



Major Hazard Risks

Prevention or Mitigation



IndianOil

GB Tolmare, DGM (HSE)

**Conference on Safety for sustainable manufacturing growth
& FICCI Safety excellence awards – 14th July 2011**



Major Hazard Risks

Toxic Gas Release

Vapour Cloud Explosions

Gas / Hydrocarbon Fires

Prevention OR Mitigation

Major Accidents

Vapour Cloud Explosions

Flixborough (1974)



Mexico (1984)



Piper Alpha 1988



Pasadena 1989



**Few
Major
Accidents**

**Feysin
1966**

**Vapour
Cloud
Explosions**

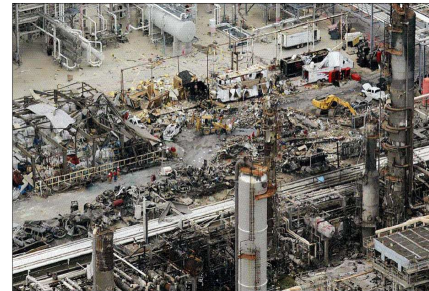
Esso Longford (1998)



Toulouse (2001)



BP Texas (2005)



Buncefield (2005)



Vapour Cloud Explosions

**Nov 1988
BPCL, Mumbai**

**Nov 1991
IPCL, Nagothane**

**1997
Vaizag refinery**

**1999
Panipat refinery**

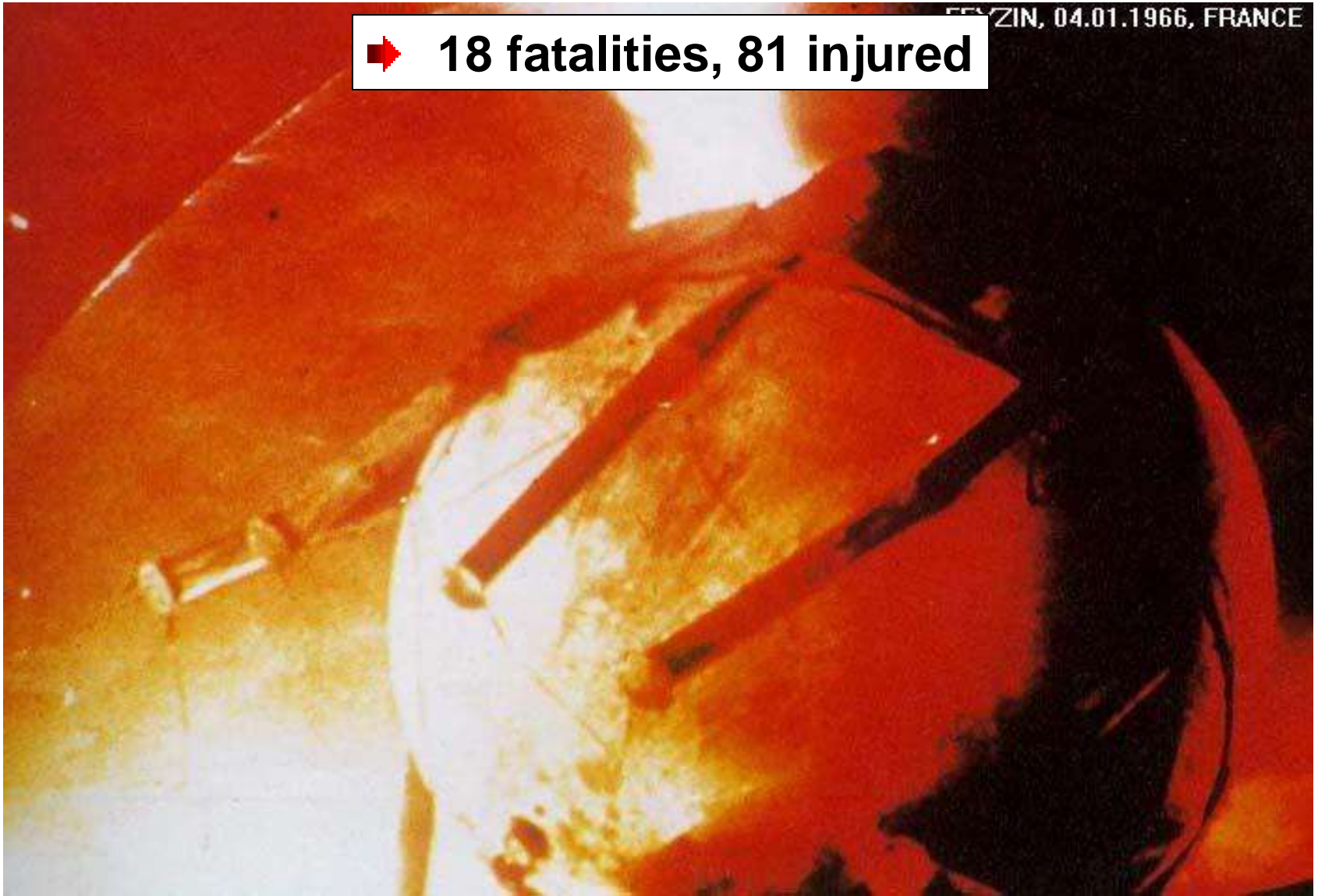
**2004
Gujrat Refinery**

**2009
jaipur Terminal**

1966 (4th January) - Feyzin, France

► **18 fatalities, 81 injured**

FYZIN, 04.01.1966, FRANCE



1974 (1st June) - Flixborough

➡ 28 fatalities, 36 injured

ROUGH, 01.06.1974,
UK



1984 (19th Nov)) – Mexico (Pemex LPG Terminal)

