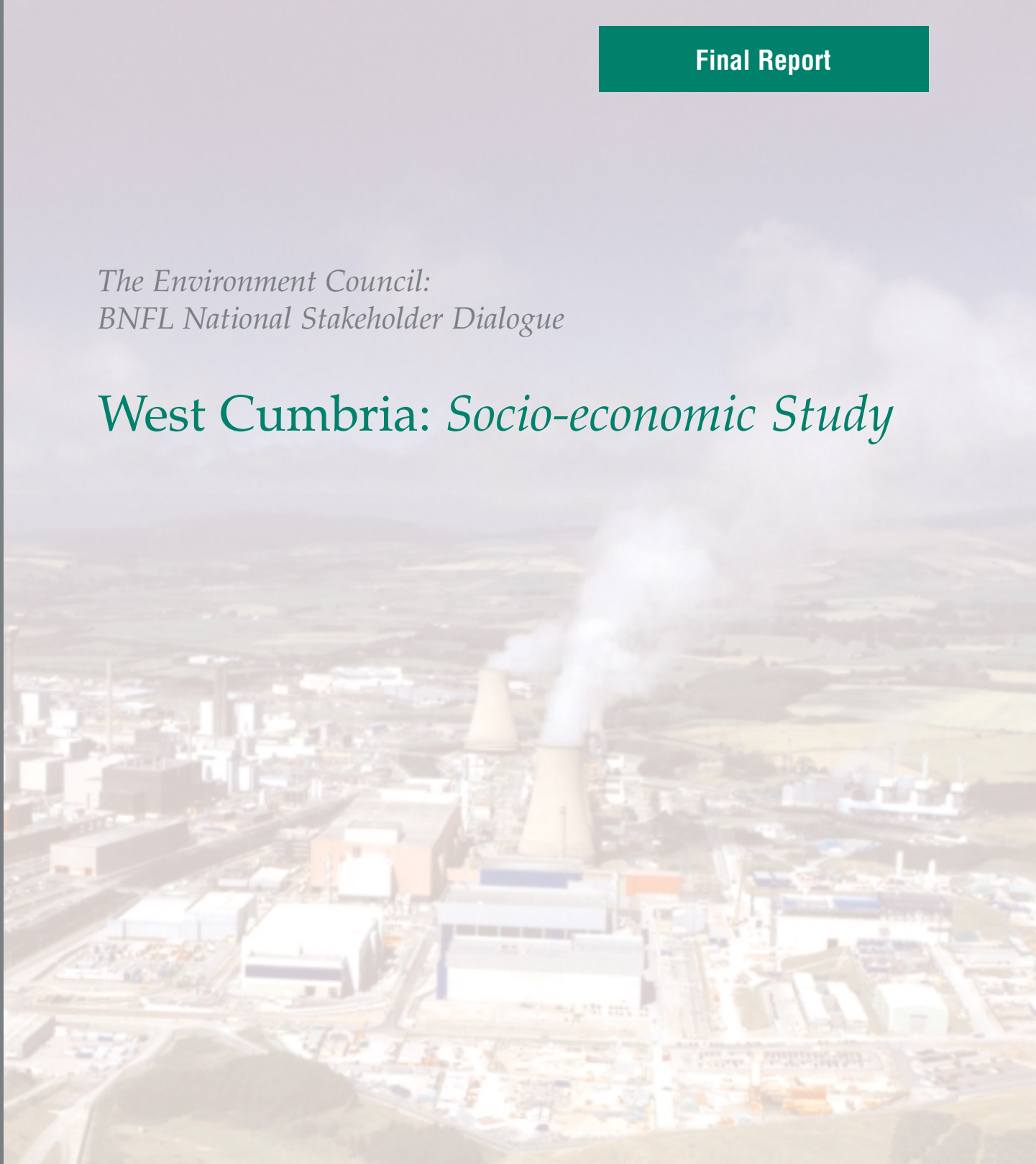
Final Report

CONSULTING SERVICES BY ENVIRONMENTAL RESOURCES MANAGEMENT

The Environment Council:
BNFL National Stakeholder Dialogue

West Cumbria: *Socio-economic Study*



November 2001

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FINAL REPORT

The Environment Council: BNFL National Stakeholder Dialogue

West Cumbria: *Socio-economic Study*

November 2001

Reference: 7109

Prepared by:

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For and on behalf of ERM Economics	
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Date:	5th November 2001 _____

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

1. This report sets out the economic and social impacts of future business scenarios for BNFL's Sellafield site on the economy of West Cumbria. The report has been prepared by ERM Economics, supported by Business Strategies Limited, as an input into the BNFL National Stakeholder Dialogue.

2. ERM's research has been supervised by a Socio-economic Steering Group whose members have been drawn from a broad group of stakeholders including BNFL, local authorities, green pressure groups and trade unions. In addition, the members of the steering group have acted as representatives of the Spent Fuel Management Options (SFMOWG) and Plutonium (PuWG) Working Groups. These have been set up as sub-groups of the national stakeholder dialogue process to examine specific issues. ERM has reported to the Socio-economic Steering Group, then to SFMOWG and PuWG, and finally to the main stakeholder group.

3. The future business scenarios adopted in this report have been produced by SFMOWG and PuWG, and are intended to be indicative of potential upper, lower and median levels of activity on site. The economic modelling undertaken for this study was undertaken during February 2001. Since that date the two groups have made further refinements to the scenarios. These refinements are not reflected in this report but are not considered to have a material impact on our findings. There is also the scope for sensitivity testing of the scenarios in the future, with variants addressing levels of reprocessing and power generation potentially being of greatest interest.

4. BNFL Sellafield is located in West Cumbria, one of the more remote regions in England. The area is characterised by a number of adverse social and economic trends which provides the context for understanding the impacts of future business scenarios for the plant. As with the UK, West Cumbria has an ageing but stable population. However, this stability masks a decline in the number of young workers relative to the UK, suggesting that young people leave Cumbria, possibly for higher education, but do not return.

5. Employment in the study area has declined steadily over the past two decades, except for the peak attributed to the construction of THORP in the late 1980s and early 1990s. This decline is partly associated with a long term decline in industrial employment, and has affected male more than female employment, which has actually grown. Past experience has shown employment trends to be heavily influenced by BNFL Sellafield site activity, with construction employment being particularly sensitive to BNFL investments.

6. The decline in employment has led to the area having unemployment levels that are persistently above levels for the North West and the UK. The occupational status of employees and average gross weekly earnings are also

lower when compared with the UK average. West Cumbria also has a lower rate of new business formation than the UK.

7. The social characteristics of the area reflect the relative decline of the local economy. Analysis by Cumbria County Council has demonstrated that the West of the county, and Copeland in particular, suffers from high levels of deprivation. The health of the West Cumbria population is also poor compared with England as a whole, with the area performing worse on a range of indicators including heart disease, strokes, cancer and suicides.

8. Educational attainment in Cumbria is poor by national standards, with less than half as many employees with a degree level qualification (or higher) as the national average. Performance is also poor at other higher levels of attainment.

9. The perception of the area reflects both the history of industrial decline and the high quality of the landscape. The area is also widely perceived as inaccessible, with only one good quality external road link and limited rail services.

10. All the future business scenarios at Sellafield will involve a loss of employment over the next 25 years. In order to gauge the likely response of the economy to these employment losses we have undertaken:

- an international literature review of the impacts of employment losses in the nuclear and other industries; and
- detailed economic modelling of the impacts of the scenarios on the local economy.

11. The literature shows that large firms contribute to the local economy in terms of expenditure and income as well as employment. Investment and employment decisions have regional impacts on employment and income and indirectly affect population and migration which, in turn, affect factors such as house prices and skill levels. Examples from the UK's coalfields show that pit closures had highly undesirable impacts on the local male labour force, with employment and economic activity decreasing significantly at a local and county level. At the county level, employment and economic activity as well as real household income dropped at the time of closure, but increased or returned to previous levels, usually after two to three years. However, this is not the case at local levels where high levels of unemployment persist for longer. Out-migration and commuting help local economies to adjust to employment shocks, but the process of adjustment can be painful and incomplete with large social costs, such as higher unemployment and crime and poorer health, being typical.

12. The nuclear industry is characterised by the wide range of choices which can be made in its design and operation. These include whether to generate electricity using nuclear power, what type of plant is used, whether to reprocess or store spent fuel from reactors, what to do with separated plutonium, and how to manage and dispose of nuclear waste. The industry

therefore is extremely complex and the Sellafield site is no exception. Feedback and constraints between the various plants and processes mean that detailed scenarios of future operations can only be produced by experts with an in-depth knowledge of the Sellafield site.

13. The scenarios developed include "Minimum" and "Blue Sky" scenarios which bound the lower and upper possibilities of future Sellafield activity. Two further scenarios within this bounded range have been developed by the Socio-economic Study group in conjunction with SFMOWG and PuWG:

- "Stop Now and prepare for closure as soon as possible" envisages mitigation of the minimum case by increased short term expenditure on cleanup and Pu immobilisation, and by commitment to long term spent fuel storage.
- The "BNFL Current Business Plan" involves the planned Magnox generation and Magnox and THORP reprocessing programmes with no uprating of cleanup and waste management operations.

14. To provide baseline information on the economic impacts of Sellafield three surveys were undertaken of site employees, BNFL suppliers and other businesses in West Cumbria.

15. In 2000 Sellafield employed approximately 11,500 BNFL, agency and contractor staff. The average age of staff was 42 and the average length of service was 14 years. Almost half of respondents stated that they live in West Cumbria because of Sellafield, and almost a fifth moved to the area to work at the site. The families of workers are often highly dependent upon the site, with almost a fifth of respondents having a partner or spouse who work on site, and more than a quarter having relatives outside their household working at Sellafield.

16. The relatively high wages offered by the company mean that employees have proportionately higher expenditures on leisure pursuits, with workers spending almost twice the proportion of their incomes than the national average on going out (to pubs, restaurants and other entertainment) and holidays.

17. Surveys of suppliers found that over 40 percent depended upon BNFL for half or more of their turnover in West Cumbria. The surveys also found that suppliers also supply BNFL indirectly, with almost 40 percent identifying other customers who supply BNFL. Not surprisingly, BNFL's suppliers indicated that their turnover and employment would be sensitive to changes in the scale of activity on site.

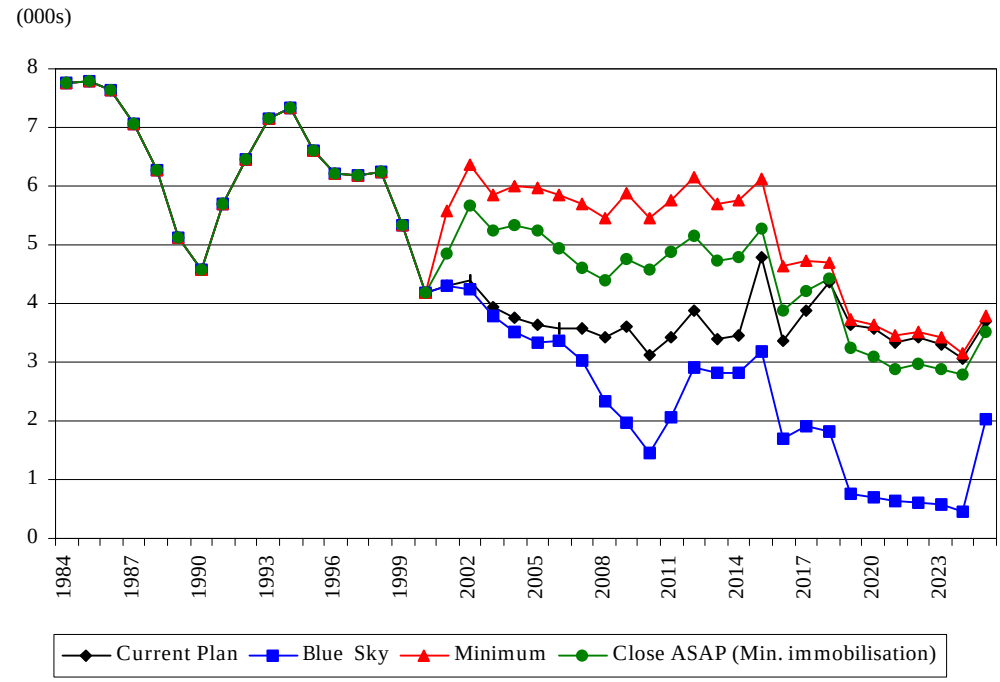
18. A similar picture was found with other local businesses who do not supply BNFL directly. ERM interviewed a variety of leisure, retail, transport and other businesses. The great majority reported that the expenditure by BNFL workers and suppliers was an important factor in their turnover, and impacted upon their ability to generate new employment. This was reflected by poor levels of business when uncertainty emerged about the future of the

plant. However, a small number of businesses also mentioned that the benefits and conditions offered by BNFL made it difficult for them to recruit and retain skilled staff locally.

19. The outlook for on-site employment at Sellafield is one of steady long-term decline. Not even the "Blue Sky" scenario, which takes the most optimistic assessment of future reprocessing activities, reverses this trend. This decline will have marked knock-on effects in the local economy, as every five jobs on site support another job in West Cumbria. This is a high local multiplier effect, but one which is not surprising given the relative isolation of West Cumbria, the high incomes of the workforce and the efforts made by BNFL to use local suppliers.

20. The objective of this study has been to provide comparative data between the scenarios. The analysis shows that the differences between scenarios are greatest in the short- to medium-term. Over the longer-term employment levels converge under the four scenarios, albeit with slightly higher levels of on-site employment under the "Blue Sky" scenario. There is a major loss of construction employment in the next few years in all scenarios. For full time employees it is significant that nearly 20 per cent of current BNFL employees are aged 50 years old or older, and this should help any adjustment that takes place over the coming years. However, the management of employment decline at Sellafield will be a key issue for the local economy in coming years. *Figure 1* illustrates unemployment in West Cumbria by scenario.

Figure 1 ***Unemployment in West Cumbria by Scenario***



21. The West Cumbria economy has adjusted to large shifts in employment in the past, especially during the mid-to-late 1980s, when the completion of THORP corresponded with a general slowdown in the national and local economies.

Excluding Sellafield, West Cumbria could still function as an economy, with about 35,000 full-time equivalent employees in industries including the public sector, retail and tourism. There would, however, be significant problems in terms of social and economic adjustment. The decline in employment will have adverse social consequences, for example on health and crime and, therefore, should be avoided for both economic and social reasons to the extent possible. These adverse social consequences have been quantified where possible.

22. The are a number of committed and potential projects that could help protect the employment base in West Cumbria. These projects will be particularly valuable in the event of a rundown in employment at Sellafield. The projects are varied, including:

- BNFL sponsored initiatives, for example relocation of staff from elsewhere in the company to Sellafield;
- private sector investments, such as the new Vertex call centre;
- developments in the energy and environment sectors, including plans for large offshore wind farms;
- improvements to transport and communications, such as further upgrades to the A595; and
- other public sector investments, including improvements to higher education provision.

23. The initiatives could generate several thousand construction and permanent jobs over the next five years. However, it is likely that West Cumbria will continue to experience employment decline, partly as a result of long-term economic trends that have hit the area disproportionately hard, and partly as a result of a decline in activities at BNFL. This employment decline will not all manifest itself in unemployment because of an ageing population, the out migration of young workers and a decline in economic activity rates. The increase in unemployment has, however, been modelled and is presented.

24. Securing new investments to create additional employment opportunities will require forward planning and a concerted lobbying effort by leading stakeholders in the region. This process should be stepped up immediately as a major decline in construction employment on site has already commenced. However, even if all partners in the region lobby effectively, securing all the potential new employment will represent a considerable challenge and will require significant additional resources to be made available.

1 INTRODUCTION

1.1 BACKGROUND TO THE STUDY

This report has been prepared by ERM Economics with support from Business Strategies Limited and sets out the economic impacts of future business scenarios at BNFL's Sellafield plant in West Cumbria(1). The study area is illustrated in *Figure 1.1*. ERM was appointed by The Environment Council as a part of BNFL's National Stakeholder Dialogue process and the report was jointly commissioned by a diverse group including BNFL, trade unions, local authorities and representatives of environmental campaign groups. In keeping with the spirit of the stakeholder dialogue process, ERM's study team has reported to the Socio-economic Sub-group, and work plans and outputs were reviewed and agreed collaboratively.

The objective of the research was to provide participants in BNFL's National Stakeholder Dialogue with accurate and accessible information on the economic impacts of the scenarios under consideration. This information will then be considered in a broader framework, which addresses other issues such as safety and environmental impacts(2).

The future business scenarios adopted in this report have been produced by the Plutonium and Spent Fuel Management Options working groups of the National Stakeholder Dialogue and are intended to be indicative of potential upper, lower and median band levels of activity on site. To enable economic modelling to commence, the scenarios were adopted as they stood at the end of January 2001. Subsequent refinements are therefore not specifically addressed in this report.

1.2 AIMS AND STRUCTURE OF THIS REPORT

This report sets out the findings of the study for review by stakeholders and includes:

- an analysis of baseline socio-economic conditions in West Cumbria and a comparison of West Cumbria with the North West and the UK (*Section 2*);
- an overview of the nuclear fuel cycle and BNFL's role within it (*Section 3*);
- experiences from other locations where major employment impacts, both positive and negative, have been experienced *(Section 4);*

(1) Given the scale and complexity of the task, the analysis has been restricted to quantifying the socio-economic impacts of BNFL's Sellafield plant. However, the approach adopted for this study would be replicable at other BNFL locations should the need arise.

(2) It should be noted that ERM was not asked to comment on broader economic development goals for the region, which are being addressed through a separate study entitled "New Visions for West Cumbria and Furness." See *Section 7.1* for more detail on this project.

- results from surveys of employees, BNFL suppliers and other local businesses (*Section 5*);

- results from the econometric modelling undertaken by Business Strategies to determine local economic impacts (*Section 6*); and

- the conclusions of a review of committed and potential future employment generating investments in West Cumbria that could help to offset the impacts of any future employment losses at Sellafield.

In addition, annexes present supplementary data and information:

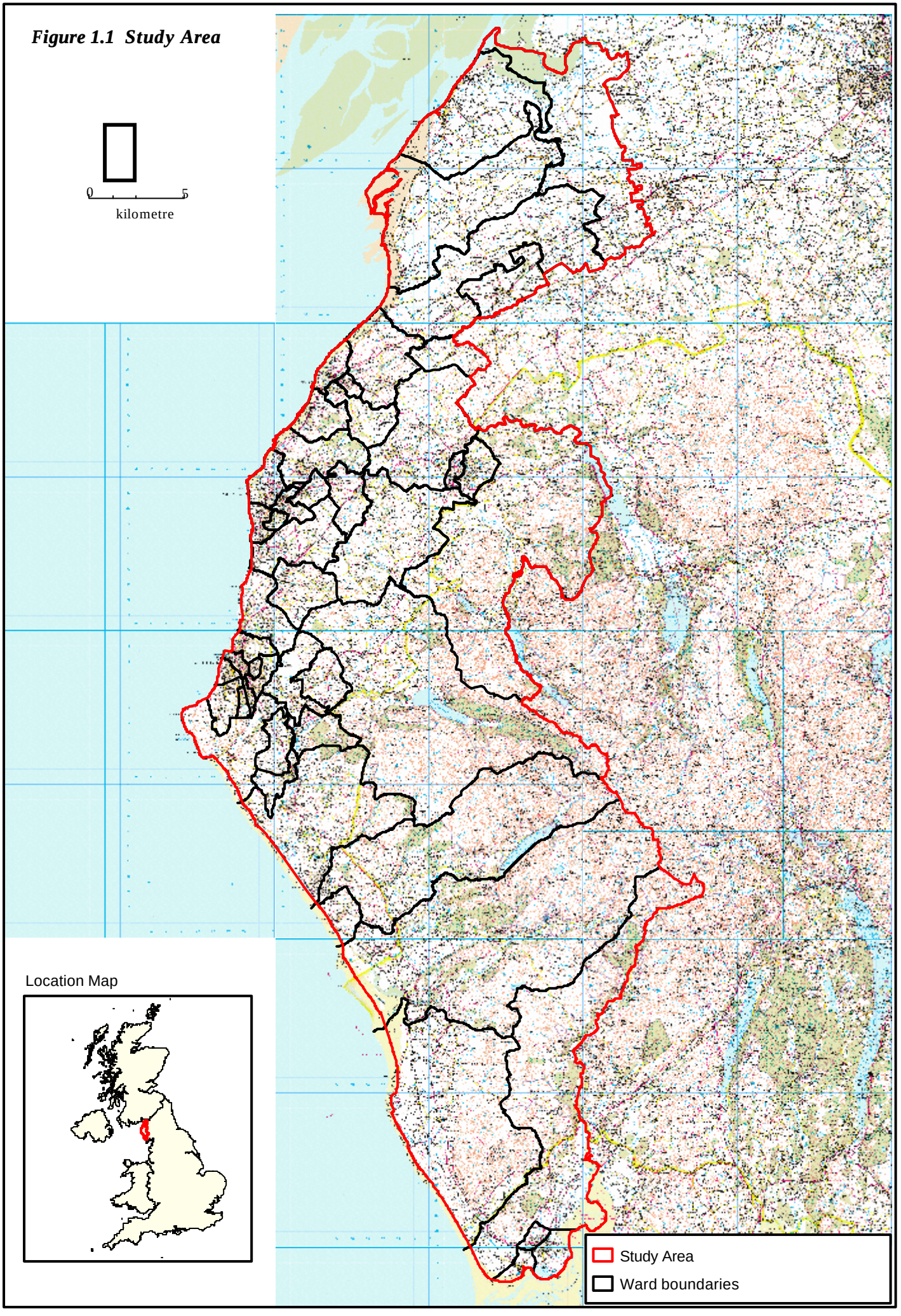
- the findings of a literature review of the impacts of changes in employment on health and crime (*Annex A*);

- a description of the methodology underlying the economic forecasts (*Annex B*);

- a bibliography (*Annex C*); and

- a glossary of key terms used (*Annex D*).

Figure 1.1 Study Area



2 SOCIO-ECONOMIC BASELINE CONDITIONS

2.1 INTRODUCTION

This chapter provides an introduction to the demographic, economic, social and environmental characteristics of the study area. The study area is defined as the Workington and Whitehaven Travel to Work Areas and takes in the borough of Copeland and the western part of the borough of Allerdale from Crummock to the coastal district of Workington and north through the wards of Ellen, Aspatria, Tarns, Waver and Silloth. The Eastern part of Allerdale, including Keswick and the Lake District National Park, is outside of the study area. Where it is not possible to provide data for the study area, data for a wider area (eg district or county) is used as a proxy.

Section 2.2 focuses on population and the demographic structure of the area, presenting data to indicate absolute and relative changes that have taken place since 1982. *Section 2.3* then examines the local economy, drawing on time series employment data to highlight the key structural changes which have occurred in the West Cumbria economy from the early 1980s to the present. In this section and elsewhere, we make use of forecasts prepared by Business Strategies based on National Statistics to extrapolate data up to 2000. The issues of unemployment, business and investment are addressed in turn before *Section 2.4* presents an examination of social issues in the study area. This includes sub-sections on health, housing, and education, where a description of the main characteristics of the study area is presented and comparisons are made with regional and national information. Finally, *Section 2.5* presents a brief review of the environment and infrastructure of the study area.

2.2 DEMOGRAPHY IN WEST CUMBRIA

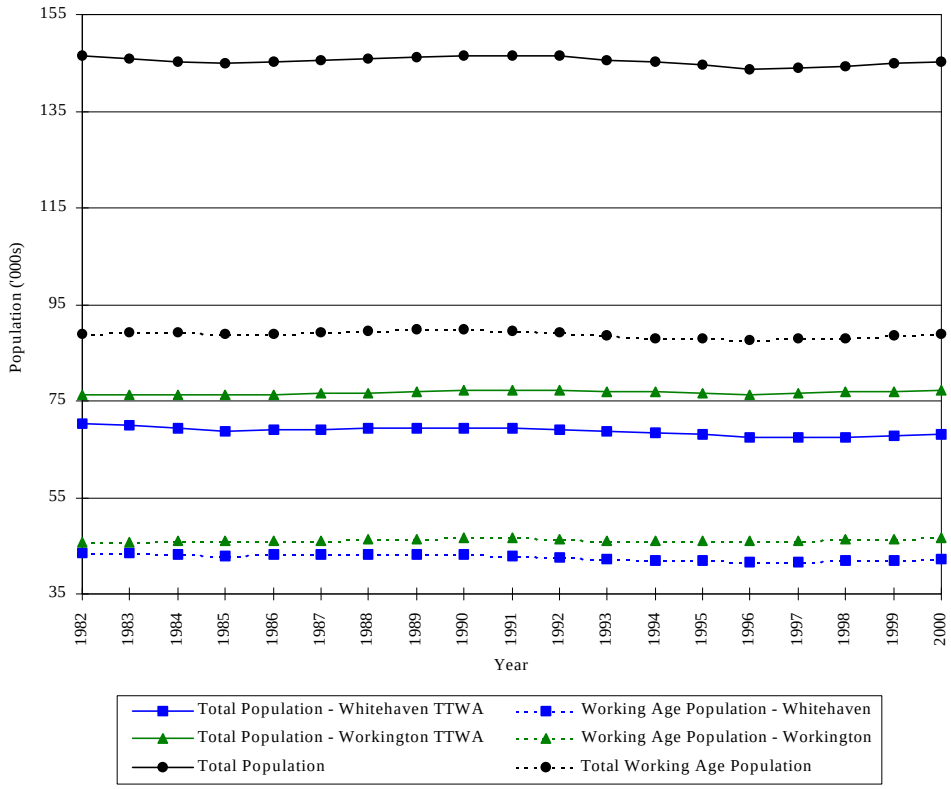
Cumbria remains one of the most sparsely populated counties in England despite the long term growth in population. Within the county, there are significant variations in population density, ranging from Eden, which has the lowest population density, to Barrow in Furness, which has the highest.

Since 1982 the total population of the Workington and Whitehaven Travel to Work Areas (TTWAs) has remained relatively constant, fluctuating in the 144,000 – 146,000 range. The most recent available data (from Business Strategies, based on National Statistics figures, unpublished) estimated the total population of the area to be around 145,227 persons in 2000. The population distribution within the two TTWAs has remained fairly constant, though in gender terms there has been a small relative decline in the number of females.

As in the rest of the North West and UK, the demographic picture is characterised by an ageing population. *Figure 0.1* shows that there are

increasing numbers of people in the working age group. This is the largest age group in the area (although it is also a the widest age range). The over 65 age group (the second largest single group and also a wide age range) is growing too, reflecting the national trend. This growth is attributable to the increasing number of men, though there are still more women in this age group. The number of women aged over 65 has not changed significantly since 1990.

Figure 0.1 Study Area Population and Age Distribution, 1982 - 2000



Source: National Statistics
Note: Figures from 1995 onwards are estimates

In the younger age groups the data indicates a declining population over the period 1982 - 2000, both among the 16-19 year old age group and the 20-24 year old group. The largest fall is in the number of female 20-24 year olds. Between 1986 and 1998 absolute numbers in this category fell by 43 percent, while for males the fall was 36 percent. Both of these figures, and especially that for females, are higher than the England and Wales reductions of 27 and 26 percent for females and males respectively.

The result of this decline in the number of young people is that the proportion of 20-24 year olds in the population of the Whitehaven and Workington TTWA, at five percent, was lower than both the UK average of 6.1 percent and the North West average of six percent (1997 figures, ONS 1999a). For 16-19 year olds, it was lower still: the UK average of 6.1 percent (and North West average of six percent) compares with the Whitehaven and Workington TTWA's figure of 4.4 percent.

Data for 1999 and 2000 indicate that the steady drop in the absolute numbers of people in these age groups may now have stopped, with population levels stabilising or showing small increases.

2.3 THE ECONOMY: EMPLOYMENT AND BUSINESS

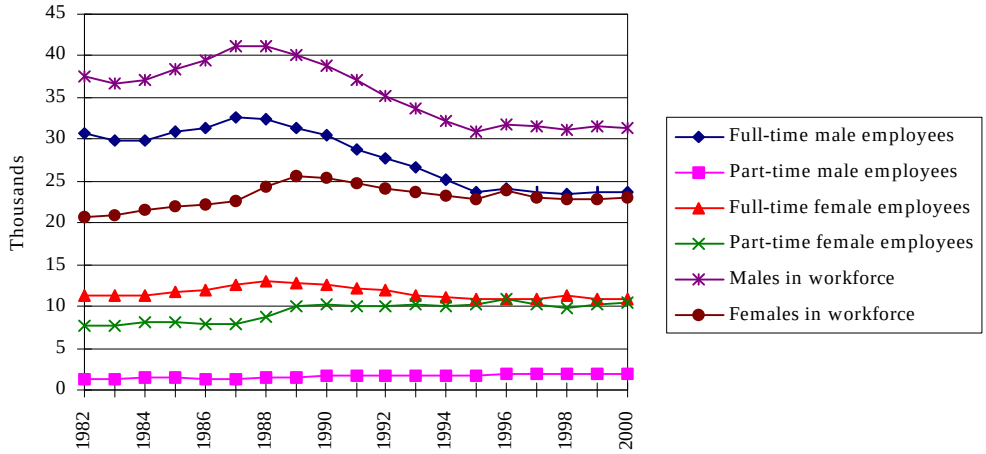
2.3.1 Employment

Introduction

Average total employment in the study area in 2000 was 54,290 (Business Strategies forecasts, unpublished, based on National Statistics data). Of the total, some 86 percent were employees and the remainder self employed. This is close to the national ratio (87:13) reported by ONS (1999a) but is slightly higher than the North West average. Self employment is often regard as a measure of entrepreneurship, so these figures suggest that the study area is close to the regional and national average.

Figure 0.2 shows the numbers of people employed since 1982 by employment type. Part-time workers are well represented in the study area, comprising some 26.3 percent of employees. This is slightly higher than the UK average of 24.6 percent (ONS 1999b) and higher still than the North West average of 24 percent. Within the study area, there has been a significant shift towards part-time employment since 1982, which at the beginning of the period represented only around 17.5 percent of employees.

Figure 0.2 Total Employment by Type, 1982 - 2000



Source: National Statistics

The figure indicates that the number of females in employment has risen since 1982 in absolute terms (over 2,200 jobs). Over the same period there was a net loss of female full-time jobs, meaning that all of these new jobs were either part-time (97 percent) or self employed (3 percent). At the beginning of the

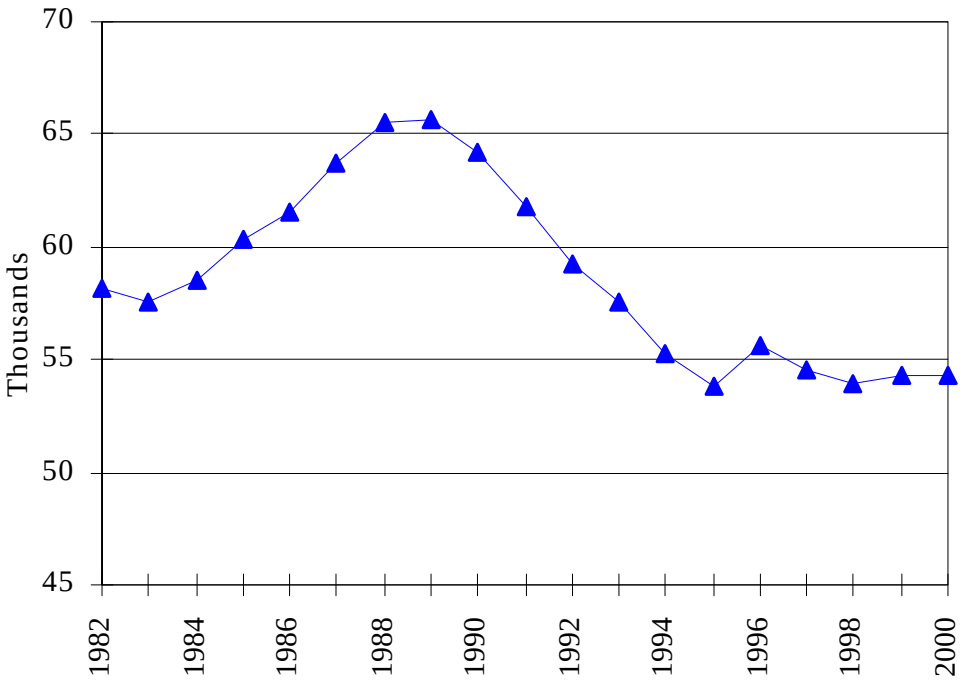
period females made up 35 percent of all employment. Now some 42 percent of all employees are female (ONS / Business Strategies), a proportion which is slightly lower than the national and North West average of 46 percent (ONS 1999a).

The seven percentage point increase in the proportion of women in the work place has occurred not just because more women are participating in the labour market. *Figure 0.2* clearly shows that there has also been a decline in male employment, and especially in full-time male employment. This was particularly so between 1988 and 1995.

2.3.2 Structural Changes in Employment: 1982 - 2000

A review of employment trends in the Workington and Whitehaven TTWAs since 1982 reveals two clear phases in the development of the local economy. The first phase, from 1982 to 1989, was a period of significant economic expansion characterised by strong employment growth. With the onset of the recession in the early 1990s, a second phase of economic activity began in which employment began to decline significantly. In 1996 falls in employment were reversed, and with the exception of 1997 and 1998, employment has stabilised since then. This pattern is clearly illustrated by *Figure 0.3*, below, which shows total full-time and part-time employees and self employed jobs.

Figure 0.3 Total Employment in Study Area (Employed and Self-employed), 1982 - 2000

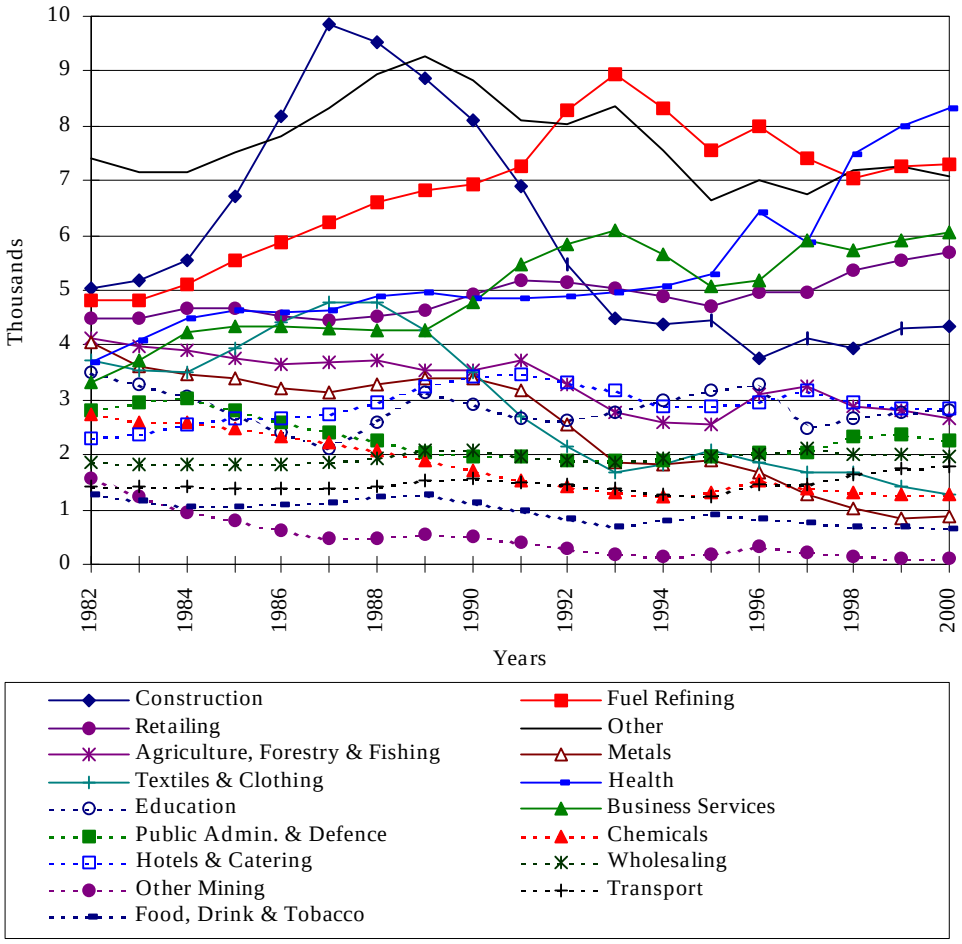


Source: National Statistics

Local Economic Expansion, 1982 - 1989

Figure 0.3 shows that some 7,500 jobs were added to the labour force in the period 1982 - 1989. Changes in employment structure for the whole of the period from 1982 to the present are shown in *Figure 0.4*, which presents employment by selected economic activity.

Figure 0.4 Changes in Employment Structure, 1982 - 2000



Source: National Statistics

The figure illustrates that during the 1982 - 1989 period, one sector in particular, construction, experienced spectacular growth. A look at the data by area shows that this rapid growth in construction employment was driven mostly by activity in the Whitehaven TTWA between 1983 - 1987. This reflects the increase in activity at the BNFL plant in Sellafield while work on the THORP reprocessing plant took place. Also experiencing strong growth during the 1980s (from some 4,800 jobs in 1982 to over 6,800 in 1989) was the fuel refining sector which includes BNFL's activities. Other areas experiencing notable growth during the 1980s were hotels and catering, health and (at least until 1988), textiles.

Though this period was a time of significant growth in some sectors, the "total employment by type" data shown in *Figure 0.1* indicates that part-time

working increased. The same data shows us that the number of women in the workforce during this time increased much more rapidly than the numbers of men.

It is clear from the data that though there was rapid growth in the (male dominated) construction and fuel refining sectors this was not paralleled by large numbers of men joining the labour force. What may have happened is that full-time male employees in declining industries, of which steel, chemicals, mining and public administration / defence were the principal ones, simply switched to new jobs elsewhere.

Structural Change and the Decline in Employment: 1989 - 2000

By 1990 the labour force comprised around 25,600 females and 40,100 males. With the onset of the recession in the early 1990s these figures began to decline significantly. Every year between 1990 and 1995 employment fell, with the main casualty being full-time jobs, which in absolute terms fell by over 8,300 from 1989 to 1995, a reduction of nearly 20 percent. At the same time, over 2,000 self employed jobs were lost. Only the number of part-time jobs remained stable.

Reflecting the national and regional picture, full-time jobs in the study area are characterised by high levels of male participation, so the decline in full-time jobs affected a greater number of men than women. By 1995 around one in ten working women had lost their jobs while approximately one in five working men had lost theirs.

