# Nuclear decommissioning: turning waste into wealth

**A context-based learning (CBL) resource**

**Student handbook**

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Produced for the Royal Society of Chemistry

# Table of contents

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## Introduction

This resource focuses on the nuclear industry, with a particular emphasis on decommissioning and the re-purposing of radioactive waste. This is a particularly interesting, but not necessarily obvious, potential career pathway for chemistry graduates, as recognised in recent Chemistry World articles.

http://rsc.li/1UmPD6d

http://rsc.li/1QAdqtn

This resource lends itself to an interdisciplinary approach. You will consider the management of a nuclear decommissioning project with a focus on adding value by re-purposing the waste and also saving costs. As a team, you will be asked to consider how to re-purpose the waste materials, but within the context of health and safety regulations. You will also need to consider how the process of nuclear decommissioning will be communicated to the general public. Nuclear energy is a topic that is often portrayed as controversial or even dangerous in the media, so how you communicate your proposed work to the public will be extremely important to the success of the project. The activity will consist of several different small groups working on specific elements that will have to come together towards the end of the project to create one whole-project solution with a logical and workable timeline.

This project will help you to explore the challenges that face multi-disciplinary problem, such as decommissioning a power plant. It also serves to highlight the benefits of working within such environment. There is a short video from a person working in the industry, which will set the scene for the task. You will be working as a group and you will be expected to come up with a solution to the problem that has been set. The assessment is also designed to look for evidence of good teamwork, your ability to communicate findings effectively and to ask questions and assess the work of your peers. In this module we would like you will get a taste for the multidisciplinary nature of decommissioning a nuclear power plant, in a way that closely resembles real-life situations arising in industry.

You have to consider what it takes to decommission a nuclear power plant. This task involves many, diverse aspects. Let us start by defining what we mean by nuclear decommissioning. Nuclear decommissioning is the process of dismantling a nuclear power plant to the point at which radiation protection measures are no longer required. Completion of the decommissioning procedure means that former nuclear sites can be returned to general use.

In the UK we currently have 17 nuclear sites at various stages of decommissioning, ranging from first generation Magnox reactors, sites at Sellafield, Springfields and Capenhurst, as well as the fast-reactor research facility at Dounreay. The task of decommissioning a nuclear reactor involves many challenges, from the initial removal of the fuel for storage and reprocessing, to dealing with intermediate and low-level radioactive wastes. For example, in the case of Magnox reactors this task includes large volumes of graphite moderator. However, decommissioning is not simply about removal of radioactive waste in isolation. There are clear regulations to comply with, environmental, staff and public safety, alongside less nuclear-specific tasks, such as financing an operation that can take 20 – 100 years and cost hundreds of millions of pounds.

Your brief is to consider the key aspects of decommissioning and spent-fuel reprocessing. You should develop strategies to minimise the quantity of waste through creative uses of the materials involved, considering costs for the decommissioning and reprocessing procedures you propose. In doing so, you will explore, through various discussion topics and presentations, the radiochemistry involved in waste management, as well as more general topics, such as nuclear regulation and interactions with the media. You will be split into groups to fulfil various tasks for this module, but you must also organise and manage the whole project, coming together to discuss and integrate the different parts to produce a holistic solution.

## Learning outcomes

By the end of this module, you will be better able to:

LO1 – Work as a group to develop a solution to a complex, open-ended problem
LO2 – Research and evaluate information relating to the nuclear industry
LO3 – Propose holistic solutions for dealing with radioactive waste
LO4 – Present scientific information to different types of audiences (eg, general public technical specialist, business managers etc)
LO5 – Critically reflect on their own performance as an individual and as a team member
LO6 – Appreciate the complex issues involved in decommissioning
LO7 – Understand how chemistry (and chemists) can be applied (and contribute) to solutions for decommissioning.

Also, demonstrate knowledge and understanding of:

- Types and sources of radioactive waste
- Chemistry of key radionuclides
- Socio-political impacts of radioactive waste and nuclear waste management and decommissioning
- Key aspects of legislation and policy
- Role of public engagement and accountability in the policy and regulation framework
- Principles of project management, including project appraisal and financing
- Principles of risk assessment, hazard identification and reduction in project planning

Apply knowledge and understanding of:

- Waste processing, treatment and encapsulation technologies and waste management strategies for their specific project
- The case for geological disposal of nuclear waste and the multi-barrier approach to the construction of a post-closure safety case
- Project management for their specific project
- Legal and regulatory requirements for their specific project

Demonstrate:

- Critical thinking,
- Time management
- Commercial/business awareness
- ICT skills

### Assessment
Assessment briefs, mark sheets and assessment criteria are provided in each case.

**Management group meeting**
(Evaluate management of the activity and group dynamics)
(LO1, LO2, LO3, LO6, LO7)

**Technical report**
(LO1, LO2, LO3, LO4, LO6, LO7)

**Press release**
(LO4)

**Peer evaluation**
(Based on WebPA system)
(LO5)

**Self-evaluation/reflection**
(LO5)

## Course structure for the project
This structure has been designed assuming that there will be a one hour session each week for the course.

## Table 1: Course structure

| Schedule | Time commitment |
|---|---|
| Weeks 1 – 6 | One hour session per week.<br>An additional 2 hours per week of self-study in conjunction with the material provided are expected. |
| Weeks 7 – 9 | In total 5 group meetings<br>One hour per week project workshop session<br>An additional 5 hours per week of self/group study are expected on the project |
| Week 10 | Two hour skills and reflection session<br>Approximately 5 hours of preparation for the management meeting (ie. assessment) are expected. |
| Week 11 | Assessment in the form of a management meeting |

Total: 48 hours + assessment

## Session 1 – Radiochemistry

**PowerPoint 1 + video interview with a radiochemist**

The aim of the radiochemistry session is to introduce you to the key techniques used within the nuclear industry to separate useful fuel from waste. A key point is to be able to appraise the benefits and drawbacks of the types of methods used, particularly for the widely applied solvent extractions. A further aim is to provide you with an overview of the whole nuclear fuel cycle, to convey the multifaceted nature of the challenges involved.