► 500 fatalities, Terminal destroyed



1988 – Piper Alpha

➡ 167 fatalities, Platform destroyed



1989 (23rd Oct) – Pasadena

➡ 23 fatalities, Over 130 injured

23.10.1989, USA



1998 (25th Sept) – Esso Longford

➡ 2 fatalities, 8 injured



Explosion
Abnormal operating condition

Toulouse

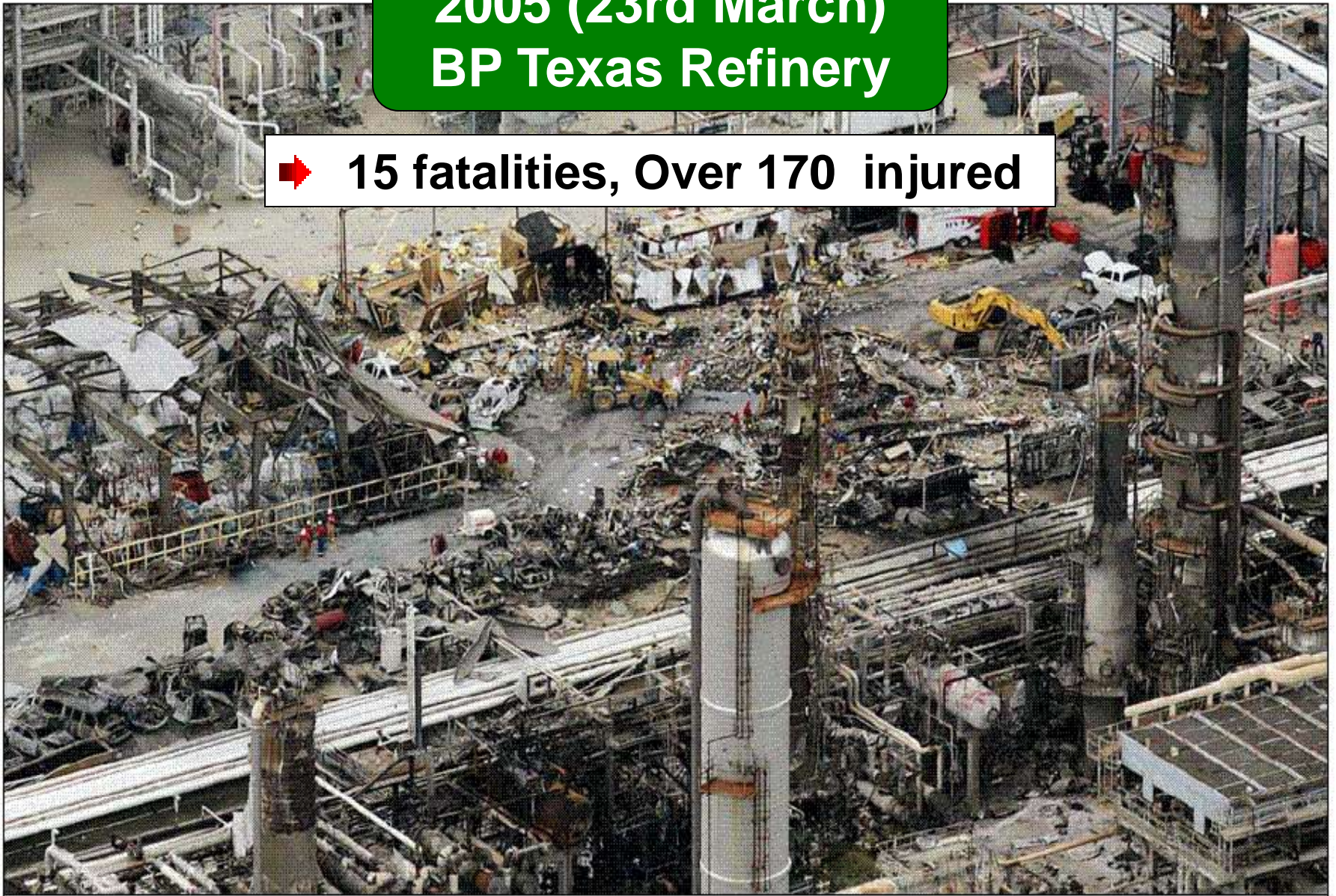
21st September 2001

➡ 31 fatalities, 2442 injured



2005 (23rd March) BP Texas Refinery

➡ 15 fatalities, Over 170 injured



1999 Thai refinery

➡ 7 fatalities



2009 (23rd Oct) - Puerto Rico

▶ **Fatality Nil, One minor injury**

Normal Tank filling operation



2005 (11th Dec) – Buncefield

➡ Fatality Nil, 43 injured



Major Accidents - Fall outs



Major Accidents - Fall out

Low freq / High consequences events

Remember !!!

All efforts are of questionable value
if ultimate objectives are not achieved

Options – Prevent OR Mitigate

Will mitigation approach help?

No easy answers.
You are judged on the basis of
what you did, and not what you said.

VCE Incidents

- Typical aspects**

Vapour Cloud Explosions



Prevention OR Mitigation - Remember
All efforts are of questionable value
if ultimate objectives are not met

- Anger in the local community,
- Intense regulatory scrutiny,
- Litigation,

- Massive media coverage, and
- Attacks on motives, competence and commitment to safe operation

Mitigation

What did we do so far?

**More on mitigation !!!
(Fire Fighting Measures, Detectors, CCTV)**

**Full Drive / Attention
at all levels**

**Will mitigation take care of media
attention, community anger & litigations.**

Mitigation Measures- Issues

**Fire Fighting Efforts
Big Dimensions !!!**

**Will detection help?
Smoke! Fire! Gas/HC**



Fire Fighting Efforts - Buncefield

4



(4) Large-volume monitors and large-diameter hose are required to battle a large tank fire.

Fire Fighting Efforts - Buncefield

**Fire subsequent to VCE for 5 days.
600 fire fighters fought the inferno.**

**Huge quantity of water / foam required
Foam 786 KL Water 68 Million Liters**

**Fire fighting appliance mostly deployed
“High Volume Long Range Monitors”**

Are they proven / effective?