The temporary boom in the local construction industry, which had reached its peak in 1987, ended with the completion of BNFL's major projects and by 1992 construction had returned to its pre-THORP levels of employment. The end of the construction boom may have also contributed to decline in the metals sector. On a declining trend through the 1980s, metals continued to decline into the 1990s after staging a partial recovery in 1988 and 1989. Between 1990 and 1993 the metals sector lost 45 percent of its workforce. Textiles and clothing also lost nearly two thirds of its workforce between 1988 and 1993, making only a temporary recovery in 1994 and 1995.

In conclusion, the number of full-time jobs lost over the 18 year period beginning in 1982 was some 7,500. To some extent, new part-time jobs may have compensated for this decline. Since 1982 there has been a net gain in part-time jobs of 3,400 in the study area, and the decline in full-time jobs appears to have stopped.

The Economy in 2000

In employment terms, the economy of the study area is characterised by dependency on the fuel refining and health sectors for nearly a quarter of all employment (these sectors represent some 13.4 percent and 10.6 percent of employment respectively). Other key sectors in order of size by employment

are retail, construction, business services, hotels and catering, education and agriculture, forestry and fishing.

There is empirical evidence supporting a shift since 1982 from a manufacturing to services. However within the business service sector there have been declines in specific areas of activity such as banking, insurance and communication which have been contrary to trends witnessed nationally and in the North West. The table below shows sectoral changes in employment in the study area since 1982.

Table 0.1 Employment by Largest Sectors, 1982 - 2000

Ranking by	1982		2000	
Employment	**Industrial Sector**	**Employment**	**Industrial Sector**	**Employment**
1	Construction	5,027	Fuel Refining	7,291
2	Fuel Refining	4,803	Health	5,746
3	Retail	4,500	Retail	5,704
4	Agriculture	4,126	Construction	3,911
5	Metals	4,045	Business Services	3,484
6	Textiles	3,735	Hotel / Catering	2,838
7	Health	3,682	Education	2,809
8	Education	3,521	Agriculture	2,661

Source: Business Strategies based on National Statistics data, unpublished

Notes: (a) See *Section 6* of this report for employment dependent upon Sellafield site activity

(b) It is likely that the large changes in health and education employment are a result of classification errors by the returning local authority. It is not possible to verify this though as returns are confidential

Of the eight largest sectors in 1982, the table illustrates that six remain in the top eight today: fuel refining, health, retail, construction, education and agriculture.

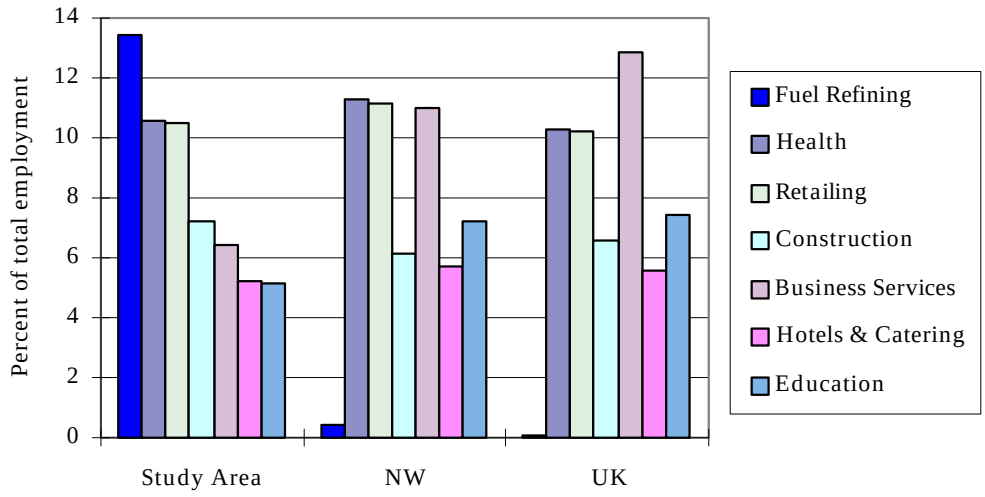
Turning to the national and regional picture, with the exception of fuel refining, the area's main activities are similar to those in the North West and UK as a whole. *Figure 0.5* shows the seven most important economic sectors in the study area, according to the proportion of the total workforce that they employ. For comparative purposes, these sectors are also shown for the North West and UK.

The main difference (apart from fuel refining) is in business services, where the study area appears underrepresented. What is also notable is that each of the other six main economic activities in the study area are also the main activities in the UK and the North West, though the order of importance varies.

Skill Base

Disaggregated data is available by ward showing figures on the occupation of people by professional, managerial, technical, skilled, unskilled and other grades, though no attempt has been made to aggregate these ward figures to TTWA level. Instead, the focus of the following section is at district level, with Allerdale and Copeland having been used as a proxy for the study area.

Figure 0.5 Percentage of all Employment by Economic Activity



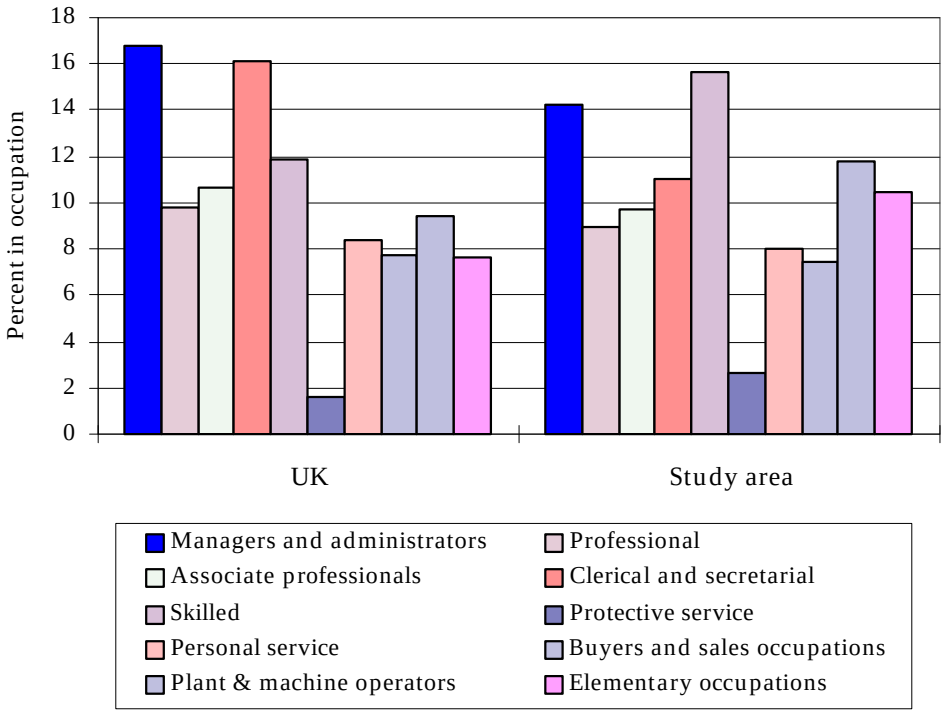
Source: National Statistics

The categorisation used is based on that employed by National Statistics, though some of the categories have been combined to allow easier presentation and comprehension. The categories used are:

- managers and administrators, including corporate managers, administrators, proprietors in agriculture and services and prison officers;
- professional occupations, like doctors, solicitors, chemists, pharmacists, university professors and clergymen;
- associate professionals, including computer programmers, nurses, actors underwriters, building inspectors and laboratory technicians;
- clerical and secretarial workers, including civil service administrators, accounts, records and wages clerks and computer operators;
- skilled occupations, including plasterers, bricklayers, carpenters, motor mechanics, knitters, weavers and dental technicians;
- protective service occupations, such as NCOs in the armed forces, security and police officers;
- personal service staff, including cooks, waiters, hairdressers, nursery nurses and undertakers;
- buyers and sales occupations, including sales representatives and assistants;
- plant and machine operators, among which are metal making, food, drink, tobacco and paper process operatives, assemblers and line workers;
- elementary occupations, including labourers, mates to trades people, kitchen porters, couriers, refuse collectors and farm workers.

Using these categories to divide the labour force into “skill base categories” provides a skill base profile for the study area as shown in *Figure 0.6.*

Figure 0.6 Employment by Occupational Social Class



Source: National Statistics
Note: Key reads left to right, and then down, ie "Managers" is the first bar and "Elementary" the last

The figure shows that the main occupational social class differences between the study area and the UK as a whole are in:

- clerical and secretarial, which is under represented in the study area by over five percentage points;
- skilled occupations, which are over represented by nearly four percentage points; and
- elementary occupations, which are over represented by nearly three percentage points.

Other lesser differences are the relatively low numbers of managers and administrators in the study area and the proportion of people employed as plant and machinery operators, which is slightly higher than the national average.

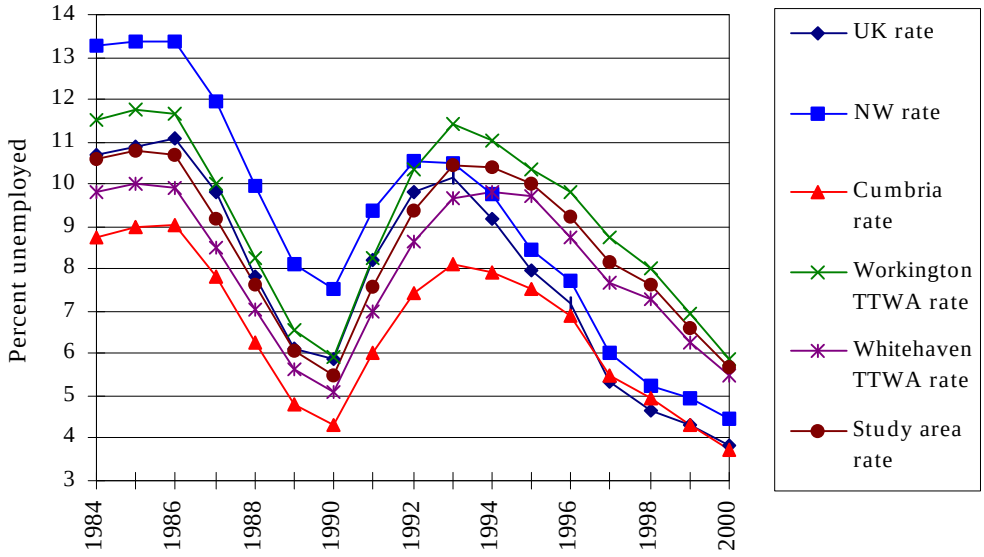
The above average reliance of the area on manufacturing is reflected both in the high numbers of machine operators and skilled people and in the relatively low numbers of clerical workers.

2.3.3 Unemployment

Unemployment in the study area broadly reflects the inverse of changes in overall employment detailed above. From 1984 to 1986, claimant count

unemployment rates in the overall study area were close to 10 percent(1). Disaggregation of the two TTWAs reveals that the Workington TTWA had a slightly higher rate than the neighbouring Whitehaven TTWA. Whilst high in today's terms, in the context of the then unemployment figures for the North West (13.3 percent) and the UK (10.7 percent), unemployment in the study area was not exceptional, and indeed was much better than the regional average (see *Figure 0.7*).

Figure 0.7 Comparative Unemployment Rates, 1984 - 2000



Source: National Statistics

The figure shows unemployment rates in the study area (as a whole and disaggregated by the two TTWAs) relative to those in Cumbria, the North West and the UK, between 1984 and 2000. It shows that in the latter half of the 1980s there was a sustained fall in unemployment rates across all the areas examined.

The beginning of the 1990s brought the start of a new recession which led to significant increases in unemployment at the national, regional and sub-regional levels. Despite impacts of the recession, unemployment rates did not reach the peaks experienced in 1984. Nonetheless, the Figure shows that unemployment in the study area did get worse relative to the UK and the North West. This was especially true for the Workington TTWA, which unlike Whitehaven benefited less from the growth in fuel reprocessing activities.

By 1993 the rate of increase in unemployment in the UK and North West had begun to fall but this pattern was not reflected in the study area. By 1994 unemployment rates in the study area were higher than in the UK in general

(1) The claimant count unemployment rate is the number of unemployment claimants divided by the workforce, where the workforce is the number of employed plus the number of unemployment claimants.

and in the North West. Though there has been increased convergence of unemployment rates in the two TTWAs of Workington and Whitehaven since then, unemployment rates in the study area remain in excess of those for the North West and UK as a whole.

2.3.4 Business

The Stock of Businesses

The number of businesses created in an area and the changes in the stock of businesses gives an indication of the nature and health of the local economy in that area. ONS collect annual data showing the number of businesses registered for VAT by sector and annual changes in these figures show whether the trend is rising or falling. This data is not available at TTWA levels but it is published at district level. The figures for Allerdale and Copeland are used as a proxy for the combined Workington and Whitehaven TTWAs in *Table 0.2*.

Table 0.2 Businesses Registered in Copeland and Allerdale by Sector

VAT industry	1998 stock in Copeland	Change since 1995	1998 stock in Allerdale	Change since 1995	1998 total business stock	Percent change since 1995
Agriculture, fishing	410	-15	1,015	0	1,425	-1
Mining, energy and water	5	0	5	0	10	0
Manufacturing	80	-5	165	-10	245	-5.7
Construction	135	-25	335	-25	470	-9.6
Wholesale & retail	355	-40	625	-80	980	-10.9
Hotels & restaurants	195	-15	360	-30	555	-7.5
Transport & communications	55	-5	145	-5	200	-4.7
Finance	5	-5	5	-5	10	-50
Real estate	135	+30	250	+15	385	+13.2
Public admin, other	95	+5	170	+15	265	+8.1
Education, health	20	0	35	-5	55	-8.3
All industries and services	1,490	-75	3,110	-130	4,600	-4.3

Source: NOMIS, 2000

Note: NOMIS figures are rounded to the nearest five businesses. Stocks are as at the beginning of each year

The table shows that over the four years 1995-1998 inclusive the two districts between them lost some 4.3 percent of total businesses, with the number of businesses in the two districts at the end of the period being some 4,600. The sectors which lost the largest absolute number of businesses were wholesale and retail, hotels and restaurants and construction. Analysis of the employment data indicates that over the same period, the number of construction jobs fell, reflecting the reduction in construction businesses. Conversely, the number of wholesale and hotel and catering jobs remained

constant, and the number of retail jobs rose, suggesting that in these sectors there is a trend away from smaller firms and towards larger enterprises.

Only two sectors experienced a growth in the number of businesses across Allerdale and Copeland, and these were real estate and public administration, the latter including social security, charities, libraries and cultural activities. The trends in West Cumbria are at odds with the North West and the UK, where the late 1990s saw moderate net increases in business registrations.

Investment

A study of capital expenditure in manufacturing between 1993 and 1997 in Cumbria indicates which sectors invest the most in their asset base.

Table 0.3 Capital Expenditure by Manufacturing Sector (£m) 1993 - 1997

Description	1993	1994	1995	1996	1997
Food products, beverages and tobacco	35.2	27.6	35.4	29.6	26.3
Textiles and textile products	4.9	5.4	4.2	2.3	2.2
Leather and leather products	1.0	2.4	1.2	0.9	2.0
Wood and wood products	1.1	1.6	2.4	0.9	2.0
Pulp, paper and paper products, print etc.	17.9	16.7	15.6	21.0	34.9
Chemicals and chemical products	28.3	29.1	36.7	28.6	15.5
Rubber and plastic products	13.0	11.7	14.3	21.8	17.8
Other non-metallic mineral products	5.0	7.2	4.5	3.1	5.9
Basic metals and fabricated metal products	23.2	10.9	26.8	10.0	10.8
Machinery and equipment not classified elsewhere	0.7	1.5	2.3	2.0	1.4
Electrical and optical equipment	2.8	3.3	3.2	3.9	4.5
Manufacturing not classified elsewhere	2.1	3.4	3.8	4.8	6.9
Column totals	**135.2**	**120.8**	**150.4**	**128.9**	**130.2**

Source: Cumbria Economic Bulletin, March 2000

There are two sectors excluded from the above table: coke, refined petroleum and nuclear fuel, which largely comprises BNFL's activities, and transport equipment, largely accounted for by GEC Marconi Marine (Vickers). At the time of publication investment data were not available for these two sectors as publishing the data might reveal commercially confidential information. However, data provided to the consultants by BNFL for the four financial years 1993/94 to 1996/97 illustrate the scale of manufacturing investment carried out by BNFL relative to other manufacturing investment in Cumbria. These figures are shown in *Table 0.4* and exclude investment in the "transport equipment" sector.

Table 0.4 BNFL Capital Expenditure (£m), 1993/4 - 1996/97

	1993/94	1994/95	1995/96	1996/97
BNFL capital investment	328	327	373	372
Ratio of BNFL investment to non-BNFL Cumbrian manufacturing investment	2.42 : 1	2.71 : 1	2.48 : 1	2.86 : 1

Source: BNFL and Cumbria Economic Bulletin, March 2000

Even though *Table 0.3* shows Cumbria's manufacturing investment by calendar years and the BNFL data is shown for financial years, it is clear from the two tables that BNFL dominates manufacturing investment in Cumbria to an enormous extent. The tables show that in the period covered, BNFL's expenditure on capital items has been 2.4 to 2.8 times the investment for the rest of Cumbrian manufacturing.

2.4 SOCIAL ISSUES

2.4.1 Health

The study area falls under the remit of the North Cumbria Health Authority. The North Cumbria Health Authority (NCHA) has its headquarters in Carlisle and covers a wider region than the study area. As well as Copeland and Allerdale District Councils it also includes those of Carlisle and Eden. Whilst some health data are available by ward, the majority are provided at overall health authority level, with some figures also provided at district level.

Mortality

Health statistics show a marked variation from region to region for a variety of factors - including diet, age structure, occupational status, smoking, drinking and nature of residence. In particular, there is a well recognised link between prosperity and health.

Overall, mortality rates in North Cumbria are five percent higher than the average levels for England and Wales, an excess mortality rate which represents some 200 additional deaths per annum (North Cumbria Health Authority, 1999).

More than half of this excess mortality is due to ischaemic heart disease. Cancer is also a major cause of ill health in North Cumbria as it is elsewhere in the UK, being responsible for around 900 deaths per annum(1).

Within the Health Authority as a whole, the death rate varies across the district council areas, with the highest rates in Allerdale and Carlisle. *Table 0.5* illustrates some average annual age-specific death rates (per 100,000) for

(1) Cancer is major cause of death across the UK. This report neither studies nor implies any link between radioactive discharges and cancer.

selected causes. Data relate to 1995 - 1997, the latest period for which figures are available.

Table 0.5 Average Annual Death Rates per 100,000 by Selected Cause

Cause	Sex	Allerdale	Copeland	NCHA	Carlisle	Eden	England and Wales
All causes	Male	1,194	1,033	1,146	1,195	1,116	1,056
	Female	1,302	1,152	1,234	1,239	1,206	1,111
All cancer	Male	320	294	313	336	279	283
	Female	281	242	267	276	258	252
Cancer of lung, trachea and bronchus	Male	98	73	86	90	73	78
	Female	38	51	47	52	50	42
Breast cancer	Female	44	43	48	55	48	47
Ischaemic[1] heart disease	Male	314	296	316	324	333	277
	Female	274	272	279	291	274	223
Stroke	Male	116	68	99	92	126	87
	Female	180	143	171	173	189	142
All accidents	Male	39	26	37	42	38	24
	Female	35	23	23	13	19	17
Motor vehicle accidents	Male	16	10	15	19	13	9
	Female	5	2	3	1	7	3
Suicide, self inflicted injury & injury undetermined	Male	14	20	16	17	11	15
	Female	5	3	5	7	5	5

Note: Caused by an inadequate supply of blood to the heart
Source: North Cumbria Health Authority (NCHA), 1999

Particular insights can be gained by comparing the health data for Allerdale and Copeland with the England and Wales averages, although differences in age structure and demographics need to be taken into account. In the cause of death groups appearing in the table, a review of the data indicates that Allerdale's "all causes" average annual death rate does not compare favourably with the England and Wales average. Three of the key reasons for this are the categories of "all cancers", "stroke" and "ischaemic heart disease", for which Allerdale has a higher than average death rate. Copeland's death rate for heart disease is also higher than the England and Wales average. This finding is consistent with overall ward data which reveal that mortality ratios tend to be worse in the coastal and western areas of the North Cumbria Health Authority region.

Mental Health

Suicide rates are a poor indicator of mental health, but NCHA (1999) employs them for target setting on mental health issues because "there is simply nothing else suitable". Suicide in the NCHA region is the second highest cause of death in young men aged 15-34, exceeded only by deaths in motor vehicle accidents. NCHA notes that this group, young men, frequently experience social isolation and exposure to drugs, alcohol and poverty (see *Annex A* for a review of past studies on the link between unemployment and health).

2.4.2 Housing

Housing data is available at both ward and district level, though not been at the level of the TTWA.

In 1998, there were a total of 67,694 households in Allerdale and Copeland, of which 57 percent were in Allerdale and 43 percent in Copeland (Cumbria County Council District Profiles, 1999). *Table 0.6* shows dwellings in the two districts by type.

Table 0.6 Dwellings in Allerdale and Copeland by Type (1998)

Type of Dwelling	Number in Copeland	%	Number in Allerdale	%	Total number	%	UK figures %
Detached	5,198	18.2	8,835	22.6	14,033	20.7	24
Semi-detached	10,163	35.5	12,313	31.5	22,476	33.2	32
Terraced	10,687	37.4	13,916	35.6	24,603	36.3	26
Purpose built flat	1,689	5.9	2,749	7.0	4,438	6.6	14
Other household space	628	2.2	955	2.4	1,583	2.3	4
Caravans, and other	227	0.8	334	0.9	561	0.8	-
Total	28,592	100	39,102	100	67,694	100	100

Source: Cumbria County Council, District Profiles (1999), National Statistics (2000)
Note: For UK figures, caravans and other are included in the category "other household space"

Across Allerdale and Copeland, the most common type of housing is terraced, which makes up 36 percent of the total. This compares to 35 percent for the North West (source ONS 1999a) and 26 percent nationally (National Statistics, 2000). The next most common type is semi-detached, comprising a third of all dwellings. This compares to 38 percent in the North West (ONS 1999a) and 32 percent nationally (National Statistics 2000). Some 20 percent of dwellings are detached, which is slightly lower than the national average of 24 percent, though as expected for a predominantly non-urban area, there are fewer flats in the study area than in the rest of the country.

In line with the situation across the North West and in England, most people living in Allerdale and Copeland are either buying their own houses or have finished buying them. Two-thirds of houses are owner occupied, close to the England and North West figure of 68 percent (ONS, 1999a). *Table 0.7* shows dwellings by tenure.

Table 0.7 Tenure of Dwellings

Household Tenure	Number in Copeland	Percent	Number in Allerdale	Percent	Total	Percent
Owned outright	6,558	22.9	11,230	28.7	17,788	26.3
Buying	12,203	42.7	14,683	37.6	26,886	39.7
Local Authority rental	5,851	20.5	6,903	17.7	12,754	18.8
Housing Authority rental	2,237	7.8	3,102	7.9	5,339	7.9
Private rental	1,165	4.1	2,332	6.0	3,497	5.2
Other	572	2.0	852	2.2	1,424	2.1
Total	28,586	100	39,102	100	67,688	100

Source: Cumbria County Council, District Profiles, 1999, figures based on 1991 census

The proportion of people renting their houses from Local Authorities is slightly higher than the England and North West figures of 16 and 17 percent respectively, as is the number of houses rented from housing authorities, however private rentals in the study area are a lower proportion of the total than generally found elsewhere.

House Prices

House prices in the North West have been rising consistently since 1995 and strong growth is especially evident in the case of higher quality housing. *Table 0.8* gives an indication of the degree to which house prices have changed at the regional and sub-regional level. Allerdale and Copeland are used as a proxy for price changes in the study area.

Table 0.8 Percentage Change in House Prices by Location and Type, 1995 - 2000

Dwelling location/type	Detached	Semi-detached	Terraced
North West	+30	+24	+20
Cumbria	+31	+19	+18
Allerdale	+31	+20	+23
Copeland	+12	+3	+5

Source: Land Registry
Note: 2000 based on Q1 and Q2 data

The strongest house price rises are in the North West, followed by Allerdale, Cumbria, and then Copeland.

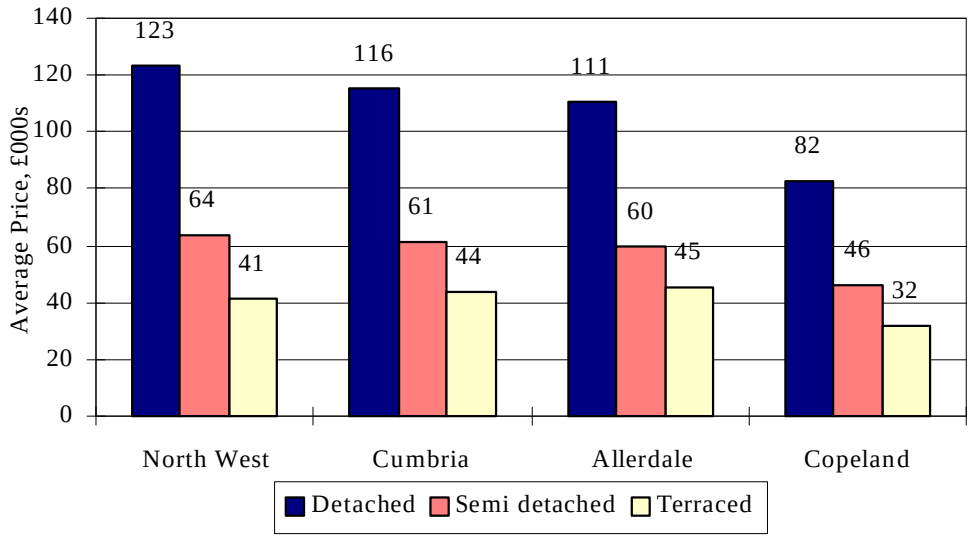
Perhaps the most striking evidence shown in the table are the relatively low rates of price rises experienced in the Copeland property market since 1995. Copeland is more representative of the study area than Allerdale, because average prices of houses in Allerdale are pulled up by more expensive properties outside the study area (eg Keswick and the Lake District National Park).

The differential between house prices in East and West Cumbria is a clear indication of the general dislocation between the East and West Cumbrian economies, with labour shortages and relative affluence prevalent in East

Cumbria, whilst the West Cumbrian economy is characterised by high levels of unemployment and deprivation.

Figure 0.8 shows absolute house prices, which are based on data for September 2000.

Figure 0.8 House Prices by Area, September 2000



Source: Land Registry

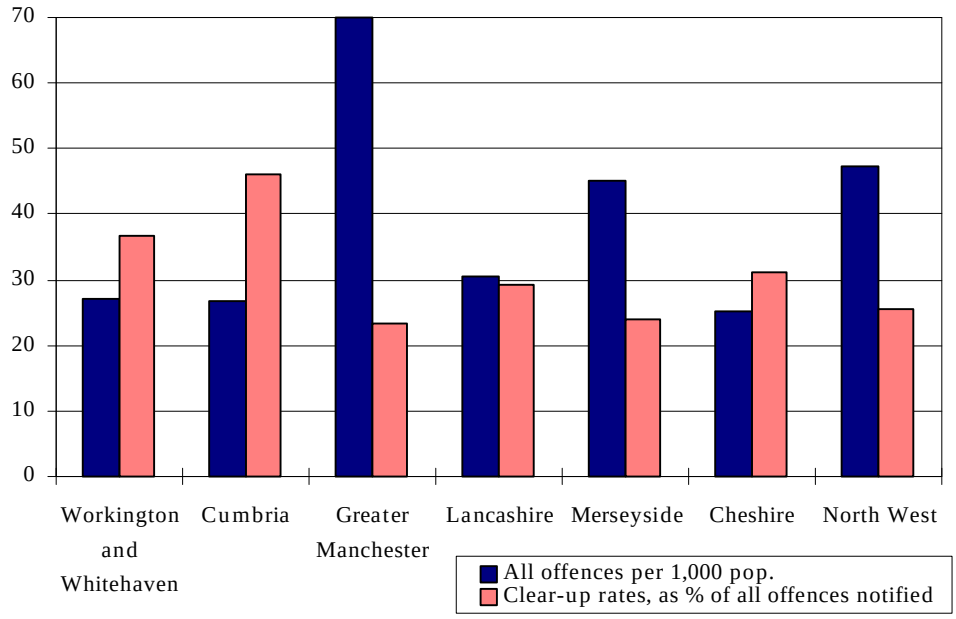
The figure illustrates that on average, detached and semi-detached properties in the North West are more expensive than those in Cumbria, while in turn, properties in Cumbria cost more than equivalent housing in Allerdale. Terraced housing in Cumbria and Allerdale is more expensive than the average price for this kind of property elsewhere in the North West, possibly because of the premium commanded for this type of housing in the Lake District National Park, which is a popular place amongst people who wish to buy second homes or retire there. Of the four areas shown, Copeland has the lowest residential property prices.

2.4.3 Crime

To understand the impact of crime on the study area, statistics were obtained from the Home Office showing notifiable offences recorded by the police between April 1999 and March 2000. To avoid inappropriate comparisons of absolute numbers of crimes for areas of different populations, all comparisons were made on a "crimes per *x* thousand people" basis, while clear up rates are expressed as a percentage of all notified crimes solved.

The closest proxy to the study area for which crime figures are collected is Basic Command Unit level which in this case is the Workington and Whitehaven police force area.

Figure 0.9 Notifiable Offences by Selected Area, 1999-2000



Source: Home Office (2000)

Figure 0.9 shows all notified offences by selected area. In 1999 - 2000 there were 27.1 notified offences per 1000 people living in the study area. This compares very well with the North West average of 47.3, though from examination of the Figure it can be seen that the North West average is skewed by high figures especially in Greater Manchester and to a lesser extent Merseyside. The "all offences" figure is comparable to the Cumbrian and Cheshire averages of respectively 26.7 and 25.0 per 1000. The clear up rate for all offences stands at 36.5 percent, lower than the Cumbrian average of 46 percent but higher than the averages for each of the other sub-regions: Cheshire, Lancashire, Merseyside and Greater Manchester.

Cumbria tends to have lower crime levels and higher clear up rates than these other sub-regions and this is most likely due to its more rural setting. Part of the explanation for the relatively good performance of the Workington and Whitehaven areas is that having smaller towns, urban crime is reduced, leading to an overall lower average.

Data are also available for the following specific crimes:

- violence against the person;
- sexual offences;
- robbery;
- burglary;
- motor vehicle theft; and
- thefts from motor vehicles.

For violence against the person, sexual offences and robbery, Workington and Whitehaven has fewer crimes per 1000 people than does Cumbria as a whole.

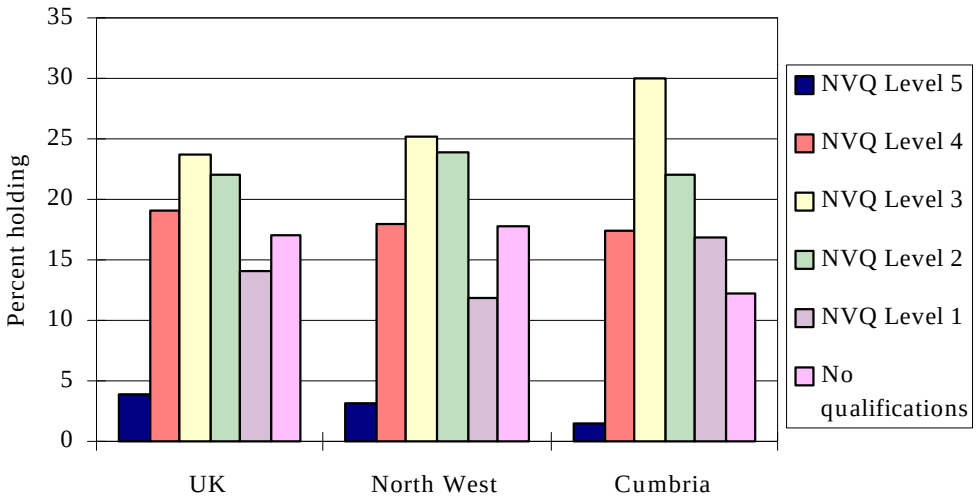
For the sexual offences and robbery, its level is lower than the average for each of the other sub-regions. For burglaries and motor vehicle thefts, Workington and Whitehaven has figures that are higher than average for Cumbria, but lower than those of the other sub-regions. Only in the thefts from motor vehicle category does the Workington and Whitehaven area perform less well, with higher numbers of offences than Cumbria, Cheshire and even Lancashire, with its large urban belt extending through Burnley, Accrington, Blackburn and Preston.

2.4.4 Education

Education and training qualifications are collected as part of the Labour Force Survey, administered by National Statistics. The data are not available at ward or TTWA level: the most disaggregated level at which these data are made available is for Cumbria as a whole.

As part of the survey, respondents aged over 16 are asked what is the highest level qualification they have. *Figure 0.10* presents the findings from the March - May 2000 quarterly database, and shows the proportion of people for whom each National Vocational Qualification (NVQ) level is the highest qualification held. Because of the number of different types of qualifications held (around 40) each one is converted into an equivalent NVQ. NVQ level 5 is the highest qualification, and includes higher degrees, while NVQ level 1 is the lowest, and includes GCSEs below grade C and CSEs below level 1.

Figure 0.10 Highest Qualifications Held



Source: Labour Force Survey, National Statistics, March - May 2000

The figure shows that the proportion of people in Cumbria who have an NVQ Level 5 qualification (equivalent to a higher degree) was half that of the North West overall, and less than half of the UK average. This suggests that the Cumbrian labour force is not as qualified at the top end of the scale than in the rest of the country. However, the proportion of people in Cumbria who responded that they had no qualifications at all was some five percentage

points lower than in the North West and UK, showing that more Cumbrians have achieved a minimum level of qualifications than people elsewhere.

In Cumbria, as in the North West and UK, the most commonly held level of educational attainment was NVQ Level 3, which includes 2 or more A levels, a BTEC National or certain trade apprenticeships. Thirty percent of people in Cumbria reached this standard (the corresponding figures for the North West and UK were 25 and 24 percent). It is likely that this good performance relative to the regional and national average is at least partly a result of relatively large numbers of people having completed apprenticeships while working for one or other of West Cumbria's large industrial employers.

2.4.5 Social Exclusion

There are many parts of both rural and smaller urban areas where poverty and deprivation exist. The incidence of disadvantage is an important factor in determining the demand for local services, particularly for health, as the causes of ill health include poverty, socio-economic disadvantage, stress, unemployment, unhealthy diets and addiction to alcohol, tobacco and drugs. Indeed, there is "a simple and obvious link between being poor and having poor health" (North Cumbria Health Authority, 1999).

Cumbria County Council's Information and Intelligence team employs what is known as a "geo-demographic classification" to categorise people into one of six groups, to help assess social disadvantage. The technique used is the "ACORN" method developed by CACI Information Services, which is used widely by local government and also in marketing. ACORN is an acronym for "a classification of residential neighbourhoods" and is a postcode based system based on 1991 census data which assesses the socio-economic group of people likely to be living in certain types of accommodation. Six broad categories are defined which are then sub-divided further as required. The six categories are:

- "thriving" - the people established at the top of the social ladder, who are healthy, wealthy and confident consumers;
- "expanding" - business people in better off families, paying off mortgages and bringing up children in affluent, family areas;
- "rising" - young, affluent urban people or young professionals in towns and cities, working and studying their way up the career ladder;
- "settling" - skilled workers and "comfortable middle agers" in the middle of the social spectrum, living in home owning areas and leading steady lifestyles;
- "aspiring" - those trying hard to increase their quality of living, often new home owners or white collar workers living in better off multi-ethnic areas;
- "striving" - the people who find life most demanding; the definition includes council estate residents, older people living in less prosperous areas or people in multi-ethnic, low income areas.

CACI's assessments of the social disadvantage (and advantage) of residents in Cumbria (and elsewhere) are carried out for each ward and also at district

level. The findings for Copeland and Allerdale are presented in *Table 0.9* below.

Table 0.9 Social Disadvantage: Estimated Percentage of Households Matching Each Categorisation

Household Group	Allerdale %	Copeland %	Cumbria %
Thriving	21.6	13.1	25.0
Expanding	6.8	10.8	6.0
Rising	0	1.1	1.0
Settling	35.0	27.7	35.0
Aspiring	17.1	24.4	16.0
Striving	19.5	22.9	16.0

Source: Cumbria County Council, District Profiles, 1999

Perhaps the most striking characteristic presented in the table is how poorly the top "thriving" group is represented in Copeland, relative to the average for the county. Towards the more disadvantaged end of the scale too, the relatively poor performance of both Allerdale and Copeland is also apparent, with both districts performing worse than Cumbria as a whole in the bottom ("striving") and second from bottom ("aspiring") groups.

Only in the expanding category do both Allerdale and Copeland exceed the Cumbrian average. Copeland's relatively good performance here (four percentage points above the county average) may well be based on significant numbers of BNFL staff living in affluent / executive type family areas within the borough.

The implications of these findings are that in Allerdale, and particularly in Copeland, there are likely to be higher levels of deprivation compared to the rest of Cumbria, leading to greater demand for welfare and public services.

Income Levels

A complete data set showing income levels for the TTWAs which comprise the study area is not available. However, data from the New Earnings Survey (1999) suggests that insofar as gross weekly earnings in the study area reflect the Cumbria average, they are likely to be lower than the averages for the North West and for Great Britain as a whole. *Table 0.10* presents this data.

Table 0.10 Average Gross Weekly Earnings, 1999 (£'s, Adult Rates)

Type of Employment	Great Britain	North West	Cumbria
Full-time employees	400	373	361
Full-time males	442	415	406
Full-time females	327	299	278
Full-time manual males	335	333	345
Full-time manual females	222	222	219
Full-time non manual males	526	488	477
Full-time non manual females	347	315	295

Source: New Earnings Survey, 1999

Notes: Only relates to employee incomes (not self-employment incomes). Also excludes social benefit incomes, incomes from stocks and shares, employers social contributions etc

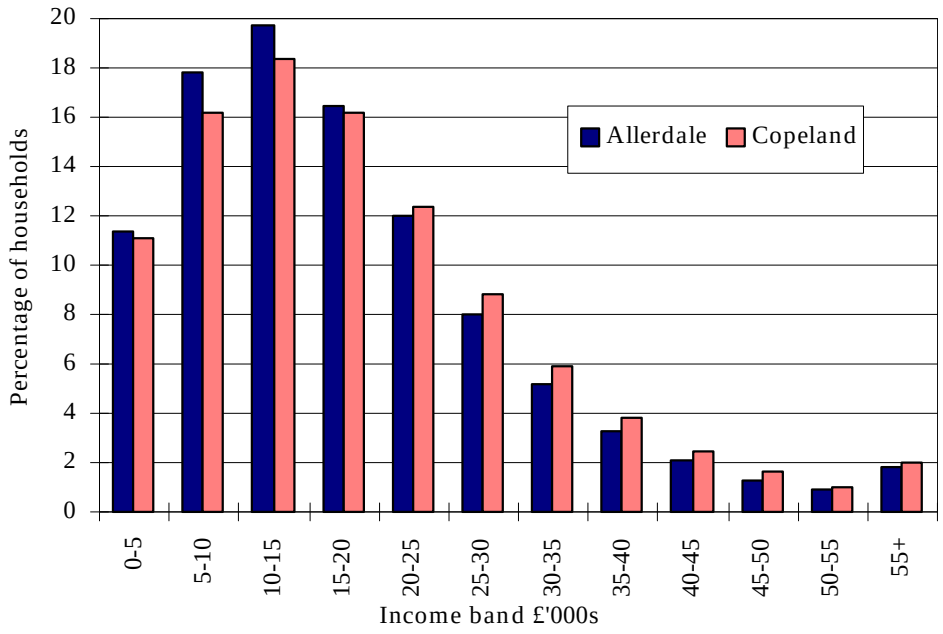
The table shows that in all of the seven categories presented, the Great Britain average figure is higher than the North West figure, which in turn is higher than the Cumbria figure - with one exception. The exception is the case of full-time manual males. In this category, the pattern of the GB average being higher than the North West average is maintained, but the Cumbrian average was not only higher than the North West average (by £12.40 per week) but is also higher than the average for Great Britain as a whole (by £10 per week). The explanation for this is almost certainly the relatively high wages paid by BNFL to manual staff at its plants in West Cumbria.

