

# Safety Measures

A case study for use in teaching in Engineering Ethics

## Abstract

This case study concerns the obligations that a company may have to implement safety measures, even when this is not dictated by the letter of the law.

## Teaching Format

1 hour session, small group discussions

## Practicalities

This session is aimed at students who have done some ethics before. It can be integrated into any module where safety is considered but would be particularly suited to modules where chemical processing plants are studied.

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## Relevant Ethical Concepts & Issues

- Duty of Care
- Responsibility
- Duty to Obey the Law
- Safety

More information about these concepts and issues can be found in the 'Glossary for Engineers' document

## Partners in producing this resource

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## Safety Measures

Michael White is a Safety Officer for Chemco who works at their detergent alkylate plant in Essex. Alkylates produced at the plant are sold on to manufacturers of various cleaning products, both domestic and industrial. Michael's general duties are to write and review safety procedures for the plant and a lot of his time is spent focussing on the safety aspects surrounding dangerous substances, as many of the substances used in the production of alkylates are classified as dangerous.

Industries which use large amounts of dangerous substances are subject to Control of Major Accident Hazards (COMAH) legislation. This means that if the amount of a dangerous substance kept on a site is expected to reach a particular level (indicated by column A in the table below) the company must notify the Health & Safety Executive (HSE). They must also have accident prevention plans in place, demonstrating that the company has thought about how to manage risks and put in place procedures to do this effectively.

If the amount of a dangerous substance exceeds a higher level (indicated by column B in the table below) further measures must be taken by the company to ensure the safety of the site. This includes completing a safety report for the site; an extremely detailed document outlining how safety measures have been put in place, including geographical, meteorological, geological, hydrographic and historical surveys of the site. The existing on-site accident prevention plans are required to be made more rigorous and tested once level (B) is reached and the company must also devise additional emergency plans for people off the site; this will include producing and disseminating information to anyone who could be affected by an accident on the plant, such as local residents and businesses.

<i>Dangerous substance</i>	<i>Quantity in tonnes</i>	
	A	B
Methanol	500	5,000
Liquefied extremely flammable gases and natural gas	50	200
Bromine	20	100
Hydrogen Fluoride	10	20
Carbonyl dichloride (phosgene)	0.3	0.75
4, 4-Methylenebis (2-chloraniline) and/or salts, in powder form	0.01	0.01
Polychlorodibenzofurans and polychlorodibenzodioxins	0.001	0.001

The table above reflects a recent change in the law; the upper level of hydrogen fluoride (shown in column B) has just been lowered from 40 to 20 tonnes. As a result of this, Chemco now find that the amount of hydrogen fluoride (HF) in their plant is above this threshold and so they are required to perform the further measures set out in the COMAH. Chemco have three months to comply with these regulations and submit the safety report and other relevant documents to the HSE.

Michael is put in charge of this project and begins by examining the amount of HF in the plant and how it is stored. Almost the first thing he notices is that Chemco do not need to have so much HF in the plant, and that if they reduced the stock level to what is needed, then this would put them below the level that would require the additional measures.

The plant is 25 years old; there is an office block nearby and a newly-built school and housing estate 1 km away.

## Questions

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If you were Michael and were in charge of making the decision about what to do next:

- (i) What lines of investigation would you wish to pursue to help you make your decision?
- (ii) What would you recommend that Chemco do? Give three reasons why this is the best course of action. Could you defend this decision ethically?
- (iii) Does it make a difference to your decision knowing that the school and houses nearby were built long after the chemical plant?
- (iv) Would it make a difference to your decision if you discovered that the local residents are mainly employees of Chemco and their families?
- (v) How have the needs and interests of Chemco employees featured in your decision? What responsibilities do you think that Chemco have towards their employees?
- (vi) Does it make any difference to Chemco's responsibilities that they are a business operating for financial gain?
- (vii) Is there any level of safety risk to the public that is acceptable?

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## Tutor Notes

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This 1 hour session starts with students taking part in small group discussions followed by a discussion with the class as a whole. The scenario and questions should be given to the students as a handout. The tutor takes a facilitator role directing questions where necessary to generate discussion, allowing students to voice their own opinions and encouraging them to justify their answers.

