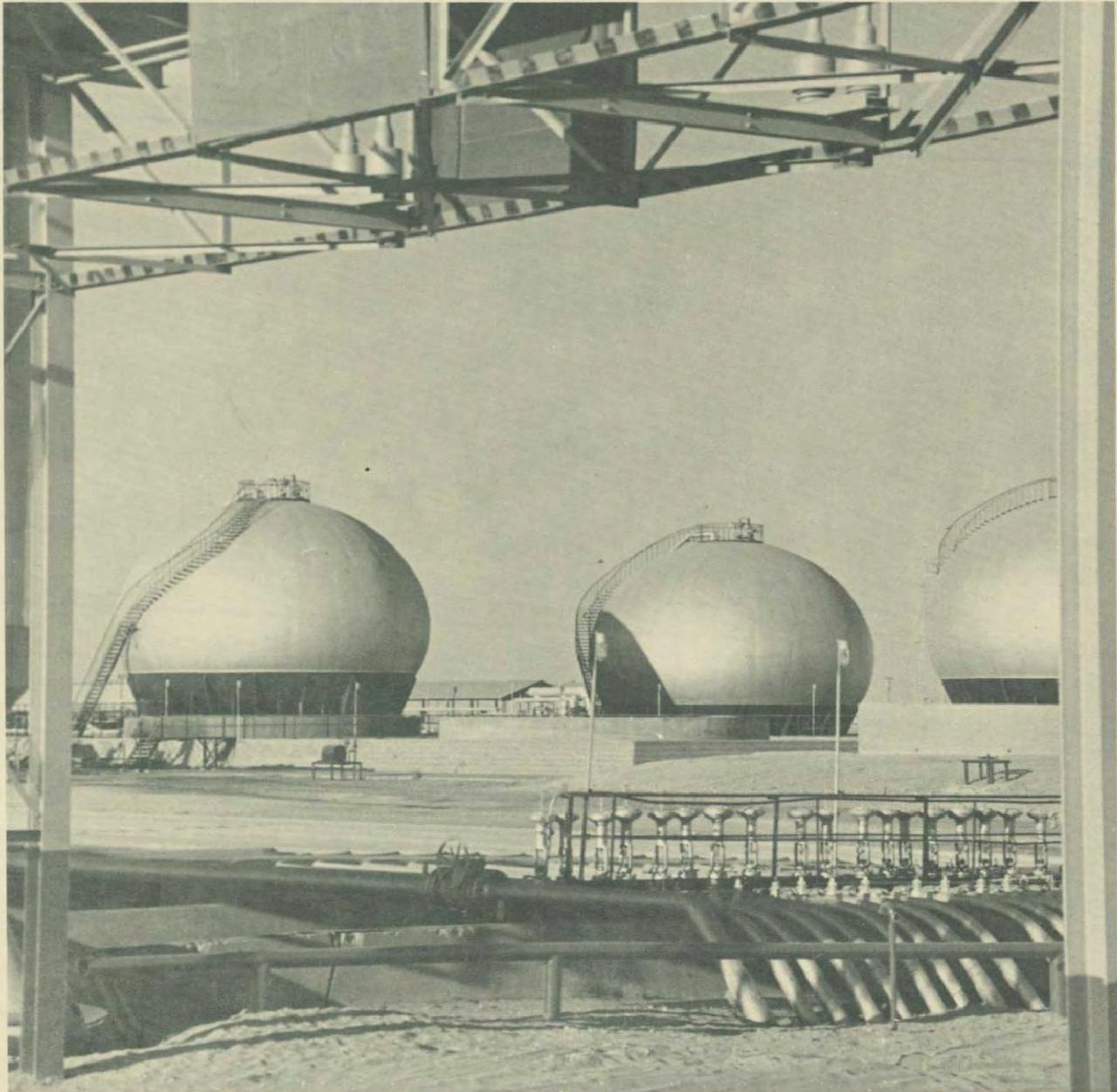
AERIAL VIEW – RAS TANURA TANK FARM AND TERMINAL