The Cumbrian group earning the least relative to the Great Britain average are full-time non manual female workers, whose average gross income is only 85 percent of the GB average. This ratio is reflected in women's pay generally, with Cumbrian full-time females earning 15 percent less than the GB average.

Income distribution by TTWA is not available, but district income figures are prepared. Copeland and Allerdale can therefore be used again as approximates for the study area. A graphic illustrating income distribution in these two boroughs is presented in *Figure 0.11*.

The figure shows a skewed pattern of income distribution in which a higher proportion of households have a low income. For example, approximately 11 percent of the population of both districts have an income of between zero and £5,000. The majority of households (53 percent in Allerdale and 51 percent in Copeland) have an income between £5,000-£20,000. *Figure 0.11* also tells us that higher proportions of Copeland residents are in receipt of larger incomes than Allerdale residents, ie the residents of Copeland, on this measure, have higher incomes than their neighbours in Allerdale. It is difficult to draw any conclusions in comparison with national figures which are calculated using different income groups.

Figure 0.11 Gross Annual Family Income 1998: Copeland and Allerdale



Source: Cumbria County Council, District Profiles (1999)

In August 1998, 3.1 percent of households in Copeland were claiming Family Credit, while 10.4 percent of the local population were either claiming income support, or were dependant children living in households claiming income support. For Allerdale, 3.4 percent of households were claiming Family Credit, while 9.0 percent of local people were either claiming income support, or were dependant children living in households claiming income support (Cumbria County Council, 1999).

Car Ownership

Areas of high car ownership are often seen as affluent (and those with low car ownership seen as poor) and the rates of car ownership in an area can be used by central government to aid in the allocation of resources to local authorities for certain services. However in parts of Cumbria and in other places where there is a high rural population and low levels of public transport, this relationship becomes weaker, as owning a car becomes a necessity for those who wish to work, and/or have access to local services.

In Copeland, the number of households without access to a car (33.2 percent) is higher than the average for Cumbria (31 percent), the North West (31 percent) and England (29 percent) though not Scotland. This has implications for both accessibility and social exclusion, particularly where households without cars are located in predominantly rural areas of the borough.

In the district of Allerdale, overall car ownership is higher, most likely reflecting the lifestyles and behaviour of those consumers who live in the wealthier parts of the borough. Yet with 29.9 percent of all households still

lacking access to a private car, the figure remains above the England average, notwithstanding the relatively remote nature of the area.

2.5 THE ENVIRONMENT IN WEST CUMBRIA

2.5.1 Perception of Area

West Cumbria suffers from the legacy of industrial decline. Yet some of those industries which remain, for example chemicals, electronics and nuclear reprocessing, have been able to develop strongly, which has had a counterbalancing impact on the image of the region.

Away from industry the external image of West Cumbria benefits greatly from the area's location immediately next to the Lake District. Tourism used to be concentrated in the south and central Lake District and, up until ten years ago, few visitors ventured west to the Cumbria coast to places such as Maryport, Whitehaven or Workington or to the Furness peninsula. However more tourist activity is now taking place in the study area with, for example, Whitehaven's small port, which used to serve local industry now being proposed to be redeveloped as a tourist and leisure facility. The intention is that this will provide a new focus to the town and act as a catalyst in its regeneration. Recent research into tourist perceptions of West Cumbria has indicated that Sellafield plays no significant role in deterring visitors, with 84 percent of visitors surveyed in Kendal saying that the plant has no influence on their selection of destinations for visits(1).

2.5.2 Infrastructure

The nature of the area, bounded as it is by the sea to the North, South and West, and having the Lake District on its east side, has meant that transport links are generally poor. Key infrastructure links are largely on a north-south axis rather than an east-west one. The principal main road link is the A66, providing access to the M6, to the east of the study area and linking Cumbria southwards with England and Wales and northwards with Scotland. Following the same corridor as the M6 is the West Coast Main Line offering direct services to Glasgow, (with connecting services to and from West Cumbria).

Within West Cumbria local communication has been improved by reconstruction of the A66 to Workington via Cockermouth, while the coastal A595 provides the main link between Millom in the South of the study area and Workington. Further North the A596 continues to Maryport and then leaves the study area on its way to Carlisle.

The Port of Workington is West Cumbria's main general cargo port, with key traffic being bulk cargoes such as coal, chemicals, steel, scrap and timber.

(1) Perception of West Cumbria, a report by the Bowles Green Partnership for the West Cumbria Tourism Initiative, 2000

Further down the coast, and just beyond the study area there is a port at Barrow as well as a small airport.

2.6 CONCLUDING REMARKS

As with the UK, West Cumbria has an ageing but stable population. However, this stability masks a decline in the number of young workers relative to the UK, suggesting that young people leave Cumbria, possibly for higher education, but do not return.

Employment in the study area has declined steadily over the past two decades, except for the peak caused by the construction of THORP in the late 1980s and early 1990s. This decline is partly associated with a long term decline in industrial employment, and has affected males more than female employment, which has actually grown. Past experience has shown employment tends to be heavily influenced by BNFL Sellafield site activity, with construction employment being particularly sensitive to BNFL investments. The decline in employment has led to the area having unemployment levels that are persistently above levels for the North West and the UK. The occupational status of employees and average gross weekly earnings are lower when compared with the UK average. West Cumbria also has a lower rate of new business formation than the UK.

The social characteristics of the area reflect the relative decline of the local economy. Analysis by Cumbria County Council has demonstrated that the West of the county, and Copeland in particular, suffers from high levels of deprivation. The health of the West Cumbria population is also poor compared with England as a whole, with the area performing worse on a range of indicators including heart disease, strokes, cancer and suicides. With regard to housing, the stock in West Cumbria is more likely to be terraced and semi-detached, with fewer detached houses and purpose built flats. Housing tenure in the study area is generally comparable with England, but house prices have not risen as fast as in the rest of the North West or England. Finally, educational attainment in Cumbria is poor by national standards, with less than half as many employees with a degree level qualification (or higher) as the national average. Performance is also poor at other high levels of educational attainment.

The perception of the area reflects both the history of industrial decline and the high quality of the landscape. It is also relatively inaccessible, with only one good quality external road link and limited rail services.

West Cumbria therefore suffers from a number of economic and social problems, which provide the context for assessing the impacts of future scenarios for the Sellafield Plant.

3 RESEARCH EVIDENCE ON THE IMPACT OF EMPLOYMENT EVENTS ON LOCAL COMMUNITIES

3.1 INTRODUCTION

The volume and nature of employment at BNFL's Sellafield complex together with the isolation of West Cumbria mean that the site's interactions with the local economy are unique. However, insights into the impact of changes in employment on site can be gained from examining the effects of major changes in employment elsewhere.

An international literature review of the impacts of major employment changes has therefore been undertaken focusing on:

- the nuclear industry, both in the United Kingdom and abroad; and
- on other industries in economically depressed or peripheral regions of the United Kingdom.

The cases identified are described briefly in *Table 0.1*.

Table 0.1 Case Studies of Major Employment Changes

Company	Location	Brief Description
Nuclear Industry Case Studies		
Dounreay	Caithness, Scotland	Major nuclear installation in very remote location whose employment has fluctuated over time
Savannah River Site	South Carolina and Georgia, United States	Major nuclear site whose mission of manufacturing materials for nuclear weapons has terminated, and which is now in the decommissioning and waste management phase
KSO	Oskarshamn, Southern Sweden	Nuclear power plant scheduled for closure
Case Studies from Other Industries		
Pfizer Pharmaceuticals	East Kent, England	Major science led manufacturer in remote and economically depressed area of Kent
VSEL / BAe Systems Shipyard	Barrow-in-Furness, England	Major employer in Cumbria which has experienced large run down in employment
UK Coalfields	South Wales, County Durham and Nottinghamshire	Large employers of well paid manual workers in predominantly rural areas
Swan Hunter Shipyard	Tyne and Wear, England	Major shipyard which closed in an economically depressed area of North East England

This section sets out a summary of available knowledge on each of these cases.

3.2 THE IMPACT OF MAJOR EMPLOYMENT CHANGES IN THE NUCLEAR INDUSTRY

3.2.1 Dounreay

Background

In 1988 it was decided that expenditures on the UK fast breeder nuclear reactor programme would be heavily reduced. A reduction in research and development (R&D) expenditure from more than £50 million to £10 million per annum was projected, implying a substantial and sharp reduction in R&D related employment (some 1,500 jobs) at the Atomic Energy Authority (AEA) establishments at Harwell, Risley and Sellafield over the period to 1991 (Pieda plc, 1996). A cut in employment, albeit smaller than at the other sites, was announced also for Dounreay over the same period. The shut-down of the prototype fast reactor was, however, not planned to occur until 1994, and of its associated fuel reprocessing plant until 1997. Despite an initially and comparatively small job loss (some 300), a more substantial reduction had occurred by 1997.

Employment in other sectors, except energy and water, also fell slightly (from 1981 levels). The primary sector had been showing a long term decline since the 1960s, whilst manufacturing employment, which had rapidly increased between 1966-81 fell between 1981 and 1991. However, between these years there was no significant change in the employment structure in Caithness, suggesting that until 1991 the run down had not had any major impact on the region. The data indicate, however, that a substantial loss in employment has taken place since 1991 (Pieda, 1998). Dounreay accounted for as much as one fifth of the total labour force in Caithness in 1988 and is, despite subsequent redundancies, still the largest employer in the local area.

Economic and Social Impacts

- *Employment Effects.* The downsizing of Dounreay has been gradual, and it is therefore difficult to identify indirect impacts on employment. However, the direct number of employees was over 2,100 in 1988 and has decreased to a current number of around 1,200 (UKAEA website, 2000), meaning that more than 900 jobs have been lost. The Pieda report (1996) found that around 1,000 jobs had been lost in the service industry, which is dominated by the run down at Dounreay, and accompanied by a fall of around 400 jobs in manufacturing in the area (indirect effects). The net disposable income(1) on site amounted to £19.9 million in 1988 and £16.9 million in 1996 (in each year's prices). However, expressed in constant 1988 prices the disposable income fell to £12.4 million in 1996, a drop of £7.5 million in real terms.

- *Expenditure Effects.* In 1996 the value of local inputs purchased by Dounreay had fallen by some £1.8 million per annum (in 1988 prices). This

(1) Expressed net of income taxes and insurance contributions.

is contributed to a loss of local incomes and employment in the local economy.

- *Regional Change in Unemployment Levels.* The vast majority of employees at the Dounreay Plant are male. Prior to 1988 this ensured that male unemployment in Thurso was much lower than for the Highlands and Islands area as a whole. However, male unemployment increased between 1988 and 1994 in Wick as well as Thurso from 16.8 percent to 19 percent and 8.6 percent to 15.9 percent respectively. Female unemployment rates have traditionally been lower than male in the Highlands and Islands area, and fell between 1988-95. In total, unemployment increased from 8.8 to 10.8 in Thurso, but decreased from 12.8 to 10.8 in Wick over the 1988 to 1994 period. Although Dounreay employed labour from a wide range of locations, the greatest impact was on the local Thurso travel-to-work area.

Over the period 1988 to 1995, the percentage employment reduction in related manufacturing and service sectors was 29.6 percent, much higher than the corresponding reductions for the Highlands and Islands (5.8 percent) and Scotland (1.5 percent). Total employment in Caithness fell by 13 percent between 1991-93. It is, however, important to note that employment in the whole of the UK also declined over this three year period from 21.117 million to 26.060 million, a fall of 3.9 percent.

- *Migration*. From a population of just under 3,300 in 1951, Dounreay experienced an increase in population to over 8,000 in 1961 and 9,000 in 1971. However, as early as 1971, ie before the downsizing of Dounreay, there was a trend of a slow but steady decline (3.8 percent by 1991). By 1994 the population had fallen by a further 2.4 percent, which indicates a more rapid decrease in the level and an increase in out-migration. This is contrary to the regional increase in population of 16 percent that the Highlands and Islands experienced over the years to 1991.

- *Housing.* The housing stock was stable between 1981 and 1988. Between 1988-91, however, a drop in the housing stock of nearly 100 from 3,636 to 3,561 occurred, probably related to out-migration.

- *Skill Levels.* There were some 350 employees with degrees at Dounreay in 1988 but this number has dropped along with the decline in the research and development activity. Nevertheless, as decommissioning work has substituted for other activities, there has been an increased need for project management and economic and safety assessment skills, which also require highly trained staff.

3.2.2 The Savannah River Site, USA

Background

In the 1980s and 1990s the Savannah River Site (SRS), on the border of South Carolina and Georgia, spent between $1.3 and $2 billion per annum in terms of purchases of goods and services. More than 60 percent of these

expenditures had a direct impact on the two state economies, thus also creating significant indirect effects. In terms of total income, SRS's contribution to the two states amounted to somewhere between $1.6 billion and $2.7 billion annually between 1987-97, although most of the impact was concentrated in the Central Savannah River area.

Prompted by a change in defence policy in 1991, however, the total expenditure has decreased continuously since 1992 with subsequent effects on regional employment and income. These effects are examined below.

Economic and Social Impacts

- *Employment.* The facility as a whole cut the number of employees by 40 percent (from 25,180 to 15,032) between 1991 and 1997 (direct effect). Contractors were forced to undertake reductions in their staff, leading to a loss of 845 jobs, and indirect job losses amounted to 16,642. Thus, in total 26,068 jobs, or 36 percent of those dependent on SRS, were lost over the period. However, the impact of SRS layoffs during 1991-97 was not as severe as might be expected from the heavy dependence of these counties on SRS. This could be attributed to several reasons: migration and retirement, and a generally strong regional and national economic performance over these five years.

Table 0.2 Savannah River Site Employment Impacts - Total for Region

Effect	Fiscal Year 1990-91	Fiscal Year 1996-97
Savannah River Site Jobs	23,056	14,475
Jobs created through procurement	3,351	2,506
Indirect jobs	46,035	29,393
Total	**72,442**	**46,374**
Change between 90/91 - 96/97:		
- absolute numbers	**-26,068**	
- percentage change	**-36 percent**	

Source: Grewal (1997)

- *Expenditure Effects.* Site expenditures were decreased by 30 percent in real terms between 1991 and 1997. The impact of budget cuts was more severe on the payroll (33 percent of total dollar expenditures) as compared to procurement (9.5 percent).

- *Income Effects.* As a result of the decreased expenditures, the states of South Carolina and Georgia experienced a total drop in direct and indirect income from $2.8 to $1.9 billion between 1992-97. The downsizing at SRS had most significant implications for the income in the immediate vicinity of the site and the decrease in total income between the fiscal years of 1990/91 and 1994/95 was $181 million (see *Table 0.3*). It is, however, thought to have decreased significantly more after 1994/95, but data for this period are unavailable.

Table 0.3 Income Impact of SRS on the Region ($ Millions)

Effect	Fiscal Year 1990-91	Fiscal Year 1994-95*
Total direct impact	1,129	1,042
Indirect impact	1,242	1,147
Total Income impact	2,370	2,189
Change between 90/91 - 94/95		
- absolute numbers ($ Millions)	**-181**	
- percentage	**-8 percent**	

Source: Grewal (1997)
*Data for 1996-97 are not available, but the decrease is undoubtedly larger than demonstrated by the table

3.2.3 KSO, Sweden

Background

In anticipation of the restructuring of Swedish energy provision, the Swedish association of municipalities with nuclear reactors, KSO, carried out a study to forecast the socio-economic consequences. The resulting report (KSO, 1999) describes the projected effects in the five different municipalities. The projections provided by the report are based upon a total closure of the nuclear industry in 2005, and the analysis stretches as far as 2017. The report covers all the reactors scheduled for closure in Sweden. However, in terms of relevance to Sellafield, Oskarshamn is of most interest. The Oskarshamn plant is poorly situated in terms of infrastructure and, albeit located in the more populous south of Sweden, communications are poor and the surrounding area somewhat less economically prosperous than the national average.

Social and Economic Impacts

- *Employment*. Of the 13,900 jobs in the municipal labour market, 1,072 are employed by the nuclear plant. Industry is the single largest sector of employment (4,000), followed by health care (3,000), commerce (2,000) and energy production (1,100). Of the 1072 employed in the nuclear plant, 85 percent live in the municipality and 15 percent in the region or a nearby town. A total closure would consequently cause a direct job loss of 1072, corresponding to 8 percent of the regional labour market.

- *Expenditure Effects.* Closure of the Oskarshamn reactor will affect 220 suppliers who generate around 600 full-time jobs per annum (indirect effects). Estimates regarding induced effects show that an additional 50 percent of the directly employed, ie 535 jobs, would be lost. These estimates are based on a decline in other sectors, eg manufacturing, business and schooling. In total, the projected job loss amounts to over 2,200, or 16 percent of the current labour market.

- *Migration*. Three different scenarios were estimated. Firstly, a projection of population change was prepared. Secondly and thirdly, to this baseline was added the effects of a total closure, resulting in migration of either 50 percent or 75 percent of redundant workers below 55 years of age and their families. Hence, it was assumed that those over 55 would follow the migration pattern of previous years. By year 2017, this would mean that an additional 1,255 to 1,876 residents would have migrated away from Oskarshamn due to the closure of the power station.

- *Housing*. Oskarshamn is presently experiencing an excess supply in the housing market, and house prices are consequently low. Assuming the above migration scenarios, this problem will worsen unless the lost jobs at the nuclear plant are substituted by other opportunities. If migration turns out to be in line with the 50 percent migration scenario, the demand for housing is estimated to drop by 955 units and, if in line with the higher scenario, by 1250. Given that the total *population* is 27,000, these numbers are likely to have a significant impact on the local housing market.

- *Skill levels*. As compared with the local economy, employees at the nuclear plant have a fairly high level of education, 36 percent having completed at least a one-year course at university (compare with 20 percent locally). Plant closure would therefore bring down the skill levels in the local economy.

3.3 THE ECONOMIC IMPACTS OF EMPLOYMENT CHANGES OUTSIDE THE NUCLEAR INDUSTRY

3.3.1 VSEL Shipyard, Barrow-in-Furness

Background

The VSEL (now BAe Systems) shipyard in Barrow-in-Furness was at its peak of activity during the Trident nuclear programme in the late 1980s and early 1990s. Since then, the economic activity has decreased dramatically but Barrow, a borough of 70,000 people, is still partially dependent upon the company.

The area is of interest for three reasons. Firstly, VSEL like BNFL is by far the largest employer in the local economy. Barrow is perhaps dominated to a higher degree by a single employer than any other borough of similar size in Britain (Beatty and Fothergill, 2000). Secondly, infrastructure and characteristics in the local economy resemble those of the Whitehaven TTWA (where BNFL is situated). Thirdly, some of skills required are somewhat similar in the two industries, and cuts in the labour force could potentially render workers of similar skills redundant.

Economic and Social Impacts

In 1999, a survey was carried out (Beatty and Fothergill, 2000) to assess how employment and benefit claimants have been affected by the changes in the

VSEL labour force. It involved interviews with 329 men aged 25-64 who were either long-term unemployed or "economically inactive". The following summarises key findings.

- *Employment - claimant count effects.* In 1990, Barrow's shipyard employed 14,400 people and the redundancy programme was originally intended to take this number down to between 7,000 and 9,000. However, a decision was taken in 1992 to further reduce the level to 5,000 by 1995. As a consequence, the Barrow TTWA lost one third of its 1989 workforce due to shipyard redundancies (Klosinski, 2000). Currently, with some short-term contractors the total labour force is 5,400, thus rendering the direct job losses 9,000. Some services such as security (Reliance Security Services), finishing (Denholm) and computer services (Computer Science Corporation) have been out-sourced, making the numbers directly dependent on the shipyard a little higher. Despite the reduction in the workforce, Barrow had an unemployment rate above 6 percent (early 2000), a high figure relative the UK average (4 percent) but low considering the scale of employment loss.

- *Hidden Unemployment.* One reason for these seemingly paradoxical data is hidden unemployment. The term is defined as unemployed non-claimants, participants on government schemes, excess early retired, and excess long-term sick. By adding these groups to benefits claimants, a measure of real unemployment is derived. It counts "all those who might reasonably be expected to have been in work in a fully-employed economy" (Beatty and Fothergill (2000). The claimant count is heavily dependent on Department of Social Security rules. Thus, as rules governing eligibility for unemployment benefit have tightened, the numbers recorded as unemployed have fallen. The real unemployment figures may be nearly treble the official data (see *Table 0.4*).

Table 0.4 Alternative Measures of Unemployment in Barrow-in-Furness

Gender	Claimant Count (percent)	Real Unemployment (percent)
Men	11.9	25.6
Women	3.7	20.4
Total	8.6	23.5

Source: Beatty and Fothergill (2000)

In terms of incapacity benefit claimants, Barrow ranks as fourteenth out of 353 English districts - at 15 percent of all 16-64 year old men. This represents 3,500 men out of a total male working age population in the town of just 23,500. Clearly, very many of these individuals would be unable to work due to illness or incapacity regardless of employment opportunities. However, Beatty and Fothergill assume a range of hidden unemployment of between 2,100 and 2,700. Not all of these workers are fully able bodied and capable of manual work.

- *Migration*. Given that the majority of the incapacity benefit recipients are older, one would expect unemployment (hidden or otherwise) figures to rise rather than out-migration, as older workers have less incentive to move to gain new work and are often less able to re-skill. In addition, population levels normally only change gradually, so a rise in unemployment should be expected in any case (Beatty and Fothergill, 2000). This presumption is reinforced by the fact that the number of men of working age in Barrow claiming sickness-related benefits actually fell from 4,100 to 3,500 between 1996 and 1999. Over the same period, claimant unemployment among men in Barrow has fallen by less than the national average - by about a third in Barrow compared to nearly half across Britain as a whole. However, young people are more mobile. Indeed, the current pattern in West Cumbria is that this group leaves the area to access higher education and employment, and often does not return (SQW, 2000).

The experience of Barrow confirms the capacity of a local economy to adjust to losses of employment in a major employer. However, the social costs of this adjustment may be hidden.

3.3.2 Pfizer

Background

Pfizer is situated at Sandwich in East Kent. The area has suffered from a number of economic shocks in recent years, including a decline in employment at the Channel ports, the closure of the East Kent coalfield and the rapid reduction in employment at military installations in the area. Despite being in the South East of England and close to connections to continental Europe, the area is poorly served by highway and public transport links. For example, rail journeys from London to Sandwich take well over two hours, despite the distance being only 75 miles.

As a result, the East Kent economy displays many of the problems prevalent in remote rural parts of the UK in that its level of economic activity is low. The service sector accounts for as much as 75 percent employment in the area, with health, education and other public administration the largest component. The second largest category of employment is distribution and hotels, followed by transport and communications.

Economic and Social Impacts

The study identified the following economic impacts:

- *Employment*. Direct employment supported by the company supported 3,400 jobs in East Kent with an additional 250 spread around the UK. Indirectly, Pfizer supported another 1,250 and 625 opportunities in Kent and East Kent respectively. Induced employment was estimated to amount to 285 and 325 in the respective economies and, expressed in jobs supported per Pfizer job, the figures were 0.7 in Kent and 0.5 in East Kent.

- *Expenditure Effects.* Pfizer's accounts indicated an expenditure of £534 million in 1997, of which £438 million was operational (ie flowed into the economy). Kent accounted for 18 percent (12 percent in East Kent) of all goods and services purchased by Pfizer and nearly a quarter of goods purchased in the UK. Capital expenditure amounted to £96 million, of which the majority was sourced in the UK.

- *Income Effects.* The total amount of economic activity created by Pfizer was estimated at £964 million in expenditure with a value added component of around £827 million. The contribution to the UK economy was a value added of £358 million. For every pound spent by the company, a total of £1.80 flowed into the economy through indirect and induced expenditure effects.

- *Wages.* Employees were well paid, receiving 70 percent higher wages than the average of the rest of Kent, although this partly reflects the highly qualified nature of the workforce.

- *Migration.* In the four year period preceding 1998, 300-600 employees per year were recruited to the company, mainly from outside Kent. 40 percent of the employees at Pfizer had a degree or a higher degree. In effect the company draws skilled labour to the area as well as creating employment opportunities locally.

3.3.3 The Swan Hunter Shipyards

Background

Following the bankruptcy of the Swan Hunter shipyard in 1993 a gradual closure followed only to result in a re-opening in 1995. Tomaney et al (1995) carried out a study to assess the experiences of the nearly 3,000 workers made redundant or otherwise leaving the company in the two-year period. A questionnaire was sent out to 2,200 former employees, of which 1,645 replied.

Economic and Social Impacts

- *Migration.* Of those active in the labour market, one fifth had found employment outside the North East of England, thus implying that a sizeable proportion migrated as a result of the redundancy.

- *Duration of Unemployment.* Of the 1,645 respondents, 38.5 percent remained unemployed two years after the closure. Importantly, those made redundant at an earlier stage were slightly more likely to have found employment (33 percent versus 45 percent, see *Table 0.5*).

- *Education.* Of the skilled manual workers, 42 percent were unemployed at the time of the survey, nearly on par with the unskilled (45 percent). Managers and design / technical workers, and clerical workers were all experiencing significantly lower unemployment rates, 18 percent for the former two categories and 29 percent for the latter category.

- *Age structure.* Age proved the most crucial factor for re-employment, with 50 percent of those aged 50-54 still out of work in 1995. Interviews revealed that these workers had experienced discriminatory attitudes from employers. Although employment rates increased with the amount of time from the incident, the rate of unemployed workers over 50 years of age was much higher than that of younger workers.

- *Health.* Only a very small fraction had left the labour market through retirement. However, as many as 12 percent of the respondents reported being sick, two years after redundancy, with a strong bias towards workers between 60-64.

- *Skill transfer.* 60 percent of those employed at the time of the survey were using the skills acquired whilst in the shipyard. Many of those who were not felt bitter about the fact that their skills were not appreciated elsewhere.

Table 0.5 Employment Status by Date of Leaving Swan Hunter (Percent)

	Occupational Status					
Year of leaving	**Not Stated**	**Unemployed**	**Retired**	**Sick**	**Education and Training**	**Employed or Self-employed**
1994 or later	1.8	44.8	0.3	7.6	2.0	43.5
1993 or earlier	2.1	32.7	1.5	16.0	3.6	44.1

Source: Tomaney et al (1995)

3.3.4 The South Wales, Durham and Nottingham Coalfields

Background

The coalfield areas of South Wales, Nottinghamshire and Durham provide a diverse cross section of experiences in the coalfields. The examples from Wales and, in particular, County Durham are particularly given the more peripheral nature of these regional economies.

Economic and Social Impacts

- *Employment*. In Nottinghamshire, as many as 26,900 jobs (or 18.9 percent of total jobs in the coalfield area) were lost in direct employment (see *Table 0.6*). The region also experienced a natural increase in the workforce of 6.3 percent. South Wales and Durham also saw large slumps in the coal industry employment and job reductions were in the order of 23,800 (12.2 percent) and 15,700 (10.6 percent). Although there were natural increases in the work forces in both regions, they were more moderate than that of Nottinghamshire.

Table 0.6 Labour Market Impacts - Changes 1981-1991

Effect	Coalfields		
	South Wales	Nottinghamshire	Durham
Employment in coal in 1981	27,800	41,900	22,900
Job *loss* in coal 1981 to 1991 (number)	23,800	26,900	15,700
Job loss in coal (percent) (1)	12.2	18.9	10.6
Natural increase in workforce (percent)	3.0	6.3	3.9
Net out-migration (percent)	5.9	5.3	4.3
Increase in net out-commuting (percent)	-3.4	3.4	-4.0
Reduction in economically active (percent)	8.6	6.2	8.3
Increase in non-coal jobs	4.2	6.5	4.9
People on government schemes (percent)	2.2	1.7	3.2
Increase in unemployment (2)	-2.2	2.3	-2.3

Source: CRESR (1996)
(1) As a percentage of economically active (ages 16-64) males in the coalfield area in 1981
(2) The authors note that the inclusion of hidden unemployment (or "discouraged workers") would virtually double the number of unemployed given by the claimant figures

- *Migration.* Migration flows showed great diversity between areas but all the large coalfields lost significant numbers of male workers through net out-migration. Durham experienced a loss of just over four percent through such labour flows whilst Nottinghamshire and South Wales experienced net reductions of between five and six percent.

- *Out-commuting.* Contrary to expectations, net out-commuting decreased in South Wales and Durham by between 3-4 percent, whereas Nottinghamshire saw an increase by over three percent.

- *Economic activity rates.* A reduction in economic activity amongst men of working age (18-64 years) strongly affected coalfield areas. South Wales experienced the greatest drop (8.6 percent), followed by Durham (8.3 percent) and Nottinghamshire (6.2 percent).

- *Post-closure job creation*. Most coalfields saw an increase in non-coal jobs, although to varying degrees. In Durham and South Wales, employment in sectors outside the coal industry increased by 4.9 percent and 4.2 percent respectively, both superseded by Nottinghamshire where as many as 6.5 percent new jobs were created outside the coal industry as compared with 1981.

- *Regional Change in Unemployment*. The Nottinghamshire coalfield experienced an increase in unemployment of 2.3 percent. The increase might have been reinforced by a lower net out-migration and reduction in economically active as compared with South Wales and Durham where the unemployment figures actually decreased by just over two percent (due to general improvements in the national unemployment figures).

The coalfield case studies show that male employment was unambiguously and negatively affected by the closures, with tens of thousands job losses in

each coalfield area and significant slumps in economic activity rates. To a large extent, however, this was offset by alternative job creation and to some degree by out-migration and commuting, thus insulating unemployment from dramatic increases. It is important to note that the decrease in economic activity disguises some of the real unemployment increase which might be as much as double the size of the given numbers (CRESR, 1996). The loss of male jobs in pit villages was proportionally much higher than in coalfields in general (see *Table 0.7*).

Table 0.7 UK Labour Market Accounts - A Comparison between Coalfields and Pit Villages (1981-91)

Parameters	Coalfields (percent change)	Pit Villages (percent change)
Job loss in coal	12.8	25.0
+ Natural increase in workforce	5.0	4.6
- Net out-migration	4.8	8.3
- Increase in net out-commuting	0.4	4.8
- Reduction in economically active	6.8	7.3
- Increase in non-coal jobs	3.6	2.5
-Number on government schemes	2.2	2.5
= Increase in unemployment	0.04	1.7

Source: Beatty & Fothergill (1996)

3.3.5 Taff Merthyr Colliery - Worker Experiences Two Years After Closure

In 1994, two years after closure of the Taff Merthyr Colliery in South Wales, a survey of a hundred former employees was undertaken (Guy, 1994). The survey found:

- *Wages.* Whilst employed at Taff Merthyr, the workers had an average salary of £270 per week. Over four fifths of those now in paid employment have had to adjust to a lower wage, the new average for outside the coal industry being £153. Only two percent earned more at the time of the survey. However, 47.9 percent were actually in employment(1) two years after the closure whilst 44.9 percent were unemployed and 7.1 percent in training.

- *Employment*. The great majority of those men currently unemployed (70 percent) had been out of work continuously after leaving the pit, despite most workers looking for a wide variety of employment outside the coal industry.

- *Health.* As many as 55 percent of those respondents who were not working were claiming sickness benefit rather than unemployment benefit,

(1) Including self-employment (2 percent).

indicating significant health problems and hidden unemployment (claimants of incapacity benefit are not counted as unemployed).

- *Skill match.* Only a hand-full of workers were working in the mining industry at the time of the survey. The vast majority of redundant workers in employment had found jobs in factories, which covers a wide range of differing employment, from temporary and unskilled to well-paid and highly skilled. Others found employment in the service sector.

3.4 DISCUSSION

Introduction

Throughout *Section 3.3* the impact of sudden employment shocks on a range of economic and social indicators has been assessed. This section provides a summary of the more important effects(1).

The economic factors have been analysed over a ten year time span, with the employment loss being the central year in each case (ie data are presented for the five years preceding the incident and the five years following it. Given that the downsizing in Dounreay was spread out over several years and that most of the pit closures took place over an extended period, it proved difficult to isolate a particular incident. This problem is illustrated by the Durham coalfields, where the relevant closures occurred over a number of years(2). Given that the relevant time spans cover different periods of time, any simultaneous national downward employment bias is automatically less important in the analysis. This point is further strengthened by the fact that the coalfields experienced an economic trend that was distinctly different from the national economic performance(3).

Employment

The employment figures varied greatly between the different areas over the ten-year period. Counties such as Nottinghamshire and the Highlands and Islands occasionally reached employment rates(4) of nearly 60 percent whereas Tyne and Wear, and Mid-Glamorgan experienced levels around 50 percent. Also the *changes* in employment were markedly different in the years preceding as well as following the incident. The coalfield areas of Mid-Glamorgan and Durham both saw increases in employment of between 1-3 percent, whilst Tyne and Wear and Nottinghamshire experienced a decrease in employment even before the main closures. To some degree this can be

(1) It should be noted that this final analysis has been confined to the UK cases as it has proved difficult to find comprehensive regional data for the US nuclear plant closure, and because the Swedish nuclear plant closure was pre-closure.
(2) In order to account for the sequence of closures and thus isolate the different shocks, macro indicators were measured in two periods: the first starting in 1986 and the second lagged by two years starting in 1988.
(3) ''Overall, male employment in the non-coal component of coalfield economies in England and Wales fared some 10 percentage points better than in the economy as a whole. In effect, this meant that by 1991 there were 65,000-70,000 more male jobs in the coalfields outside coal than if national trends had prevailed" (Beatty and Fothergill, 1996).
(4) As measured of the economically active population.

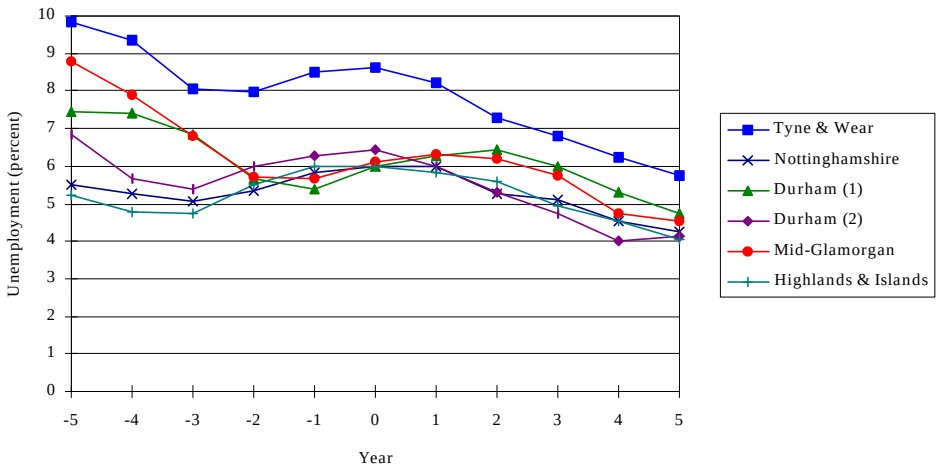
explained by the fact that Nottinghamshire experienced a sequence of mine closures earlier which put downward pressure on employment in the area.

There is an interesting pattern to be found across the case studies in that a significant drop occurred in employment in the year of employment loss. Notably, Durham and Mid-Glamorgan experienced decreases of as much as 5 percent in year zero as compared with the previous year, and Nottinghamshire and Tyne and Wear saw a decrease of 1 percent. Highlands and Islands experienced increasing employment, but this can more credibly be ascribed to the sequential nature of the Dounreay downsizing and to other factors in the region(1). Interestingly, there appears to be a trend of recovery in employment only two to three years after the closure or rundown.

There was a return to similar or higher employment rates in nearly all cases after only 2-3 years, as shown in *Figure 0.1*. This indicates that the different regional economies have a large capacity to accommodate structural changes within only a few years.

This view is further confirmed by the unemployment rate in which a downward trend can be seen in all regions over the period. There is, however, a clear-cut upward turn in unemployment around year zero which returns to the long term trend about two years after the employment loss.

Figure 0.1 Unemployment Rate



Source: ERM analysis

Economic Activity

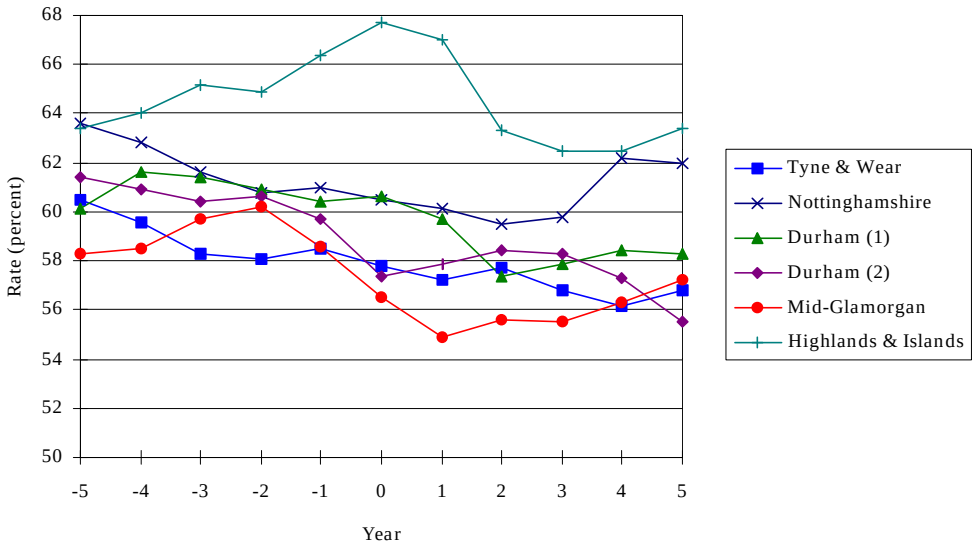
Concern regarding a reduction in the rate of economically active was raised in the earlier case studies. In particular, it was argued that the high level of economic inactivity disguises unemployment. The rationale behind this argument is that workers become discouraged in areas where there is a great

(1) eg there was a trend of out-migration from Thurso to other parts of Highlands and Islands (1998).

shortage of employment opportunities, thus transferring from the unemployment-related benefit system to that of sickness-related benefits. This phenomenon was demonstrated in particular by the closures in the coalfields and that of VSEL in Barrow (CRESR, 1996, and Beatty and Fothergill, 2000). The net effect is to transfer people out of the official unemployment count and thus generate hidden unemployment.

