

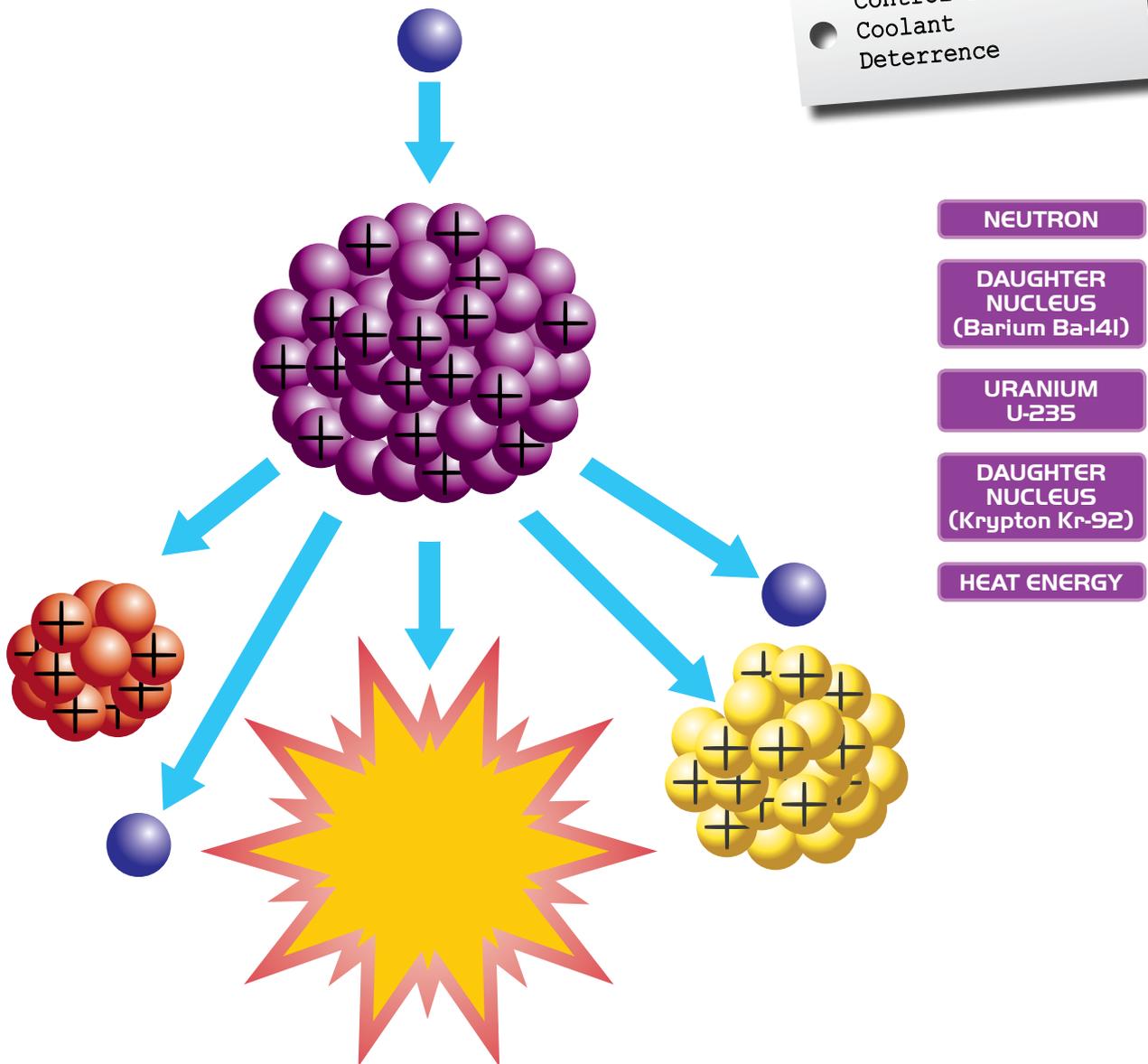
Nuclear Fission

Part I. The Moment of Nuclear Fission

The following diagram represents the moment of nuclear fission. It is not possible to actually film this taking place because the atoms are too small to see them reacting. Label the diagram using the words in the purple boxes.

Word Bank

- Radioactivity
- Uranium
- Half-life
- Nuclear fission
- Chain reaction
- Nuclear reactor
- Control rods
- Coolant
- Deterrence



As additional neutrons are released after the moment of nuclear fission, these in turn can strike further uranium nuclei, causing more reactions.

However scientists know enough about the process to be able to control the reaction to release sufficient energy to just generate useable power. This is the process that takes place in power stations and on board Royal Navy nuclear-powered submarines.





