Copied to: Mr Huke, Department of Energy

British Nuclear Fuels plc

Head Office: Risley Warrington Cheshire WA3 6AS
Telephone: Padgate (0925) 832000 Telex: 627581
Direct Dial (0925) 83 5004

cc Press Office.
Detectives.
MA

Your ref: Our ref: RLP/bw/CE5/1 Ext:

Mr M Addison
Private Secretary
10 Downing Street
LONDON SW1

18 October 1985

Dear Mr Addison

PROGRAMME FOR PROPOSED VISIT TO BNFL ESTABLISHMENTS

... Please find attached our updated programme, which now takes account of the outcome of our discussions with Inspector Strevins, plus our more detailed consideration of timings, in particular with respect to press coverage aspects and flying times.

The main effect of these considerations has been to put back the arrival time at Sellafield by 10 minutes, so that the Sellafield arrival time is now 15.25 instead of 15.15. At the same time, the Sellafield itinerary has been reordered to allow the Opening Ceremony for the Fuel Handling Plant and the Site Ion Exchange Effluent Plant to be completed before 16.00 hours in order to meet deadlines for TV coverage in early evening news bulletins. You will also note that the on-site routes have been somewhat shortened, in particular for the Springfields visit.

... As mentioned in my letter of 17 October, briefing information on the Company in general is now available and I enclose four copies with this letter. Please let me know if you require further copies. A further brief, relating specifically to the visit programme, will be available nearer the date.

I am copying this letter to Mr Huke at the Department for his information.

Yours sincerely

B. Walsby

for R L Pilling
Production Director

(Dictated by Mr Pilling and signed in his absence)

18 October 1985

Outline Programme for proposed VIP visit to British Nuclear Fuels plc, 1 November 1985

09.45	Arrive Capenhurst
	Proceed to Visitors centre for welcome (refreshments available, wash-room facilities available)
09.55	Short presentation on the Company by Mr C Allday
	Short presentation on the work of the Site and on the commercial aspects of Enrichment Division
10.15	Proceed to Centrifuge Assembly Plant and tour plant
10.40	Proceed to Enrichment Plant and tour plant
11.05	End of tours and prepare for departure (Wash-room facilities available)
11.10	Depart Capenhurst
11.35	Arrive Springfields
	Proceed to General Manager's Dining Room for welcome (refreshments available and Wash-room facilities available)
11.45	Short presentation on the work of the Site and on the commercial aspects of Fuel Division work
11.55	Proceed to AGR Canning and Assembly Plant and tour plant
12.20	Proceed to Magnox Canning Plant and tour plant
12.40	Proceed to Training Centre and tour centre
12.55	End tours and prepare for departure (Wash-room facilities available)
13.00	Depart Springfields

13.15	Arrive Heysham
15.00	Depart Heysham
15.25	Arrive Sellafield
	Proceed to Exhibition Centre for Wash-room facilities
	Proceed to Fuel Handling Plant for welcome (refreshments available)
15.40	OPENING CEREMONY with unveiling of commemorative plaque
15.55	Tour Fuel Handling Plant and Site Ion-Exchange Effluent Plant
16.30	Proceed to THORP viewing platform to view construction work
16.40	Proceed to Exhibition Centre
16.45	Short presentation on the work of the Site and on the commercial aspects of reprocessing work
17.00	Transfer to Assembly Hall, Building 111 to meet invited guests and for presentation of gifts to the Visitor
17.30	Depart Sellafield

Mark

PRIME MINISTER'S VISIT TO BRITISH NUCLEAR FUELS
FRIDAY 1 NOVEMBER

0745 Depart No.10 for Northolt

Car 1 Prime Minister
Mr Wicks
Detective

Car 2 Mr Ingham
Mr Alison
Miss Jelley

Police Car Detective

0830 Depart Northolt by RAF Andover

0930 Arrive Hawarden

Met by Mr Con Allday, Chairman and Managing Dir, BNFL

0935 Depart Hawarden by RAF Puma Helicopter + Mr Allday
[Press helicopter will accompany party throughout tour]

0945 Arrive CAPENHURST

Car to Visitors Centre

0950 Met by:-

Neville Chamberlain (BNFL's Director for (Enrichment)

Peter Roberts (Capenhurst's Gen. Manager)

0955 Presentation by Mr C Allday on Company
Presentation on the work of the site and on the commercial aspects of Enrichment Division

1015 Transfer to Centrifuge Assembly Plant

(Put on white coat and cloth overshoes)

1040-1105 Tour of Enrichment Plant

1110 Depart Capenhurst by helicopter

1135 Arrive SPRINGFIELDS

Met by:-

Dr Horsley (General Manager)

1145 Presentation on the work of the site and on the commercial aspects of Fuel Division work

1[illegible]5 Tour of AGR Canning and Assembly (Mr R K Jenkins)

1220 Tour of Magnox Canning (Mr D J Mitchell)

1240-1255 Tour of Apprentice Training Centre (Mr C A Matthews & Mr R A Perry)

1300 Depart Springfields

1315 Arrive **HEYSHAM**

[Mr Newey's office: 0524-54290]

Met by:-

Lord Marshall (CEGB Chairman)
Stan Newey (Heysham II Project Manager)

By car to CEGB Site Office

1335 Lunch & presentation:

1338 John Baker (generating strategy)
1355 Stan Newey (progress with Heysham II)

1404 Sign Visitors' Book

1405 Put on protective clothing

1407 Depart by car for

1411 Tour of Heysham II construction accompanied by Stan Newey:-

reactor charge hall
control room
turbine hall

By car to

1500 Depart Heysham by helicopter

1525 Arrive **SELLAFIELD**

Car to Exhibition Centre

[Tel:0940-28074]

Met by:

Gordon Steele (Dir of Reprocessing)

Proceed to Fuel Handling Plant for welcome (refreshments)

1540 Unveil plaque and short speech

1555 Tour Fuel Handling Plant & Site Ion-Exchange Effluent Plant

1630 Visit THORP Viewing Platform to view construction work

1[illegible]0	Depart THORP Platform for Exhibition Centre
1645	Presentation on the work of the site and on the commercial aspects of reprocessing work
1700	Depart for Assembly Room
	Reception for industrialists and local VIPs - Mr Allday will present gift.
1730	Depart Sellafield by helicopter
1740	Arrive **Barrow**
1745	Depart Barrow by Andover
1910	Arrive **Northolt**
	By car to Chequers
1950	Arrive Chequers

If Helicopters Unable to Take-Off

Police cars from Hawarden to Heysham
" " from Heysham to Sellafield [or car to Hawarden/ *plane to Barrow/ car to Sellafield]
" " from Sellafield to Barrow

*40minutes

(NB Capenhurst and Springfields will be dropped from programme)

If Andover Unable to Take-Off
Police cars to London

Hawarden to Springfields: 40mins

MJ2BGP

BNFL

British Nuclear Fuels plc

GENERAL BRIEFING NOTES

CONTENTS

THE COMPANY

INTRODUCTION

British Nuclear Fuels plc (BNFL) and its predecessors have been manufacturing fuel for nuclear reactors, reprocessing and recycling the fuel after use and managing the waste products for nearly 40 years.

In its present form the Company dates from 1971 when it was created out of the former Production Group of the United Kingdom Atomic Energy Authority (UKAEA). The change in status provided greater financial and administrative flexibility and has enabled the Company to expand and develop on commercial lines. BNFL became a public limited company in 1984 and all the shares are held by the Government.

BNFL has major holdings in two subsidiary companies. BNFL Enrichment Limited is wholly owned by British Nuclear Fuels plc and is the central subsidiary through which all financial aspects of participation in the tripartite centrifuge project are handled. Pacific Nuclear Transport Limited, incorporated in England in 1975, has as its main purpose the transport of irradiated fuel from Japan to Europe. BNFL holds 62½% of the shares, the remainder being held by Japanese and French organisations.