To account for this, the rate of economically inactive was considered. The results show that the derived unemployment trend is indeed somewhat misleading: it overstates the employment trend and points in a different direction to that of the economic activity rate for certain years, thus confirming the concern. Nevertheless, the economic activity rates mirror the trend established by the employment rate, namely that activity rates declined in the years immediately after the employment losses but typically started to recover later.

Figure 0.2 Economic Activity Rates



Source: ERM analysis

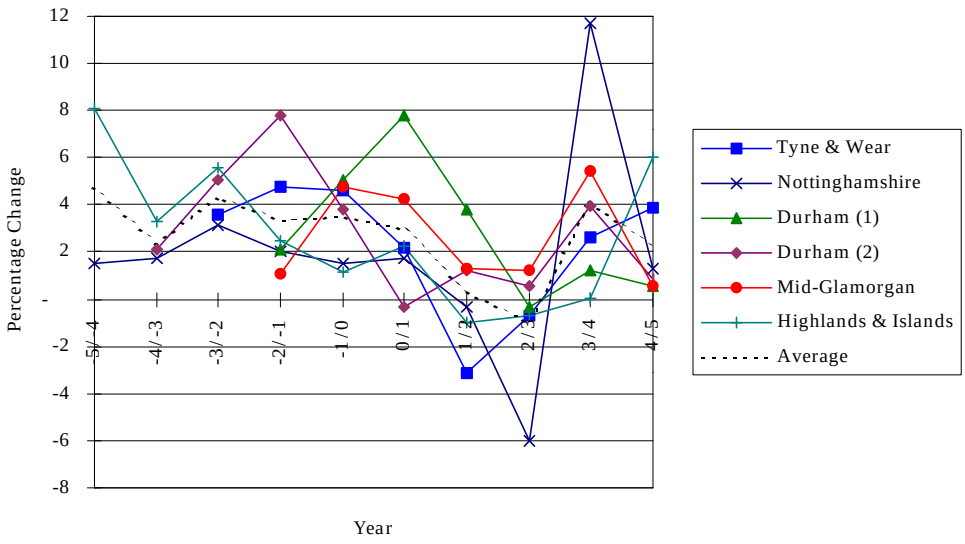
Notably, the unemployment and economic activity rates both tend towards a conversion with the employment rate a couple of years after the year of incidence, again indicating the an area's capacity to accommodate economic shocks.

Real Household Income

Taken as an average of all regions' real household income, the annual growth rate fluctuated between 2-5 percent over the period preceding the critical year (see *Figure 0.3*). Durham in particular experienced a sharp increase in the annual growth rate of real household income but similar to all other counties there was a significant slump between the year before and the actual year of the incident, lasting until around two years after. Tyne and Wear,

Nottinghamshire, and Highlands and Islands all had a period of between 2-3 years of negative growth rates but, along with all other counties, experienced an upswing thereafter.

Figure 0.3 Real Household Income Growth



Source: ERM analysis

Multiplier Effects

Although larger firms (with 100 or more employees) are less common in rural than in urban areas (1.4 percent of firms vs. the national level of 2.2 percent), they account for a considerably larger share of rural employment (RDC, 1998). As shown in the case studies, larger rural firms are a very diverse group. For the most part larger rural firms are not highly dependent upon their local area for suppliers or customers (RDC, 1998), with the exception of those who have nurtured a local supplier or customer base. They do, however, have a significant, positive impact on the local employment base and typically employ their workforce from the adjacent communities.

3.5 CONCLUDING REMARKS

The linkages between firms and the local economy are influenced by a variety of economic and social factors. For example, plant closures are likely to coincide with a national economic recession. It has even been shown that linkages vary between foreign owned and indigenous firms (Turok (1993b) in Barrow and Hall, 1995) and it is therefore difficult to draw any definite conclusions. By examining recent UK evidence on the impact of large employment losses a number of observations can be made.

Case studies such as Pfizer, Savannah River and Dounreay make clear that large firms contribute greatly to the local economy in terms of expenditure and income as well as employment. Although they are not dependent on local suppliers, the latter are much affected by actions of the former (RDC, 1998). Investment and employment decisions by large companies have regional impacts on employment and income and indirectly affect population and migration which, in turn, affect factors such as house prices and skill levels.

This view is further confirmed by the effects that changes within these organisations have had at county level. The coalfield examples showed that the impact of pit closures on the local male labour force was strongly negative (Beatty and Fothergill, 1996 and CRESR, 1996), with employment and economic activity decreasing significantly at a local and county level. At the county level, employment and economic activity as well as real household income dropped at the time of the incident, but increased or returned to previous levels only a couple of years after. However, evidence suggests that the actual sites where jobs have been lost have not experienced the same rate of regeneration as the region as a whole. For example, both Ollerton (the Guardian, 2000) and Taff Merthyr (Guy, 1994) have continued high levels of unemployment and lower activity rates.

Although it is intuitively obvious that large firms do have a great impact on their immediate surroundings, the case studies have shown that out-migration and commuting help local economies to adjust to employment shocks. In addition, the county level data have shown that, if defined more widely, local economies do indeed have the capacity to adjust in employment terms within only a few years. However the process of adjustment can be painful and incomplete, with large social costs, such higher unemployment and crime and poorer health, being typical.

4 THE NUCLEAR INDUSTRY, BLOCKS AND SCENARIOS

4.1 INTRODUCTION

This section describes the activities at the Sellafield site, for both BNFL and other operators. Some of these activities are essential, but many are optional, either in terms of whether they should occur at all or at what level of activity they can be carried out. Within this framework, *scenarios* of future operations of the Sellafield site operations have been developed by the Spent Fuel Management Options and Plutonium Working Groups.

The activities at Sellafield cannot be viewed in isolation. Sellafield is an integral part of the UK nuclear fuel cycle; additionally, there are interactions with the world-wide nuclear fuel cycle. *Section 4.2* gives a brief description of the nuclear fuel cycle. *Section 4.3* presents a summary of the UK Nuclear Industry and the Sellafield site's role within it, plus the interactions of the Sellafield Site with the world-wide Nuclear Industry.

In order to assess potential levels of activities on the Sellafield site, the activities of the site have been split into *blocks*. These *blocks* include both the nature of the activities on site and also the potential future scale of these activities. The blocks and their derivation are described in *Sections 4.4* and *4.5*. By combining a set of blocks which covers all the activities of the site, "walls" can be built representing complete Sellafield scenarios. Scenarios are described in *Section 4.5*. The scenarios developed have been designed to cover the full range of potential scale of activities of the Sellafield site, from *"Minimum"* to *"Blue Sky"*. Finally, concluding remarks are made in *Section 4.7*.

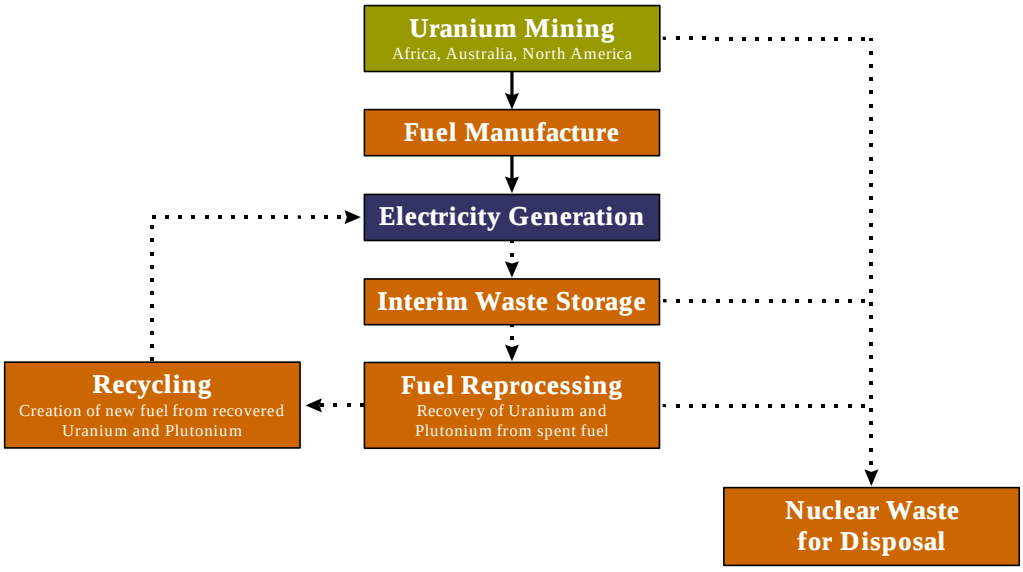
4.2 THE NUCLEAR FUEL CYCLE

Figure 0.1 gives a summary overview of the UK Nuclear Fuel Cycle and a brief description is provided below:

- Uranium ore is imported from Africa, Australia or North America to the UK.

- Fuels are then produced form this ore at the BNFL Springfields site, near Preston. Magnox reactors use natural uranium metal fuel. Other plant types (AGR and PWR) use enriched uranium in the form of ceramic uranium oxide. In the UK, UNRECO enriches uranium at its Capenhurst plant in Cheshire.

Figure 0.1 The Nuclear Fuel Cycle: a Summary



- The fuels produced are burnt in Nuclear Reactors, with the heat from nuclear fission being used to form steam which then drives steam turbines to produce electricity. Over time, the build up of the fission products formed from the uranium reduces the efficiency of power production to the extent that new fuel must be used. The fuel removed from the reactor is termed "spent fuel". The spent fuel contains uranium, plutonium and waste products.

- Following generation, spent fuel can either be treated as a High Level Waste and stored, awaiting final disposal, or reprocessed. Reprocessing, which, in the UK, only takes place at the Sellafield site, involves the recovery of uranium and plutonium from spent fuel. Spent fuel is received at Sellafield from both the UK and overseas customers, of which Japan, Germany and Switzerland are the most important.

- The uranium and plutonium recovered during reprocessing can be used to form new fuels. In the UK, uranium oxide can either be returned to the BNFL Springfields site near Preston to form new AGR fuels or can be combined with plutonium oxide to form MOX (Mixed Oxide Fuel) on the Sellafield site.

- Nuclear waste is produced at all stages in the Nuclear Fuel Cycle. It is categorised according to its level of radioactivity: High (HLW), Intermediate (ILW) or Low (LLW). The management and disposal of nuclear waste depends predominantly on its radioactivity level but also on the chemical (eg acidic) and physical properties (eg liquid) of the waste stream.

In between each of these processes nuclear material may need to be transported. For example, uranium mining and enrichment and fuel assembly is typically undertaken at more than one location. Similarly, power stations and waste reprocessing typically take place on separate sites.

4.3 THE UK NUCLEAR INDUSTRY

4.3.1 Fuel Manufacture

As noted above, there is no mining of uranium ore in the UK. However, fuel manufacture in the UK is undertaken by BNFL, a company wholly owned by Government. All UK fuels for the Magnox and AGR reactors are produced at BNFL's Springfields site near Preston, which also produced the first loadings of fuel for the UK's only PWR, Sizewell B. In addition, the MOX Demonstration Facility (MDF) at Sellafield has until recently been producing small amounts of fuel, and the Sellafield MOX Plant (SMP) is awaiting licensing from the government before full operations can begin.

4.3.2 Electricity Generation

The UK has been generating electricity commercially using nuclear power since 1956. The UK's first nuclear reactors are based on Magnox technology. These use non-enriched natural uranium metal fuel elements within a Magnox (magnesium alloy) cladding. Magnox reactors have relatively low thermal efficiencies due to the limited temperatures under which they can operate. Apart from the UK, only France, Japan and Italy built a very limited number of Magnox reactors.

The second generation of UK reactors are based on AGR (Advanced Gas Reactor) technology, using enriched uranium dioxide fuel pellets within stainless steel cladding. These reactors are thermally more efficient than the Magnox reactors, but were not adopted anywhere else in the world.

Rather than using gas for cooling the reactor core, LWRs (Light Water Reactors) use ordinary or "light" water as a coolant. Two variants of the water cooling system were built across the world: Pressurised Water Reactors (PWR) and Boiling Water Reactors (BWR). In the UK, only Sizewell B (PWR) uses this technology, but they are the most common reactor type world-wide.

The Ownership of UK Nuclear Power Plants

The UK electricity supply industry was privatised in the 1980s. The original intention was that all nuclear plant operated by the State-owned CEGB and SSEB would also be privatised, but in the event only the AGR and PWR reactors were privatised, and the industry now consists of these reactors owned by British Energy in the private sector, with the Magnox stations transferred to BNFL. Liability for experimental reactors previously operated by the UKAEA at Dounreay and elsewhere remains with them.

Tables OLE_LINK1*4.1* to OLE_LINK2**Error! Not a valid link.** show the remaining operational nuclear plants. The combined capacity of 13 GWe represents 17.5 percent of the UK electricity supply industry's capacity in 2000. BNFL's Magnox plant represent 4.5 percent of the UK's capacity and British Energy's AGR and PWR plant 13 percent. Nuclear plant tends to run as base load plant and although it constitutes only 17.5 percent of capacity, it generates 29 percent of the UK's electricity.

BNFL's Magnox Plan

BNFL made an announcement regarding its lifetime plan for the remaining Magnox plant on 23 May 2000. The Hinkley A plant would not be re-opened following maintenance but other plant would be operated out as far as 2021 if possible. The implications of this decision are:

- Magnox fuel will continue to be produced at BNFL's fuel manufacturing site at Springfields near Preston until 2010;

- The Magnox Reprocessing plant (B205) will close once all Magnox fuel has been reprocessed. It is expected that this will be around 2012, although it could be later depending on throughput schedules achieved.

Table 0.1 UK Magnox Plants (Owned by BNFL)

Name	Grid Connection	Closing Date(1)	Age at Cessation of Generation	Net Capacity (MWe)
Reactors Undergoing Decommissioning				
Berkeley	1962	1989	27	2 x 138 = 276
Transfynydd	1965	1993	28	2 x 195 = 390
Hunterston A	1964	1990	26	2 x 150 = 300
Reactors to be Decommissioned				
Calder Hall (Sellafield)	1956-64	2006-08	50	4 x 50 = 200
Bradwell	1962-67	2002	40	2 x 123 = 246
Chapelcross	1959-71	2008-10	50	4 x 50 = 200
Dungeness A	1965-71	2006	40	2 x 220 = 440
Hinkley Point A(2)	1965-73	2000	35	2 x 235 = 470
Oldbury A	1967-71	2013	45	2 x 217 = 434
Sizewell A	1966-74	2006	40	2 x 210 = 420
Wylfa	1971-77	2016-21	45 / 50	2 x 495 = 990
Summary	**1956-77**	**2002-21***	**35-50**	**3,400**

Source: BNFL Press Release, 23 May 2000 (see www.bnfl.com)

Notes: (1) Continuing to run Oldbury and Wylfa to these dates depends upon the development and use of Magrox fuel. A decision on the use of Magrox fuel will be taken in around 2003. Oldbury and Wylfa also need to undergo a periodic safety review in order to secure operation to these dates.

(2) Hinkley Point A will not be bought back into operation from its current shutdown for business reasons.

(3) BNFL has subsequently announced that it would not be proceeding with the use of Magrox fuel.

Table 0.2 UK AGR Plants (Owned by British Energy)

Name	Grid Connection	Net Capacity (MWe)
Dungeness B	1983-92	2 x 555 = 1,110
Hartlepool A	1983-90	2 x 605 = 1,210
Heysham 1	1983-90	2 x 575 = 1,150
Heysham 2	1988-91	2 x 625 = 1,250
Hinkley Point B	1976-80	2 x 610 = 1,220
Hunterston B	1976-83	2 x 595 = 1,190
Torness	1988-92	2 x 625 = 1,250
Summary	**1976-92**	**8,380**

Table 0.3 UK LWR Plants (Owned by British Energy)

Name	Grid Connection	Net Capacity (MWe)
Sizewell B PWR	1995-2002	1,188
Summary	**1995-2002**	**1,188**

4.3.3 Reprocessing

Two major choices arise from what to do with spent fuel:

- treat it as a High Level Waste and store the whole fuel assembly until the heat emissions have declined to levels where the waste can be packaged for final disposal; or

- reprocess the spent fuel, recovering uranium and plutonium and generating other wastes requiring storage and eventual disposal.

The UK has traditionally chosen the reprocessing route, whereas other countries (notably the US) favour treating spent fuel as a waste.

There are only three major reprocessing facilities in Western Europe as shown in *Table 0.4*.

Table 0.4 Western European Reprocessing Plants

Name	Country	Opened	Capacity (tonnes/year)
BNFL, Magnox, B205 (Sellafield)	UK	1964	1,200
BNFL, THORP (Sellafield)	UK	1994	1,200
Cogema, Cap la Hague	France	1990-1994	1,650
Sources: BNFL, Institute for Energy and Environmental Research, www.ieer.org			

The Sellafield plant reprocesses all of the UK's Magnox fuel. The THORP plant reprocesses fuel from the UK AGR plants and from customers overseas.

4.3.4 *Recycling*

Uranium

Uranium oxide from reprocessing can be used to make new fuel elements for AGR or LWR plants. In the UK, recovered uranium has been used only for AGR fuel at BNFL's Springfields plant near Preston.

MOX (Mixed Oxide Fuel)

MOX is formed from a mixture of uranium oxide and plutonium oxide (typically with plutonium at around five to seven percent). MOX can be used in any LWR, typically up to about 30 percent of the fuel loading. *Table 0.5* shows the Western European MOX plants – the planned commissioning of the Sellafield MOX Plant (SMP) would increase the current Western European capacity by some 75 percent. The UK government announced on 3 October 2001 its acceptance of plutonium commissioning and subsequent operation of the Sellafield MOX Plant, though at the time of writing this remains subject to judicial review. Current MOX production is dominated by French and Belgian plants. Until licensing of the SMP, UK capacity was limited to the MOX Demonstration Facility (MDF) at Sellafield. BNFL has announced that MDF will now operate as a support facility for SMP.

Some commentators contend that the future MOX market is highly uncertain. It depends to some extent on whether MOX is seen as a method for disposing of 'free' plutonium. MOX is unable to compete on cost with newly mined uranium at currently low uranium prices, but for some utilities the choice is a strategic one.

Table 0.5 Western European MOX Plants

Name	Country	Opened	Capacity (tonnes/year)
BNFL, MOX Demonstration Facility (MDF), Sellafield(1)	UK	1993	8
BNFL, Sellafield MOX Plant (SMP)(2)	UK	*	120
Belgonucleaire (Dessel)	Belgium	1973	35
CEA (Caderache)	France	1963	115
Total (including SMP)			**278**

Source: Institute for Energy and Environmental Research, www.ieer.org
Notes: (1) BNFL plans to run MDF as a support facility for SMP
(2) Not yet commissioned

4.3.5 *Nuclear Waste*

As noted above, nuclear waste is categorised into three types depending on its activity: High, Intermediate and Low. The following briefly describes each type and where it arises on the Sellafield site:

- High Level Waste (HLW) has the greatest concentration of radioactive materials and produces substantial quantities of heat. The vast majority of the UK's liquid HLW is stored on the Sellafield Site. This liquid HLW is

vitrified (solidification in borosilicate glass) and is then encased in stainless steel. If un-reprocessed spent fuel and plutonium were declared to be waste, they would also be HLW. Long term policy for the management of HLW is in the process of being determined.

- ILW is less radioactive. It consists primarily of metals from the cladding of fuel rods, with smaller quantities of cement, graphite, organic materials and inorganic sludges. On the Sellafield site, ILW results from the removal of cladding materials during reprocessing, decommissioning work and from the treatments of effluents prior to discharge to the environment. ILW is typically encapsulated in stainless steel drums. Long term policy for the management of these wastes is in the process of being determined.

- LLW (Low Level Waste) is the least radioactive. Most of the LLW produced by the nuclear industry at present is metals and organic materials, which arise largely as lightly contaminated miscellaneous scrap. The metals are mostly in the form of redundant equipment; the organic materials are mostly discarded protective clothing, paper towels and plastic wrappings. When nuclear plants are decommissioned, there will be large quantities of LLW consisting of building materials and big items of plant and equipment. Most of the nuclear waste produced outside the nuclear industry is LLW. In the UK, LLW is disposed of at the national depository at Drigg (4.5 miles south of the Sellafield site). LLW is compacted and containerised prior to landfill. Currently, 50 percent of LLW disposed of to Drigg arises from the Sellafield site.

4.4 BLOCKS OF ACTIVITY AT SELLAFIELD

4.4.1 Introduction

In order to facilitate a detailed economic analysis of the implications of business scenarios at Sellafield, activities at the site have been broken down into a number of blocks that can be modelled, either individually or collectively as parts of one of the four scenarios described below. This section therefore describes the blocks. First, however, we present a brief history of the Sellafield site.

4.4.2 Sellafield Site Operations

The Sellafield site is one of the most important and complex nuclear sites in the UK. It houses all the UK's reprocessing and MOX production facilities (as noted above, the government has given approval for plutonium operation of SMP, but at the time of writing this is subject to judiial review), plus the UK's smallest operational commercial reactor plant (the Calder Hall Magnox plant). It is difficult to understand the operations of the site without understanding its history.

Plutonium Production for Weapons Production

The current Sellafield site occupies an area 1½ miles by 1 mile (750 acres). Prior to 1946, Windscale was already acting as a Defence site. Nuclear operations began at Sellafield (then named Windscale) in 1946. Two atomic piles were built with the purpose of producing plutonium for nuclear weapons for the UK and its allies (principally the US). During nuclear fission of uranium in the piles, plutonium was produced which was recovered using chemical separation and sent to the Aldermaston weapons production site in Berkshire. The heat from the piles was not recovered and no power was generated. The piles were closed down in 1957 following a fire and they are now being decommissioned by a consortium, that includes BNFL, Rolls Royce and Nukem, on behalf of the owner, the UKAEA.

Commercial Nuclear Development

Sellafield also became a key site in commercial nuclear development in the UK. The world's first commercial nuclear power station, Calder Hall (a Magnox plant), was connected to the electricity grid in 1956 and is still operational. Magnox plants were not highly efficient and a prototype of the next generation of UK nuclear plant (AGR – Advanced Gas Reactor) was built on the Sellafield site and operated between 1963 and 1981.

Reprocessing of Spent Nuclear Fuel

UK policy has favoured reprocessing spent nuclear fuel rather than storing it as a high level waste. Reprocessing involves chemical separation of spent nuclear fuel, whereby the spent fuel is dissolved in nitric acid and the uranium and plutonium are then separated from this solution.

The Sellafield site had built up experience of chemical separation when producing plutonium from the Windscale atomic piles. Reprocessing of spent fuels from the UK's Magnox reactors began in 1964.

The UK also wished to reprocess fuel from its subsequent generations of reactors. Foreign nuclear generating companies also expressed considerable interest in this route. Thus, in the early 1970's, when it was expected that prices for newly mined uranium would continue to increase, the THORP (Thermal Oxide Reprocessing Plant) was proposed and designed. The building of THORP was controversial, but after a public inquiry construction began in 1980. The project was a major engineering exercise, taking over 10 years and costing £2.8 billion.

After a further public consultation before THORP was commissioned, reprocessing began on spent fuel in March 1994. Contracts with UK and overseas generators had been signed to cover reprocessing of 7,000 tonnes of spent fuel over the 10 year period to 2004 and 60 percent of the required volume for the second decade of operation.

MOX (Mixed Oxide Fuel) Production

The decision not to develop fast breeder reactors in the UK in the foreseeable future has meant that a new use, storage or disposal options have to be found for the plutonium freed from spent fuel by reprocessing. LWRs were becoming the standard across the world in the 1980's and 1990's. Rather than using uranium fuel only, it is possible to operate LWRs using a combination of uranium fuel and MOX as discussed in *Section 4.3.4.* The share of MOX which can be used in the fuel and its percentage of plutonium vary by reactor type.

In response to this market opportunity, a MOX Demonstration Facility (MDF) was built at Sellafield and has been operational since 1993. The MDF has a capacity of only 8 tonnes of fuel per year, and its successful operation encouraged the construction of the much larger Sellafield MOX Plant (SMP) at a cost of £300 million, which has a capacity of 120 tonnes of fuel per year. The SMP was completed in 1998 and has been commissioned sing uranium only. It will not be fully operational until commissioning is completed with both uranium and plutonium and is currently dependent on a UK Government decision regarding the authorisation of the plant.

4.5 DERIVATION OF BLOCKS

4.5.1 Background

A key task for this study was to build a workable model of employment and spend aspects of Sellafield and West Cumbria for scenarios of future Sellafield activity. Such a model must be able to take account of variations in scenarios that might occur as the study progresses and beyond.

At the time of letting the study contract, three scenarios – "Blue Sky", "Current Business Plan" and "Minimum Case" – were defined in terms of reprocessing throughputs and waste outputs, but not by plant activities. However, it was recognised that to fulfil the task defined above the activities of the Sellafield site would have to be modelled on a plant by plant basis. This was actioned by the Socio-economic Sub-Group(1) and led to the preparation of a paper "Data for the Socio-economic Study: The Block and Brick Approach".

The Sellafield site contains a large number of plants and processes. Some of these are independent of the operation of the other plants and processes. Others are inherently linked, sometimes in a complex manner with many feed-backs and constraints. The approach taken was therefore to break down site operations into groups of plants (Blocks) which functioned virtually autonomously, and to define support plant and infrastructure activity blocks which gave the total site activity in any scenario. A correct choice of Blocks

(1) Task undertaken by Gregg Butler of Westlakes Research Institute, reporting to the Socio-economic Sub-Group. The content of this format has subsequently been iterated and endorsed by the Socio-economic Sub-group in conjunction with SFMOWG and PuWG.

should allow disaggregation of Sellafield activities so that practically any future scenario decided on by the two Working Groups could be modelled by using different sets and timing of blocks. ERM and other members of the socio-economic sub-study steering group have acted as a peer reviewer of this process, to ensure that both the blocks and the scenarios represent realistic and reasonable options.

The process was somewhat complicated by the need to track the developing ideas of the two Working Groups for future scenarios for Sellafield. The Groups studied a very large number of future possibilities, with many permutations of different activities, plants, and timings. It was decided that the pragmatic solution was to keep the study to a small number of scenarios, making sure that these spanned the range future activities at the site. This, it was presumed, would also bound the range of socio-economic effects in West Cumbria. In the event the three original scenarios, were extended to four, and the derivation of both Blocks and scenarios is discussed below.

An important fact to bear in mind is that the blocks and scenarios chosen were designed to enable the range of possible economic outcomes to be determined and, ultimately, to allow any scenarios defined by the two Working Groups to be modelled. The scenarios used for the initial analysis were adopted by the Socio-economic Sub-group with the approval of the Working Groups. They do not, however, represent agreed "Working Group Choices", but are merely representative of the sort of future scenarios that the Working Groups themselves are engaged in analysing.

4.5.2 Derivation of Blocks

General

There are nine main areas of activity on the Sellafield site which need to be modelled:

1. Magnox reprocessing: which takes in spent Magnox Fuel from power stations and converts this into various waste streams, uranium and plutonium. The plants have processed fuel from the Latina station in Italy, and is still receiving fuel from the Tokai Mura station in Japan. After this future in-feed will be solely from the BNFL-owned UK Magnox stations. The range of programmes for consideration in this group was reduced by the announcement of Magnox station closure dates on 23 May 2000. This set the maximum programme which needed to be considered.

2. Calder Hall power station has four Magnox reactors, is BNFL owned, and sits on the Sellafield site. The time scale of operation of this reactor within the maximum programme and the fate of its fuel are clearly a Sellafield variable.

3. THORP reprocessing: which takes spent fuel feed from foreign light water reactors and BE-owned AGR reactors in the UK. This also converts the fuel into various waste streams, uranium and plutonium. Some of the

scenarios being examined by the Spent Fuel Management Options Working Group involve the construction of a new head end plant to enable THORP to reprocess Magnox fuel.

4. Fuel storage: currently most fuel stored at Sellafield is destined for reprocessing and is stored under water. The possibility of extending this activity and / or changing to dry fuel storage is being examined by the SFMOWG. Other storage options have been included for the storage of the products of the various processing options considered by the Plutonium Working Group (see below).

5. Plutonium: which is being studied by the Plutonium Working Group (PuWG). Various processes are being studied by which the plutonium output from the reprocessing activities could be stored(1), used as Mixed oxide or inert matrix fuel, or immobilised as a waste.

6. One of the options being looked at by the PuWG is the construction of a plutonium burning reactor or reactors at Sellafield.

7. Cleanup Plants: former activities have produced a waste inventory on the Sellafield site which, it is agreed by all, should be recovered and treated to produce waste forms which can be passively stored - for long periods if required. Waste will also be produced by the decommissioning of historic, current, and any future plants, and these activities also must be modelled.

8. Support Plants: these are plants which will deal with retrieved wastes and effluent arisings, plus overall site service provisions. They are often essential to many different activity streams.

9. Infrastructure Activities: these activities - research and technology, safety and analytical services, purchasing and stores, human relations, information technology and the like, must be modelled for the various levels of activity envisaged by the overall scenarios.

The length of time over which the socio-economic effects can be credibly identified is limited. It was agreed that the data would be limited to 25 years into the future, with the knowledge that this would preclude the need to model some of the longer time scale blocks. Within this general limit, individual blocks have been given assumed time-scales derived either from programmes or from assumed decision dates and plant build times. Again these time-scales have not been "agreed" by the groups, but have been agreed to bound the likely range of activities necessary for the Socio-economic modelling required.

(1) The PuWG has not been considering storage as a long term management option, but has included interim storage in strategies involving the use of Pu as fuel and Pu immobilisation.

Magnox Reprocessing

Two Magnox Reprocessing blocks have been identified to bound the range of possibilities as shown below.

Table 0.6 Magnox Reprocessing Blocks

Block Number	Plant Scenario	Description	Time scale comments
01 - M1	Magnox "Stop Now"	Magnox reactors stopped 1.4.2001 and all irradiated fuel kept in reactors long term. All fuel already wet or in ponds is reprocessed through the current route.	Defined by programme
02 - M2	Magnox "New Plan"	As defined by BNFL 23 May 2000 announcement and subsequent fuel reprocessing programmes.	Defined by programme
Note:	A development in SFMOWG is the possible use of a new head end plant on THORP to allow it to reprocess Magnox fuel. This could then be used instead of B205 for some of the Magnox reprocessing programmes considered above. This development is included as a block in the THORP Reprocessing series below.		

Calder Hall

Two Magnox Reprocessing blocks have been identified to bound the range of possibilities as shown below.

Table 0.7 Calder Hall Blocks

Block Number	Plant Scenario	Description	Time scale comments
03 - C1	Calder stop now	Calder stops generation on 1.4.2001, but continues to store fuel until dry stores are available	Defined by programme
04 - C2	Calder to plan	Calder stops as per BNFL Magnox plan	Defined by programme

THORP Reprocessing

To the three levels of oxide fuel reprocessing identified below has been added the Magnox reprocessing option from the note in *Table 0.6*.

Table 0.8 THORP Reprocessing Blocks

Block Number	Plant Scenario	Description	Time scale comments
T1	THORP "Stop Now"	Stop reprocessing 1 April 2001	Defined by programme
T2	THORP "Current Business Plan"	As defined by BNFL	Defined by programme
T3	THORP "Blue Sky"	As defined by BNFL	Defined by programme
T4	THORP Magnox head end	New head end plant to allow Magnox to be treated – decision taken 1.4.2001	Design and build programme and capacity to be defined

4.5.3 Fuel and Plutonium Wasteform Storage

Blocks relating to the storage of fuel and plutonium wasteform are presented below.

Table 0.9 Fuel and Plutonium Wasteform Storage Blocks

Block Number	Plant Scenario	Description	Time scale comments
SN2	AGR Dry Storage at Sellafield	Torness-type drying facility and dry store commissioned as soon as practicable to take all AGR fuel not reprocessed in the THORP Stop Now Brick T1.	Defined by build time scale
SN2a	Extension of dry storage.	Dry storage at Sellafield extended to accept the output of a Pu ceramic wasteform and spent fuel. (relates to Pu3/Pu5)	Defined by Pu3 and 5 build time-scales
SN3	AGR Conditioning for disposal	Not initially required for socio-economic study, as time scale >25 years.	>25 years
SN4	Dry storage	Cask storage of "low spec MOX" output from SMP or un-irradiated Pu ceramic in casks in a "secure warehouse" (relates to Pu1/Pu8)	6 years minimum to start
Note:	This has been modified, with SN2a covering storage of low spec MOX or Pu ceramic with a radiation barrier provided by spent fuel. Assume co-storage in casks. SN4 then covers storage of low spec MOX or Pu ceramic in the equivalent of a secure engineered drum store.		

Plutonium

Current BNFL plans envisage the return of foreign-owned plutonium separated in THORP as MOX fuel fabricated in the Sellafield MOX Plant (SMP). Three blocks are included to cover early THORP closure, current and "Blue Sky" programmes.

The possibilities being examined by the PuWG, and included for modelling in the Socio-economic Study, include:

- Conversion of the UK Pu stocks from the various programmes into low- or fuel-specification MOX or purpose-designed ceramic wasteforms, or into MOX or inert matrix fuels.

- The use of the UK MOX or inert matrix fuel in reactors.

- The storage of Pu ceramic wasteforms (low spec MOX or purpose designed) either with or without a radiation barrier (provided by vitrified HLW or co-storing with spent fuel).

- The provision of reactor(s) at Sellafield to burn UK MOX or inert matrix fuel.

These options give rise to the blocks shown in *Table 0.10*.

Table 0.10 Plutonium Blocks

Block Number	Plant Scenario	Description	Time scale comments
SMP1	Reference Case SMP	Converts the Pu output from T2 into MOX fuel for delivery to foreign customers.	Driven by Pu output from T2 and SMP capacity
SMP2	SMP Early Closure	Converts the Pu Output from T1 into MOX fuel for delivery to foreign customers.	Driven by Pu output from T1 and SMP capacity
SMP3	SMP Blue Sky	Converts the Pu Output from T3 into MOX fuel for delivery to foreign customers.	Driven by Pu output from T3 and SMP capacity
Pu1	Unmodified SMP	Unmodified SMP to convert all UK origin Pu to MOX (low spec or for reactors)	Driven by plant throughput
Pu1a	Extend SMP	Extend SMP capacity to enable output from T3 for foreign customers and convert all UK Pu to MOX.	Driven by Pu to be treated
Pu2	Modified SMP	Modify SMP to produce Pu-bearing ceramic waste form or inert matrix fuel from UK Pu.	Driven by plant conversion time scale
Pu3	New Build Plant – inert matrix fuel or ceramic	New plant to produce Pu-bearing ceramic wasteform or inert matrix fuel from UK Pu.	Driven by decision and plant build time scale
Pu4	VHLW radiation barrier	Low grade MOX or Pu-ceramic in cans surrounded by vitrified HLW. Adapt existing vitrification plants or new plant build.	Driven by decision and plant build time scale
Pu5	Spent fuel radiation barrier	Uses stored spent fuel as a radiation barrier – storage covered under SN2a above. This block would cover the plant needed to co-load a Pu waste form into a cask with spent fuel.	Add-on to Pu1, Pu2, Pu3
Pu6	Interim Storage as PuO2	Not modelled separately as the spends for the increased or decreased amounts of Pu storage are picked up in other blocks.	N / A
Pu7	Pu burning reactor at Sellafield	Current assumption is a Westinghouse AP1000 twin-pot at Sellafield. NB Pu7 does not form a part of any scenarios tested in *Section 6*. The impacts are, however, set out in *Section 7*.	12 year start assumption being tested
Pu8	MDF	Now defined as a support facility.	

Cleanup and Decommissioning

Cleanup and decommissioning are not currently being studied by a working group. There is a high degree of agreement that the activity is important and needs to be modelled, but a wide variation in opinion as to what programmes are politically and financially credible. The two Blocks in *Table 0.11* span the range of possible programmes.

Table 0.11 Cleanup Blocks

Block Number	Plant Scenario	Description	Time scale comments
CU1	Current Cleanup Plan	Decommissioning spend and manpower figures for the current BNFL Waste Management and Decommissioning plan.	Time to final status (green or brown field) will be >25 years
CU2	Early Shutdown, maximum activity, cost no object	Decommissioning spend and manpower figures for the earliest considered combination of THORP and Magnox reprocessing shutdown with a maximum credible rate of waste management and decommissioning activities. This can be termed the "Early Shutdown, maximum activity, cost immaterial" scenario, and will be the upper bound of "concentrate on cleanup" scenarios.	Time to final status (green or brown field) will be >25 years

Support Plants

Support plants are presented in *Table 0.12*.

Table 0.12 Support Plant Blocks

Block Number	Plant Scenario	Description	Time scale assumed (S, M, L)
SP1	Current BNFL Magnox and THORP Plans	Spend and manpower figures for support plants (definition needed) in the current THORP / Magnox operating mode.	Programme driven
SP2	After End of Reprocessing – early close	Spend and manpower figures for support plants (definition needed) when only BNFL Waste Management and Decommissioning Plan operational.	Programme driven
SP3	Support Plants Blue Sky	Needed to align with any scenario using T3 (THORP Blue Sky).	Programme driven

Infrastructure Activities

Infrastructure activities are capable of being dynamically modelled to reflect a range of site activities. This will be a great advantage if different scenarios are subsequently examined by the current or future Working Groups. The extremes and a reference case are represented by the three blocks defined below.

Table 0.13 Infrastructure Blocks

Block Number	Plant Scenario	Description	Time scale assumed (S, M, L)
Inf1	Current BNFL Magnox and THORP Plans	Spend and manpower figures for infrastructure activities (definition needed) in the current THORP / Magnox operating mode.	Programme driven
Inf2	After End of Reprocessing – early close	Spend and manpower figures for infrastructure activities (definition needed) when only BNFL Waste Management and Decommissioning Plan operational.	Programme driven
Inf3	Infrastructure Blue Sky	Needed to align with scenarios using T3 THORP Blue Sky.	Programme driven

4.6 SCENARIOS FOR FUTURE ACTIVITIES AT SELLAFIELD

4.6.1 Introduction

Blocks cover both an activity and the potential level of this activity in the future. As stated earlier, combinations of blocks are put together to form "walls" or scenarios. Such scenarios can be used either to bound the range of future potential site activities or to show sensitivities of scenarios to changes in one or a small number of blocks.

