

# NUCLEAR ENGINEERING

INTERNATIONAL

1956-2006 GOLDEN ANNIVERSARY

NOVEMBER 2006

[www.neimagazine.com](http://www.neimagazine.com)



**SPECIALIST SKILLS**

**THE COST OF COMPETITION?**

# Privatisation costs

*An analysis of the impact privatisation could make on the UK nuclear decommissioning market. By Ian Jackson*

The UK Nuclear Decommissioning Authority (NDA) spends £2.2 billion of taxpayers' money each year – enough to add a penny to the basic rate of UK income tax. The real total for the UK nuclear legacy will almost certainly be higher than the current £70 billion estimate because it excludes the £9.7 billion cost of decommissioning military nuclear weapons plants and nuclear powered submarines, and £5.3 billion for decommissioning commercial nuclear power stations that are due to close over the next 20 years. The taxpayers' final bill is likely to be closer to £85 billion, about the same cost as running

the UK National Health Service for a year, and there is every chance that it will continue to rise. Recent official estimates of cleanup costs have escalated on average by around 10% each year over the past four years, increasing from £48 billion in 2002, to £56 billion in 2004, and rising again to £70 billion in 2006. The NDA's nuclear liability provisions jumped over 26% in the 2005/6 financial year alone.

Investing in nuclear technology uniquely captures governments in a lengthy cycle of expenditure that once started, will take a century to exit – ten years to license and build a modern nuclear power station, 60 years to operate and maintain it, and 30 years

to decommission it. Few other technologies have the capacity to bind government spending for a 100 years. As a result, the long-term costs of nuclear power can only really be estimated and estimates are only as good as the economic assumptions on which they are based. Today, forecasting the cost of nuclear cleanup remains more of an art than a science. Energy investors generally remain wary about dealing with back end liability costs of decommissioning and nuclear waste disposal unless these costs are underwritten by government guarantees. Moreover, nuclear costs are notoriously hard to control in an industry where safety is at stake and must remain paramount irrespective of economic arguments. These issues do raise doubt about whether nuclear power can really withstand the cost control discipline of a purely private energy supply market without some form of government assistance.

Investors entering the decommissioning market must remember the economics of cleanup are relatively new. Commercial lessons learned from nuclear power generation do not necessarily apply to nuclear cleanup. For much of its 60-year history the nuclear industry in Britain has operated as a large nationalised monopoly staffed by public sector workers. What makes the current situation particularly interesting is that by 2012 almost all of the nuclear cleanup work will be undertaken by commercial firms competing against each other in the private sector. For successful companies, the rewards could be very large. With good management, firms could likely achieve margins of between 10 and 15% profit on the NDA's annual £2.2 billion procurement budget, creating annual profits of around £220 million to £330 million each year that will be shared out between the firms carrying out the work. Over the next six years, the plan is to create an instant mini-market of experienced commercial organisations ready and willing to compete for nuclear decommissioning contracts. In effect, this is a full privatisation, albeit



BNG profits from commercial power stations but will refocus on decommissioning. Photo courtesy BNFL

somewhat through the back door. In principle, this new vision of a competitive decommissioning market sounds great for both the industry and taxpayers. The public gets hazardous nuclear plants dismantled for a bargain price and hopefully lower tax bills, while business gets fair and predictable profits from a long term-work programme.

### DECLINING MARKET

Nuclear decommissioning is, by definition, a declining market. In the countries that have developed nuclear technology there are, after all, only a certain number of nuclear sites that will need to be cleaned up. When this work is complete, the commercial decommissioning opportunities will be over, unless more nuclear power stations are built. A key question then is why would an investor want to buy into a declining marketplace? The main reason is that government contracts offer companies dependable cash flow and moderate profit at relatively low risk, when compared with other more speculative commercial investments. Furthermore, the British decommissioning market is growing as nuclear cleanup costs have escalated, which is bad news for taxpayers but good news for companies and their investors. The key attraction for investors is that decommissioning contracts provide a relatively stable base of government-funded work in which contractors are guaranteed to recover their costs plus an agreed level of profit, subject to achieving certain performance targets. At present the NDA has pegged the maximum level of profit that can be earned at 4.4% of the annual turnover of each nuclear site. But this margin is likely to rise to between 8 and 15% when commercial competitions for site management contracts have been competed in the private sector between 2007 and 2012.

