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## 1 INTRODUCTION

Dubai Supply Authority (DUSUP) is responsible for procuring, transmitting, storing and delivering natural gas to customers in the Emirate of Dubai. DUSUP has assigned Dubai Petroleum Establishment (DPE) the responsibility for operating DUSUP assets; and authorised DPE to manage all emergency events occurring on its own operated facilities and pipelines (in liaison with other governmental entities).

DPE-DUSUP designs operates and maintains DUSUP's onshore pipelines and related facilities to International Standards in order to ensure an uninterrupted flow of gas and other hydrocarbons across Dubai. The onshore hydrocarbon pipeline network consists of approximately 700 kilometres of pipelines ranging from 48" high pressure gas pipelines down to 10" condensate lines. The gas pipelines operate at high-pressures up to 960-psig and transport highly explosive and flammable natural gas. A number of jet fuel and fuel oil pipelines share the corridors with the gas and condensate pipelines.

DPE-DUSUP operates within the No Objection Certificate (NOC) system across the Emirate of Dubai. Managed through the Government of Dubai e-NOC portal, operated by the Roads and Transport Authority (RTA). The NOC System is in place in Dubai to review and pre-approve any work on a Right of way, Public way, or to administer / create any prerequisite controls e.g. traffic diversions. The same system is also used to review, approve and set conditions for monitoring and controlling third parties activities in the vicinity of onshore pipelines.

DUSUP Pipeline corridor is shared by DEL, ENOC Group, EMDAD and DEWA. NOC for the pipelines are reviewed by respective pipeline Owners or Operators (DEL, ENOC Group, EMDAD) and processed through Government of Dubai e-NOC portal. NOC for DEWA pipelines are processed directly by DEWA through e-NOC. DUSUP may be one of the many authorities of those approvals are required. Obtaining NOC from one authority will not relieve the developer or developer's representative from the responsibility of obtaining NOC from other applicable authority /authorities.

The majority of the onshore hydrocarbon pipeline network is laid-out in designated DUSUP corridors that are secured by fences and controlled access gates. Parts of the onshore pipeline network run in the Right of way, Public way and in unfenced corridors - due to the close proximity of road infrastructure.

Dubai's rapid development has led to significant changes in populated areas adjacent to the pipeline corridors. Some sections of the corridors; first constructed across open desert, are now in proximity to new and planned future developments.

## 2 PURPOSE

The purpose of this document is to provide procedural guidance for the development of land adjacent to the pipeline corridor. In order that the proposed development design considers the necessary safe land use planning criteria (as prescribed in section 6 of this report - Figures 1 & 2) and further demonstrated in the Quantitative Risk Assessment (QRA) work carried out by DUSUP and DEL; who operates the 48" Gas Pipeline from Abu Dhabi to Dubai.

### 3 REFERENCES:

1. DPE - Pipelines Risk Assessment Studies - DP-ENG-ONS-E00444-TS-RPT-0001
2. Benchmarking Study of International Zoning Distances around Pipelines Document No: DP-60-R-01
3. DEL - UAE Gas Pipeline Network QRA Report: UTS-DOL-0000-GRP-01176
4. Regulation No. (4) Of 2009 Concerning Implementation of Works within the Right of Way in the Emirate of Dubai
5. UAE Fire and Life Safety Code of Practice : CDGH-OP-25 - September 2018

### 4 DEFINATIONS & ABBREVIATIONS

#### 4.1 Abbreviations

Abbreviation	Description
DPE	Dubai Petroleum Establishment
DUSUP	Dubai Supply Authority
DEL	Dolphin Energy Limited
DEWA	Dubai Electricity and Water Authority
ENOC	Emirates National Oil Company
EMDAD	EMARAT, Air BP and Shell Joint Venture
GIS	Geographical Information System
LNG	Liquefied Natural Gas
LSIR	Location Specific Individual Risk
LUP Zone	Land Use Planning Zone
NOC	No Objection Certificate
RTA	Roads and Transport Authority
QRA	Quantitative Risk Assessment.

