

OIL & GAS

# Risk Assessment Best Practices to enhance Operational Safety

PHMSA's Underground Natural Gas Storage Safety Workshop

**Vijay Raghunathan**

July 14<sup>th</sup> 2016

**Vijay.Raghunathan@dnvgl.com**

# Agenda

---



## Process Safety in Gas Storage



## Motivation



## Risk Management Approaches

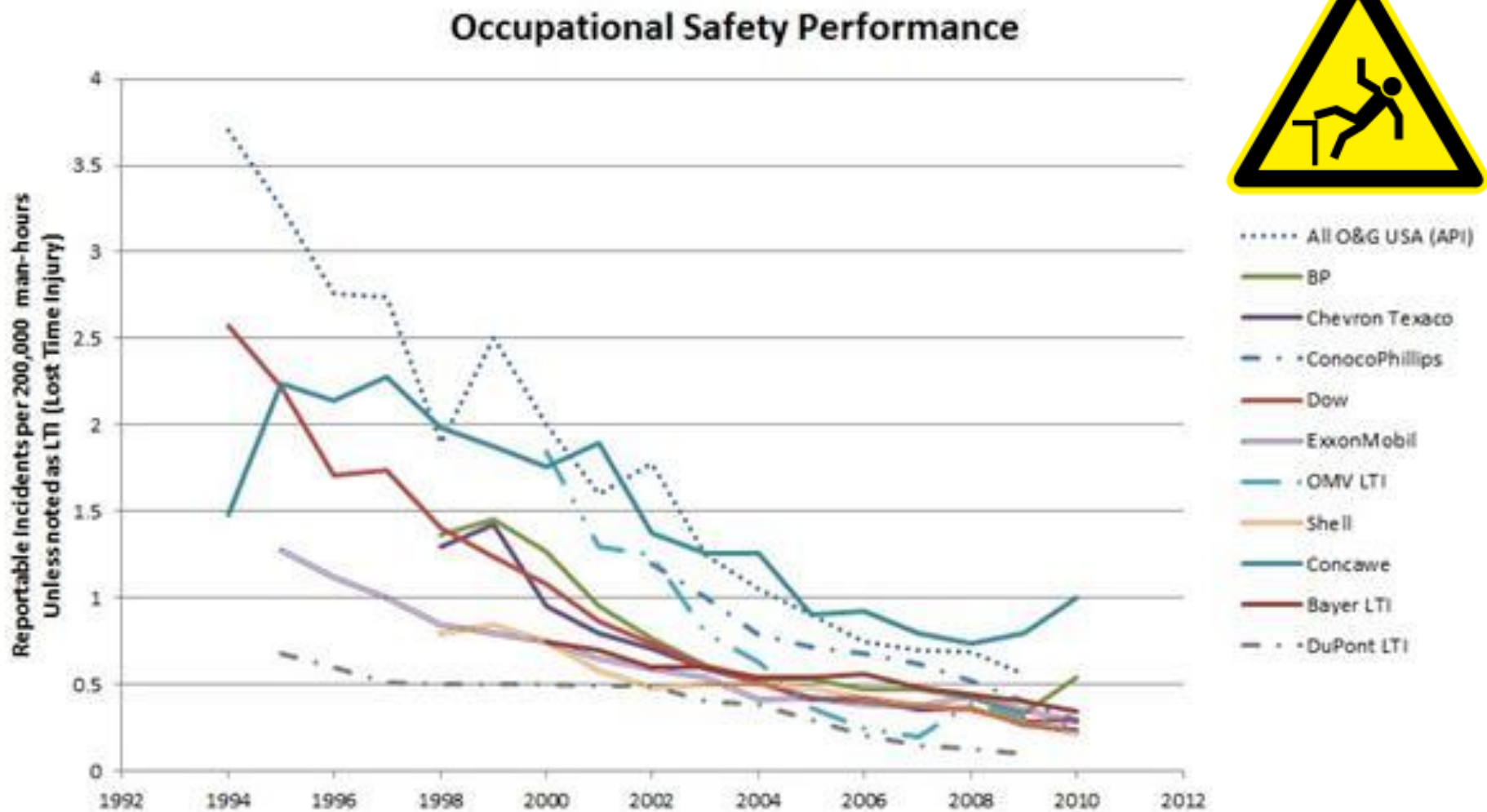


## Conclusions

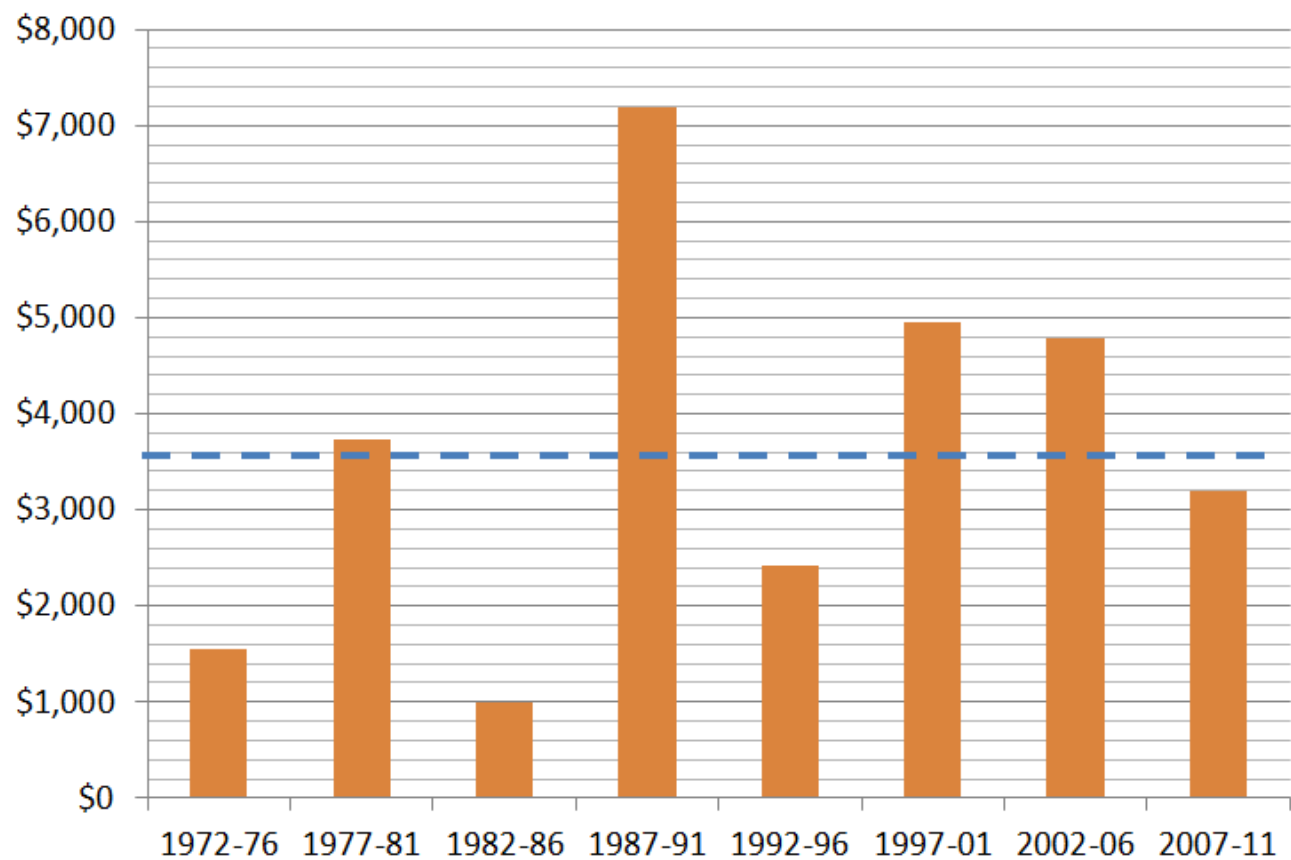
# Process Safety Challenges- Underground Gas Storage Facility



# Occupational Safety



## Total loss per 5 yrs



■ Total loss per 5 yrs

Average loss each 5 yrs  
= \$3600 million

## Motivation

---

- Gas Storage Incidents (Aliso Canyon Gas Leak, Moss Bluff, others)
- API 1171, API 1170
- PHMSA Advisory Bulletin, Feb 2016
- DOGGR Onshore Well Regulations
- PIPES ACT, June 2016

