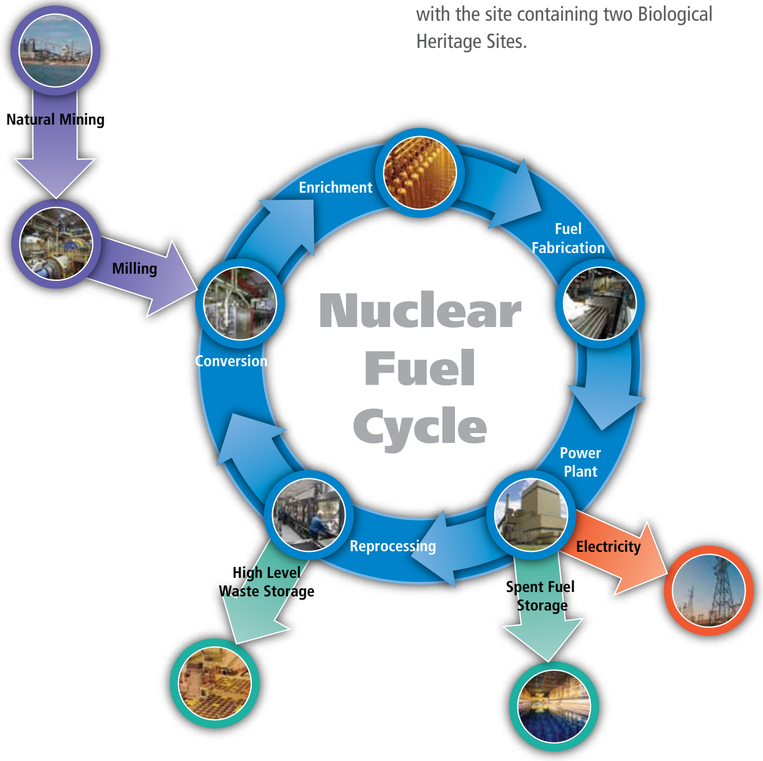
- Springfields Fuels Limited is the site licence company for the Springfields site.
- Springfields has been safely making nuclear fuel since 1946 and has the facilities to manufacture fuel for most types of nuclear reactors.
- Springfields was the first plant in the world to make nuclear fuel for commercial power stations and has produced several million fuel elements, supplying products and services for reactors in 11 countries.
- Over 15% of the UK's electricity comes from fuel manufactured at Springfields.
- Springfields was the first nuclear site in the UK to put a Biodiversity Action Plan in place to manage the site's environmental areas, with the site containing two Biological Heritage Sites.



www.westinghousenuclear.com

Nuclear Fuel Manufacture at Springfields

Westinghouse

Springfields Fuel Manufacture

Fuel for nuclear reactors (power stations) in the UK and overseas is made at our Springfields site, near Preston, in the UK.

Fuel for Nuclear Reactors is made from uranium ore. The fuel is used in nuclear reactors to generate electricity. Currently on average, 15% of the world's electricity supply is generated by nuclear power.

Nuclear energy makes a significant contribution towards reducing greenhouse gas emissions. Globally, electricity supplied by nuclear power stations avoids the emission of around two billion tonnes of carbon dioxide annually.

The Manufacturing of Nuclear Fuels

The raw material used to make nuclear fuel is uranium rock that is mined all over the world. The ore that is taken contains about 1.5% uranium. To concentrate the uranium content, the ore is ground, treated and purified using chemical and physical processes. This results in a uranium ore concentrate which contains around 80% uranium.

The uranium ore then passes through a number of chemical processes before being converted to Uranium Trioxide (UO_3).

The $U0_3$ is then processed into Uranium Tetrafluoride (UF_4) before being converted into Uranium Hexafluoride (UF_6).

How You Make Uranium Hexafluoride (Hex)

The UF_4 is reacted with fluorine gas to produce a uranium hexafluoride (UF_6) gas. The UF_6 is then heated to about 95°C and at this temperature, under pressure, the UF_6 turns into a liquid. The liquid UF_6 is then run into transport cylinders using remote handling equipment. The UF_6 is then transported to enrichment organisations throughout the world.

The enriched UF_6 arrives at Springfields. It then follows different processes depending on the type of fuel being made.

Advanced Gas-cooled Reactors

The Advanced Gas-cooled Reactor (AGR) is unique to the UK and is the second type of nuclear reactor to be run in the UK. In all, 14 AGR reactors have been built and run in the UK since 1963. (All of the UK's AGR reactors are operated by a company called EDF Energy).