4.6.2 Timing of Blocks

Several of the blocks require new plant or processes to be built and commissioned. Such new build requires time. When a scenario includes such a block, it must be noted that the block cannot be implemented immediately.

4.6.3 Study Scenarios

Background

Four scenarios have been developed by the Socio-economic Sub-group. These aim to bound the full range of future activities of the Sellafield site to 2050. No comment is made on the probabilities of any of the scenarios occurring in practice; indeed cases could be made for the development of a large number of further scenarios based on new combinations of blocks and / or sensitivities from the four scenarios presented.

However the scenarios as presented are designed to show the range of possible future activities possible and to highlight the effects of some of the main choices available in the future. The scenarios are described below.

"Minimum" Scenario

This scenario defines the minimum future activity of the Sellafield site well. Key points are:

- The Magnox stations (including Calder Hall) are closed at the earliest possible date (assumed to be 1/4/2001) – *Blocks M1, C1.*

- THORP and Magnox Reprocessing activities cease as early as credible (Magnox reprocessing continues to deal only with spent fuel already wet stored on the Sellafield site and in reactors) – *Blocks M1, T1.*

- No new facilities to store and/or condition spent AGR fuel are planned.

- No MOX will be produced from either the MDF (MOX Demonstration Facility) or SMP (Sellafield MOX Plant).

- Clean-up rates are not increased above current levels - *Block CU1.*

- Support Plants and Infrastructure activities revert to levels needed for CU1 – *Blocks SP2, Inf2.*

- The early closure of all BNFL's principal revenue generating activities would be a serious matter for the company but, in common with the terms of reference of this Study, no account is taken of any financial constraints.

Blocks operative: M1, C1, T1, Pu6, CU1, SP2, Inf2

"Stop Now and Prepare for Closure as Soon as Possible" Scenario

In common with the "Minimum" scenario, the "Stop Now" scenario includes the earliest possible closure of Power Generation and Reprocessing activities on the site. However, the site is tasked with cleaning up as soon as is practicable, and activities to immobilise the stock of UK plutonium and to undertake long term storage of AGR fuel are undertaken. Key points are:

- Rather than reprocessing in THORP, spent AGR fuel continues to be transported to Sellafield and is dry stored (*Block SN2*) before being conditioned for final disposal (*Block SN3*).

- The rate of site clean up is yet to be defined, but is considered to be increased to the maximum possible rate without financial constraints (*Block CU2* with support plant activity remaining at planned levels – *Block SP1*) Two options are defined for dealing with plutonium.

- In the "minimum immobilisation" case, the MDF (*Block Pu-8*) and SMP (*Block Pu-1*) will be used to produce low specification MOX which will be stored on site in dry casks in a warehouse (*Block SN-4*).

- "Maximum immobilisation" of plutonium would be achieved through its placement within a ceramic (*Block Pu-3*) and a spent fuel radiation barrier (*Block Pu-5* – co-storage covered as *Block SN2a*)(1).

Blocks Operative: M1, C1, T1, SN2, [CU2 plus SP1, SN3 >25 years]. Pu blocks: Pu-1 plus SN4 as a minimum. Maximum Pu 3 or Pu5 plus extended storage SN2a, Pu-8 (for time scale dictated by Pu-1).

"BNFL Current Business Plan" Scenario

This scenario takes the current BNFL Business Plans for Magnox and THORP reprocessing. In the case of Magnox, they reflect the Magnox station closure dates stated in the 23 May 2000 announcement. The key points of the scenario are:

- Power Generation from the Magnox stations (including Calder Hall) continues according to the programme announced by BNFL on 23 May 2000. (*Block C2*).

- All Magnox fuel is reprocessed at Sellafield through the current reprocessing route. (*Block M2*).

- THORP continues to reprocess to the completion of the current business plan. (*Block T2*).

- SMP is commissioned and produces MOX fuel (*Block SMP1*), supported by MDF (*Block Pu-8*) as a development facility.

- Clean-up rates are not increased above current planned levels (*Block CU1*) with decreases in the levels of Support Plants (from *Block SP1* to *Block SP2*) only taking place after the end of Reprocessing.

- *Block T4*, the new head end plant for THORP to deal with Magnox, is not included in this scenario, but could be run as a variation, as it would be called into play in the event of variations to the current plan; for example to cover shortfalls in B205 Magnox reprocessing plant throughput.

The scenario envisages BNFL maximising its income in the medium term without increasing Clean Up rates of the Sellafield site above current plans. It is advisable that sensitivities are applied to this scenario to reflect the possibilities that Power Generation and / or Reprocessing will be at lower levels than envisaged: changes could occur in any one of the business environment, political environment, environmental regulation or safety / technical issues..

Blocks operative: M2, T2, C2, SMP1, Pu6, CU1, SP1, Pu8, Inf1

(1) This spent fuel barrier option is included largely because of the ready availability of the spent fuel barrier.

"Blue Sky" Scenario

This scenario aims to make the most optimistic possible assessment of the future reprocessing activities of the Sellafield site. Additional to the "BNFL Current Business Plan" are:

- THORP continues to operate for a further 10 years, to around 2024 (*Block T3*).
- MOX production in SMP is increased above the current capacity (*Block SMP3* plus *Pu8* and *Pu6*) by constructing a further line (*Block Pu-1a*).
- Clean-up rates are maintained at the current plan (*Block CU1*).
- Infrastructure and Support plant effort is increased to cope with additional reprocessing (*Blocks SP3* and *Inf3*).

Sensitivities can be run based on this scenario by subtracting out one or more options to investigate their effects on the results. The building of a new plutonium-burning reactor on site on a time scale requiring increases in MOX production above the SMP capacity is seen as highly speculative but was examined as a variant on the Blue Sky case (see *Section 7*).

Blocks operative: M2, C2, T3, SMP3, Pu6, Pu8, SP3, Inf3.

4.6.4 Interpretation of the Scenarios

As noted above, it was originally envisaged that three scenarios would be produced representing maximum and minimum scenarios bounding the range of possible futures of the Sellafield site.

The current set of four scenarios retains the minimum and maximum approach ("Minimum" and "Blue Sky" respectively), but rather than one central scenario, two have been proposed:

- "Stop Now and prepare for closure as soon as possible" can be interpreted as "Minimum" plus mitigation by increased short term expenditure on cleanup and Pu immobilisation and by commitment to long term spent fuel storage.
- "BNFL Current Business Plan" is the currently planned Magnox generation and Magnox and THORP reprocessing programmes with no up-rating of cleanup and waste management operations.

These scenarios are intended to show the effect of reduction in reprocessing and early closure of Calder, versus the mitigation available by increased expenditure on early cleanup with commitment to spent fuel storage. Further differences could be explored using sensitivity analyses.

4.6.5 Possible Variants Using THORP Magnox Head End

The THORP Magnox Head End is used by several of the scenarios being examined by the Spent Fuel Management Options Working Group. It is judged that the scenarios defined above will still span the full range of activity on the Sellafield site. If any of the THORP Magnox Head Options are preferred they can be run as variants, probably by simple interpolation, after the main Socio-economic study.

4.7 CONCLUDING REMARKS

A brief overview of the history and configuration of Sellafield provides the context for the blocks and scenarios for future Sellafield site operations developed by the Socio-economic Study Group. The main points are that:

- The nuclear industry is characterised by the wide range of choices which can be made in its design and operation. These include whether to generate electricity using nuclear power, what type of plant is used, whether to reprocess or store spent fuel from reactors, what to do with separated plutonium, and how to manage and dispose of nuclear waste.

- The nuclear industry is extremely complex and the Sellafield site is no exception. Feedback and constraints between the various plants and processes mean that detailed scenarios of future operations can only be produced by experts with an in-depth knowledge of the Sellafield site. Clearly this knowledge is most prevalent within BNFL and, to a lesser extent, organisations (including NGOs) who have had a professional interest in the development and operation of the site. BNFL and other members of the steering group could therefore seek to influence the design of the scenarios to meet their own needs. ERM has seen no evidence of such bias and would like to commend and thank BNFL and other members of the socio-economic study sub-group for their attitude and assistance throughout the process.

- The scenarios developed include "Minimum" and "Blue Sky" scenarios which bound the lower and upper possibilities of future Sellafield activity. Two scenarios within this bounded range have been developed by the Socio-economic Study group:

  - "Stop Now and prepare for closure as soon as possible" envisages mitigation of the minimum case by increased short term expenditure on cleanup and Pu immobilisation, and by commitment to long term spent fuel storage.
  - The "BNFL Current Business Plan" involves the planned Magnox generation and Magnox and THORP reprocessing programmes with no up-rating of cleanup and waste management operations.

- Many other scenarios could be developed either additionally or as alternatives to the two mentioned above. The actual future of Sellafield site

activity is extremely uncertain, and could be altered by political, commercial, regulatory, environmental and technical policies and pressures, both from within the UK and overseas. Hence, it is recommended that a series of sensitivity runs are made, particularly around the "BNFL Current Business Plan" scenario. Of particular interest would be the effects of lower levels of reprocessing and power generation and also the effects of different levels of site clean up activities.

5 SURVEY RESULTS

5.1 INTRODUCTION

This section of the report presents the results of surveys targeted at three main groups namely: employees; suppliers to BNFL; and local firms, with the aim of identifying the current level of dependence on BNFL in the local economy. Results from the surveys have been used as inputs to the modelling reported in *Section 6.*

5.2 EMPLOYEE SURVEY

5.2.1 Introduction

The aim of the employee survey was to provide information in order to assess the impact of each of the scenarios on direct employment at BNFL and, consequently, expenditure in West Cumbria.

The questionnaire was designed to:

- identify the socio-economic characteristics and skills of the workforce;
- assess the dependency of local employment on BNFL; and
- identify the level and type of expenditure (by BNFL employees) in West Cumbria.

5.2.2 Sample Size

There are approximately 6,000 direct employees at BNFL. In addition, there are approximately 1,100 agency staff and 4,400 contractors, 3,500 of whom are construction contractors and the balance work for companies providing site services such as cleaning and catering.

A list of all BNFL employees was used to select a representative sample of 1,000 BNFL employees including a proportion of agency (50) and contractor staff (150). The sample was structured between operations according to the relative magnitude of change within each operation under the scenarios. The sample sizes were therefore: support services (150); THORP (200); MOX (80); Calder Hall (80); reactors (80); waste retrieval and decommissioning (50); waste management services (80); and Magnox reprocessing (80). The sample was also stratified by qualification and occupation (Band 2 - 5) to allow analysis of the impact of each of the three scenarios on the skills and employment profile at the plant. A high response rate of 65 percent meant that a total of 650 questionnaires were returned.

5.2.3 Approach to Surveys

A pilot survey of between 5-10 questionnaires was completed by randomly chosen employees at BNFL to ensure that questions were clear to participants and meaningful in terms of the information required.

The distribution of the employee questionnaires was undertaken by BNFL with returns being sent to Trade Union officials. The covering letter emphasised the independence and confidential status of the survey. Surveys were posted to employees' home addresses and hence completed without the aid of an interviewer. In the analysis, the responses of employees have been weighted by grade to ensure that surveys are representative.

5.2.4 Survey Findings

Socio-characteristics and Skills of the Workforce

The first section of the employee questionnaire aimed to find out the basic socio-economic characteristics of the workforce. Based on the (weighted) average employee, the results suggest that the workforce at BNFL is relatively long-serving:

- the mean average age of employees at BNFL Sellafield is 42 years old; and
- the mean length of service with BNFL Sellafield is 14 years.

Dependency of Local Employment on BNFL

The employee questionnaire was designed to reveal how dependent West Cumbria is on BNFL. A series of questions were put to employees regarding motivation to move to, and stay resident in West Cumbria. The survey results show:

- nearly half of all respondents (45 percent), stated the main reason for choosing to live in West Cumbria was to work for BNFL Sellafield; and

- nearly a fifth of all respondents (19 percent), stated that BNFL was the reason for choosing to move to the area.

The survey also found that:

- 19 percent of BNFL employees have spouses / partners who also work at BNFL Sellafield;

- 10 percent lived in a household where more than one member was employed at the site; and

- just over a quarter (26 percent) stated that they had other relatives (outside their own household and not already accounted for) working at BNFL Sellafield.

Level and Type of Expenditure of by BNFL Employees in West Cumbria

The final section of the questionnaire asked employees what proportion of their annual disposable income they spent on various goods and services as given in *Table 0.1*. The results show that the highest proportion of annual disposable income in terms of the categories given, is "housing", followed by "other" and "groceries".

Table 0.1 Spend on Goods and Services

Goods and Services	All Respondents
Housing	24
Groceries	17
Cigarettes	1
Restaurants, pubs and clubs	9
Vehicle running costs	13
Travel	2
Holidays in Cumbria	2
Holidays outside Cumbria	10
Other	22
Total	**100**

Source: ERM survey

These results are similar to results obtained nationally under the household expenditure survey, except for more being spent on holidays, restaurants, pubs and clubs and other leisure pursuits.

5.3 SUPPLIER SURVEY

5.3.1 Introduction

The Supplier Survey was sent to a sample of businesses which supply BNFL with capital equipment and on-going supplies. The same form was sent to both capital and recurrent expenditure suppliers. This is because the ways in which the local economy is impacted are essentially the same, although the breakdown between employment costs and costs of capital items will differ. The aim of the survey was to identify the degree to which local suppliers are dependent on the continued activity of BNFL for their business. The results of the survey were used to estimate the likely impact on BNFL's suppliers of the implementation of any of the three scenarios (and their component blocks). Such impacts could lead to the expansion or contraction of suppliers' businesses with subsequent knock-on effects on the local economy, especially where jobs are created or no longer required.

5.3.2 Population and Sample Size

The total population of suppliers to BNFL is around 16,000. This includes one-off suppliers of capital equipment as well as those on which BNFL relies for the continuing operation of its business. In the latter case these suppliers include the providers of services as well as goods.

A sample of 88 questionnaires were sent to individual suppliers of BNFL. The list was provided direct from BNFL and included all the largest suppliers to BNFL as well as a sample of smaller suppliers, with some 80 percent of questionnaires being directed at large suppliers and 20 percent being directed at smaller companies. The businesses targeted were representative of the Standard Industrial Classifications of relevance to the study; including for example, machinery and equipment, engineering, construction, chemicals, transport services etc.

To ensure that the emphasis is placed on the impact on the local economy of BNFL's operations, all of the suppliers targeted were based in West Cumbria, although some questionnaires were sent to firms which had a head office outside of the study area. In these cases respondents were invited to answer with respect only to their operations in the study area.

5.3.3 Approach

The survey forms were sent out in the middle of November and follow-up telephone calls were made to all of those who had not replied by the middle of December. BNFL staff made subsequent follow up telephone calls directly to suppliers to encourage them to complete the questionnaires. By the end of January, 37 usable, completed questionnaires had been received and the responses from these were reviewed, coded and input into a spreadsheet for subsequent modelling. All respondents who sent back a completed questionnaire were contacted in order to acknowledge receipt of the competed survey form and to thank the supplier for their participation.

5.3.4 Survey Findings

About the Business

The first section of the questionnaire was used to confirm basic information about the suppliers to BNFL and gain a clearer picture of business operations.

Site Location

- 15 suppliers (40 percent) have just one other site within the UK, 11 (30 percent) have between 2 and 5 other sites and the remaining 11 (30 percent) have between 6 and 13,000; and

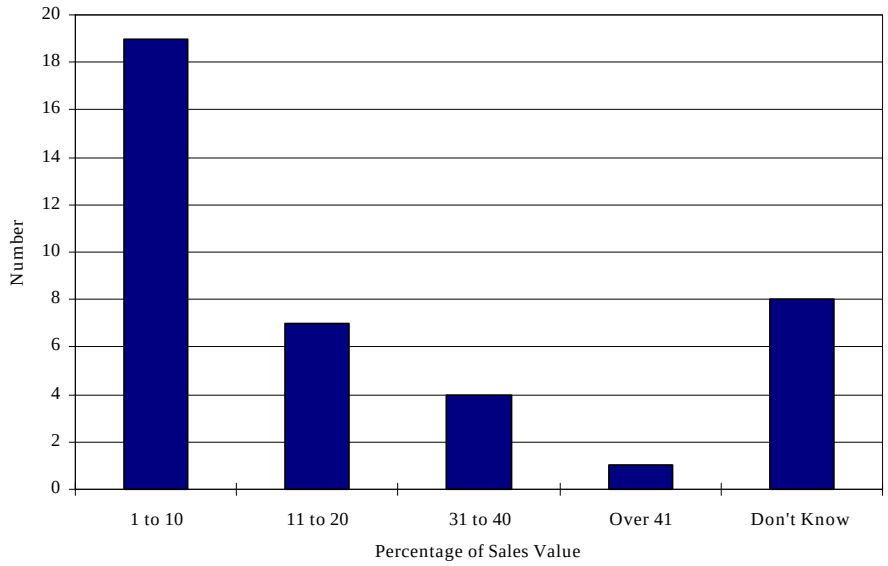
- 32 out of 37 suppliers used a site which is within the West Cumbria travel to work area (TTWA) to supply BNFL.

Main Customers

The 37 suppliers were asked to identify their 5 main customers. Out of 185 customers given, 39 are based within the study area (21 percent). The significance of these 39 customers to the supplier was measured in terms of

their contribution to the suppliers own sales value. This was given in percentage terms and is illustrated in *Figure 0.1*.

Figure 0.1 Customers Located Within West Cumbria as a Percentage of Sales



Source: ERM survey

Number of Employees

The number of people employed by the supplier at the sites within question totalled 10,620, with the majority of suppliers (62 percent) employing between 1 and 50 full-time equivalent employees (*Table 0.2*).

Table 0.2 Number of People Employed by the Company at that Site

Full-time Equivalents	Number of Respondents	Percent %
1 to 50	**23**	**62**
51 to 100	8	22
101 to 150	2	5
351 to 400	3	8
401+	1	3
Total	**37**	**100**

Source: ERM survey
Note: the one company employing more than 400 employed 8,420

Annual Turnover

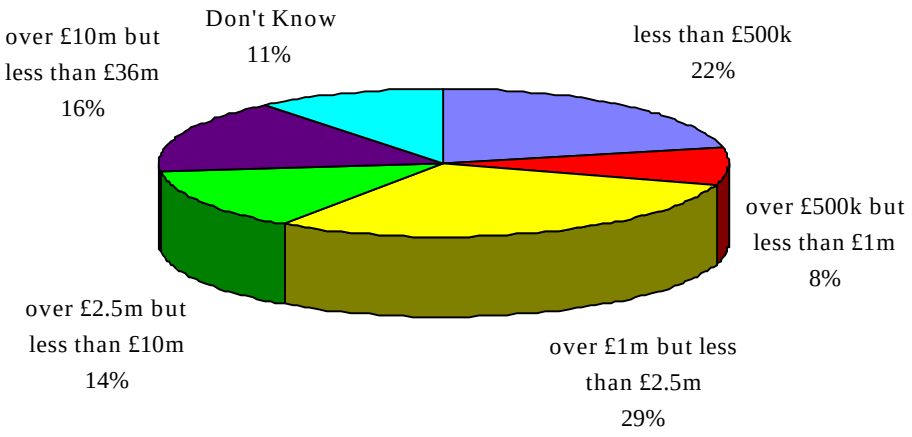
The respondents were asked to estimate their annual turnover.

- The sum of all answers is £181.6m, equalling an average of £5.5m annual turnover per supplier (based on 33 respondents, 4 did not answer).

- 29 percent of suppliers have an annual turnover of between £1m and £2.5m, followed by 22 percent with an annual turnover of less than £500k.

A significant proportion (16 percent) also have an annual turnover of over £10m *(*see *Figure 0.2).*

Figure 0.2 Annual Turnover of Company in West Cumbria



About the Services Provided to BNFL Sellafield

Suppliers tended to supply goods to more than one BNFL site with the highest number supplying SCS (*Table 0.3*). The type of goods supplied are given according to Standard Industrial Classification (SIC).

Reliance on BNFL

The questionnaire aimed to indicate how reliant companies are on BNFL through a series of questions relating to the size and value of business with the company:.

- 59 percent of businesses stated that under 50 percent of their business was with BNFL of which 10 (27 percent of the total) stated under 10 percent.

- 41 percent stated that over 50 percent of their business was with BNFL, of which 5 (14 percent of the total) stated between 91 percent and 100 percent.

Table 0.3 BNFL Site Supplied

Site	Number of Respondents	Goods Supplied
All	13	Machinery and equipment not classified elsewhere Fabricated metal products, except machinery Supporting and auxiliary transport activities Other business activities Wholesale trade except motor vehicles Construction
Calder	4	Fabricated metal products, except machinery
Drigg	2	not stated
Magnox	3	Construction
SCS	15	Sewage and refuse disposal, sanitation Machinery and equipment not classified elsewhere Wholesale trade except motor vehicles Construction Other business activities Computer and related activities
T &O	2	not stated
THORP	3	Other business activities Machinery and equipment not classified elsewhere
WMS	5	Other non-metallic mineral products
WR&D	4	Machinery and equipment not classified elsewhere Other business activities
All except SCS	1	Medical, precision and optical instruments, clocks

Source: ERM survey

A further breakdown is given in *Figure 0.3.*

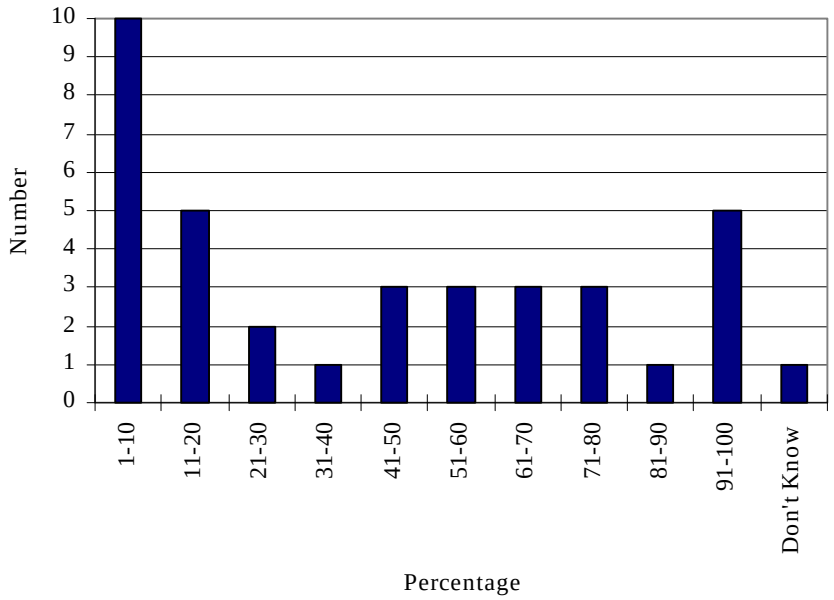
An issue raised by respondents was partnership arrangements, (mentioned by four respondents), all of whom were in agreement that partnership with local businesses offered advantages to both parties.

"We are about to sign a partnership agreement with BNFL, through which we hope to be able to provide better resource management and workload forecasting, leading to a better service"

Most respondents welcomed the opportunity to ensure local labour is used as much as possible and two respondents were critical of BNFL's perceived low use of local firms and labour.

"*BNFL's main contractors do not make sufficient use of local labour and sub-contractors. It is common for them to establish small local offices in Sellafield and bring their work force from elsewhere"*

Figure 0.3 Percentage of Business with BNFL



Source: ERM survey

Expenditure on Wages

The number of staff directly involved in the provision of services to BNFL for all companies is 844. Not all firms provided information regarding their expenditure on wages, but of those that did (employing 743 staff) company expenditure totalled £13.14m, giving an average wage of £17,690. The pressure BNFL exerts on local wages was mentioned by more than one supplier.

"BNFL has a significant upward impact on local wage rates, and because of the large number of staff they employ, its difficult for us to hire skilled labour and good quality school leavers as modern apprentices"

Suppliers to BNFL

Respondents were also asked which of their main customers also supply BNFL:

- 14 respondents out of 37 (38 percent) identified 15 customers who work directly for BNFL; and
- this constitutes 8 percent of the 185 main customers identified.

The types of goods supplied by the main suppliers to BNFL, and the types of goods supplied to the main customer by the respondent are given in *Table 0.4*.

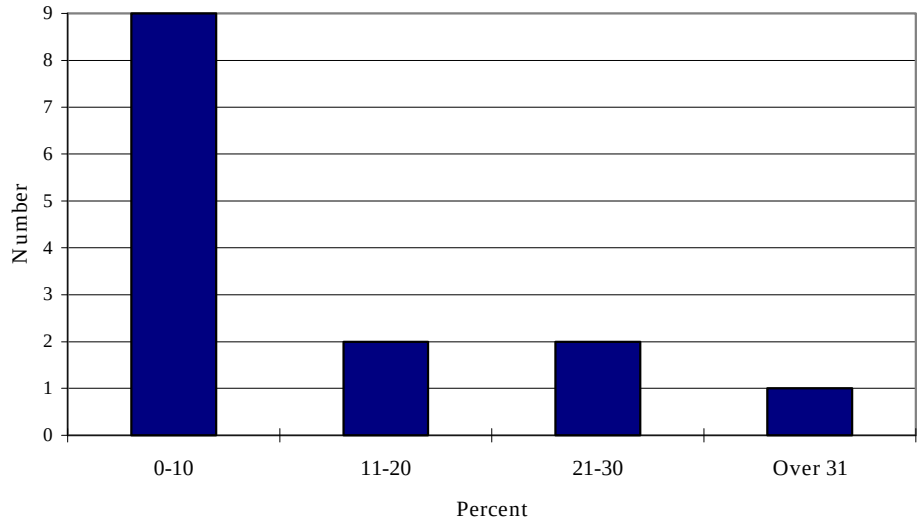
Table 0.4 Which of Your Customers also Work Directly for BNFL Sellafield?

Company	What do they supply ?	What do you supply them ?
1	Real estate activities	Wholesale trade except motor vehicles
2	Construction	Construction
3	Hotels and restaurants	Other business activities
4	Chemicals and chemical products	Land transport; transport via pipelines
5	Machinery and equipment not classified elsewhere	Fabricated metal products, except machinery
6	Machinery and equipment not classified elsewhere	Other business activities
7	Machinery and equipment not classified elsewhere	Fabricated metal products, except machinery
8	Construction	Construction
9	Other business activities	Wholesale trade except motor vehicles
10	Fabricated metal products, except machinery	Machinery and equipment not classified elsewhere
11	Construction	Construction
12	Hotels and restaurants	Wholesale trade except motor vehicles
13	no answer	Other business activities
14	no answer	Wholesale trade except motor vehicles
15	no answer	Wholesale trade except motor vehicles

Source: ERM survey

The proportion of turnover dependent on supplying these customers who themselves work for BNFL is given in *Figure 0.4*. Most respondents stated a fairly low figure, with 60 percent stating 10 percent and under.

Figure 0.4 Proportion of Turnover Dependent on Supplying Businesses who Themselves Work for BNFL (of the 15 of 37 Businesses that are Dependent)



Source: ERM survey

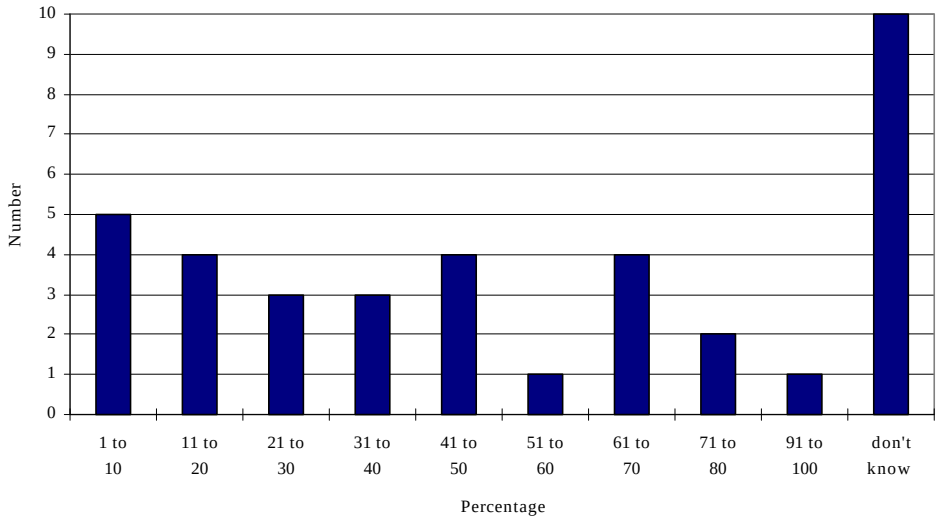
Suppliers to BNFL Suppliers

The final part of the questionnaire aimed to identify the types of characteristics and locations of the suppliers used by the respondents in order to fulfil their contracts with BNFL.

Each company was asked to give their 3 main suppliers and most did, a total of 74 names were given. Only 12 of these were thought to be located within the travel to work area (16 percent), although 41 addresses were missing (55 percent). The total expenditure with supplies for all respondents associated with fulfilling contracts with BNFL was £33.3 m

In proportion to total expenditure on supplies (all contracts not just BNFL contracts), 51 percent of respondents (19) thought that this represented under 50 percent of their total expenditure on suppliers and 22 percent (8) respondents thought that this represented over 50 percent of their total expenditure on suppliers. The remaining 10 respondents did not know.

Figure 0.5 ***Cost of Fulfilling BNFL Contracts as a Proportion of Total Expenditure on Suppliers***



Source: ERM survey

Effects of Changes in Future BNFL Activity

As one would expect, there is a direct correlation between BNFL operations and the operations of companies who supply BNFL. The results are summarised in *Table 0.5* and described in more detail below.

Table 0.5 Summary of Impacts of Changing Levels of Business with BNFL

Level of Change in Business with BNFL	Percentage of Companies Reporting Corresponding Change in Business
Increase in business with BNFL by:	
• 20 percent	65 percent
• 40 percent	86 percent
• 60 percent	92 percent
• 80 percent	97 percent
• 100 percent	97 percent
Decrease in business with BNFL by:	
• 20 percent	62 percent
• 40 percent	84 percent
• 60 percent	92 percent
• 80 percent	95 percent
• 100 percent	95 percent
Source: ERM survey	

(a) Increase in BNFL operations

- 24 companies (65 percent) stated that an increase in business with BNFL by only 20 percent would have a positive impact on jobs of which 63 percent (15) stated that the impact would be between 1 and 10 FTEs. 21 percent (5) did not know and the remaining 16 percent(4) were split amongst higher categories.

- 32 firms (86 percent) stated that an increase in business with BNFL by 40 percent would have a positive impact on jobs of which 59 percent (19) stated that the impact would be between 1 and 10 FTEs, 25 percent (8) stated higher categories and 16 percent (5) did not know.

- 34 firms (92 percent) stated that an increase in business with BNFL by 60 percent would have a positive impact on jobs of which 59 percent (20) stated that the impact would be between 1 and 10 FTEs, 29 percent (10) stated higher categories (including 2 suppliers who stated the two highest numbers 69 and 300) and 12 percent (4) who did not know.

- 36 firms (97 percent) stated that an increase in business with BNFL by 80 percent would have a positive impact on jobs of which 33 percent (12) stated that the impact would be between 1 and 10 FTEs, 25 percent(9) stated high categories (of between 21 and 400), 22 percent(8) stated that the impact would be between 11 and 20 FTEs, and 19 percent (7) did not know.

- 36 firms (97 percent) stated that an increase in business with BNFL by 100 percent would have a positive impact on jobs of which 56 percent (20) stated high categories (with 500 at the top end of the range), 22 percent (8) stated between 1 and 10 FTEs, 14 percent(5) stated between 11 and 20 FTEs and 8 percent (3) did not know.

(b) Decrease in BNFL operations

- 23 firms stated that a decrease in business with BNFL by 20 percent would have a negative impact on jobs of which 65 percent (15) stated that the impact would lead to a decrease of between 1 and 10 FTEs, 19 percent (5) did no know and three suppliers stated higher losses (18, 23 and 100).

- 31 firms stated that a decrease in business with BNFL by 40 percent would have a negative impact on jobs of which 55 percent (17) stated that the impact would lead to a decrease of between 1 and 10 FTEs, 23 percent (6) stated between 11 and 20 job losses, 19 percent (5) did not know and three suppliers stated higher losses (36,46 and 200).

- 34 firms stated that a decrease in business with BNFL by 60 percent would have a negative impact on jobs of which 59 percent (20) stated that the impact would lead to a decrease of between 1 and 10 FTEs, 21 percent (7) stated high categories, 12 percent(4) stated between 11 and 20 and 12 percent (4) did not know.

- 35 firms stated that a decrease in business with BNFL by 80 percent would have a negative impact on jobs of which 43 percent (15) stated that the impact would lead to a decrease of between 1 and 10 FTEs, 40 percent stated higher categories and 17 percent (6) did not know.

- 35 firms stated that a decrease in business with BNFL by 100 percent would have a negative impact on jobs of which 49 percent (17) stated that the impact would lead to a decrease of between 1 and 10 FTEs, 40 percent stated high categories (the highest being 103,116 and 500) and 12 percent (4) did not know.

5.4 LOCAL FIRMS SURVEY

5.4.1 Introduction

This survey was intended to provide verification of the linkages in the economy, for example, the level of spending from employees of BNFL Sellafield and its suppliers and other indirectly dependent companies.

The survey population is defined by the total number of businesses in the study area (Workington and Whitehaven Travel to Work Areas). In identifying the type of local firms which should be included, the consultants identified three main separate categories of business. These were businesses which operate as "third tier suppliers" (ie they supply goods or services to firms which supply BNFL directly), businesses which operate within the tourism sector, and businesses thought to be relatively independent of both tourism and BNFL related activities.

They final selection of businesses included:

- local hotels, restaurants and pubs;
- local shops and petrol stations;
- transport companies (eg taxis, mini bus hire);
- other retail outlets which rely upon spending induced by BNFL; and
- businesses providing products and services to companies known to directly supply BNFL.

A number of firms in the latter group (which may be classed as "suppliers of suppliers") were identified directly as a result of the local suppliers' survey, the questionnaire for which included a question asking respondents to state the names and addresses of two or three of their own largest suppliers.

In a small number of cases (five) it became apparent that BNFL was a minor customer of the respondent. Where this was the case the interview was continued and results were recorded in a separate category of firms, BNFL direct suppliers.

5.4.2 Approach to Surveys

In order to achieve a good response rate the survey was undertaken by means of face to face interviews. The interviews were undertaken in business premises in each of the study area's largest towns, namely Millom, Cleator Moor, Egremont, Whitehaven, Workington and Maryport, as well as in smaller settlements. The number of interviews undertaken in each town was weighted according to the towns' size, with most being undertaken in the larger towns of Workington, Whitehaven and Egremont. In order to get a representative selection of fifty firms, the following sample was developed:

- 30 percent of completed questionnaires from third tier suppliers;
- 30 percent of completed questionnaires from firms in the retail and tourism sector (this included supermarkets, bars and restaurants as well as more traditional guest houses, museums and tourist attractions);
- 40 percent of completed questionnaires from firms not in either of these categories.

The interviews were carried out over three days in December 2000. A total of 175 businesses were visited for the survey and 55 completed questionnaires were obtained, plus an additional five which turned out to be from direct suppliers to BNFL. After all of the interviews had been finished, the responses to the completed questionnaires were reviewed, coded and input into a spreadsheet for subsequent modelling. A quantitative study was made of all 55 completed questionnaires for the three main groups of businesses.

5.4.3 Business Responses

The main business activity of respondents is given according to the standard industrial classification (*Table 0.6).*

Table 0.6 Main Business Activity and Number of Employees

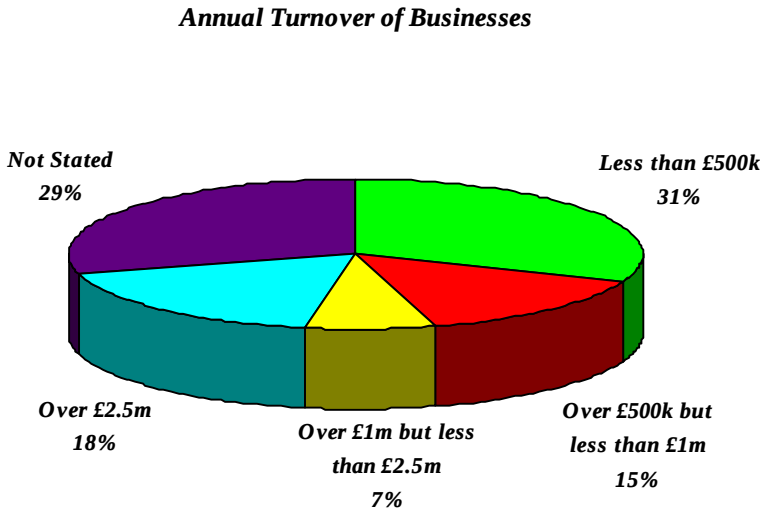
SIC	Activity	Number of Businesses	Number of FTE employees *(13 business did not know)*
18	Wearing apparel; dressing and dyeing of fur	1	180
20	Wood and wood based products, articles of straw	1	don't know
21	Pulp, paper and paper products, articles of straw	1	don't know
26	Other non-metallic mineral products	1	45
27	Basic Metals	1	57
28	Fabricated metal products except machinery	1	6
30	Machinery and equipment not classified elsewhere	1	7
31	Office Machinery and computers	1	7
36	Furniture, Manufacturing not classified elsewhere	1	45
40	Electricity, gas, steam and hot water supply	1	3
45	Construction	1	6
50	Sale, maintenance and repair of motor vehicles; sale of fuel	3	96
51	Wholesale trade except motor vehicles	6	7
52	**Retail trade, except of motor vehicles, repair**	**14**	**125**
55	Hotels and restaurants	7	58
63	Supporting and auxiliary transport activities	1	9
64	Post and telecommunications	1	don't know
65	Financial intermediation, except insurance and pension	2	101
71	Renting of machinery and equipment without operator	3	3
74	Other business activities	6	135.5
92	Recreational, cultural and sporting activities	1	1.5
	Total	55	892

The highest number of respondents within one sector was (14) in the "retail (except motor vehicles)" sector, whilst the highest number of jobs within one sector are generated by "wearing apparel; dressing and dying of fur", followed by "other businesses", "retail (except motor vehicles)" and "financial intermediation (except insurance and pension)". The number of full-time equivalent (FTE) employees per business is between 1 and 10 for just under half of all firms (25), with the remaining 30 dispersed amongst higher categories.

Annual Turnover

The sum of all respondents' annual turnover totalled £81m, equalling an average annual turnover of £2m (based on 39 respondents). In terms of the four categories shown in *Figure 0.6*, the category in which the highest number of businesses fall is less than £500k.