Regulatory

Public

Corporate EHS  
Objectives

Business  
Performance

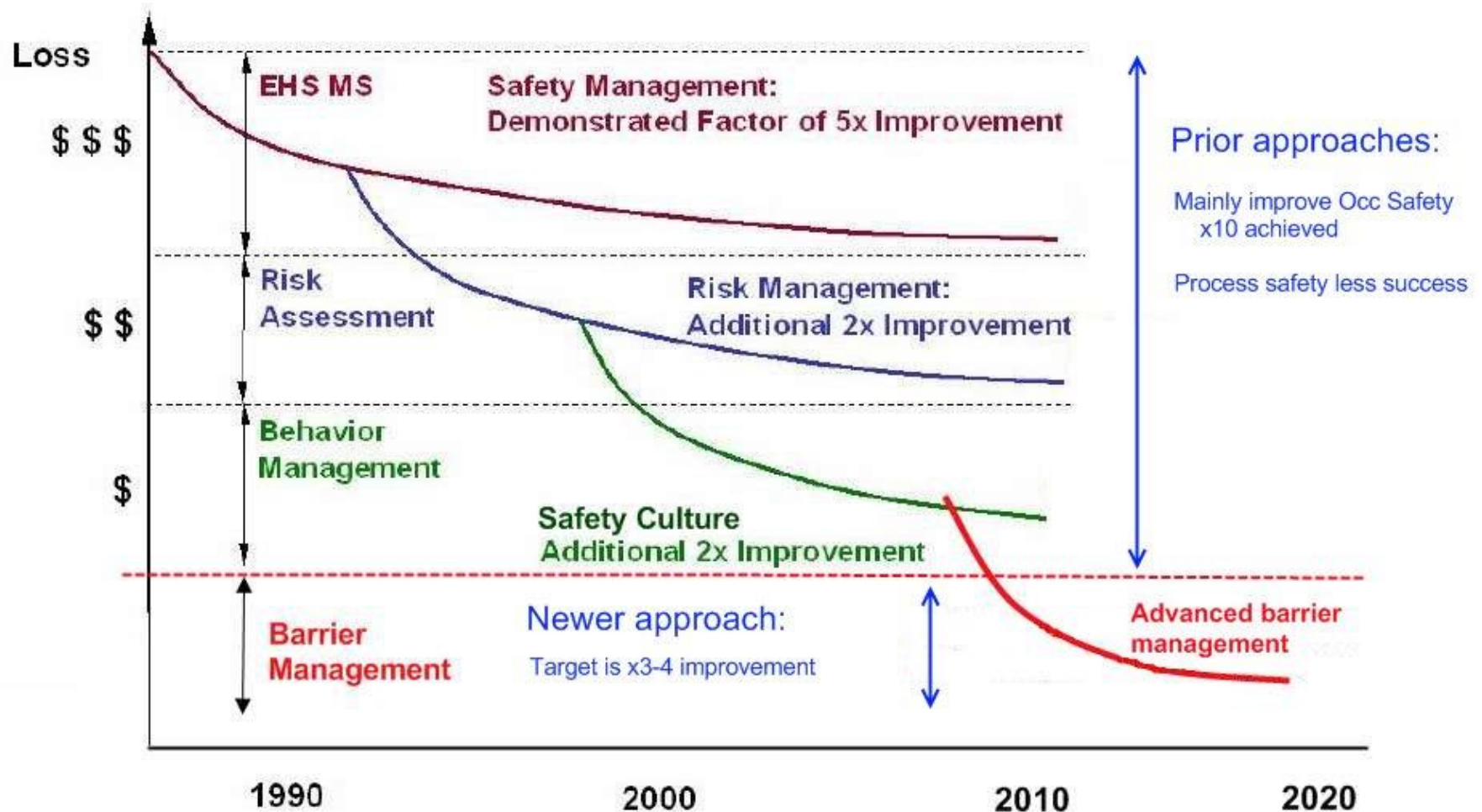
Industry Best  
Practices

# Managing Process Safety

---



# Trends in Process Safety Enhancement- DNV GL