AGR fuel is a type of oxide fuel and is made from uranium dioxide powder. An AGR fuel element is made up of uranium oxide pellets stacked inside stainless steel tubes. These tubes are then grouped together in a graphite 'sleeve' to form a 'fuel assembly'. An AGR assembly is made up of 36 stainless steel tubes, each containing 64 pellets.

How Do We Make AGR Fuel?

The isotope found in uranium which most readily splits (fission) in a nuclear reactor is U-235, but only 0.7% of naturally occurring uranium is U-235.

Enriching uranium can increase the U-235 content to around 3%. Enriched fuel can reach much higher temperatures in a reactor and is more efficient in generating electricity.

Uranium contains two isotopes (atoms) - uranium 235 (U-235) and uranium 238 (U-238). Both isotopes have identical chemical properties so the only way they can be separated is by their weight. U-238 is heavier than U-235.

The main method used to separate them is the 'gas centrifuge process' which involves spinning the uranium as a gas (uranium hexafluoride) in a 'centrifuge'. As the centrifuge spins at a very high speed, the heavier U-238 moves to the outside and the U-235 stays near the middle. This separates the isotopes. This process is repeated in a large number of centrifuge machines to produce the right quality of enrichment needed.

After UF_6 is enriched, it is sent to Springfields where the UF_6 is converted to uranium dioxide (UO_2) powder in a kiln using a process called the 'Integrated Dry Route' (IDR).

The Integrated Dry Route is a unique process we developed which changes UF_6 into a ceramic grade uranium powder, in a single stage. We do this by mixing it with steam and hydrogen in a kiln. IDR is the most environmentally friendly conversion technique now available.

We then process the UO_2 powder again, press it, heat it in a furnace and grind it to produce the fuel pellets. The fuel pellets (which are about the size of a thimble) are stacked inside a stainless steel fuel tube.

Once the tubes are sealed and pressurised, they are put together in the graphite 'sleeve' to form the AGR fuel assembly. After it is thoroughly inspected to check the quality of the fuel, we pack it ready to send to an AGR reactor.

Light Water Reactors

Light Water Reactors (LWRs) are used worldwide, the fuel for Light Water Reactors is a type of oxide fuel. The fuel elements from these reactors are made up of uranium dioxide fuel pellets stacked inside zirconium alloy fuel tubes. We then group these tubes together to form a fuel assembly. For example, a typical LWR fuel assembly is made up of 264 zirconium alloy tubes, each containing about 372 pellets.

How Do We Make LWR Fuel?

LWR fuel uses the same manufacturing process as for AGR fuel. The fuel pellets (which are smaller than an AGR pellet) are then loaded inside zirconium alloy tubes, which are about three metres long. We then pressurise and seal them and fit them inside a pre-assembled framework. We then inspect the assembly before we send it to the reactor.

Intermediate Products

As well as making nuclear fuel, we also produce intermediate uranium products such as enriched uranium dioxide powder, granules and pellets, whilst having the facilities to manufacture uranium hexafluoride.

How Do We Make Uranium Dioxide Powder, Granules and Pellets?

UF_6 is turned into a gas which we then feed into the IDR kiln. Here the gas is changed into UO_2 using the IDR process. The UO_2 powder is then sifted and blended and either granulated and pelleted to be produced into nuclear fuel or stored before it is exported to customers throughout the world. The enriched UF_6 is then converted into oxide fuel at Nuclear Manufacturing Plants.

Components

As part of the fuel production process we have our own Component Manufacturing Plant on site. This plant machines all the AGR stainless steel cans and support grids used in fuel elements throughout the UK's fleet of AGR reactors.

The plant has over 30 years experience in delivering and developing precision made nuclear components safely, to quality, on time and to cost. The plant works in a range of materials as required by the customer to exacting nuclear standards.

Decommissioning

The landscape at Springfields is starting to change. Old plants and redundant buildings are being decommissioned and demolished as part of our ongoing decommissioning programme.

Land has been returned to what it would have looked like prior to 1946, ponds have been reinstated and hundreds of trees have been planted as part of our bio-diversity action plan.

Uranium Recovery

The processing of residues, which were created from past and present fuel manufacturing operations are also carried out by Springfields. These residues contain uranium which can be recycled into the fuel product for customers, or where this is not possible the uranium is consolidated into a stable form for interim storage.

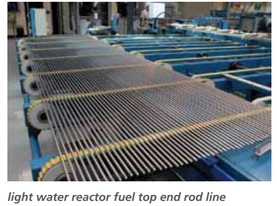
springfields site

enriched uranium residues recovery plant

integrated dry route kiln

advanced gas-cooled fuel element assembly

lwr rod puller



light water reactor fuel top end rod line

component manfacturing plant

decommissioning of legacy plant

natural and depleted uranium recovery plant