APPLICATION STANDARD

FOR

SAFETY BOUNDARY LIMIT

FIRST EDITION

OCTOBER 2015

FOREWORD

The Iranian Petroleum Standards (IPS) reflect the views of the Iranian Ministry of Petroleum and are intended for use in the oil and gas production facilities, oil refineries, chemical and petrochemical plants, gas handling and processing installations and other such facilities.

IPS are based on internationally acceptable standards and include selections from the items stipulated in the referenced standards. They are also supplemented by additional requirements and/or modifications based on the experience acquired by the Iranian Petroleum Industry and the local market availability. The options which are not specified in the text of the standards are itemized in data sheet/s, so that, the user can select his appropriate preferences therein.

The IPS standards are therefore expected to be sufficiently flexible so that the users can adapt these standards to their requirements. However, they may not cover every requirement of each project. For such cases, an addendum to IPS Standard shall be prepared by the user which elaborates the particular requirements of the user. This addendum together with the relevant IPS shall form the job specification for the specific project or work.

The IPS is reviewed and up-dated approximately every five years. Each standards are subject to amendment or withdrawal, if required, thus the latest edition of IPS shall be applicable

The users of IPS are therefore requested to send their views and comments, including any addendum prepared for particular cases to the following address. These comments and recommendations will be reviewed by the relevant technical committee and in case of approval will be incorporated in the next revision of the standard.

Standards and Research department

No.17, Street14, North kheradmand

Karimkhan Avenue, Tehran, Iran .

Postal Code- 1585886851

Tel: 88810459-60 & 66153055

Fax: 88810462

Email: Standards@ nioc.ir

GENERAL DEFINITIONS

Throughout this Standard the following definitions shall apply.

COMPANY :

Refers to one of the related and/or affiliated companies of the Iranian Ministry of Petroleum such as National Iranian Oil Company, National Iranian Gas Company, National Petrochemical Company and National Iranian Oil Refinery And Distribution Company.

PURCHASER :

Means the “Company" where this standard is a part of direct purchaser order by the “Company”, and the “Contractor” where this Standard is a part of contract document.

VENDOR AND SUPPLIER:

Refers to firm or person who will supply and/or fabricate the equipment or material.

CONTRACTOR:

Refers to the persons, firm or company whose tender has been accepted by the company.

EXECUTOR :

Executor is the party which carries out all or part of construction and/or commissioning for the project.

INSPECTOR :

The Inspector referred to in this Standard is a person/persons or a body appointed in writing by the company for the inspection of fabrication and installation work.

SHALL:

Is used where a provision is mandatory.

SHOULD:

Is used where a provision is advisory only.

WILL:

Is normally used in connection with the action by the “Company” rather than by a contractor, supplier or vendor.

MAY:

Is used where a provision is completely discretionary.

CONTENTS: PAGE No.

0. INTRODUCTION

0.1 Designs for Safety

Efficiency and Safety in industrial operations can be greatly increased by careful planning of the location, design and layouts of a new plant or an existing one in which major alteration are to be made. Numerous accidents, explosions and fires are preventable if suitable measures are taken right from the earliest planning stages.

In the design of the layout of new plants, sufficient spacing between equipment should be provided to ensure that adequate separation exists for:

1) Safety (isolation to contain a fire or to minimize the involvement of adjacent facilities; access for fire fighting)

2) Access for operation and maintenance.

National or local codes specify minimum distances between the various components of a gas/oil/petrochemical plants. In addition Major gas/oil/petrochemical plants have their own

Specifications or recommended minimum distances between various types of equipment. When necessary, the latter recommended spacing may be reduced after evaluation of the risk involved and a decision by Owner to accept it. In case reduced spacing is accepted, additional safety and fire protection facilities may be required to compensate for the greater risk.

The risk evaluation will be carried out by risk engineer, he will identified the restriction limit of fire zone/impacted area/restricted area.

It is always preferable that high hazard processes be located in small isolated areas of limited occupancy or in areas away from hazard involved. Lower-hazard operations can justify larger unit.

0.2 Safe Distance Limits

Selection of safe distances from the possible hazards involves consideration of a number of factors; possible hazards to the community and their relationship to climate and other conditions, highly flammable materials (hydrocarbon liquid and gases) and toxic gases, amount of harmful substances, drainage and waste disposal. Plan for safety boundary limits should include all necessary safety precautions and each case shall be carefully studied and planned by competent engineers.

Safety distance shall be calculated with following considerations:

- Risk assessment to determine Hazard distances base on different scenarios (gas dispersion, jet fire, pool fire, vapor cloud explosion and etc) by using related software (subject to company approval).
- Consequences modeling and analysis referenced to applicable standard.

In this standard, some of the subjects are adapted from the following specifications and handbooks:

- “The last revision of NIOC safety regulation”
- Equipment Spacing (Process STD 601 - Safety - Design Philosophy, by Foster wheeler), 1978
- Equipment Spacing (Safety in Plant Design - ExxonMobil Proprietary), 2000

General Specification- Safety, GS EP SAF 253, by TOTAL

1. SCOPE

This Standard specifies minimum requirements for safe spacing of hydrocarbon production, gas and oil refineries, petrochemical complexes and safe distance of oil and gas wells to other production facilities and third parties buildings, high tension elec. pole, roads and residential areas. This Standard is also a guide line for normal operations but each special case shall be carefully studied considering all factors of possible hazards.

Note 1:

This standard specification is reviewed and updated by the relevant technical committee on Nov. 2000. The approved modifications by T.C. were sent to IPS users as amendment No. 1 by circular No 127 on Nov. 2000. These modifications are included in the present issue of IPS.

Note 2:

This is a revised version of this standard, which is issued as revision (1)-2015. Revision (0)-1996 of the said standard specification is withdrawn.

2. REFERENCES

Throughout this Standard the following dated and undated standards/codes are referred to. These referenced documents shall, to the extent specified herein, form a part of this standard. For dated references, the edition cited applies. The applicability of changes in dated references that occur after the cited date shall be mutually agreed upon by the Company and the Vendor. For undated references, the latest edition of the referenced documents (including any supplements and amendments) applies.

IPS-E-PR-190	"Engineering Standard for Layout & Spacing"
IPS-E-PR-470	"Engineering Standard for Process Design of Emergency Measures"
IPS-E-PR-800	"Engineering Standard for Process Design of Steam Boilers"
IPS-G-SF-900	"General Standard for Noise Control and Vibration"
IPS-E-EL-110	"Engineering Standard for Hazardous Area"
IPS-E-SF-100	"Engineering Standard for Classification of Fires and Fire Hazard Properties"
IPS-E-GN-100	"Engineering Standards for Units"
IPS-C-PI-140	"Construction Standard for Transportation Pipelines (Onshore)"

API (AMERICAN PETROLEUM INSTITUTE)

RP 14C	"Recommended Practice for Analysis, Design, Installation, and Testing of Basic Surface Safety Systems for Offshore Production Platforms"
RP 14G	"Recommended Practice for Fire Prevention and Control on Open Type Offshore Production Platforms"
RP 14J	"Recommended Practice for Design and Hazards Analysis for Offshore Production Facilities"
RP 505	"Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone1 and Zone 2"
STD 521	"Pressure-relieving and Depressuring Systems"

3. DEFINITIONS AND TERMINOLOGY

3.1 Blow down Drums

A stock into which the contents of a unit are emptied in an emergency.

