CARL THEMATIC REPORT

Six Domains of Decision for Stakeholder Involvement in Nuclear Waste Management

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December 2007

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1. Introduction: Nuclear Waste Management as a Process of Technical and Political Collection and Isolation

In and of themselves, radioactive wastes can be viewed as relatively straightforward wastes as only one type of hazard – ionizing radiations – is usually considered important in defining them. The emission of ionizing radiations from, for example, spent nuclear fuel is spontaneous and uncontrollable, posing an extreme threat to human health and the environment. This problem is then greatly exacerbated by the exceedingly slow rate of decay of many radionuclide atoms rendering them a continuing and inescapable threat for as much as 100,000 years. Initially, when the problems posed by the waste materials resulting from nuclear weapons and nuclear energy production were first recognized in the 1950s, two broad approaches to disposal were envisaged. The first of these was the dilution and dispersal of the wastes throughout the oceans of the world, while the second was the collection, containment and isolation of the wastes in some inaccessible location (Berkhout 1997: 289, de la Bruhèze 1992: 151). Already by the mid-1950s, the latter option was agreed upon as the basic objective of nuclear waste management. In line with this consensus, the first evaluation of geological disposal was published in 1957 by the US National Academy of Sciences focussing on the suitability of different rock types (Sundqvist 2002: 65). Subsequently, when nuclear waste emerged as an issue of considerable public concern during the 1970s, in countries like (West) Germany, Sweden, the UK and United States, it was the alleged technical feasibility of achieving the long-term collection and isolation of wastes, through geological disposal for example, that was advanced as the best recipe for confronting public disquiet. Thus, during the course of the 1970s, it became increasingly apparent that the technical task of collecting and isolating nuclear waste from the biosphere is simultaneously a political task. It can be understood as a combined technical and political task which needs to be addressed not only to protect human health and the environment, but also to respond to the vision of nuclear waste as an Achilles Heel cancelling out the advantages to be won from the development of civil and military nuclear technologies alike (Blowers et al 1991).

Perhaps most notably in Sweden during the 1970s, although similar moves were made in other countries (eg. in West Germany and the UK), the completion of a domestic nuclear power programme was, through government legislation, made conditional upon the presentation of a demonstrated long-term solution to the waste problem. As a result of this

legislation, what could be interpreted as a combined technical and political demonstration of 'absolute nuclear fuel safety' called the KBS concept was launched in Sweden at the end of 1977. As a technical blueprint, this concept was designed to publicly invalidate the claims of the anti-nuclear movement concerning the uncontainable and incalculable perils of the peaceful atom (Anshelm 2006: chp.3, Sundqvist 2002: chp.4). At roughly the same time in the United States, concern rapidly escalated over the potential threats arising from nuclear materials, including reprocessed or non-reprocessed spent fuel, falling into the wrong hands. By 1974, the US Atomic Energy Commission had begun to envisage the public harm resulting from the explosion of an illicitly made nuclear weapon as greater than that resulting from any plausible reactor accident (Walker 2001: 107). Thus, the issue of so-called nuclear 'safeguards' gained prominence as a vital dimension of all comprehensive nuclear waste management programmes. Not only, are all such programmes today dedicated to the isolation of hazardous waste from the biosphere, but also, to varying degrees, to the secure distancing of various unpredictable rogue elements (for example, terrorist organizations) roaming the biosphere from the waste.

Differences of technical and political opinion over the relative importance of the nuclear safeguards issue has led to the emergence of profound differences in nuclear waste management practice between, for example, the United States and Sweden versus France and the United Kingdom (Carter 1987, Walker 2000). After the 1970s, Sweden has followed the lead of the US in classifying spent nuclear fuel as a waste product for direct disposal. In the US, this classificatory practice directly expresses concerns over the risks for nuclear proliferation that an international nuclear reprocessing industry is believed to represent. In Sweden, on the other hand, concerns over nuclear proliferation have melded with a long-standing commitment to phase out nuclear power, to make the direct geological disposal of the nation's spent nuclear fuel the most rational policy option to pursue. In contrast to Sweden and the US, France and the UK continue to classify spent nuclear fuel as a resource, not a waste product. This is simultaneously a technical and a political choice relating to decisions not to treat nuclear reprocessing as something to abstain from for reasons of international security. This willingness on the part of some nations to keep in circulation nuclear materials that others consider best kept protected and isolated is one important influence shaping the scope and focus of stakeholder involvement in nuclear waste management today.

Therefore, it can be asserted that appreciating the full scope and potential for stakeholder involvement in nuclear waste management entails an appreciation of the field as one *where technical options and political choices cannot be pried apart*. *Every technical decision in nuclear waste management is also a political decision and vice versa.* Currently, it can be argued that the inseparability of technology and politics in nuclear waste management is only officially-acknowledged and widely recognized in one domain: the siting of waste facilities and geological repositories in particular. Here, despite the case of Yucca mountain, the achievement of *local consent* has won near universal recognition as a legitimate factor in contemporary siting decisions. That just siting decisions have become more easily recognizable as simultaneously technical and political decisions can be related to a central paradox of nuclear waste management as a process of collection and isolation: rendering nuclear waste and nuclear waste politics peripheral to more or less everywhere, always implies bringing them home to somewhere. For some location, or some small collection of locations, national or international success in nuclear waste disposal, will always mean that nuclear waste, both physically and politically, becomes anything but peripheral to their future existence. Hence, if nuclear waste management as collection and isolation is to be prevented from automatically leading to the creation of so-called 'peripheral communities', characterized by powerlessness, economic marginality and environmental degradation (Blowers 1999, Blowers and Leroy 1994), the need to allow for just local stakeholder involvement in siting decisions can appear unquestionable.

In this paper, the ambition is to look beyond what has been described as democratic localism (Hunold 2002) and currently existing citizen stakeholder involvement focussing on the issue of local consent to the siting of given waste facilities, to discuss the scope and rationales for less confined national citizen stakeholder involvement offering broader recognition to the inseperability of technical and political decision-making in nuclear waste management. In relation to such broader and more inclusive stakeholder involvement, neither the stakeholders, nor the issues, nor the technologies, nor the sites for involvement are so closely circumscribed or pre-determined as in more established cases of local stakeholder involvement. With reference to the CARL countries, while Sweden and Belgium have been among the pioneers in fostering democratic localism and local stakeholder involvement, the 'participatory turn' in UK nuclear waste management can be seen as an interesting experiment advancing more inclusive national stakeholder involvement. This more inclusive approach relates to a felt need in the UK to 'go back to first principles' after 1997, and to open up a greater variety of

so-called upstream issues in nuclear waste management to public engagement and citizen stakeholder involvement – that is issues in a nuclear waste management programme arising *prior* to the issue of the acceptability of a given facility in one or several of a limited number of candidate communities (Simmons, Bickerstaff and Walls 2006, Chilvers 2007).

In the next section we shall clarify further the differences between local stakeholder involvement versus national stakeholder involvement in nuclear waste management. We shall do this by attending to the different types of stakeholder identity underlying each of them. In brief, local stakeholder identities relate firstly to either voluntary, or involuntary acts of inclusion in the siting of more or less well-defined waste facilities. Following such inclusion, stakeholder involvement comes to revolve around efforts to build and maintain trust and acceptance for a developer and their facility among a limited local population, extending to an acceptance of the waste itself as *legitimately belonging* in the locality. A national stakeholder identity, on the other hand, relates firstly to membership of a nation-state which has after 1945 enjoyed the benefits, and lived with the risks, of nuclear power production and, in some cases, the security provided by a nuclear weapons deterrent. As will be discussed, national stakeholder involvement in nuclear waste management continues to remain under-developed, not only because of anti-nuclear sentiment and widespread 'nuclear fear' (Weart 1988), but also due to the general absence and invisibility of the waste problem in the everyday lives of most citizens living in nuclear states. It remains hard for citizens in general to seek involvement in a problem, or recognize any ownership of it, as long as the lines of connection implicating them in its existence remain relatively indistinct and opaque.