View





# Quantitative Risk Assessment

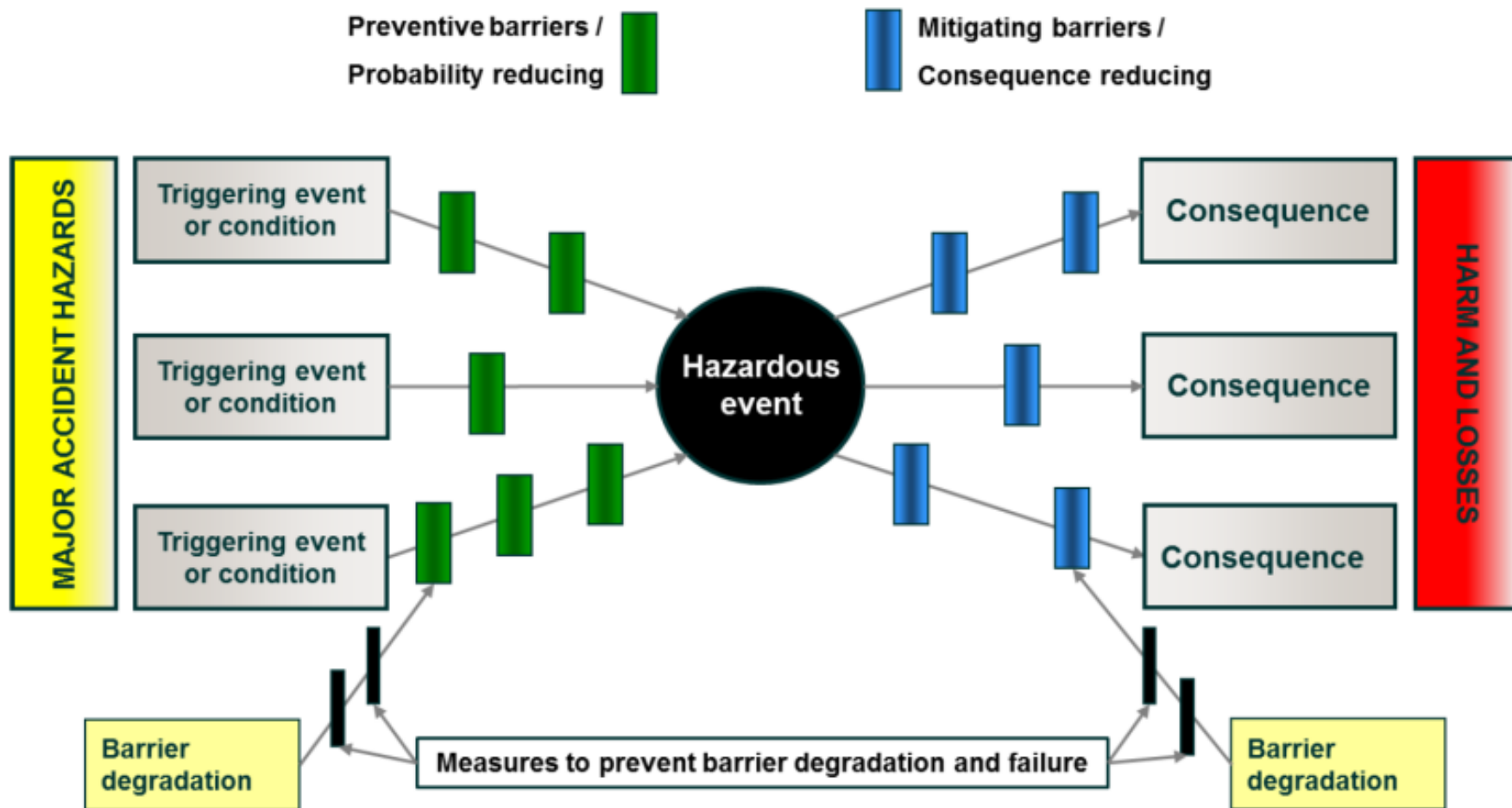
- Hazard Identification
- Gas Dispersion
- Fire, Explosion Impact
- Environmental Impact
- Likelihood Estimate
- Risk Analysis & Mitigation