In addition to the above BNFL holds shares in a further eight related companies as follows:

Company	Shareholding
Centec GmbH	33%
Urenco Limited	33%
Combustibili Nucleari Spa	50%
Nukleardienst GmbH	50%
United Reprocessors GmbH	33%
Nuclear Transport Limited	33%
NTL–Nukleare Transportleistungen GmbH	33%
NTL–Société Nucleaire Pour Les Transports Lourds SARL	33%

Notes

COMPANY OBJECTIVES

The Company's primary objectives are:

1. To earn a return on capital employed which is satisfactory to the shareholder and is consistent with the contractual, legal and social framework within which the Company operates.
2. To achieve a high degree of self financing in meeting the Company's future investment requirements.
3. To provide an efficient and economic fuelling service to the UK Generating Boards and to meet the needs of other domestic customers.
4. To obtain profitable overseas business in order to provide greater growth, with its attendant economies of scale, than that offered by the UK market alone.

These objectives are pursued subject to two overriding conditions:

1. That standards of safety and environmental protection are maintained well within statutory requirements; and
2. That overseas business is only undertaken within the guidelines laid down by Government to avoid increasing the risk of proliferation of nuclear weapons.

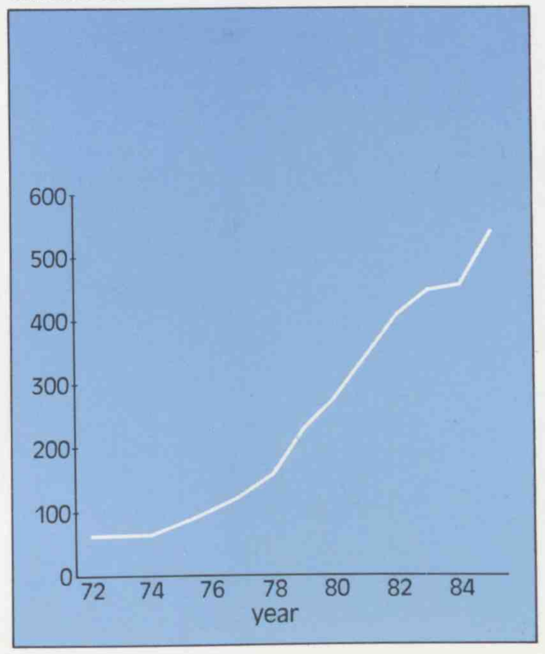
In structuring its business, the Company pays particular attention to the remuneration and welfare of its present employees and, through expansion, seeks both to extend their opportunities and offer additional employment prospects.

Notes

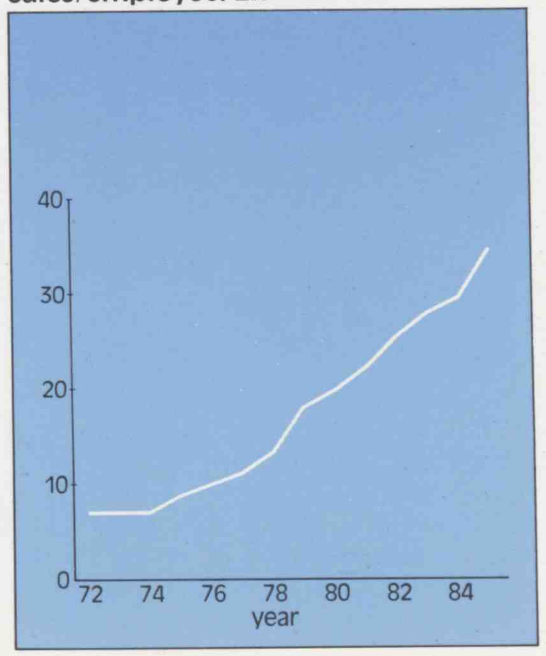
FINANCIAL RESULTS

The Company's financial results from the time of its inception up to the end of the last financial year are illustrated in the following graphs.

