

# **Natural Gas Migration Hazards Associated with Underground Gas Storage Facilities**

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# OVERVIEW OF DANGERS OF UNDERGROUND GAS STORAGE

One of the gravest dangers posed by underground gas storage facilities is the potential for natural gas to migrate through the geologic formation to the surface creating an explosion hazard. These hazards are particularly important to be considered in urban environments where the explosion of gas can cause serious harm to people. The Playa Vista project, which involves several thousand people and commercial development, must fully consider these problems. An example where these problems were not addressed, would be the Fairfax area and the unfortunate gas explosion injuring 23 people and causing many fires.

In summary, development of this area should not be considered unless all questions of public safety can be answered. Continuous soil gas monitoring must be a requirement if this project is permitted to progress. There should be no permission to build any structures over abandoned oil wells. All abandoned wells in the area should be accurately located and continuously monitored for gas leaks.

In 1985, a natural gas explosion in the Fairfax district of Los Angeles injured 23 people. Seeping gas burned for days through cracks in the sidewalks, paving and in and around foundations. This area is located directly over an oil and gas field. As a result of this explosion and fire, building codes were altered in this area requiring gas monitoring and special ventilation in existing commercial buildings. Imperious barriers were placed under new construction. Unfortunately, the safeguards have proven to be only partially effective.

Over 300 underground natural gas storage projects are operated throughout the United States. Many years of operational experience at these projects has established that vertical gas leakage to the surface is a serious problem. Several explosions from this migrating gas have occurred. *In conclusion, no structures should be built over these storage projects.*

There are four gas storage projects in the southern California area: Whittier, Montebello, Playa Del Rey and Honor Rancho. All of these projects have experienced problems. The Whittier field has been closed. The Montebello field has had numerous gas leakage problems resulting in litigation and requiring the gas company to purchase several homes. Playa Del Rey has had a long history of documented gas migration from the storage reservoir along with many complaints from surface owners of noxious odors. Honor Rancho has had gas leakage problems along faults into a nearby Tapia Oilfield and gas has been observed

bubbling up in a nearby water reservoir. Again, *based upon the experiences in southern California alone, gas storage projects should not be located in urban areas.*

Under no circumstances should structures be permitted to be built over abandoned wells, particularly when the reservoir that they penetrate is subject to repressurization by free gas. To protect existing structures in an area subject to vertical gas migration, a gas migration and soil gas monitoring program is required to mitigate the hazard.

Furthermore, the migrating gas contains hazardous carcinogenic chemicals consisting of benzene, toluene and mercaptans. The effect upon local residents and the environment needs to be addressed. The gas company has acknowledged dumping thousands of cubic feet of natural gas every month, which is vented to the atmosphere.

*In summary, the above listed safety and health hazards have not been addressed in the environmental impact report for the Play Vista development. The report should be rejected.*

# **Natural Gas Hazards**

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## **A. Subsurface gas migration (Explosion Hazard at 5 to 15% by volume with air)**

- (1) Confined spaces of buildings.
- (2) Vaults, tunnels, sewers.
- (3) Entrapment below paved areas.
- (4) Entrapment in secondary collector zones

## **B. Emissions from Processing Plant.**

- (1) Noxious odors

## **C. Carcinogenic Chemicals**

- (1) Benzene
- (2) Toluene
- (3) Odorization Agents (sulfur compounds)
- (3) Other