3.2 Rundown Tank

One of the tanks in which are received the condensate from the still agitators or other refinery equipment and from which the distillates are pumped to larger tanks known as work tanks or storage tanks. Rundown tanks are also known as "pans" or receiving tanks. If the condensate were received directly into the larger storage tank, the lubing of a still would contaminate unnecessary perhaps thousands of liters or barrels of distillate.

3.3 Blending Tanks

A tank used for any mixture prepared for the special purpose "e.g." the product of a refinery are blended for marketing.

3.4 Muster Point

Muster point is a safe place where everyone in an area/plant/building is ordered to go when there is an emergency event.

3.5 Fire Zone

Fire zones are areas within the installation were equipment are grouped by nature and/or by homogeneous level of risk attached to them. The partition into fire zones is such that the consequences of a fire, a flammable gas leak or an explosion corresponding to the credible event likely to occur in the concerned fire zone shall not impact other fire zones to an extend Where their integrity could be put at risk.

3.6 Restricted Area

The restricted area is the area within the boundaries of the installation and hence under the control of COMPANY, which is affected permanently by normal operation of the facility or exceptionally by the consequences of an emergency situation caused by a major failure.

3.7 Impacted Area

The impacted area is the area that extends beyond the boundaries of the installation but which is nevertheless affected up to some extend (1) either permanently by normal operation of the facility (noise, radiations, etc.) or exceptionally by the consequences of an emergency situation caused by a major failure.

4. SYMBOLS AND ABBREVIATIONS

ESDV emergency shutdown valve

5. UNITS

This standard is based on international system of units (SI), as per IPS-E-GN-100 except where otherwise specified.

6. IMPACTED AREA

6.1 Definition

The impacted area is the area that extends beyond the boundaries of the installation but which is nevertheless affected up to some extend (1) either permanently by normal operation of the facility (noise, radiations, etc.) or exceptionally by the consequences of an emergency situation caused by a major failure (2) defined in section 4.2.2.

Impacted area is not under the control of COMPANY but shall be agreed with LOCAL AUTHORITIES for instance to limit construction of buildings, in particular permanent settlements, or operation of transportation means open to public and to define a contingency plan internal to COMPANY (3) requiring mobilisation of resources external to COMPANY. (see relevant case study in Appendix A)

Note 1: Consequences to public shall be below the threshold of permanent incapacity.

Note 2: Major failure is not to be confused with catastrophic failure which corresponds to a theoretical incident involving the combination of the total hazardous inventory in the worst physically attainable condition, regardless of possibility to occur. Catastrophic failures constitute the basis used to establish the external contingency plan conducted by the Authorities having Jurisdiction.

Note 3: The internal Contingency Plan may cover areas extending beyond the impacted area but this is not the purpose of the present document to elaborate upon it.

6.2. Restricted Area

6.2.1 Definition

The restricted area is the area within the boundaries of the installation and hence under the control of COMPANY, which is affected permanently by normal operation of the facility or exceptionally by the consequences of an emergency situation caused by a major failure (1).

As a consequence COMPANY shall have the control, either automatically through appropriate systems or manually by means of alarms and signals, of all possible sources of ignition, including vehicles, likely to be present in the restricted area. The level of risks prevailing in the restricted area is not compatible with the presence, even temporary, of public and the restricted area shall therefore be materialised by a security fence. (see relevant case study in Appendix A)

Note 1: The major failure considered for restricted area contour determination is the same major failure as envisaged for impacted area, only the criteria applicable to risk consequences shall be different and generally less stringent.

6.3 Fire Zones

6.3.1 Definition

Fire zones are areas within the installation were equipment are grouped by nature and/or by homogeneous level of risk attached to them. The partition into fire zones is such that the consequences of a fire, a flammable gas leak or an explosion corresponding to the **credible event** likely to occur in the concerned fire zone shall not impact other fire zones to an extend where their integrity could be put at risk.

The status of the ESD and EDP system and active fire-fighting means (operative vs. inoperative), when incorporated into the incident scenarios, bear impact on the fire zone contour. In all cases the

design shall preclude propagation of fire to adjacent fire zones in case the fire-fighting means are not operative as per design intention. (see relevant case study in Appendix A)

7. HYDROCARBON PRODUCTION AND PROCESSING PLANTS

7.1 Layout and Design

The final layout prepared by designer shall be reviewed and approved by relevant company's safety department to ensure that all safety precautions are observed.

7.1.1 General safeguards

Spacing of equipment shall be in accordance with Oil Insurance Association Appendix A, Tables 1 to 3 Attached. When the topography of the site is level, arrange drainage to minimize exposure of process areas to large spills. Otherwise, locate storage tanks at a lower elevation than process areas. The plant shall have enough space and easy access to muster points.

7.1.2 Objectives of spacing design

The objectives of the spacing recommendations in this section are as follows:

• To permit access for firefighting, fire trucks and other emergency equipment.

• To permit access for operators to perform emergency shutdown actions in a fire situation.

• To minimize involvement of adjacent facilities in a fire and hence prevent further equipment failures.

• To ensure that critical emergency facilities are not subject to fire damage.

• To separate continuous ignition sources from probable sources of release of flammable materials.

• To avoid danger of nuisance to persons or facilities beyond the adjacent property lines.

• To minimize exposure of facilities to adverse consequences resulting from events external to the site.

• To permit access for normal operation and maintenance.

• To permit access for turnaround maintenance activities.

• To permit turn around maintenance activities to be carried out without impact to adjacent, non-involved units.

• To enhance site security.

The equipment spacing distances detailed in IPS-E-PR-190 are recommended minimum figures which, in most cases, will satisfy the above objectives. However, special considerations for a particular plant or local factors may justify deviations from the recommended figures, as described IPS-E-PR-190.

7.1.3 ESDV LOCATION IN PLANT

ESDV location will be identified according to consequences modeling report.

