2-2 Nuclear Power

Main Reading text

Every **aspect** of our modern world needs energy. We need energy to power our cities, energy to transport goods around the world so that we can trade and **enrich** our lives, energy for local transport such as cars, motorbikes and buses, energy for communications such as the internet and smart phones, and energy for looking after the millions of animals and farms that we need to produce our food.

Since the recent past oil and gas have been our main **sources** of energy, and before that it was wood. But we have cut down most of the forests, and continue to destroy what little is left; and quite soon we will have used up all the oil and gas. So what is left? Without energy we will very easily return to the **primitive stone-age** life of a few thousand years ago.

There are several **options** for the future, and the one we are going to consider in this article is **nuclear** power. The type of nuclear power we are going to look at is the process of using the energy inside **atoms** to create heat, and then using this heat to create electricity.

There are two ways of using the energy of atoms, **fusion** and **fission**. Fusion happens when two atoms are pushed together with a lot of force. Nuclear fusion is the process that occurs in the sun as four atoms of hydrogen (very light) are pushed together to form one atom of helium (a little heavier) and energy is released. Hydrogen bombs obtain their **enormous** destructive power from fusion.

The other way of using the energy of atoms is nuclear fission. Fission happens when an **unstable** atom, such as uranium235 is split into more-or-less two equal parts and energy is released along with many **particles** known as **neutrons**. If there are enough of these neutrons, they can hit another unstable atom of uranium and cause that to split, and so on. More fission occurs, leading to what is called a chain reaction. However the neutrons can be controlled and so the reaction can be controlled, and this is the process that is used to **generate** electricity.

The energy released from splitting atoms is converted into heat by passing it through water. The water gets very hot and turns to steam. The steam is used to drive a **turbine**, and this turbine generates electricity. There is a link at the end of this unit which will take you to a good model of this process.

Turbines are essential for creating electricity, and we will meet them again in the next article.

Now we know the general principles of generating electricity from nuclear power. Let's consider some of the dangers. Usually we consider danger in terms of deaths. That is, how many people die as a result of some accident or as a result of using something. For example, how many people die each year from using the roads, and compare this to how many people die from using airplanes. It can easily be seen that using airplanes is much safer than using roads. But be careful, understanding results like this is not easy as there are many other **factors** to consider.

Another problem in understanding the danger from nuclear power stations is that the danger can take a long time to show. If you get hit by a car, the injury is immediate and easy to see. If you get **exposed** to **radiation** from a nuclear power station, there may be no **obvious** sign of injury for 10 to 20 years. You may then develop cancer, but proving that this cancer is a result of exposure to radiation is very difficult to achieve. In fact we can only do this **statistically**. For example, the **estimated** cancer deaths over the next 30 years from radiation exposure as a result of the Fukushima accident range from 15 to 1300, with an expected final number of 130. However, no cancer deaths have been recorded so far. As you can see these numbers don't really help us to understand the danger.

If we look at the number of people who are injured or who die in the nuclear power industry, including the **miners** who dig out the uranium and members of the public who suffer from the effects of pollution; and compare that with other power industries we can see that nuclear power is very safe.

Some estimates of death and injury world-wide for a two-year time period:

Coal:	2,736 deaths, plus 25,000 serious illnesses	total =027,736
Gas:	348 deaths, plus 3,400 serious illnesses	total =003,748
Oil:	342 deaths, plus 2,900 serious illnesses	total =003,242
Nuclear:	13 deaths, plus 54 serious illnesses	total = 000067

The problem with nuclear power is that if there is an accident, then you will not know you are in danger because you can not see, hear, feel touch or smell radiation. Plus, there is good chance that our food will be **contaminated**, but we will not know until we get ill. For example, radioactive **iodine** escaping from a nuclear power plant can contaminate a large area of grassland. The cows eat the grass and **concentrate** the iodine in their milk, which we then drink. Fortunately radioactive iodine does not stay radioactive for a long time, and in a few months the danger would be past, but during those few months we

could be in serious danger.

We have looked briefly at how nuclear energy is used to create electricity, and some of the problems. Now let's turn our attention to some the benefits.

Well, in fact the benefits are enormous.

The new generation of **fast breeder reactors** use uranium238 instead of uranium235. In these reactors the nuclear waste that is usually produced is recycled to create more energy. This results in much less radioactive waste and this recycling means that *at the moment* there is around 160,000 years worth of fuel available for energy production. Taking the overall amount of uranium available on earth, it has been estimated that there is up to five billion years' worth of uranium238 available for use.

In countries with nuclear power, radioactive waste **comprises** less than 1% of total industrial **toxic** wastes, much of which remains **hazardous** for long periods. Overall, nuclear power produces far less waste material by volume than fossil-fuel based power **plants**. Coal-burning plants are particularly noted for producing large amounts of toxic and mildly radioactive ash that are released into the atmosphere.