Figure 0.6 Annual Turnover of Businesses in the Local Business Survey



Source: ERM survey

Type of Customer

Key findings were as follows:

- for 37 businesses, their main customers were residents;
- for 17 businesses, their main customers were from outside Cumbria;
- for 14 businesses, their main customers were visitors and tourists;
- for 13 businesses, their main customers were other West Cumbria Businesses; and
- 39 knew where their customers are based, although not all could apportion turnover to customer type as shown in *Table 0.7*.

Impact of scenarios upon local firms

47 businesses were asked if they thought any customer spending in their business depended on BNFL's operations. An overwhelming majority of 72 percent (34) gave an affirmative answer yes. Only 2 businesses (4 percent) did not know and 11 (25 percent) thought customer spending was not dependent on BNFL's operations.

Table 0.7 Percentage of Turnover by Customer Type

Type of Customer	Percentage of Turnover	Number of Businesses
West Cumbria Residents	not stated	9
	1-10%	1
	11-50%	12
	51-70%	3
	71-80%	6
	81-90%	2
	91-100%	6
Visitors and Tourists to the area	not stated	22
	1-10%	7
	11-50%	7
	51-100%	3
West Cumbrian Businesses	not stated	23
	1-10%	7
	11-50%	1
	51-100%	8
Businesses from outside West Cumbria	not stated	23
	1-10%	4
	11-50%	7
	51-100%	5
Other	0%	36
	1-10%	1
	11-50%	2
	51-100%	0

Impact on Local Firms of Changes in Employment at BNFL

In order to gauge impacts, companies were asked about the effects of a hypothetical 20 percent increase and decrease in employment at BNFL. Responses are discussed below.

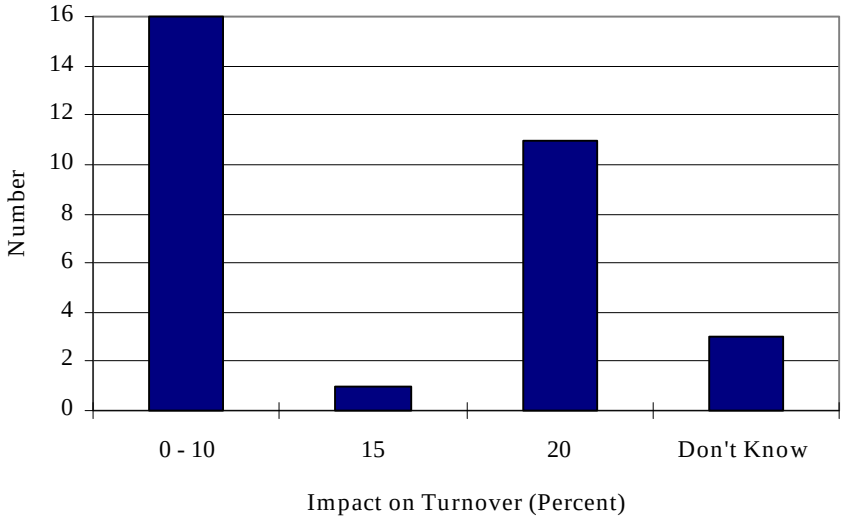
(a) 20 Percent Increase in Employment at BNFL

31 business (91 percent) out of the 34 respondents who thought that customer spending was in some way related to BNFL operations stated that an increase in employment at BNFL would have a positive impact on their own business turnover.

Impact on turnover was given in percentage terms and is illustrated in *Figure 0.7*. The first column includes all those who stated between 1 percent and 10 percent increase, whilst the remaining columns 15 percent and 20 percent were given as exact figures.

As illustrated in the figure, half of all businesses thought that their turnover would be increased by up to ten percent if employment at Sellafield increased. In terms of employment, 12 out of 34 businesses (35 percent) stated that increasing employment at BNFL would have a positive impact on their own capacity to generate new jobs .

Figure 0.7 Positive Impact on Local Firms of an Increase in Employment at BNFL



Source: ERM survey

Therefore, most respondents envisaged expansion in their business should employment increase at Sellafield. Respondents at the fringe of the study area (eg Millom or Maryport) were less likely to report this though. For those respondents who anticipated little change in their own circumstances, this was more likely to be where the respondents came from the fringe of the study area such as Millom or Maryport. Two respondents remarked that BNFL's expansion would cause them recruitment difficulties, due to BNFL's perceived dominance of the engineering industry in the area. This is a theme which also arose in the supplier survey. Sample responses given by local firms for this question included:

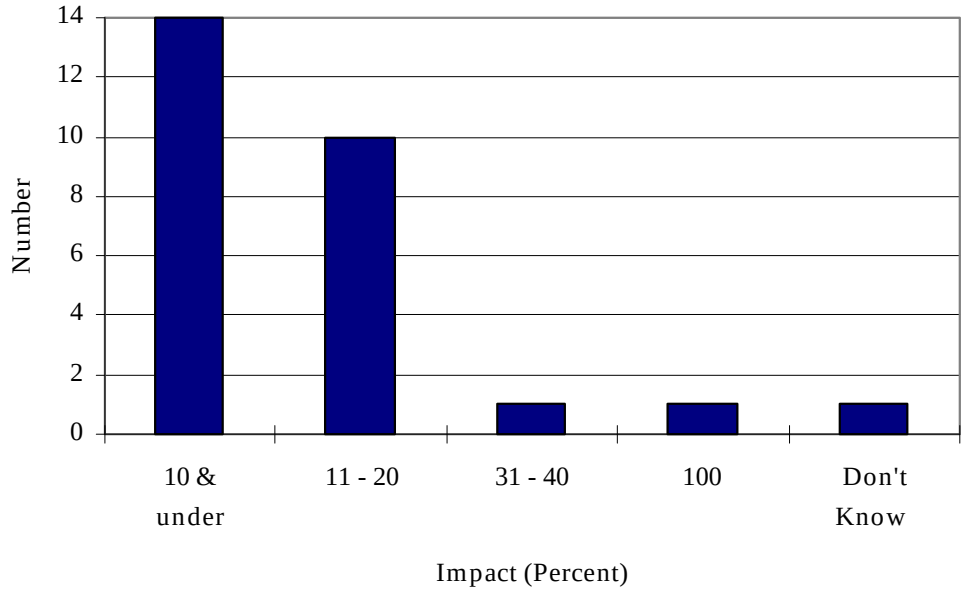
- *Buy more stock, leading to a higher turnover (vehicle sales and repair).*
- *Home deliveries would increase, people would feel more secure and incur larger shopping bills as a result (retail foods).*
- *We would expand through serving meals (pub).*
- *We would need to relocate to a bigger factory and office (computer engineering).*
- *More vehicles and staff would be needed (engineering supplier).*
- *Would not make any difference (materials handling equipment).*
- *No effect (retail foods, Millom).*
- *Wouldn't change greatly, as a competitor would probably move in (name withheld).*
- *No need to change, impact would be insignificant (tourist attraction, Maryport).*
- *Buy more vehicles, rent more space (industrial cleaner).*
- *Increase staffing (DIY supplier, Workington).*
- *Won't need to do much, in longer term may employ an extra person (carpet retailer, Millom).*
- *Wouldn't need to change much (travel agent).*
- *We may lose employees to BNFL and thus have problems recruiting high skilled labour (engineering firm, Cleator Moor).*

- *It would be harder to keep employees, both skilled and unskilled (plastics company, Whitehaven).*

(b) 20 Percent Decrease in Employment at BNFL

27 businesses (79 percent) out of the 34 respondents who thought that customer spending was in some way related to BNFL operations stated that a decrease in employment at BNFL would have a negative impact on their own business turnover.

Figure 0.8 Negative Impact on Local Firms of a Decrease in Employment at BNFL



Source: ERM Survey

If employment declined, 12 out of 34 businesses (35 percent) stated that it would have a negative impact on their own capacity to generate additional jobs.

Most respondents who had thought that an expansion would help their business thought that contraction would have a negative effect. Only one respondent, a bed and breakfast owner, expected a higher turnover due to increased income from benefit claimants.

Two engineering firms (both with turnovers in excess of £3m) thought there might be labour market *benefits* for them in the event of a decline in employment at BNFL. Sample responses from local firms in answer to this question are presented below:

- *We would have to diversify in some way - after looking extremely carefully at how to change (manufacturing and installation of double glazing).*
- *We would need to have a big restructure of staff - part-timers' hours would be cut and full-timers would need to work longer for no extra pay (retail foods).*

- *We would not be able to expand (pub).*
- *There would be less employment in the area, and knock-on effects on local businesses (and therefore our business) (name withheld).*
- *No effect (retail foods, Millom).*
- *Reduce costs, cut vehicles and staff (industrial cleaner).*
- *Decrease staffing (DIY supplier, Workington).*
- *Scare stories about BNFL in March, April and May 2000, plus the floods, led to us being down by £0.5 million (travel agent).*
- *Local engineering contractors would become less expensive, this would be good for us (engineering firm, Cleator Moor).*
- *We would need to condense deliveries, so instead of 3-4 deliveries a week there would be one or two larger ones. This saves on fuel and time costs (wholesale food supplier to fast food outlets).*
- *When Kangol laid off 100 staff, there was an initial drop in one of our customer's turnover [a take away food shop in Cleator Moor], though there was a recovery when people began to feel more secure again. This kind of thing would happen all over West Cumbria (wholesale supplier to fast food outlets).*
- *Given the degree of reliance on coach parties, the impact of changes in BNFL activity is unlikely to be enormous (hotel, Workington).*

Impact of BNFL (Including the Visitor Centre) on Tourism

The widely held view of respondents was that BNFL has a neutral or positive impact on local tourism. Only one respondent thought West Cumbrian tourism would be healthier without the plant, with many acknowledging the contribution from the visitors centre. Whilst acknowledging the perceived contribution that BNFL makes to tourism, two respondents from Maryport noted that they thought Maryport was too far away to benefit.

Sample responses included:

- *I do not think there would be a difference either way (retailer).*
- *Without BNFL, there would be a decline in tourism, everything else being equal (vehicle sales and repair).*
- *Tourism would decrease as the visitor centre is well advertised (pub).*
- *The visitor centre raises the profile of the coastal strip in general. What they are doing with advertising is good as it makes people more aware that there is more to Cumbria than the central lakes. But I doubt that people are attracted this far (this view was expressed by two separate tourist attractions in Maryport).*
- *It would be better without the plant. But the plant is necessary for the local economy (newsagent).*
- *BNFL has a positive impact. The visitor centre is an interesting day out, especially for people from North Cumbria (travel agent).*
- *Bad news about BNFL leads to a sustained reduction in tourism which takes about 2 years to recover from. Otherwise the effect is neutral (art gallery).*
- *Tourism would decrease slightly without BNFL (supermarket, Millom).*
- *It does not make any difference, at least to our clientele. In the nine years we've been running this hotel only one person has made a strong objection to the plant. Others are flexible and are willing to listen to arguments (hotel, Workington).*

Other Comments

These comments can be broadly grouped into three categories: comments about the impact of the plant in the local economy, comments about the environmental issues arising from the plant, and comments about BNFL's interaction with other local firms.

The impact of the plant on the local economy is shown by some of the anecdotal evidence which was given to the interviewers, including the following:

- *In my tiny village south of Carlisle there are three people who work for BNFL. In my family my father used to work for BNFL and my husband works for them. My cousin and her husband both work for BNFL. One other cousin works for BNFL. And two of my cousins' husbands work for BNFL (tourism officer).*
- *There was a significant rise in business when the Sellafield plant went on to monthly pay. The day after pay day (the 15th of each month) we have a regular rise in business of 20 percent as people go on big shops and home deliveries increase. It works the other way, too. Previous rumours about job losses have led to significant reductions in shopping bills as people economise (supermarket, Whitehaven).*
- *When the fuss over the forged quality assurance on the Japanese fuel rods hit the local press we had over 100 cancellations. These people cancelled for fear of not being able to pay for their holiday. Many of them would have lost their £200 deposits (travel agent, Whitehaven).*
- *We are very busy immediately after BNFL pay their staff on the 15th. The clients don't change but the orders do - an extra £200 per customer is not unusual. Also, it is very common for employees of BNFL (especially those on shifts) to send out for takeaway food for 20-30 people (wholesaler to fast food outlets).*
- *When there are bad news stories there are quiet weeks, people stop asking for quotes (it usually recovers). This is because people don't want to buy on tick with job insecurity (heating and plumbing installations).*
- *Whenever there is a rumour about lay-offs at BNFL, consumption decreases. People cut down on spending immediately (car spares).*

The environmental aspects arising from the operation of a nuclear waste reprocessing plant were alluded to by several respondents. The comments made in this regard included these:

- *Nobody wants it but where would we be without it? It is necessary to compromise between the needs of the local economy and the needs of the environment (manufacturer and installer of double glazing).*
- *It [the plant] needs to be safe, but I am happy with it. What alternative is there? It is a very big employer (travel agent).*
- *Sellafield is good from an economic point of view, but not from and environmental one (petrol station).*
- *They should invest money into alternative fuel on the same site so that nuclear power can eventually be substituted for another energy source.*

As in the Supplier Survey, there was a concern from a small number of respondents about the impact of BNFL on the local labour market and that BNFL are not doing enough to work with and support local industry. The comments came from five businesses (just under 10 percent of the total)::

- *BNFL should do more to support local and small businesses (vehicle sales and repair).*
- *They don't use sufficient local resources. They say they do, but they don't. My clients are complaining they can't get access (recruitment and accountancy).*
- *They used to use local business but now they don't. They've gone to single partnership agreements. We used to work for them, but not any more (name withheld).*
- *We used to supply BNFL, but now they've gone to a single supplier. Many of these are big multinationals from outside the area (name withheld, separate business from above).*
- *It is harder to recruit professional business type people as BNFL have bid up the wages of professionals and even administrative staff (tourist attraction, Maryport).*

5.5 CONCLUDING REMARKS

Surveys of employees, suppliers and other local businesses have been undertaken for this study in order to develop an understanding of the role of the site in the local economy.

In 2000 Sellafield employed approximately 11,500 BNFL, agency and contractor staff. The average age of staff was 42 and the average length of service was 14 years. Almost half of respondents stated that they live in West Cumbria because of Sellafield, and almost a fifth moved to the area to work at the site. A number of families are highly dependent upon the site, with almost a fifth of respondents having a partner or spouse who work on site, and more than a quarter having relatives outside their household working at Sellafield.

The high wages offered by the company lead to unusually high expenditures on leisure pursuits, with workers spending almost twice the proportion of their incomes than the national average on going out (to pubs, restaurants and other entertainment) and holidays as the national average.

Surveys of suppliers found that over 40 percent depended upon BNFL for half or more of their turnover in West Cumbria. The surveys also found that suppliers also supply BNFL indirectly, with almost 40 percent identifying other customers who supply BNFL. Not surprisingly, BNFL's suppliers indicated that their turnover and employment would be sensitive to changes in the scale of activity on site.

A similar picture was found with other local businesses who do not supply BNFL directly. ERM interviewed a variety of leisure, retail, transport and other businesses. The great majority reported that the expenditure by BNFL

workers and suppliers was an important factor in their turnover, and impacted upon their ability to generate new employment. This was reflected by poor levels of business when uncertainty emerged about the future of the plant. However, a small number of businesses also mentioned that the benefits and conditions offered by BNFL made it difficult to recruit and retain skilled staff locally.

6 ECONOMIC IMPACT ASSESSMENT

6.1 INTRODUCTION

This section reports the results of the economic modelling undertaken for this study. The results are presented for the four scenarios, which have been developed by the Socio-economic Sub-group. The scenarios are built up from combinations of blocks, which cover both an activity and the potential activity in the future, and have been developed to bound the range of future potential site activities or to show sensitivities of scenarios to changes in one or a small number of blocks.

The four scenarios reported in this chapter are:

- "BNFL Current Business Plan";
- "Minimum Scenario";
- "Stop Now and prepare for closure as soon as possible"; and
- "Blue Sky".

The scenarios are described in more detail in *Section 3* of this report. The focus for the analysis of each scenario is on numbers employed over the scenario forecast horizon (1999/2000 through to 2025/2026), the corresponding knock-on impact on the rest of the local economy and residential location of the site employees.

The current business plan provides the baseline against which the other scenarios are compared. It is important to note that this is not because it is believed that this scenario is more likely to happen than the other scenarios put forward, it is simply that any scenario needs to be measured against a common baseline in order to calculate impacts.

The activities of BNFL clearly have a major impact on the rest of the West Cumbria economy. The employment consists of:

- *Direct employment*. BNFL employees, Agency staff and contractors, expressed as full-time equivalents;

- *Indirect employment* (industry effect). Employment in BNFL's suppliers; and

- *Induced employment* (spending effect). Employment generated by expenditure in the local economy by direct and indirect employment.

The employment impacts of the four scenarios are presented in *Sections 6.2* to *6.5*. *Section 6.6* provides a comparative evaluation of the four scenarios by examining the knock-on effects on the local economy of each scenario on unemployment, migration flows and population.

6.2 *"BNFL CURRENT BUSINESS PLAN" SCENARIO*

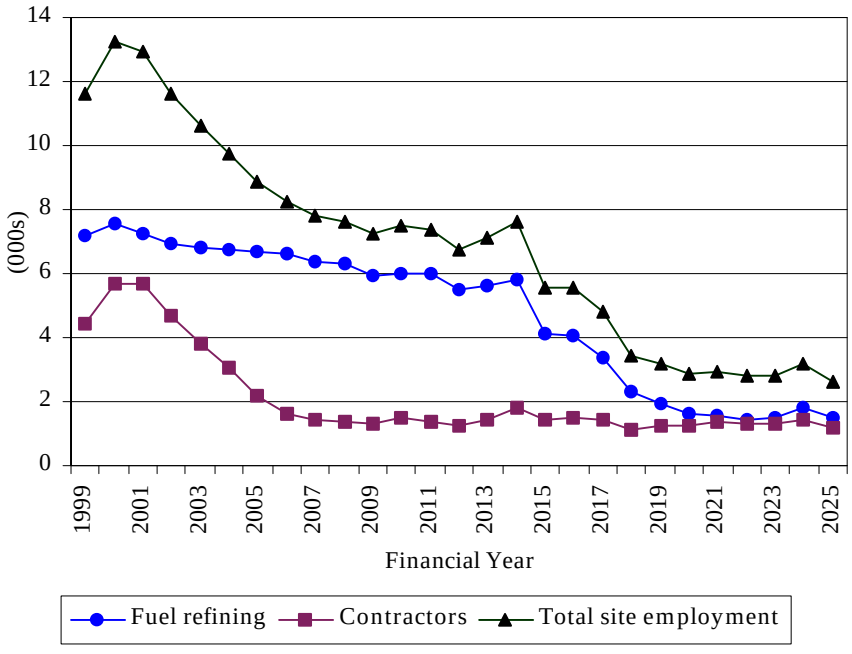
6.2.1 *Site Employment*

Measured in terms of full-time equivalent employees (FTEs), average site employment in the 1999/2000 financial year was around 11,600(1). This total is built up from three components: BNFL employees (52 per cent), Agency staff (10 per cent) and Contractors (38 per cent).

Males dominate the on-site workforce numbers. Of the total BNFL employees, 17 per cent are females, of whom over forty per cent work in an operations support role (eg HR and facilities management). Results from the Contractors survey show that almost all capital related contractors are male, while service oriented contractors (eg cleaners and caterers) are split 60:40 males : females.

Looking ahead using site employment projections supplied by BNFL, *Figure 0.1* shows projected site employment projections out to 2025/26, for Fuel Refining (BNFL employees plus Agency staff) and Contractors.

Figure 0.1 Projected Site Employment at BNFL Sellafield Under Current Business Plan Scenario (FTEs)

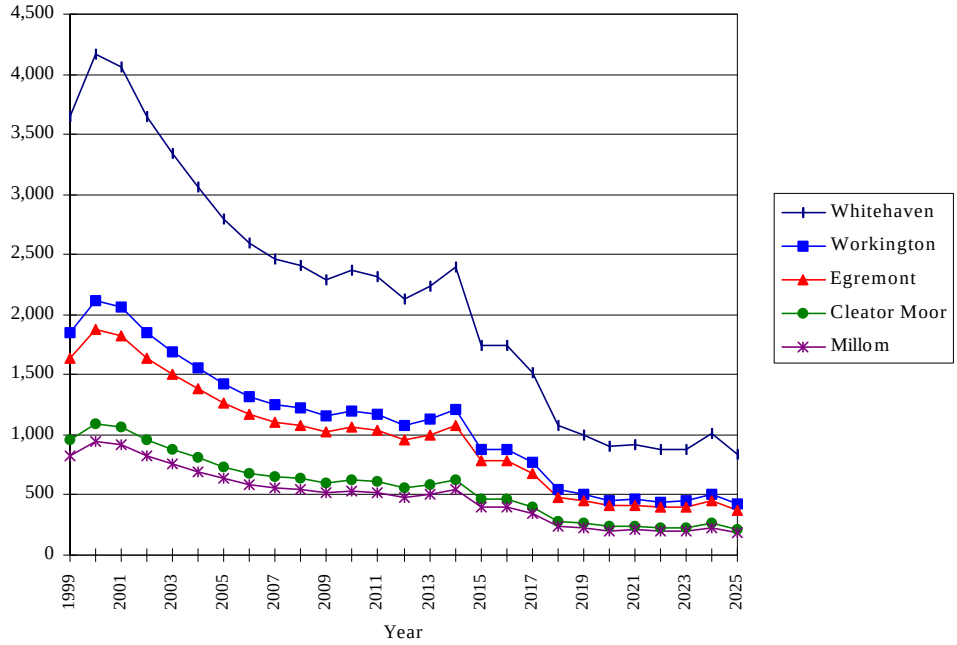


The figure shows that site employment is expected to have peaked at a little over 13,000 during 2000/01 and thereafter is expected to fall. The rate of decline is rapid in the period to 2006 (as construction workers lose their jobs),

(1) Full-time equivalent employment counts a part-time worker as 0.4 of a full-time worker.

from 2014 to 2018 (as THORP closes) and after 2025. *Figure 0.2* illustrates the residential location of employees over time.

Figure 0.2 Selected Residential Locations of Site Workers - Current Business Plan



6.2.2 *Indirect Employment*

In terms of on-site employment, BNFL is an important part of the local economy. Yet its influence does not stop there. If BNFL increases production it will need more employees (direct employment effect) and it will need to buy in more goods and services (some of which will be bought locally). The increases in employment will generate more income from employment some of which will be spent in the local economy. The increased purchases of goods and services from local industries will also generate extra income for local industries. Extra sales will generate additional employment and purchase effects so there will be second round then third round effects etc.

The sum of all these effects (including changes to levels of government spending) will give the total impact of site activity on the local economy. The total impact divided by the initial change is known as the *multiplier*.

The Office for National Statistics (ONS) provides UK-level information about the purchases patterns of industries and consumers, which are contained in Input-Output tables. Techniques are available for estimating what the input-output table should look like in West Cumbria(1). These techniques are supplemented using information supplied by BNFL on their purchasing patterns by block, and information from the employee survey which asked

(1) Annex C provides details of the methodology used to localise the UK-level input-output table.

BNFL employees about the proportion of their incomes that are spent on various categories of goods and services.

For example, the employee survey showed that the proportion of income spent on discretionary spending in pubs, clubs and restaurants and on holidays was significantly higher than UK consumers as a whole.

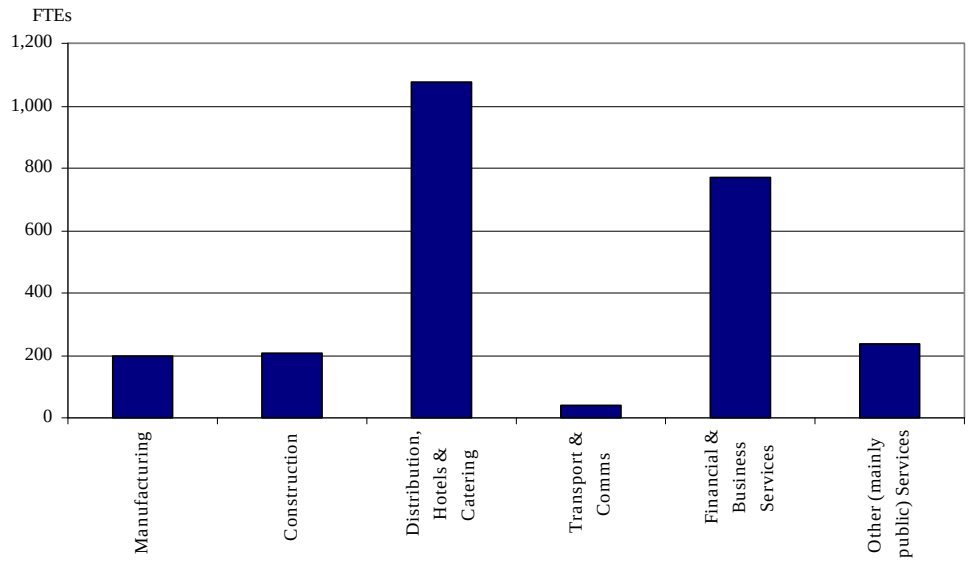
The mix of numbers of BNFL employees, Agency staff and Contractors has knock-on effects on the local economy in terms of their employment incomes and hence spending power, some of which may be spent locally. Estimates of take-home pay during 1999/2000 for BNFL employees and Agency staff were a little under £18,000, but for contractors this drops to just under £14,000.

It is not just the mix of BNFL employees, Agency staff and Contractors that is important. Earnings by block differ considerably, reflecting the skill levels required to carry out the tasks and duties associated with the job in a competent and efficient manner. Top of the earnings league are those employed in the Research and Technology, while average earnings for those employed in Support Services (eg human resources and safety) tend to be lower.

To forecast earnings by block, we have assumed that the grade profile within each block remains the same in the future and hence any changes in the level of employment by block are increased pro rata. The ratio of BNFL employees to Agency staff by block also remains fixed over the forecasts period. Overall site earnings are in excess of the average for the rest of the local economy, and we expect this to continue in the future.

Figure 0.3 shows the level of jobs in West Cumbria, by broad industry, that are wholly dependent on site activity. On-site employment of 11,500 supports around 2,500 local "indirect" jobs. This gives a multiplier of a little over 1.2, suggesting that 100 on-site jobs support a further 20 jobs in the West Cumbria economy. This multiplier is high in the UK context. For example, HM Treasury Guidance suggests a typical multiplier of between 1.05 and 1.11 for local employment impacts. The high multiplier is less surprising once the high disposable income of workers and the isolated nature of West Cumbria is taken into account.

Figure 0.3 Jobs Dependent on Site Employment by Sector



In terms of the types of job supported by site-activity, 1,100 jobs are in the Distribution, Hotels and Catering sector (14 per cent of total jobs in that sector). Around 800 jobs in the Financial and Business Service sector are wholly dependent on site activity. These include such jobs as car rental, accounting, and banking.

6.2.3 West Cumbria Employment

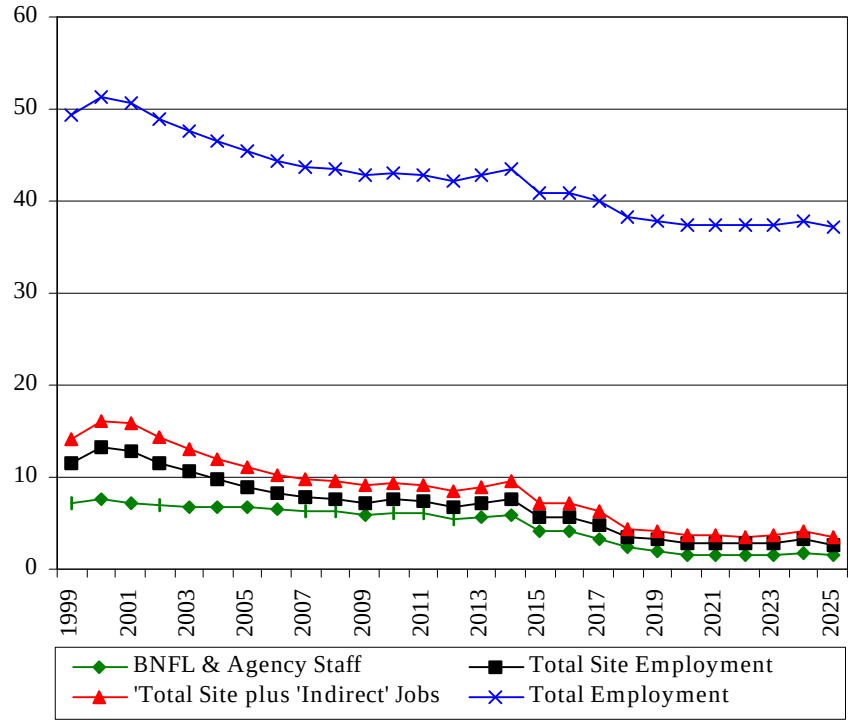
Although Sellafield supports (both directly and indirectly) nearly 14,000 jobs in the West Cumbria economy, there are many other jobs that have no ties with site-activity. In 1999/2000, it was estimated that there are about 35,000 non-BNFL dependent jobs in West Cumbria. These jobs cover all industries from manufacturing through to services.

Figure 0.4 shows the breakdown of employment in West Cumbria, between site-employment, "indirect" jobs and other "non-Sellafield site" dependent jobs.

With site activity set to decline over the forecast period, bringing with it a decline in knock-on indirect jobs, it is left to the remainder of the West Cumbria economy to provide more support for the local jobs base.

Although these employment changes are large, it must be remembered that they will largely occur over a long period of time, and it is therefore likely that the economy as a whole will be able to adjust to the decline in BNFL related employment. As with many other parts of the county, West Cumbria has seen a structural shift in its employment base away from manufacturing and towards services over the past 20 or so years.

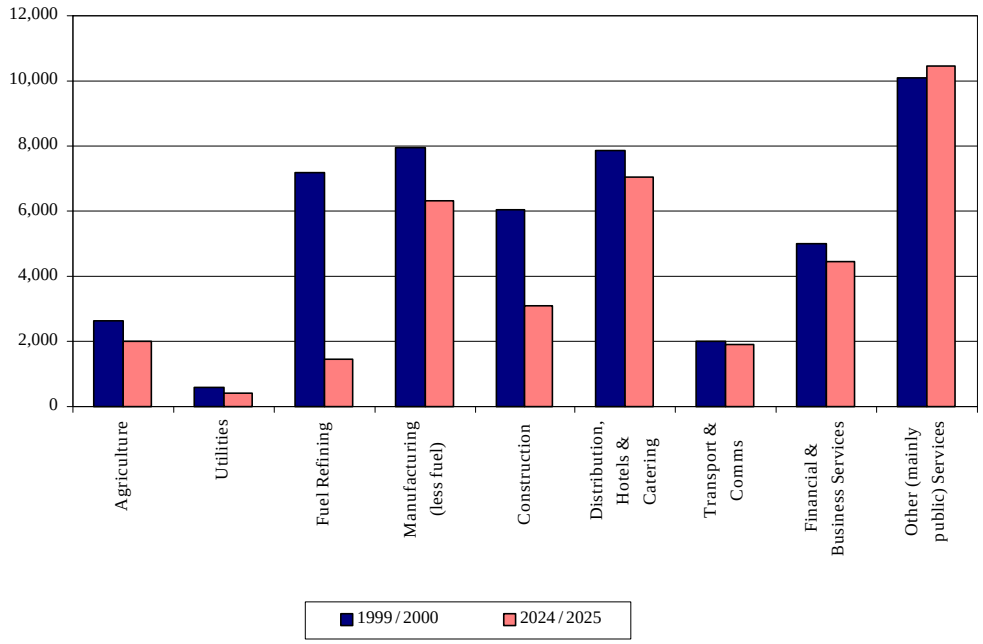
Figure 0.4 Employment in West Cumbria (FTEs '000s)



The forecasts produced for this study suggest that the changing orientation of the economy will continue over the foreseeable future, on the back of strong growth in private services such as hotels and catering and retailing, as well as in mainly public services such as health. For the former, this has much to do with changing patterns of income and spending as incomes rise and additional spending is more on leisure pursuits and other discretionary spending. For the latter, much of the growth is down to the general ageing of the population, and a corresponding response in increased government expenditure on hospitals and other support services for the elderly.

This point is reiterated in the *Figure 0.5* below, which shows changes to the sectoral composition of the West Cumbria economy over the next 25 years.

Figure 0.5 Changes in the Sectoral Composition of the West Cumbria Economy 1999 to 2025



Despite the overall change being of manageable proportions, it must be recognised that certain areas within West Cumbria will be hit disproportionately hard. It must also be recognised that some of the new employment growth will be in occupations that offer much lower salaries and less attractive conditions of employment than BNFL does at present (for example seasonal employment in the tourist industry). These issues are addressed below.

6.2.4 Location

The relative isolation of Sellafield within West Cumbria means that there is very little commuting to the site from outside Workington TTWA or Whitehaven TTWA. Ninety-six per cent of BNFL employees live in either of the two TTWAs, although the Whitehaven TTWA dominates, with over 70 per cent of BNFL employees living there.

For those working at Sellafield, the choice of where to live within West Cumbria is determined by the willingness and ability to pay for accommodation. BNFL employees on higher incomes (Grades 2, 3 and 4), have a higher propensity to live in highly desirable residential locations such as Cockermouth, while those towards the bottom end of the BNFL pay scale (Grade 5), have a higher tendency to live in more traditional industrial communities such as the towns of Whitehaven and Egremont. Residential locations of BNFL employees are illustrated below in *Table 0.1*.

Table 0.1 Residential Location of BNFL Employees by Grade

Location	Resident Employees	Percent of total	Grade 2/3	Grade 4	Grade 5
Whitehaven	1,831	30.3	9.7	29.0	61.3
Workington	915	15.2	7.4	29.3	63.3
Egremont	771	12.8	7.4	26.7	65.9
Cleator Moor	438	7.3	4.2	26.8	68.9
Millom	393	6.5	8.0	26.7	65.3
Seascale	331	5.5	22.0	33.4	44.6
Cockermouth	309	5.1	34.5	35.8	29.7
Frizington	224	3.7	12.8	29.2	58.0
Maryport	155	2.6	5.2	22.2	72.5
St Bees	142	2.4	26.3	34.3	39.4
All Employees	6,038	100	11.9	29.5	58.6

Source: Analysis of BNFL payroll data

Note: This table covers only directly employed BNFL staff, ie it excludes agency and contract staff. These workers are also overwhelmingly local, and hence residential location patterns will be very similar

6.3 "MINIMUM" SCENARIO

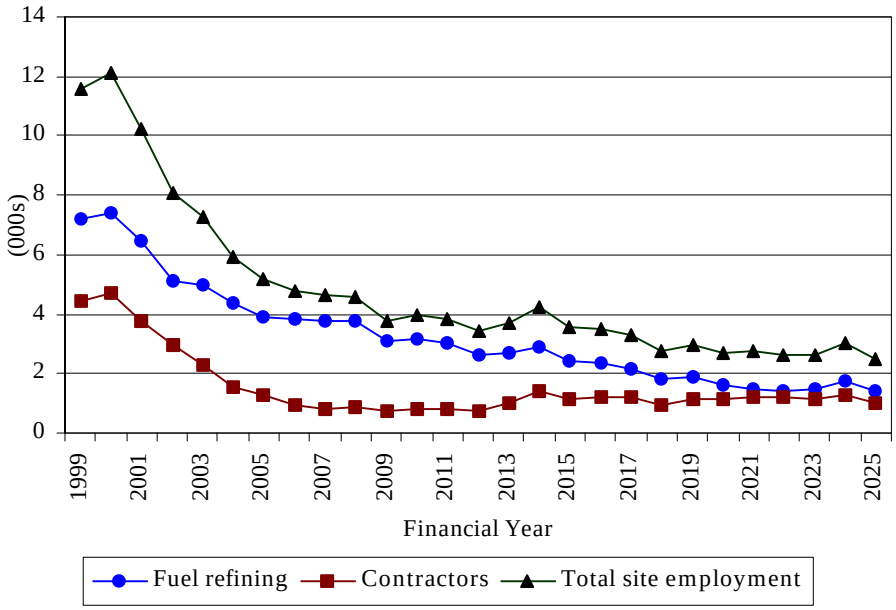
6.3.1 Employment

The key feature of this scenario is the earlier wind down in activity for BNFL and Agency staff when compared against the "Current Business Plan" Scenario. Although Calder Hall remains fully staffed until around 2010, the decline in activity in THORP and Magnox reprocessing account for a direct employment loss of around 1,700 against Current Plan by 2002. Reigning back site activity also brings about a decline in employment in support services such as HR and purchasing and stores. Employment of site contractors also falls back as capital spend declines, which reduces the numbers of capital related contractors, and site activity declines, thus reducing the need for service contractors such as cleaners and caterers.

Adding together all direct effects means that on-site employment is forecast to diverge from the "Current Business Plan" scenario by as much as 3,800 (2004/05), and on average by about 3,000 lower until around 2014.

Through industry and consumer spending effects, the decline in direct employment at Sellafield brings about an accompanying decline in local "indirect" jobs supported by site activity. Compared against the "Current Business Plan" scenario, this amounts to between 500 and 600 fewer local full-time equivalent jobs each year over the next decade.

Figure 0.6 Site Employment Under Minimum Scenario



The majority of the indirect job losses are due to the consumer spending effects rather than through local industry purchases. In total, BNFL sourced around 30 per cent of its supplies locally in 1999/2000. When Agency staff are stripped out, this drops to about 20 per cent. Engineering and Business service activities such as car rental are typical of activities sourced locally.

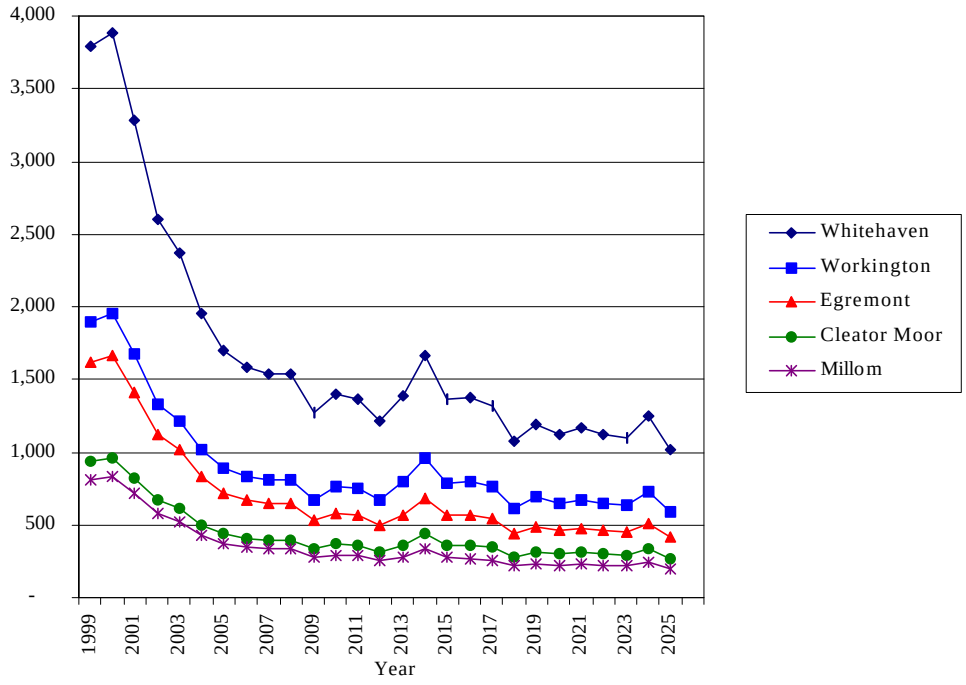
On-site employment picks-up noticeably over the period 2014-2016 as decommissioning of downstream activities commences. The additional jobs are expected to go to both capital related contractors and BNFL employees. Thereafter, on-site employment levels move generally in line with that envisaged under the "Current Business Plan" scenario.