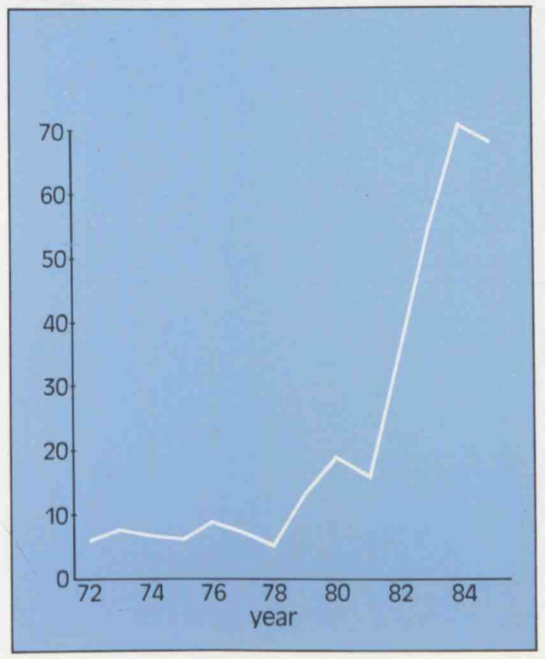
Sales: £M



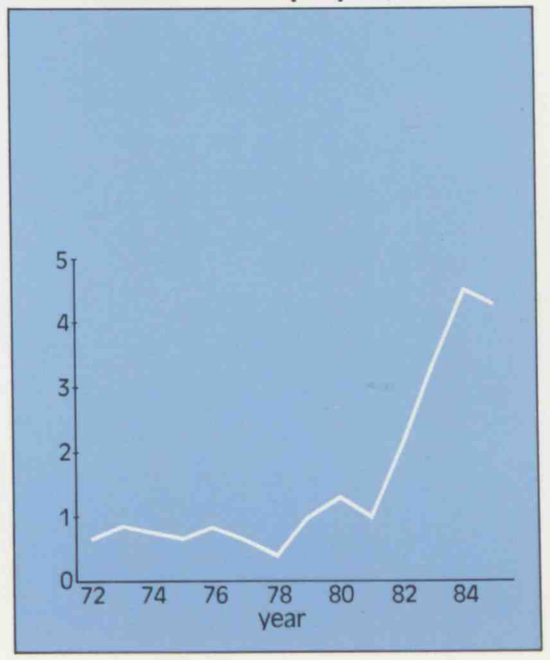
Sales/employee: £K



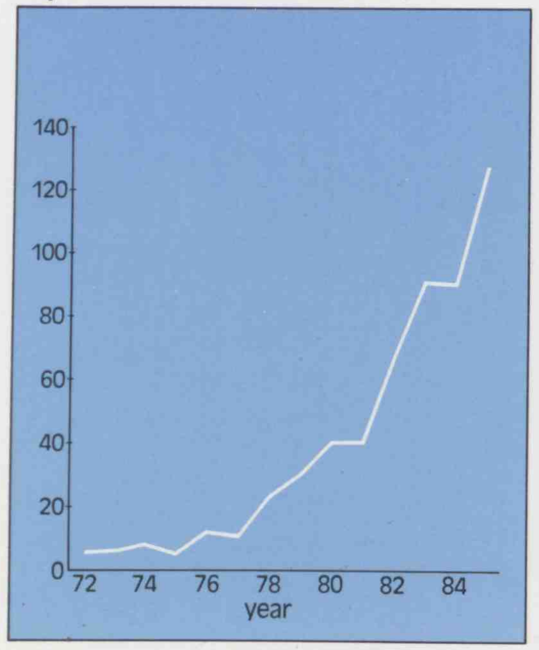
Profit before tax: £M



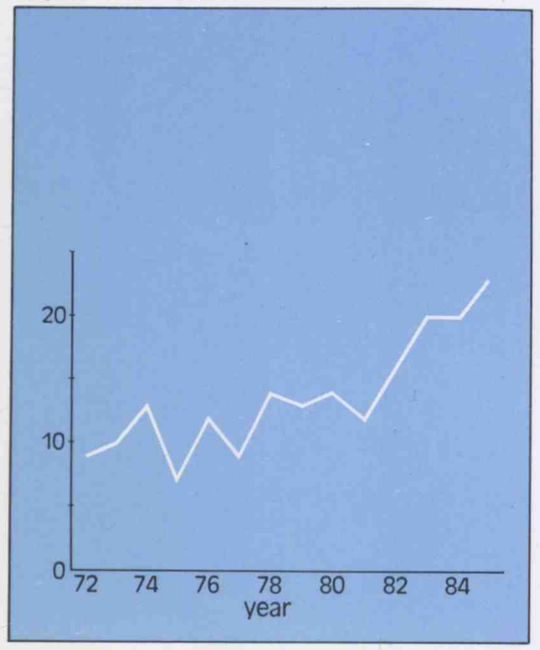
Profit before tax/employee: £K



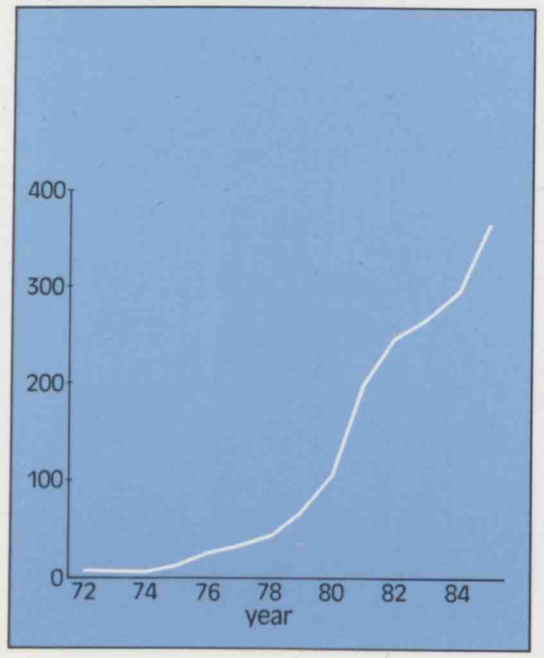
Export sales: £M



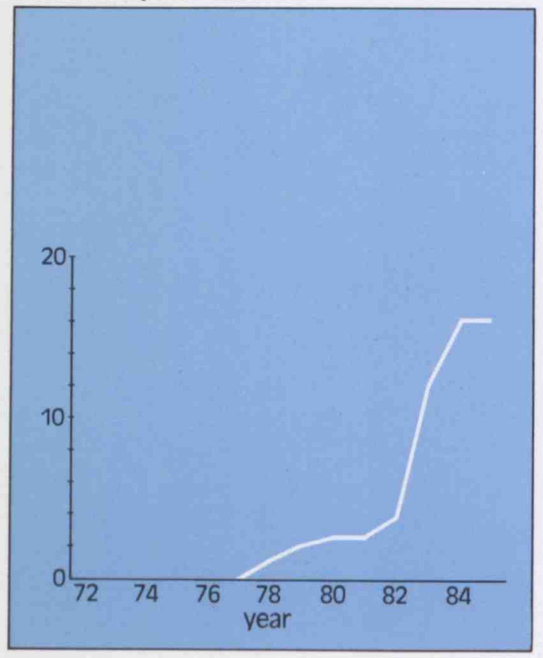
Exports as % total sales



Capital expenditure: £M



Dividend paid: £M



Notes

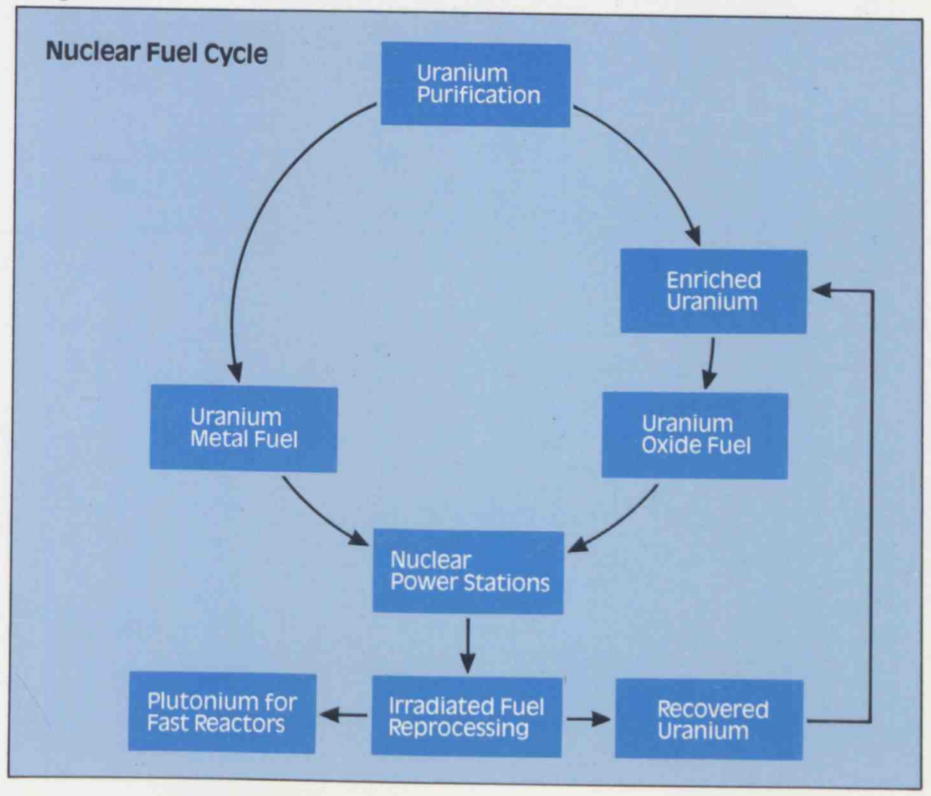
AREAS OF BUSINESS

The Company's main areas of business are in the provision of Nuclear Fuel Cycle Services. It is also involved in the generation of electricity, supplying power to the English and Scottish grids from the Calder and Chapelcross nuclear power stations. Finally, work is carried out for the Ministry of Defence.

The basic elements of the nuclear fuel cycle are shown in diagram 1. The products produced by the Company in support of this cycle are:

Uranium metal fuel (Magnox fuel)
Uranium oxide fuel (AGR and LWR fuel)
Natural uranium hexafluoride for enrichment
Enriched uranium hexafluoride
Enriched uranium oxide powder
Enriched uranium oxide pellets
Irradiated fuel transport services
Reprocessing services
Plutonium for Fast Reactors
Plutonium for mixed oxide fuel
Depleted uranium for recycling

Diagram 1



In addition, wastes generated in the course of production of these products are handled by BNFL, on behalf of the customers, into a form where they can be disposed of safely or, in the case of overseas customers, can be returned to the country of origin.