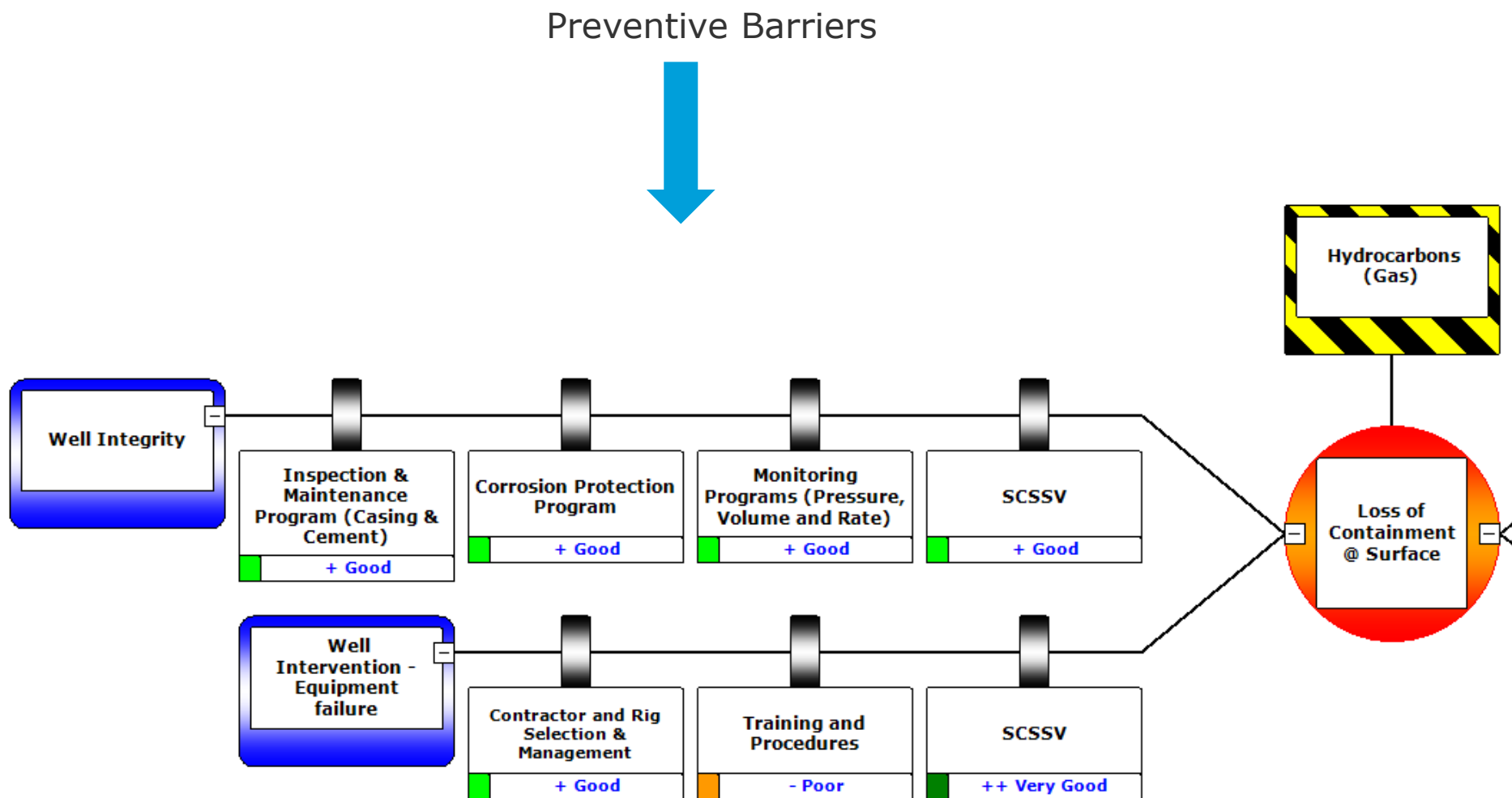
## Application

- Safety Risk Compliance
- Public Risk
- Facility Siting of Buildings/Trailers
- Benchmarking of Facilities
- ALARP decisions using Cost Benefit Analysis (Need for SCSSV, ESDV)

