# Bhopal: *When Hazard Controls Aren't*

**Leadership ViTS Meeting**
**6 June 2005**
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**Office of Safety and Mission Assurance**
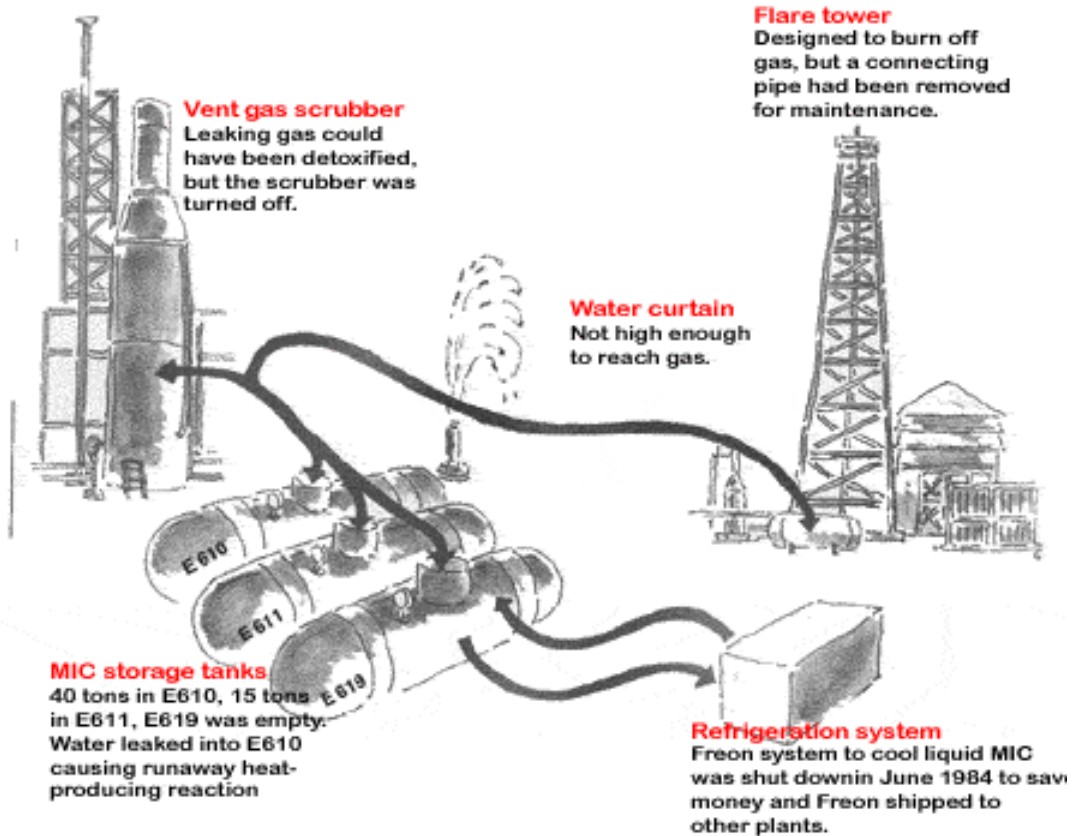
# The Accident and its Consequences

- During the nights of December 2nd and 3rd, 1984, a Union Carbide plant in Bhopal, India, began leaking 27 tons of a deadly gas called *methyl isocyanate (or MIC)*.

- Not one of the six safety systems designed to contain such a leak was operational allowing the gas to spread throughout the city of Bhopal.

- Half a million people were exposed to the gas. About 8,000 died the first week and 20,000 have died to date. More than 120,000 people still suffer from ailments caused by the accident and subsequent pollution of the plant site. The ailments include blindness, extreme difficulty in breathing, and gynecological disorders.
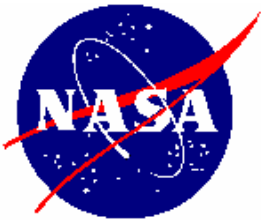