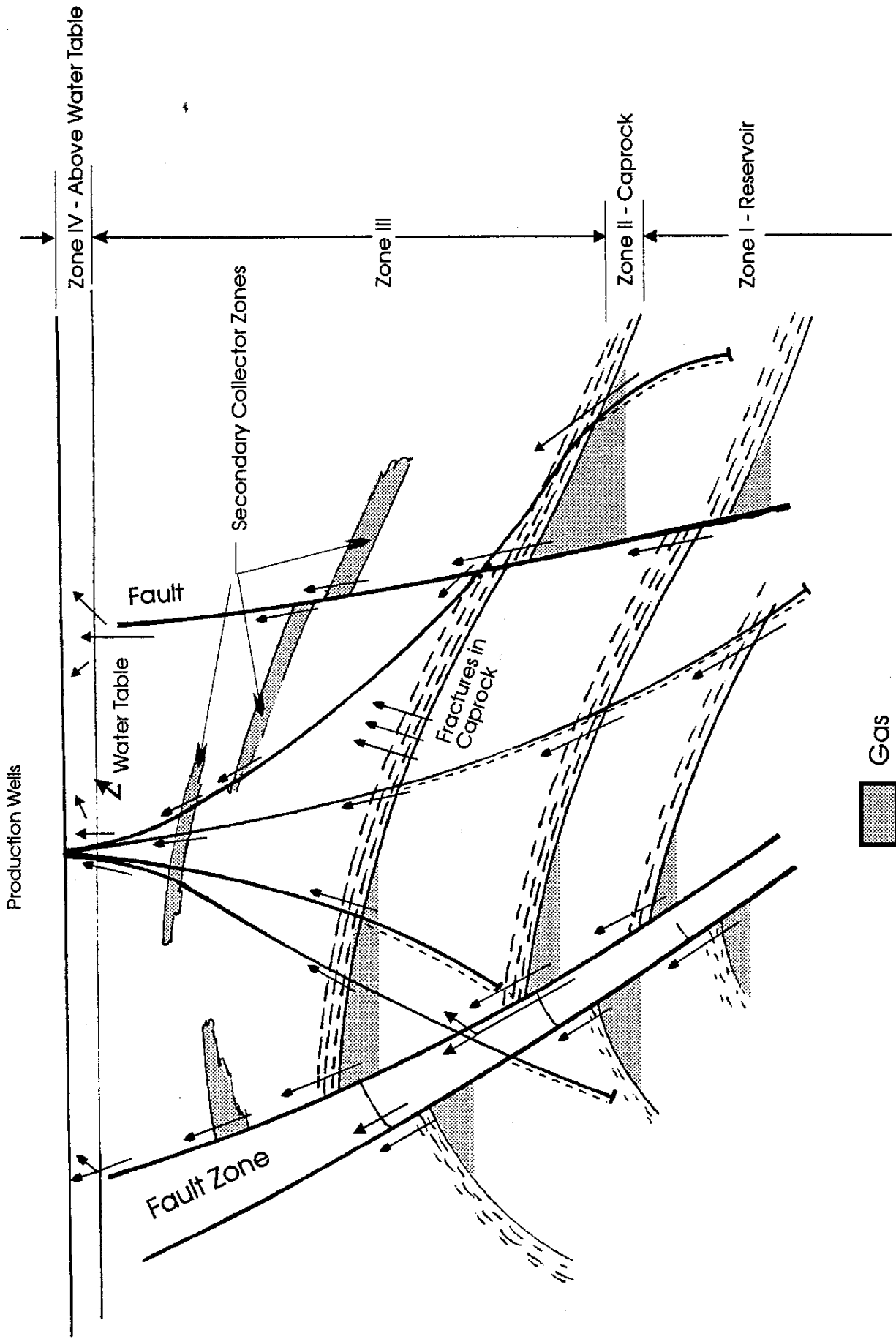
# Potential Paths of Gas Migration

## **Natural:**

- a) Faults
- b) Fracture Systems

## **Man Made:**

- a) Existing producing wells
- b) Abandoned well bores
- c) Fracture systems generated by overpressuring and cyclic pressurizing.



# POTENTIAL PATHS OF GAS MIGRATION

# **Problems Generated**

**by  
Underground Gas Storage  
Facilities**

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Playa Del Rey Oil Field, California

Montebello Oil Field, California

Salt Lake Oil Field, California

El Segundo Oil Field, California

Honor Rancho Oil Field, California

Huntsman Gas Field, Nebraska

Herscher Gas Storage, Illinois

Mont Belvieu Gas Storage, Texas

Brenham, Texas

Leroy Gas Storage, Wyoming

# Playa del Rey Oil Field

**Depth:** 5400' to 6400'

## **Problems:**

Massive gas leakage from the storage area.