### Introduction (5 minutes or less for this section)

To begin the class, give the students time to read the scenario.

### Small Group Discussions (10-15 minutes)

Next split the students into groups of 4-6 and get them to discuss the questions. (These are ideal numbers but larger groups are workable. There should really be no more than 6 groups in a class and larger group sizes are preferable to greater numbers of groups so expand group sizes if necessary). Encourage students to move chairs (or themselves) around where possible so that group members can hear each other and so that the different groups are sufficiently distinct from one another. It is often useful to split up groups of friends and put students with people with whom they would not normally converse. While this might make the students awkward to begin with, it helps them to focus on the task and usually ensures that a broad range of opinions are represented within each group, making the discussion livelier and more involved. Tell each group that they will be reporting their answers back the class; perhaps each group could nominate a 'scribe' at this point to jot down the points each member of the group makes. Get the groups to discuss the questions given after the scenario. Explain that you are looking for students to justify the answers that they give (just answering 'yes' or 'no' is not enough!); you will be expecting to hear why groups thought what they did as well as what they thought when they report back.

**Note:** If time is pressing or if the number of groups is too large then you may want to allocate just one question to each group to cut down on discussion and feedback time. Alternatively, you may wish to nominate just one group to give a presentation with the other groups using the time just for discussion of the questions. This option is particularly good where the class runs over a number of weeks as groups can take it in turns to present or lead a discussion.

### Class Discussion (30 minutes)

Bring the students back into a large group, moving chairs where necessary, and ask one member of each group to report back to the class as a whole. Give each spokesperson a few minutes in which to give their report, and move on to the next group when they are finished. The aim of giving these reports is to ease students into talking, get the class thinking, and also to make sure that every group gets a chance to be involved in the class. There should be no discussion at this point - if other students interrupt tell them to record their thoughts on paper for the time being; they will be encouraged to contribute to discussion after everyone has given their report. It is useful to record each group's responses on a board or flipchart, or allow the presenters to do this themselves, so that they can be referred back to if necessary during the discussion and conclusion. **(5-10 minutes for the reports)**

After the reports have been delivered bring the group together for a class discussion. You can begin by running through the questions again and asking for any additional thoughts from the class, or by focusing on a question that groups gave different answers to and asking them to explain why they gave the answer they did, and why they might think that the other groups are wrong. Or, if only one group gave a presentation, you can begin by asking for comments on the presentation from the rest of the class. Discussion should flow naturally but the questions provide a basic structure if students need prompting. Below are the main points that should get covered in relation to each question. **(20-25 minutes for discussion)**

- (i) **If you were Michael and were in charge of making the decision about what to do next, what lines of investigation would you wish to pursue to help you make your decision?**

The aim of this question is to help students identify the different aspects of this case. Looking at the answers that students give to this question you can help them to separate the practical, legal and ethical issues that are relevant to the scenario. Some popular suggested lines of investigation might be the following:

- **The law:** Are Chemco legally obliged to take additional measures? What exactly are the legal requirements?
- **The risks of HF:** What are the risks associated with HF? How can they be reduced? Does removing excess HF from the site reduce risks significantly? Will new risks be created by this? (Perhaps more frequent deliveries of HF will be required and transporting the chemical brings risks to the nearby community as the tankers use the local roads, for example.) What are the likely consequences of an accident or spillage? Is an accident less likely if the amount of HF is reduced? Who is likely to be affected? (Different groups of people and the environment could be included here.)
- **The use of HF:** Can Chemco operate effectively if the amount of HF on the site is reduced?
- **Money:** How much does it cost to commission a safety report and put the additional emergency plans in place?