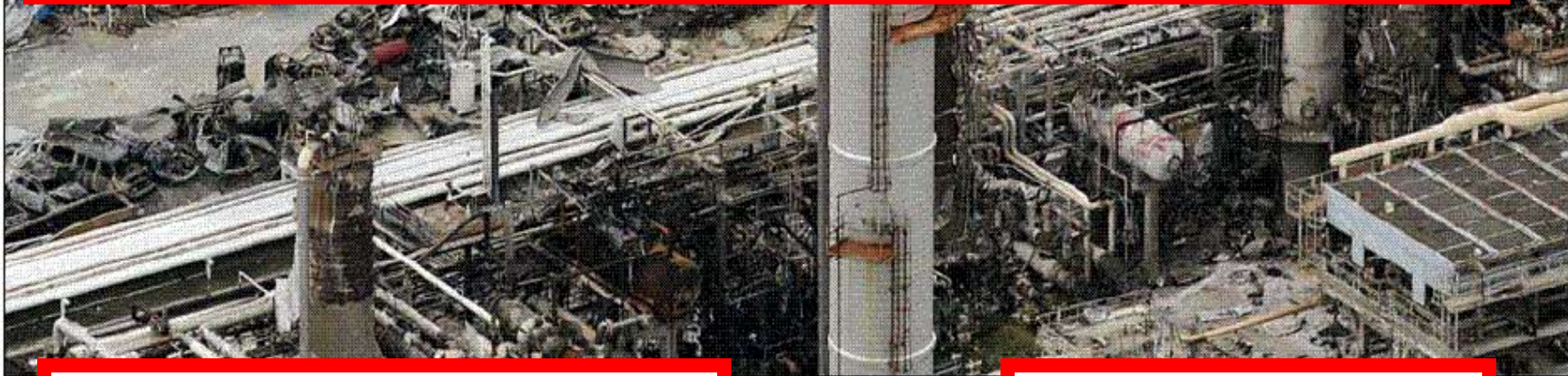
**Are there success stories elsewhere?
Thai Refinery 1999 / Puerto Rico 2009 (3 days)**

Six primary pumps each with two 6” hoses plus three booster pumps; four hydrosubs; 30 km (18 miles) of 6” hose; operated 24 hrs/day for five days at average 25,000 lpm (ca 7,000 GPM) with peak of 42,000 lpm (8500

Gas / Hydrocarbon Detectors

Area of concern

- Will industry trend of detector placement meet objective?
- Will there be detection before significant release / hazard?



Ignition

- Mostly immediate / shortly after release

Presence of people

- Mostly in all VCE incidents

Prevention What to do?

Prevention - What to do?

**Buncefield 2005
– Tank overflow**



2005 (11th Dec) – Buncefield

- ➡ No fatality (Sunday). 43 injured (None seriously)
- ➡ Tank overfilling. **High level protection did not act.**
- ➡ **300 tons gasoline in 30 minutes.**
- ➡ Explosion followed by fire.
- ➡ Simultaneously fire in 20 other tanks
- ➡ More than 600 fire fighters fought the inferno which lasted for three days.
- ➡ More than 200 people evacuated

Buncefield after the incident – Close up



Figure 6 Buncefield after the incident: Tank 912 is in the centre foreground and Tank 12 is in the top left of the picture © Chiltern Air Support

Buncefield 2005



Buncefield Oil Depot

What happened

**300 tons gasoline
overflow in 30 minutes**

- ▶ Incident involved overfilling of a large storage tank with petrol supplied through a pipeline.
- ▶ As the petrol flowed over the topside of the tank, it formed a large vapour cloud that subsequently ignited.

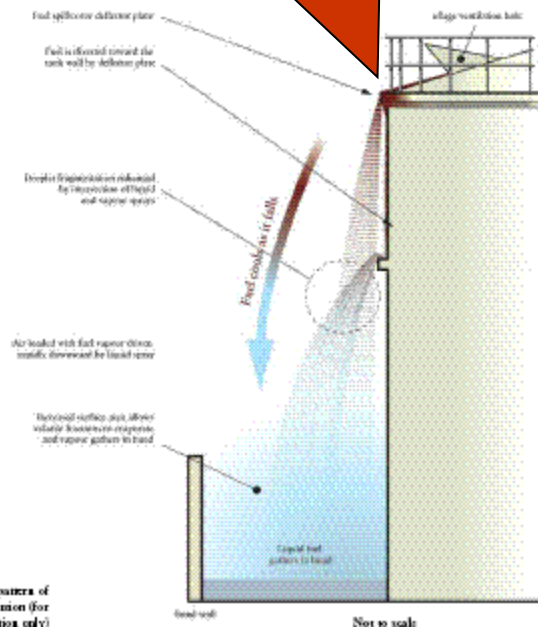


Figure 2 The pattern of fuel dispersion (for illustration only)

2005 (11th Dec) – Buncefield

Matters that matter

Basis : HSE Report

Why did Buncefield happen?



