FUEL TANK RISK ANALYSIS

For an airport project, the main risk is from the storage of Aviation Turbine Fuel (ATF) in fuel tanks. Installation and operation of ATF storage tanks facility is proposed at Mundra Airport. The airport fuel shall be received from Jamnagar refinery and nearby areas on a daily basis by tankers. Fuel farms are an efficient way to provide storage and dispensing of aviation fuels to multiple users at an airport. The fuel farm is the heart of an airport fuel delivery system. A fuel farm, however, is part of a larger fuel storage and distribution system that moves fuel from off-airport suppliers through storage tanks and into aircraft.

Accidental leakage may take place from tanks if a hole is formed or it ruptures. The rate of release of fuel from tank will depend on the size of hole. After leakage, it may form a pool or the tank may explode.

There may be various scenarios:

1. Toxic release from pool
2. Inflammable vapour formation causing vapour to burn.
3. Inflammable vapour formation causing vapour to explode.
4. Pool is under fire
5. No pool but the tank explodes causing fireball

SUMMARY OF HAZARDS

Leaking Tank, Chemical is not burning & forms an evaporating puddle	Toxic Area of Vapour Cloud
	Flammable Area of Vapour Cloud
	Blast: Vapour Cloud Explosion
Leaking Tank, Chemical is burning & forms a pool fire.	Thermal radiation
BLEVE, tank explodes & Chemical burns in a fireball.	Thermal radiation

In the present case, a prediction has been done assuming most unfavourable meteorological condition like low wind speed of 1 m/s and stable atmospheric condition F.

Assuming a hole of 10 centimetre at a height of 1m from bottom of tank, the following calculations have been done:

CASE A: CHEMICAL IS NOT BURNING & FORMS AN EVAPORATING PUDDLE

Chemical Data:

Chemical: Aviation Fuel

Nearest Chemical Name: N-OCTANE	CAS Number: 111-65-9
Molecular Weight: 114.23 g/mol	PAC-1: 230 ppm
PAC-2: 385 ppm	PAC-3: 5000 ppm
IDLH: 1000 ppm	LEL: 9600 ppm
UEL: 65000 ppm	Ambient Boiling Point: 125.6° C
Vapour Pressure at Ambient Temperature: 0.027atm	Ambient Saturation Concentration: 27,103 ppm or 2.71%

Source Strength:

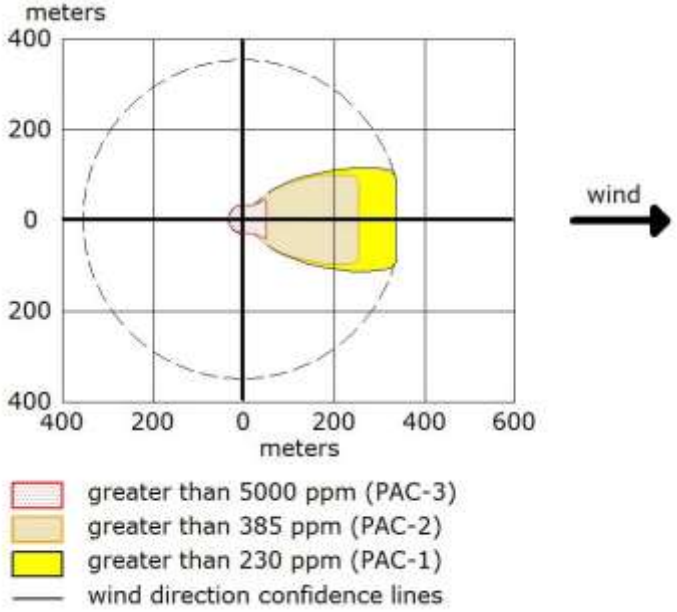
Leak from short pipe or valve in vertical cylindrical tank	Circular Opening Diameter: 10 centimetres
Opening is 1 meters from tank bottom	Flammable chemical escaping from tank (not burning)
Release Duration: ALOHA limited the duration to 1 hour	Max Average Sustained Release Rate: 64.4 kilograms/ min (averaged over a minute or more)
Total Amount Released: 2,268 kilograms	The puddle spread to a diameter of 82 meters.