A 2008 report from Oak Ridge National Laboratory **concluded** that coal power actually results in more radioactivity being released into the environment than nuclear power operation, and that the general population receives about 100 times as much radiation as from a nuclear power station.
In fact only two things come out of a nuclear power station, electricity and steam. So nuclear power makes no contribution to global warming.

In **conclusion**, we must seriously consider how we are going to provide electricity for future generations, especially if we start using electric cars and bikes, increase the number of electrical **appliances** in our homes and get more and more connected in the internet.

Vocabulary

1. **ASPECT** (n) 方面

A part of something. The way a person, place, or thing appears or behaves.

Which aspect of university life do you think is most important?

He has the aspect of a man used to giving orders and seeing them obeyed.

2. **ENRICH** (v) 豐富

To improve the quality of something. To make something better.

They tried to enrich themselves at the expense of the poor.

How can I enrich my vocabulary?

3. **SOURCE** (n) 來源

Someone or something that provides what is wanted or needed.

The college had its own power source.

His job is the family's main source of income.

4. **PRIMITIVE (adj)** 原始的

a. Of, belonging to, or seeming to come from an early time in the very ancient past.

The time when primitive man first learned to use fire.

b. Very simple and basic. Made or done in a way that is not modern and that does not show much skill.

The technology they used was primitive and outdated.

5. **STONE-AGE** []

The time in the past when humans used tools made only of stone. A period in human history that ended about 8000 years ago.

6. **OPTION** (n) 選擇

The opportunity or ability to choose something or to choose between two or more things.

You have the option of staying home or coming with us.

7. **NUCLEAR** (adj) 原子核的

Of, relating to, producing, or using energy that is created when the nucleus of an atom is split apart or joined together.

NUCLEUS [] (n) 細胞核

The central part of an atom that is made up of protons and neutrons.

8. **ATOM** (n) 原子

The smallest particle of a substance that can exist by itself or be combined with other atoms to form a molecule.

Water is one atom of oxygen and two atoms of hydrogen (H2O),

9. **FUSION** (n) 溶解；溶化

A combination or mixture of things. A process in which the nuclei of atoms are joined.

10. **FISSION** (n) 分裂

a. A process in which the nucleus of an atom is split apart.

11. **ENORMOUS** (adj) 巨大的

Very big, or a very large amount of something.

They live in an enormous house.

We chose not to travel round the world because of the enormous cost.

12. **UNSTABLE** (adj) 不穩定的

Likely to change. Not held in a secure position. Likely to move or fall

The minute we put the books down on the unstable desk, the whole pile went crashing to the floor.

13. **PARTICLE** (n) 粒子

A very small piece of something. Any one of the very small parts of matter; such as a molecule, atom, electron, neutron and others.

14. **NEUTRON** (n) 中子

A very small particle of matter that has no electrical charge and is part of the nucleus of all atoms except hydrogen atoms.

15. **GENERATE** (v) 產生

a. To produce something or cause something to be produced.

This business should generate a lot of money.

Windmills used to generate electricity.

16. **TURBINE** (n) 渦輪機

A rotary engine driven by a flow of fluid, such as water, steam, or air. In this article turbines are use to generate electricity, although there are other types, such as jet engines in airplanes.

17. **FACTOR** (n) 因素

Something that helps to produce or influence a result. One of the things that cause something to happen.

Poor planning was a major factor in the company's failure.

18. **EXPOSED** (v) 暴露

Not protected or covered.

The exposed electrical wires were dangerous.

19. **RADIATION** (n) 放射線

A type of dangerous and powerful energy that is produced by radioactive substances and nuclear reactions. Also X-rays and any energy that you can not see, such as solar radiation from the sun.

20. **STATISTICALLY / STATISTICS** (adv) 統計地/ (n) 統計學

The branch of mathematics that deals with the collection, analysis, interpretation, and presentation of large amounts of numerical information; such as the number of cars on the roads at any particular time.

21. **ESTIMATE** (adj) 估計的

To give a general idea about the value, size, or cost of something. To make an estimate of something.

They estimated the distance to be about three miles.

22. **MINER** (n) 礦工

A person who works underground, in a *mine*, from which minerals such as coal, gold, diamonds, etc. are taken.

The snow covered mountain is reflected in the still water of the lake.

23. **CONTAMINATE** (v) 汙染

To make something dangerous, dirty, or impure by adding something harmful or undesirable to it.

Be careful not to allow bacteria to contaminate the wound.

Make sure the white paint is not contaminated by any of the other colors.

24. **IODINE** (n) 碘

A non-metallic element that is essential for the correct functioning of the thyroid glands in humans and other animals. It is also used in medicine.