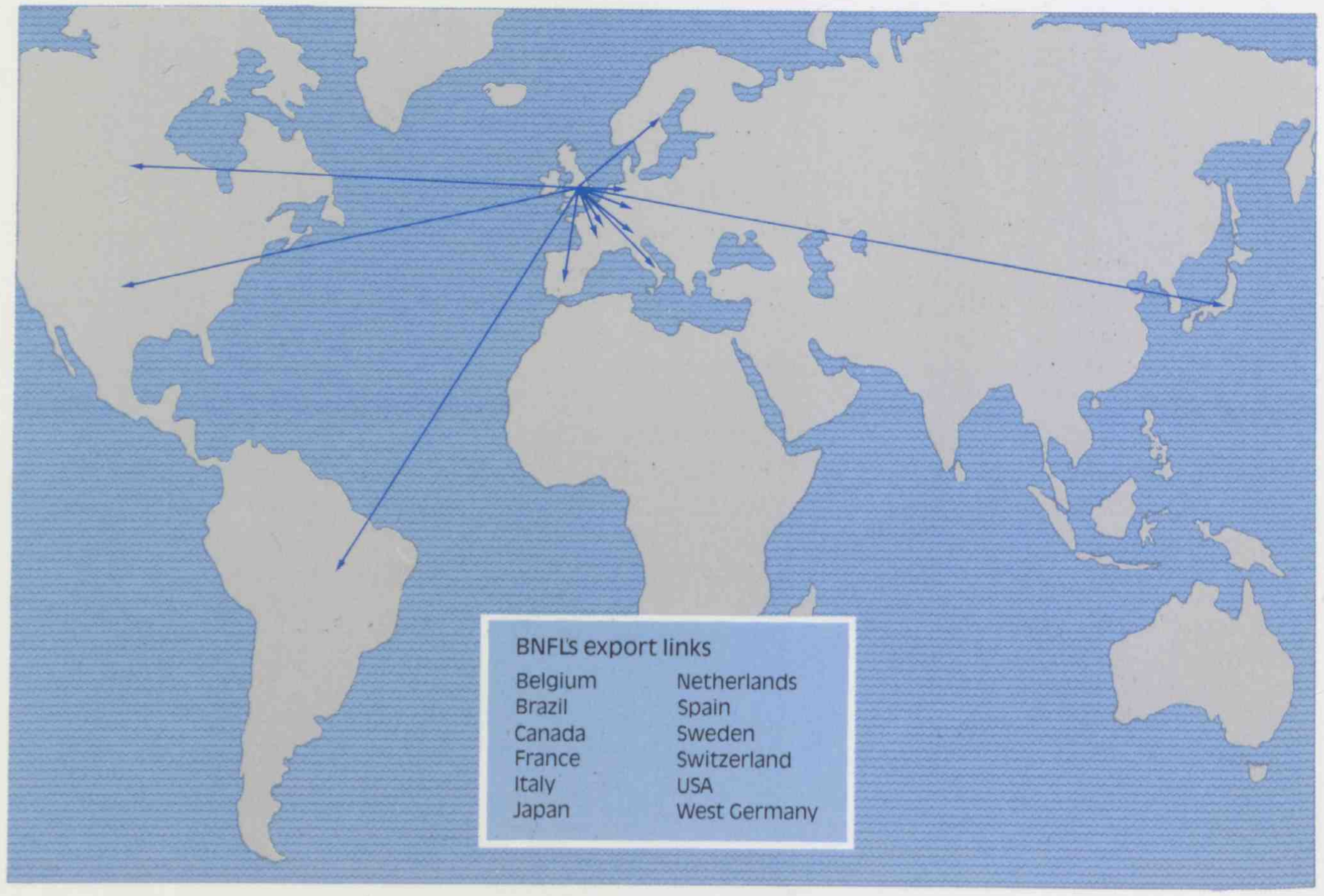
Finally, the Company has Technology Licensing agreements with overseas organisations which make use of processes and techniques developed by BNFL.

THE CUSTOMERS

BNFL's largest customers are the UK electricity Generating Boards for whom fuel has been produced to date equivalent in energy terms to more than 600 million tonnes of coal. The Generating Boards operate nine Magnox stations, using natural uranium metal fuel, and five Advanced Gas-cooled Reactors, using enriched uranium oxide fuel. A further two AGR stations are under construction. All the fuel for these reactors is supplied by the Company. In addition, should the CEGB build pressurised water reactors in the future the Company is well placed to supply the required PWR fuel under a licensing agreement with Westinghouse. Indeed, the Company has already supplied intermediate products and a small number of complete fuel assemblies for PWRs outside the UK.

As well as serving the UK Generating Boards, BNFL has also developed export markets for its nuclear fuel cycle services (diagram 2). Both fuel and intermediate products have been supplied for stations in Japan, Italy, Belgium, the Netherlands, France, Spain, West Germany and the USA. Notably, the Company now supplies about 15% of the available world market for uranium hexafluoride–an intermediate stage in the production of the oxide fuels on which most modern reactors depend. In the reprocessing area the Company has contracts with customers in Japan, Italy, Sweden, Switzerland, the Netherlands and West Germany. The total future order book for overseas reprocessing, including transport, is now worth £2,700 million.

Diagram 2.



COMPANY ORGANISATION

The Company is structured into four Divisions, based on its main nuclear fuel cycle processes and largely corresponding to the various Company sites. The Divisions are:

FUEL DIVISION

Processes uranium ore through to the production of fuel elements, excluding the enrichment step.

ENRICHMENT DIVISION

Provides uranium enrichment capability plus manufacture of equipment for the enrichment process.

REPROCESSING OPERATIONS DIVISION

Processes irradiated fuel to extract the unused uranium and the plutonium created. Provides waste handling facilities. Operates the Calder and Chapelcross reactors.

REPROCESSING ENGINEERING DIVISION

Provides design and engineering facilities associated with the Company's new reprocessing and waste handling plants.

The factories responsible for the above activities are responsible to the appropriate division, headed by a director who serves on the Company Executive but is not a main board member. Each site is an integrated unit with its own support services to the production teams including health and safety, finance and accounts, personnel, quality assurance, technical departments and general site services.

In addition to the Divisional structure there are central directorates, located at the Head Office at Risley, as follows:

Corporate affairs, including information services.
Finance.
Technical, including computing and security.
Health and Safety.
Commercial.
Personnel.

Under the Chairman and Chief Executive the board includes executive directors responsible for:

Engineering	Mr Jack Tatlock.
Technical	Dr William Wilkinson.
Production	Mr Roy Pilling.
Corporate Affairs and Company Secretary	Mr Harold Bolter.
Finance	Mr John Hayles.
Commercial	Mr Alan Johnson.

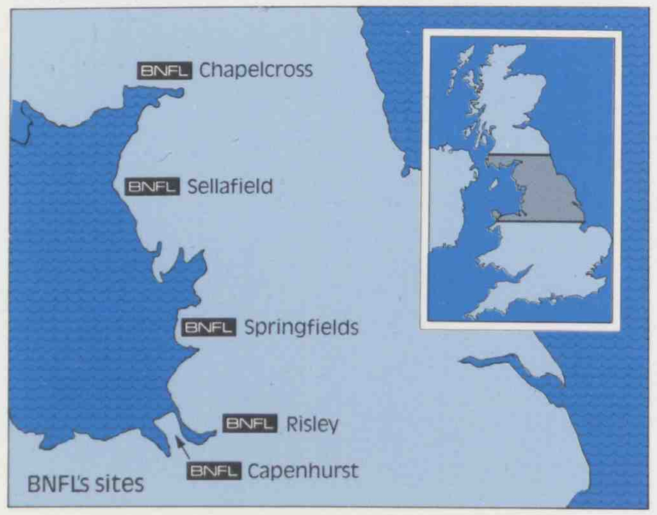
There are also six non-executive directors from outside organisations with specialist knowledge appropriate to advising on policy issues. These are:

Mr Christopher Harding	*Managing Director, Hanson Transport.*
Dr Thomas Marsham CBE	*Managing Director, UKAEA Northern Division.*
Mr Richard Morris	*Chairman, Brown and Root UK Ltd.*
Mr William Scott OBE	*Previously Coordinator Western Hemisphere, Shell International Petroleum. Now retired.*
Sir Philip Shelbourne	*Chairman, Britoil.*
Mr John Wills OBE	*Commercial Director, Albright and Wilson.*

LOCATION OF SITES

The Company's sites are concentrated in the North West as shown in the illustration below.

Diagram 3.



The relationship between the sites and the Divisions is as follows.