The maximum annual profit that can be achieved by British Nuclear Group (BNG) is currently around £31 million, 4.4% of the NDA's annual £701 million decommissioning expenditure at sites managed by BNG. Its actual profits are much higher at £72 million, mainly because the NDA is also paying it to operate the Thorp reprocessing plant, the Sellafield MOX Plant and two Magnox power stations. The underlying decommissioning profit segment is worth only £31 million. The value of a company is largely based on its potential to earn profits for shareholders. As an approximate rule of thumb, the value of a company for sale in the marketplace is



Employing skilled nuclear staff could become more expensive after privatisation.  
Photo courtesy BNFL

normally about ten times its annual profit, which would value BNG between £310 and £720 million. The problem with the higher valuation is that roughly 64% of the total profit that BNG receives from the NDA comes from commercial fuel cycle and power generation work that is under threat from closure as the NDA refocuses its activities on decommissioning. So the lower valuation towards £310 million is probably more realistic unless buyers decide that BNG is worth more for some other reason, such as better commercial prospects for new nuclear power station build.

The underlying value of BNG's decommissioning business segment over the long term would be £310 million at 4.4% profitability but this could increase up to £1052 million after a sale if BNG's new owners achieved 15% profitability on its management contracts with the NDA. If BNG were split into its three main decommissioning businesses, the 'Magnox North' business would be worth around £71 million, the 'Magnox South' business £85 million and the Sellafield business £132 million, assuming current 4.4% profit margins. On the other hand if BNG's new owners achieved 15% profit margins in the future, then the 'Magnox North' business would be worth £243 million, the 'Magnox South' business £290 million and the Sellafield business £451 million.

Applying the same logic, the maximum annual profit that could be achieved by the UK Atomic Energy Authority (UKAEA) is currently around £11 million, 4.4% of the NDA's annual £259 million decommissioning expenditure at sites

presently managed by the UKAEA. This would value the UKAEA at £114 million, assuming 4.4% profitability or possibly as high as £389 million, assuming 15% profitability in the future. Despite these projections, it's worth remembering that companies are only really worth what investors are actually prepared to pay for them. In September 2006, the American decommissioning firm Fluor reportedly offered up to £400 million to buy BNG outright, triggering a flurry of similar offers from other investors. The government has asked BNG to conclude its sale process by mid 2007 (see page 6).

### PROFIT

Potential investors in decommissioning face a fundamental dilemma. In a business environment where profits are set by government under 'cost-plus' contracts, company growth depends on increasing the government's level of spending on liabilities. But from the government's perspective, successful contract management depends on cutting liability costs for taxpayers. Without a shared financial objective it's very difficult to find 'win-win' solutions that cut costs for government while at the same time allowing nuclear firms to grow.

In business there are two main ways to increase profits: firms can either increase sales and win a larger share of the market; or they can cut back on costs and make immediate savings by downsizing. When profits grow faster than sales, as is usually the case in the first few years after nationalised monopoly companies are first privatised, the new utility firms are really



BNG has partnered with Atomstroyexport and Rosatomstroy for decommissioning work at Ignalina in Lithuania

growing by cost cutting and downsizing. Because the size of the market is limited, the only realistic way for firms to increase their profits over the longer term will be to buy up and take over smaller nuclear companies, cutting their staff to reduce wages bills. This cycle of company acquisitions will eventually result in a highly consolidated nuclear services market dominated by a few larger players that fight for profits in a steady or declining market, as more decommissioning work is completed. Indeed the government's 2002 white paper, *Managing the Nuclear Legacy*, envisaged a longer-term cleanup budget of only £1 billion per year, less than half of the NDA's spend today. This might begin to happen as early as 2012 when the NDA's commercial spent fuel reprocessing activities are scheduled to end. This could make decommissioning companies a bad long-term investment on the stock market because share prices tend to reflect next year's expected growth and earnings potential, rather than short-term profits. Shareholders, especially large institutional investors such as pension funds, need consistent corporate performance and steady growth in earnings and market share. When forecasts of a company's future earnings drop, the share price lowers, devaluing the company.