After establishing the difference between local and national stakeholder involvement, we shall set about outlining and discussing six interlocking decision domains constituting six potential arenas for the variable and contestible growth of public engagement and citizen stakeholder involvement in nuclear waste management. In all of these domains for involvement, tightly-wedded technical and political decisions have to be made, if programmes of nuclear waste management are to advance. As shall be related, with reference to different CARL country experiences, public engagement and stakeholder involvement in all of these decision domains, apart from one, has been hitherto limited. While there remain no final guarantees that enlarged public engagement and stakeholder involvement across these domains will lead to better quality decisions, the continued absence of such engagement and involvement, no doubt constitutes one important reason why so few communities, not already hosting nuclear

facilities, have been persuaded to actively participate in the site selection processes for specific waste facilities. The six interlocking domains for the potential growth of broader citizen stakeholder involvement in nuclear waste management can be initially set out as follows:

1. The 'What' Question – What is nuclear waste for collection and isolation, and what is not?
2. The 'Why' Question – Why is collection and isolation being pursued?
3. The 'Who' Question – Who shall be responsible for planning and executing collection and isolation?
4. The 'When' Question – What time frame should be set for the carrying-out of collection and isolation?
5. The 'How' Question – How should collection and isolation be achieved?
6. The 'Where' Question – Where should collection and isolation take place?

In the concluding discussion we shall return to the issue of the interrelations of local and national stakeholder involvement. The focus of attention will be on nuclear waste management and disposal as implying a phased public disinvolvement with the waste question as programmes of collection and isolation proceed. In this connection the qualities of voluntarism as a mechanism for legitimately advancing phased disinvolvement will be discussed. In particular, given different CARL country experiences, voluntarism will be discussed as a mechanism promoting the growth of a new breed of 'nuclear parks' as the siting processes for major waste facilities tend to gravitate towards existing nuclear sites.

2. Local Stakeholder Involvement versus National Stakeholder Involvement

As was shown in the CARL Country Reports, new patterns of stakeholder involvement in nuclear waste management can be characterised as responding to failures of 'technocratic decision-making'. Technocracy is usually defined as the government or control of society by an élite of technical experts, and is typically counterposed to more participatory and inclusive patterns of decision-making. However, when it comes to nuclear waste management, while technocracy can be presented as a problem during the collecting and isolating of wastes, it must still be seen as legitimately characterising its final goal. The objective after all is to place nuclear waste *outside* of society, and somewhere where no one, or perhaps only a

relative few (hopefully skilled and expert, if not an élite), need to be concerned, and practically involved with it in future. Viewed in this light, what have tended to be labelled failures of 'technocracy' in nuclear waste management, may also be fruitfully analysed as failures of 'participation'. Protests in all the CARL countries against geological and geotechnical investigations in particular locations have been typically protests *against* local involvement and participation in nuclear waste management and *for* the exclusion of the citizenry concerned from policy programmes. As simultaneously failures of technocracy and broader countrywide participation, these events can be said to coincide with a *premature public withdrawal from participation in* nuclear waste management at the outset of policy programmes. Getting collection and isolation right appears to imply phased public disinvolvement with the waste, as a combined process of technical and political decision-making first addresses the 'what', 'why', 'who' and 'when' questions, before moving on to the questions of exactly 'how' and 'where'. However, when very many citizens and their communities appear determined to distance themselves from the problem from a very early stage, then phased public disinvolvement can quickly appear as unrealistic.

Reinterpreting what have been labelled failures of technocracy, as encompassing failures of participation, we can see such failures as actually encouraging, as much as discouraging, technocracy in nuclear waste management. Given the very real and even pressing existence of a waste problem, and the size and magnitude of the task of collection and isolation, what can be done in the face of early countrywide withdrawal from policy processes, other than persevere with these processes left concentrated in the hands of expert and professional stakeholders and just a few residual local communities? As we shall see, treating widespread public desertion of the waste problem as confirming the inescapability of something approximating technocratic control, or alternatively, as motivating a return to 'first principles' and attempts to include citizen stakeholders from day one in collection and isolation processes, are two different policy directions currently setting the CARL countries apart.

When does a combined crisis of technocracy and participation in nuclear waste management trigger a return to 'first principles'? When does such a crisis end up highlighting the self-defeating nature of technocracy, rather than its inescapability? The different patterns of stakeholder involvement we witness in Sweden and Belgium versus the UK today, reflect qualitative differences in the waste management crises these countries faced during the 1990s. In Sweden, there has never been a total crisis of participation in nuclear waste management.

During the 1980s, two major waste facilities, CLAB and SFR, were established in Oskarshamn and Östhammar *without* significant local or national stakeholder involvement, at the same time as a wave of local protests blighted attempts to advance the siting of a deep repository for the nation's spent fuel. As the crisis of participation in the siting of a deep repository for spent fuel worsened *after* a turn to voluntarism in 1992, the critical issue for SKB (Swedish Nuclear Fuel and Waste Management Company) became how to guarantee the participation of communities already hosting nuclear facilities in the new siting process, as the supply of alternative volunteers dried up. In this situation, the Muncipality of Oskarshamn (Sweden's first large-scale commercial reactor site) itself came to play a key role in heightening both the legitimacy and the fruitfulness of SKB's shift to a siting process for a KBS-3 repository based on voluntarism and local acceptability. The municipality saw in the early nineties, how a crisis of participation afflicting the siting of such a repository was growing acute for SKB, especially after initial feasibility studies in the north of Sweden had run into problems. Given this situation, Oskarshamn anticipated that SKB were on the verge of turning to communities already hosting nuclear facilities, and started lobbying government to win more autonomous powers for all communities volunteering to join the siting process for a KBS-3 repository (Elam and Sundqvist 2006). Oskarshamn, therefore, were already busy engaged in reforming a national siting process *before* they officially joined it as a volunteer. Through their actions, the Municipality of Oskarshamn not only succeeded in empowering themselves as a local stakeholder, but also in assuming the role of a local guardian of the siting process for a KBS-3 repository as a whole.

The turn to voluntarism in the siting of a low- and intermediate level waste facility in Belgium in 1998, came after 47 non-nuclear communities had removed themselves from a list of potential sites for a repository (Bergmans and Van Steenberge 2006). In notable contrast to SKB, NIRAS/ONDRAF (Belgian Agency for the Management of Radioactive Waste and Enriched Fissile Materials) felt obliged at this point to abandon a strictly technocratic approach not only to the 'where' question regards the siting of a repository, but *also* to the 'how' question regards repository design. So, NIRAS/ONDRAF have been closer than SKB to a return to 'first principles', but still only in relation to the collection and isolation of given types of waste, and only within the framework of locally-defined 'mini-public' partnerships where the overriding concern has remained the achievement of a locally-negotiated settlement of the 'where' question regards an 'integrated repository project'.