However there are criteria for identifying location of Emergency shutdown valve that shall be considered as following:

Three cases shall be considered:

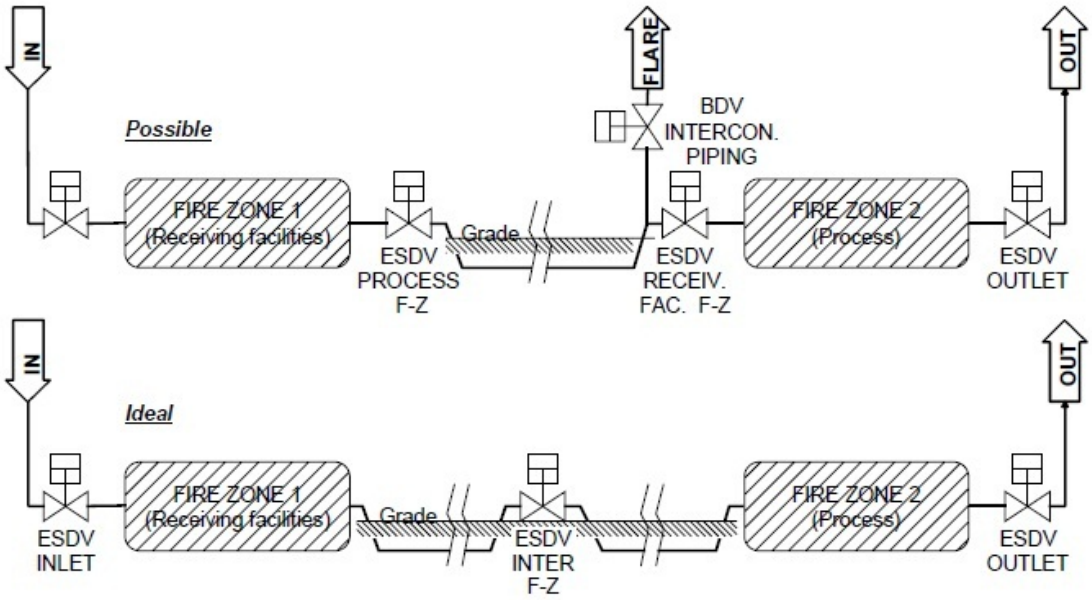
a) Inlet/outlet of the facility: ESDV shall be located within the fire zone it pertains to, but far enough from the closest hazardous equipment so that it shall always ensure.

Between ESDV and hazardous equipment can be calculated, the criteria being that the ESDV shall

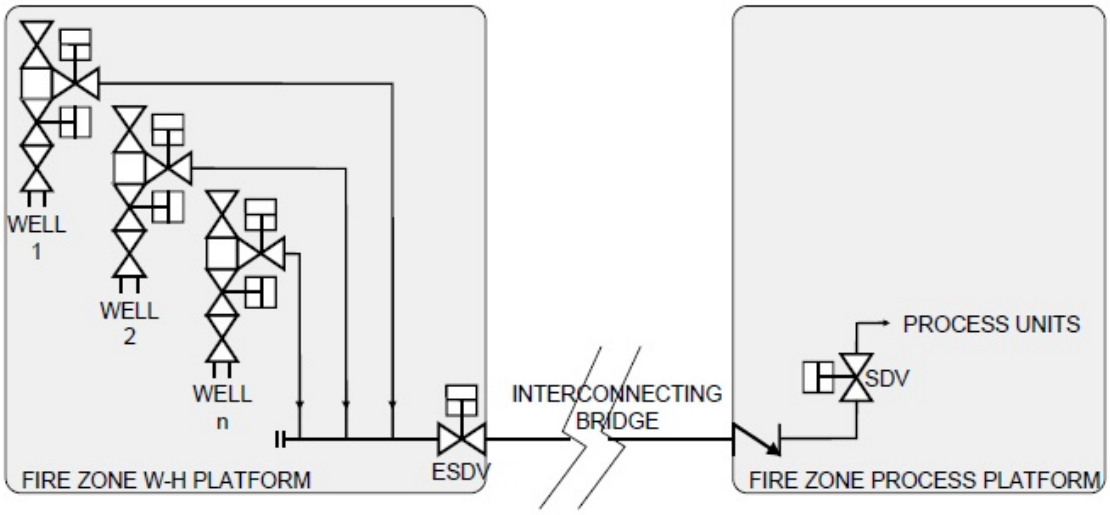
not be exposed to a radiation level of more than 15.9 kW/m^2 (5000 BTU/hr/sqft), solar radiation included, and/or an overpressure of more than 300 Mbar in case of explosion in the fire zone it protects.

b) Interconnection between fire zones: Ideally the criteria valid for ESDV at facility inlet/outlet shall apply and one single ESDV shall be installed on the interconnection at Sufficient distance of both fire zones. However, in order to reduce distances and or to avoid existence of "isolated" ESDVs, it is authorized to locate ESDV protecting a fire zone at the limit of the adjacent fire zone and vice-versa, providing the interconnection between both fire zones is suitably protected (e.g. buried) and the interconnecting piping can be depressurized in case of an emergency (see figure1 - Interconnection between fire zones).

• **Bridge offshore:** In the specific case of interconnection between a wellhead platform and, say, a process platform by a bridge, the wellhead platform ESDV located as per criteria above on the process platform can be replaced by a check valve, just to prevent back-flow towards the wellhead platform (see figure 2 - Bridge offshore).



INTERCONNECTION BETWEEN FIRE ZONES
Fig 1



BRIDGE OFFSHORE
Fig 2

7.1.4 Tank Farm/Tankage Area (Substitution)

7.1.4.1 Tanks for the storage of the same products should be grouped together within a diked area, subject to the prescribed limitations of the dike capacity.

7.1.4.2 Unless otherwise approved by Client, there shall be road on four sides of each diked area and roads shall be linked to minimize the effect if one road is cut off during the fire. Also there shall be at least one access road to diked area and two stairways from two opposite sides.

7.1.4.3 LPG or other liquefied flammable gases shall be stored remote from other products.

7.1.4.4 Wherever possible storage tanks should not be located on high ground overlooking the facilities. This prevents spillage of flammable liquid flowing downhill and endangering the operating plant.

7.1.4.5 For crude oil tanks with diameter less than 48 m, individual bounded compounds are not required, but for each crude oil tank with a diameter of 48 m or greater, a separate bounded compound.

7.1.4.6 Spacing of tanks and storages shall be in accordance with IPS-E-PR-190.

7.1.5 Fire water tank/pump/fire station location

Location of fire water tank /pump will be considered in safe area, in that area there will not any source for radiation higher than 3.2 kw/m^2 also over pressure limit shall be appropriate for atmospheric storage design.

The location of fire station shall be appropriate as safe as personal will be accommodate there its radiation level shall not be higher than 2 kw/m^2 and there is not possibility for effect of H_2S release in that area.