Despite the apparently large £85 billion market potential over the next 100 years, it's hard to see the real commercial incentives for companies to enter the nuclear market on the cheap by undercutting their rivals, especially when other business risks are considered. Nuclear companies can suffer from unpredictable and costly regulatory interventions, claims for compensation or penalties for mishaps that inevitably occur. For example, BNG was 'fined' a £2 million profit penalty by the NDA in 2006 for a radioactive leak at the Thorp facility at Sellafield. The company was also prosecuted and

fined half a million pounds by the criminal courts. This meant losing around 3.5% of its £72 million annual profits plus significant reputation damage. UKAEA was 'fined' a £2 million profit penalty the same year by the NDA for a spillage at a radioactive waste packaging plant at Dounreay, in northern Scotland.

In contrast to the USA, the UK nuclear regulatory system is based on setting broad environmental goals rather than fixed standards for cleanup. This means decisions are made on a case-by-case basis. The lack of prescription has hit some nuclear operators heavily in the past. In 2003, a report by the House of Commons Public Accounts Committee highlighted a 62% cost overrun of £357 million in the cost of new nuclear submarine facilities at Devonport and singled out regulatory factors as the main cause.

**MARKET STRUCTURE**

In the nuclear industry, winning public sector contracts is often crucial for the viability of firms and, as a consequence of this, the public sector can and does affect market structure by choosing to award contracts to a larger or smaller number of suppliers. It is important for the NDA to get this choice right because long-term changes in market structure caused by short-term restrictions or distortions cannot easily be reversed. A problem with government nuclear contracts is that the public sector is highly risk averse and somewhat reluctant to choose new suppliers. In effect, civil servants are worried because any failure of procurement that affects safety tends to be highly visible in the news media – sometimes with political consequences. This risk aversion limits nuclear contracts to large, reputable firms and existing suppliers. The effect is that new or smaller firms often find it very difficult to enter the nuclear market, a situation which suits the existing nuclear suppliers rather well because it allows them to charge the NDA higher prices.

This situation is not peculiar to the nuclear industry and is a more common problem than generally realised. The 2004 Office of Fair Trading report, *Assessing the impact of public sector procurement on competition*, estimates that more than 10% of the £117 billion spent on government contracts each year shows an indication of competition problems where the concentration of government contracts was limited to a few competing firms in markets not regarded as very open. More recent

studies published jointly by the Office of Government Commerce and the Office of Fair Trading in 2006, which analysed the impact of competition on the £2 billion domestic household waste management market since its commercialisation in 1988, found that privatisation has resulted in industry consolidation that has reduced competition, not improved it.

The overall picture for financial investors is that at best decommissioning should probably be viewed as a moderate risk, medium-term business investment, requiring good profit margins to make the difficulty of entry into the nuclear market worthwhile for commercial companies. The result for taxpayers is that far from privatisation reducing costs to the taxpayer, the bill for cleanup of Britain's nuclear liabilities will most likely continue to spiral upwards.

According to the NDA's 2006/7 annual plan, over 80% of the NDA's £2.2 billion expenditure each year will be spent on labour resources, and this figure rises to 97% over the long term. Although regulatory factors can be difficult to deal with because of uncertainty, compliance with tough environmental and safety regulations is not really a major cost driver but paying the wages of highly trained and experienced nuclear workers is. Over the past decade, the mantra of successive governments has been that the introduction of competition to public services brings greater efficiency, cheaper costs for taxpayers and lower prices for consumers. But although it may seem counterintuitive, the relatively low salaries paid to supposedly inefficient nuclear workers in the public sector over the past 60 years has probably helped to prevent the costs of decommissioning from spiralling too far out of control. This is because, in the past, the government had tremendous bargaining power as the sole employer, which helped to prevent wages from rising too fast. The wages of nuclear workers across the country remained broadly similar and there was little advantage in moving from one nuclear site to another.