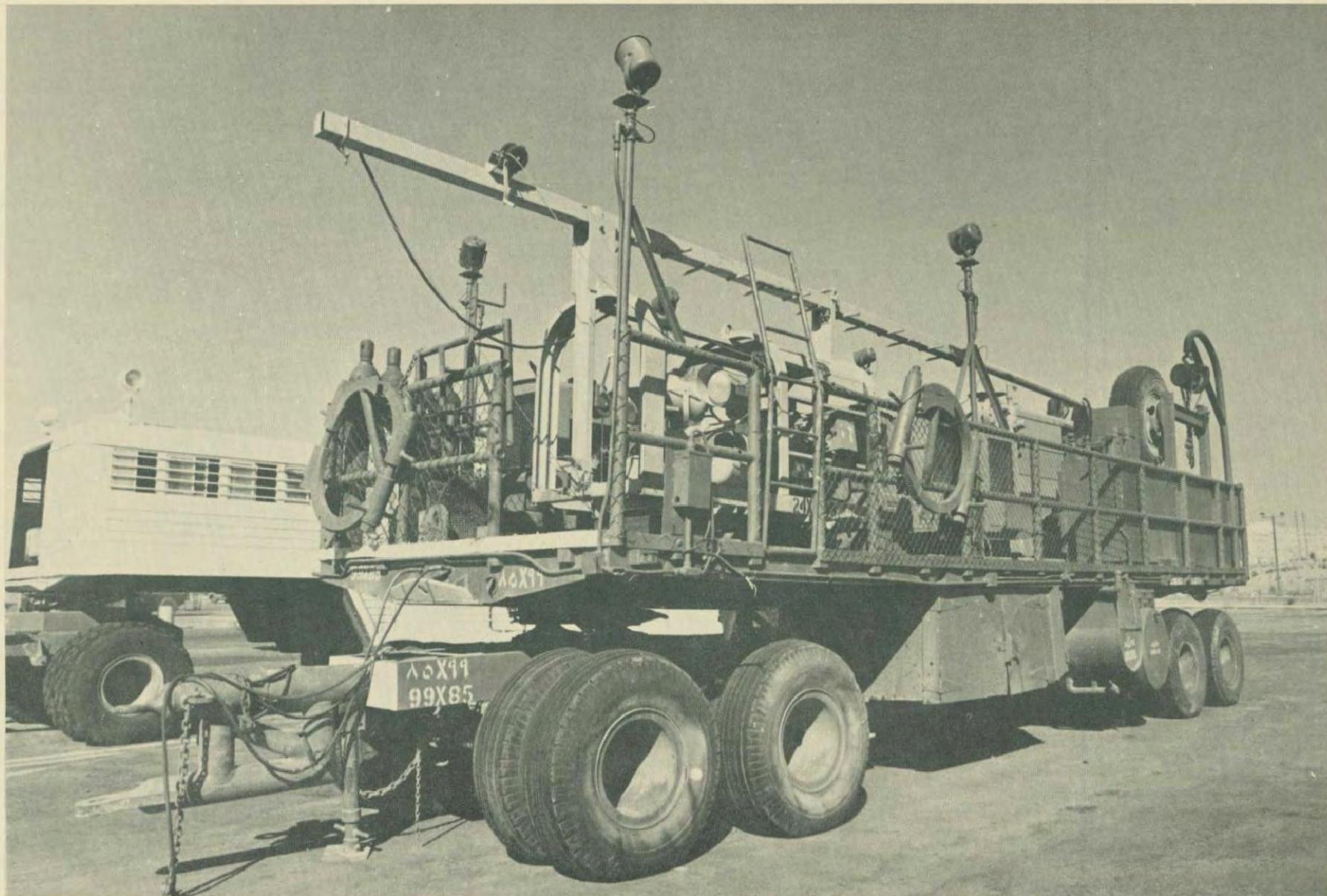
SEA ISLAND NUMBER 2, RAS TANURA.

Two tankers are loading, right and left. Sea Island number 3 is in the background.

ATTACHMENT 10



ABQAIQ COSP Number 1 spheroids. Pipe manifolds are in the foreground.



PIPELINE EMERGENCY REPAIR EQUIPMENT TRAILER