## Session 2 – Yellowcake discussion

As part of the yellowcake discussion, the procedure for producing nuclear fuel is presented. Here, you will be able to observe the synergies between the processes and techniques used for extracting uranium fuel from ore, including its preparation for enrichment and the chemistry behind fuel reprocessing. This insight will enable you to see the wide applicability of their skills within the nuclear industry. Additionally, it allows you to discuss the key steps in uranium extraction and the broader socio-political factors that need to be considered eg how the choice of reactor design relates to issues of proliferation.

## Session 3 – Low-level radioactive waste disposal

**PowerPoint 2**

Here, you are introduced to waste classification and the legal limits that determine the treatment, handling and disposal of such waste. The focus is on low-level waste and how it is treated in the UK. However, as part of the discussion, differences in waste classification between the UK and other countries will be highlighted. You will also be asked to consider novel solutions to waste disposal, such as accelerator driven systems. As part of this session, you are expected to critically assess different strategies for waste disposal, such as the possibility of retrieving the waste in the future, and the implications of such strategies.

## Session 4 – Legislation health and safety

**Power Point 3, handbooks + video**

You will be introduced to the most relevant parts of the legislation governing decommissioning. You will also be given appropriate documentation for subsequent discussions led by the tutor. This will be augmented by considering the legislative implications of several real-world examples, also led by the tutor.

## Session 5 – Media
**PowerPoint 4 + videos**

A discussion on what it takes and “Do you think this is a career option for you”? A short video from a prominent scientist involved in science communication on the television and radio will be made available to you prior to this session. This will be complemented by a presentation on the fundamentals of working successfully with the media, together with examples of what (and what not) to do.

## Session 6 – Group discussions on media interaction

You will be asked to look for examples of convincing, unconvincing or misleading media interactions and to bring those to the discussion. You will also be asked to explain why you consider the examples you've picked fall into these categories. This will be discussed among your peers and also with the tutor.

## Session 7 – Workshop for working on the project

## Session 8 – Workshop for working on the project

## Session 9 – Workshop for working on the project

## Session 10 – Skills and individual reflection assignment
**PowerPoint 4**

Class discussion on skills required for working in the nuclear industry
Discussion on the individual reflective assignment

## Session 11 – Management meeting
**Assessment**

# The project brief
You will be split into groups for the project. You should imagine that you work for a nuclear energy company, and that your task is to work as part of a specially commissioned interdisciplinary team to develop a safe and compliant method for the decommissioning of the power plant.

The groups will be split into two sets. Half of the groups will be working on the radiochemistry side of decommissioning and the other half on waste disposal. After the introductory workshops and the discussions with the tutor you will explore questions like:

- What are the conventional methods of decommissioning used at the present time (eg testing, analysis, legislation, health and safety, etc.)?
- Are there any alternative methods, well known or new, which could be used?
- Is the use of alternative methods going to be beneficial and have you spotted some gaps in the system?

You should describe the results of their findings individually in your final technical report. Additionally, as a group you will have to prepare a short summary (2 pages), which will be distributed to your peers before the final meeting.

## Assessment

There is no final examination associated with this module. All the marks come from four pieces of coursework: the technical report, the management board meeting, the personal and peer reflection and the press release. The assessment of the technical report and project presentation (during the management board meeting) will be staff marked as a team contribution i.e. all members of the team will get the same mark. However, the team mark will be modified by the peer assessment (PA) score (which is a reflection of the individual's contribution to the group effort) to yield a mark for each student. (See the group-work section and appendix 8 to see how the PA score is derived).

### Technical report

**Weighting 30%**

The technical report should be a record of all of the work undertaken by the group in arriving at the final presentation for the project. The technical report should include:

- Details of the technical, legislative, commercial/financial and safety considerations for the project.
- Your conclusion on the effectiveness of the methods used currently and also your findings on the direction of new and alternative approaches which could be beneficial.

The criteria against which the technical report will be assessed are given in appendix 1. As can be seen, the bulk of the marks will be given for content of the material. However, the report should be collated in such a way that it is easy for someone who has not been involved in the project to follow and to find out what has been done. Therefore, there are marks for having a logical structure and a complete table of contents.

A short summary of the findings of each group (2 pages A4) should be submitted two weeks prior the management board. This should be distributed to the panel members (staff assessors), and to the other groups of students working on different tasks who will be attending the board meeting. This latter point is important. As well as giving you the opportunity to prepare questions for the other groups in advance, each group will increase their knowledge through exposure to this additional material. This should help you to grasp the overall complexity and synergy of the task as a whole. Also, by dividing the students in groups and asking different groups to work in parallel on the same problem we should stimulate your competitive side.

## Management board meeting

**Weighting 30%**

The management board meeting is the culmination of work on the project. As a group, you will meet with all the other groups. Each group will be given 15 minutes to present their work on the project. There will be additional time (15 minutes) for your peers from the other groups to ask questions. You will be required to make a good and professional impression when presenting and additionally, work well as a team (20% of the final presentation mark will be for group coherence). The questions asked by students to members of the other groups are also taken into account when deciding on the final marks. Not only should you be able to get a feeling of realism and involvement if you are the one asking the questions in the meeting, but also it will teach you to asses work in a critical way and also to extract the most relevant information from the reports of your peers. The board meeting will be observed by a panel of academics and industry professionals who will be in a different room, monitoring you via a video-conference connection. The panel will only intervene if there is a need to or to request clarification of a point, eg to ask you for additional information necessary for the assessment. The assessment sheet that the panel will use, including an explanation of the marking criteria, is shown in appendix 2 at the end of the module handbook.

## Personal and peer-reflection

**Weighting 20%**

The personal reflection will be completed and handed in individually. The reflection should be approximately 1000 words, summarising skills, knowledge and competencies developed during the module and reflecting and evaluating on your progress and experiences.

When completing the summary:

- You should try to analyse your experiences and say what you have learnt as a result of participation in the module. Thoughts about personal development, how organisations work, as well as how you plan to build on what you have learnt from this experience in the future (i.e. an action plan), should be included.
- You should set out what you hoped to get from the experience and quantify if your expectations have been met? How have you made the best of this opportunity?

- If you had problems, how were these resolved? Does this tell you something about how you will be able to cope in the future?
- You will assess your group peers. This will enable you to consciously and quantitatively compare your own performance against that of the other members of your group and to reflect on any differences.