Over the next few years, four important changes are likely to upset the *status quo*, producing a significant escalation of salaries and greatly increasing costs for taxpayers:

- A projected 40% loss of trained workers through retirement.
- The absence of young people entering the nuclear industry to make up these losses.

- Increasing scarcity value of the shrinking labour pool of trained and experienced nuclear talent.
- And as a result, more intense wage competition for nuclear workers amongst private sector decommissioning firms bidding for nuclear cleanup contracts.

A fact often conveniently forgotten by governments is that competition can mean high prices as well as low.

In December 2002, the Department of Trade and Industry (DTI) published an influential study looking at the uniqueness of nuclear skills in Britain. Unsurprisingly it transpires that few young people dream of dismantling ancient nuclear reactors or entombing radioactive waste in concrete for a living. The science and engineering qualifications necessary to do the job are also regarded by students as particularly difficult and unglamorous. Most of the nuclear industry's vocational apprenticeships and training schemes for young people were closed in the early 1990s after research programmes ended. The shrinking pool of students with a science background will inevitably have an effect on the number of trained workers in the future. These factors will play a role in the expected 40% decline in the 56,000-strong UK nuclear workforce over the next 15 years. Retiring workers are not being replaced by new recruits. Less qualified teams of manual workers, who often work in uncomfortable conditions inside protective containment suits within radioactively contaminated buildings, may not be so technically specialised but nevertheless work in a niche that is hazardous and unpleasant. This is partly why unskilled jobs in the nuclear sector often command a higher salary premium. However, the business, finance and oil sectors offer more attractive prospects.

Wages will rise, not because companies are generous, but because they will have no choice if they want to attract experienced nuclear workers who can be relied upon. This will inevitably escalate nuclear liability costs for taxpayers.

At first sight this appears to be good news for businesses on 'cost-plus' contracts, who would make more profit as government cleanup expenditure rises. However, in practice the escalation of wage bills will probably force the government to re-tender contracts on some form of fixed-price basis that would make cleanup contracts more risky and less profitable. The end result of salary escalation is that nuclear employees might become an increas-

ingly expensive resource only marginally profitable for private companies.

#### SELLING ABROAD

The structure of the industry has recently become much more fragmented, beginning with divestment and privatisation of AEA Technology in 1996, to the recent sell-offs from state-owned BNFL of Westinghouse in 2006, and the proposed sale of BNG in 2007. After privatisation, AEA Technology subsequently sold off most of its nuclear business to Serco Assurance, RWE Nukem and Nexia Solutions causing further fragmentation. Despite this pattern of sell-offs and acquisitions the resident nuclear workforce at each nuclear site has changed very little. The same people are doing more or less the same jobs at the same locations, the only real change being fragmentation of the original public sector workforce into a multiplicity of private sector companies. In short, the size of the trained nuclear labour pool appears to be relatively fixed at around 56,000 with few genuinely new entrants.

The NDA claimed in its five-year strategy document, published in March 2006, that more than half of its expenditure is subcontracted to smaller companies. But it is questionable whether this claim is realistic because it probably simply reflects the degree of transfer of existing staff from the public sector. Nuclear sites are not yet swarming with new faces. Despite the intensive organisational restructuring seen over the past few years, the basic proposition remains that the site workforce does the majority of the work. This implies that the labour cost base and maximum profits are largely fixed unless salaries are reduced or there are redundancies. Downsizing can help deliver short-term profits but the scarcity of remaining nuclear workers will eventually push wages up, increasing costs and reducing shareholder profitability. Because stock market investors are only interested in long-term profitable, growing companies, nuclear firms will need to expand and find new markets for their services. The only realistic way for British decommissioning firms to expand is to find profitable opportunities abroad. It is for precisely this reason that American companies are keen to move into the British nuclear cleanup market because their own domestic market in the USA will eventually become saturated by a small number of big players.

