

**Task: Write an investigative report of at least 1,000 words outlining the details of a well-known technological disaster.**

### The task in detail:

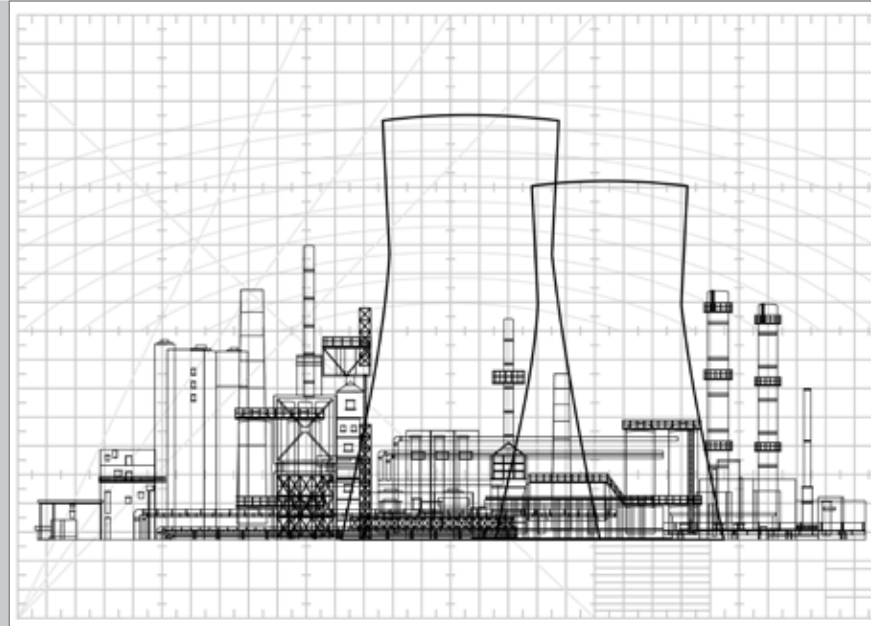
Choose **one** from the following:

- Bhopal gas disaster – India (1984)
- Chernobyl disaster – Soviet Union (1986)
- New Orleans floods (Hurricane Katrina) – USA (2005)

Considering the literature on the event, what appear to have been the main technical causes of this disaster? Discuss whether a **lack of ethics** appears to have been responsible for what happened.

You should discuss the issues with reference to relevant industry codes of ethics.

You should base your analysis on at least five different sources. **The report must be correctly referenced and must not contain plagiarised material.**



## Technical and ethical issues in the Bhopal gas disaster

### Abstract

The Bhopal gas disaster occurred in the Indian city of Bhopal in 1984. It caused the death of at least 2,000 people, and was also responsible for significant ongoing health issues for the Bhopal community for many years after the accident. This report investigates the main technical causes of the disaster, and also considers whether a lack of ethics was responsible for what happened. Reports show that the immediate cause of the incident was the accidental release of water into a tank of the chemical methyl isocyanate (MIC), triggering a runaway chemical reaction. It is widely held that this release of water was due to poor maintenance of the water pipes and valves leading to the tank (Eckerman 2005). A key ethical principle in engineering is that practicing engineers “should always strive to serve the community ahead of other personal or sectional interests” (Engineers Australia, 2010). Analysis of the Bhopal case suggests, the owners of the plant, Union Carbide, did not invest sufficiently in the maintenance of the facility and so appear to have been in breach of this key ethical principle.

### 1.0 Introduction

In 1984, the Indian city of Bhopal was the scene of a major catastrophe. The Bhopal gas plant located five kilometres from central Bhopal experienced a malfunction that caused the release of deadly gas into the city and its environs. The accident caused the death of at least 2,000 people, and was also responsible for significant ongoing health issues for the Bhopal community for many years afterwards.

### Activity

1. Look at the assignment question left
2. Now read the sample report. Read the accompanying comments on the side as you go.
3. **Note: This is high standard work that demonstrates a number of features of good report writing. Which features of the report do you think you could draw on for your own writing?**

This is a text mainly about ‘concerns’ that the author has about digital technology. The SUMMARY section of the review has been organised around this theme of “major concerns”. When you are writing your own summary of a text you will need to pay attention to how you will STRUCTURE your understanding of the text.

### Introduction

This example follows the conventional structure for setting out an introduction to:

Introduce the topic area

Introduce the purpose of the report

Introduce the method of research used

Note: the Introduction typically covers the first elements of the abstract (topic area, purpose), but in more detail.

The purpose of this report is to investigate:

- the main technical issues behind the disaster
- the extent to which ethical issues were responsible for what happened

Data collected for the report were from a range of primary and secondary sources written on the subject. The report also refers to the Engineering Australia Code of Ethics which outlines standards of professional behaviour required in Engineering and technical fields.