6.3.2 Location

The early closure of all BNFL's principal revenue generating activities and subsequent loss of jobs in the local economy, is likely to have spatial implications depending where those who lose their jobs actually live.

Data supplied by BNFL provided details of where BNFL employees live and what block they work in and their grade. We have assumed that Agency staff have the same residential profile by block as BNFL employees, and that Contractors, due to their lower take-home pay, follow a similar residential profile as Grade 5 employees (i.e. they have a higher propensity to live in Maryport and Cleator Moor). *Figure 0.7* shows how changes in site employment may impact at an area level.

Figure 0.7 Selected Residential Locations of Site Workers - Minimum Scenario



The figure clearly illustrates that over the next decade Whitehaven in particular will see a significant decline in the number of residents who work on-site. Our estimates suggest that this decline may be as much as 2,500 within the next 7 years.

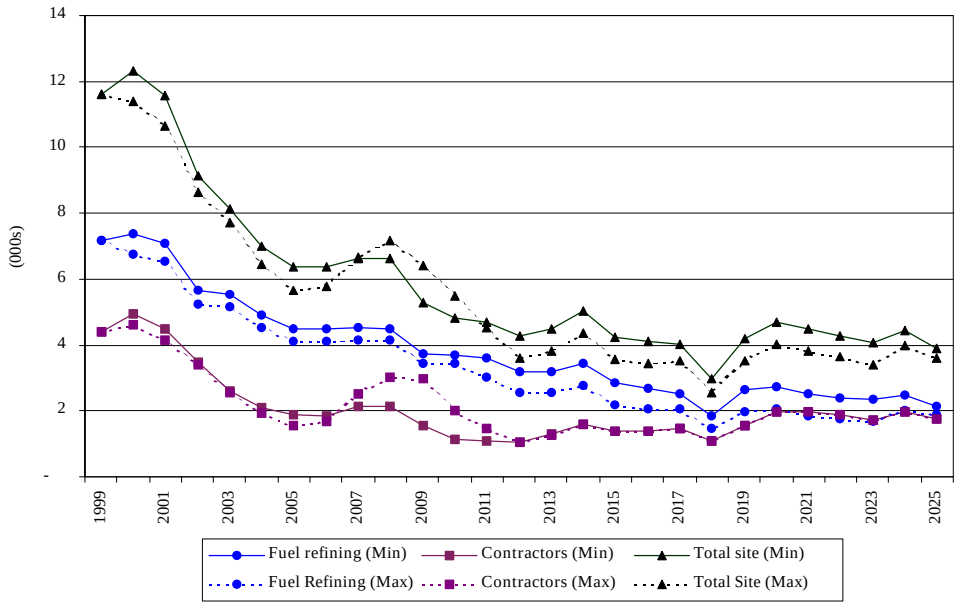
6.4 *"STOP NOW AND PREPARE FOR CLOSURE ASAP" SCENARIO*

6.4.1 *Employment*

This scenario represents a scenario between the minimum and maximum approach as defined by "Minimum" and "Blue Sky" scenarios. However, the two options defined for dealing with plutonium provide a different employment profile over the next 25 years. This is shown in *Figure 0.8*.

Total site employment under "minimum immobilisation" is marginally higher than "maximum immobilisation" over the next 7 to 8 year because MDF and SMP continue to operate. However, under the "maximum" scenario construction of a spent fuel radiation barrier and a ceramic waste plant commences around 2007/2008, and leads to an influx of capital related construction workers pushing overall site employment up by almost 1,500 within two years. Also, earlier shut-down of activity brings about an opportunity for earlier decommissioning. This commences around 2018/19 and pushes site employment to around the 4,000 mark, marginally above that forecast under "Current Business Plan" scenario.

Figure 0.8 Employment Projections for the "Stop ASAP" Scenario (Minimum and Maximum)



6.4.2 Location

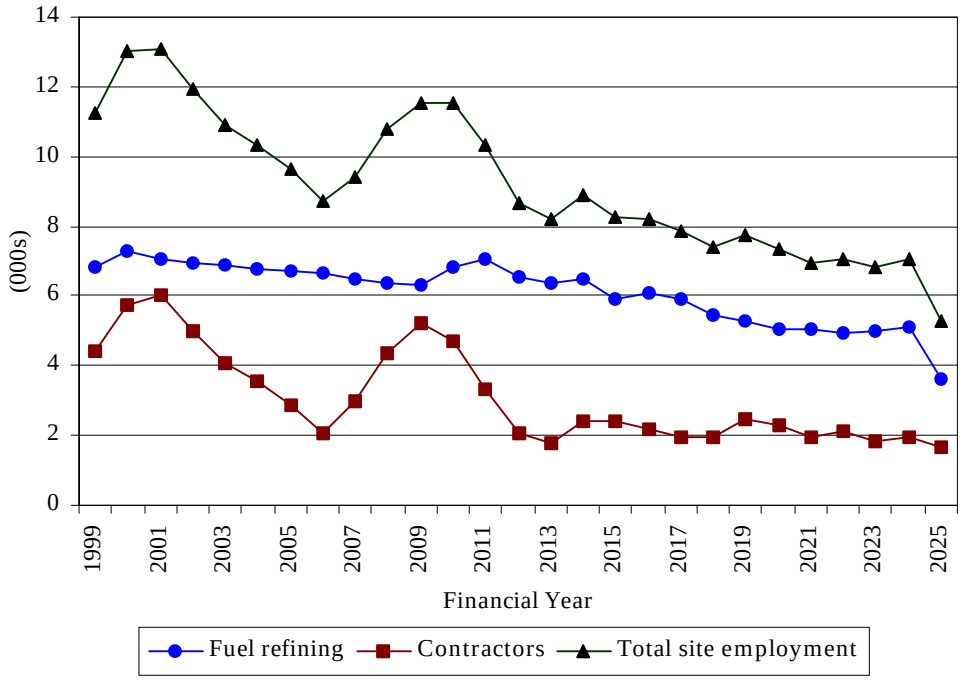
The decline in site-employment under this central scenario is less pronounced than under the "minimum" scenario, and correspondingly the knock-on effects spatially are less pronounced than discussed in *Section 6.3.3*.

6.5 "BLUE SKY" SCENARIO

6.5.1 Employment

The main features under this scenario are the relatively small change in employment of BNFL employee and Agency staff over the next two decades, and a small increase in the number of contractors due to new capital spend associated with, amongst other projects, the construction of a further line for MOX production, a new waste vitrification plant and the refurbishment of THORP.

Figure 0.9 Site Employment Under "Blue Sky"

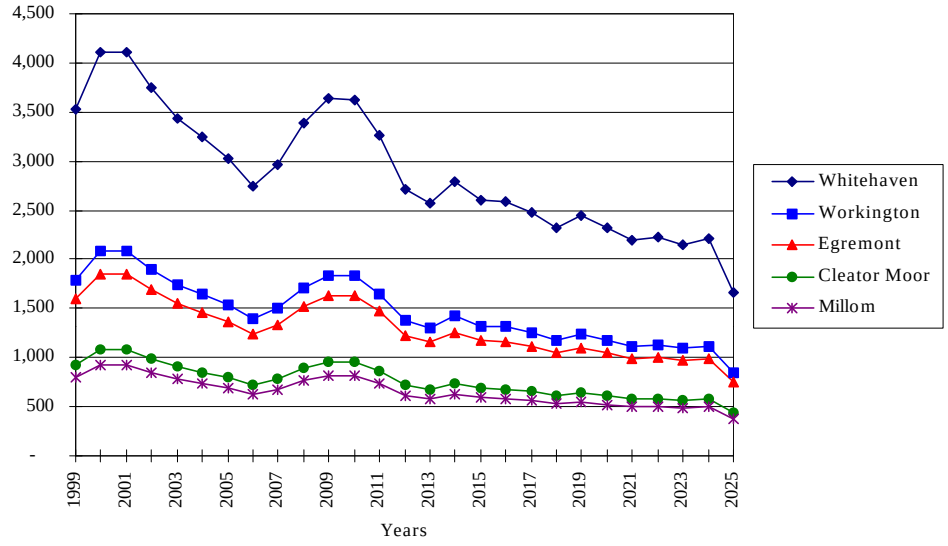


As explained in *Section 6.2.3*, changes in on-site activity have indirect effects on the local economy through changes in consumer spending and industry purchases. In 2010, at the peak of on-site employment under "Blue Sky" scenario, on-site jobs support around 1,000 *extra* "indirect" jobs in the local economy through multiplier effects, *compared* against the baseline "BNFL Current Business Plan" scenario. Thereafter, on-site employment under the "Blue Sky" scenario supports on average about 800 *extra* jobs in the local economy through indirect effects *compared* against the baseline "BNFL Current Business Plan" scenario.

6.5.2 Location

Sharp increases in site-employment will have knock-on effects at an area level, too. If we assume that contractors moving into West Cumbria to work locate in areas where contractors currently predominate, then areas such as Maryport, Cleator Moor and Egremont, may experience stronger upward pressure on their local employment market than areas such as Cockermouth and Whitehaven. *Figure 0.10* shows how changes in the residential profile of on-site employees under the "Blue Sky" scenario.

Figure 0.10 Selected Residential Location of Site Employees - Blue Sky



6.6 COMPARATIVE EVALUATION

6.6.1 Employment

Figure 0.11 below shows forecasts of total employment in West Cumbria under the four scenarios. The forecasts include the four elements that make-up local employment:

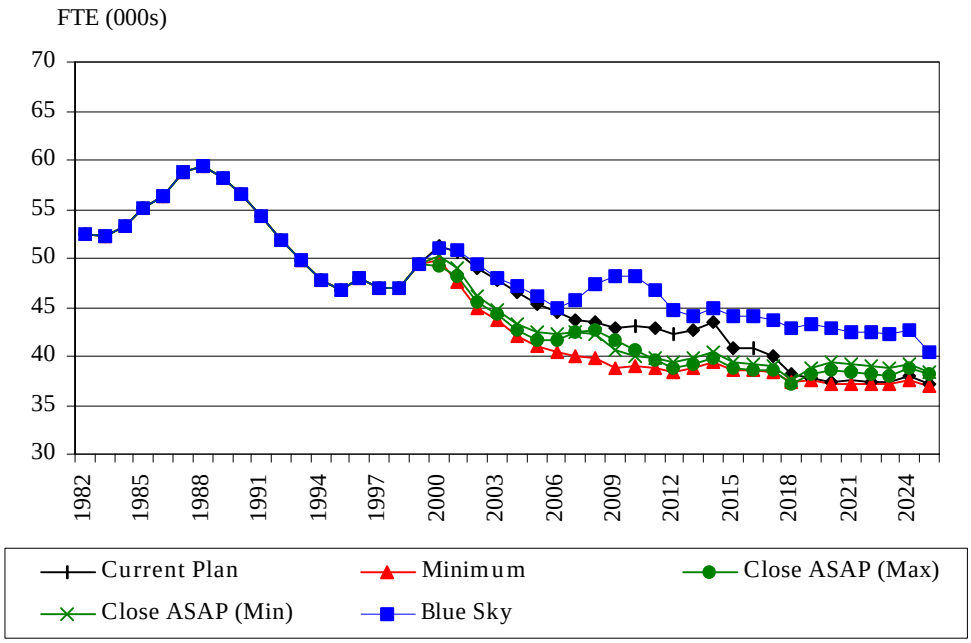
- on-site BNFL employees and Agency Staff;
- on-site contractors;
- indirect jobs that are supported by site activities, with a *multiplier* of 1.2; and
- non-BNFL dependent employment.

When the forecasts for FTE employment in West Cumbria under the four scenarios are viewed against historical trends in employment, the over-riding picture is one of fundamental employment decline. Even the "Blue Sky" scenario cannot arrest the long-term decline in employment.

6.6.2 Unemployment and Inactivity

Against a back-drop of declining employment, we would expect unemployment to increase. However, this is not a one-to-one adjustment. When a job is lost in the local economy, either directly or indirectly, as site activity decreases, the individual concerned has a choice of one of four paths to take. They can:

Figure 0.11 Employment in West Cumbria Under Each Scenario



- get another job (which means one less job for someone else to take);
- leave the area (migrate);
- become unemployed; or
- become economically inactive (retire, take long-term sick leave, return to education etc)

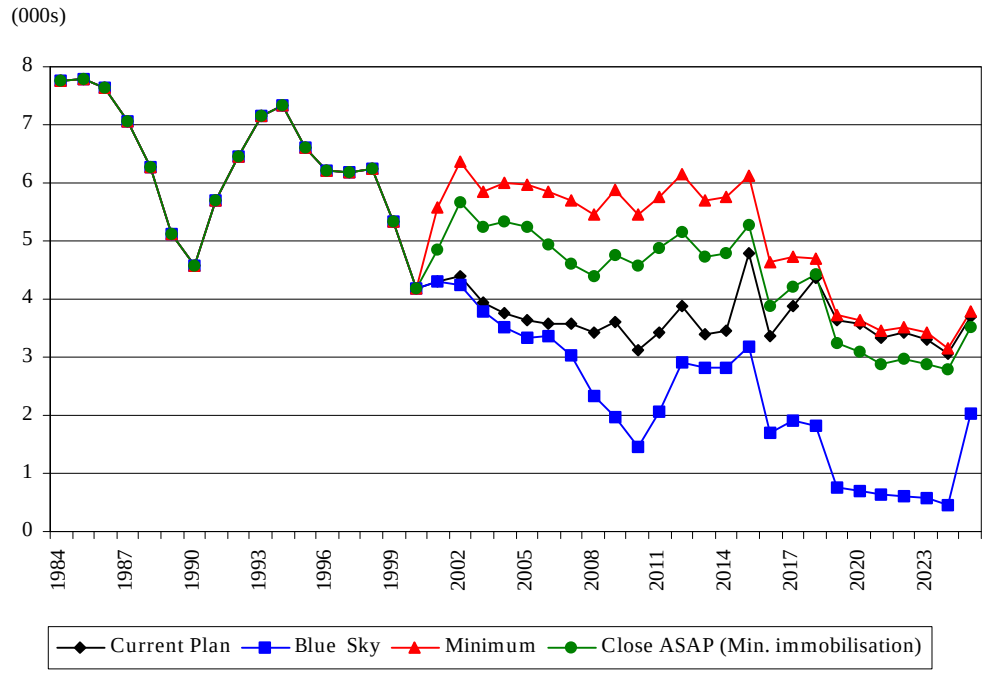
The employee survey sheds some light on this decision making process. The results from the survey show that, about 40 per cent of those surveyed said they would leave West Cumbria if they lost their job at Sellafield. The result for capital contractors is higher still, reflecting the mobility of such workers. This is far higher than results of previous studies although, given the isolation of the site and the difficulty for people to commute to jobs outside West Cumbria, this finding is not surprising.

Accordingly, assumptions have been made to examine the impact of changes in on-site employment on migration, unemployment, economic inactivity and the population of West Cumbria. These are set out below. For every 100 FTE jobs lost on-site:

- "indirect" jobs decline by 20 – Multiplier of 1.2;
- 60 percent of capital related contractors will migrate;
- 15 percent of BNFL employees will migrate;
- 10 per cent of "Other local employees" migrate; and
- of those people who do not migrate, 70 per cent become unemployed and 30 per cent become economically inactive.

Figure 0.12 shows forecasts of ILO unemployment under the four scenarios(1).

Figure 0.12 Unemployment Levels by Scenario



Under the assumptions outlined above, the level of unemployment under the "Blue Sky" scenario approaches zero. This suggests that when on-site employment increases significantly over a short time period, in-migration of capital related will exceed 60 per cent.

In reality, job losses on site are likely to be planned, and perhaps focus on retirees. The current age profile of the workforce will help rather than hinder such a policy, as 17 per cent of BNFL employees are aged 50 years or older.

Historically, unemployment rates in Whitehaven TTWA have been lower than in Workington TTWA. However, given the residential location of on-site employees, job losses are likely to have a disproportionate effect on unemployment rates in Whitehaven TTWA.

6.6.3 Migration and Population

Forecasts incorporating the impact of migration flows under the four scenarios show that, with the notable exception of the "Blue Sky" scenario, population in the study area remains broadly constant within the 142,000-145,000 range over the next 25 years. These forecasts use the local ONS population forecast for Cumbria (1999 to 2010, adjusted to fit West Cumbria) as a baseline. ONS predicts a rising population in the study area in coming

(1) The International labour Organisation (ILO) definition of unemployment covers people who are: out of work, want a jobs have actively sought work within the previous four weeks and are available to start work within the next fortnight; or out of work and have accepted a job that they are waiting to start in the next fortnight. It provides a more complete measure of unemployment that the claimant count.

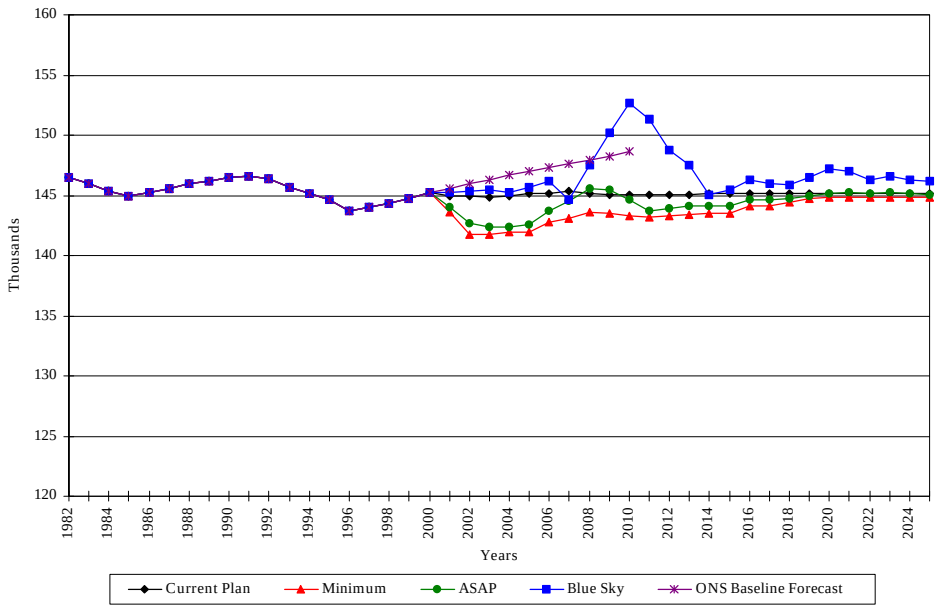
years (based on recent trends and consultations with local authorities). Hence, even the stable level under Blue Sky and Current Plan for the next five or so years represents a lower population than would otherwise be expected (which would have knock-on effects on issues such as local authority revenues and public sector employment).

As *Figure 0.13* shows, in-migration rises dramatically under the "Blue Sky" scenario around 2008-2010, on the back of an influx of capital related contractors moving into the area to work on the refurbishment of THORP and construction of additional MOX and waste vitrification capacity plant, amongst other things.

Evidence from the employee survey shows that the number of dependants for BNFL employee and contractors alike is around 1.4, which is in line with the national average. Hence, for every employee moving into West Cumbria to work on site, population increases by 2.4.

The increase in population under the "Blue Sky" scenario is in excess of the increase experienced in the mid to late 1980s as THORP was constructed. This is partly because the pool of labour that can fill these jobs is shrinking as the population in the study area continues to age and unemployment levels decline to historical lows.

Figure 0.13 Population Projections in West Cumbria Under Each Scenario



Note: The ONS baseline forecast ends at 2010.

6.7 *CONCLUDING REMARKS*

The outlook for on-site employment at Sellafield is one of fundamental decline. Not even the "Blue Sky" scenario, which takes the most optimistic assessment of future reprocessing activities, can arrest this long-term decline.

The key decision is how to manage the decline over the short-to-medium term, as over the longer-term employment levels converge under the four scenarios, albeit with slightly higher levels of on-site employment under the "Blue Sky" scenario. The age structure of the workforce should help any adjustment that takes place over the coming years through opportunities for early retirement (although new jobs will obviously still be required for new entrants to the workforce). Nearly 20 per cent of current BNFL employees are aged 50 years old or older.

The West Cumbria economy has adjusted to large shifts in employment in the past. This was witnessed especially during the mid-to-late 1980s, when the completion of THORP corresponded with a general slowdown in the national and local economies. Even without any site activity, West Cumbria would still function as an economy on the back of about 35,000 full-time equivalent employees spread across industries including the public sector, retail and tourism.

However, the adjustment required to take account of a large decline in employment at Sellafield would be traumatic -unemployment would rise, out-migration would occur and new replacement jobs would be unlikely to be of the quality of BNFL employment in terms of salaries, benefits or stability. It must also be recognised that impacts will not be uniform across West Cumbria. The nearby towns that have the heaviest dependence on BNFL (such as Whitehaven, Workington, Egremont, Cleator Moor and Millom) will feel the effects of any downturn in employment (and hence associated social problems) most strongly.

7 VISIONS FOR WEST CUMBRIA

7.1 INTRODUCTION

This section of the report sets out a range of possible initiatives that could help to mitigate any loss of employment at Sellafield as a result of declining construction and operational activity. To recap, the impact assessment found that:

- there were 11,500 workers on site in 2000, with a further 2,500 jobs in West Cumbria being dependent upon the plant;
- 35,000 jobs in West Cumbria are not BNFL related in any way;
- under all scenarios there is a forecast loss of employment;
- a major decline in construction employment has already commenced, with some 3,500 jobs being lost over the period to 2005;
- under current Business Plan and Blue Sky permanent employment is protected until 2015 and 2025 respectively;
- under the two do minimum scenarios there is a loss of permanent employment within the next five years;
- by 2025 all the scenarios converge to approximately 2,000 to 2,500 jobs on site;
- unemployment is forecast to decline over the next 25 years, as economic models tend towards equilibrium; and
- experience from other regions where there have been major job industrial losses suggest that, whist the social costs are enormous, economies do generate new jobs over time, although not necessarily of the same quality in terms of pay and conditions (see *Section 3*).

There is therefore an immediate need to provide employment opportunities for construction workers who are going to lose their jobs but remain in West Cumbria over the next five years. Failure to meet this objective will result in rising unemployment and a wide range of associated social costs.

The need to address a decline in permanent employment is more dependent upon the scenario being considered, but is pressing under all scenarios in the medium to long term.

It should be noted that it is not the role of this report to set out a development strategy for West Cumbria, or to assess what level of funding might be required. This task is the focus of a separate study entitled "New Visions for

West Cumbria and Furness," which is being sponsored by a range of local and regional agencies(1). However, it is clear that West Cumbria will need considerable assistance to adjust successfully to the decline in employment at BNFL, and that the need to adjust arises out of policy towards the nuclear industry, which is determined at national level. The local community will therefore be bearing the costs of changing national policy, and it seems reasonable that resources should be provided to help address the challenge of regenerating the local economy.

7.2 APPROACH TO DEVELOPING VISIONS

The initiatives proposed have been formulated after consultations with a number of stakeholders including:

- members of the socio-economic study steering group (comprising representatives of BNFL, Cumbria County Council, Copeland Borough Council, environmental campaigning groups and the trades unions);
- senior BNFL staff, including representatives from human resources, public affairs, community relations and investment, strategic planning and also the deputy head of site at Sellafield;
- Sellafield shop stewards, comprising representatives of unions on site;
- the *New Visions* Steering Group; and
- the Pathfinder Group, which acts as a co-ordinating group for regeneration projects in West Cumbria, and which includes representatives from local government (both officers and councillors), the North West Development Agency, voluntary groups and other deliverers of regeneration projects.

Following these consultations, a number of initiatives have been identified under six broad categories:

- major investments that have already been announced(2);
- actions that BNFL itself could take;
- energy and environmental initiatives;
- transport and communications;
- major private sector initiatives; and
- major developments in public services.

(1) The New Visions study is addressing the long-term development objectives for the region, and assessing issues such as requirements for government assistance. Whilst the studies are separate, the detailed projections prepared for this report have been made available and hence have infomed the development of a strategy for the future development of the area. The New Visions study is being sponsored by agencies including Cumbria County Council and Copeland Borough Council, which are also sponosers of this socio-economic study.
(2) Restricted to projects which would have a significant impact on employment and unemployment forecasts but which are not included in the economic modelling as they were announced after the modelling was undertaken.

Some of projects we identify under these categories touch on themes discussed by the New Visions project. For example, we have identified renewable energy and developments in higher education as potential sources of new job creation. However, on the whole we have focussed on short to medium terms employment requirements rather than longer term aspirations for re-orientating the economy.

With the exception of existing committed projects, the approach to identifying employment generating initiatives has been to:

- focus on those projects which meet a clearly defined business or public services need;
- assume no specific link between BNFL Sellafield activities and additional employment projects, whilst at the same time acknowledging that a drastic cut in employment on site should provide a catalyst for greater public sector investment in the region;
- include only projects that have a realistic chance of implementation, ie they fall within existing policy commitments; and
- produce indicative estimates of construction and operating employment for the projects (using full-time equivalents in all cases).

In addition, we have only defined projects for the next five years(1). There would be opportunities to generate further employment initiatives beyond the five year time frame, and there is no reason to doubt that these could be of a similar scale to those identified below.

It should be noted that whilst all of the initiatives are feasible, their implementation will depend on a considerable political commitment to the area. Therefore, if many jobs are to be realised, partners from across West Cumbria and the rest of the county will need to lobby effectively. Such an effort would need to involve senior figures from local government, local MPs and business leaders.

7.3 COMMITTED NEW PROJECTS

Three projects that will have a significant effect on the local economy have been announced in recent months. These are:

- The development of a contract call centre by Vertex, a part of the United Utilities group. The centre is currently being built and, once operational, will employ 1,000 staff.
- Upgrading of the A595 from Parton to Lillyhall. This £18 million scheme has recently received approval (although timing remains uncertain) and

will greatly improve access to and from Workington from the A66. Given the level of construction spend, we estimate that 200 to 300 person years of construction employment will be generated by this project over two years.

- The development of a new hospital in Workington. This £12 million project is estimated to create 350 to 400 person years of construction employment.

Taking the mid-range employment forecasts, these major investments are likely to provide:

- 1,000 permanent jobs; and
- 625 person years of employment in construction.

7.4 BNFL SPONSORED INITIATIVES

Extensive discussions were held with senior BNFL staff and a range of options were reviewed for boosting employment at Sellafield or elsewhere in West Cumbria in future years. Company options considered include:

- relocation of staff from other BNFL sites within the United Kingdom;

- further increases in purchasing from local suppliers;

- further attempts to spin-off internal units into free-standing businesses that can develop markets outside the company;

- Sellafield becoming an international centre of expertise for the decommissioning and clean-up of nuclear facilities; and

- land release for uses that might benefit from some aspects of Sellafield's infrastructure (in a similar fashion to the existing gas fired power station adjacent to the site).

It was concluded that the maximum number of jobs that might be created at Sellafield as a result of these initiatives would be approximately 200. Whilst this seems modest, it is explained by:

- There is believed to be little scope to increase local procurement because of the considerable efforts made to localise purchasing over the last five years.

- Investments already made at Westlakes, which houses a number of BNFL spin-off businesses. BNFL also note that the success of past spin-offs has been limited. Given the employment terms offered by BNFL, there are also a limited number of staff who are willing to give up secure, well remunerated employment for higher-risk entrepreneurial ventures.

(1) With the exception of the plutonium burning reactor, for which construction would not start until after 2005.

- Much of BNFL's employment at other sites is operational, and is controlled to a great extent by regulatory and safety considerations.

- The great majority of employment associated with overseas sites that BNFL might be contracted to decommission / decontaminate would be located at the site, rather than at any BNFL facility in the UK.

Other possible actions by BNFL include investment in regeneration projects in the local community. BNFL is already very active in this area through:

- A five year plan to provide £15 million to local regeneration agencies, including the West Cumbria Development Fund and the Cumbria Inward Investment Agency.

- Sponsorship of a number of local development initiatives, such as the Prince's Youth Business Trust.

Discussions with the company have indicated that although funding for these schemes is not at risk at present, there is little scope for increasing resources at the present time.

The possibility of new power generation investments at Sellafield (both nuclear and non-nuclear) is addressed under the environment and energy heading below.

These projects give:

- no construction employment; and
- 100 permanent jobs.

As defined in *Section 4*, the 'Stop now and prepare for closure as soon as possible' scenario includes provision for storage to accommodate the arisings from accelerated waste treatment and decommissioning, and the provision of dry storage for all AGR fuel not reprocessed. It does not include the transport of wastes from other sites to Sellafield or the use of Sellafield as a national above-ground waste storage facility.

7.5 ENERGY AND ENVIRONMENT

There are a number of energy and environment projects that may be implemented in West Cumbria in the coming years. Work commissioned by Friends of the Earth in 1997 highlighted some of these options(1). Schemes that may make a significant contribution to local employment include:

(1) The Economic and Environmental Impacts of Alternative Investment Scenarios for the West Cumbrian Economy, Ecotec for Friends of the Earth, 1997. FoE's report assessed the potential employment impacts of £20 million worth of investments, which was 10 percent of the cost of the Rock Characterisation Facility that was proposed. The £20 million budget is much less than the potential expenditure on renewables set out in this report, hence ERM's employment projectsions are higher.

- Development of approximately 180 MW of offshore wind energy. Licenses for offshore wind farms off the coast of Cumbria have recently been granted(1). Based on research undertaken by ERM on the economic impacts of wind energy, we estimate that this could create about 2,000 person years of construction employment and 120 during the operational phase. There is also the possibility of further onshore wind farm development in West Cumbria, but plans for this are less well developed.

- Development of biomass energy production. Biomass energy production generates power from agricultural and forestry crops that are sustainably managed, and hence has lower carbon emissions. In common with other UK regions, the North West of England has a responsibility to develop renewables capacity over the coming decade. Research undertaken by ERM into the capacity for renewable energy in the region(2) suggests that about 20 MW could be developed in West Cumbria. This would generate 60 person years of construction employment and 180 in operation (including many in land management). Biomass energy could also form the basis of a new national forest adjacent to the Lake District National Park, which could generate significant employment in leisure industries.

- Development of a waste to energy plant. There is already a gas fired power station adjacent to the Sellafield site which takes advantage of the transmission grid connections established for the Calder Hall power station. A further investment opportunity might arise out of requirements for new waste management capacity in the North West, which would also benefit from the rail connections to the site. Landfill capacity is decreasing in the region and it is possible that new waste to energy capacity will be needed. Although from an environmental and waste management perspective this would have disadvantages, the construction of a 30 MW facility (capable of handling approximately 500,000 tonnes of waste per annum) could be expected to generate 1,200 person years of employment in construction and 60 permanent jobs.

- Development of a plutonium burning reactor. The plutonium group of the BNFL national stakeholder dialogue has identified the construction of a plutonium burning reactor as one management option for stored plutonium. No decision has been made as to whether or not the group will support this option and it is included here to inform debate at the request of the Group. The construction of the reactor is forecast to produce approximately 8,800 years of employment over six years, starting no earlier than 2007. Once operational, the reactor would employ 400. The plutonium burning reactor can also be viewed as a proxy for other new nuclear generating capacity on site. The estimated profile of employment would be:

(1) See www.offshorewindfarms.co.uk for more details of UK wide sites
(2) See www.etsu.com/nwre-study for more details of the ERM report

Employment Type	2007	2008	2009	2010	2011	2012	2013	2014
Construction	1,040	1,660	2,080	1,660	1,250	1,090	-	-
Operation	-	-	-	-	100	200	400	400

Excluding the plutonium burning reactor, these projects could generate:

- 3,260 person years of construction employment; and
- 360 permanent jobs.

7.6 TRANSPORT AND COMMUNICATIONS

West Cumbria is characterised by poor transport and communications infrastructure. This is reflected in the lack of good road access, poor rail services, a lack of modern information technology infrastructure and distance from major external gateways such as ports and airport. Even compared with other regions of the UK which also suffer relative isolation, such as the North East, the South West, the Highlands of Scotland and Northern Ireland, West Cumbria is poorly connected. There is therefore plenty of scope for investing in local infrastructure. Potential projects include road, rail and sea transport projects:

- Further upgrades to the A595 and A5092. Although the Lillyhall to Parton upgrade will provide trunk road access from the A66 as far south as Whitehaven, South of Sellafield the road is particularly poor all the way to the junction with the A590. Two projects of a similar scale to the Lillyhall to Parton improvement and costing £36 million could be expected to create 400 to 600 person years of construction employment. Longer term options that are being considered include a new crossing of the Duddon Estuary, which would improve access between West Cumbria and Barrow-in-Furness the M6, and also take through-traffic away from the southern boundary of the National Park. However, no costings data are available yet and we have therefore not attempted to assess employment impacts.

- Development of Irish Sea ferry services. West Cumbria is potentially well placed to offer sea services as it has the shortest sea crossing to the Isle of Man, and could also offer reasonable access to Northern Ireland as the access to Whitehaven from England (via the M6 and A66) is much better than to Stranraer. Based on a modest port facility focussed on Isle of Man traffic, construction employment could total 130 person years and 100 onshore and onboard operational jobs could be created.

- Improvements to the rail infrastructure. There are a number of possible rail investments, including improving the coastal rail link and re-opening closed branch lines off the West Coast Mainline into the heart of the Lake District. We have not attempted to quantify the employment effects of such investments because it is unlikely that they could be implemented in

the short to medium term, and because we are not aware of any cost data that could form the basis for economic impact calculations. However, the feasibility of such schemes should be considered in more detail.

- Extensions to the fibre optic cable network to enhance opportunities for communications based industries. At present, West Cumbria's IT network is poor by national standards. The Vertex call centre is likely to lead to some improvement and it is though that this might yield spin-off benefits for Whitehaven. At present it is not clear if this will happen and so we have not attempted to quantify employment impacts.

Therefore, these projects could generate:

- 630 person years of construction employment (based on mid-point estimates); and
- 100 permanent jobs.

7.7 PRIVATE SECTOR

There will clearly be continued private sector investment in West Cumbria which will generate employment, particularly in the services sector. However, the economic model forecasts this. Therefore, private sector investment over and above the initiatives mentioned above can only be counted if it comprises major projects such as the Vertex call centre. We have assumed, conservatively, that there will not be another large investment of this type in the near future.

7.8 OTHER PUBLIC SECTOR PROJECTS

A gradual rise in public sector employment is included in the economic forecasts. Therefore, once again the only projects it is legitimate to include are major one-off projects.

Possible projects include:

- Expansion of the animal tracking centre at Workington. The animal tracking centre was established to monitor cattle movements in the aftermath of the BSE crisis. Following the outbreak of Foot and Mouth Disease, there is also the prospect that the movement of other livestock will be monitored. We have estimated that this might lead to an increase in employment of 400 permanent jobs.

- Expansion of higher education. Cumbria is one of the few counties in the UK not to have a university. There has been a gradual development of the higher education infrastructure in West Cumbria and this is forecast to continue with for example, continuing investments at Westlakes Science Park and Lillyhall College. Over the next five years there may be a modest increase in employment in the sector of perhaps 50 to 100 permanent jobs.

- Development of other public infrastructure. There are opportunities for the continuing development of other public infrastructure. For example, the growing prison population and the desire to close the country's Victorian jails has meant that there is a major prison building programme. It is possible that West Cumbria could attract an additional prison, with a capital cost of approximately £40 million. This could be expected to generate approximately 550 person years of construction and 500 permanent jobs.

These projects suggest employment of:

- 550 person years of construction employment; and
- 975 permanent jobs (using mid-point estimates).

7.9 SUMMARY OF POTENTIAL NEW EMPLOYMENT AND IMPACT ON THE WEST CUMBRIA ECONOMY

A summary of potential new job creation projects is presented in *Table 0.1* below. In addition to summing construction employment, as these are not permanent jobs we have estimated the effect over the next five years.

Table 0.1 Summary of Potential New Employment(1)

Initiative	Construction Employment	Permanent Employment
Existing committed projects	625	1,000
BNFL initiatives	-	100
Energy and environment		
- non plutonium reactor	3,260	360
- plutonium reactor(2)	8,800	400
Transport and communications	630	100
Private sector	-	-
Other public sector	550	975
Total		
- excluding plutonium reactor	**5,065**	**2,535**
- including plutonium reactor(2)	**13,845**	**2,935**
Construction employment averaged over next *five* years(3) excluding plutonium burning reactor	**approximately 1,010 jobs per annum**	-

Note: (1) Over and above economic forecasts
(2) Construction of the plutonium reactor is forecast to start no earlier than 2007
(3) The standard factor for converting temporary employment into full-time equivalent (FTE) jobs is 1 FTE = ten years of employment. However, as these projects will happen over a five year timeframe we have divided by five to identify employment effects over that period

Source: ERM estimates based on local consultations

As noted above, job creation on this scale will require considerable lobbying for both resources and inward investments.

7.10 ADJUSTED EMPLOYMENT, UNEMPLOYMENT AND POPULATION IMPACTS

7.10.1 Introduction

The results of the economic modelling have been treated as an intermediate output which would be modified once the results of the visions phase were available. This section therefore sets out revised impact data based on the assumption that the employment generation outlined in *Table 0.1* is secured. As noted above, such an outcome would require considerable lobbying by partners in Cumbria.

The impacts are set out under:

- employment;
- unemployment; and
- population.

In this section we have disregarded the plutonium burning reactor.

7.10.2 Employment

To assess the impacts of the additional employment creation projects we have compared site employment with site employment plus the additional jobs. illustrates the impact that the new projects have.

The figure shows that *with* the additional job creation initiatives:

- employment under the Current Plan and Close ASAP scenarios is generally as high as under Blue Sky *without* additional initiatives;

- employment under the Minimum scenario remains lower than Blue Sky *without* additional projects; and

- employment under Blue Sky remains at or above the 2001 level for most of the period to 2011.