In the UK, crisis in nuclear waste management after 1997 can be presented as having been deeper and more profound than anything experienced in Sweden and Belgium for two reasons which together have compounded the case for a more fundamental 'return to first principles'. Firstly, while siting processes for specific waste facilities in Sweden and Belgium may have ground to a halt in the past, and suffered severe setbacks, they have never demonstrably failed in the same highly-visible fashion as the siting of a Rock Characterisation Facility (RCF) in Sellafield failed in 1997. If Östhammar, Oskarshamn and Nyköping had joined their fellow nuclear community Varberg in saying no to a local feasibility study in 1995, then SKB's KBS-3 repository might have reached a similar point of no return. Also, if Mol and Dessel had joined the nuclear communities of Huy and Beveren in abstaining from identifying themselves as local stakeholders in the siting of a repository for low- and intermediate level waste, this project might also have been more or less doomed, rather than severely setback and delayed. The problem in the RCF case was that Nirex (Nuclear Industry Radioactive Waste Executive) appeared to be treating local acceptability as an important factor in the siting process while still not officially acknowledging that they were doing so. By failing to adopt the principle of voluntarism, the move in 1989, from 537 potential sites across the country, down to just two in the nuclear communities of Sellafield and Dounreay appeared too convenient and contrived. Rather than a legitmate balance of technology and politics, politics appeared to be decisively steering a siting process, which was still being publicly portrayed as overwhelmingly technical in character (Simmons, Bickerstaff and Walls 2006). After being refused planning permission by Cumbria County Council for a siting of the RCF in Sellafield, the subsequent Public Inquiry became an arena for the prolonged public condemnation of Nirex's siting strategy, culminating in a government statement confirming the need for full disclosure and complete openness in any future RCF development plans. In the face of such overwhelming public criticism, Nirex was forced to accommodate a fundamental rethink of nuclear waste management as a combined process of technical and political collection and isolation.

The second reason why crisis in UK nuclear waste management after 1997, has been more severe than the crises experienced in other CARL countries, connects with the existence of a more pervasive crisis of science and society relations in the UK from the mid-1990s onwards. The RCF siting failure in Sellafield came directly after the BSE crisis in the UK, when expert advice on food safety was shown to be desperately wanting (Simmons, Bickerstaff and Walls 2006). This initial highly-profile case led to a growing crisis of public confidence in expert

authority across many sectors in the UK, which after the RCF debacle, also came to engulf the field of nuclear waste management. In 2000, an influential House of Lords Select Committee went as far as to claim that science's 'license to practice' in society could no longer be taken for granted. It also concluded that, if confidence in science in the UK was to be restored, direct dialogue with the public should henceforth form an integral part of all science-based policy-making (House of Lords 2000).

This recommendation, and a more pervasive 'participatory turn' in UK science and society relations, clearly influenced the new Managing Radioactive Waste Safely (MRWS) process set in motion after 2001. Even prior to this date, a new commitment to broad citizen stakeholder in UK nuclear waste management had been established by events such as the National Consensus Conference on Radioactive Waste co-sponsored by Nirex in 1999, and the Citizens' Panel on Partitioning and Transmutation commissioned by Nirex, and held at Lancaster University in 2001. These 'upstream' or 'front end' stakeholder involvement events are clearly different from the local patterns of stakeholder involvement we find in CARL countries like Sweden and Belgium. A key point is that they appear to be premised on the assumption that, public desertion of the waste problem can be potentially overcome. If ordinary citizens living in nuclear states, but outside of nuclear communities like Oskarshamn, Mol and Sellafield can be successfully included as active participants in events discussing basic policy options and technical choices, then phased public disinvolvement in the design and siting of nuclear waste facilities no longer needs to be seen as so unrealistic.

Of all the CARL countries, Sweden can be seen as having had the greatest experience of national stakeholder involvement in nuclear waste management. This involvement, however, was firstly connected with the growth of a popular anti-nuclear movement in the 1970s, where the waste issue was repeatedly presented as an uncontainable and irresolvable problem. Prior to the Three Mile Island incident, it was the waste problem, rather than that of reactor safety, that was put forward as the primary reason for Sweden to curtail its nuclear power programme. In this context, a national stakeholder identity was called into being, for example, by the radical scientist Hannes Alfvén, when he claimed that everytime a family cooks dinner using nuclear power they deliver a deadly dose of waste into the care of future generations (Alfvén 1975: 16). It was just in response to the claims of the Swedish anti-nuclear movement, including an anti-nuclear Prime Minister, regards an irresolvable waste problem, that the KBS (Kärnbränslesäkerhet/Nuclear Fuel Safety) project was first initiated in Sweden

in 1976. Given that nuclear waste management has encompassed, not only in Sweden, but also more widely, an ambition to counter popular anti-nuclear forces in society how can a new commitment to enlarged national stakeholder involvement be embraced today? In light of past experiences, opening up for national stakeholder involvement can appear to be only asking for a return to political trouble and strife.

Arguably, the justification for broader public engagement and stakeholder involvement in nuclear waste management today stems from the success of nuclear power and weapons producers in overcoming opposition to the development of nuclear technologies in the past. When we take into account that nuclear power currently generates about 59% of the electricity consumed in Belgium, roughly 33% of that consumed in Slovenia, 45% of that consumed in Sweden and 20% of that consumed in the UK, continued public neglect of the waste problem in these countries can appear indefensible. Through systems of finance for nuclear waste management introduced in countries like Sweden and the UK, consumers of nuclear power have already been established as financial stakeholders, and as the 'polluters' that ultimately pay for the solution of the waste problem. However, rather than coinciding with an acceptance of nuclear citizenship and some measure of collective responsibility for the waste problem, such payment at present perhaps more closely resembles 'hush money' – money knowingly (or unknowingly) paid to keep the waste problem out of citizen sight and out of citizen mind.

For both local and national stakeholder involvement to advance, ownership of the waste problem needs to be renegotiated and partly redistributed. Professional and expert ownership of the problem must be to some degree relinquished, as wider public ownership is both recognized and accepted. Local stakeholder involvement as manifested in the CARL countries still only bears witness to limites renegotiations and minor redistributions of waste problem ownership. In the first instance, it appears as if minor extensions of waste problem ownership, beyond expert control, are only condoned in order to win access, to a minimally adequate number of candidate sites, for more or less given waste facilities. Thus, it remains questionable whether nuclear waste management is actually being drawn *into* society through local stakeholder involvement, or if the few participating communities are not actually being drawn *out* in order to align them with what remain relatively closed decision-making circles. If extending some stake in the waste problem to the consumers of nuclear power (the polluters who finally pay) is one basis upon which a firmer platform for broader citizen stakeholder

involvement might be constructed, even other ways of elucidating the bases for such involvement are imaginable. In the Swedish context, for example, nuclear power has been associated with the emergence of a distinctive 'development block' in national socio-economic development (Kaijser 1992). From this perspective, some consumers of nuclear power can be seen as always having been larger and more *intensive* than others. The development of nuclear power generation in Sweden was firstly of benefit to the domestic steel and paper and pulp industries whose competitiveness was greatly enhanced by cheap and plentiful energy supplies. In addition, even Sweden's early abortive attempts to build a sophisticated heavy-water reactor in the late 1960s, provided invaluable experience for a domestic electrical equipment industry as this evolved into an internationally-competitive constructor of nuclear reactors not only in Sweden, but also in Finland (Kaijser 1992: 451). Thus, all of the constituent elements in a Swedish nuclear 'development block', encompassing the local communities that these different elements have historically-sustained, can be seen as deserving inheritors of a stake in Swedish nuclear waste management as phased collection and isolation of wastes.