#### 4.2 Definitions

DPE	DPE is the government entities that operates DUSUP assets as Onshore Operations Team and has authority to manage all emergency events occurring on its own operated facilities, pipelines and all crisis occurring within pipeline corridors in liaison with other governmental entities.
DUSUP	DUSUP is the legal commercial entity that own Margham Field, Margham Plant Facilities, Gas Control Station, LNG Platform and Onshore Pipelines within pipeline corridors and has given to DPE full operatorship of all its facilities.
DUSUP Corridor	DUSUP Corridor is the land allocated by Dubai Municipality or other statutory government authority to DUSUP for the construction, operation and

	<p>maintenance of gas and fuel pipelines in the emirates of Dubai.</p>
Onshore Hydrocarbon Pipelines Network	<p>Approximately 700 kilometres of onshore hydrocarbon pipelines operating in Dubai. The network consist of gas, condensate, jet fuel and fuel oil pipelines. The gas pipelines operate at high-pressures up to 960-psig and transport highly explosive and flammable natural gas. The jet fuel and fuel oil pipelines operate at 653-psig share the same corridors. The condensate pipeline operate at 1000-psig and also share corridor with other pipeline.</p>
QRA	<p>QRA (Quantitative Risk Assessment) is a formal and systematic risk analysis approach to quantify the risks associated with the operation of gas and other hydrocarbon pipelines and study the exposure of risk to the nearby development, people, environment, company assets and its reputation.</p>
Project Specific QRA	<p>QRA (Quantitative Risk Assessment) that is commissioned by the project developer and/or developer consultant to challenge the DUSUP / DEL QRA and provide recommendations as necessary for risk reduction in accordance to section 8.</p>
LUP Zone	<p>LUP Zone means a distance or area within which there are potentially significant consequences for the developments such as residential areas, buildings, and areas of public use. LUP Zone is referred to the area that is falling between the limit of LUP Zone and Proximity Zone.</p>
Proximity Zone	<p>The DUSUP Proximity Zone is defined by the LUP risk criteria defined in Table 1 - (<math>LSIR &gt; 1.00E-04</math>).</p>
Inner Zone	<p>The DUSUP Inner Zone is defined by the LUP risk criteria defined in Table 1 - (<math>1.00E-04 &gt; LSIR &gt; 1.00E-05</math>).</p>
Middle Zone	<p>The DUSUP Middle Zone is defined by the LUP risk criteria defined in Table 1 - (<math>1.00E-05 &gt; LSIR &gt; 1.00E-06</math>).</p>
Outer Zone	<p>The DUSUP Outer Zone is defined by the LUP risk criteria defined in Table 1 - (<math>LSIR &lt; 1.00E-06</math>).</p>
Right of Way [Ref. 4]:	<p>The distance between two lines of construction as set out in plans approved by Dubai Municipality.</p>

Public Way [Ref. 4]:	Every way open for the public including all kinds of roads, side-streets, public squares, bridges, tunnels, crossroads, median strips, public parking, footpaths and pedestrian crossings.
Service Lines [Ref. 4]:	Water distribution lines, electricity lines and cables, communication lines, sewage network, irrigation lines, rain water ducts, lighting network, and intelligent information network, and other public and private service lines and other related facilities. (Inclusive of Pipelines)

## **5 CONSIDERATIONS FOR DEVELOPMENTS NEAR DUSUP PIPELINE CORRIDOR – LUP ZONES:**

Pipelines transport hazardous hydrocarbons that, when released, can pose a significant threat to the people, infrastructure and the natural environment near the pipeline. Pipeline failures are characterised as low probability, high consequence events.

Land development for residential and commercial purposes in close proximity to hazardous liquid and gas transmission pipelines increases the likelihood of damage to the pipelines and the potential for impact to the community from pipeline failure.

Property developers/plot owners and pipeline operators have key roles to ensure the protection of people/communities adjacent to the corridor, to enhance pipeline safety, whilst also protecting the environment and critical pipeline infrastructure.