7.10.3 Unemployment

The additional jobs created by the employment projects would clearly compensate for some of the employment that will be lost on site in the future. However, one job created does not equal one less unemployed person due to assumptions within the model about migration and multipliers. These are:

- *Migration*. The model assumes that 60 percent of construction workers will migrate if they lose their job and that 15 percent of permanent migrate. Therefore, new employment will in effect reduce the amount of out-migration, meaning that a new construction job leads to a decrease in

unemployment of 0.4 jobs. Similarly, a new permanent job will lead to a fall in unemployment of 0.85 jobs.

- *Multiplier effects.* This study has found that BNFL site employment has an employment multiplier of 1.2 in the local economy, ie every five jobs on site support one job offsite as a result of procurement and consumer expenditure by employees. The additional jobs will have a lower multiplier because it is unlikely that other employers will pay as well or will make the same efforts to purchase goods locally. Hence, we have assumed a multiplier of 1.1.

As illustrated in *Figure 0.2*, the additional employment projects could make a significant difference to levels of unemployment in West Cumbria(1). Such schemes could, by ameliorating unemployment, have significant social benefits, for example in public health and levels of crime (see *Annex A*).

(1) The negative unemployment with additional projects would lead to in-commuting (and eventually immigration) into West Cumbria.

Figure 0.1 Total Employment Impacts of Additional Employment Creation Projects

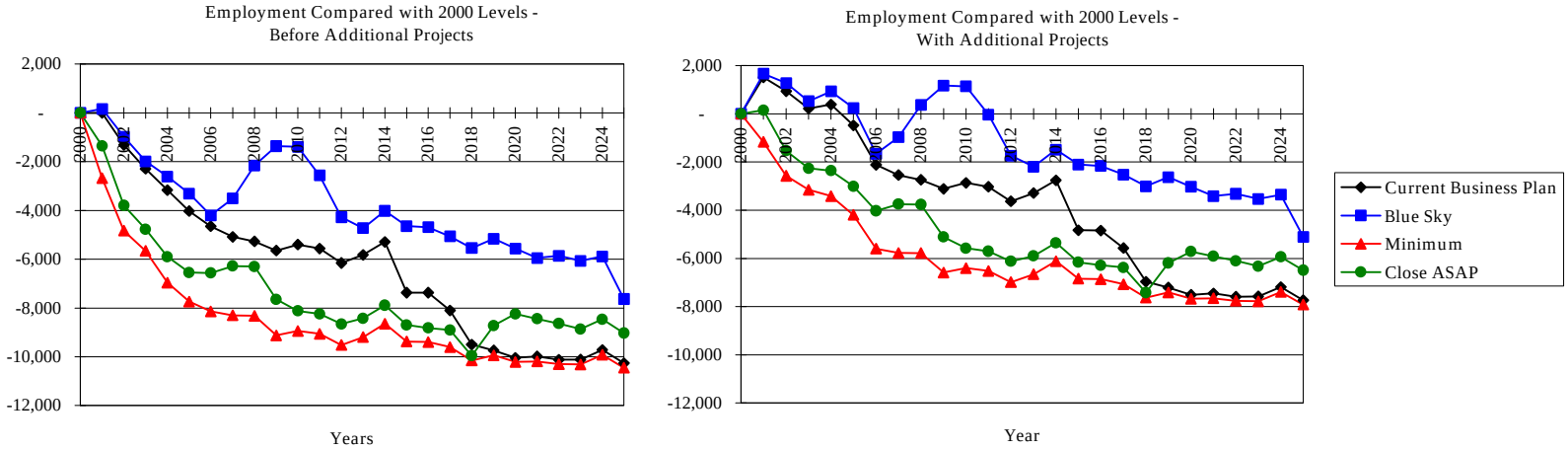
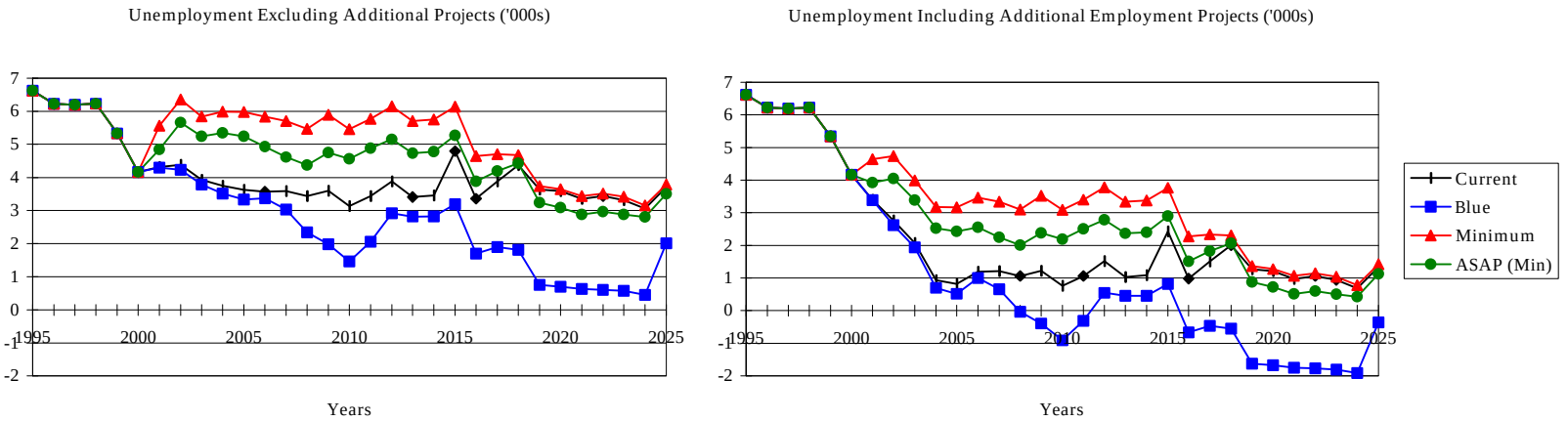


Figure 0.2 Unemployment Impacts of Employment Creation Projects



7.10.4 Population

The effect of changes in employment at Sellafield could have a major impact in the scale and quality of public services available in West Cumbria, and on the demand for housing. We have therefore produced adjusted population projections using the migration assumptions set out above, and have assumed an average household size of 2.4. The impact of the plutonium burning reactor is not included.

Figure 0.3 illustrates the impact of the additional employment projects on population. Even without the additional employment projects, there is a gradual rise in population by 2025, although this is preceded by a marked decline in 2000 to 2005 as construction employment declines on site in the Minimum and Stop ASAP scenarios.

The additional employment creating projects make a major difference to population, particularly in the period to 2005, when the impact of retaining construction workers is marked. After 2005, the additional projects contribute generally to higher population in the area, and smooth out the impacts of the construction activity planned for 2008 to 2015 period in Blue Sky. This increased population will in turn lead to a greater demand for public services such as health care and education.

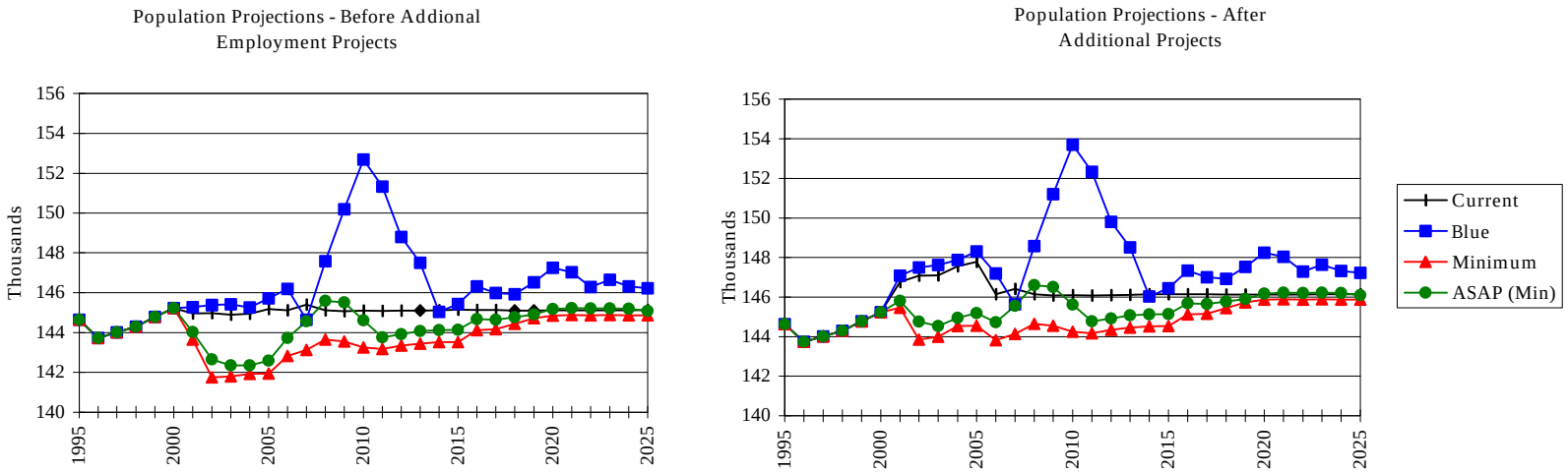
7.11 SECURING THE ADDITIONAL EMPLOYMENT PROJECTS

This document is not intended to form a part of the economic development planning process in West Cumbria. However, ERM has been asked by the Socio-economic Steering Group to set out key steps that would be required to realise the potential projects. These actions should be initiated as soon as possible in order to address the major decline in construction employment that has already commenced. The suggested key steps are:

- Convene a high level group consisting of local government, the North West Development Agency, local MPs, businesses, trade unions, voluntary groups and campaign groups (green and otherwise). It is possible that existing groups such as the Pathfinder Group or the Save Our Sellafield campaign could form the basis of such a group.

- The group should further investigate the feasibility, costs and benefits of projects outlined in this report and the *New Visions* study, identify requirements for any public funding and develop an investment programme, with projects prioritised according to value for money and employment impact.

Figure 0.3 Population in the Study Area With and Without Additional Employment Projects



- Raise awareness of the challenges facing the region and the opportunities for protecting the employment base of West Cumbria with partners including the regional development agency, the Government Office for the North West, central government departments and, if possible, Downing Street and the European Commission. The objective would be to secure funding and necessary consents to ensure that the development of the new projects was commenced as soon as possible.

7.12 CONCLUDING REMARKS

The are a number of committed and potential projects that could help protect the employment base in West Cumbria. These projects will be particularly valuable in the event of a rundown in employment at Sellafield. The projects are varied, including:

- BNFL sponsored initiatives;
- private sector investments;
- developments in the energy and environment sectors;
- improvements to transport and communications; and
- public sector investments.

However, it is likely that West Cumbria will continue to experience employment decline, partly as a result of long-term economic trends that have hit the area disproportionately hard, and partly as a result of a decline in activities at BNFL. This employment decline will not necessarily manifest itself in unemployment because of an ageing population, the out migration of young workers and a decline in economic activity rates (not all of it voluntary). The decline in employment will have adverse social consequences, for example on health and crime and, therefore, should be avoided for both economic and social reasons to the extent possible.

Securing new investments to create additional employment opportunities will require careful planning and a concerted lobbying effort by leading stakeholders in the region. This process should be stepped up immediately as a major decline in construction employment on site has already commenced.

Annex A

Literature Review: The Impacts of Unemployment on Health and Crime

A1 LITERATURE REVIEW: THE IMPACTS OF UNEMPLOYMENT ON HEALTH AND CRIME

A1.1 INTRODUCTION

The importance of employment in terms of well-being is difficult to assess. It may serve to define an individual's role in society and thus form a set of social relationships which provide a structure in life. A job loss may therefore lead to exclusion of an individual from the rest of society and have several adverse effects. Set out below are the findings of a literature review on the implications of such effects, in particular those of health and crime.

A1.2 HEALTH

A1.2.1 Available Research

Lewis and Sloggett (1998) assess the linkage between suicide, deprivation and unemployment. Although they find an insignificant and relatively low correlation between low social class and suicide, they identify a strong link with unemployment and permanent sickness, with the unemployed and permanently sick 2.79 times more likely than the employed to commit suicide (adjusted for bias from other socio-economic variables), as shown in *Table 1.1*. In addition, they suggest that *insecure* employment is linked with suicide.

Morrell et al. (1998) conclude that youth unemployment and youth suicide are strongly associated. They argue also that unemployment is associated with psychological symptoms, such as depression and loss of confidence. In particular, Morell et al. (1994) showed that unemployment amongst youth aged 16-25 was causally linked to a 50 percent increase in risk of psychological disturbance (see *Table 1.1*).

Junankar (1991) finds a positive *association* (his italics) between unemployment and mortality, also when adjusting for social class and region of residence within the UK. He notes the difficulty in disentangling the direction of causation, but suggests the link to be from unemployment to morbidity to mortality, with a long lag between the first and the last.

Bethune (National Statistics, 1999) finds that unemployment carries a risk of premature mortality, and that this risk is higher for men than women. She also states that women's own economic activity is of great importance as mortality was found to be lower than average even if their husbands were unemployed, and higher than average even if their husbands were in employment. Mortality from all major causes was found to be consistently higher than average amongst unemployed men. Bethune states that factors such as pre-existing ill-health, social class, or marital status cannot account for the raised mortality amongst unemployed, and therefore concludes that unemployment has an independent causal effect on mortality (see *Table 1.1* for more detailed results).

Table 1.1 Health Effects of Unemployment - A Summary of Studies

	Type of health effect			
	Death (all causes) SMR+	**Suicide SMR+**	**Physical Illness**	**Mental Illness**
Morrell et al. (1994)[a]				150
Moser et al. (1987) & (1990)[b]	137			
Iversen et al. (1987)[b]	140-150			
Martikainen (1996)[b]	135-211 (M) 130-161 (F)		160-180[c] 200[d]	
Mathers (1994)[b]			200[c] 130-140[d]	
Junankar (1991)	124-139			
Bethune (1999)	125 (M) 121 (F)	187 (M) 312 (F)		
Lewis & Sloggett (1998)		279[e]		

Notes:

* Interpretation of table: Numbers are given as SMR (Standardised Mortality Ratio) ratios, eg 137 implies that an unemployed individual is 37 percent more likely to be subject to the health effect than an individual in employment.

\+ SMR is a measure of how much more or less likely a person is to die in the study population than someone of the same age and sex in the standard population.

(a) Source: Morrell et al. (1997)

(b) Source: Mathers & Schofield (1998)

(c) Likelihood to report poor health

(d) Likelihood to report chronic illness

(e) Odds-ratio rather than SMR

(M) Male

(F) Female

Isacsson (1999) warns, however, that there may be a bias in estimates such as those of Lewis and Sloggett (1998). He states that mental disorder rather than unemployment itself is likely to be the explanation, pointing at evidence of a fivefold increase in the unemployment rates in Sweden between 1990 and 1994 accompanied by a 14 percent fall in suicide rates.

Also Crombie (1989) is cautious in establishing a link between unemployment and health effects. He assesses the correlation between unemployment and suicide trends in Scotland between 1976 and 1986 and though he finds an association between the trends nationally, no such association is found when trends are analysed by health board areas or aggregates of local government districts. Crombie therefore concludes that the data do not support the hypothesis that the rise in unemployment is a direct cause of the rise in suicide rates among men.

A1.2.2 Concluding Remarks

Attributing ill-health and suicide to unemployment alone is, of course, simplistic. However, it seems likely that unemployment has some impact on suicide rates as well as physical and mental illness(1). Studies outside West Cumbria (including elsewhere in the UK as well as abroad) have estimated that mortality rates for the unemployed are 21 to 111 percent higher than amongst the employed individuals, and even higher if suicide is considered alone. It also seems likely that the likelihood of reporting physical illness or being mentally ill is greater too for unemployed individuals.

A1.3 CRIME

A1.3.1 Literature Review

All recorded crime reported by the British Crime Survey(2) fell between 1995 and 1997 by 15 percent, and again between 1997 and 1999 by 10 percent. In the context of property crime, BCS attributes part of the decline to the 'current economic cycle, with low levels of unemployment and relatively high economic growth' which have reduced the needs for the proceeds of crime(3).

This view is supported to some extent by the Home Office (1994), who found occasional correlation between unemployment and burglary, vehicle crime and theft offences. However, in their study, which analyses data from 1984 to 1992, no overall evidence was found to suggest that a consistent correlation existed between unemployment and recorded crime at the police force level.

Farrington et al. (1986) investigated the official crime rates of male youths aged 14 to 18 according to whether they were at school, unemployed or in full employment. They found that crime rates were higher during periods of unemployment than under employment. Unemployment was associated with a higher rate of committing crimes for material gain, but not with other types of crimes, thus indicating that financial need may be the link.

Chiricos (1987) reviewed the findings of 63 studies on the linkage between unemployment and crime. He concluded that property crimes, data from the 70s, and sub-national levels of aggregation produce consistently positive and frequently significant correlation. On the other hand, he found a negative correlation between unemployment and crimes of violence. Saying that the 'opportunity effect'(4) reduces the scope for crime, he concluded that the financial motivation effect is strong enough to show that there is a strong correlation between unemployment and crime.

Unlike many earlier studies, Raphael and Winter-Ebmer (1999) found a significant and positive effect of unemployment on property crimes as well as

(1) This is not biased by the transfer of unemployment benefit claimants to sickness beneftit claimants, as discussed in *Section 2* of the Draft Phase 2 report.
(2) BCS, 2000
(3) BCS 2000, p. 57
(4) This suggests that lower economic activity leads to fewer crime targets and brings about better protection of property.

crimes of violence. The latter has often been shown to be negatively correlated to unemployment, but the authors correct for what they call an omission of variables in those studies by including variables of 'crime fundamentals' such as alcohol consumption.

Table 1.2 Elasticities of Crime* - A Summary of Studies

	Type of Crime								
	All Property	**Burglary**	**Larceny**	**Auto Theft**	**All Violent**	**Murder**	**Rape**	**Robbery**	**Assault**
Avio & Clark (1976)a		0.4	0.17	0.16				0.08	
Holtman & Yap (1978)a		0.39	0.59					-0.29	
Chiricos & Norton (1982)a		0.17	0.33	0.35				0.58	
Mathur (1978)a		0.04	0.14	0.09				-0.01	
Avio & Clark (1978)a		0.76	0.67					0.86	
Furlong & Mehay (1981)a		1.57	1.53					1.46	
Raphael & Winter-Ebmer (1999)	1.38	2.03	0.99	1.72	0.62	-1.37	-0.28	1.12	0.58
Dickinson (1994)b		0.4							

Notes:

* A one percent change in unemployment brings about percentage changes in each category of crime as stated in the relevant columns, eg according to Avio and Clark, a one percent increase in unemployment leads to a 0.4 percent increase in burglary.

(a) Source: Chiricos (1987)

(b) Source: Home Office (1994)

Table 1.2 outlines the elasticity of crime with regards to unemployment. It is important to note that the numbers have been derived using different methods and types of data.

A1.3.2 Concluding Remarks

Although there is no consensus amongst authors as to whether unemployment has an independent effect on crime, its seems plausible to suggest that unemployment will increase at least some crime rates. In particular, there seems to be a strong link between unemployment and property crimes, where the elasticities across studies are quite similar.

A1.4 IMPLICATIONS FOR WEST CUMBRIA

A1.4.1 Health Impacts

The literature review identified studies that have found a correlation between unemployment and health. The studies suggest that mortality rates of the

unemployed are 21 to 111 percent higher than amongst the employed individuals, and even higher if suicide is considered alone. The unemployment forecasts set out above have been used to identify the possible impact on health in the community. Because the overwhelming proportion of any jobs lost on site will be done by males, we have used mortality data for men in preparing this assessment.

Data from National Statistics indicate that the number of male deaths per 100,000 of population for all causes in the North West is 1,039 per annum. To indicate what this might mean for West Cumbria, this figure must be divided by 100,000, multiplied by the increase in the number of unemployed and then increased by the estimated percent increase attributable to unemployment. The results are presented in *Table 1*.2.

Table 1.3 Possible Range of Impacts on Mortality by Scenario: Compared with Current Plan (Average Impact on Deaths per Annum 2001 to 2025)

Scenario	Impact of a 21 Percent Increase in Mortality	Impact of a 111 Percent Increase in Mortality
Current Plan	-	-
Blue Sky	-4	-21
Minimum	3.1	16.2
Stop ASAP	1.4	7.7
Impact of Additional Employment Creation Projects	*-5.2*	*-27.3*

Source: ERM analysis

The results in the table suggest that:

- the additional employment created under Blue Sky would reduce mortality;
- the lower employment associated with both Minimum and Stop ASAP would be likely to increase worker mortality; and
- the additional employment creation projects reduce mortality by more than either of the do-minimum scenarios increase it.

Although many of the studies reviewed did find a correlation between unemployment and mortality, other studies have argued that the correlation is not proven. Therefore, these results should be viewed with caution and treated as indications of possible scales of impacts rather than reliable forecasts.

A1.4.2 Impacts on Crime

The literature of the impacts of unemployment upon levels of crime has suggested a positive relationship between increasing crime and increasing

unemployment. The correlations vary according to the type of crime, and to the research methods used. For example, for every 1 percent increase in unemployment the estimates for the increase of:

- burglary are from 0.04 percent to 2.03 percent;
- car theft are from 0.09 percent to 1.72 percent; and
- robbery are from -0.29 percent to 1.46 percent.

Figure 7.2 illustrated that unemployment would vary considerably under different scenarios, and it therefore appears that scenarios could have a marked impact upon the incidence of crime.

Annex B

Details of Forecasting Approach

B1 METHODOLOGY OF FORECASTS

B1.1 INTRODUCTION

The project methodology has been presented to members of the Spent Fuel management Options and Plutonium Working Groups. At these presentations requests were made for more detail on the economic modelling techniques being used. Therefore this annex outlines:

- the methodology used, which is embedded in the production of Business Strategies' forecasts of output and employment;
- information on the reliability of forecasts in recent years; and
- a list of recent studies in which the model has been used.

B1.2 NATIONAL AND REGIONAL FORECASTS

The starting point for our forecasts is a very wide range of historical economic data that is collected at a highly disaggregated level and covers all the major economic indicators. The majority of this data come from the Office of National Statistics (ONS), formerly the CSO (Central Statistical Office) and OPCS (Office of Population Censuses and Statistics). Data also come from a number of other sources including the Labour Force Survey, the CBI's survey of manufacturing industries, and the European Commission's survey of consumer confidence.

These data describe the historical performance of the UK economy and its constituent regions. Two areas of effort are then required. The first is to ensure that the data are consistent with one another. Data from different sources are invariably of different vintages. Furthermore, official data are frequently revised in the light of new information.

The second effort is the construction of equations which represent the historical pattern of relationships between the many indicators involved. Each equation explains the performance of a particular indicator in terms of a number of other indicators. There is an equation for all the major indicators, at the national and regional level. In principle, everything is related to everything else.

The model is then used to produce an initial forecast. This is inspected by regional and sector experts both internal and external to the company. These experts pass judgement on the forecast in light of their detailed knowledge. Alterations are made for significant pieces of inward investment, or infrastructure development, or changes to European funding, in the form of "add factors". A new forecast is then produced, which is again subject to rigorous inspection. This process continues until those ultimately responsible for the forecast are satisfied with the results.

B1.3 COUNTY/LOCAL LEVEL FORECASTS

County, Travel to Work Area (TTWA) and local authority districts (LAD) forecasts are prepared once national and regional forecasts are finalised.

The key feature at this geographical level is that far fewer reliable economic data are available. Business Strategies make use of employment data, drawn from the various censuses of employment conducted since 1981 and population data. (The Index of Production, which provides measures of output at county level is, in our opinion, too unreliable to be used in any systematic way).

In broad terms, the historical performance of county economies is interpreted in terms of their share of the regional economy of which they are a part. In turn, the performance of the sub-areas are based on their share of their encompassing county. For each sector of the economy, equations are produced for output and employment which explain the observable relationship between these variables at the local and regional level.

The equations used for forecasting output in the production industries make use of this first level of modelling (i.e. they model the changes at the county and regional levels) without further refinements.

The equations used for the service industries are driven by a greater range of variables. The output equations for the service industries incorporate both population and intermediate (business-to-business) demand.

The construction sector is also treated slightly differently. Its equations are based upon those used to model the service industries, but instead of including a measure of intermediate demand, they incorporate data on investment spending by both service and production industries.

The models are solved to produce forecasts of output for each of the 28 industries. Again, in broad terms, if area X has accounted for a steadily rising share of a sector P in region Y, then its share will continue to increase into the future. This applies whether the sector is increasing or decreasing in size.

These calculations are executed for every sector and every county in a region. All totals must sum to regional totals. In turn, the calculated sub-county level totals must sum to county total. This whole process culminates with a set of county and sub-county level forecasts that are entirely consistent with the national and regional forecasts upon which it is based.

B1.4 ANALYSING THE IMPACT OF BNFL ON THE WEST CUMBRIA ECONOMY

B1.4.1 Introduction

The starting point from which to measure the scenario impacts of BNFL on the two TTWA economies is to produce a set of baseline output, employment, and population forecasts for the two TTWAs against which we can assess the relative impacts of shocks to the local economy. The broad methodology for constructing the baseline output and employment is based on shift-share equations (as described above). In short, the historical performance of a TTWA economy is interpreted in terms of its share of the county economy of which it is a part.

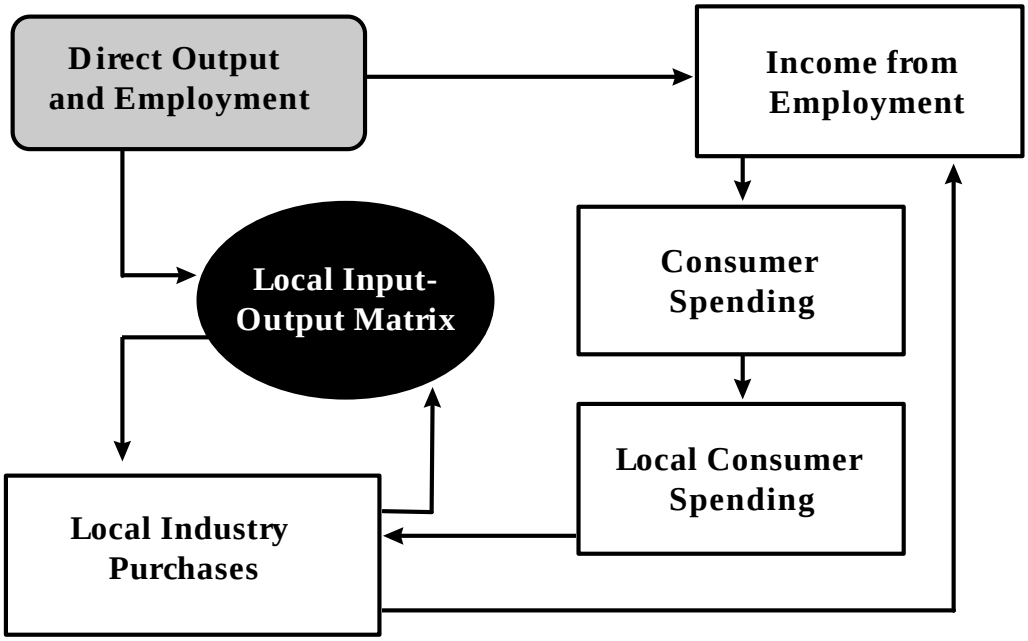
To examine the knock-on effects of changes in expenditure by one industry on the rest of the local economy, it is necessary to identify the spending flows between that industry and the local / national economy and to identify leakages of expenditure outside of the local / national economy. At the UK level, this information is available at a considerable level of industry detail in the UK input-output tables, which identify the spending flows between industries (ie intermediate purchases and capital spending), but also flows from government to industries and from consumers to industries.

B1.4.2 The Use of Input-Output Tables

Input-output tables can be used in the following manner. If an industry increases production it will need more employees (direct output and employment effect) and it will need to buy in more goods and services (some of which will be bought in the local / national economy). The increase in employment will generate more income from employment some of which will be spent in the local economy. The increased purchases of goods and services (also known as intermediate purchases or intermediate demand) from local / national industries also generate extra income for local industries.

There may also be further sources of increased spending. Further industrial investment may be needed to create extra capacity and there may be changes to levels of government current and capital spending. The extra sales of local industries to satisfy the additional consumer, investment and government spending and intermediate demand will generate additional employment and intermediate demand from those industries and so there will be second round and then third round effects etc. The sum of all of these effects will give the total impact on the local economy. The total impact divided by the initial change is known as the multiplier.

Figure B.1 Structure of the Input-Output Model



The size of the multiplier depends on the extent of any *leakages* from the local economy. If we are looking at the UK, leakages are:

- spending that goes to the rest of the world, rather than to the national economy; and
- any increased income that is retained by consumers, firms or government rather than being spent (as this project is analysing the impact on West Cumbria, leakages will be spending that occurs outside of West Cumbria.

The leakages in turn will depend crucially on the geographical area concerned. The larger the area, the lower will be the extent of any leakages in the form of imports. In this study we are concerned primarily with two geographical areas - West Cumbria and the UK with the Rest of the World making up the balance in the model. We aim to do this by building two input-output models - one for West Cumbria and one for the UK as a whole.

B1.4.3 The West Cumbria Input-output Model

As mentioned above, input-output tables are available for the UK as a whole at a considerable level of industry detail. Tables are also available for Wales and Scotland. For a local area such as West Cumbria there are techniques for estimating / guessing what the input-output table should look like.

This is based on looking at the UK relationships and then making an allowance for the relative concentration of an industry in the local economy. To take an extreme example, as there is no vehicle manufacturing in West Cumbria we know that other local industries make no local intermediate purchases from local vehicle manufacturing.

What estimation techniques will not do, however, is to provide detailed and accurate information about BNFL's purchasing patterns, let alone purchasing patterns associated with different BNFL processes. This is where estimation techniques are supplemented with information from BNFL themselves and from the supplier, employee, capital expenditure and local firm surveys, undertaken by ERM.

The surveys will enable Business Strategies to use local knowledge and data to calibrate the model to reflect, as closely as possible, the West Cumbria economy. For example, we may find that the share of intermediate purchases made locally (ie sourcing from local suppliers) maybe much stronger than suggested by the local industry structure, which in turn suggests that there will be a greater knock-on impact on the local economy from changes in expenditure by BNFL.

The West Cumbria model also captures the consumer spending effect of any increase in the number of FTE jobs. Information on earnings is needed to undertake this analysis, which is available from the New Earnings Survey. In this case, we can supplement our own local earnings estimates using the NES data by incorporating actual earnings data supplied by BNFL. The employee survey will also help inform the model as to the level and nature of purchases made by local employees and where these purchases actually take place (i.e in the local economy or beyond).

B1.5 THE ACCURACY OF RECENT FORECASTS

The analysis below summarises aspects of our regional employment forecasts, comparing our forecasts for 1999 made at the beginning of the year (when no quarterly employment data was available) with the outturn figures, now available from the ONS.

Tables B.1 shows how we expected each region to perform relative to the UK average for full-time equivalent (FTE) employment and for employment measured on the International Labour Organisation (ILO) definition, ie taken from the Labour Force Survey. Thus, *Table B1*, column 1 shows how we expected the North East to under-perform the national average by 1.4 per cent. Column 2 reveals the under-performance to have been 1.6 per cent, producing an error of -0.2 per cent.

The average error for each region's relative performance was 0.5 per cent, a relatively good performance in a year of considerable economic uncertainty, although for FTE employment we were very successful on forecasts made for London, South East, South West, North East and North West(1). For ILO employment, we were most successful in South East, South West, North East, North West and Scotland.

(1) Most forecasts for 1999 were pessimistic given concerns about the impact of the Asian economic crisis, stock market volatility and the Russian default on foreign debt payments in 1998.

Table B.1 March 1999 Forecasts for 1999 vs Current Estimates (August 2000) - Regional Relativities (Regional Growth Less UK Growth)

Region	Forecast Regional Growth vs UK	Actual Regional Growth vs UK	Error
Full time equivalent employment			
North East	-1.4	-1.6	-0.2
Yorkshire & the Humber	-0.3	-1.0	-0.7
East Midlands	0.7	0.1	-0.6
Eastern	0.6	1.4	0.8
London	0.0	0.0	0.0
South East	0.6	0.6	0.0
South West	0.2	0.2	0.0
West Midlands	-0.3	-1.1	-0.8
North West	0.3	0.2	-0.1
Wales	-0.6	1.0	1.6
Scotland	-1.1	-0.7	0.4
Northern Ireland	-1.0	0.1	1.1
ILO Definition for Unemployment			
North East	-1.1	-0.9	0.2
Yorkshire & the Humber	0.1	0.5	0.4
East Midlands	0.6	-0.7	-1.3
Eastern	0.4	-0.2	-0.6
London	-0.4	0.8	1.2
South East	-0.1	0.0	0.1
South West	0.2	0.2	0.0
West Midlands	-0.5	-1.4	-0.9
North West	0.8	0.8	0.0
Wales	-0.2	0.5	0.7
Scotland	-0.6	-0.4	0.2
Northern Ireland	0.5	0.0	-0.5

B1.6 PREVIOUS USE OF THE BSL MODEL

Set out below are descriptions of a number of studies where BSL have used their local economic impact model:

- ***Impact of ScottishPower on the Scottish and UK economies.*** In 1997 and 1999, Business Strategies carried out an assessment of the impact of the major utility group ScottishPower on the Scottish and UK economies. The study also covered an assessment of the impact of Manweb and Southern Water on their respective local economies. The findings of the study received extensive press coverage throughout the country.

- ***Assessing the Impact of the Chemicals Sector on the Forth Valley Economy.*** In 1999, Business Strategies completed a study that quantified the direct and indirect contribution of the Grangemouth chemicals sector to the Forth Valley economy. The study, that was produced for the Grangemouth Development Group (GDG), also identified other softer

benefits made by the Grangemouth chemicals sector e.g. to the oil & gas sector in Scotland and put these impacts in the context of activity in the sector in the UK, EU and globally.

- ***Scottish Homes - Impact of the Housing sector on Scotland***. This impact study looked at the impact on the Scottish economy of the housing sector. The direct and indirect contribution of the sector through links with eg builder's merchants, business services, housing administration and the retail sector were estimated. The direct and indirect impact of their activities was measured in terms of the jobs, spending and output associated with the sector's activity.

- ***Forth Valley Enterprise - Investment spending scenario analysis.*** This report used the original version of the Business Strategies Impact Assessment Model to assess the relative impacts of different spending scenarios on the Forth Valley economy. Possible outcomes in terms of spending, output and jobs were ranked in terms of their overall impact on the Forth Valley economy.

- ***Property Investor – Implications of the Sale of Rover for the local economy.*** The study examined in broad terms the scale of the consequences for a retail development in Solihull of the sale by BMW of Rover's Longbridge site and the Land Rover plant at Solihull. It identified possible positive effects, which may flow from regeneration of the Longbridge site and more particularly the beneficial effects of Ford's purchase of Land Rover. The study also demonstrated that the prosperity of the Solihull area and retail development catchment area is not narrowly based on the vehicle industry.

- ***Coventry & Warwickshire Forecasting Model (1997)***. A major project to develop a forecasting system for Coventry & Warwickshire CCTE and Councils. Used the Business Strategies baseline forecast in conjunction with a spreadsheet-based investment and scenario planning model to allow the client to develop a number of forecast and investment scenarios in their area.

- ***Kent County Council/Kent TEC, "Summary Computer Model."*** As part of Kent Prospects, Business Strategies developed a summary computer model for Kent County Council and Kent TEC. The model contains forecasts for Kent and its constituent districts and sub regions and is capable of running scenarios at a detailed sectoral level. Also as part of Kent Prospects, Business Strategies produced a set of forecasts for the Kent economy. In particular, two of the forecasts were specially adapted to accommodate local information. Specifically, firms' views (as expressed in the Kent Prospects Employer Survey) were used to calibrate one forecast. The employment implications of site development in the county were incorporated into another.

- ***Blue Circle, "North West Kent."*** In a series of consultancy reports, we have been acting as advisers to Blue Circle in their plans to develop North West Kent. Most importantly, we were involved in formulating and presenting to government the case for locating at Ebbsfleet an international passenger station on the high speed Channel Tunnel rail link.

- ***Enterprise Ayrshire, "The economic implications of Prestwick Airport."*** Alongside monitoring the local economy, a second report was prepared which examined the particular role of Prestwick Airport in the local economy and the impact that development of the airport would have both on the local economy and on Scotland as a whole.

- ***Consortium Study: "Local Economic Development: Creating Local Linkages."*** The process by which local economic development takes place has become of increasing interest over the last few years. This project aimed at identifying and assessing the impact of customer and supplier linkages in a local economy. The study included a survey of businesses in eight selected areas which dwelt specifically on both purchasing practices and proximity to customers. It also included a detailed industrial analysis of each area. This provided the basis for a discussion on some of the policy issues faced by a local area to finally make recommendations on key elements of any policy.

Annex C

Bibliography and Key Consultees

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C1.2 CONSULTEES

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Annex D

Glossary of Terms

D1 GLOSSARY OF TERMS

ACORN	A Classification of Residential Neighbourhoods
AEA	Atomic Energy Authority
AGR	Advanced Gas-cooled Reactor
BNFL	British Nuclear Fuels plc
BWR	Boiling Water Reactors
CACI	An income data service
CEGB	Central Electricity Generating Board, former name of the UK's state owned electricity generator
DETR	Department of Environment, Transport and Regions
DWG	Discharges Working Group
ERM	Environmental Resource Management
FTE	Full Time Equivalent
GCSE	General Certificate of Secondary Education
HLW	High Level Waste
ILO	International Labour Organisation
ILW	Intermediate Level Waste
KSO	A Swedish nuclear power company
LLW	Low Level Waste
LWR	Light Water Reactors
MDF	MOX Demonstration Facility
MOX	Mixed Oxide Fuel
MP	Member of Parliament
MWe	Mega Watte
NCHA	North Cumbria Health Authority
NCO	Non-commmissioned (military) Officer
NOMIS	National Online Management Information System
NGO	Non- Government Organisation
NVQ	National Vocational Qualification
ONS	Office of National Statistics
Pu (WG)	Plutonium (Working Group)
PWR	Pressurised Water Reactors
RDC	Rural Development Commission
SFMO (WG)	Spent Fuels Management Options (Working Group)
SMP	Sellafield MOX Plant
SRS	Savannah River Site (US nuclear installation)
SSEB	South Scotland Electricity Board (former state owned electricity generator for southern Scotland)
Thorp	Thermal Oxide Reprocessing Plant
TTWA	Travel to Work Area
UKAEA	United Kingdom Atomic Energy Authority
UNRECO	The UK's supplier of enriched uranium
VAT	Value Added Tax
VHLW	Very High Level Waste (radioactive)
VSEL	Ship builder at Barrow-in-Furness (now a part of Bae Systems)
WVP	Waste Vitrification Plant

WWG Wastes Working Group

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