Buried costs

In this extract from his new book, "Nukenomics – The commercialisation of Britain's nuclear industry", Ian Jackson looks at the radwaste disposal market and how it influences the economics of new nuclear build.

In principle, the market for selling radioactive waste management services is no different to any other business. The traditional commercial model for selling goods and services involves setting a price based on recovery of the company's fixed costs, variable costs, and sales and marketing costs plus a profit margin. Internal or virtual markets that operate inside organisations usually work in much the same way except there are no sales and marketing costs or profit margins added. Different parts of the same organisation trade with each other on the understanding that neither will generate a profit for their particular business group – an arrangement known as inter-trading.

The internal market for radioactive waste management services in the UK is operated today by the Nuclear Decommissioning Authority (NDA). The NDA is vertically integrated, meaning that it supplies waste management services to itself and – in theory at least – they ought to be cheaper than buying in nuclear waste services from an outside company if they were available on the open market. Prices for waste management ought to be the cheapest possible because the service is based on simple cost recovery with no marketing costs and no profit mark-up added.

The problem is that internal markets are rarely competitive, especially in the public sector. They lack any serious outside competition and competition is normally essential to drive down prices. Over the past five years, estimates of the NDA's cleanup costs have escalated on average by around 9% each year. This means that the cost of waste management services – the internal market price for dealing with waste – must also have escalated by around 9% annually because waste management costs are always a fixed proportion of the NDA's total liability costs. (The NDA's 2006/7 accounts show a nearly constant waste management cost segment ranging from 27% to 30% over the past five years.) The overall picture is that the NDA's £22 billion lifetime cost for managing the 478,000m^3 of intermediate- and high-level waste forecast by the Committee on Radioactive Waste Management (CoRWM), implies a levelised unit cost of some £46,000/m^3 of waste. These costs are basically for treating and storing radioactive wastes that will arise from the NDA's nuclear decommissioning programme. The cost is driven by the cost for building and running plants for retrieving raw radioactive waste from hazardous environments, processing and immobilising radioactive waste, packaging treated and conditioned radioactive waste, and for storing the packaged radioactive waste over the long term. If the lifecycle cost of a geological repository is also added – thought to be another £10 billion – then the total lifecycle cost rises to £32 billion, bringing the levelised cost of dealing with CoRWM's projected 478,000m^3 of waste to an astonishing £67,000/m^3.

For comparison, the price for disposal of low-level waste at the NDA's Low Level Waste Repository (LLWR) at Drigg in Cumbria is only around £2000/m^3. As a rule of thumb, the price for dealing with intermediate- and high-level waste seems to be about 34 times more expensive than for low-level waste, assuming an internal market operating on a simple cost recovery basis.

Officially there is no truly commercial international market for the disposal of intermediate- and high-level nuclear waste. In Britain, the bulk import and export of radioactive waste was banned under the July 1995 *Review of Radioactive Waste Management Policy: Final Conclusions* white paper. Instead each country is normally responsible for disposing of its own radioactive waste under the self-sufficiency principle of environmental management, requiring that most waste should be treated or disposed of within the region in which it is produced.

But unofficially countries do trade in small amounts of waste with Britain. These trades take place at what economists call the margin, in which foreign energy utility companies pay only the cost of providing some additional space for commercial waste in the British government's yet-to-be-built geological disposal facility for historic legacy decommissioning wastes. This marginal price gives an important commercial signal of the true market value of a radioactive waste disposal facility. Some insight into the marginal price of intermediate-level waste disposal was given for the first time in the government's detailed 70-page report, *Consultation Paper on Proposals for Intermediate Level Radioactive Waste Substitution*, published in January 2004.

Since 1976 spent fuel reprocessing contracts between Britain and nuclear utility companies in Europe and Japan have required the repatriation of radioactive wastes back to their home country, to avoid Sellafield becoming a 'nuclear dustbin'. However the British government offers an optional waste substitution service – for a price. Waste substitution is the practice of allowing disposal in the UK of foreign-owned intermediate-level radioactive wastes, that have arisen from the reprocessing of foreign spent nuclear fuel at Sellafield, in exchange for shipping a radiologically equivalent but physically smaller volume of high-level waste for return back to the overseas reprocessing customers. The advantage for foreign utilities is that they do not have to worry about constructing intermediate-level waste storage and disposal facilities in their own country, avoiding the high economic cost and political controversy of finding a disposal site. Not surprisingly, over 90% of the 325 organisations which responded to the government's 2004 consultation enthusiastically supported waste substitution. The government's Department of Trade and Industry officially approved waste substitution *via* a parliamentary statement on 13 December 2004. The NDA subsequently gave Sellafield operational approval for implementation of waste substitution to begin on 27 September 2006. The substitution consultation document explained that 6480 drums containing 3240m^3 of foreign-owned intermediate-level waste would be kept in the UK – a volume roughly equivalent to four medium-sized British houses. The approximate cost of disposal in a UK repository was estimated to be £87 million but the NDA would charge overseas utility customers a commercial fee of £650 million,