Note: The chemical escaped as a liquid and formed an evaporating puddle

PART I: TOXIC AREA OF VAPOR CLOUD

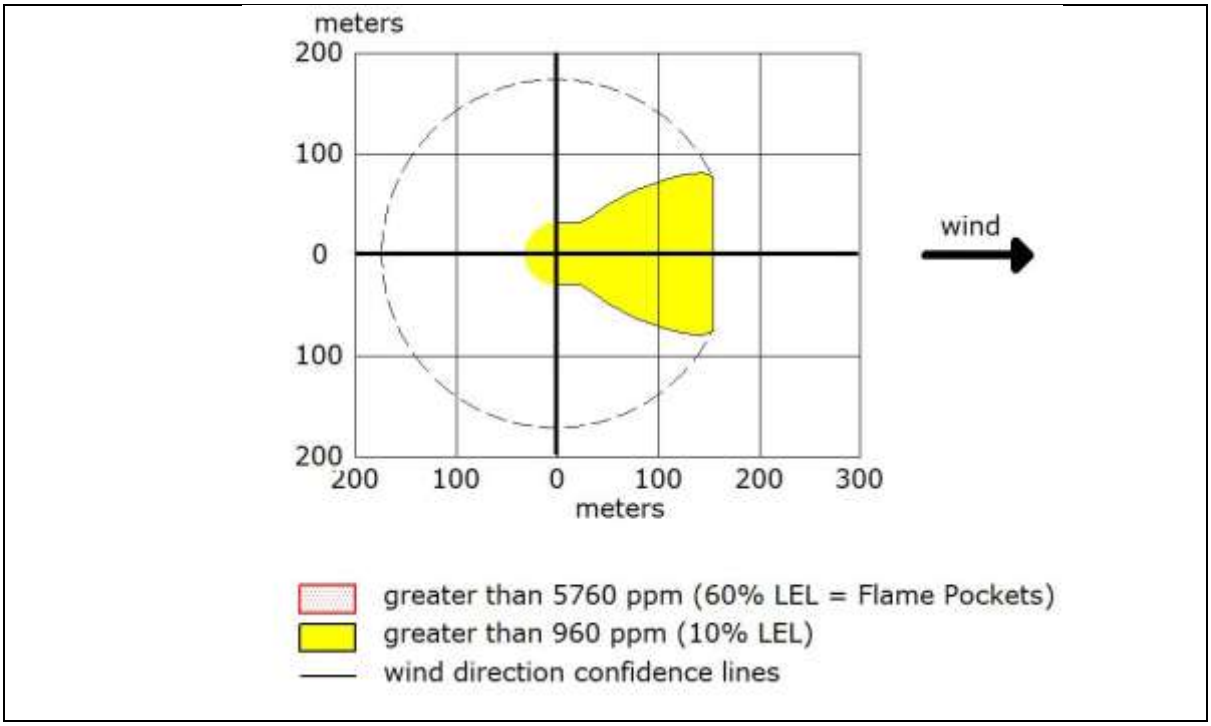
Threat Zone

Model Run: Heavy Gas	Red : 53 meters --- (5000 ppm = PAC-3)
Orange: 257 meters --- (385 ppm = PAC-2)	Yellow: 340 meters --- (230 ppm = PAC-1)