As this is only a 1 hour session it is useful to put to one side the factual and legal issues and concentrate on the ethical issues. This can be done by providing answers to at least some of the above questions. Legally speaking, Chemco only have to complete the safety report and implement the additional emergency measures if the amount of HF in the plant is set to remain at the higher level. The law gives Chemco three months to either reduce the amount of HF or produce the relevant extra documents. For the sake of brevity it can also be assumed that the removal of a large amount of HF from the plant will not affect Chemco's operations; they may require more frequent deliveries of HF but there will be sufficient stock to ensure that the plant is as efficient as usual. It can also be assumed that taking all the additional measures necessary to comply with the law will be costly to Chemco as this will involve commissioning experts to complete hydrographic and geological surveys etc. Students may already be familiar with the risks associated with HF but information outlining these risks can be found in sources in the Further Reading section of this document if not.

The ethical issues in this case are responsibility and safety; the issue of what Michael's (& Chemco's) responsibilities are towards the different groups of people involved in this case, and how 'safety' is to be defined in order that Chemco fulfil these various, and sometimes conflicting, responsibilities. These issues are addressed in the rest of the questions.

**(ii) What would you recommend that Chemco do? Give three reasons why this is the best course of action.**

Here are the four obvious courses of action with reasons students might give:

**Reduce stocks; do not complete safety report or implement additional emergency measures.** The main reason for this course of action is that it allows Chemco to comply with the law but doesn't require spending a lot of money. Chemco can simply remove the excess HF and then they are under no legal obligation to complete the time-consuming and expensive safety report. This view might be challenged by asking whether compliance with the law is enough: are Chemco sure that their current safety practices and emergency plans are adequate? Also, if stocks are reduced, there is still a possibility that they could rise again and that this increase could go unnoticed in such a busy plant.

**Leave stocks at current level; complete safety report and implement additional emergency measures.** Students might recommend this course of action by reasoning that removing the HF could be dangerous, or concluding that more frequent deliveries of HF could create other risks which are not worth accepting. Completing the safety report and putting in place emergency plans means that Chemco comply fully with the law and that they have taken everyone's interest into account; including local residents and businesses. While this may mean an initial cost for Chemco, it is worth it in the long run: more stringent safety measures will prevent accidents and reduce the likelihood of Chemco being sued in the future.

**Reduce stocks; complete safety report and implement additional emergency measures.** There are a number of reasons why this course of action is appropriate. The plant is old and with older buildings there are more things that could go wrong. Completing the safety report may identify any additional hazards that Chemco had not previously considered and allow them to factor them in to their safety plans. The fact that there is a school and office nearby may sway opinions towards favouring this course of action: if there is a major accident then the office block is certain to be affected, and the school might be affected (although this is less likely as it is further away); where Chemco's behaviour

can affect ‘innocents’ then it could be argued that the duty to uphold safety is more stringent than if only Chemco employees only are put at risk, even if this is not demanded by the law. Students also might think that the legal requirements are not stringent enough. Although Chemco could simply reduce the amount of HF in order to comply with the law, if the capacity for housing a large amount of HF exists then levels can easily rise again, perhaps at a time when thoughts of a safety report have been forgotten.

**Leave stocks at current level; do not complete safety report or implement additional emergency measures.** This is not to be recommended as a course of action since it involves breaking the law! However, students might want to argue that the law is wrong on this point - that Chemco don’t have any responsibility towards local people and so the more stringent measures are not required. If students do go down this route you could ask them whether Chemco are responsible for any environmental impacts - an HF spillage could have very serious effects on local flora and fauna.

**(iii) Does it make a difference to your decision knowing that the school and houses nearby were built long after the chemical plant?**

This might have affected the students’ decisions, the thought being that people who live nearby moved in knowing that the plant was there and so they voluntarily accepted the risks that it posed. This makes a big difference to our perception of what responsibilities a company has (although it does not affect the actual risk posed). If people voluntarily accept a risk (by drinking, smoking or driving fast cars, for example) we tend to think that companies are not responsible for any ill effects. However, it could be argued that the local planning department has some degree of responsibility here, allowing houses and a school to be built so close to the plant. It can also be argued that just by buying a house close by you are not necessarily accepting the risks posed - local residents are possibly not even aware of these risks.