Note: OIA general recommendation has shown in table no APPENDIX A NO. A.3

7.1.6 Flare radiation criteria

Allowable radiation summary table

	Emergency flaring		Max. continuous flaring	
	kW*/m^2	*BTU/hr/Sqft*	kW*/m^2	*BTU/hr/Sqft*
Impacted area	2.0	*630*	1.6	*500*
Restricted area	4.7 (2)	(2) *1500*	3.2 (1)	*(1) 1000*
Prohibited access	9.5 (3)	(3) *3000*		
Permanent personnel	4.7	*1500*	2.0	*630*
Vegetation	6.3	*2000*	4.7	*1500*
Fauna	4.7	*1500*	2.0	*630*
Beamed structure	15.8	*5000*	9.5	*3000*
Flare drum	6.3	*2000*	4.7	*1500*
Flare piping	9.5 (4)	*(4) 3000*	4.7 (4)	*(4) 1500*
Heliport and EER (5) (6)	3.2	*1000*	2.0	*630*
Helideck no stand-by (6)	4.7	*1500*		
Crane cabin	4.7	*1500*	3.2	*1000*
Atmospheric storage	3.2	*1000*	2.4	*750*
Pressure vessel storage	2.0	*630*	1.6	*500*
Process equipment	4.7	*1500*	3.2 (7)	*(6) 1000*
Drilling WO equipment	4.7	*1500*	2.0	*630*
Offices and LQs	2.0	*630*	1.6	*500*
Worshops and warehouses	3.2	*1000*	2.4	*750*

All radiation levels in next table are inclusive of sun radiation

Note 1: Assuming public can reach in less than 2 minutes an area where radiation level is less than 2 kW*/m^2

Note 2: Shielded areas where radiation level is less than 2 kW*/m^2 to be provided and match requirement of section 7.2.3. Same criteria for seawater level. Restricted area shall be fenced (onshore) beaconed with buoys (offshore)

Note 3: Access submitted to special procedure only

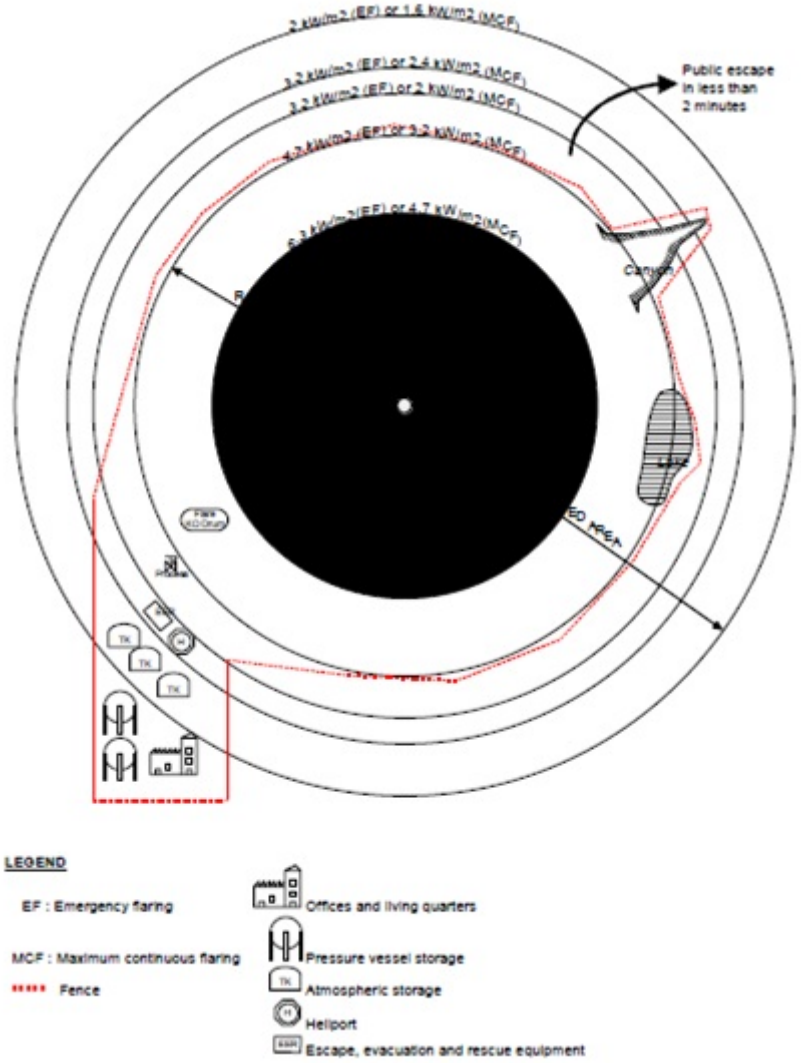
Note 4: If not achievable by position, use of thermal insulation and/or passive fire protection is recommended

Note 5: Evacuation, Escape and Rescue

Note 6: Heliport means facilities where helicopter may shutdown and refuel; helideck covers platform, without refuelling facilities and where personnel may be transferred while helicopter rotor is kept running

Note 7: Unless require permanent presence of unprotected personnel, in which case 2 kW*/m^2 maximum are acceptable

Figure 3 - Radiation thresholds, next page, captures the concepts developed above for the simplified case of only one flare and taking into account radiation effect only levels in next table are inclusive of sun radiation.



RADIATION THRESHOLDS

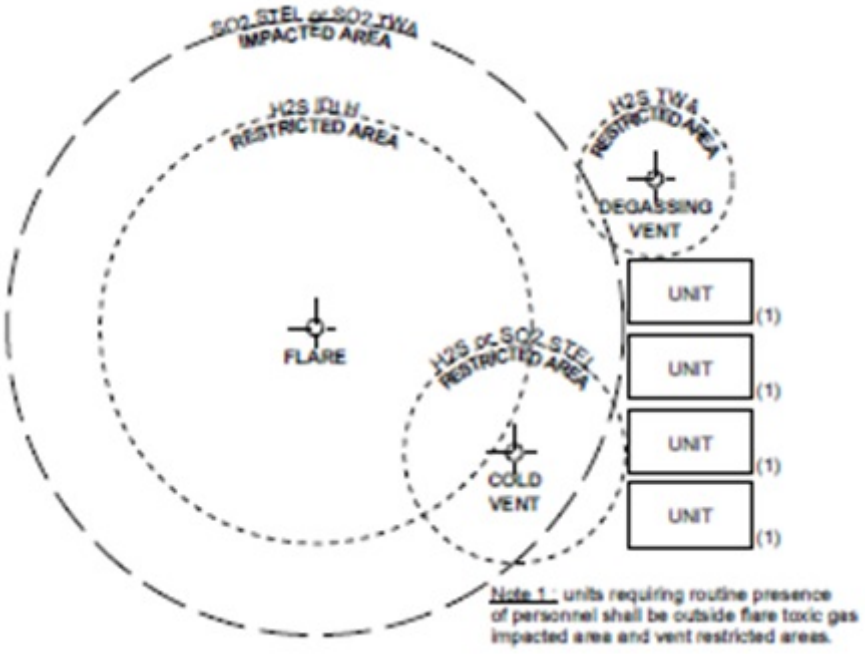
Fig. 3

The noise level should be as indicated in Table 6 of IPS-G-SF-900.

For wind direction, reference should be made to IPS-E-PR-190.

Note: the design for radiation levels mention in API 521 shall be noted.