## Press release: Short article or a video for the press

**Weighting 20%**

At the end of the module you have the option of making a short video (10 min) or writing a press release (max. 1000 words) in which you explain and present your project tasks and outcomes to the general public. This assessment will not only show what you have learned from the interaction with the media workshop, but will also open a new direction in terms of job opportunities for you. Additionally, it will be a valuable lesson about how important it is to be able to communicate science. In this time of total digitalisation through which we are living and the ubiquitous nature of social media, skills in this area are becoming ever more essential and sought after.

 

# Resources

## Science communication – The good, the bad and the ridiculous

It is no secret that there are so many incredible minds in the world who are working to advance the forefront of their fields. However, the science is rather useless – no matter how sound it may be – unless it can be communicated effectively.

Research scientists have to convince production companies that products are safe and effective. Distribution companies need to know how to market products so that they sell. Health organisations need to be able to give the public accurate information and advice. It all boils down to being able to communicate scientific information effectively to a particular target audience.

Of course, this is sometimes much easier said than done. People without a strong background in science can sometimes very easily misinterpret information. For example, this scientific study…

"Hydrogen sulfide is a gas associated with the disgusting smell of rotten eggs or human flatulence, that can be fatal in large quantities. However, the human body uses enzymes to create small amounts of the gas for cellular signalling as well. A group of researchers led by Matthew Whiteman of the University of Exeter have created a molecule called AP39 which delivers hydrogen sulfide to mitochondria in epithelial cells to preserve the function of the cells, and possibly aid in fighting disease. The results of the study were published in the journal *Medicinal Chemistry Communications* with a follow-up report published in *The Nitric Oxide Journal*."

…became this viral fiasco

"Can smelling farts cure cancer? Scientists say yes-ish"

Now we will look at some examples of both convincing and unconvincing communication. It is important to distinguish what the difference is between the two and how you can apply this to your own plans for public engagement.

### Convincing example

https://www.youtube.com/watch?v=zORv8wwiadQ

Clocking in at nearly 7 million views, it is clear that this video has reached a great deal of people. It is also clear that, after watching this, few people could argue that it is anything less than a great example of communicating scientific ideas to the public – in this case the topic is climate change.

But what is it that actually makes this such an effective tool for public engagement? Think about:

- Media – are you more likely to watch a video than read a newspaper article?

 

- Target audience – is this video likely to go to scientists or non-scientists? Students or non-students? Adults, children or both?
- Language used – is everything clear and concise? Is anything too complex? Is anything too simple?

Upon reflection, do you think that there is anything you could do to improve this? What would you need to adapt to make it suitable for your own project?

**Unconvincing example**
https://www.youtube.com/watch?v=XdLyMhNdcSc

Though this video only has a fraction of the views of the previous video, 160,000 people is still a substantial number (it's more than 5 times the total number of students at the University of Leeds) and so it is important to realise that inappropriate information can be circulated just as easily as convincing information.

Though this is undoubtedly a controversial topic, this particular video is a very poor example of 'giving people the right information.'

Consider:

- Pop-ups – Do they enhance the video at all? Do they look reputable? Are they even necessary?
- Motive – Is the person speaking of their own beliefs without bias or is there a hidden agenda? (hint – notice the links at the end)
- Jargon – Is all of the language used clear and understandable? Does the speaker explain any of the technical terms he uses? Is all of the dialogue actually necessary, or could it be simplified to avoid repetition?
- Evidence – Where is it? Are there links provided for you to find more information?

It shouldn't be too difficult for you to think of ways to improve this, but what you should really be reflecting on is how you're going to tailor your own ideas to avoid making similar mistakes. (In particular, think about the types of language you're going to use. If you're trying to reach out to the general public, you need it to be well understood by the majority – not the minority.)

**Successful example**
http://www.digitaluk.co.uk/

'digitaluk' is a non-for-profit organisation introduced to help consumers navigate the digital switch-over. Some of you may remember that in 2012 all analogue television transmission was stopped in favour of a digital service. There was outcry from many people in the lead-up to this, who were concerned that they would have to pay extra for this or that they would not be able to view certain channels any more.

In light of this, the digital-uk campaign was formed to inform the public of how they would be affected by the changeover, answer FAQs and help people prepare their television sets for the change.

This was arguably an incredibly successful campaign as the switch-over is now 2 years past and has gone very well. Why was it so successful/well orchestrated? Think about:

- Simple infographics – does a picture really speak a thousand words?
- Interactive support – how helpful was it having a helpline/website for the public to refer to?
- Information – how informative are the posters/billboards? Do they contain enough information? Or not enough?
- Mascot – Do you think the 'robot mascot' was helpful in engaging the public? Do you think having a recognisable 'logo' was a powerful tool?

Simple pictures and posters can be very effective but remember what Einstein said – "Keep your idea as simple as possible, but no simpler!"

### Controversial example – Social media


**Figure 1: Anti-vaccination image.**

This final example is a word on the dangers of social media. It is important to realise just what a powerful tool it can be, with the ability to post virtually any piece of information you can conceive of and have it potentially reach millions of people within a day. For example, Facebook alone has approximately 757 million daily users and 1.23 billion monthly users.

The problem with this, of course, is that anyone can have a Facebook account. People who use these social networking facilities will very rarely look at the credentials of the person posting the information, nor will they research the information themselves. Unfortunately, there is sometimes a tendency for users to blindly accept what they read – which is what makes it such a dangerous medium.

Thinking specifically about the above examples – but also about other things you may have seen/read – you need to consider the possibility that whatever pictures/information/infographics/logos you may use have the potential to end up on these sites. Think about:

- A useful tool – will you shun or actively use social media as a means of public engagement? (hint: have a think about how many companies have twitter/facebook accounts)
- Sources – is it clear where you've got your information from (if you're using any facts or figures) or where people can find more information?
- Trending – Is there any way you could use social media as a means to promote your campaign? A simple slogan can stand out more than a 3 page essay #hashtagpower

Social media is undoubtedly a powerful tool – if you can use it properly.

## Writing in science

Writing is used to communicate, and a variety of styles are needed to reach a variety of different audiences for a variety of different purposes. In science the main uses are to report new research, observations or events, to persuade governments or companies to fund new ventures, or for public information and education.