Buncefield – Matters that matter



► Prevention of primary release
(Attention not as warranted)

► No MOC – Why? Why?? Why???
Change that affects safety

► Buncefield SMS

► PSM Principles / Tenets

2005 (11th Dec) – Buncefield

Matters that matter

- **Prevention of primary release**
- **Attention not as warranted**



Buncefield 2005

What happened?

- No means to alert control room operators.
- Supervisors relied on alarms to control filling process.
- Tank overfilled. Vapour cloud formed . Massive explosion

Alarms

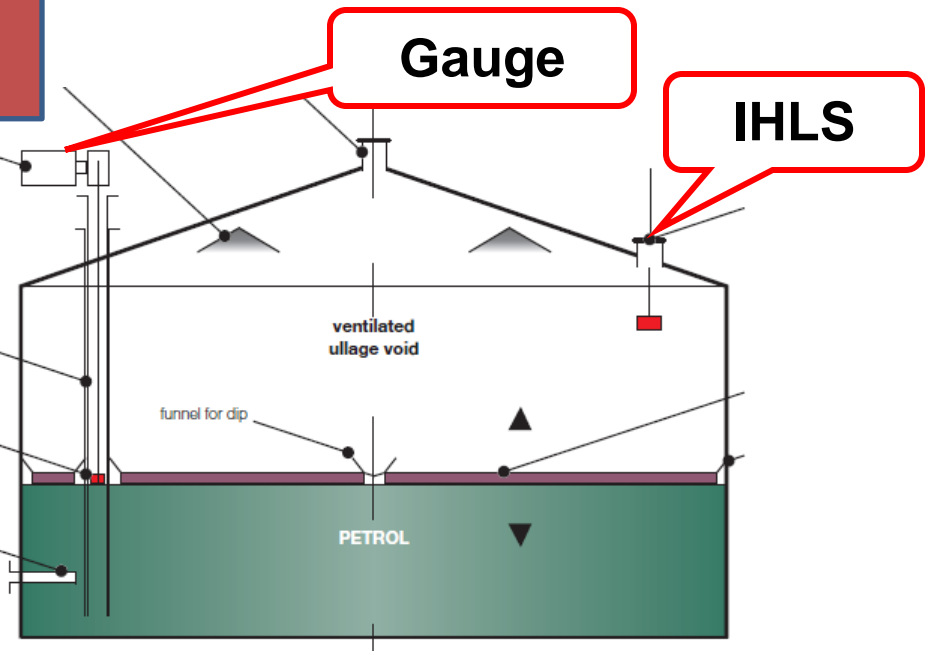
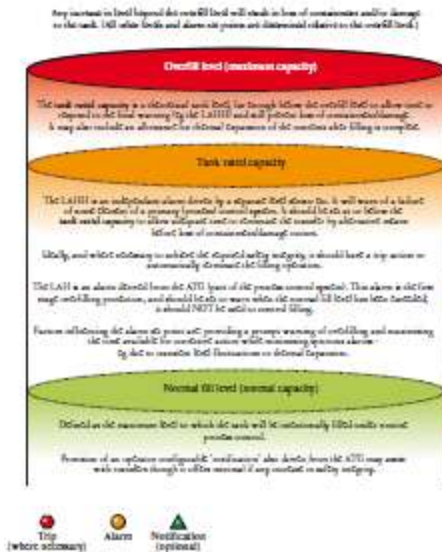
Level High-High