Special
NUCLEAR ENGINEERING INTERNATIONAL
Publications

Nukenomics

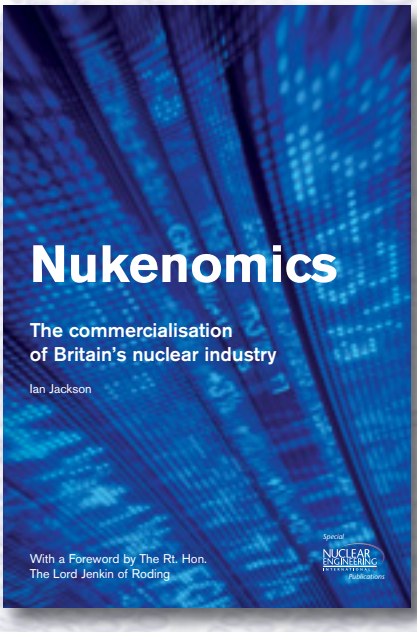
The commercialisation of Britain's nuclear industry

By Ian Jackson with a Foreword by The Rt. Hon. The Lord Jenkin of Roding

The British nuclear industry is once again experiencing rapid and turbulent commercial change, transforming from a handful of public sector owned organisations into a series of private sector ones ready to tackle Britain's £100-billion-plus nuclear cleanup legacy.

At the same time, just when the future of nuclear energy looked set to be in terminal decline, the politics of global warming have delivered a dramatic return to respectability for nuclear power. Significant investment in new British nuclear power stations now seems almost certain; a situation that was unthinkable just a few years ago.

The restructuring of Britain's nuclear industry, and the resulting implications for the private sector, are explained in Ian Jackson's book *Nukenomics – The commercialisation of Britain's nuclear industry*. This *Nuclear Engineering International* special publication describes the major trends and market forces that are actively shaping the future development of the nuclear industry today, by explaining not just what things are happening but, more fundamentally, why.



About the author

Ian Jackson joined the British nuclear industry in 1986 working initially at the Atomic Energy Research Establishment then later as a nuclear regulator. He is the author of *Siting New Nuclear Power Stations: Availability and Options for Government* published alongside the 2007 Energy White Paper. He received the Environment Agency's plain language award in 1999 for his report on the regulation of atomic weapons sites and has advised many public and private sector organisations on nuclear issues.

ORDER FORM

Nukenomics – The commercialisation of Britain's nuclear industry (ISBN: 9781903077559)

Author Ian Jackson
Publisher *Nuclear Engineering International*
Publication date April 2008
Price £20 including shipping

Send no money now. You will be contacted for payment on receipt of your order.

Please send me _____ copies of *Nukenomics* at £20 per copy

Name: _____

Address: _____

Tel: _____ Fax: _____

Email: _____

Nuclear Engineering International, 2 Maidstone Road, Foots Cray, Sidcup, Kent DA14 5HZ, UK
Tel: +44 20 8269 7773 Fax: +44 20 8269 7804 Email: info@neimagazine.com
www.neimagazine.com

delivering a net profit of £563 million (in 2003 prices) – a whopping 647% profit margin. The apparent willingness of overseas utilities to pay a very substantial premium gives an important signal of the true market price for radioactive waste disposal capacity in a British underground repository facility. The foreign utility companies appear to be paying a levelised unit disposal cost of some £201,000/m^3 of intermediate-level waste. This would value a commercial deep repository for dealing with all of CoRWM's projected 478,000m^3 of nuclear waste as worth around £96 billion if it operated on a fully commercial basis – roughly ten times the £10 billion total lifecycle cost of siting, building, operating and eventually closing a deep waste repository.

British policy of making the polluter pay – in this case overseas utility companies having their spent fuel reprocessed in the UK – means that polluters should quite rightly bear the full costs of their pollution, rather than avoid them. The important thing to remember is that these disposal prices and profit margins are what commercial utilities are willing to pay, not what they actually cost. Nobody is twisting their corporate arms. The utilities could, after all, simply take back their intermediate-level waste and dispose of it themselves. But they don't of course, because Britain offers a relatively good deal for nuclear waste disposal – a very hard to find service, priced at a level that makes good money for the British economy, that foreign utilities can afford to pay.