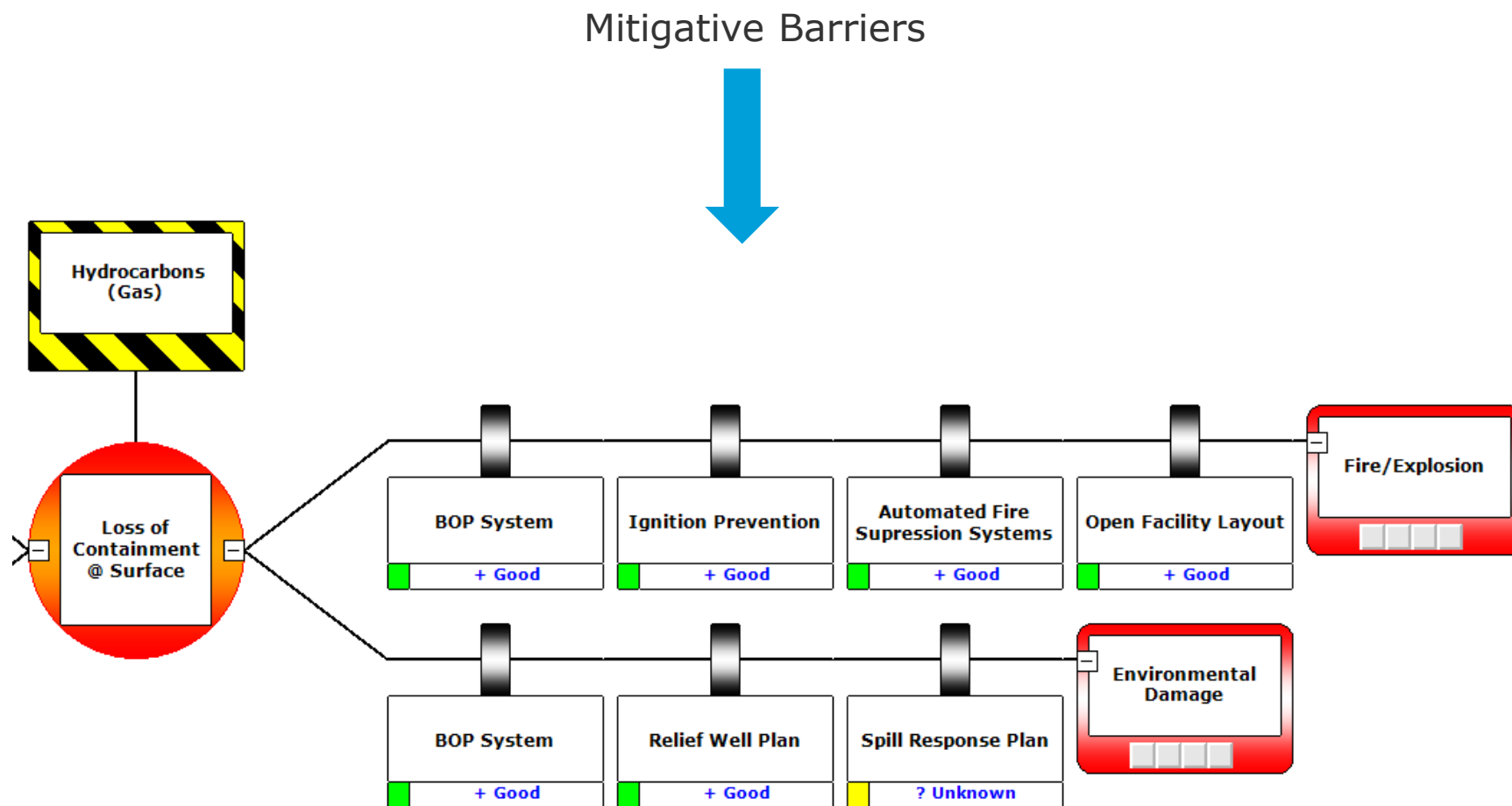
# Barrier Based Risk Assessment (using Bowtie)



## Gas Storage Bowtie Example (1/2)



## Gas Storage Bowtie Example (1/2)



## Benefits and Ease of Barrier Based Approach

---

- Visual Risk Communication Tool
- Monitor Operational Health
- Human Factors can be incorporated with ease
- PSM elements Compliance if required
  - JSA, MOC, PSSR
  - Incident Investigation
- Training Tool
- Auditing and Budgeting Tool

# Conclusion

---

1. Performance based risk management along with existing Prescriptive measures
  - Changing regulatory regime
  - Challenging financial market
  - Operations complexities
  - Ageing assets
  - Increased contractor participation
2. Quantitative Risk Assessment good for understanding impact to people, assets and environment
3. Barrier Based approach (Bowties) effective to manage operational risks

# Group Thoughts

---