Level High

User set

Gauge

IHLS

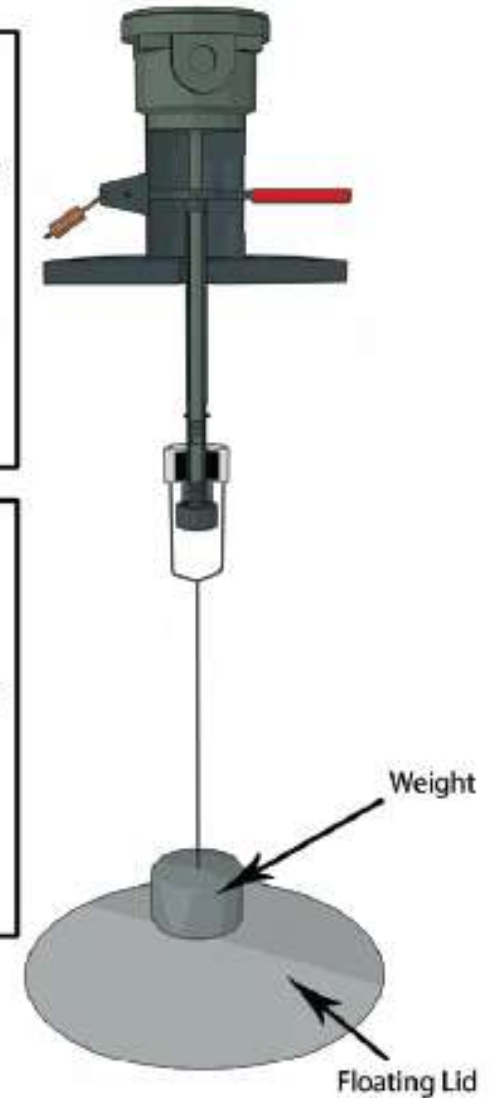
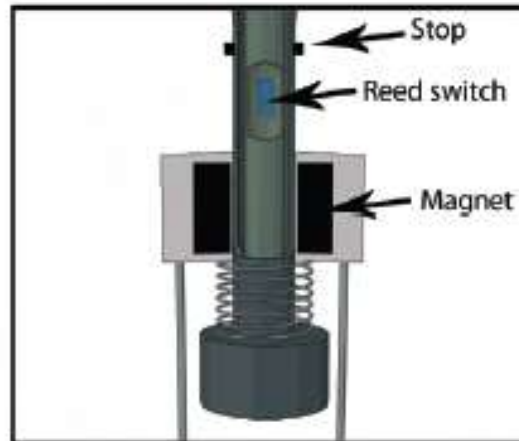
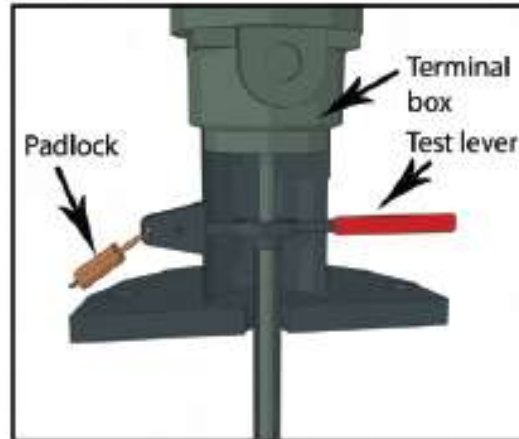