Some of these require a very formal, concise approach, when conveying precise information is most important. This is the style used in a scientific research papers. However, engaging public interest requires a more animated style, where the information to be conveyed must first catch attention and then be of relevance to their life or situation. It is this second style that will be addressed in this assignment.

This table summarises characteristics of **formal research writing**.

## Table 2:Features of formal research writing

| **Characteristic** | **Examples** | **Reasoning** |
|---|---|---|
| Formal structure | Abstract, introduction, method, results, discussion, conclusion | The structure of such a report is important because it ensures that the reader can access the information they need easily. |
| Third person/Passive voice | “Readings were taken at 5 s intervals” rather than, “I read the meter at 5 s intervals.” | Using the third person/passive voice stresses the procedure, it should not matter who carried out the experiment; writing in the first person makes reports read like a diary or a recipe. |
| Formal language | No slang: “cannot” rather than “can’t” | To be as clear as you can |
| Correct and appropriate use of technical terms | “Refractive index”, “stress” and “strain” | Technical terms and jargon are part of this style of writing, because the reader can be expected to be familiar with them. |

 

This table summarises characteristics of **popular science writing.**

## Table 3: Features of popular science writing

| Feature | Reasoning |
|---|---|
| Shorter, snappier writing | Make it easier and more interesting to read |
| Less formal language | Easier and more interesting to read |
| Less jargon | No point mentioning the jargon if the reader does not need to know about it. |
| Topical subjects | Being topical is an important part of the news – it's not news if it's not topical. |

## Writing press releases – Some tips

### What makes a story newsworthy?

In order for a story to be picked up by the media, it needs to be deemed newsworthy. What makes a story newsworthy in one medium or for one audience may not be newsworthy for another, so it is important to consider who the target audience is. There are also a number of other factors that need to be considered.

### So what?

In order for the press and the general public to take an interest in a story they need to be able to see the importance and the relevance of the work.

### Novelty

The story has to have some novelty about it. What is new about what you are communicating?

### Shock element

Is there some "shock" element to your story? If so, it is more likely to be published. However, you need to be mindful of possible implications of publishing such a story.

### Impact

The story needs to make an impact to society in some way. You can define the extent of this impact, and that will often influence where the story will be published.

### Relatable

The reader needs to understand what impact the story will have on their life or their environment. The story will only be published where the readership will be able to relate to the story.

### Writing a press release

Writing a press release is different to writing a research paper or report in a number of different ways.

 

### Headline
The headline has to attract the attention of the reader. Take a look at these examples on the BBC news website: http://www.bbc.co.uk/news/science_and_environment/

What would the 'research paper' equivalent title be?

### Writing in reverse
When writing a press release:

1. Start with the major findings. (Conclusion)
2. Next consider the implications. (Future work)
3. Then the method/analysis (Method and results)
4. Finally, the background (Introduction).

The reason is that the reader needs to understand the significance of the work and the implications in order to generate enough interest to read on. It is clear to see from the list that the order of writing is almost an exact reverse of a research paper or report.

### Implications
Consider the implications of what you have written. How would a non-expert interpret what you have said? Are there any inferences (intentional or inadvertent)?

### A picture paints a thousand words
Think about how an image or diagram can enhance your press release and attract the reader's attention. However, be mindful of copyright law when using images. If they are not Creative Commons licenced you will need to seek permission to use them.

## How to run and minute meetings
Before a meeting, you should try to ensure that everyone is clear about the agenda (and objectives) for a meeting. Your team should agree on this each time. The items on the agenda should be numbered. The same numbering system should also be used in the minutes.

Minutes should be taken, detailing the activities and the outcomes of each session. It is almost impossible to record the meeting "word for word". Therefore, it is a very useful skill to be able to pick out the important points and record them in a way that other people will be able to understand. The minutes have two major purposes: to record the substantive issues discussed (especially those agreed/approved) in the meeting and to provide a "things to do" list for the group.

When writing minutes, there are a number of rules that you should follow. It is important to avoid ambiguity; use specific details and avoid vague phrases such as, “as soon as possible.” When referring to additional documents ensure that a full reference is recorded, to allow the document to be easily located in the future. Use short, concise sentences and use the past tense. Any abbreviations that are used should be written in full the first time that they are used in each document. If there are a lot of common abbreviations it may be useful to produce a separate sheet of these abbreviations.

Action points should be clearly noted. Each action should be assigned to one or more of the team member(s). This will act as a reminder for what each member needs to do before the next session. As soon as you receive minutes and again prior to a meeting, you should read over the minutes of the previous meeting to remind yourself of what was discussed and also to check that you have carried out your action points (if not, try to do them asap if possible/appropriate).

If you are the chairperson you should make sure that the group keeps to the agenda (i.e. maintain the group’s focus). If the conversation starts to wander interrupt at a suitable point and bring the discussion back to the agenda item under consideration. If appropriate, the conversation can either be restarted in the correct agenda item, or under “any other business” at the end of the meeting; this should help to ensure that you cover all the agenda items and also make it simpler for the secretary to minute the meeting in a structured way. It is useful to summarise the key points at the end of each agenda item, to ensure that all members agree on the conclusion of each discussion. Also, the secretary will know what to minute from the discussion. At the end of each agenda item, the chair should ask the group members if they have anything else that they wish to discuss under each agenda item, before moving on to the next item. The chair should also try to ensure that all group members have a say in discussions and that any one individual does not unduly dominate a discussion or the meeting as a whole.

Each session should have a chair and a secretary. There are five sessions in all, so each member of your team will have an opportunity to play each role. If you, as a group, feel that it is appropriate, you can split a session into two or more meetings, each with separate minutes. The chair should ensure that the team sticks to the agenda, and that all the agenda items are discussed (unless the team agree to dismiss or hold it over to the next meeting). The minutes from the meetings will form part of the final assessment portfolio. This will be used to assess the ability of the group to execute tasks in a logical and timely manner, and also assess the ability to carry out and follow up on any actions generated. Minute taking is a valuable skill and your ability to take accurate and comprehensive minutes (but not containing waffle) will be assessed. Any group or sub-group meetings that take place outside of the five scheduled workshops should also be appropriately minuted/recorded.