H_2S RELEASE CRETERIA



TOXIC GAS IMPACTED AND RESTRICTED AREAS

Fig 4

Criteria for distance of flare /burn pit

	2D distances in metres	A	B	C	D	E	F	G	H	I	J
A	Elevated flare (1)	60									
B	Burn pit (1)	100	100								
C	Encl. ground flare (1)	60	100	30							
D	Over-head power line	100	100	60	15						
E	Sump tank/CD drum	60	45	30	30	3					
F	Main pipe rack	60	30	15	30	7.5	7.5				
G	Flare KO drum	30	30	15	45	7.5	7.5	7.5			
H	Oily water pit	30	15	15	30	7.5	7.5	7.5	-		
I	Cold vent	100	60	60	60	30	15	30	7.5	(2)	
J	Degassing vent	60	45	30	30	7.5	3	7.5	3	15	-

7.1.7 Fire training areas

Fire training areas are ignition sources when in use. Because of the smoke produced, they can also create a nuisance for the refinery and neighboring facilities. Fire training areas shall be 60 m from process unit battery limits, main control rooms, fired steam generators, fire pumps, cooling towers and all types of storage tanks. They shall also be 75 m from property boundaries, administration, shop and similar buildings and from the main substation.

7.1.8 Oil and gas pipeline safety boundary limit requirement for oil and gas line based on NIOC safety regulation shall be per TABLE 1- Appendix C.

7.1.9 Gas pipeline safety boundary limit requirement in the NORTH of Iran shall be per chapter 19,

IPS-C-PI-140.

APPENDICES

APPENDIX A

CRITERIA

A.1 Fire Zone

According to SP-SEC-253, “the partition into fire zones is such that the consequences of a fire, a flammable gas leak, or an explosion corresponding to the credible event likely to occur in the concerned fire zone shall not impact other fire zones to an extend where their integrity could be put at risk”.

The fire zone shall not overlap inside the unit. The overlap is admitted if inside the overlapped area no equipment are installed but only piping and pipe rack that shall be fireproofed.

The main principle adopted for the partition of the plant into fire zones is that it is not generally acceptable that a single credible event could result in the total loss of function of the plant.

The set of credible events taken as scenario are:

- Gas dispersion (unignited gas/spray cloud):
  - leak hole diameter: 20 mm
  - flows remains constant for 10 minutes
  - leakage flowrate limited to the maximum nominal flowrate (discharge of pump or compressor)
  - sizing criteria: 100% LFL (averaging time 10 s)
- Jet fire:
  - leak hole diameter: 20 mm
  - sizing criteria: 9.5 kW/m² (3000 BTU/hr/ft²)

    15.8 kW/m² for ESDV or piping (5000 BTU/hr/ft²)

    Nota: radiation includes solar radiation
- Pool fire:
  - retention pond in fire for single wall tank storage or pit
  - maximum flame radiation for condensate pool fire: 30 kW/m²
  - sizing criteria: 9.5 kW/m² (3000 BTU/hr/ft²)

    15.8 kW/m² for ESDV, other tank storage or piping (5000 BTU/hr/ft²)

    Nota: radiation includes solar radiation
- Vapour cloud explosion:
  - largest unit 50% full of gas at stoechiometry
  - maximum overpressure: 50000 Pa for congested unit

    35000 Pa for less congested unit
  - sizing criteria: 17000 Pa for building, equipment, storage

    30000 Pa for ESDV and piping

APPENDIX A (Continued)

The fire zones considered for this study are the following:

A.2 Restricted Area

The restricted area is the area within the boundaries of the installation and hence under the control of the Company, which is affected:

- either permanently by normal operation of the facility (radiation, ...)
- or exceptionally by the consequences of an emergency situation caused by a major failure of the facility.

The fire zones are always included in the restricted area.

The operator shall have the control, either automatically through appropriate systems or manually by means of alarms and signals, of all possible sources of ignition, including traffic means such as trucks and helicopters, likely to be present in the restricted area.

The level of risk prevailing in a restricted area is not compatible with the presence, even temporary, of public.

The set of major failures taken as scenarios are:

- Gas dispersion (unignited gas/spray cloud):
  - leak hole diameter: 80 mm for 4'' ≤pipe diameter ≤10"
    100 mm for pipe diameter ≤ 16"
    120 mm for pipe diameter ≤ 24"
    140 mm for pipe diameter > 24"
  - isolation time: 90 s, with a release duration of 400 s if there are two isolating automatic valves
    600 s if there is one single automatic isolating valve.
  - sizing criteria: 100% LFL (averaging time 10 s)
    LC0% for H_2S toxic dispersion:
    - 1000 ppm for 60 s
    - 800 ppm for 300 s
    - 700 ppm for 600 s
    - 500 ppm for 1800 s
- Pool fire:
  - same as defined for fire zone
  - sizing criteria: 4.7 kW/m² (1500 BTU/hr/ft²)
    Nota: radiation includes solar radiation
- BLEVE
  - totality of the mass of LPG taken into account
  - sizing criteria: maximum radiation level for 0% lethality, calculated according the duration of the fire ball.
- Flaring

- flares flame out:

- emergency flaring
- sizing criteria: 100% LFL (averaging time 10 s)

  LC0% for H2S toxic dispersion
  - radiation:
- emergency flaring during 15 min (2 flares in operation)
  - sizing criteria: 3.2 kW/m² (1000 BTU/hr/ft²): atmospheric storage

    4.7 kW/m² (1500 BTU/hr/ft²): restricted area, permanent personnel, process equipment

    6.3 kW/m² (2000 BTU/hr/ft²): flare drum

    9.5 kW/m² (3000 BTU/hr/ft²): prohibited access, flare piping

    Nota: radiation includes solar radiation
- continuous flaring
  - sizing criteria: 2.0 kW/m² (630 BTU/hr/ft²) permanent personnel

    2.4 kW/m² (750 BTU/hr/ft²): atmospheric storage

    3.2 kW/m² (1000 BTU/hr/ft²): restricted area, process equipment

    4.7 kW/m² (1500 BTU/hr/ft²): flare drum

    Nota: radiation includes solar radiation

A.3 Impacted Area

The impacted area is the area that extends beyond the boundaries of the installation but which is nevertheless affected:

- either permanently by normal operation of the facility (radiation, ...)
- or exceptionally by the consequences of an emergency situation caused by a major failure of the facility

The restricted area shall be always contained inside the impacted area.