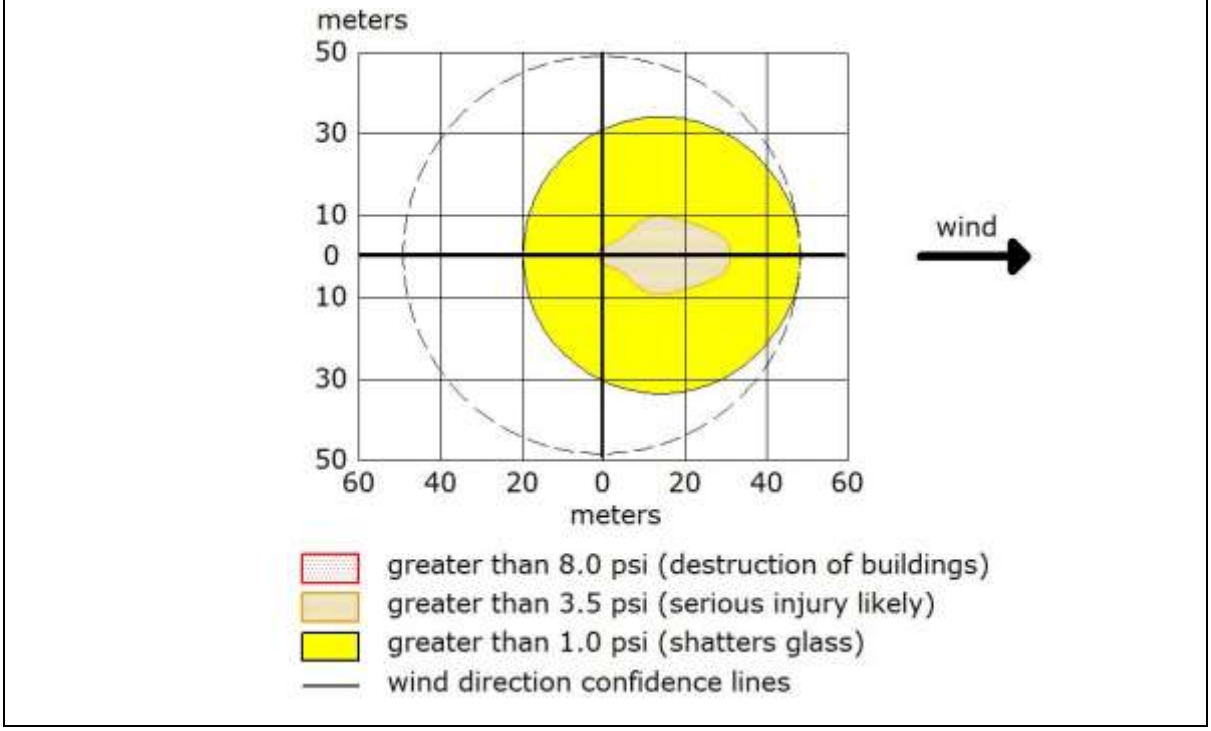
PART II: FLAMMABLE AREA OF VAPOR CLOUD

Model Run: Heavy Gas
Red : 49 meters – (5760 ppm =60% LEL = Flame Pockets)
Yellow: 155 meters --- (960 ppm = 10% LEL)
Note: Threat zone was not drawn because effects of near-field patchiness make dispersion predictions less reliable for short distances.



PART III: BLAST AREA OF VAPOUR CLOUD

Model Run: Overpressure (blast force) from vapour cloud explosion
Red: LOC was never exceeded --- (8.0 psi = destruction of buildings)
Orange: 32 meters – (3.5 psi = serious injury likely)
Yellow: 49 meters --- (1.0 = shatter glass)



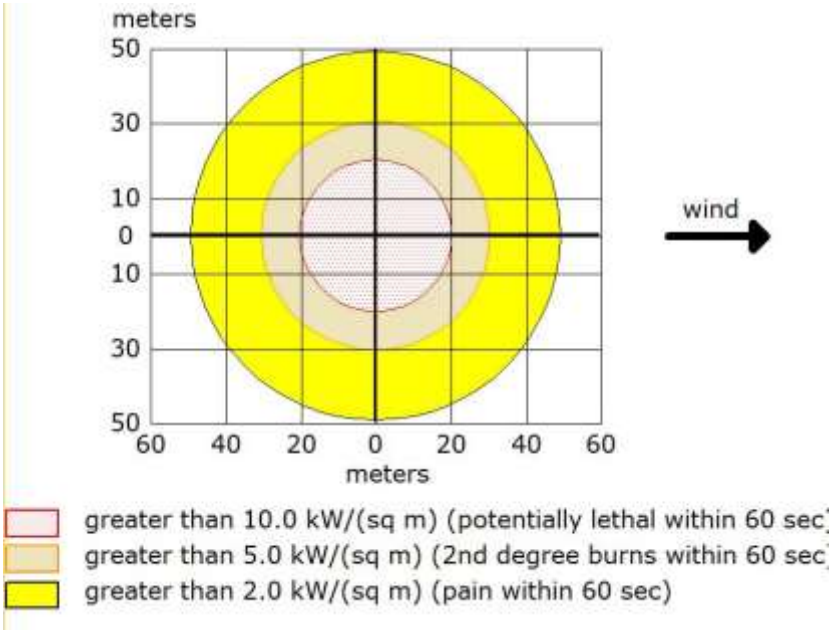
CASE B: LEAKING TANK, CHEMICAL IS BURING AND FORMS A POOL FIRE

THERMAL RADIATION FROM POOL FIRE

Red : 20 meters --- (10.0 kW/(m^2) = potentially lethal within 60 sec)	Orange: 30 meters --- (5.0 kW/(m^2) = 2nd degree burns within 60 sec)
Yellow: 49 meters --- (2.0 kW/(sq m) = pain within 60 sec)	

Source Strength

Leak from hole vertical cylindrical tank	Circular Opening Diameter: 10 centimeters
Opening is 1 meters from tank bottom	Flammable chemical is burning as it escaping from tank
Burn Duration: ALOHA limited the duration to 1 hour	Max Burn Rate: 342 kilograms/min
Total Amount Burned: 20,325 kilograms	The puddle spread to a diameter of 9.2 meters.