Citizen stakeholder involvement may even advance, and in turn, be advanced by, greater recognition of shared ownership of waste problems between nations. Several years ago, for example, a debate was initiated in Australia as to whether their mining and export of uranium for nuclear fuel production implicated them in the nuclear waste problems of other nations (Holland 2002). The UK, Sweden, Finland and Belgium are all significant importers of Australian yellowcake establishing substantive material relations of connection between mining activities on one continent and the production of nuclear waste on another. While the position of the Australian government currently remains that no relationship can be established between benefitting from the sale of uranium and taking responsibility for the waste produced through its use, important arguments have been made to the contrary (Holland 2002: 287). One argument is that, even if Australia refrains from building waste facilities of their own, they could still, in their capacity as a 'non-local stakeholder', make their sales of uranium conditional upon the ability of recipient nations to provide evidence of advancing waste disposal plans. In similar fashion, a recent Swedish television documentary (autumn 2007) has sought to stimulate debate around the environmental despoilment created by uranium mining in Australia which can in part be attributed to Sweden's unwillingness to exploit their own significant uranium reserves.

3. Six Interlocking Domains for Stakeholder Involvement in Nuclear Waste Management

Accepting nuclear waste management as a combined task of technical and political collection and isolation, national stakeholder involvement can be viewed as more of an 'upstream' endeavour (deliberating over basic policy options), while local stakeholder involvement can be seen as an essentially 'downstream' phenomenon (deliberating over site-specific issues for given facilities). Thinking in these terms, however, can be deceptive. The 'stream' in question always remains a contingent path, never maturing into a natural course for the collection and isolation process to follow. It remains a contingent path because its course is continually being influenced by the quality of the combined technical and political decisions underlying it, through which, for example, the very definition of nuclear waste may change. Thus, we should not be surprised to find discontinuities approximating the rule in collection and isolation processes, and continuities forming the exception. Unfortunately, it is impossible to stake out a path for a collection and isolation process to follow with the same confidence as we can predict the half-life of plutonium-239 or uranium-234.

One problem currently blighting the collection and isolation of nuclear waste in different contexts is the still persistent habit of trying to separate out essentially technical decisions, from essentially political ones. This risks balkanising collection and isolation processes, so that, for example, the 'how' question may develop into a jealously protected technical issue, ruling out extended stakeholder involvement, while the 'where' question may be categorized as an overwhelmingly 'political' question, over which the issue of local acceptability is allowed to rule supreme. In relation to the six domains for citizen stakeholder involvement to be discussed below, it is important to recognize that, in each and every one of them, technology and politics cannot be finally divided. Neither can be allowed, or expected to finally rule over the other, as both remain, to a greater or lesser extent, embedded in each other. Even their degree of mutual embeddednesss is not something that can be objectively determined and finally decided, but at best, only persuasively argued, and/or convincingly demonstrated.

3.1 The 'What' and 'Why' Questions

A striking feature about stakeholder involvement in nuclear waste management in the different CARL countries is that the waste being addressed is not the same waste. While all the CARL countries may agree that nuclear waste management in a nutshell is collection and isolation of the waste from the biosphere, and while all may express a preference for geological disposal, *what* they are most immediately concerned to isolate and dispose of differs. Agreeing that something is radioactive is one thing, but agreeing that it is radioactive waste is another. What nuclear waste is in the different CARL countries differs firstly according to how involved or uninvolved the country is in nuclear reprocessing. Part of the reason why Sweden appears to have come so far in nuclear waste management is that they have kept nuclear life relatively simple for themselves and curtailed their involvement in reprocessing. When nuclear waste became a matter of public concern in Sweden during the 1970s even the opponents of nuclear power tended to take it for granted that spent fuel from Swedish reactors would be reprocessed. The key recommendation of the 1976 Swedish Government Committee on Radioactive Waste was that plans for a Swedish reprocessing plant with a capacity of of 800 metric tons a year should be made as soon as possible so the plant could in operation by the early 1990s (SOU 1976: 32 p10). However, after 1978, the Swedish attitude to reprocessing changed completely. After this date, spent nuclear fuel became nuclear waste for direct disposal in Swedish bedrock. This was a combined technical and political decision mirroring both international concerns over nuclear proliferation and domestic opposition to the nuclear industry. However, it is also a decision that the Swedish nuclear industry has come to embrace over time enabling them to focus on the development of waste disposal technologies, while resigning all interest in joining the ranks of nuclear reprocessors. The history of SKB is the history of this change of Swedish nuclear heart. From an initial and short-lived focus on new technologies of 'nuclear fuel supply' (Kärnbränsleförsörjning - KBF) to a long-lasting and dedicated concern with new technologies of 'nuclear fuel safety' (Kärnbränslesäkerhet - KBS). While defining spent nuclear fuel as nuclear waste gives you larger volumes of highly radioactive material to dispose of, it also encourages you to address the disposal of this material sooner rather than later.

In this context, the UK stands in stark contrast to Sweden. The UK has been a dedicated nuclear reprocessor stemming to begin with from its early interest in producing plutonium for

its post-1945 nuclear weapons programme. Reprocessing then became an integral part of the civil nuclear programme due to the relative inefficiency of the first generation of magnox reactors running on unenriched uranium, and thereby requiring more frequent refuelling (Carter 1987: 235). Interim storage of spent magnox fuel was also complicated by the fact that the fuel's casing corrodes in water (Walker 2000: 835). Even the UK's second generation advanced gas-cooled reactors (AGRs) were accompanied by a commitment to reprocessing, despite the fact that long-term interim dry storage of spent fuel deriving from these reactors, as well as from later magnox reactors, was shown to be feasible (Harris 2000, Walker 2000). So unlike Sweden's brief flirtation with reprocessing, the UK civil nuclear programme has been ensnared and entrapped in a closed nuclear fuel cycle since birth (cf Walker 2000). It is only in relation to the operation of the UK's first pressurised light-water reactor at Sizewell that reprocessing has not been considered imperative, although the spent fuel from this plant is still not currently classified as waste (Defra 2007: 11). The UK commitment to reprocessing has made one site, Sellafield (formerly Windscale), into a national and international collection point for spent fuel. While spent fuel in Sweden is collected in Oskarshamn for unreprocessed interim storage in CLAB, the vast majority of spent fuel in the UK has always been transported to Sellafield for reprocessing. As a result of these differing arrangements, Oskarshamn has developed in the last twenty years into a recognized international centre for innovations in geological disposal technology, while Sellafield has developed into such a centre for (troubled) innovation in nuclear fuel supply. Prior to the construction of CLAB, the first spent fuel from Oskarhamn's first reactor was transported to Windscale for reprocessing in 1975. The understanding at that time was that British Nuclear Fuels Limited (BNFL) would retain the high-level waste resulting from reprocessing and take care of its disposal (SOU 1976: 26). This prioritising of the development of nuclear fuel supply services over the development of nuclear waste disposal technology became a source of public controversy in the UK during the 1970s. Like the Nuclear Power Stipulation Act in Sweden demanded in 1977, the 1976 Flowers Report in the UK recommended that no further commitment to the expansion of nuclear activities in the UK could be made until 'it has been demonstrated beyond reasonable doubt that a method exists to ensure the safe containment of long lived, highly radioactive waste for the indefinite future' (quoted in Carter 1987: 241). This appeared a particularly important recommendation in relation to the continued development of reprocessing in the UK as the first contracts to reprocess foreign spent fuel at Windscale had not included return-to-sender clauses regarding the resulting high-level waste (Blowers et al 1991: 59). However, with the introduction of such clauses, the UK

commitment to reprocessing has remained in place and been reconfirmed, for example, by the commissioning of the new Thermal Oxide Reprocessing Plant (THORP) in 1994. If the UK had been able (or forced) to follow the Swedish pattern and had redefined spent fuel as waste during the 1970s, they might also have come as far today in implementing a repository concept like KBS-3. Instead, the majority of the UK's (and a significant portion of Japan's) high-level waste currently remains unconditioned and stored in liquid form in water cooled tanks in Sellafield. Rather than geological disposal, the next step for this waste is vitrification (to be completed around 2015), to be followed by a period of at least 50 years interim storage for the UK portion of it, again in Sellafield (Simmons, Bickerstaff and Walls 2006, Walker 2006, Thompson 2000).