Numerous complaints by landowners regarding gas seepage into their homes.

Noxious odors from processing facilities.



# Montebello Oil Field Los Angeles, California

**Depth:** 5000' to 7000''

## **Problems:**

Leaking gas required evacuation of families on numerous occasions.

Several homes had to be purchased by the gas company when well bore leaks could not be fixed without tearing down the homes.

# **Salt Lake Oil Field Los Angeles, California**

**Depth:** 2500' to 5000'

## **Problems:**

- 1) 1.2 billion cubic ft. of gas was injected into the formation and lost.
- 2) Well blow outs occurred, endangering hundreds of people and caused major damage.
- 3) Fairfax gas explosion and fire injuring 23 people.

# **El Segundo Oil Field Los Angeles, California**

**Depth:** about 3000'

**Problem:**

Gas and propane storage resulted in leaks into the geological formation. A housing development was threatened resulting in the need to install an \$8 million gas venting system.

The storage field was then closed.

# Honor Rancho

Depth: 8,000' to 10,000'

## Problems:

Migration of gas along faults from the storage project into the nearby Tapia Oil Field.

Gas has been noted bubbling up in a nearby water reservoir.

# Huntsman Gas Storage Facility Southwestern Nebraska

**Depth:** 4800' - depleted gas field

**Problem:**

Gas leakage occurred from the field into an adjoining oil and gas producing field operated by a different company.

Large lateral gas migration occurred through the geological structure which had been erroneously thought to be impossible.

# Mont Belvieu, Texas

**Depth:** Salt Dome

**Problem:**

A gas leak caused the evacuation of 50 families from the city located over the storage field. A housewife was burned from a flash fire caused by high levels of gas that seeped into her home.

The event caused severe financial difficulties for the city that had to pay for housing and lodging.

# Brenham, Texas

**Depth:** Salt Dome

## **Problem:**

A gas leak in an underground storage project killed a 6-year old boy and injured 19 people. The blast destroyed many structures, and registered a near 4 on the richter scale.

The gas leak was detected an hour before the explosion, but this was not sufficient time to prevent the devastation that followed.

# Leroy Gas Storage Facility

**Depth:** 2950' -- Aquifer Storage

## **Problem:**

- 1) Gas Leakage to the surface.
- 2) Well corrosion problems causing gas migration problems about well bores.
- 3) Fault plane interaction facilitating gas migration to the surface.

## **Comment:**

Gas migration was confirmed on the surface by bubbling gas in the adjacent creek and pond.



# Recommendations

- 1) No structures should be built over gas storage projects.
  - a) Soil gas monitoring and hazard analyses are necessary to establish distance restrictions.
  - b) Gas detection, special ventilation and subsoil barrier construction is required in perimeter areas.
- 2) No structures should be built over abandoned wells.
- 3) Continuous gas monitoring for leakage, and evaluation of well integrity is required to assure protection of existing structures and people.
- 4) Evaluation of exposure to hazardous chemicals including benzene, toluene and mercaptans associated with the gas storage project is required.

# Conclusions

- ◆ Underground gas storage facilities have demonstrated a long history of gas migration problems.
- ◆ Experience has shown that gas storage facilities can create a serious risk of explosion and fire, especially when located in an urban setting.
- ◆ The theory of gas storage within geologic formations does not take into consideration the many real world problems such as fracture zones and imperfections in the geologic layers that will result in the migration of gas toward the surface.
- ◆ It is a virtual impossibility to assure that there will not be migration of gas to the surface.
- ◆ Noxious odors and emissions of carcinogenic chemicals from the gas storage operations can create serious environmental concerns.