## 2.0 Technical issues in the Bhopal disaster

The technical causes of the disaster were analysed in detail in a report that was commissioned by the relevant state government (Madhya Pradesh Government 1987). In this report, the main technical cause was identified as the emission of the toxic chemical, methyl isocyanate (MIC), caused by a leakage of water into a tank holding the chemical. According to the report, the leakage was caused by the malfunctioning of a lip-blind plate leading to the tank. The water entering the tank sparked a runaway chemical reaction, accelerated by contaminants in the tank, high temperatures and also by the presence of iron from corroding non-stainless steel pipes. The reaction increased the temperature in the holding tank to over 200 degrees Celsius, which in turn forced a large quantity of MIC gas out of the tank and into the surrounding air (Eckerman, 2005).

It is estimated that a total of 30 metric tons of MIC gas was emitted over a period of 45 - 60 minutes before the process could be shut down (see Figure 1). Because the gas cloud was composed of materials denser than the air, it stayed close to the ground and spread into the neighbouring Bhopal community (Eckerman, 2005). It is reported that people of smaller stature – especially children – were the worst affected by the disaster. The main cause of death was choking, with the death toll estimated at 2000 by some (Rice, 2006), and as high as 8,000 by others (Eckerman 2006). The affected area, spanning a radius of 15 kilometres, is shown in Figure 2.



**Fig. 1: The Bhopal plant during the accident**

<http://businessodisha.in/wp-content/uploads/2014/12/industrialaccidents2.jpg>

### Sub-headings

Use of sub-headings is an important way to show the structure of your report

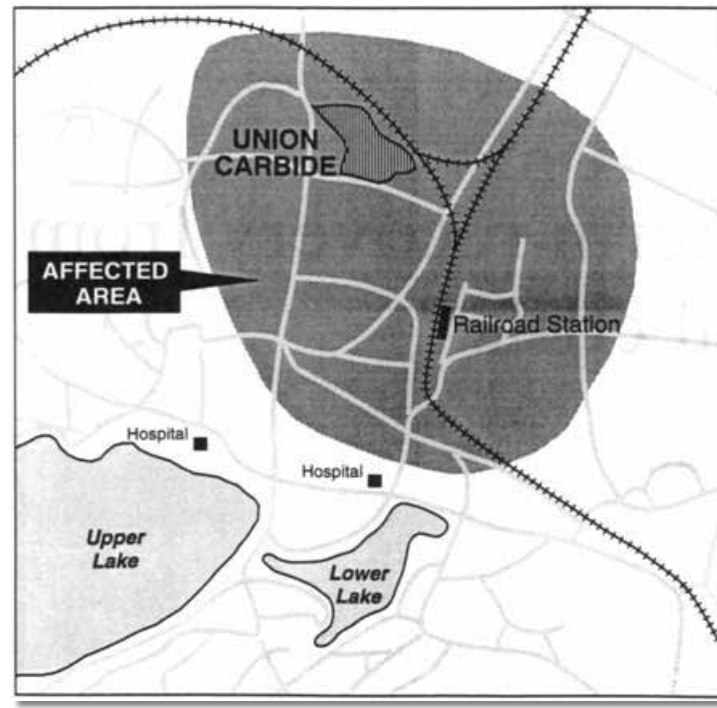
### Use of Figures

When you introduce a figure, diagram, table etc. into a report, it is always necessary to introduce it at an appropriate point in the text.

### Referencing Figures

Figures, tables etc. should always be presented with a number and a title

Note: When you are using a figure, table etc. taken from the public domain (e.g. from Google Images), it is necessary to acknowledge the source.



**Fig. 2: The affected area in relation to the Bhopal plant**  
<http://archive.unu.edu/unupress/unupbooks/uu211e/uu211e07.jpg>

### 3.0 Ethical issues in the Bhopal disaster

Professional codes of ethics encompass the personal, organizational and corporate standards of behaviour expected of professionals (Chadwick, 1998). An example of such a Code is the one produced by Engineers Australia – Our Code of Ethics (Engineers Australia, 2010). In this section, the key principles in this code are summarised. These principles are then considered against the facts that are known about the Bhopal disaster to determine whether a lack of ethical behaviour appeared to be a contributing factor in the disaster.

#### 3.1 Engineering Australia's Code of Ethics

EA's Code of Ethics document is intended "to define the values and principles that shape the decisions Engineering professionals make in engineering practice" (p. 1). The main principle of the code is stated as follows:

As engineering practitioners, we use our knowledge and skills for the benefit of the community to create engineering solutions for a sustainable future. In doing so, we strive to serve the community ahead of other personal or sectional interests (p. 1).

The Code is then organised around four main themes: Demonstrating integrity; Practising competently; Exercising leadership; Promoting sustainability. Under each of these themes are a series of specific ethical prescriptions. For example, under the theme of 'Integrity', Engineers are advised that they should: i) act on the basis of a well-informed conscience; ii) be honest and trustworthy; iii) respect the dignity of all persons (p.2).