If spent fuel is waste in Sweden, but not waste in the UK, Belgium appears to be struggling to make up its mind. Belgium has been more entangled with reprocessing than Sweden, but less than the UK. Thanks to the aborted transnational Eurochemic venture, where Sweden was a participating country, Belgium was host to a prototype reprocessing plant *before* it had established a domestic nuclear energy programme. Then, after nuclear power production commenced in Belgium in 1975, spent fuel was sent to La Hague for reprocessing until a government moratorium was imposed in 1993 preventing further reprocessing contracts being signed. Like in Sweden, Belgium's involvement in reprocessing has declined as a commitment to the phasing out of nuclear power has grown. The difference remains, however, that Belgium's entanglement with reprocessing has been more intimate and more prolonged, and although a moratorium on the construction of new reactors has been in force since 1988, it was only in 2003 that a phasing out of nuclear power was officially decided upon (Bergmans and Van Steenberge 2006). This contrasts with the Swedish experience where connection with reprocessing was severed already in the early 1980s, at the same time as a gradual phase out of nuclear power became official policy. While Sweden's decision to phase out nuclear power remains far from irreversible, it has served as a constant profoundly colouring nuclear waste policy in a way that the much later decision in Belgium has not as yet succeeded in doing. While the KBS project has been researching and demonstrating the feasibility of the direct disposal of spent fuel for about 25 years, equivalent research in Belgium continues to remain heavily focussed on the geological disposal of reprocessed high level waste, despite the now 14 year national moratorium on reprocessing (Bergmans and Van Steenberge 2006). The current situation regards the future of reprocessing in Belgium appears to resemble something like a techno-political stand-off between those still favouring a closed

nuclear fuel cycle on the one hand, and those wishing to break out of this fuel cycle on the other. While the moratorium on reprocessing has been in force for more than a decade, both the Belgian reactor owners and the Belgian nuclear research community have yet to embrace the redefinition of spent fuel as nuclear waste (Bergmans and Van Steenberge 2006). In this context, Mol and Dessel appear to be two strategic communities still significantly wedded to a closed nuclear fuel cycle. As home to the Belgian Nuclear Research Centre (SCK-CEN), Mol also hosts the HADES underground laboratory where geological disposal of vitrified high-level waste has been, since the beginning of the 1980s, a primary research focus. In similiar fashion, Dessel, the historic site of the Eurochemic plant, was also one of the first sites in Europe to pioneer MOX fuel production in the early 1970s (Walker 2006: 246), a nuclear activity to which it remains connected, together with the interim storage of all the vitrified high-level waste which is still being returned in batches from La Hague.

In light of the different CARL country experiences, the question of *what* nuclear waste is in each country is clearly intimately connected to the question of *why* disposal of different radioactive materials is, or is not, being currently pursued in each case. Nuclear waste is always disposed of in order to protect human health and the environment. However, spent fuel has not been subject to long-term interim storage in the UK because both the safety and viability of the country's magnox and AGR reactors has been claimed to demand a commitment to nuclear fuel reprocessing. That spent fuel is treated as waste in Sweden clearly reflects the nation's long-standing, though still not irreversible commitment to phasing out nuclear power. If the intention is to phase out nuclear power, defining spent fuel as waste must be seen as a logical step to take. Such a step breaks the nuclear fuel cycle as a cycle of technological enchantment drawing countries into an ever-expanding range of nuclear activities. Seen from another angle, however, defining spent fuel as waste can be more of a temporary measure and tactical retreat enabling the nuclear industry to lower its public profile and steer clear of the controversy that can follow from the wider circulation of fissile materials. As public confidence grows, or is restored, in a relatively anonymous nuclear industry more ambitious technological plans encompassing reprocessing can be hatched anew.

It is often argued that in order to make progress in nuclear waste management in any context, the 'waste question' and the 'industry question' must be held apart. Regardless of the arguments for or against nuclear power, legacies of nuclear waste now exist which must be

safely isolated from the biosphere. Linking the waste question to the future of the industry in any country only leads to an 'over-politicization' of the waste problem hindering the search for workable solutions. Such reasoning neglects the fact, however, that definitions of nuclear waste are always everywhere already highly political. To define spent fuel as waste is already a way of saying no to reprocessing as one component of the nuclear industry, at least in your own country, and at least for the time being. The problem in Belgium today is not that the industry question is interfering with the high-level waste question, but that the 'what' question is not subject to broad and inclusive discussion and dialogue. Reprocessing has been stopped due a political decision, and yet a redefinition of spent fuel as waste has still to be condoned by the nuclear industry. A hiatus in highly radioactive nuclear waste management has occurred – a situation of combined political and technical deadlock. In the UK, a redefinition of some of the country's spent fuel as waste is anticipated in future (Defra 2007: 11). If this takes place, however, this will happen due to, rather than independently of, strategic decisions within the nuclear industry itself. While currently, one or another definition of nuclear waste tends to reign supreme in any country, the future may well be one where different definitions have to peacefully co-exist for waste management to proceed. Achieving such co-existence clearly calls for new forums where the legitimacy and reasoning behind alternative definitions of nuclear waste can be openly discussed and debated so that workable compromises can be achieved.

Significant redefinitions of *what* nuclear waste is will always be accompanied by strings of arguments justifying *why* a new direction in nuclear waste management should be pursued. Typically these strings of arguments will either be designed to promote a significant expansion or contraction of nuclear activities in a country. While a redefinition of spent fuel as nuclear waste may typically be associated with the dedication of nuclear waste management to the phasing out of nuclear power in a country, it may also at times be associated with reasoning supporting an expansion of nuclear activities, and maybe the construction of a new and more efficient reactor for example. While it may appear that prevailing definitions of nuclear waste in particular countries are relatively immutable, they always must be seen as remaining vulnerable to relatively sudden and concerted challenges. In the United States, for instance, the apparently long-standing, rock-solid, definition of spent fuel as nuclear waste has been challenged by the new Global Nuclear Energy Partnership (GNEP) proposed by President Bush in 2006 (Solomon 2007, Walker 2006). Part of the reasoning behind this proposal is that a return to nuclear fuel reprocessing in the United States

after a gap of 30 thirty years could help reduce nuclear weapons proliferation by lowering the incentives for other countries to develop new reprocessing and fuel enrichment facilities of their own. Also it is argued that defining spent fuel as waste has created umanageable volumes of waste already likely to exceed the design capacity of the Yucca Mountain repository before it opens (Solomon 2007). If such an initiative as the GNEP won broad support it would bring into question the dominant principle that each nation should take care of its own waste. Given such a situation Swedish and Finnish waste management programmes might start appearing deviant and antiquated instead of approximating international best practice as they do today. In other words, regardless of how settled and satisfied a country may be with its approach to defining what is, and what is not, nuclear waste, alternative definitions should always remain open to discussion and debate. Rather than weakening any programme of waste management this should render it more robust, by better enabling it to both repel illegitimate challenges and to defer to reasonable criticisms.