Remember, the minutes should:

- Have a title
- Provide details such as: location, start time, end time, date, chair and secretary.
- List who was present and who was absent.
- Confirm the previous minutes as being an accurate and fair record (or note changes approved);

- Begin with matters arising from the minutes of the previous meeting.
- Provide a record of progress made with each action point.
- Provide an update on issues in minutes that are not going to be covered elsewhere in the agenda
- Provide a useful summary of the discussions that take place under each agenda item.
- List the decisions taken for future actions, who made the suggestions and show which individual(s) has/have been assigned to which tasks.
- Give the date of the next meeting.

Note, when a set of minutes have been finalised and approved they should be signed and dated by the chair (of the meeting considering them) on behalf of the team/committee. It is this signed copy that needs to be put into the final group assessment portfolio.

The requirement to produce team meeting minutes can serve several functions:

- It helps to keep the project on schedule, by providing a record of where you are up to in your work.
- It illustrates an important formal procedure, which you will come across in many workplace situations.
- It provides training in producing an informative, concise record of the key issues at a meeting. This is a highly valuable skill.
- It provides a formal structure for meetings, which may help to make them more efficient.
- It illustrates the method and effort made by a team which might not be reflected otherwise in their results.
- It provides a record of individual contributions that can act as a useful aid to assessment when assigning individual marks to a team effort.

An example (fictitious) set of minutes is outlined below. You should ensure that you use a logical numbering system. It is often useful to set the minutes out in a table.

## Staff-student committee minutes

Applied Science Department

Monday 5th December 2012, 12:00 – 1:30pm
Present: AB (chair), CD (secretary), EF, AM, JK, SM.

### 1 Apologies

AH, MS

### 2 Previous minutes (meeting on Tuesday 4th October 2011)

The minutes of the previous meeting were approved and signed by the chair.

### 3 Matters arising from the minutes of the meeting held on 11 October 2011

3.1. Re 4.1: Induction programme for new first years – reps from the science library and ISS have both agreed to participate next year, still awaiting confirmation from Royal Society of Science. (Action: CD to chase up SM).
3.2. Re 4.4: completed.
3.3. Re 4.6: completed.
3.4. Re 5.7: a response was tabled and approved by the committee.
3.5. Re 6.8: confirmed.
3.6. Re 7.2: ongoing. (Action: AB).

### 4 Safety

4.1 Fumehoods (LB)

An audit of work carried out in the laboratories, which requires the use of a fumehood should be drafted. This could be used to assess the needs of the researchers and their possible relocation in the department or the purchase of fume-cupboards. *(Action: LB)*

The results of the review of fume-cupboard space in the department should be discussed at the departmental meeting. *(Action: CD to raise in staff meeting and AM to raise in safety committee meeting)*

4.2 Apparatus left unattended forms (EF and SM)

There are new forms that all staff and research students should now be using when apparatus / reactions are left unattended. These forms must be countersigned by the supervisor or nominated person. *(Action: CD to distribute forms and details of procedures to all concerned and include in postgraduate handbook)*

### 5 Modular course review, lectures, practicals and assessment

5.1 Lecture times (JK)

Some lecturers are over-running the timetabled lecture session. It would be appreciated if lecturers would keep to the timetabled slot. *(Action: JK raise at L and T meeting)*

5.2 Overhead projector in MLT (JK)

This is partly broken and is likely to need replacing. *(Action: AM to raise in L and T meeting)*

5.3 ASCI3000 (JW)
Students would like a wider choice of projects *(Action: AB to raise in L and T meeting)*

5.4 ASCI2001 (CD)
This is a 10 credit practical module. The amount of material for this module requires reviewing *(Action: JK to review with practical sub-group committee)*

## 6 Postgraduate matters

6.1 Thesis/report feedback
It would be useful to students and supervisors if an approximate deadline for reviewing theses/reports was discussed when work is submitted to the supervisor for comment. *(Action: AB to raise in staff meeting)*

If this idea is agreed, the matter should be included in the postgraduate handbook. *(Action: CD)*

## 7 Main library student user group

7.1 CD as student rep
There has been a meeting already but CD was unaware of it taking place. *(Action: CD to contact library and follow up as necessary)*

AM queried if CD was also involved with issues relevant to the science library. This would be useful since many references relevant to the applied science department are kept here. *(Action: CD)*

## 8 Any other business

8.1 Deadlines related to ASCI2001 coursework were not maintained for the applied science students. *(Action: AB to raise in L and T meeting)*

8.2 Computers
Four new computers are now available in the common room for students to use.

There have been occasions when students have been told to leave computer clusters due to timetabled teaching sessions. A review of the use of computer clusters by students should be carried out *(Action: CD to see SM)*

8.3 Common room
This area is welcomed by the students as a place to meet fellow members of the department. However, students are reminded to maintain this area tidy and rubbish free. *(Action: student reps to inform year groups)*

## 9 Date of next meeting
5th March 2012

## The management board meeting

### Presentations – general

Throughout this module, and no doubt at other times during your degree, you will have undertaken various activities where you had to communicate verbally with your friends, classmates and tutors. Many students find presentations nerve wracking and so try to avoid them. Although giving a presentation may seem daunting, they do become easier with practice and they do develop skills useful for future employment eg the ability to plan, develop and communicate a theme. When they go well they can be an excellent confidence booster. As with most things it is essential that you plan well before giving a presentation and that you are familiar with the material. Below are some tips.

- Make sure you are clear about the purpose and length of the presentation and the target audience.
- Research topic thoroughly and allow sufficient time for preparation of the presentation
- Make sure the presentation is ordered logically into introduction main body of information and concluding remarks or summary
- Check the facilities available; for example if you need a projector with computer make sure you have access to these
- Practise presentation by giving it several times to an empty room or to friends; and them to listen and could teak the content and delivery
- Try recording your presentation and listening back to it. Are you talking too quickly, too slowly? Is their variation in your intonation?
- Make sure you maintain eye contact with your audience: never turn your back on them to deliver the presentation to the projector screen (a frequent mistake made by people who are nervous)
- Make sure your audience can hear you by speaking clearly and sufficiently loudly (in a large room a good tip is simply it ask people at the back if you can be heard)
- Deliver at a pace that is not too fast and not too slow (if you have rehearsed with an audience of friends and then they should have advised you on this). There is a temptation when nervous to speak too rapidly – if you have rehearsed well you should be able to overcome your nerves
- Never read out your presentation to your audience: this appears monotonous and reduces lack of eye contact (i.e. it stifles interaction with your audience)
- Make sure you know how to pronounce scientific terms before the presentation – this will add to your confidence
- If using PowerPoint slides, take advice from your tutor on font size and display options – do not be tempted wow your audience with your technical abilities at the expense of the actual content. Do not display too much information and never read from the slides, use them as a prompt only – the slides should complement the content of your talk
- At the end of the presentation thank your audience and asked them if they have any questions: thorough preparation should mean you are able to answer them.