Nuclear- Power on Submarines: For or Against?

Following are extracts from recent articles, issued by the Campaign for Nuclear Disarmament (CND) and the Royal Navy. Read these carefully, underlining key points for and against nuclear power on submarines.

Article 1 Nuclear-Powered Submarines
Statement produced by CND (Campaign for Nuclear Disarmament), 2001

Campaign for Nuclear Disarmament

"Last year's tragic accident to the Russian nuclear-powered submarine Kursk focussed the world's attention on the hazards of nuclear power afloat.

In addition, although with much less publicity, a British nuclear-powered submarine, HMS Tireless, after leaking radioactive reactor coolant into the Mediterranean, has been under repair in Gibraltar Dockyard since May last year, to the growing anger and alarm of people in much of southern Spain.

All British, American, French, Russian as well as some Chinese submarines are nuclear-powered. Some of these submarines – including the British/American Trident boats – are armed with long range, ballistic nuclear missiles as well as conventional, high explosive (HE) torpedoes.

Submarine reactors work on the same principles as the larger ones used on land in nuclear power stations. However submarine reactors are built-in, sealed units that contain enough uranium fuel rods to last for ten years or more. The longer period a fuel rod is in a reactor, the more radioactive it becomes and the more plutonium is created in the burning process. Thus the core of a submarine reactor that is close to refit/replacement date will be extremely radioactive.

Modern submarines therefore have a combination of one or more of nuclear reactors, inflammable torpedo fuel, HE torpedo warheads – and of course in the case of the missile-firing submarines, several hundreds of tonnes of explosive missile fuel as well as either HE or nuclear warheads – all in a confined space.

FISHY BUSINESS

Several nuclear-powered and/or armed submarines, both Russian and American, have sunk, all but one in deep water. However the Kursk is lying in the much shallower water (approximately 300 metres) of the Barents Sea. This is likely to have important consequences if, or rather when, it leaks radioactivity.

The fish we eat live in such comparatively shallow waters. Whales and dolphins only dive down to a few hundred meters. The waters of the Barents Sea are particularly rich in fish such as herring and cod. Not only is it an important fishery, but it is also a major spawning ground. Many of the herring caught off the Scottish coast begin life in the Barents Sea.

"Sooner or later, the Kursk will have to be raised."



Library picture of older Russian Submarine

Note: Since this article was published, The Kursk has been raised. Source: Campaign for Nuclear Disarmament. The article content has not been changed but the design does not reflect the original article. Available at: <http://www.cnduk.org/>





Article 2 **The Submarine Fleet**
Statement produced by the Royal Navy

The Submarine Fleet



Submarines contribute to peace and security by providing a conventional deterrence to anyone or any nation that may pose a threat to world stability. They combine qualities of stealth, endurance and flexibility. These characteristics afford the submarine an unparalleled freedom to operate world-wide, acting independently or in support of a surface ship or land operations.

Modern nuclear submarines can travel at speeds in excess of 25 miles per hour (40 kilometers per hour) and can maintain this speed indefinitely, so allowing the submarine the ability to go anywhere in the world quickly and quietly. Submarines can dive to depths in excess of 250 metres. The actual depth is classified information.

Nuclear submarines are able to produce their own indefinite supply of air, water and power for driving the submarine forward. Its only limitation for staying submerged is the amount of food on board, or if they sustain a major defect.

Safety is a top priority for submarines. The submarine is designed and operated to ensure that the crew, the public, and the environment are protected from the risks of radiation. The ship is designed with "shielding" around the reactor to reduce radiation levels. Radiation levels are very low, so much so that a submariner gets less radiation at sea than a person on a beach receiving radiation from the sun and other natural sources.

Conventionally powered submarines were disposed of either by selling them to other friendly nations or by scrapping. Nuclear powered submarines are disposed of by taking them to a port where there are facilities to remove all the equipment that can be re-used. After the removal of all non-essential equipment, the submarine is monitored to ensure that the nuclear power plant is still safe and that there are no harmful emissions. This monitoring will continue until it is decided that the nuclear fuel is safe to be removed and disposed of safely.

Royal Navy submarines perform a number of vital roles:

To provide a platform for sea to land missiles:

The Tomahawk Land Attack Cruise Missile allows certain submarines to influence a land battle by posing a threat in the period prior to hostilities.

To protect the fleet: The submarine also has an unrivalled capability to seek out and destroy other submarines that may pose a threat to any friendly force.

To provide surveillance: The ability to approach close to opposition forces to monitor their operations and movements whilst remaining undetected is a classic

capability of the submarine. This surveillance can include underwater photography, sometimes of surface warships, which will almost certainly be unaware of the submarine's presence.