25. **CONCENTRATE** (v) 集中

a. To make(something, such as a liquid stronger by removing water.

The soup should be gently cooked for a few minutes to concentrate its flavors.

b. To think about something. To give your attention to the thing you are doing, reading, watching, etc.

It's hard to concentrate with all that noise.

26. **COMPRISE** (v) 包含

To be made up of something. To include or consist of something.

The play comprises three acts.

A large community, comprising fifty buildings.

27. **TOXIC** (adj) 有毒的

Poisonous. Containing poisonous substances.

The gas from that chemical are highly toxic.

That chemical the farmer is spraying on his fields is highly toxic to birds.

28. **HAZARDOUS** (adj) 有危險的

Involving risk or danger,

It was a hazardous sea trip.

These hazardous chemicals can make you very ill.

29. **PLANT** (n) 工廠

Something that grows out of the ground, like a flower or tree, but also:

A building or factory where something is made. The land, buildings, and equipment of an organization

A furniture plant that employs hundreds of people.

30. **CONCLUDED / CONCLUSION** (v) 推斷出/ (n) 結局

To stop or finish. To come to an end. To end in a particular way or with a particular action. To form an opinion. To decide something after a period of thought or research.

They concluded that her argument was good.

We concluded we would have to wait a little longer.

31. **APPLIANCES** (n) 器具；設備

Machines such as a stove, microwave, or dishwasher that (in this case) are powered by electricity and that are used in our homes.

Review exercise

Choose to best word or phrase to complete the following sentences base on the text.

1. We need energy for local _____ such as cars, motorbikes and buses.
   (A. transport B. homes C. houses D. offices)
2. In the _____ oil and gas have been our main sources of energy.
   (A. future B. recent past C. times D. present time)
3. There are several _____ for the future.
   (A. transports B. places C. ideas D. options)
4. There are two ways of using the energy of _____, fusion and fission.
   (A. atoms B. nuclear power C. electricity D. power stations)
5. Nuclear fission is the process that is used to _____ electricity.
   (A. have B. send out C. generate D. power)
6. The steam is used to _____ a turbine, and this turbine generates electricity.
   (A. push B. generate C. drive D. create)
7. It is dangerous to get _____ to radiation from a nuclear power station.
   (A. exposed B. generate C. drive D. create)
8. The cows eat the grass and _____ the iodine in their milk.

(A. make B. generate C. bring D. concentrate)

9. Much of this toxic waste remains _____ for long periods.

(A. inside B. hazardous C. difficult D. transported)

10-. Nuclear power produces far _____ waste material by volume than fossil-fuel based power plants.

(A. less B. small C. away D. fewer)

True or False

1. Hydrogen bombs obtain their enormous destructive power from fission. T/F
2. Neutrons are an important part of the fission process. T/F
3. Nuclear power comes from the energy inside the sun. T/F
4. A controlled chain reaction occurs in the fission process. T/F
5. The energy released from splitting atoms is converted into heat by passing water through the atoms and molecules. T/F
6. The steam created by the nuclear reaction is used to drive steam engines. T/F
7. Statistics is used to describe the behavior of large amounts of data. T/F
8. Radioactive iodine escaping from a nuclear power plant can never contaminate grassland. T/F
9. Even if radioactive iodine escapes from a nuclear power plant, it won't cause any harm to humans because we don't eat it. T/F
10. Coal-burning plants produce large amounts of toxic and mildly radioactive ash that is released into the atmosphere. T/F

Reading Comprehension - choose the best answer

1.( )Why could nuclear power be so important for the future energy needs of our planet?

a. The sun is burning fuel all the time, therefore at some time in the future it will have no fuel left and so we need to think now about our future energ needs and how we will survive.

b. At some time in the future we will run out of fossil fuels, such as gas and oil, and therefore we need to start preparing now for future energy needs.

c. Because the population of the world is increasing, we need nuclear energy to provide electricity to the farms that look after the millions of animals that we need to produce our food.

d. Nuclear power has lots of benefits and is not dangerous and therefore should be used by every country.

2. ( ) What is the main problem we face when we use nuclear power?

a. There are several problems with using nuclear energy to create electricity, but the main problem is that the process of getting energy from atoms is the same process as making hydrogen bombs, and so it is a very dangerous technology.

b. There are several problems with using nuclear energy to create electricity, but the main problem is the large amount of toxic waste that is created. Keeping this waste safe and stopping it from contaminating our environment is a serious difficulty.

c. There are several problems with using nuclear energy to create electricity, but the main problem is the high number of people killed or suffering serious illnesses as a result of working in the nuclear industry.

d. There are several problems with using nuclear energy to create electricity, but the main problem is one of accidental contamination. This is a dangerous problem because we may not know that we, and some of our food is being contaminated.