DPE-DUSUP engaged a third party Risk Consultant to conduct a benchmarking study to compare the pipeline safety requirements adopted by other countries. The objective of the study was to identify the Land Use Planning (LUP) criteria to be used for the determination of pipeline zoning distances in the Emirate of Dubai, UAE in order to protect members of the public from major hazard consequences related to hydrocarbon pipeline operations.

The international benchmarking study has considered pipeline safety standards from industry regulators, industry codes and standards, industry groups, associations and other public domain information. Appropriate regulatory bodies and specific regulations relating to pipeline safety for the following countries have been identified and reviewed: United Kingdom, USA, Canada, Netherlands, Belgium, Australia, Singapore and China. The study recommended that DPE-DUSUP:

- Implement risk based approach in development of LUP Zones.
- Incorporate a requirement for assessment of societal risk where appropriate.
- Include a combined risk and consequence based approach similar to that of the UK to ensure a minimum protection distance Inner Zone is always applied for every pipeline.

## **6 LAND USE PLANNING ZONES:**

DUSUP and Dolphin Energy (DEL) independently carried out Quantitative Risk Assessment (QRA) studies to assess the risk from existing pipelines (for land use planning purposes) in the areas adjacent to hydrocarbon pipelines. Subsequently DUSUP and DEL issued guidelines to limit the use of the land adjacent to the pipeline corridor - based on their distance from the pipeline. Land Use Planning Zones may extend up to 500 meters beyond the Pipeline corridor

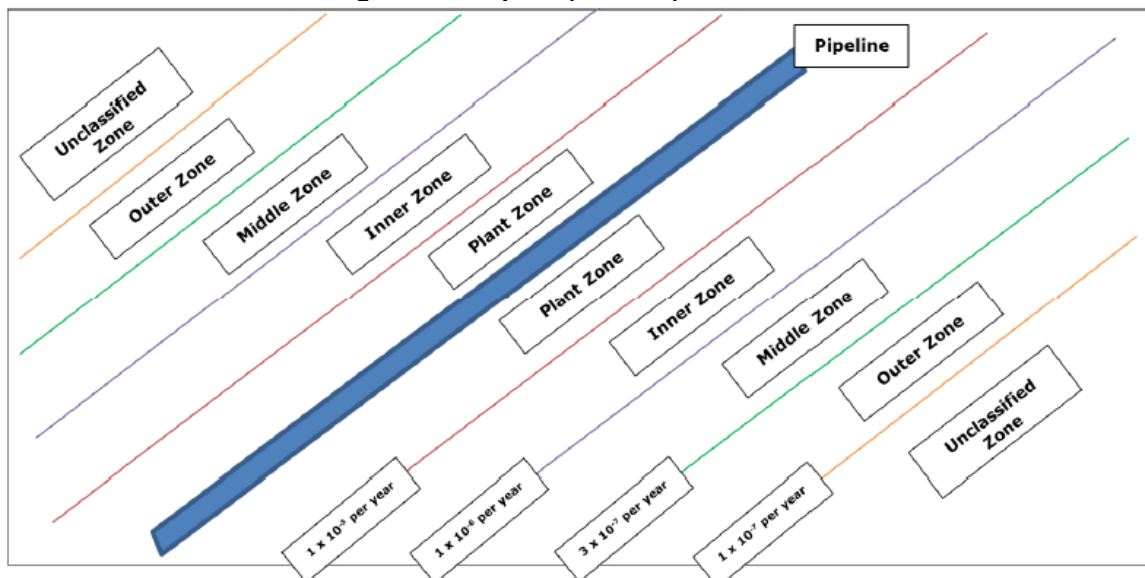
limit and are divided into 4 or 5 Land Use Zones for DUSUP and DEL respectively, with corresponding restrictions for LUP.