#### Analytical framework

Central to much academic writing is having an ANALYTICAL FRAMEWORK. This is the key idea or concept that you use to analyse the findings of your study.

Having an ANALYTICAL FRAMEWORK means that you have a systematic and critical approach to the subject. It is important to highlight this framework in your work.



The principles in the Code that seem most relevant to this particular case – that is one involving a major accident and the death of civilians – are the requirements that Engineers:

- engage responsibly with the community and other stakeholders (4.1)
- practise engineering to foster social, cultural, health, safety and well-being of the community and the environment (4.2).

### 3.2 Analysis of ethical issues in in the Bhopal disaster

There is some dispute about what human factors contributed to the disaster. Union Carbide, the US owner of the plant, has maintained that the accident was the result of sabotage (Union Carbide, 2015). Their claim is that several disgruntled employees deliberately poured water into the tank, thus setting off the reaction. Their main evidence for this claim is the testimony of another employee who reported some fellow workers behaving suspiciously around the site of the tank just prior to the accident. Thirty years on, the company has continued to forcefully put this claim; however it has not been sufficiently proven (Eckerman, 2005).

On the other hand, there is evidence that in the lead up to the accident, the Bhopal plant had not been maintained by the company to an acceptable standard, and also that certain safety standards had been breached. Some of the issues around maintenance and safety identified at the plant are:

- Alerts prior to the accident concerning corrosion of the pipes leading to the tank containing the MIC
- Alerts prior to the accident concerning malfunctioning of the crucial valve preventing water entering the tank
- Evidence of unsafe quantities of MIC stored in the tanks
- Inadequate training of personnel in charge of the plant to respond to the disaster when it happened
- Inadequate safety provisions, including the lack of provision of a safety manual written in the workers’ native language.

Although it has not been proven conclusively, it is widely held that the first two of these factors were directly responsible for the accident (Eckerman, 2005; Rice 2006). The effect of the additional factors mentioned meant that the response when the accident did occur was inadequate. It is suggested that these deficiencies in both maintenance and safety practices at the plant were largely the result of cost cutting efforts within the company in the lead up to the accident (Eckerman, 2005),

As noted in the Engineers Australia Code of Ethics (Engineers Australia, 2010), an overriding principle for engineers is “to strive to serve the community ahead of other personal or sectional interests (p. 1). This principle is backed up by articles 4.1 and 4.2, which require engineers “to act responsibly with the community” and also to ensure “its health, safety and well-being”. **The actions, and also inactions, of the company in this case suggest that it was in breach of its ethical responsibilities by placing its own interests ahead of the Bhopal community.**

#### Answering the question

In this report this sentence is crucial – as you will note, it provides an answer to the question that was posed in the topic:

*Whether a lack of ethics appears to have been responsible for what happened.*

An answer is provided for this question. You will also note that the answer is expressed in an appropriately qualified way:

*The actions ... of the company in this case SUGGEST that ...*

Often in academic work, our conclusion are not absolutely certain, so we need to show this in our writing. It is important however, to have a conclusion to present.

## 4.0 Conclusion and recommendations

The Bhopal disaster is now held up in the world as “a symbol of corporate negligence” (Eckerman, 2006: p.48). The event shows that neglect of ethical principles can not only have devastating effects on communities, but in the long run is often destructive of companies. In the aftermath of the disaster, Union Carbide was required to pay compensation amounting to \$470 million dollars. The reputation of the company was destroyed, and its CEO now lives under permanent threat of arrest.

## References

Chadwick, R 1998, Professional Ethics. In E. Craig (Ed.), Routledge Encyclopedia of Philosophy. London: Routledge.

Eckerman, I 2005, The Bhopal saga: causes and consequences of the world’s largest industrial disaster. India: Universities Press.

Eckerman, I 2006, The Bhopal disaster 1984-working conditions and the role of the trade unions. Asian-Pacific Newsletter on Occupational Health and Safety, 13:2, pp. 48-49.

Engineers Australia (2015). Our code of ethics. <https://www.engineersaustralia.org.au/code-ethics-article> [Retrieved 12/02/2015].

Madya Pradesh Government (1987). Bhopal Gas Tragedy Relief and Rehabilitation. <http://www.mp.gov.in/bgtrrdmp/relief.htm> [Retrieved 12/02/2015].

Rice, A 2006, Bhopal revisited — the tragedy of lessons ignored, Asian-Pacific Newsletter, 13:2, pp. 46-48.

Union Carbide (2015). Statement of Union Carbide Corporation Regarding the Bhopal Tragedy”, Bhopal Information Center <http://www.bhopal.com/> [Retrieved 12/02/2015].

### References

The last section of your report is the list of REFERENCES. References are listed in alphabetical order, and should provide all relevant details about the sources you have used. You should check the format to be used in the library’s Harvard Style Guide.

Note that you should only list those sources that have actually been CITED in the report