According to the DTI's 2005 report, *Global Decommissioning Opportu-*

*nities*, 50% of the world's civil nuclear power stations will close by 2016 and the worldwide market for nuclear decommissioning services is expected to be around £300 billion over the next 30 years. In the countries that have developed nuclear technology, there are only a certain number of nuclear sites that will need to be cleaned up. When this work is completed the commercial opportunities will be over. Well aware of the declining domestic market, the chief executive of the UKAEA, Dipesh Shah, told the House of Commons Trade and Industry Committee in March 2006: "Our ambition, in a nutshell is that over a period of five years and in terms of profitability, we would be doing as much outside the UK as we would within the UK." But it's doubtful whether a major nuclear organisation such as the UKAEA can win enough foreign business to support 50% of its 2300 workforce on overseas projects.

Countries that are sufficiently advanced to have their own nuclear technology or sufficiently rich to have bought the technology from abroad, usually have their own trained and relatively cheap nuclear workforce. These countries don't need foreigners to supply labour, what they need is expertise to train their own people instead. Decommissioning 'know-how' is exportable, decommissioning labour is not. The expansion of British nuclear decommissioning companies into new markets abroad, if it ever happens at



Waste storage and disposal cost forecasts have escalated. Photo courtesy BNFL



Demolition could be a part of decommissioning where privatisation can drive down costs.  
Photo courtesy BNFL

all, probably won't involve small armies of workers jumping on aeroplanes to carry out work in exotic foreign locations. By the same token, Britons are unlikely to see teams of highly trained Japanese reactor technicians descending on Sizewell B power station to carry out repair work during its periodic maintenance shutdowns.

If globalisation means 'the same everywhere' then nuclear markets are not truly global. Instead it's better to think of them as a series of local markets operating within their own individual cost structures, labour conditions and regulatory regime. For example, BNG has partnered with Atomstroyexport and Rosatomstroy for decommissioning work on former Soviet reactors in Lithuania, where BNG is basically providing management expertise. This overseas business model has more in common with a modern management consultancy firm than a hands-on decommissioning contractor. Even within the 25 member countries of the European Union (EU), nuclear trade is very limited. It is notoriously difficult to sell foreign nuclear services into, for example, France – the second largest economy in the EU – despite the very large French nuclear power programme that supplies over 75% of the nation's electricity.

Probably the most sensible strategy for a British firm wanting to expand its nuclear operations abroad is to either buy or team up with local companies employing their indigenous nuclear labour force and then add a few foreign managers to teach them how to decommission effectively. This is the basic commercial formula that American firms are using to become involved in nuclear cleanup in Britain today. But even if companies are able to raise the funds needed to acquire overseas nuclear firms, they are not always for sale. Nuclear technology is invariably

sensitive and foreign ownership usually raises issues of political concern to governments.

Despite the apparent £300 billion global market for nuclear decommissioning services, for many companies the most likely outcome is that expansion of their nuclear cleanup services abroad will be mostly unsuccessful. Only a small percentage of the British nuclear workforce can ever hope to sell their services into other nuclear markets. This small elite will be highly profitable for decommissioning firms. But much of the remaining workforce left behind in Britain will become an increasingly expensive resource paid for by the NDA and by the same token only marginally profitable for the private sector companies employing them.