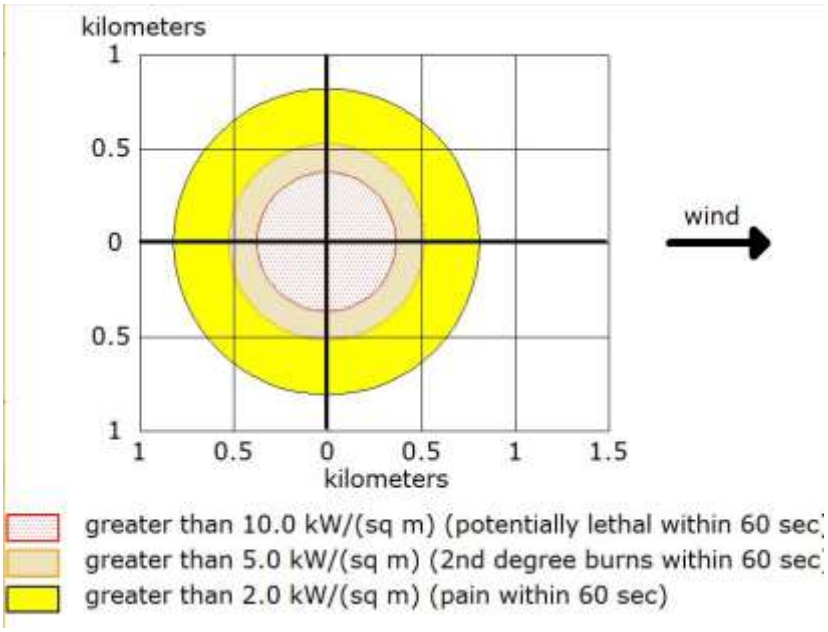
CASE C: BLEVE, TANK EXPLODES & CHEMICAL BURNS IN A FIREBALL

Threat Zone

Threat Modelled: Thermal radiation from fireball	Red: 371 meters --- (10.0 kW/(sq m) = potentially lethal within 60 sec)
Orange: 524 meters --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)	Yellow: 817meters --- (2.0 kW/(sq m) = pain within 60 sec)

Source Strength

Leak from hole vertical cylindrical tank	Circular Opening Diameter: 10 centimeters
Opening is 1 meters from tank bottom	BLEVE of Flammable liquid in vertical cylindrical tank
Fireball Diameter: 172 meters	Burn Duration: 11 Seconds



Summary For Aloha Results

Situation		Affected Distance (m)		
		Red	Orange	Yellow
Leaking Tank, Chemical is not burning &forms an evaporating puddle	Toxic Area of Vapour Cloud	53	257	340
	Flammable Area of Vapour Cloud	49	-	155
	Blast: Vapour Cloud Explosion	-	32	49
Leaking Tank, Chemical is burning & forms a pool fire.	Thermal radiation	20	30	49
BLEVE, tank explodes & Chemical burns in a fireball.	Thermal radiation	371	524	817

Interpretation: It has been interpreted that the worst case scenario will be explosion of tank and the chemical will burn in a fireball (BLEVE). The maximum distance till where the effect of accident can be seen, will be up to a distance of 817m.

Therefore, it requires immediate evacuation of population up to 817m and provide immediate medical facilities for injured persons as mentioned in Disaster Management Plan.

The ATF Safety data sheet is attached as **Annex 7.1**.

7.1.1 Risk Mitigation Measures

The risk mitigation measures for the proposed Mundra airport are as given below:

- Prompt action in the event of an accidental release of ATF is essential.
- Where there is a possibility of a flammable liquid spill, provisions will be made to ensure as follows:
  (i) The spread of the spill is limited
  (ii) Non-flammable absorbent material is available for immediate use;
  (iii) Ignition sources can be quickly removed
  (iv) The area is well ventilated

- Routine testing and inspection will be carried out for storage area, hoses and fueling tanker and record will be maintained.
- Leakages from tanker may be prevented by a suitable regime of preventive maintenance and inspection.
- Heat and smoke detectors will be provided at strategic locations.
- Adequate fire-fighting facilities will be provided near storage and handling of ATF.
- Fire-
- fighting facilities will be tested as per schedule.
- Ground staff near aircraft will be trained to take measure in the event of spillage and during fire emergency.
- Fueling in Aircraft and DG sets 'day tank' will be done under the supervision of trained operators.
- Open vents will be provided of goose neck type, covered with a 4 to 8 mesh screen to discharge the vapours of hydrocarbons from storage tanks.
- Every storage tank and tanker, including all metal connections, will be effectively earthed.
- Static grounding of aircraft will be ensured whenever the aircraft is parked; including during refueling and defueling.
- Check list for operators for checking safety system and equipment will be prepared and check records kept in safe custody.
- The critical operating steps will be displayed on the board near the location where applicable.
- Thermal Safety Valve (TSV) will be provided at the operating manifold (outside dyke).
- Standard Operating Procedure (SOP) will be followed while unloading or fueling the aircraft.
- Mock drill will be conducted in every three months involving all concerned agencies.
- All concerned agencies will be provided Disaster Management Plan and regular interaction will be made.