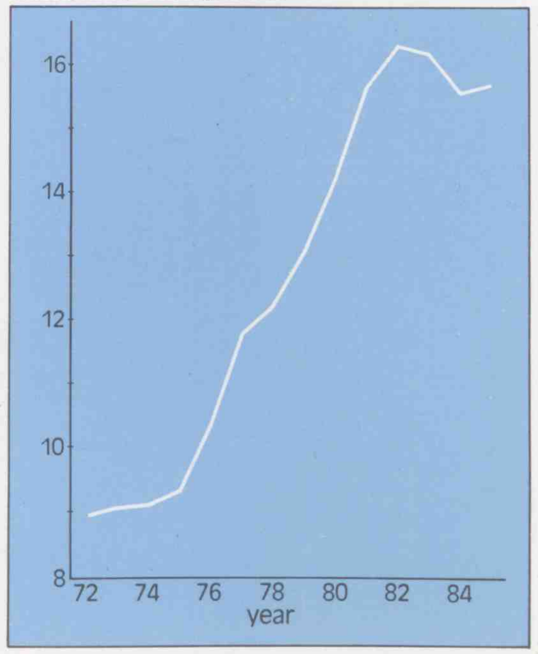
Capenhurst Site (near Chester)	→ Enrichment Division
Risley Site (near Warrington)	→ Head Office + Reprocessing Engineering Division.
Springfields Site (near Preston)	→ Fuel Division
Sellafield Site (West Cumbria) + Chapelcross Site (Dumfriesshire)	→ Reprocessing Operations Division

In addition the Company maintains a London office.

EMPLOYMENT STATISTICS

The historical Company employment figures are as shown below. It can be seen that the Company's workforce has grown from 9,000 to over 15,000 people in just over 10 years.

Company manpower



The average number of people employed by the Company during 1984/5 was 15,678. The staff cover a wide range of skills and the workforce includes some 1,500 graduates, predominantly engineers.

The distribution of employees between the various sites is as follows:

Capenhurst	approx. 2,200	14% total
Risley	approx. 2,480	16% total
Springfields	approx. 3,810	25% total
Sellafield	approx. 6,080	40% total
Chapelcross	approx. 650	4% total

In addition the Company employs some 190 officers and ratings in its transport operations.

The distribution between broad skill groups is shown below:

Non-industrials	
Engineers	23%
Scientific	6%
Administration	15%
Total	44%

Industrials	
Craft	17%
Non-craft	33%
Apprentices	6%
Total	56%

The following unions are represented in the Company

Civil and Public Services Association (CPSA)
Society of Civil and Public Servants (SCPS)
Institution of Professional Civil Servants (IPCS)
General, Municipal, Boilermakers and Allied Trades Union (GMBATU)
Amalgamated Union of Engineering Workers (AUEW)
Electrical, Electronic, Telecommunications and Plumbing Union (EETPU)
National Union of Sheet Metal Workers, Coppersmiths, Heating and Domestic Engineers (NUSMWCHDE)
Transport and General Workers Union (TGWU)
Union of Construction, Allied Trades and Technicians (UCATT)

Notes

TRAINING

BNFL has well established apprentice training schemes at all its sites, with some 1,000 drawing office and craft apprentices under training at any one time. In recent years the numbers have been retained at this level even though the Company personnel requirements were unlikely to result in all apprentices being offered permanent employment with the Company.

An undergraduate sponsorship scheme provides financial assistance at many universities. More than 100 students are under sponsorship at any one time, although not all will eventually join BNFL.

BNFL participates in the Youth Training Scheme, offering some 260 YTS places. The YTS places arise in the areas of craft work, process worker training and general worker training. Consideration is currently being given to the extension of the one year training programmes to two year programmes and also to the means of providing participants with some form of qualification to indicate the standard of performance reached.

Notes

RESEARCH AND DEVELOPMENT

Research and development work is carried out in support of operating plants, in support of design of future plants and on a speculative basis to maintain the Company's longer-term competitiveness. Some £54M was spent on R&D in 1984/85.

By far the greatest effort is on reprocessing. The Reprocessing Operations Division has one of Britain's largest R&D departments associated with a production plant. Main areas of R&D work are:

Waste management research, including support for the encapsulation plants which will incorporate intermediate wastes into a concrete matrix for disposal.

The vitrification process, with a full-scale inactive pilot plant at Sellafield.

Work in support of THORP, which includes a THORP miniature pilot plant which covers all parts of the production process. Major inactive rigs relating to THORP include the full-scale pulsed column test rig and a full-scale fuel shear machine.

Generic work, not specifically related to one project, including materials development, containment and ventilation and remote handling.

All the above R&D is backed up by technical groups having expertise in such areas as shielding design, criticality assessment, stress analysis and seismic analysis.

At Springfields research is carried out into automated handling and inspection as well as into alternative processes. Extensive development facilities for the production of ceramic fuels include various types of presses, sintering furnaces and equipment for non-destructive testing involving laser, X-ray and gamma scanning techniques.

At Capenhurst, research is continuing on more advanced centrifuge designs and on laser technology for uranium enrichment. Capenhurst has also developed expertise in seismic investigations and undertakes work of this nature for other parts of BNFL and for outside industry.

Notes

HEALTH AND SAFETY

BNFL's policy on health and safety is to ensure that any hazards to its employees and to the general public are kept as low as is reasonably practicable and well within the statutory regulations. In addition there are effective procedures for consultation on health and safety matters with representatives of both employees and local communities. The radiation exposure of the workforce, collectively, on average and in respect of the numbers most highly exposed, has shown a declining trend over the last ten years. Average exposures have been below one tenth of the regulatory limit since 1980.

At each of the sites there are health and safety and medical departments which advise local management and carry out specific monitoring to confirm that safety and environmental protection arrangements are satisfactory. Co-ordinated standards are maintained throughout the Company.

Operational sites are licensed under the Nuclear Installations Act and are subject to inspection by the Nuclear Installations Inspectorate (NII). The standards of radiological protection are based on the recommendations of the International Commission on Radiological Protection (ICRP) as endorsed by the National Radiological Protection Board (NRPB).

Safety begins with the careful design of plant, with shielding and containment to reduce radiation exposure and with safety systems to protect people and plant. Plant operating procedures are designed to minimise radiation exposure and achieve incident free work. The NII and Authorising Departments examine plant at the design and construction stage to ensure that they are satisfactory in respect of safety and waste management.

Monitoring of the workforce is achieved by both monitoring of the working environment (for example by fixed or mobile instruments) and monitoring of the individual workers (for example by film badges, in-vivo monitoring and urinalysis). Similarly, monitoring of the off-site environment is achieved by both fixed monitoring instruments and by the collection and analysis of environmental samples (for example sea water, seaweed, silt, grass).