### MARKET IMPLICATIONS

This has some important implications for potential investors in nuclear decommissioning companies. At present there is a great deal of market interest in the proposed sale of parts of BNG. It makes economic sense for the government to sell while the market is high, but the interest is mainly driven by the improved prospects for new build worldwide. This is why the government's \$5.4 billion sale of reactor vendor Westinghouse earlier in 2006 was so successful, despite its apparently very high price/earning ratio of 33 that would normally make a company too expensive for a buyer to acquire. The problem for the BNG sale is that the nuclear decommissioning market is not the same as the nuclear electricity market. It is questionable whether nuclear decommissioning business expertise could be readily applied to building a new generation of nuclear reactors. This undermines the economic rationale for buying BNG unless bidders are confident of winning decommissioning contracts.

The Energy Act 2004 says that the NDA's purpose is to decommission nuclear facilities, promote competition for contracts and secure value for money for the taxpayer. The central plank of its competition strategy is to artificially create a vibrant commercial decommissioning services market over the next six years. However, there is a paradox at the heart of the government's privatisation strategy for the nuclear industry. Its largest player, BNG, is worth little to investors if it has no forward contracts, making the firm very hard to sell. But granting forward contracts that continue BNG's monopoly will destroy the market diversity that the NDA is trying hard to achieve. This is in addition to the problems of reduced profit as the NDA moves away from commercial fuel cycle and power work. These factors suggest that the newly created £85 billion nuclear decommissioning market is fragile and there may be some risk of market failure – or more likely a market correction in which BNG is split up and sold at a price cheap enough for investors to gamble that the new businesses can win work without having long-term forward contracts in place. This halfway house solution appears to offer the UK Treasury and taxpayers best value for the sale of BNG while at the same time ensuring diversity in the new cleanup market.

### MANAGING COSTS

The immediate financial dilemma facing the NDA is how to reduce the nuclear legacy bill while still paying nuclear firms good enough returns. In 2004, the UK Treasury set the NDA a difficult target of reducing taxpayers' nuclear liability by 10% by 2010. This may prove to be an impossible goal but the NDA is employing a range of tactics that could slow down recent annual increases. Although the scarcity of skilled labour is likely to be a significant driving force behind escalating costs over the long term, wages are not the whole story. Nuclear liability costs are currently rising much more rapidly, at around 10% each year, whereas salaries and inflation are rising at only 2.4% each year, meaning that some other factors must be responsible for accelerating costs. Precisely what these factors are is not yet completely clear but they probably reflect some continuing technical uncertainty over the scale of what liabilities really exist and the work required, coupled with escalation in waste management and disposal cost estimates.

Decommissioning has been described

as like a Chinese puzzle box in which new problems are revealed the deeper one looks, as successive layers of complexity are revealed. Each year the decommissioning management contractors tend to look a little deeper at what needs to be done and then cost the tasks accordingly. As a result, the NDA's three-year near-term cost projections are reasonably accurate but forecasts of longer-term lifecycle baseline costs remain highly speculative. It is these difficult long-term projections that are rising by 10% each year.

The NDA appears to be applying a four-pronged strategy to help tackle these problems:

- Set challenging financial targets for contractors.
- Dampen the escalation of wages by increasing the available labour, making use of skilled workers from other industries and encouraging young people to enter the nuclear sector through sponsored education and training initiatives.
- Deskill decommissioning requirements by performing the most hazardous decommissioning tasks during the first 10 to 20 years, leaving relatively standard demolition and cleanup jobs to be carried out by cheaper lower skilled workers in later decades.
- Look for innovative opportunities to apply commercially available technology from other industries to solve nuclear decommissioning problems in a cheaper, faster and safer way.

To reduce costs immediately, the NDA asked site management contractors to make savings of 7% each year from 2006, implying total savings of 35% by 2012. The management contractors, BNG and the UKAEA, responded by asking their own suppliers to make savings of 15% in 2006, with BNG aiming to make 30% savings from the supply chain in future. To help achieve this, BNG has progressively slimmed down the number of suppliers to Sellafield from a peak of around 15,000 in 2000 down to 4,000 by 2006, so that the company can more easily set common terms and conditions, lowering prices.