Although DUSUP and DEL both apply the same general approach for LUP, the assignment of Location Specific Individual Risk (LSIR) criteria for different zones (and their resulting restrictions on developments) differ. The acceptance criteria for LUP zones; and their associated Location Specific Individual Risk (LSIR) figures, is a corporate risk management decision for each individual operator; as a result, both DUSUP and DEL guidelines for LUP were developed independently of each other. Although similar, DUSUP and DEL (ADNOC) LUP criteria do have some differences, as indicated in Figures 1 & 2, and further detailed in Sections 6.1 to 6.5 below. It should be noted that where both DUSUP and DEL LUP zones have been applied to DUSUP GIS maps, the most stringent zoning criteria has been applied when comparing both DUSUP and DEL outputs from QRA analysis’.

**Table 1: DPE LUP Criteria**

Off-Site Population	Proximity Zone	Inner Zone	Middle Zone	Outer Zone
LUP risk criteria customised and refined for DPE	LSIR > 1.00E-04 per year	1.00E-04 per year > LSIR > 1.00E-05 per year	1.00E-05 per year > LSIR > 1.00E-06 per year	LSIR < 1.00E-06 per year
Normally unoccupied, e.g. car park, farms, etc. (<10 buildings /km <sup>2</sup> )	Withhold NOC	Release NOC	Release NOC	Release NOC
Low density population e.g. small workplaces (>10 and <30 buildings per km <sup>2</sup> )	Withhold NOC	Release NOC	Release NOC	Release NOC
General public, e.g. residential (>30 buildings per km <sup>2</sup> )	Withhold NOC	Withhold NOC	Release NOC	Release NOC
Vulnerable people, e.g. schools, hospitals, etc.	Withhold NOC	Withhold NOC	Withhold NOC	Release NOC
Very large or sensitive, e.g. large shopping malls, tall multi-storey buildings, sports stadia, etc.	Withhold NOC	Withhold NOC	Withhold NOC	Release NOC

**Figure 2 - Dolphin (ADNOC) LUP Criteria:**



## 6.1 Proximity Zone:

The proximity zone is determined by an assessment of the risks and/or hazards of the installation using Location Specific Individual Risk (LSIR) criteria - LSIR is the risk indicator most frequently adopted for assessing the risk in LUP:

- DUSUP Proximity Zone risk criteria =  $LSIR > 1.00E-04$  per year
- Dolphin 'Plant' Zone is defined as  $LSIR > 1.00E-05$  per year and development or use is set as "No Development"

**NOTE:** The terms 'Proximity Zone', 'Plant Zone' and 'No-Go Zone' occupy similar areas and can generally be used interchangeably when considering DUSUP NOC requirements. However; proximity zones and plant zones are defined by the risk profile (as described above), whereas no-go zones are indicative of general restricted access areas within the pipeline corridor (or other hazardous sites).

### DUSUP Restrictions in the Proximity Zone:

- No development is permitted in the Proximity zone.

### Dolphin (ADNOC) Interpretation of Criteria:

- No development is permitted in the Plant zone.

## 6.2 Inner Zone:

The inner zone is determined by an assessment of the risks and/or hazards of the installation using Location Specific Individual Risk (LSIR) criteria - LSIR is the risk indicator most frequently adopted for assessing the risk in LUP:

- DUSUP Inner Zone risk criteria =  $1.00E-04$  per year  $> LSIR > 1.00E-05$  per year
- Dolphin Inner Zone is defined as  $LSIR \leq 1.00E-05$  per year and development or use is set as "Low density activities e.g. playing fields"

### DUSUP Restrictions in the Inner Zone:

The following developments are **NOT Permitted**:

- Residential (for developments of densities  $> 30$  buildings per km<sup>2</sup>)
- Vulnerable people, e.g. schools, hospitals, etc.
- Large shopping malls (Gross Leasable Area  $> 80,000$ m<sup>2</sup>)
- Tall multi-storey / high-rise buildings (Structures having a total height of occupiable or usable space of more than 23 Meters above the lowest grade or lowest level of Fire Service Access into that occupancy is categorized as a High-rise Building as per UAE fire and life safety code of practice)
- Sports stadia, etc.

### Dolphin (ADNOC) Interpretation of Criteria:

These refer to general playing fields where occasional presence of playing personnel are expected. These personnel are directly associated with the facility operations (recreational activities).