The set of major failures taken as scenarios are:

- Gas dispersion (toxic cloud):
  - same as defined for fire zone
  - sizing criteria: IDLH for H_2S toxic dispersion :
    - 500 ppm for 60 s
    - 400 ppm for 300 s
    - 360 ppm for 600 s
    - 300 ppm for 1800 s
- Pool fire:
  - same as defined for fire zone

APPENDIX A (Continued)

- sizing criteria: 3.2 kW/m² (1 000 BTU/hr/ft²)

  Nota: radiation includes solar radiation

- Vapour cloud explosion:
  - same as defined for fire zone
  - sizing criteria: 5000 Pa
- Flaring
  - SO_2 dispersion:

    sizing criteria: 2 ppm for continuous flaring

    5 ppm for emergency flaring
  - radiation:

    emergency flaring during 15 min (2 flares in operation)

    sizing criteria: 2.0 kW/m² (630 BTU/hr/ft^2)

APPENDIX B
TABLE B.1 - OIA (OIL INSURANCE ASSOCIATION) GENERAL RECOMMENDATIONS FOR SPACING IN REFINERIES

Minimum Distance Meters	SERVICE BUILDING	PROCESS UNITS	BOILERS UTILITIES & ELECT GEN. EQUIP. ETC.	FIRED PROCESS HEATERS	PROCESS VESSELS FRACT. EQUIP. ETC	GAS COMPRESSOR HOUSES	LARGE OIL PUMP HOUSES	CONTROL HOUSES	COOLING TOWERS	CONTROLS FOR DROP-OUT STEAM SNUF & SPRAY -DROP-OUT	BLOWDOWN DRUMS & FLARE STACKS	PRODUCT STORAGE. TANKS	RUNDOWN TANKS	BLENDING TANKS	HAZARDOUS LDG. & UNLDG. FACILITIES. INCL DOCKS	FIRE PUMPS	TURRET NUZZLES	FIRE HYDRANTS	FIRE EQUIP. HOUSES
SERVICE BUILDINGS	10 SEE BLD CHART																1 15	1 15 TO 75	15 TO 75
PROCESS UNITS	30	3 15 TO 30															1 15 TO 30	1 15 TO 75	30
BOILERS,UTILITIES&ELECT GENERATING EQUIPMENT, ETC.	30	30															1 15 TO 30	1 15 TO 75	30
FIRED PROCESS HEATERS[2]	2 30	2 15	2 30	2 8													1 15 TO 30	1 15 TO 75	30
PROCESS VESSELS. FRACTIONATING EQUIPMENT, ETC.	30	-	30	2 15													1 15 TO 30	1 15 TO 75	30
GAS COMPRESSOR HOUSES	30	-	30	2 30	9	SEE BLDG. CHART											1 15	1 15 TO 75	30
LARGE OIL PUMP HOUSES	30	-	30	2 30	6	9	SEE BLDG. CHART										1 15	1 15 TO 75	30
CONTROL HOUSES *		-	30	2 15	15	15	9	7 SEE BLD. CHART									1 15	1 15 TO 75	30
COOLING TOWERS	15 TO 30	30	30	2 30	30	15 TO 30	15 TO 30	15 TO 30	6 8 TO 15								1 15 TO 30	1 15 TO 75	30 TO 60
DROPOUT CONTROLS. STEAM SNUFFING & WATER SPRAY CONTROLS	-	-	-	2 15	15	15	6	SEE NOTE	15	-							1	1	
BLOWDOWN DRUMS & FLARE STACKS	3 60 TO 90	3 60 TO 90	3 60 TO 90	3 60 TO 90	3 60 TO 90	3 60 TO 90	3 60 TO 90	3 60 TO 90	3 60 TO 90	3 60 TO 90							1 30	1 30	75
PRODUCT STORAGE TANKS[11]	11 60	4 75	4 75	2 4 75	4 75	4 75	4 75	4 75	75	8 75	8 60 TO 90	9 SEE NOTE					1 15 TO 30	1 15 TO 75	90
RUNDOWN TANKS	30	5 60	5 60	2 5 60	5 60	5 60	5 60	5 60	5 60	5 60	8 60 TO 90	9 SEE NOTE	9 SEE NOTE				1 15 TO 30	1 15 TO 75	90
BLENDING TANKS	60	60	60	2 60	60	60	60	60	60	60	8 60 TO 90	9 SEE NOTE	9 SEE NOTE	9 SEE NOTE			1 15 TO 30	1 15 TO 75	75
HAZARDOUS LOADING & UNLOADING FACILITIES INCLUDING DOCKS	60	60	60	2 60	60	60	60	60	60	60	8 60 TO 90	4 75	4 75	4 75	15 TO 75		1 15 TO 30	1 15 TO 75	75
FIRE PUMPS	15 TO 30	75	0	75	75	30	30	-	-	-	90	90	90	90	90	-	-	-	-

Note:
*** Control houses serving unusually large or hazardous units and central control houses for multiple units or housing computer equipment, require greater spacing and may require blast-resistant construction.**

APPENDIX B (Continued)

TABLE B.2 - OIA GENERAL RECOMMENDATIONS FOR SPACING

MINIMUM DISTANCE IN METERS	PROCESS UNIT-HH	PROCESS UNIT-LH	TANK FRAMS -HH	TANK FRAMS-LH	PROCESS WAREHOUSE-LH	SHIP G. & REC G.-HH	SHIP G. & REC G.-LH	SERVICE BUILDINGS	BOILER AREA	FIRE PUMPS	EMERGENCY CONTROLS	WATER SPRAY CONTROLS	TURRET NOZZLES	EMERGENCY FLARES	PILOT PLANTS	LARGE COOLING TOWERS	FIRE HYDRANTS	FIRED PROCESS HEATERS	
B PROCESS UNIT- HIGH HAZARD	60									75	30	5 15	15-30 TO Center of Target	For 30m Flare that is 8m above Surrounding Equipment, Use 90m	60	45		15 To 30	
PROCESS UNIT- LOW HAZARD	30	15								45	15				60	30		15	
C TANK FARMS- HIGH HAZARD	1 75	1 75	1½ Dia. LARGER							75		5 30			75	75		60	
TANK FRAMES- LOW HAZARD	2 60	3 30	ONE Dia. LARGER	½ Dia. LARGER						60					60	60		60	
D PROCESS WAREHOUSE LOW HAZARD	45	4 45	1 75	3 30	4 15					60					60	45		30	
E SHIPPING & RECEIVING- HIGH HAZARD	60	60	2 45	3 30	45	15				45	30	5 15			60	60		60	
SHIPPING & RECEIVING-	45	30	30	15	6	15	-			30	15				45	45		30	

IN PETROCHEMICAL PLANTS

LOW HAZARD																		
F SERVICE BUILDINGS	60	30	60	30	30	45	30	SEE BLDG. CHART		30					60	30		30
BOILER AREA	60	45	60	45	30	60	30	30	-	-					60	30		30

APPENDIX B (Continued)

TABLE B.2 (Continued)

MINIMUM DISTANCE IN METERS	PROCESS UNIT-HH	PROCESS UNIT-LH	TANK FRAMES-HH	TANK FRAMES-LH	PROCESS WEREHOUSE-LH	SHIP G. & REC G.-HH	SHIP G. & REC G.-LH	SERVICE BUILDINGS	BOILER AREA	FIRE PUMPS	EMERGENCY CONTROLS	WATER SPRAY CONTROLS	TURRET NOZZLES	EMERGENCY FLARES	PILOT PLANTS	LARGE COOLING TOWERS	FIRE HYDRANTS	FIRED PROCESS HEATERS	
MINIMUM DISTANCE IN METERS	REACT	COMP	TANKS	FRACT-EQUIP.	CONT. ROOMS														
REACTOR	8 [6]																		
SMALL COMPRESSOR HOUSE OR PUMP HOUSE	12 [6]																		
INTERMEDIATE STORAGE. TANKS HIGH HAZARD RUNDOWN-FEED	30 TO 60	30 TO 60	ONE DIA. [7]																
FRACTION EQUIPMENT	15	9	30																
CONTROL ROOMS *	15 TO 30 [6]	15 TO 30	30	15 TO 30	3														