TAV IHLS Switch

Padlock to retain check lever in working position

Padlock not for security
Anti tamper proof

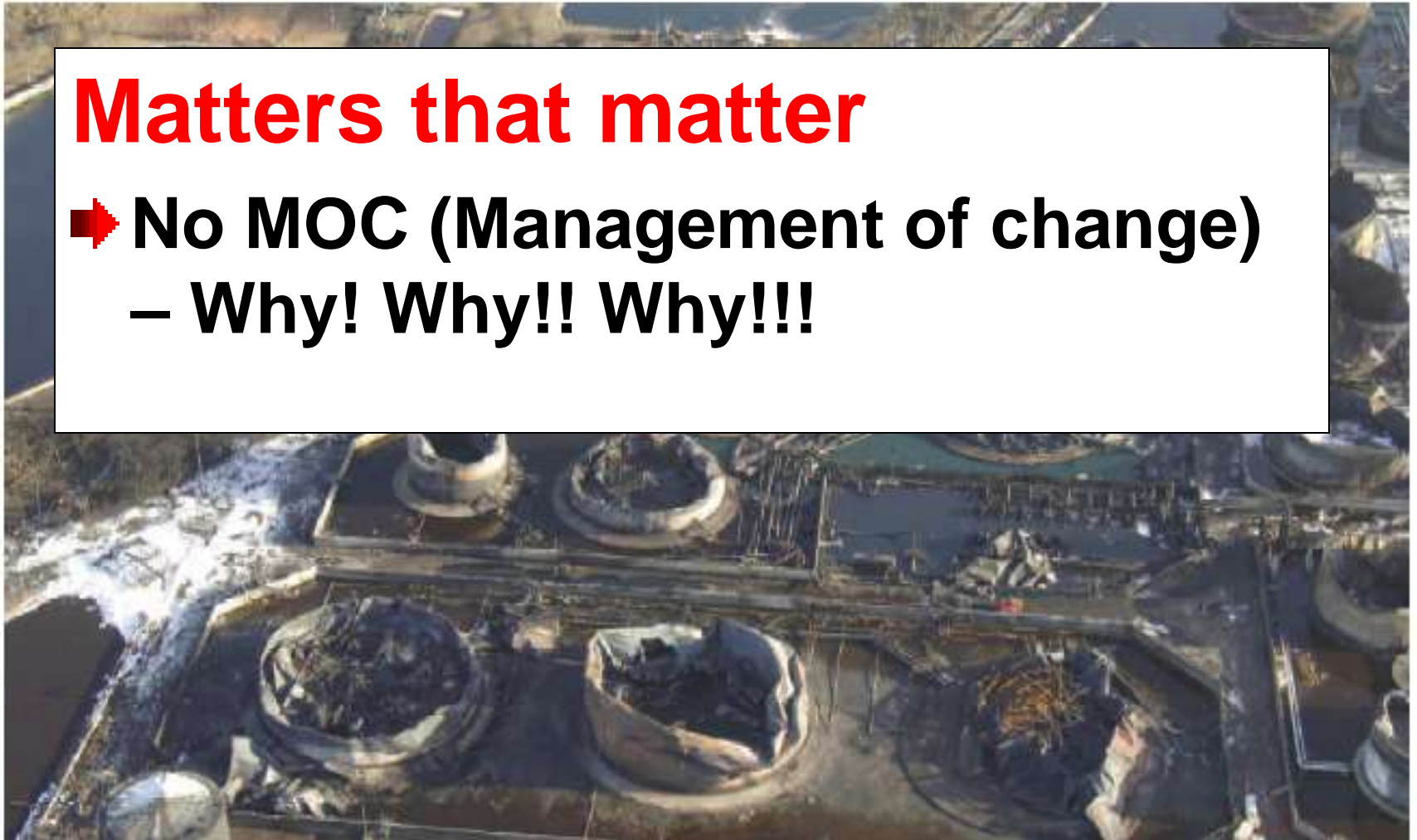
Padlock not fitted
after test



2005 (11th Dec) – Buncefield

Matters that matter

- ➡ **No MOC (Management of change)
– Why! Why!! Why!!!**



2005 (11th Dec) – Buncefield

Matters that matter - Why no MOC?

- IHLS not working (4 months) – Tank 912 kept in operation
- IHLS not working (9 months) – Tank 911 kept in operation

- IHLS design intent : Primary containment
- Design intent : Not protected

Remember

- MOC does not mean interlock / protection bypass



Understand Design Intent

Protect Design Intent



Take care of MOC

Not only interlock & protection bypass

2005 (11th Dec) – Buncefield

- ➡ Focus not only on personal safety
- ➡ Focus on Primary containment

2005 (11th Dec) – Buncefield

Matters that matter

➡ PSM Principles / Tenets



PSM – Principle / Tenets

➡ There should be a **clear** understanding of major accident risks and the safety critical equipment and systems designed to control them.

➡ There should be systems and **a culture** in place to detect signals of failure in safety critical equipment and to respond to them quickly and effectively.

➡ **If understanding & culture then no problems**

➡ **Why did Buncefield happen?**

Absence of clear understanding and Culture

➡ **Ensure clear understanding & Culture**

- Senior management down to shop floor

Points to ponder

- ➡ **Is there a clear understanding?**
(SCEs for major hazard risks & their design)
- ➡ **IHLS not operative : Design not understood**

- ➡ **Is there a culture/ system to manage SCEs?**
(Detection of SCEs failure & quick response)
- ➡ **Gauge stuck up problem 14 times in 4 months**
(No attempt to identify definitive cause)

Points to ponder

► **Understanding & culture exists for PSV (SCE)**

Attention / Drive at all levels

Reason : Perception (fear) of hazard / risk

Does it commensurate with hazard / risk

► **Less Attention / Drive at all levels for other SCEs**

(Level alarms, ROVs, Remote Switch-off, Dykes)