[List taken from: Verran and Dawson (2011)]

### Guidelines and pointers for this assessment

Although this is a “meeting” you need to prepare as if you were giving a presentation; You need to present your ideas to start the dialogue with the other group.

Don't panic — the assessor is there to see the extent of your knowledge not to trip you up or make you look bad.

Don't get bogged down in the detail, the presentation needs to be succinct — the questions will provide an opportunity for you to expand on areas.

You don’t have to use PowerPoint, although you might want to use it to structure your ideas. However, it is unlikely that you will have a projector, so you will need to give a handout to the other team members if you want them to see your slides. You can use handouts or diagrams if you think it is appropriate.

## Group work

The majority of work you do in this module will be done as part of a group. This is for a number of reasons; most importantly, the best way to learn to work as part of a team (a key skill for employers) is to work as part of a group or team. Also when they work well, teams achieve results greater than the sum of the individuals.

### Calculating each individual contribution to group work

To try and best reflect every individual's contribution to the team effort, the group mark for the progress log and project pitch will be multiplied by a peer assessment (PA) factor so that each student will get an individual mark for the coursework.

Individual student’s mark = Student’s PA score × Group mark

To calculate the PA scores at the end of the module you'll be asked to score yourself and your colleagues’ efforts using the criteria in the table below. (A worked example of how the numbers are used to calculate each PA score is given in appendix 8).

## Table 4: Peer evaluation scores

| **Write the names of the other group members in the blank boxes on this row:** | **You** | | | | |
|---|---|---|---|---|---|
| Level of enthusiasm/participation | | | | | |
| Suggesting ideas | | | | | |
| Understanding what was required | | | | | |
| Helping the group to function well as a team | | | | | |
| Organising the group and ensuring things get done | | | | | |
| Performing tasks efficiently | | | | | |

(For each criterion marks are awarded as follows: 4 for 'better than most of the group in this respect', 3 for 'about average for this group in this respect', 2 for 'not as good as most of the group in this respect', 1 for 'no help at all in this respect' and 0 for 'a hindrance to the group in this respect'

You will see that the criteria focus on a range of activities that help a team work effectively. This table should be used to genuinely reflect the range of contributions within a working team. Obviously a score of 0 can and should be given where deserved. However, for someone who has seriously hindered the function of the team, such as by persistent absence or obstructive behaviour (and so deserves a string of 0s) then this table should not be the first indication of that behaviour.

# Appendices

## Appendix 1: Technical report assessment sheet

Group members:

Project title:

Module:

| | Fail | Poor | OK | Good | Excellent |
|---|---|---|---|---|---|
| Appropriate technologies selected | E | D | C | B | A |
| Business justification for the technologies | E | D | C | B | A |
| Understanding of the science | E | D | C | B | A |
| Well-presented/good standard of writing | E | D | C | B | A |

Comments:

To improve:

Overall grade/mark for company description:

 

## Appendix 2: Management meeting assessment sheet

Group members:

Project title:

Module:

| | Fail | Poor | OK | Good | Excellent |
|---|---|---|---|---|---|
| Professional conduct | E | D | C | B | A |
| Good teamwork demonstrated | E | D | C | B | A |
| Well-presented argument | E | D | C | B | A |
| Scientifically sound | E | D | C | B | A |
| Appropriate decision for the business | E | D | C | B | A |

Comments:

To improve:

Overall grade/mark for company description:

 

## Appendix 3: Press release/video assessment sheet

Group members:

Project title:

Module:

| | Fail | Poor | OK | Good | Excellent |
|---|---|---|---|---|---|
| Professionally written/presented | E | D | C | B | A |
| Succinctly written/presented | E | D | C | B | A |
| Well-presented argument | E | D | C | B | A |
| Appropriate for the target audience | E | D | C | B | A |

Comments:

To improve:

Overall grade/mark for company description:

 

## Appendix 4: Self and peer reflection assessment sheet

Name:

Student ID:

Project title:

Module:

| | Fail | Poor | OK | Good | Excellent |
|---|---|---|---|---|---|
| Reflection on own skills development | E | D | C | B | A |
| Reflection on working in a team | E | D | C | B | A |
| Consideration of skills developed | E | D | C | B | A |
| Reflection on impact on own career plans | E | D | C | B | A |

Comments:

To improve:

Overall grade/mark for company description:

 

## Appendix 5: Marking criteria

## Table 5: Technical report

| Mark | Appropriate technology selected | Business justification for technology | Understanding the science | Well-presented/good standard of writing |
|---|---|---|---|---|
| A | Highly relevant decision.<br><br>Very clear and well-articulated explanation of the decision | Excellent justification showing high level of business insight.<br><br>All content highly relevant | Clear evidence of extensive research. Excellent examples showing excellent understanding and insight | Excellent and professional use of language.<br><br>No spelling or grammatical errors. |
| B | Good decision.<br><br>Reason for the choice is well-articulated | Keeps a clear focus on the business justification.<br><br>All material relevant | Shows evidence of a range of relevant research. Supports points well with examples. Good understanding of the science. | Good use of language.<br><br>Suitably professional tone, good grammar and spelling. |
| C | A relevant decision, although the reason for the choice may not be well articulated. | Focuses on the business justification<br><br>Occasionally include some minor irrelevancies. | Shows evidence of some relevant research. Supports most points with examples. Limited understanding of the science. | Adequate use of language.<br><br>I.e. Overall clear, though some minor errors in spelling or grammar. |
| D | Choice has limited scope. | Some failure to focus on the business at times. May have omitted some basic concepts or included unimportant areas. Is not always relevant | Shows evidence of limited research; Supports some points with examples but these may be badly chosen. Very limited ability to summarise | Poor standard of writing.<br><br>Several spelling and grammatical errors. |
| E (Fail) | Poor decision. Technology is of no relevance to the exercise | Has not addressed the subject matter in any substantial way.<br><br>The document contains much irrelevance. | The presenter shows minimal or no evidence of background reading. Points made in the presentation are unsupported. May be major errors of fact. | Extremely poor writing that affects understanding.<br><br>I.e. many spelling/grammatical errors. |