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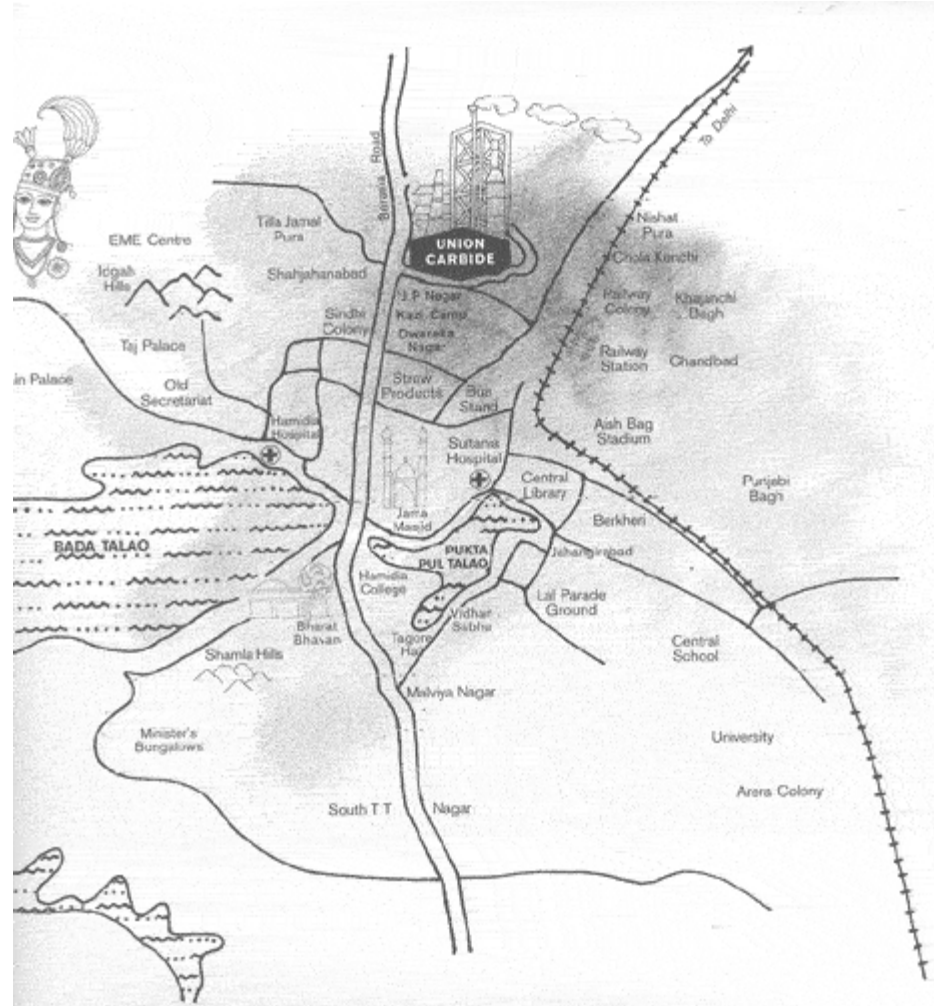
# Six Safety Systems Failed

- **Six safety systems were designed to control a MIC gas leak hazard**

- **None of the systems functioned when needed**

- **On the night of December 2nd, when an employee was flushing a corroded pipe, water flowed into the largest MIC tank**

- **An uncontrolled reaction ensued blowing the tank off its concrete sarcophagus and spewing a deadly cloud of chemical which was carried by prevailing winds and settled over much of Bhopal.**

**Vent gas scrubber**
Leaking gas could have been detoxified, but the scrubber was turned off.

**Flare tower**
Designed to burn off gas, but a connecting pipe had been removed for maintenance.

**Water curtain**
Not high enough to reach gas.

**MIC storage tanks**
40 tons in E610, 15 tons in E611, E619 was empty. Water leaked into E610 causing runaway heat-producing reaction

**Refrigeration system**
Freon system to cool liquid MIC was shut down in June 1984 to save money and Freon shipped to other plants.

E 610
E 611
E 619

(3)

# Accident Causes

- **The proximate cause of the accident was water leak into MIC tank due to pipe failure**

- **Contributing causes were failures of or lack of all 6 safety controls**

- **Extremely poor maintenance practices and the absence of modern safety procedures and critical configuration management were the next level of causes**

- **The root cause was company management negligence and incompetence.**

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# What Does This Have to Do with NASA?

- **NASA operates daily in a controlled hazard environment**

- **Where controls are necessarily limited, we often operate with "accepted risk"**

- **We formally accept risk based on reasonable mitigations**

- **We must continuously ensure that controls and risk acceptance rationale <u>remain in place</u>**

**or we are kidding ourselves!**

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