Reason : Poor understanding of hazard / risks

Shift in understanding and culture for other SCEs

Story same in oil industries worldwide

Safety Critical Equipment



Do they get attention as warranted
Understand SCEs

Matters that matter – Attention / Drive

Focus not on primary containment

Vapour Cloud Explosions
Tank / Column overflow

2005
BP Texas Refinery

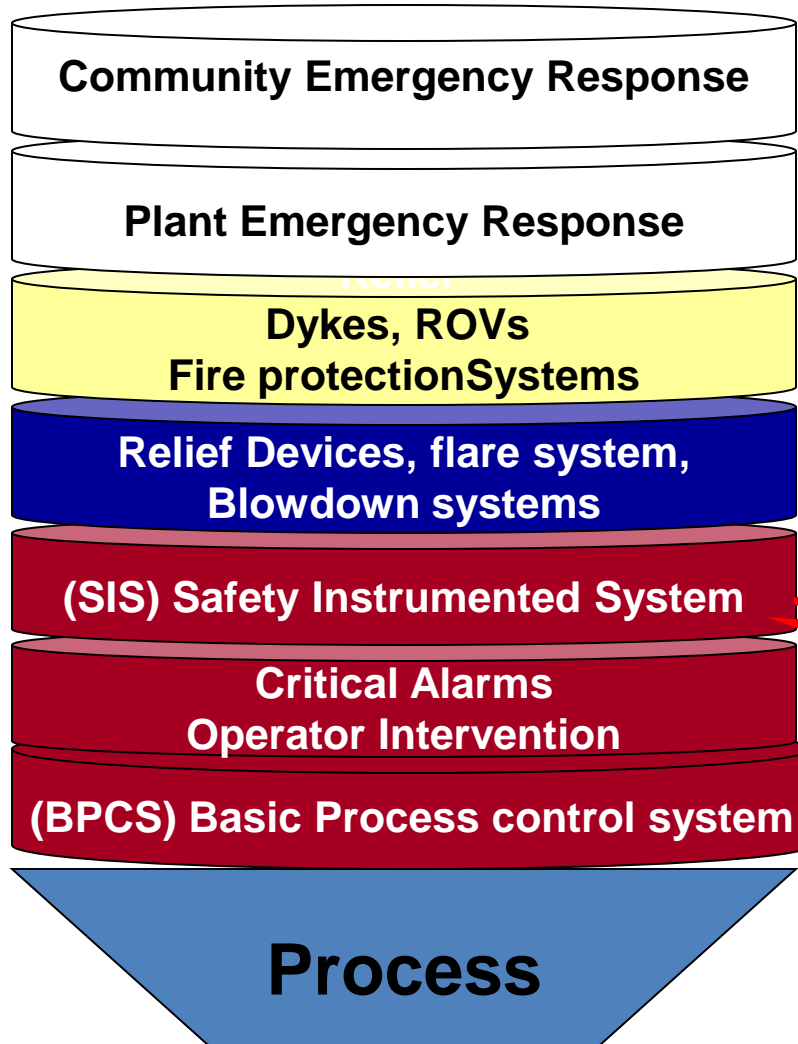
2005
Buncefield

1999
Thai Refinery

2009
Puerto Rico

Safe guards Vs SCEs : Attention / Drive

Avoid ← Prevent ← Control ← Mitigate



Thai Refinery 1999
level alarm not heard/ in
manned location

09- Puerto Rico
High level alarm/protn
was not OK.

2005-Buncefield
Tank high level alarm /
protection did not work.

2005- BP Texas Refinery
No automatic feed cut-off on
high column level

➡ Focus not on primary containment

➡ Focus not on Mitigation Vs accident Fallouts

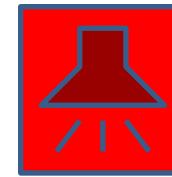


Management of Major Hazard Risks
Core Issues

Management of Major Hazard Risks

Core Issues

- ▶ **Focus not only on personal safety**
- ▶ **Focus on Major Hazard Risks**
 - **Particularly primary containment**
- ▶ **Pay extra attention to SCEs as warranted**
- ▶ **Take care of MOCs (Management of change)**
- ▶ **Know safety critical actions & their consequences**



Appeal!

Appeal!!

Appeal!!!

Major Hazard Risks

Raise awareness of hazards and risks



- ▶ **Understand design intent**
- ▶ **Protect the design intent**

Thank you