There is doubt about whether cost reductions of 35% are feasible over a six-year period and what impact that might have on safety. A 35% cost reduction implies a cut of at least one third of the workforce. In 2005, a former director of Sellafield wrote to the NDA warning that competition and cost reductions could lead to serious

nuclear safety incidents, a concern that appeared to be shared by the government's independent nuclear safety watchdog the Nuclear Safety Advisory Committee. But it's also worth remembering some downsizing of the national workforce is inevitable as sites shift from commercial production to decommissioning mode. For example, following the planned closure of Thorp reprocessing operations in 2012, the Sellafield nuclear workforce is expected to shrink dramatically from around 12,000 employees to about 4000, a 67% reduction, by 2018. Moreover the £1.27 billion income generated from the NDA's commercial reprocessing and electricity generation activities inherited from BNFL only just outweighs the £1.15 billion cost of operating those facilities.

The NDA's chief executive recently pointed out that if the NDA shut down its commercial activities to focus wholly on decommissioning, then it would lose the marginal 10% benefit of operating these facilities, but it would also cut its annual operating costs by 55%, bringing the NDA's total spend down to about £1 billion a year – in line with the government's long-term spending plans. On the other hand, the construction of new nuclear stations over the next five to ten years would further increase demand for skilled labour from the shrinking pool of nuclear workers, inevitably increasing salaries for both decommissioning and construction projects. The Blair government's energy review, published in July 2006, supported the development of a new generation of nuclear power stations, provided that these could be financed within the private sector.

In March 2006 the Nuclear Industry Association (NIA) forecast that new nuclear build would need an average of 1400 construction jobs at each new nuclear power station, creating a demand for perhaps 4200 extra workers for a likely series of three new PWR stations. However, construction of reactors would probably require few specialist nuclear engineers and could be mostly undertaken by civil, electrical and mechanical engineers from the UK construction industry. The NIA estimates a new build programme would only require about 5% of the total engineering resource pool available in the UK. There are a few pinch points where some specialist skills would still be needed, mainly where nuclear safety case and licensing expertise would be required. If there is a European resurgence in nuclear power then a queuing system will

probably develop for orders placed in the early stages of any 'nuclear renaissance', slowing down market growth. On balance, the overall picture is that a programme of new build would increase demand for people with nuclear skills but not dramatically so. A shortage of supply will tend to push wages upwards in a few key areas, such as safety and licensing, but won't necessarily escalate the wages of all nuclear workers across the board.

A final challenge facing nuclear contractors is the need to reduce costs through innovation. The nuclear research and development community has declined substantially in the UK from around 9000 researchers ten years ago to probably fewer than 1000 today. BNFL's research and development arm, Nexia Solutions, has gone from a peak of 1700 employees down to 657 and over the past year Nexia's turnover has fallen by £34 million – nearly a third of its business. While this drop is alarming, it's probably the right thing to do; research and development expenditure in other high tech companies is normally around 10% of sales. The NDA's annual spend on decommissioning is £960 million, implying the need for a research budget of about £96 million. This is close to the £90 million total actually spent by the NDA on research carried out by Nexia (£79 million), and Nirex (£11 million), which is now to become part of the NDA.

The NDA's 2006 report *Research and Development – Needs, Risks and Opportunities* sets out the key areas where innovation is needed. Because radioactive waste is extremely expensive to store and dispose, the overall policy direction is now towards smarter treatment rather than bulk disposal, and this becomes more capital intensive due to the processing facilities required. But because decommissioning is still a business where bills are driven by labour costs, the innovations would need to be spectacular in order to make any appreciable impact on reducing costs for taxpayers. In addition, decommissioning does not lend itself to automation.

The NDA sees more promise in technology transfer from other industries that can quickly be adapted to nuclear decommissioning. If a shovel works, then use a shovel. This more commercial approach seems to be the main area of interest at present. ■

*Based on the report "Paying for Nuclear Clean-up: An Unofficial Market Guide" by Ian Jackson, Jackson Consulting (UK) Ltd., PO Box 142, Newton le Willows, Cheshire WA3 2WB, UK*