APPENDIX B (Continued)
TABLE B.3 - GENERAL RECOMMENDATIONS FOR SPACING IN GAS PLANTS

MINIMUM DISTANCE IN METERS	SERVICE BUILDING	GAS COMPRESSOR HOUSE	LARGE PROCESS OIL PUMP HOUSE	DISTILLATION & FRACTIONATION	UTILITIES	PRESSURE TANKS	ATMOSPHERIC	LOADING RACKS	MAIN GAS CONTROL VALVE	FIRE PUMPS	OPEN FLAMES	ORDINARY ELECTRICAL	EMERGENCY CONTROL STATION-MINIMUM OF 2	TURRET NOZZLES	FIRE EQUIPMENT HOUSE	FLARES	STEAM SNUFF AND/OR BLOWDOWN CONTROL	HYDRANTS	LEAN OIL PUMPS
SERVICE BUILDING	SEE CHART								15	30	0		BOTH STATIONS SHOULD BE LOCATED AT LEAST 75 AND NOT OVER 150 FROM COMPRESSOR HOUSE, PROCESS AREA, LOADING RACKS, HEATERS, AND MAIN GAS LINES. MINIMUM BETWEEN STATIONS.		15	HIGHT LESS THAN 25 , 90 FROM PLANT. HIGH OVER , 60 FROM PLANT.		15 TO 30 [4]	
GAS COMPRESSOR HOUSE	30 [1]	-							75 TO 150	60	30	15			15		15	15 TO 30	15
LARGE PROCESS OIL PUMP HOUSE	30 [1]	15	-						75 TO 150	60	30			15	15		15	15 TO 30	
DISTILLATION AND FRACTIONATION	30 [5]	15	9	-					75 TO 150	60	30			15	15		15	15 TO 30	15
UTILITIES	15	30	30	30	-				75 TO 150	0	0				15			15 TO 30	30
PRESSURE TANKS	45 [2]	60	60	60	45	- [2]			30	75	30			15	30			15 TO 30	60
ATMOSPHERIC TANKS	30 [2]	60	60	60	30	15	TWO DIA OF LARGEST		30	75	30			15	30			15 TO 30	60
LOADING RACKS	30	60	60	60	30	30	30	15 TO 30	30	45	30	30		15	30			15 TO 30	60
FIRED HEATERS	30	30	30	30	15	45 TO 60	30	30	30	45	-				15		15	15 TO 30	30

APPENDIX B (Continued)

TABLE B.2 (Continued)

MINIMUM DISTANCE IN METERS	SERVICE BUILDING	GAS COMPRESSOR HOUSE	LARGE PROCESS OIL PUMP HOUSE	DISTILLATION & FRACTIONATION	UTILITIES	PRESSURE TANKS	ATMOSPHERIC TANKS	LOADING RACKS	MAIN GAS CONTROL VALVE	FIRE PUMPS	OPEN FLAMES	ORDINARY ELECTRICAL	EMERGENCY CONTROL STATION-MINIMUM OF 2	TURRET NOZZLES	FIRE EQUIPMENT HOUSE	FLARES	STEAM SNUFF AND/OR BLOWDOWN CONTROL	HYDRANTS	LEAN OIL PUMPS
Control Houses	15	30	30	15	15	60	60	60	60 TO 150	15	30			15	15			15 TO 30	30
COOLING TOWERS	3 15 TO 30	3 15 TO 30	3 15 TO 30	30	30	75	60	60	30		30			15 TO 30	15 TO 30			15 TO 30	15 TO 30
SKID UNITS FOR PACKAGE PLANT	30	15	15	12	30	30	30	60	75 TO 150	45	30			15	30				15

APPENDIX B (Continued)

TABLE B.4 - PROXIMITY OF REFRIGERATED STORAGE VESSELS TO BOUNDARIES AND OTHER FACILITIES

BOUNDARY LINES OR OTHER FACILITIES	MINIMUM SPACING OF DOME ROOF TANKS	MINIMUM SPACING OF SPHERES OR SPHEROIDS
Property lines adjacent to land which is developed or could be built upon public highways main line railroads	60 m (1)	60 m (1)
Utility plants, buildings of high occupancy (offices, shops, labs, warehouses, etc.)	1-½ vessel diameter but not less than 45 m not exceed 60 m(1)	60 m (1)
Process equipment (or nearest process unit limits if firm layout not available)	1 vessel diameter but not less than 45 m need not exceed 60 m(1)	60 m (1)
Non-Refrigerated pressure storage facilities	1 vessel diameter but not less than 30 m need not exceed 60 m	¾ vessel diameter but not less than 30 m need not exceed 60 m
Atmospheric storage tanks (stock closed cup flash point 55°C)	1 vessel diameter but not less than 30 m need not exceed 60 m	1 vessel diameter but not less than 30 m need not exceed 60 m
Atmospheric storage tanks (stock closed cup flash point 55°C or higher)	½ vessel diameter but not less than 30 m need not exceed 45 m	½ vessel diameter but not less than 30 m need not exceed 45 m

Note:

1) Distance from boundary line or facility to centerline of peripheral dike wall surrounding the storage vessel shall not be less than 30 m at any point.

TABLE B.5 - PROXIMITY OF ATMOSPHERIC STORAGE TANKS TO BOUNDARIES AND OTHER FACILITIES

BOUNDARY LINES OR OTHER FACILITIES	MINIMUM DISTANCE FROM			
	LOW FLASH OR CRUDE STOCKS IN FLOATING ROOF TANKS	LOW FLASH STOCKS IN FIXED ROOF TANKS	CRUDE STOCKS IN FIXED ROOF TANKS	HIGH FLASH STOCKS(1) IN ANY TYPE OF TANK
Property lines adjacent to land whic is developed or could be built upon public highways, main line, railroads and manifolds located on marine piers. Building of high occupancy(offices, shop, labs, warehouses, etc.)	60 m	60 m	60 m	45 m (3)
Building of high occupancy(offices, shop,labs, warehouses, etc.)	1-½ tank diameter but not less than 45 m need not exceed 60 m	1-½ tank diameter but not less than 45 m need not exceed 60 m	60 m	1 tank diameter butnot less than 30 m need not exceed 45 m (3)
Nearest process equipment, or utility plant (or nearest unit limits if firm layout not available)	45 m	45 m	60 m	½ tank diameter but not less than 30 m need not exceed 45 m (3)(4)

Notes:

1) When future change ("Switch Service") to low flash or crude service is specified, use other applicable columns of this Table.