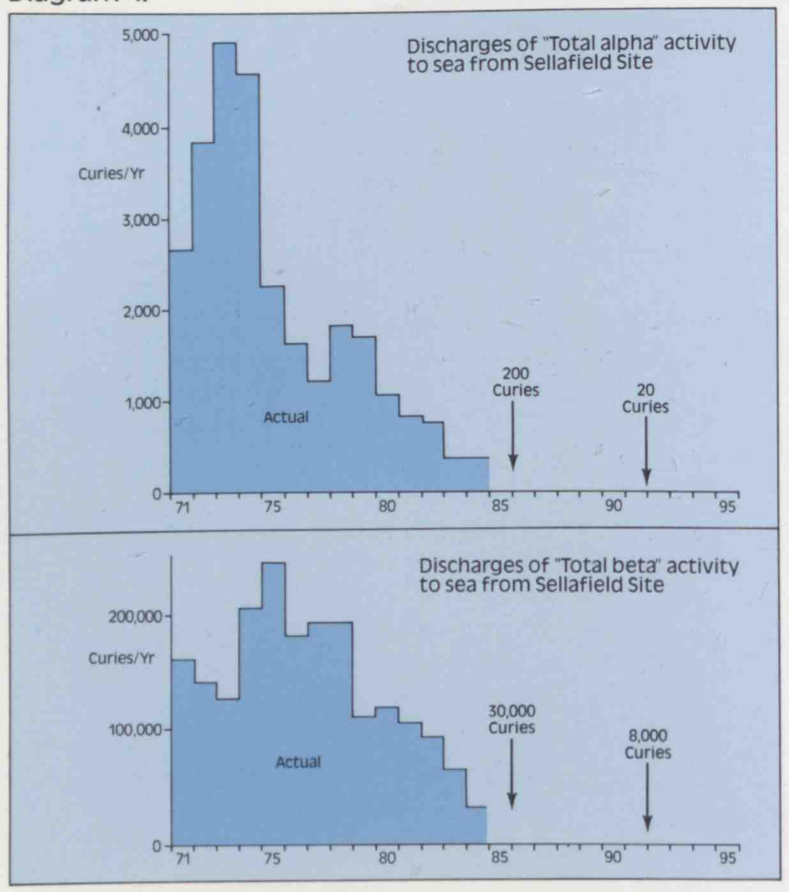
Notes

ENVIRONMENTAL IMPACT

Radioactive discharges from the sites to the environment are only permitted under authorisations issued jointly in England by the Ministry of Agriculture, Fisheries and Food and the Department of the Environment. These ministries initiate monitoring additional to that by BNFL to confirm that arrangements are satisfactory and consistent with ICRP recommendations.

The levels of discharge to the environment are shown in the diagrams below. Alpha discharges, mainly plutonium, are now about one twelfth of the peak level and beta discharges, including caesium, are now about one seventh of the peak level. A £150 million project to reduce discharges still further was announced during 1985 so that by 1991 beta discharges will be reduced to a few per cent and alpha discharges to less than one per cent of peak levels.

Diagram 4.



Publications
The Company publishes annual reports covering occupational safety, radioactive discharges and associated monitoring of the environment.

Mortality study
A study of mortality among BNFL workers and ex-employees is being carried out which covers a period of more than 30 years. The study has concentrated on experience at Sellafield and results so far indicate the cancer rate is slightly less than would be expected from national statistics with no significant difference between radiation and non-radiation workers.

COMMUNITY RELATIONS

The Company is committed to supporting the economic and social interests of the communities around its sites. Its programme of financial support ranges from the underwriting of major civic projects to numerous small donations. In developing its community relations programme BNFL observes the following principles:

Projects are selected with concern for local needs and priorities, with support concentrated in areas where the Company has a significant presence.

The Company also believes that support should not be limited to cash funding; manpower and its skill frequently represent a significant contribution to projects.

A summary of some of the major items from the programme is given below.

As a result of commitments made at the Windscale Public Inquiry into the construction of THORP:

Nearly £3M has been invested in a project to provide housing in Whitehaven as part of a local authority redevelopment scheme.

£4.5M has been invested in a new Sellafield access road.

In addition BNFL is to pay for the refurbishment of Whitehaven Town Hall–a listed building–and construct a running track near Whitehaven.

Sponsorships and donations worth £90,000 were made during 1984/85 both to major national or local appeals and to local charities and organisations. These include sporting organisations, music societies, schools, hospitals and associations for the sick and disabled.

Deeside, Warrington, Chester and the Dumfries area of Scotland are benefiting from job creation sponsorships.

Sellafield apprentices refurbished the interior of the Old Customs House in Whitehaven, now being used by Age Concern.

Apprentices are also encouraged to take part in local community and charity projects through the Duke of Edinburgh Award Scheme, or City Challenge, a scheme which includes projects to help the elderly, sick and handicapped.

An essential link between BNFL operational sites and local communities is provided by the local liaison committees on which BNFL managers regularly meet with representatives of local authorities, the health and emergency services, the NII and Authorising Departments.

PUBLIC RELATIONS

Maintenance of public support for BNFL's role in the nuclear industry is a key objective for the Company. This requires public understanding of the Company's activities and the associated technology. The programme to achieve this involves:

Close liaison with the press and broadcasting media. Some 50 press releases were issued in 1984/85 and newspaper and TV reporters were invited to Sellafield during the year to look round the Fuel Handling Plant/SIXEP complex.

BNFL 'Talks service'; talks are given to a variety of organisations by volunteer members of staff–380 given in 1984/85.

Visits to Company sites–over 29,000 in 1984/85. This figure includes about 15,000 visits to the Sellafield permanent exhibition centre.

Exhibitions at various events all over the country.

Liaison with the education service.

BNFL are currently involved in the preparation of a major new advertising campaign, designed to explain the importance of nuclear energy and present a more positive image of the Company and its achievements.

The Company devotes significant effort to ensure that opinion formers and decision takers are correctly informed about its work and associated issues. This programme includes liaison with elected representatives ranging from MPs and MEPs to parish councillors, with the local liaison committees playing a significant role at local level.

Notes

FUTURE DEVELOPMENTS

On a world-wide picture, nuclear power now supplies 12% of electricity produced, with more than 300 operating reactors in 25 nations. Some 200 reactors are under construction and more than 120 are planned. The International Atomic Energy Agency forecasts that world-wide nuclear electricity generation will reach 20% by the year 2000. Within the EEC nuclear electricity is growing faster than other energy sectors–26% of its electricity was generated by nuclear power in 1984 and this is expected to reach 30% this year. This situation indicates scope for growth in export business. The market for this business is, however, highly competitive with a world-wide surplus of capacity in most areas of the nuclear fuel cycle.

In order to meet the challenge of the future the Company has a major investment programme, totalling £3,700M over the next ten years. Capital expenditure authorised at the end of 1984/85 was £1,985M, of which contracts have been placed for £158M. In addition to the capital expenditure a further £1,500M will be spent on materials and services. Over 90% of the above expenditure is with British suppliers and, at a rate of about £500M per year, supports an estimated 50,000 jobs in British factories, plus some 3,500 workers engaged in construction and installation on BNFL sites.

The major developments are as follows:

A fourth centrifuge plant at Capenhurst, scheduled to be commissioned in stages between 1987 and 1990.

A facility at Capenhurst to be used for providing enrichment services to the Ministry of Defence, to be brought on line in stages from 1985 to 1987.

The thermal oxide reprocessing plant (THORP) at Sellafield, to provide oxide reprocessing services, due to begin operation in the early 1990s.

Vitrification plant at Sellafield, to convert highly-active waste to a glass form, due to begin operation in 1989.

Additional effluent treatment plants at Sellafield, to reduce further environmental discharges, various plants coming into operation up to the mid 1990s.

Waste encapsulation plants at Sellafield, to convert intermediate solid wastes for storage in a permanent repository, coming into operation from 1989 to the mid 1990s.

Notes

THE DIVISIONS

INTRODUCTION

The Company is structured into four Divisions:

Enrichment Division
Fuel Division
Reprocessing Operations Division
Reprocessing Engineering Division

Enrichment Division

The uranium enrichment activities of BNFL are centred on Capenhurst Works near Chester. The site includes modern gas centrifuge enrichment plants in operation or under construction, research and development laboratories, centrifuge manufacturing workshops, design offices and comprehensive technical support services and facilities. In addition a new enrichment facility to meet the needs of the MOD is sited here.

Fuel Division

The Fuel Division, located at Springfields Works near Preston, processes several thousand tonnes of uranium a year to produce fuel for all types of nuclear power stations, as well as converting ore concentrates to uranium hexafluoride for customers in Britain and overseas. Other plants provide for the recovery as uranium dioxide of residues from fuel manufacturing operations and for the conversion of depleted uranium hexafluoride from enrichment plant operations to uranium metal and other compounds.