**(iv) Would it make a difference to your decision if you discovered that the local residents are mainly employees of Chemco and their families?**

Again, the thought is that employees and their families have also voluntarily accepted any risks posed by the plant as they have chosen to live close by and they are also profiting from the activities at the plant. This means that although Chemco need to obey the law, it could be argued that they need not go out of their way to protect these residents; they are certainly not required to go beyond what the law demands. However, it can be argued, on the other hand, that Chemco have a particularly strong obligation towards their employees, more so than to ordinary members of the public, and so they should do as much as possible to protect their wellbeing (the next question addresses this in more detail).

**(v) How should the interests of Chemco employees be factored in to your decision? What responsibilities do you think that Chemco have towards their employees?**

Students should have factored in the interests of Chemco employees quite highly into their decisions: employees are the ones most likely to be injured in accidents as they work in close proximity to the chemicals. Also, it might be thought that the employer-employee relationship is a special one which means that Chemco are responsible for looking after the safety and wellbeing of their employees. Chemco will also be under a legal duty to keep their employees safe.

Students will more than likely agree that Chemco have a responsibility to look after their employees’ safety but may have trouble articulating why this is. The fundamental thought here is that, as employers, Chemco have a ‘duty of care’ towards their employees. A ‘duty of care’ is a responsibility to exercise a level of care towards an individual in order to avoid injuring or harming that individual. A duty of care is a *role-specific* duty in that it arises from certain roles that people may play, or relationships they may have with one another. Because of the role that Chemco have as employers, this generates a duty of care to their employees. Parents have a similar duty of care towards their children.

The question of how far this duty extends covers two issues: firstly, who is included in the group ‘employees’, and second, how far should Chemco go in making their employees safe? ‘Employees’ are usually defined as those under permanent employment with the company; however, the law also recognises duties towards casual or temporary staff as well as contractors working on site. It may be up to individual companies to decide whom they would count as

'employees' but one could argue that duties of care are owed to anyone who works on the site for a significant amount of time, whether in full-time employment with Chemco or not.

With respect to the issue of how far Chemco should go in keeping their employees safe again, indication can be taken from the law. Legally, a duty of care extends to doing 'as much as is reasonably practicable' to prevent harm or injury. Obviously, Chemco cannot make things totally safe in the refinery as this is impossible (even the 'safest' of activities come with risks, albeit very minimal ones) and it is clearly not practicable to remove all hazardous chemicals from the workplace as the refinery would cease production. However, Chemco are obliged to take certain measures to ensure safety, and these will be both preventative and palliative. Preventive measures essentially entail making sure that unnecessary hazards are avoided: storing chemicals in appropriate environments, sensible handling of dangerous substances. Palliative measures include planning for emergencies by producing evacuation plans, and maintaining safety equipment. Staff training can help to implement both preventative and palliative measures by ensuring that employees do not cause unnecessary hazards and that they are briefed on how to evacuate and use emergency equipment.

It is worth discussing with students at this point about how these preventative and palliative measures should be decided upon. One may wish to argue that preventative measures should be a priority - the prevention of harm is preferable to its amelioration. However, when does prevention of harm cease to be 'reasonably practicable'?

**(vi) Does it make any difference to Chemco's responsibilities that they are a business operating for financial gain?**

The thought here is that Chemco are profiting from activities at the plant they have a stronger obligation to the local community; as they are 'taking something out' of the community, so they should 'put something back'. Ensuring that the risk to the safety of local residents, schools and businesses is minimised is the least that they can do. If Chemco were performing a public service their responsibilities may be less widespread, not because this would mean that they were permitted to conduct 'unsafe' practices but because the cost of undertaking expensive safety reports may not be seen as worth it; the money may be better spent in improving the public service in question.

**(vii) Is there any level of safety risk to the public that is acceptable?**

Answering this question requires separating the different factors which are likely to affect judgement concerning the acceptability of a risk. These are given below. Getting students to simply respond to the question and then grouping their responses under these different factors is a good way to provoke discussion of this topic.