## 6.3 Middle Zone:

The middle zone is determined by an assessment of the risks and/or hazards of the installation using Location Specific Individual Risk (LSIR) criteria - LSIR is the risk indicator most frequently adopted for assessing the risk in LUP:

- DUSUP Middle Zone risk criteria =  $1.00E-05$  per year  $>$  LSIR  $>$   $1.00E-06$  per year
- Dolphin Middle Zone is defined as LSIR  $\leq 1.00E-06$  per year and development or use is set as “Light Industrial Activities. No development  $>$  25 persons”

#### DUSUP Restrictions in the Middle Zone:

The following developments are **NOT Permitted**:

- Vulnerable people, e.g. schools, hospitals, etc.
- Large shopping malls (Gross Leasable Area  $>80,000m^2$ )
- Tall multi-storey / high-rise buildings (Structures having a total height of occupiable or usable space of more than 23 Meters above the lowest grade or lowest level of Fire Service Access into that occupancy is categorized as a High-rise Building as per UAE fire and life safety code of practice).
- Sports stadia, etc.

#### Dolphin (ADNOC) Interpretation of Criteria:

- Light industrial set up may be permitted with number of workers not exceeding 25 (per km).

### **6.4 Outer Zone:**

The outer zone is determined by an assessment of the risks and/or hazards of the installation using Location Specific Individual Risk (LSIR) criteria - LSIR is the risk indicator most frequently adopted for assessing the risk in LUP:

- DUSUP Outer Zone risk criteria = LSIR  $<$   $1.00E-06$  per year
- Dolphin Outer Zone is defined as LSIR  $\leq 3.00E-07$  per year and development or use is set as “Residential. No developments  $>$  25 persons”

#### DUSUP Restrictions in the Outer Zone:

- No restriction to land use planning and development in the outer zone.

#### Dolphin (ADNOC) Interpretation of Criteria:

- Any industrial set up permitted.
- Residential development with more than 25 (per km) personnel is not permitted.
- Social gathering centres, Schools and Hospitals are not permitted

### **6.5 Unclassified Zone:**

Dolphin has an additional ‘Unclassified Zone’ - this is defined as LSIR  $\leq 1.00E-07$  per year and development or use is set as “Schools and hospitals”

#### Dolphin (ADNOC) Interpretation of Criteria:

- Any Residential development is permitted.
- Social gathering centres, Schools and Hospitals are permitted.

## **7 LAND USE PLANNING NOC PROCESS**

DUSUP requires developers of the plots within 500 meters from the corridor limit to obtain a DUSUP NOC Approval to proceed with the development as per the following process:



### 7.1 Information NOC:

Developer shall first apply for Information NOC to identify the development distance from the Hydrocarbon Pipelines and the LUP Zone(s) restrictions.

DUSUP require the developer to amend / adjust master development plan and/or plot development plan to comply with the restriction of the LUP Zone.

#### Documentation Required for LUP Information NOC:

NOC applicant shall submit the following documents:

- AutoCAD drawing on DLTM datum showing proposed project limit.
- Land Use Description.
- Master Plan for the development.
- Design quantities of permanent staff employees and general public (customers) expected for the development

#### LUP Information NOC Processing Time:

Expected Processing time for QRA related DUSUP Information NOC is 10 working days.

### 7.2 Design NOC:

DUSUP require developer to apply for design NOC with the amended plan that meets the LUP guidelines requirements for approval. After review and confirmation that the design complies with the LUP guideline, DUSUP will issue design NOC Approval.

#### Documentation Required for LUP Design NOC:

NOC applicant shall submit the following documents:

- PDF copy of project plan incorporating DUSUP pipeline information, including proposed building(s), amenities, type of use and expected population.
- AutoCAD drawing of project plan incorporating DUSUP pipeline information on DLTM datum, including proposed building layout, amenities, type of use and expected population.
- Cross section drawing showing the height of building and separation distance from DUSUP corridor.