PAYING THEIR FULL SHARE

The price of waste disposal in a geological repository has become more commercially important with the publication of the government's *White Paper on Nuclear Power* published in January 2008. As a pre-condition for allowing the construction of a new generation of nuclear power stations in Britain, the government decided that energy utility companies must meet their full share of the costs for nuclear waste management and disposal. According to the white paper, energy companies have indicated that they would be prepared to pay a significant risk premium, over and above the expected costs of disposing of waste, in return for having the certainty of a fixed upper price.

In plain language, the energy companies want fixed price caps on nuclear waste disposal; an understandable position given that the Nuclear Decommissioning Authority's (NDA's) waste management cost forecasts have escalated by 9% annually in recent years. Because the NDA is already charging foreign nuclear utilities a premium of 647% profit margin for disposal of substituted intermediate-level wastes, then logically this market premium should be the disposal pricing benchmark for British nuclear utility investors too. Commercially speaking, it is hard to justify charging British utility customers a lower price for geological disposal than overseas utility customers paying for disposal in the same repository. It would also risk accusations of giving preferential state aid subsidies to nuclear energy utilities investing in Britain, that are potentially illegal under European state aid competition law.

The issue of what utilities should commercially pay as their fair contribution towards the full share of the costs of a repository is controversial because the wastes produced from new nuclear reactor build could have a significant impact on the overall scale of a geological repository. CoRWM's July 2006 report, *Managing our Radioactive Waste Safely*, warned ministers that the greatest impact on the total radioactive inventory of a nuclear waste repository – the total amount of radioactivity contained at the disposal site – would be from a future programme of new nuclear reactor build. Assuming that 10 new nuclear reactor units were built in Britain, CoRWM estimated that the total volume of waste in a repository would increase by about 8% (some 41,000m^3 comprising an extra 9000m^3 of intermediate-level waste and 32,000m^3 of spent fuel waste) but the total radioactivity in the repository would increase by 300%. Ten reactor units is a sensible forecast because this number would be needed to replace the 9GWe of nuclear capacity expected to be lost from retirement of Britain's Magnox and AGR nuclear power station fleet over the next 15 years.

Assuming that British utilities would pay the same £201,000/m^3 disposal price tag as overseas utilities, then the price of waste disposal for a new build programme would be around £8.2 billion. On the other hand, if the utilities paid only the NDA's internal market rate of £46,000/m^3, the minimum to recover its present waste management costs, then the price of waste disposal from a new nuclear build programme would fall to £1.9 billion. In fact the expansion of a repository to accommodate new build waste might prove to be quite cheap because of the economies of scale normally achieved from scaling up industrial plant capacity. The 'six-tenths rule' is often used in the process industry as a general guide to calculating the extra costs of a larger plant. If the cost price of a plant '£P1' is known at capacity 'C1', then the cost price of a new plant '£P2' of capacity 'C2' is given by £P2 = £P1 x $(C2/C1)^{0.6}$. Using the six-tenths rule, increasing the repository size from CoRWM's 478,000m^3 base case up to 519,000m^3 to accommodate an extra 41,000m^3 of new build waste, would probably increase repository costs by only around 5%. Because the total lifecycle cost of a repository is thought to be £10 billion, the price of extra space for new nuclear build waste ought to be around £500 million. This would bring the marginal cost of disposal of new build waste in an expanded repository down to a rock bottom price of £12,200/m^3 of waste.

British nuclear utility companies would be well advised to lobby for disposal prices fixed towards the lower £500 million valuation, perhaps adding a fairly generous 100% market premium to reflect the risk of repository cost escalation borne by the NDA. Meanwhile taxpayers and the Treasury might want to press for the full £8.2 billion marginal valuation that foreign nuclear utility companies appear willing to pay for geological disposal of substituted wastes. The problem is that unfortunately this fully commercial price would make disposal far too expensive, killing the prospects of any new nuclear build programme in Britain. The £8.2 billion waste disposal cost, spread across 10 new reactors, amounts to £820 million per reactor, equivalent to 41% of each reactor's expected £2 billion capital cost. Business models for nuclear generation assume back end costs of only 5% for decommissioning and waste management. As a result, the NDA may need to fix repository waste disposal prices in the range from £500 million to £1000 million (£50 million to £100 million per new reactor) for new build to remain economically viable. The bottom line is that nuclear energy utilities probably need fixed waste disposal 'prices' for repository disposal capped somewhere in the range from £12,200 to £24,400/m^3, but the NDA's true marginal 'cost' is nearer to £67,000/m^3, and the commercial 'value' of the repository asset could approach £201,000m^3 if operated as a fully private sector venture.

Extracted from "Nukenomics – The commercialisation of Britain's nuclear industry" by Ian Jackson, published in April 2008 and available from Nuclear Engineering International. Ian Jackson, Jackson Consulting (UK) Limited, PO Box 142, Newton le Willows, Cheshire WA3 2WB, UK