## Table 6: Management meeting

| Mark | Well-presented argument | Good teamwork demonstrated | Scientifically sound | Appropriate decision for the business | Professional conduct |
|---|---|---|---|---|---|
| A | Clear evidence of extensive research. Excellent examples showing excellent understanding and insight | Excellent synergy between team members. Highly coherent presentation and answered questions very well as a group. | Very clear and well-articulated explanation of the science and the decisions taken. | Highly relevant decision.<br><br>Very clear and well-articulated links to the business and its future plans | Excellent articulation and confident speaking. Excellent listening skills demonstrated within the team and answering questions. |
| B | Shows evidence of a range of relevant research.<br><br>Supports points well with examples. Good understanding of the business. | Good synergy between team members. Coherent presentation and answered questions well as a group. | Understanding of the science and the reasons for the decisions made are well-articulated. | Good decision for the business.<br><br>Links to the business and its future plans are well-articulated | Articulate and appropriate speaking.<br><br>Good listening skills demonstrated within the team and answering questions. |
| C | Shows evidence of some relevant research. Supports most points with examples. Limited understanding of the business. | Some synergy between team members. Mostly coherent presentation and answered questions reasonably well as a group. | Relevant and sensible decision although the reason for the decisions may not be well-articulated. Some areas of confusion with the science. | A relevant decision for the business, although the significance of the choice may not be well-articulated. | Mostly articulate; lacking confidence in places.<br><br>Mostly answered questions well and responded well to other team members. |
| D | Shows evidence of limited research; Supports some points with examples but these may be badly chosen. Very limited ability to summarise. | Lack of synergy between team members. Patchy presentation and didn't work as a team to answer questions. | Not always clear why decisions made are scientifically sound. | Decision is of limited value to the business. | Not confident in delivery. Mostly conveyed the message.<br><br>Answered some questions well but others poorly. Some friction within the team. |

| | | | | | |
|---|---|---|---|---|---|
| E (Fail) | No evidence of background reading. Points made are unsupported. May be major errors of fact. | Inability to work as a team.<br><br>Clear signs of friction between team members. | No explanation of the decisions made or incorrect scientific assumptions. | Poor decision for the business and lack of evidence for the decision making. | Inarticulate and hard to comprehend.<br><br>Inability to answer the questions. Poor teamwork. |

## Table 7: Press release

| Mark | Professionally written/presented | Succinctly written/presented | Well-presented argument | Appropriate for the target audience |
|---|---|---|---|---|
| A | Excellent catchy title. Highly relevant picture. Excellent formatting for whole article. References correctly and neatly displayed. | Excellent grammar, spelling and punctuation. All text in proper paragraphs. Good use of subsections. Attention grabbing introduction. Logical progression of ideas. Clear conclusion. | Science content completely correct Excellent evidence of background reading. | At a highly appropriate level for the target audience.<br><br>Highly informative and thought provoking. |
| B | Catchy title. Relevant picture. Good formatting for whole article. References mostly correctly displayed. | Mostly good grammar, spelling and punctuation. Text essentially in paragraphs. Maybe some subsections. Good introduction and clear progression of ideas. Summed up with conclusion. | Science content mostly correct. Good evidence of background reading. Some variety of good sources. | At essentially the appropriate level for the target audience.<br><br>Informative and interesting article for the general reader. |
| C | Acceptable title. Includes a picture. Acceptable formatting for text. Maybe some references, but not well displayed. | Several grammatical mistakes. Some text in paragraphs, but many stray sentences. No subsections. Progression of ideas but not attention grabbing or clear. No clear conclusion. | Some errors in scientific content. Poor evidence of background reading. Wikipedia used as main reference. | Not really at appropriate level for the target audience (may be too simplistic or too complex)<br><br>Some interesting elements. |
| D | Uninspiring title. No picture. Poor formatting for whole article. Limited referencing. | Poor grammar. Not really in paragraphs. No subsections. Poor progression of ideas Hard to follow. No conclusion. | Very limited science content. No real evidence of background reading. References non-existent, or only Wikipedia used. | Not really at appropriate level for the target audience. Little or no information about the topic. |
| E (Fail) | No noticeable title. No picture. Very poor formatting. No references. | Really poor grammar. No real structure to text. Hard to follow. | No evidence of research. No references. | Totally inappropriate for the target audience.<br><br>Of little interest or relevance to the general reader. |

(Adapted from criteria developed by Dr Alison Voice, University of Leeds, with permission)

## Table 8: Reflection

| Mark | Reflection on own development | Reflection on contribution to team | Consideration of skills needed in nuclear industry | Consideration of own future career plans |
|---|---|---|---|---|
| A | Highly reflective account of own development through the course.<br><br>Excellent examples throughout | Highly reflective account of own contribution to the team through the course.<br><br>Excellent examples throughout | Extensive and very insightful consideration of the skills which are most relevant to nuclear industry. | Detailed consideration of own career thinking and how the module has impacted on the decision making process. |
| B | Good reflective account of own development throughout the course<br><br>Good examples used to illustrate the point. | Good reflective account of own contribution to the team throughout the course.<br><br>Good examples used to illustrate the point. | Thorough and insightful consideration of the skills which are most relevant to nuclear industry. | Consideration of own career thinking and how the module has impacted on the decision making process. |
| C | Good reflection in places of own development but also quite descriptive.<br><br>Some examples given. | Good reflection in places of contribution to the team, but also quite descriptive.<br><br>Some examples given. | Good consideration of the skills that are most relevant to nuclear industry. | Limited consideration of own career thinking and how the module has impacted on the decision making process. |
| D | Mostly descriptive account of own experiences.<br><br>Very limited examples, or irrelevant for the point made. | Mostly descriptive account of contribution to the team.<br><br>Very limited examples, or irrelevant for the point made. | Very limited attempt to consider relevant skills for nuclear industry. | Very little consideration of own career thinking and no reference to the module. |
| E (Fail) | Very poor account. Conveys little or no useful information.<br><br>No examples given. | Very poor account. Conveys little or no useful information<br><br>No examples given | No consideration of skills required. | No consideration of own career thinking. |