To provide inshore and Beach Reconnaissance:

Using modern video technology or digital photography a submarine is able to approach a coastline in shallow water and make a significant contribution to the intelligence collection effort prior to any subsequent maritime or land action.





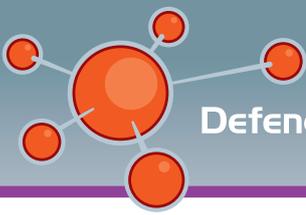
The Nuclear Debate

In January 2008, the Government published the Nuclear Power White Paper and invited energy companies to put forward plans to build and operate new nuclear power stations. Below are press releases from Friends of the Earth and the Government News Network which present the opposing arguments for and against new nuclear power stations. A summary of the main points follow.

Article 1 Press release from Friends of the Earth Nuclear power is not the answer, 9 Jan 08

Source: Friends of the Earth. Available at: http://www.foe.co.uk/resource/press_releases/nuclear_power_is_not_the_a_09012008.html [Accessed on 29th Jan 08]





Article 2 Article from the Government News Network (GNN)
UK Government invites new Nuclear Power into the energy mix, 10 Jan 08

UK Government invites new Nuclear Power into the energy mix, 10 Jan 08

Energy companies were invited today to bring forward plans to build and operate new nuclear power stations as part of the UK's strategy for a secure, diverse, low carbon energy mix.

Energy Secretary, John Hutton, said:

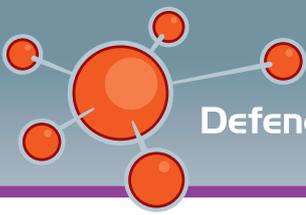
"Giving the go ahead today that new nuclear power should play a role in providing the UK with clean, secure and affordable energy is in our country's vital long term interest. "Set against the challenges of climate change and security of supply, the evidence in support of new nuclear power stations is compelling. We should positively embrace the opportunity of delivering this important part of our energy policy. "I therefore invite energy companies to bring forward plans to build and operate new nuclear power stations. "With a third of our generating capacity coming offline within the next twenty years and increasing reliance on imported energy it is clear we need investment in a range of new energy infrastructure. Measures in the Energy Bill will drive a greater deployment of renewables and enable investment in carbon capture and storage and offshore gas infrastructure. These will help build our energy security, reduce emissions and place the UK at the forefront in the development of low carbon energy technology."

The Government believes it is in the public interest that new nuclear power stations should have a role to play in this country's future energy mix alongside other low-carbon sources; that it would be in the public interest to allow energy companies the option of investing in new nuclear power stations; and that the Government should take active steps to open up the way to the construction of new nuclear power stations. It will be for energy companies to fund, develop and build new nuclear power stations in the UK, including meeting the full costs of decommissioning and their full share of waste management costs.

Nuclear power is:

- * Low-carbon - helping to minimise damaging climate change;
- * Affordable - nuclear is currently one of the cheapest low-carbon electricity generation technologies, so could help us deliver our goals cost effectively;
- * Dependable - a proven technology, currently supplying a fifth of our electricity supplies, with reactors capable of producing electricity reliably;
- * Safe - backed up by a highly effective regulatory framework; and,
- * Capable of increasing the diversity of our energy supplies and reducing our dependence on any one technology or country for our fuel supplies.





Part 1: Are you for or against?

The arguments FOR nuclear power

- ▶ Only small amounts of waste materials are generated
- ▶ Nuclear fuel is very reliable and isn't affected by weather conditions
- ▶ Fuel costs are low and large quantities of power are generated
- ▶ Does not produce carbon dioxide, sulphur dioxide or nitrogen oxides
- ▶ Despite the dangers attached to radioactive waste, the nuclear power industry has an excellent track record. Over many years of operation, Chernobyl and the Windscale fire have been the only accidents that are known to have injured the public
- ▶ Radiation levels from operating nuclear reactors are lower than from other power sources.

The arguments AGAINST nuclear power

- ▶ Nuclear waste is potentially dangerous for millions of years
- ▶ Currently, there are no long term plans for final, safe disposal of waste
- ▶ Nuclear energy is not renewable and there are more efficient and renewable sources of energy
- ▶ Nuclear power stations would only deliver around 4-5% of UK energy consumption
- ▶ There is a lack of space in the UK in which to store waste material including water
- ▶ An accident could be disastrous
- ▶ Very high costs during the build phase
- ▶ High maintenance costs
- ▶ Decommissioning is very expensive
- ▶ Nuclear power stations could be potential terrorist targets
- ▶ Limits the need to focus on and invest in the development of alternative energies.

Part 2: Research and write similar for / against statements for alternative UK energy sources