3.2 The 'Who' and 'When' Questions

After the RCF siting failure in Sellafield in 1997, a key concern for the reform of UK nuclear waste management became the transfer of Nirex from industry to government ownership. This was effected in April 2005 and was generally seen as guaranteeing greater transparency and legitimacy within UK waste management (Simmons, Bickerstaff and Walls 2006). However, both, before and after 1997, Nirex's overall level of responsibility for UK nuclear waste management was always limited compared, for example, to the level of responsibility held by SKB in Sweden. Historically, high-level waste management was never part of Nirex's remit. Their core concern after their formation in 1982 was the design and siting of facilities for intermediate level waste as well as a portion of low-level waste. Prior to their integration with the Nuclear Decommissioning Authority (NDA) in November 2006, Nirex's first concerns did not exceed the setting of packaging standards for producers of intermediate-level waste to comply with (the so-called 'Letter of Compliance' process) and the triennial collation of the UK Radioactive Waste Inventory. In addition, Nirex were after 1997 concerned with developing a generic concept for the phased geological disposal of intermediate- and low-level waste. This was then tentatively extended to a new and, for them, novel concern with developing such a disposal concept for high-level waste/spent fuel as well. This task was pursued firstly in co-operation with international partners possessing greater

experience from the field. An upshot of this has been that SKB's KBS-3 concept was put forward by Nirex in 2005 as the UK Reference Repository Concept for the disposal of high-level waste and spent fuel (Nirex 2005).

Nirex's extremely belated interest in high-level waste disposal reflects the fact that the final disposal of such waste has not been a serious priority in the UK apart from a brief period during the late 1970s in the aftermath of the Flowers Report published in 1976. Sir Brian Flowers in the UK, resembles Hannes Alfvén the Nobel laureate in Sweden, as a nuclear 'turncoat', and as someone who played a decisive role in transforming nuclear waste into a major matter of public concern during the 1970s. As Luther Carter (1987: 240-246) has described it, however, the question of the geological disposal of high-level waste was 'finessed' in the UK at the end of the 1970s. The interim solution of making such waste 'passively safe' through vitrification, and then storing it for at least 50 years on site in Sellafield, was successfully advanced as a way of both technically and politically containing the problem for decades to follow. In Sweden, on the other hand, such a 'finessing' of the problem, alternatively formulated as one of 'nuclear fuel safety' was not an option in the 1970s. Although, a central interim storage facility for the nation's spent fuel was brought into operation in Oskarshamn in 1985, allowing for its long-term temporary storage, the construction of a geological repository for this 'waste' has been the immutable centrepiece of national waste management policy since 1984.

Rather than viewing Nirex and SKB as having been sister organizations, it is perhaps more informative to think of SKB as the company that BNFL has never become. In the mid-70s, before the publication of the Flowers Report in the UK, and the passing of the Nuclear Power Stipulation Act in Sweden, SKB and BNFL were in the same business. SKB were then SKBF, the Swedish Nuclear Fuel Supply Company. In 1976, the Swedish Government Committee on Radioactive Waste recommended that SKBF should take responsibility for continued pilot studies and pre-projecting of a Swedish reprocessing plant (SOU 1976: 32 p.88). The same Committee also recommended the immediate formation of 'a special Government organization for all long-term management of radioactive waste and associated work, in particular the conduct of connected R&D (SOU 1976: 32 p.12). Such an organization was indeed formed - the Programme Committee for Radioactive Waste (PRAV) - but this body was then disbanded at the beginning of the 1980s as SKBF mutated into SKB, the Swedish Nuclear Fuel and Waste Management Company (Elam and Sundqvist 2006).

Public concern over the long-term management of radioactive waste in Sweden in the 1970s not only led to the Swedish nuclear industry abandoning all plans to engage in nuclear reprocessing, it also led to them actively and lastingly embracing the task of the phased geological disposal of the nation's spent nuclear fuel. Rather than becoming a new player in the international nuclear fuel supply business, SKBF as SKB became the founder of a new Swedish/Baltic nuclear fuel safety business focussing on the direct disposal of spent fuel (Elam and Sundqvist 2007). The 1977 Nuclear Power Stipulation Act in Sweden came at a time when the Swedish nuclear power programme was in the midst of being established. Several reactors had been commissioned, several were under construction, and several more were planned. At this juncture, the new Act made the fuelling of new reactors conditional upon the ability of the reactor owners to show how the waste resulting from reprocessing, or alternatively, the non-reprocessed spent fuel, could be finally stored with 'absolute' safety (Elam and Sundqvist 2006). The anti-nuclear forces supporting the Stipulation Act were confident that they had presented the burgeoning Swedish nuclear industry with a mission impossible guaranteed to halt its growth and effect its early retirement. Although, these anti-nuclear forces were to be disappointed, they still helped to transform the Swedish nuclear power programme. The Stipulation Act took the waste problem out of the hands of the newly-formed PRAV, and very publicly placed it squarely in the lap of the Swedish reactor owners. It instigated a 'public theatre of proof' where the nuclear industry was obliged to come up with a final solution to the waste problem before the Swedish Nuclear Inspectorate (SKI) in order to secure its future existence. In response to this unprecedented challenge, the first incarnation of nuclear fuel safety, focussing on the final disposal of reprocessed high-level waste - KBS 1, was able to win government approval in 1980, while the third, focussing on the direct disposal of spent fuel - KBS 3, achieved such approval in 1984.

Thus, in the Swedish case, the 'polluter pays' principle has been significantly expanded, so that the producers of nuclear waste have after 1977, continued to be held publicly responsible for not only financing, but also creating and implementing a credible solution to the problem of nuclear fuel safety. The KBS 3 project has continued since 1984 as a research, development and *demonstration* project where SKB are legally-bound to present regular proof of their continued progress in designing and siting a KBS 3 repository (Elam and Sundqvist 2006). The great strength of these arrangements, compared to those found in other countries, is that nuclear fuel safety and the direct disposal of spent fuel have been instituted as a core concern of the Swedish nuclear industry for 25 years now. Their relative weakness, on the

other hand, is that by obliging the nuclear industry to make the issue of nuclear fuel safety their own, opportunities for meaningful public involvement and engagement in the field have been curtailed. It is only after the introduction of the Swedish Environmental Code in 1999 that room has been made for citizen representation, in addition to expert representation, in Swedish nuclear waste management.

The 'public theatre of proof' overlooking the implementation of the KBS 3 concept has, under the Act on Nuclear Activities from 1984, developed into a relatively closed policy planning circle with SKB and the two government authorities, SKI and SSI (Swedish Radiation Protection Institute), at its centre. The legitimacy of this set-up has always rested upon the clinical separation of state and industry, as regulator and implementer of the KBS project. However, what remains perpetually ignored with respect of this situation is the complete fusion of state and industry within the KBS project itself (Elam and Sundqvist 2007). The largest owner of nuclear reactors in Sweden today remains Vattenfall AB, a wholly state-owned public limited company since 1992, and formerly the State Power Board; the first state-owned power generating and distribution authority in the world when it was established in 1909 (see Lidskog 1998: 23, SOU 1976: 32 p.21). Interestingly, not only is the KBS project partly controlled by the Swedish state through Vattenfall AB, but also, partly by the Finnish state through their majority shareholding in Fortum who have a significant stake in both the Oskarshamn and Forsmark reactor sites (Elam and Sundqvist 2007). So the ultimate interface between state(s) and industry in Swedish nuclear waste management is not the one between SKB and SKI/SSI, but the one to be found within SKB's executive boardroom.