APPENDIX B (Continued)

2) Spacing may be reduced to 30 m for a tank or group of tanks meeting all of the following:

a) All tanks are an integral part of the given process operation.

b) Each tank is less than 15 m in diameter.

c) The total capacity of the group does not exceed 7950 m^3 (50,000 bbl).

3) Spacing should not exceed 30 m when that all of the following requirements are met:

a) The stock is stored at ambient temperature and the closed cup flash point is above 93°C; or if heated, not above 93°C and not within of its flash point.

b) The stock should not be received directly from a process unit where upset conditions could lower its flash point.

c) The total capacity of any tank does not exceed 31800 m^3 (200,000 bbl) and the total capacity of any group of tanks does not exceed 79500 m^3 (500,000 bbl).

d) There are not tanks storing low flash stocks within the same group.

4) Spacing should not exceed 15 m when that all of the following requirements are met:

a) The requirements given in Note 3, subpara. a and above.

b) All tanks are an integral part of the given process operation.

c) Each tank is less than 25 m in diameter and the total capacity of a group of tanks does not exceed 7950 m^3 (50,000 bbl).

d) There are not tanks storing low flash stocks within the same group.

TABLE A.6 - PROXIMITY OF ATMOSPHERIC STORAGE TANKS TO EACH OTHERS

TYPE OF STOCKS AND TANKAGE	MINIMUM SPACING BETWEEN (1) (2)		
	SINGLE OR PAIRED TANKS	GROUPED TANKS	ADJACENT ROWS OF TANKS INSEPARATE GROUPS (1)
Low flash or crude stocks in floating roof tanks	¾ tank diameter need not exceed 60 m	½ tank diameter need not exceed 60 m	¾ tank diameter not less than 25 m need not exceed 60 m
Low flash stocks in fixed roof tanks	1 tank diameter	½ tank diameter	1 tank diameter not less than 30 m
Crude oil stocks in floating roof tanks	¾ tank diameter need not exceed 60 m	Not permitted	
Crude oil stocks in fixed roof tanks	1-½ tank diameter (pairing not permitted)	Not permitted	
High flash stocks in any type tank	½ tank diameter need not exceed 60 m	½ tank diameter need not exceed 60 m (3) (4)	½ tank diameter not less than 15 m need not exceed 60 m

Notes:

1) Spacing between high flash and low flash tank groups shall be governed by the low-flash criteria.

2) A minimum spacing of 3 m shall be provided between any tank shell and the peripheral dike or toe wall.

3) Finished stocks with a closed cup flash point above 93°C may be spaced a minimum of 2 m apart provided that all of the following requirements are met:

a) The stock is stored at ambient temperature: if heated, not above 93°C and not within 10°C of its flash point.

b) The stock is not received directly from a process unit where upset conditions could lower its flash point below the limits of subpara. above.

APPENDIX B (Continued)

c) There are not tanks storing low-flash stocks within the same group.

4) Finished stocks with a closed cup flash point of 54°C or higher but less than 43°C may be spaced 1/6 of the rim of their diameters apart, except:

Where the diameter of one tank is less than one-half the diameter of the adjacent tank, the spacing between the tanks shall not be less than one half the diameter of the smaller tank, provided that all of the following requirements are met:

a) The spacing between tanks is not less than 2 m.

b) The stock is not heated above 93°C and not within 10°C of its flash point.

c) Group Tanks do not exceed a total capacity of 15900 m3 (100,000 bbl) and there are no tanks storing low-flash stocks within the same group.

d) The stock is not received directly/from a process unit where upset conditions could lower its flash point below the limits of subpara. b above.

TABLE A.7 - PROXIMITY OF NON - REFRIGERATED PRESSURE STORAGE VESSELS/DRUMS TO BOUNDARIES AND OTHER FACILITIES

BOUNDARY LINES OR OTHER FACILITIES	MINIMUM SPACING TO SPHERES, SPHEROIDS AND DRUMS
Property lines adjacent to land which is developed or could be built upon public highways, main railroads, and manifolds located on marine piers	60 m (1)
Building of high occupancy (offices, shop, lab, warehouses, etc.)	60 m (1)
Nearest process equipment, or utilities, point (or nearest unit admits if firm layout not available)	60 m (1)
Refrigerated storage facilities	¾ tank diameter, but not less than 30 m need not exceed 60 m
Atmospheric storage tanks (stock closed cup flash point of 55°C and below)	1 tank diameter, but not less than 30 m need not exceed 60 m
Atmospheric storage tanks (stock closed cup flash point above 55°C)	½ tank diameter, but not less than 30 m need not exceed 45 m

Note:

1) Distance from boundary line or facility to centerline of peripheral dike wall surrounding the storage vessel shall not be less than 30 m at any point.

APPENDIX C

TABLE 1 - THE SAFETY DISTANCE FOR OIL PIPELINES

	Diameter (inch)	Distance
Underground pipelines	6-8	30 m+20 m per 10 atm
	8-10	60 m+20 m per 10 atm
	12-14	100 m+3 m per 1 atm
	18-24	120 m+3 m per 1 atm
	Up 24	150 m+3 m per 1 atm
ground pipelines	6-8	5 m+10 m per 10 atm
	8-10	10 m+10 m per 10 atm
	12-14	12 m+10 m per 10 atm
	18-24	15 m+10 m per 10 atm
	Up 24	20 m+10 m per 10 atm

TABLE 2 - THE MINIMUM DISTANCES OF PRODUCTION UNITS

FLARES

FROM PUBLIC ROADS

FLARES	PUBLIC MAIN ROADS METERS	PRIVATE OR BRANCH ROADS METERS
OIL OR GAS BURNING	200	200
PITSGROUNDLEVEL FLARES	200	150
HIGH LEVEL FLARES	150	100
UNITS COLD FLARES	100	50

Notes:

1) If the above figures can not be followed, the case shall be thoroughly examined by committee of production engineers and authorities concerned.

The committee will prepare drawing of the area with detailed conditions stating why the above distances can not be observed and recommend the proposed distances.

2) Distances between flares shall not be less than 100 meters.

TABLE 3 - MINIMUM DISTANCES OF OIL/GAS WELLS

FROM OTHER PRODUCTION FACILITIES

STRUCTURES			
		ASMARI (METERS)	BANGESTAN (METERS)
1	Gas pipelines laid on the ground	200	200
2	Gas pipelines buried	60	60
3	Oil pipelines laid on the ground level	200	200
4	Burried oil pipeline	60	60
5	High tension electrical pole	200	200
6	Telephone lines	200	200
7	Oil & gas production units and facilities	400	400
8	Burning pits of productions units	300	300
9	Ground level flares	300	300
10	Production units flare stacks	150	150
11	Cold flares	300	300
12	Residential areas	400	400
13	Public roads	300	300
14	Private and branch roads	200	200
15	Oil/Gas wells	200	200