## Appendix 6: Initial skills audit – start of project

Adapted with permission from University of Leeds (Chemistry: Idea to Market; S Maw, P McGowan and S Pugh) and University of Birmingham (Mathematics in Industry; M Grove)

Please complete this audit on your own. Try not to over analyse but give your immediate feeling of how experienced you feel in each of these skill areas, how able you are (i.e. how well you perform these tasks) and how confident you feel when doing these activities. It is important you give brief (bullet point) examples of activities you have undertaken for each skill if you are able to do so.

## Table 9: Initial skills audit

| Skill | Brief description | Score (1 – 5) | | | Notes and example activities |
|---|---|---|---|---|---|
| | | Experience | Ability | Confidence | |
| Teamwork | Be able to work as part of a team by making meaningful contribution to a collective task | | | | |
| Communication & persuasion | Persuade others, using a variety of approaches, through informed opinion and negotiate support for ideas | | | | |
| Decision making | Evaluate issues and make decisions in situations of ambiguity, uncertainty and risk | | | | |
| (Verbal) presentation | The ability to communicate ideas and arguments effectively verbally, using approaches tailored to the needs of different audiences. | | | | |
| Written (presentation) | The ability to communicate ideas effectively in writing, using approaches tailored to the needs of different audiences. | | | | |
| Project planning | Take responsibility in project planning and in the management of tasks and activities. | | | | |

| Skill | Brief description | Score (1 – 5) | | | Notes and example activities |
|---|---|---|---|---|---|
| Time management | The ability to work in an efficient, effective and flexible manner to prioritise and complete a range of tasks. | | | | |
| Finding information | Collect, evaluate and interpret information from a variety of sources; present findings objectively and concisely recognising any limitations. | | | | |
| Perseverance | Demonstrate perseverance, resilience and determination to achieve goals, especially within challenging or complex situations. | | | | |
| Independence | The ability to work and learn independently, using self-reflection to critique individual performance. | | | | |

## Appendix 7: Group work – evaluating the contribution from each group member

Please complete the table below assigning a value for each criterion for each person using the guidance below. The figures you give will be used to calculate the peer assessment factor as outlined in the module handbook.

## Table 10: Peer evaluation scores

| **Write the names of the other group members in the blank boxes on this row:** | **You** | | | | |
|---|---|---|---|---|---|
| Level of enthusiasm/participation | | | | | |
| Suggesting ideas | | | | | |
| Understanding what was required | | | | | |
| Helping the group to function well as a team | | | | | |
| Organising the group and ensuring things get done | | | | | |
| Performing tasks efficiently | | | | | |

For each criterion marks are awarded as follows:

4 for 'better than most of the group in this respect'

3 for 'about average for this group in this respect'

2 for 'not as good as most of the group in this respect'

1 for 'no help at all in this respect'

0 for 'a hindrance to the group in this respect’

## Appendix 8: Details of how the peer assessment score is calculated

The calculation is based around the allocation of a group mark for the work produced by the group (in this case for the project pitch) and the manipulation of this group mark to derive a mark for each individual within the group. The formula adopted is as follows

Equation 1: Individual student's mark = Student's PA score × Group mark

Where PA stands for Peer Assessment.

The PA score is obtained by asking students to access each other's contributions via a peer assessment form. Each individual's scores are then added up to give an individual PA total. This is then divided by the average PA total for the group to give the individual's PA Score.

Equation 2: PA Score = $\frac{Individual\ PA\ total}{Average\ PA\ total}$

The PA score reflects the individual's comparison with the other members of the group.

### A worked example

Three students, Angela, Julie and Thomas, worked in a group and received a group mark of 60%. The PA self-assessment results are summarised below:

In row 2 of the table: A= Angela, J = Julie and T = Thomas

## Table 11: A worked example of peer evaluation scores

| **Marks awarded to:** | **Angela** | | | **Julie** | | | **Thomas** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Marks awarded by:** | **A** | **J** | **T** | **A** | **J** | **T** | **A** | **J** | **T** |
| Level of enthusiasm/participation | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 2 | 2 |
| Suggesting ideas | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| Understanding what was required | 2 | 2 | 2 | 0 | 2 | 1 | 2 | 2 | 3 |
| Helping the group to function well as a team | 2 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 |
| Organising the group and ensuring things get done | 2 | 3 | 3 | 1 | 1 | 1 | 2 | 2 | 2 |
| Performing tasks efficiently | 2 | 3 | 2 | 1 | 2 | 1 | 2 | 2 | 2 |
| Totals | | | 39 | | | 21 | | | 36 |

 

$$Average\ PA\ score\ = \frac{(39\ +\ 21\ +\ 36)}{3} = 32$$

Applying equation 2 for each student reflects each individual's effort in comparison to the rest of the group. A PA score >1 is above average, <1 is below average.

$$Angela's\ PA\ score\ = \frac{39}{32}\ = 1.22$$

$$Julie's\ PA\ score = \frac{21}{32}\ = 0.66$$

$$Thomas'\ PA\ score = \frac{36}{32}\ = 1.13$$

Applying equation 1 is the final step which adjusts the group mark by the student's PA score:

Angela: 1.22 x 60% = 73.2%

Julie: 0.66 x 60% = 39.6%

Thomas: 1.13 x 60% = 67.8%

[Taken from Lejk et al., (1996)]

 

## Appendix 9: List of useful references

Nuclear energy's next generation, Chemistry World, October 2014
http://rsc.li/1UmPD6d

Careers clinic: Nuclear sector, Chemistry World, November 2010
http://rsc.li/1QAdqtn

Nuclear decommissioning authority
http://bit.ly/1VQoZRK

Nuclear sector jobs
http://bit.ly/1VQoZRK

Cogent Sector Skills Council: Nuclear Industry
http://www.cogentskills.com/nssg/

 