If, as appears likely, the UK is set to embark upon a programme of nuclear new build, the time would appear to be ripe to (belatedly) introduce a UK equivalent of the Swedish Nuclear Stipulation Act. Such a mechanism could overcome the relative neglect of the question of the geological disposal of high-level waste and spent fuel in the UK and turn it into a core component of the future development of the nuclear industry itself. However, there are reasons to believe that it may still be a long time before BNFL mutates in line with the Swedish pattern into the British Nuclear Fuel and Waste Management Company. Even if a programme of new build is embarked on, it seems unlikely that the issue of 'nuclear fuel safety' (KBS) will come to dominate nuclear waste management policy in the UK as it has done in Sweden since the 1970s. Given the recent incorporation of Nirex (established 1982) into the NDA (established 2005), the issue of 'nuclear decommissioning' appears destined to

frame UK nuclear waste management for decades to come. The decommissioning of the UK's magnox and AGR reactors as well as a fleet of obsolescent nuclear submarines is a mammoth task for the NDA to address in the coming years (Simmons, Bickerstaff and Walls 2006). While the current intention may be to co-locate a future geological disposal facility for intermediate/low-level waste and high-level waste/spent fuel (Defra 2007: 18), it is easy to see the disposal of the enormous volumes of intermediate/low-level waste resulting from the decommissioning of nuclear plants (combined with those coming from reprocessing) taking precedence. A focus on 'legacy wastes' in the UK today also appears to work against a speedy redefinition of spent fuel as nuclear waste as this would only put more on the NDA's already brimming plate of nuclear leftovers. In fact, as in the past, it seems unlikely that the UK will be able to afford the luxury of classing spent fuel as waste for many decades to come. As well as obsolete reactors and submarines, the NDA must also address the legacy of reprocessing in the UK, *while still remaining dependent upon the income derived from this activity* (NDA 2006/7: 3). The legacy of reprocessing includes a large amount of Japanese high-level waste that still awaits vitrification before it can be transported back to Japan. In addition to this, Sellafield also hosts about 17 tonnes of Japanese plutonium which must be first incorporated into MOX fuel before it can be shipped home - a process the NDA hopes will be completed by 2016 (Walker 2006: 749).

Interestingly, a factor affecting the future of high-level waste and spent fuel management in the UK may well be the extent to which the collaboration established between Nirex and SKB before the former's integration with the NDA is allowed to continue and grow. SKB is developing an international consultancy business and the UK is obviously an important market. However, this also raises questions regarding the accountability of SKB in Sweden if KBS 3 outgrows its country of origin, and mutates into an increasingly global reference point, or even a 'global brand' in nuclear fuel safety for high-level waste disposal as well as the direct disposal of spent fuel (Elam and Sundqvist 2007). Clearly, the NDA's plans to subject implementation work, and perhaps even the construction of a geological repository to a process of 'competitive procurement' suggests that nuclear waste management may be on the point of turning into a field of international business development similar to the one that nuclear reprocessing became during the 1970s and 80s.

NIRAS/ONDRAF in Belgium are again a very different agency from SKB. Although tasked by the federal government to manage all forms of radioactive waste in the country regardless

of their origin, NIRAS/ONDRAF appears to remain in a rather subservient position vis-à-vis the nuclear industry. While the 'polluter pays principle' applies, the waste producers are able to negotiate with NIRAS/ONDRAF every five years, both regarding the nature of management programmes to be pursued, and what they consider adequate funding (Bergmans and Van Steenberge 2006). Also, for a waste management programme to be initiated, the nuclear industry must first declare the materials concerned 'in excess' in order for NIRAS/ONDRAF to be able to assume ownership of them. Rather than SKB, NIRAS/ONDRAF appear to more closely resemble the Swedish body PRAV that was wound up already at the beginning of the 1980s. Like NIRAS/ONDRAF, PRAV was a public body tasked with co-ordinating research and long-term planning in relation to the waste problem. However, they never achieved fully independent funding, or fully independent decision-making powers vis-à-vis the Swedish nuclear industry. PRAV disappeared in Sweden as the nuclear industry itself assumed responsibility for nuclear waste management in response to new government legislation demanding that the final disposal of high-level waste/spent fuel be immediately addressed. Such a pattern of development appears unlikely to occur in Belgium today, but the currently ambiguous status of spent fuel does place NIRAS/ONDRAF in a difficult situation. As well as having to regularly negotiate funding with the nuclear industry, NIRAS/ONDRAF must also take advice from a Permanent Technical Committee regards all major policy decisions. As Bergmans and Van Steenberge (2006) point out, 11 of the 15 members of this Committee are waste producers, mostly coming from firms and organizations with established links to a closed nuclear fuel cycle. This tends to place NIRAS/ONDRAF in the middle of a technical-political divide today, by asking to them to respond to political decisions that their financiers and their advisors find hard to embrace. Here the situation of NIRAS/ONDRAF is not helped by the relatively low profile assumed by the federal regulator FANC in Belgian nuclear waste management. Compared to, for example, the commanding position held by SKI in Swedish nuclear waste management, FANC appears to be operating on the sidelines of the Belgian radioactive waste management scene.

While NIRAS/ONDRAF appear hamstrung in their ability to take responsibility for the long-term management of high-level waste and spent fuel, they appear better positioned to prepare themselves for the future task of nuclear decommissioning in Belgium. After the government decision in 2003 to phase out nuclear power in Belgium, the lifespan of the country's reactors has been fixed at 40 years. Although not an immutable decision, this has enabled a legally binding framework to be put in place guaranteeing that the funds will be available to

NIRAS/ONDRAF to follow a pre-decided schedule for decommissioning (Bergmans and Van Steenberge 2006). This actually places NIRAS/ONDRAF in a better position than SKB regards the task of decommissioning as currently no political decision is in force in Sweden fixing the lifespan of the 10 reactors still in operation which has recently been extended to at least 60 years (Eriksson 2007)

Turning to the Slovenian case, we can witness an openness to exporting the spent fuel/high-level waste problem that we do not find in the other CARL countries. Slovenian radioactive waste management policy is firstly concerned with the siting of a final repository for low- and intermediate-level waste. A schedule for this process has been included in national legislation making it a requirement that the choice of repository site be confirmed by 2008 and the facility brought into operation by 2013 (Polič, Kos and Železnik 2006). In addition, a time frame has also been agreed between the governments of Slovenia and Croatia regards the decommissioning of the Krško nuclear power plant of which they are joint owners. This process is set to be initiated in 2023 and completed by 2036. On the other hand, no final decision as to whether or not, Slovenia's spent nuclear fuel should be exported or domestically disposed of is planned to be taken until 2030 (Polič, Kos and Železnik 2006). In effect, Slovenia appears to be waiting for someone else to devise a plan for the disposal of their spent fuel for them. While national responsibility for low- and intermediate waste may remain a constant, spent fuel and high-level waste can once again be expected to be addressed through international co-operation, and perhaps first and foremost in Slovenian minds, through a common European radioactive waste management policy.