The conversion of uranium ore concentrates to natural uranium hexafluoride requires a multi-stage route involving initial purification and conversion to uranium tetrafluoride. Some of the uranium tetrafluoride is processed to uranium metal which is then used in the fabrication of Magnox fuel elements while the majority is reacted with fluorine to produce uranium hexafluoride for enrichment. A separate depleted uranium trioxide feed, originating from reprocessing operations is also converted via the tetrafluoride stage to 'hex' for recycling. Following enrichment uranium hexafluoride is converted to ceramic grade uranium dioxide powder which is further processed and fabricated into oxide fuel elements. In addition, many of the fuel element components required for fuel element fabrication are manufactured on site.

Reprocessing Operations Division

Reprocessing operations are carried out on the Sellafield site. The site is divided into two works comprising the major operating units, with a central site support organisation.

Windscale Works includes the chemical reprocessing plants, effluent disposal and facilities for plutonium fuel fabrication and waste management, research and development, technical accountancy and site training.

Calder Works includes the Calder Hall power station and a similar station at Chapelcross in Dumfries and Galloway, fuel receipt, storage and decanning plants and site engineering services.

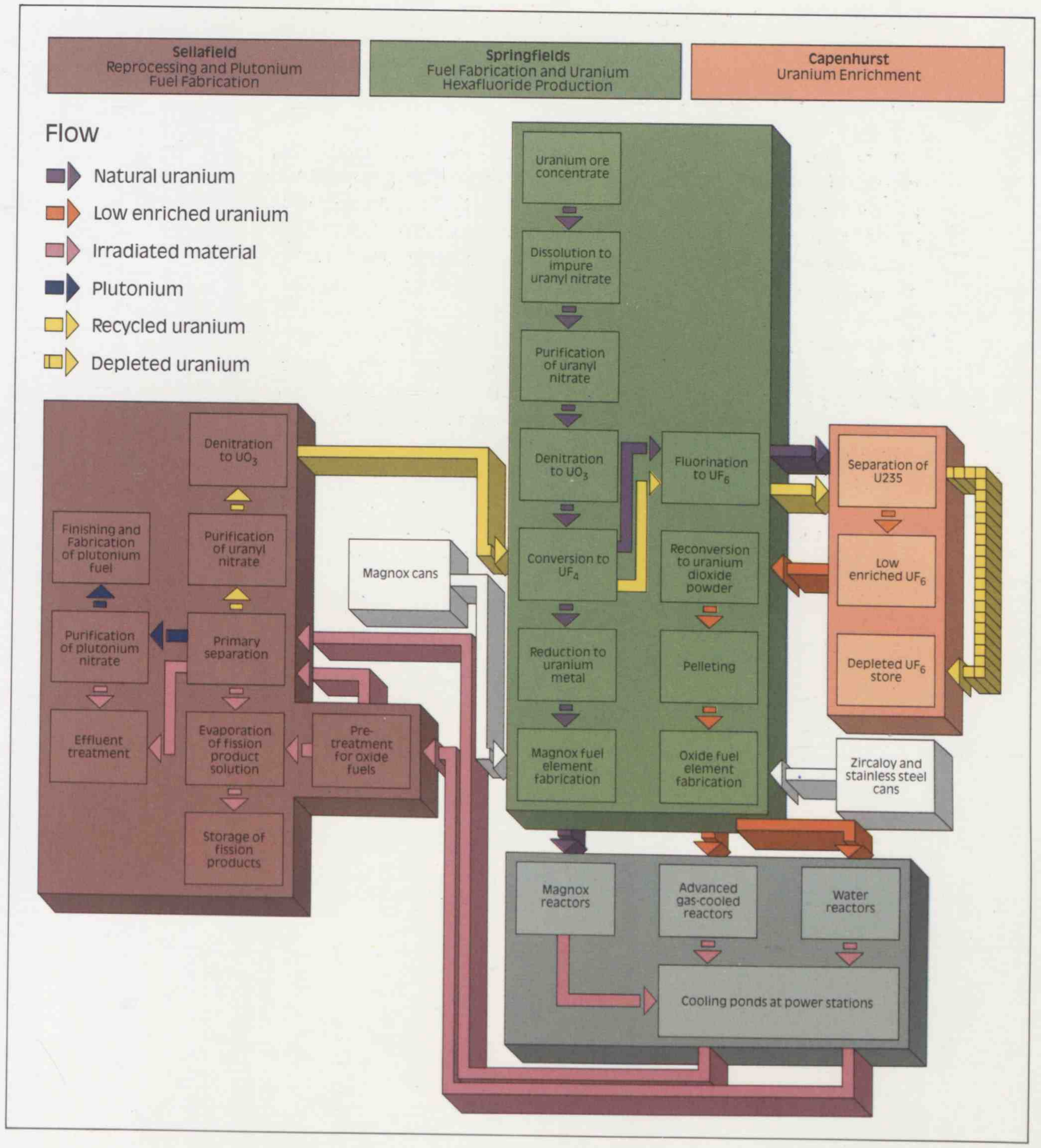
Reprocessing Engineering Division

The Reprocessing Engineering Division, located at Risley, is responsible for the engineering design and project management of plants constructed at Sellafield. The work of the Division spans the range from conceptual studies through detailed appraisal studies, detail design, construction, testing and handover of completed plants to the Reprocessing Operations Division.

The Division employs modern techniques such as Computer Aided Design (CAD) for many purposes, including finite element stress analysis, process vessel design, process piping layout and safety evaluation work. In its construction management function the Division utilises such techniques as modular construction, automated welding and computer aided manufacture (CAM). Quality Assurance (QA) procedures are used in all activities to monitor the design function and subsequently QA is used in all manufacturing and construction stages to ensure that all projects are built to demonstrably high standards.

Notes

Main Site Processes

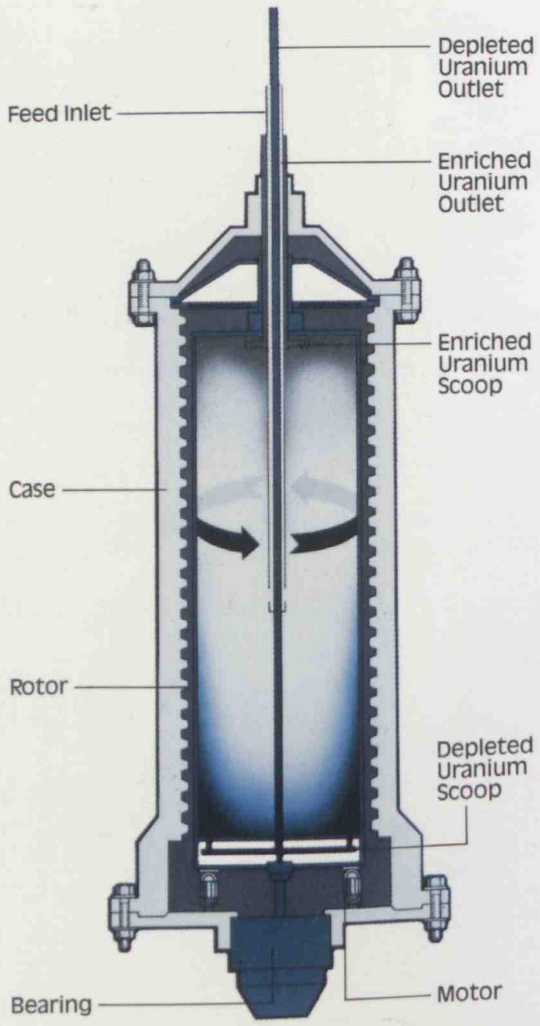


TECHNICAL NOTES ENRICHMENT

Enrichment is carried out using a gas–uranium hexafluoride ('hex')–and exploiting the slight difference in weight between U235 and U238 to effect separation by a centrifuge process. The process was developed at Capenhurst in the 1970s and the first production plant began operation in 1977.