#### LUP Design NOC Processing Time:

Expected processing time for QRA related DUSUP Design NOC is 15 working days (counted from the last submission/resubmission date to the date of approval)

### 7.3 Construction NOC:

Prior to commencing construction DUSUP require the contractor to apply for construction NOC based on the previously approved Design NOC. The construction NOC will also address any construction related conditions. DUSUP will ensure that the construction complies with the design NOC requirements and will issue Construction NOC approval with all applicable standard and specific conditions.

#### Documentation Required for LUP Construction NOC:

NOC applicant shall submit the following documents as per approved QRA:

- PDF copy of project plan incorporating DUSUP pipeline information, including proposed building(s), amenities, type of use and expected population.

- AutoCAD drawing of project plan incorporating DUSUP pipeline information on DLTM datum, including proposed building layout, amenities, type of use and expected population.
- Cross section drawing showing the height of building and separation distance from DUSUP corridor.
- QRA study report (if applicable)

#### LUP Construction NOC Processing Time:

Expected processing time for QRA related DUSUP Construction NOC is 7 working days.

### **8 CHALLENGING DUSUP LUP ZONE RESTRICTIONS:**

In case the developer wants to challenge the DUSUP / Dolphin LUP Restrictions that are based on DUSUP and/or Dolphin Energy Quantitative Risk Assessment data, the developer shall appoint a DUSUP and/or Dolphin Energy approved risk consultant to specifically study the planned development.

The DUSUP QRA methodology quantifies the risk arising from defined hazardous release scenarios from a pipeline or a group of pipelines (in corridors or corridor sections). The risk measure used to determine LUP zones is Location Specific Individual Risk (LSIR) which is the level of risk experienced by a hypothetical person who is in a specific location for 24 hours a day, 365 days a year. The pipeline LSIR figures are fixed, and cannot be altered by the Project Specific QRA. Only DUSUP may change the pipeline related LSIR figures, based on any changes to the pipeline operations. The project specific QRA shall instead identify the Individual Risk Per Annum (IRPA) figures, Societal risk (FN curves) and Possibility of Loss of Life (PLL) figures experienced by the human population related to the project as per the master plan, taking account of the population distribution of inhabitants, workers and customers etc. while also considering any mitigation measures to avoid exposure.

#### Considerations of Project Specific QRA:

- Risk consultant shall use DNV Phast and Safeti software version 8.22 (or later) to carry out the consequence and risk modelling, respectively. This is consistent with the current DUSUP QRA/FERA studies.
- The primary objective of the study is to conduct a Quantitative Risk Assessment (QRA) for the specific project, considering:
  - Evaluating the potential fire, flammable gas dispersion, and toxic gas dispersion hazards from potential loss of containment events from the in-scope pipelines;
  - Examining the frequency and consequences of each hazard using existing pipeline QRA data, and hence the associated risk, for each of the identified hazards;
  - Presenting the calculated Individual Risk Per Annum (IRPA), and Possibility of Loss of Life (PLL) figures for the expected population densities;
  - Determine the societal risk FN curve for agreed sensitive areas;
  - Evaluate the results against DUSUP and DEL LUP criteria; and
  - Provide recommendations as necessary for risk reduction.
- The technical assumptions used in the project specific QRA must be included in the Assumptions Register for review and approval by DUSUP and DEL.

#### Documentation Required for LUP Challenge:

NOC applicant shall submit the following documents:

- Project Specific Quantitative Risk Assessment (QRA) by approved Risk Consultant.
- The developer letter accepting the project specific QRA and its recommendations.
- Revised master plan incorporating the recommendation shall be submitted along with the project specific QRA.

Cost of Project Specific QRA:

Any direct or indirect cost for QRA study and implementation of recommendation must be borne by the developer.

LUP Challenge Time:

The Developer or Developers representative/consultant shall submit the QRA study report and recommendations within 90 days from the date of confirmation to challenge the DUSUP/DEL QRA requirements to avoid cancellation of NOC from e-NOC.

Expected processing time for QRA related DUSUP Construction NOC is 15 working days.