There are a number of factors that are relevant when assessing the acceptability of a risk:

- How likely the event is to occur
- The groups of people at risk: e.g. children, the elderly, people in a particular geographical region
- The severity of the harm the risk threatens to cause
- Whether the risk is accepted voluntarily or imposed involuntarily
- Distribution of risks and benefits

People are willing to accept risks under certain circumstances if associated benefits are worth taking the risk for. For example, the long-term effects of mobile phones on our health are unknown and therefore the technology poses some risk. However, most of us accept this risk in exchange for the benefits that mobile phones offer. There are some factors which make people less likely to accept a risk; one of these is if this risk is imposed involuntarily. For example, emissions from a local factory may pose a small risk to health, a level of risk that we would be willing to accept in another circumstance (say, the same level of risk as travelling on an aeroplane). However, the fact that this risk is imposed upon us, rather than accepted by us makes people more unwilling to deem it an acceptable level of risk.

### **Conclusion (5 minutes)**

After the students have been given an opportunity to discuss their reports and the questions in more depth you should conclude the lesson.

This case study was based on a real dilemma faced by someone working in industry. You might want to inform the students about what actually happened in this case:

Senior management at the refinery decided to complete the safety report. They decided that if stocks can be reduced, they can rise again when the safety report issue is long forgotten. Stocks were reduced as well - it was just good practice, and safer. The fact that the plant was close to an office block was a major factor in influencing the management team's decision - they felt that they had a particular duty to protect the welfare of people who were outside of the organisation. The plant was quite old, and a safety review would just be good practice.

Below is a summary of the ethical issues involved in this case that you may also want to use to round the lesson up. You will be able to indicate how the class discussion picked up on many of the key features of this case by summarising the points that you noted from the group reports.

**Responsibilities/duties:** This case examined how a chemical company had duties towards different groups of people (employees, the public, local residents and businesses). There may be a difference in the basis for these duties: some were tied to specific role or relationships and some duties may take precedence over others. It was also difficult to work out how to weigh up all these different responsibilities. The extent of Chemco's responsibility covers the issue of who they are responsible for, and how safe they are obliged to make the environment for this group of people. Chemco's responsibility towards the public at least extends to those likely to be affected by the workings of the plant - namely those nearby. Demographically, one might want to prioritise the needs of different groups of local people. For example, schools should be factored in to safety plans more prominently than local residents. One may also want to consider the needs of residents over those of local businesses. These considerations are made on the grounds that children deserve more protection than adults: as they are unable to look after their own interests we are obliged to protect their interests for them. Similarly, residents may be regarded as 'innocents' who deserve protection where businesses do not merit this same protection.

**Safety & Risk:** Total safety is impossible to achieve and this case highlighted how the notion of safety is open to interpretation: how safe is safe? There are many different factors which are relevant when we assess whether or not a risk is acceptable and it is difficult to know how these factors should be weighted.

**Duty to obey the law:** There exists the duty to obey the law but sometimes what the law dictates departs from what we believe that morality dictates. This means that doing the right thing and obeying the law are not always the same thing: although it is wrong to disobey the law, obeying the law is sometimes not sufficient - we need to do more to discharge our duties.

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## Assessment

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Ask students to write a report, imagining that they are Michael outlining his recommendations to the management team. Reports should be 500-1000 words.

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## Further Reading

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### Safety & Risk

- Hansson, S. O. (2003) 'Ethical Criteria of Risk Acceptance', *Erkenntnis* **59**: 291-309.
- MacLean, D. (ed.) (1986) *Values at Risk*, Totowa, NJ: Rowman and Allanheld.
- MacLean, D. & Brown, P. (eds.) (1982) *Energy and the Future*, Totowa, NJ: Rowman & Littlefield.
- Rescher, N. (1983) *Risk: A Philosophical Introduction*, Washington, DC: University Press of America.

### Newspaper/ Web Articles

- Articles about the BP Texas City disaster: <http://business.guardian.co.uk/story/0,,2038680,00.html>, <http://business.guardian.co.uk/story/0,,1995649,00.html>

### Official Publications

- Information about COMAH legislation: <http://www.hse.gov.uk/comah/>
- Information about hydrogen fluoride from the USA's occupational health service: <http://www.osha.gov/SLTC/healthguidelines/hydrogenfluoride/index.html>

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<http://www.engsc.ac.uk/downloads/scholarart/ethics/safetymeasures.pdf>