The operating gas (hex) is fed continuously into the rotor of a high speed centrifuge (see diagram below). As the gas rotates centrifugal forces cause the heavier U238 molecules to concentrate at the rotor wall and the U235 molecules to move to the centre. This effect is enhanced by the use of a counter current along the rotor length. An enriched 'product' stream and a depleted 'tails' stream are withdrawn continuously from opposite ends of the centrifuge. The process is repeated many times to give the level of enrichment required–typically about four times the natural occurrence of U235. A number of centrifuges operating in series and in parallel form a centrifuge cascade–the basic plant production unit. A plant such as that at Capenhurst contains thousands of centrifuges forming a number of cascades.

Diagram 5.



Particular features of gas centrifuge plants are:

Small economic increment of capacity: A plant can be extended in modular form and in each module the cascades can be closely approximated to the ideal shape for any specified product.

Short lead time: The first product from a plant can be available two years after the investment decision.

Low power consumption: Power consumption is less than 10% of that needed for a diffusion plant. The effect of energy price increases on plant operating costs is therefore reduced.

Zero maintenance philosophy: In the rare event of a failure of a centrifuge in a cascade the continued operation of the other centrifuges is not affected. The failed unit is therefore left in place for the remainder of the life of the plant.

Notes

TECHNICAL NOTES FUEL PRODUCTION

CHEMICAL PROCESSES

Conversion of ore concentrates to pure uranium tetrafluoride

A wide range of uranium ore concentrates is received at Springfields. After sampling and assay the concentrates are dissolved in nitric acid to produce a slurry containing impure uranyl nitrate and undissolved impurities. The slurry is purified by filtration and solvent extraction in continuous mixer-settler extractors. A solution of tri-butyl phosphate in odourless kerosene is used as the extracting agent. The purified uranyl nitrate is then concentrated by evaporation and converted to uranium trioxide by thermal decomposition in a fluidised bed reactor. Nitrous fume arising passes to a nitric acid recovery plant. Pure uranium trioxide is converted to uranium tetrafluoride in a continuous process using rotary kilns. The rotary kiln process involves the hydration of the uranium trioxide followed by the reduction of this hydrate to uranium dioxide and finally hydrofluorination of the dioxide to uranium tetrafluoride.

Uranium hexafluoride production

Uranium hexafluoride is produced by the reaction of the tetrafluoride with elemental fluorine. Fluorine is produced by electrolysis of the fused salt KF.2HF and the reaction of fluorine with uranium tetrafluoride is carried out in a fluidised bed reactor containing an inert bed of calcium fluoride granules. The gaseous uranium hexafluoride produced is passed to a system of condensers where it is deposited as a solid. When a condenser is 'full' it is taken out of the circuit and heated so that the uranium hexafluoride liquifies under pressure and is run off to transit containers.

Uranium metal billet production

Reduction of uranium tetrafluoride to uranium metal is carried out by mixing with magnesium raspings, compressing the mixture into pellets and heating in a furnace. The molten uranium forms a billet which can be separated from the magnesium fluoride slag and cleaned by pickling and shot blasting.

Conversion of enriched uranium hexafluoride to uranium dioxide powder

This conversion is achieved in a single stage process termed the integrated dry route (IDR). In this process the uranium hexafluoride is converted directly to ceramic grade uranium dioxide powder by reaction with steam and hydrogen in a rotary Inconel kiln. The kiln is operated with a counter-current gas solids flow, uranium hexafluoride vapour being fed with steam at the gas outlet end of the kiln. This produces a solid intermediate, uranyl fluoride, which is then reduced by a hydrogen feed to the powder discharge end of the kiln.

FUEL ELEMENT MANUFACTURE

Magnox facilities

Fuel element designs for the Magnox stations, although basically similar, are specific to each station. The fuel manufacturing facilities must, therefore, be readily adaptable and be capable of manufacturing several types simultaneously.

Starting with the uranium metal billets, fuel rods are first cast using a vacuum casting furnace. These rods are then straightened, machined to diameter, grooved and cut to final length. The rods are then inserted into Magnox cans and various end fittings attached. Helium gas is introduced to facilitate testing of welds. The canned fuel is then subject to pressurisation to lock the can to the machined rod and the product is given further detailed inspection and testing.

Oxide Fuel Production

Uranium dioxide pellets are manufactured to a wide range of specifications dependent on the reactor type involved. Uranium dioxide granules are fed to pelleting presses and the pellets produced are then sintered. After sintering they are ground to the required diameter and then inspected prior to pin manufacture. Pin manufacture is essentially the assembly and loading of a stack of pellets into a stainless steel or zirconium can. The pins are then sealed and tested, end caps are welded on and the pins subjected to rigorous inspection before being released for fuel element assembly. The form of array in fuel elements is specific to the reactor type involved.

Fuel element component manufacture

The stringent requirements of fuel element components have given rise to the establishment of a large scale component manufacturing facility at Springfields. The manufacture of Magnox and stainless steel fuel element components involves forging, machining, welding, brazing, heat treatment and finishing operations to a high degree of dimensional accuracy.

Notes

TECHNICAL NOTES REPROCESSING

Reprocessing involves a series of chemical separation processes in which uranium fuel which has been used in a reactor is treated to separate residual uranium (about 96% of the total) and the by-product plutonium (1% of the total). It also enables highly-active waste (less than 3% of the total) to be separated. The reclaimed material can be used again as fuel and this increases the energy potential of the uranium fuel rod by 30 to 40 per cent. If the uranium and plutonium were used to their fullest potential by continuous recycling in fast breeder reactors, the energy potential of the fuel rod would be increased by about 50 to 60 times.

On arrival at Sellafield the fuel elements are transferred from the transport flasks into containers which are stored under water in cooling ponds to await reprocessing. The spent fuel is still highly radioactive and generates heat. The water provides the required degree of cooling and shielding. Storing the fuel enables short-lived radioactivity to die away before the fuel is reprocessed.

Following pond storage irradiated Magnox fuel is transferred to dry shielded cells where it undergoes a mechanical decladding process to remove the Magnox can. The cladding material is transferred to shielded storage silos, where it is stored under water. The bare uranium rods resulting are then dissolved in nitric acid following which solvent extraction is used to separate out and purify the uranium and plutonium product streams and the highly-active fission product waste stream. Current plant uses mixer settlers for the solvent extraction stages whereas the THORP plant will use pulsed columns. The solvent used is tributyl phosphate in kerosene.

For AGR oxide fuel, the fuel elements will first be dismantled and the pins will then be sheared into a basket in a batch dissolver. The basket containing the leached hulls is then removed and the dissolver liquor is clarified by centrifugation before passing to the pulsed columns for the solvent extraction processes.

Reprocessing gives rise to a variety of gaseous, liquid and solid radioactive wastes. Two types of waste, low active liquid and aerial effluents, are discharged under existing authorisations by Government Departments. The remaining wastes can be categorised on the basis of their activity into:

high level waste, which is the first cycle raffinate from solvent extraction.

intermediate level wastes, which are wastes containing significant beta-gamma activity or a greater quantity of plutonium than is suitable for sea dumping.

low level solid wastes, suitable for shallow land burial or for sea dumping under the London Convention.

Over 99% of the radioactivity in waste arising from the reprocessing of fuel at Sellafield is stored on site.

High level waste is concentrated by evaporation and stored pending introduction of vitrification. Intermediate level wastes include a wide variety of materials such as fuel element debris, ion exchange materials, sludges etc. which are currently stored pending the introduction of encapsulation routes. Low level wastes include, for example, items from laboratories and offices (eg paper towels, packaging materials), protective clothing, cleaning materials etc. These are disposed of without conditioning by shallow land burial.

Notes

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