Looking at the 'who' question in connection with the 'when' question in the different CARL countries, the key issue for achieving progress in nuclear waste disposal appears to be the extent to which the nuclear industry views the task as endogenous or exogenous to its own development. In Sweden, the development of the KBS project has been an endogenous part of the development of the Swedish nuclear industry since 1977. This is because even before the Swedish nuclear power programme was fully established, political pressure forced the nascent nuclear industry into making advanced plans for its own final burial. While the date for this final burial is now no longer fixed in time, it is very hard to imagine nuclear new build being sanctioned in Sweden without the continued implementation of the KBS3 concept. In addition, by making the implementation of KBS 3 endogenous to its own development, a new field of international business development has gradually opened up for the Swedish nuclear

industry. Regardless of whether or not nuclear power is phased out in Sweden, SKB can still end up conquering the world. Through SKB's collaboration with Posiva, the KBS concept has already outgrown its country of origin, and evolved into a Baltic technology platform. Add to this, the now major presence of E.ON, together with Fortum and Vattenfall, on SKB's executive board, and it is not hard to imagine the internationalisation of the company continuing apace (Elam and Sundqvist 2007).

In the UK, Belgian and Slovenian cases, nuclear waste management, and in particular the final disposal of high-level waste and/or spent fuel, has never been treated as a lasting priority and as endogenous to the development of the nuclear industry. Once upon a time in the early 1970s, high-level waste management was treated as largely exogenous to the development of the Swedish nuclear industry as spent fuel was exported to Windscale and participation in the Mol-Dessel-based Eurochemic reprocessing venture was supported. This resembles the policy orientation in Slovenia today regarding spent fuel disposal, where it appears the country is hedging its bets on the initiation of a European repository project for spent fuel and/or high-level in the not too distant future. In the UK and Belgian cases, it is clearly the historical commitments of the nuclear industries in both countries to a closed nuclear fuel cycle and the pursuit of innovations in nuclear fuel supply, that has led them to treat the direct disposal of spent fuel as foreign to them, and even the final disposal of high-level waste as an eventual, rather than an immediate concern.

Therefore, regards the 'who' and 'when' questions as domains for stakeholder involvement, a central focus for discussion must be how to go about emulating the Swedish lead in rendering nuclear waste management truly endogenous to the development of the nuclear industry in any country. Regardless of whether a waste management agency is public or private, it will not be successful until the nuclear industry embraces the programmes of waste disposal it proposes and recognizes them as of immediate relevance to the industry as a whole. Therefore, it can be argued that, if for no other reason, expanded stakeholder involvement in programmes of waste management is required, to ensure that these programmes remain high on the list of nuclear industry priorities. The challenge that then emerges out of this one, illustrated by the Swedish case, is how to continue to hold the nuclear industry publicly accountable once they have been persuaded to treat different programmes of waste management as approximating their own. As the Swedish case shows, programmes of waste

management that the nuclear industry has been persuaded to embrace, may eventually end up out-growing their country of origin rendering their regulation more complex.

3.3 The 'How' and 'Where' Questions

In the design and siting of nuclear waste facilities, and in particular geological repositories, the 'how' and 'where' questions are always treated as to some degree overlapping issues. Given the reliance of geological repositories on 'multiple barriers' to guarantee the long-term isolation of wastes from the biosphere, the relative importance of 'natural' versus 'engineered' barriers remains a continually contestible issue. In the different CARL countries we can witness contrasting commitments supporting the relative dominance of the 'where' question over the 'how' question, versus the relative liberation of the two questions from each other. Whether the two questions are wedded to, or liberated from each other, has also typically changed over time in the different CARL countries. Crucially, also the ease of separation of the 'how' and 'where' questions varies with the quality of waste in question, being more controversial for high-level waste/spent fuel than for low-level waste.

As a starting point for comparative discussion we can commence by addressing the changing interrelations of the 'how' and 'where' questions in the development of the Swedish KBS project. Returning again to the origins of the KBS project and the Nuclear Power Stipulation Act from 1977, this legislation made the achievement of 'absolute' nuclear fuel safety into a double-barrelled challenge for the Swedish reactor owners. The latter were tasked with publicly demonstrating both *how* and *where* high-level waste or spent fuel could be finally disposed of with absolute safety. After an initial attempt was made by the KBS project to successfully address both of these issues, the 'where' issue developed into a crucial stumbling block. The existence, or non-existence of bedrock guaranteeing absolute safety became an object of prolonged public controversy at the end of the 1970s. When a specially selected panel of geological experts eventually pronounced (unsurprisingly) that the existence of such bedrock in Sweden could not be guaranteed given current knowledge, the Swedish Nuclear Inspectorate (SKI) replied by pronouncing that, the importance of the demands made on the geological barrier should not be 'exaggerated'. According to them, long-term processes in the bedrock were to be considered of less importance so long as the integrity of the other barriers encompassed by the KBS 1 concept could be guaranteed (Sundqvist 2002: 91, Anshelm 2006:

93). Unfortunately, this attempt by SKI to free the KBS 1 concept from an ideal physical location, came the day before the Three Mile Island Incident in the U.S. in March 1979. Thus, the issue defied immediate settlement and a nationwide programme of study-site investigations was initiated during the early 1980s, still dedicated to finding something approximating the most ideal bedrock conditions to house a repository for the nation's spent fuel (Elam and Sundqvist 2006, 2007).

In the end, it was not until 1992, and the switch to a siting process for a KBS 3 repository based on voluntarism, that a decisive disentanglement of the 'how' and 'where' questions could be effected. Thereafter, the political geography of the nation was allowed to take precedence over its physical geography in the search for the most appropriate repository site (Lidskog and Sundqvist 2004).

So the KBS 3 repository concept in Sweden stands in marked contrast today to the Yucca Mountain repository in the U.S. While KBS 3 has evolved into a robust engineering design which, according to SKB, can be feasibly accommodated in many locations across Sweden (SKB 1986: 86, 1989); the Yucca Mountain repository remains a *mountain* possessing highly specific geological and hydrological characteristics making it, according to the U.S. Department of Energy, uniquely suited to host a repository (Carter and Pigford 2005, Macfarlane and Ewing 2006). Taking Sweden's two major waste facilities already in existence – CLAB and SFR – in neither case was the 'where' question allowed to consume the 'how' question. Neither became the object of nationwide siting processes, as both were successfully sited for largely pragmatic operational reasons in Oskarshamn and Östhammar respectively. This is especially interesting to note in case of SFR as a geological repository for low- and intermediate-level waste. In Belgium, Slovenia and the UK, the siting sagas for such a repository have roughly followed the pattern of the KBS 3 repository siting process in Sweden: an initial focus on geology encompassing the whole nation, followed by a turn to voluntarism, allowing for the self-selection of a shortlist of sites, for what is presented as an increasingly flexible repository concept. In the case of SFR, however, although geological and groundwater conditions were argued to be of vital importance, these were found possible to accommodate by searching no further than in the immediate vicinity of the Forsmark nuclear power plant (Elam and Sundqvist 2005).

Liberating the 'how' question from the 'where' question involves the creation of more flexible repository concepts. Because KBS-3 is not synonymous with a particular mountain in Sweden, but with a diagrammatic representation of copper canisters surrounded by bentonite clay, 500 metres down in anonymous bedrock, it has evolved into a generic repository concept and a technology platform which, although encompassing the most rigorous siting requirements, can be freely transported between different candidate sites in Sweden, and even successfully inserted into other national programmes of waste management (i.e. the Finnish and UK programmes). In other words, KBS 3 continues to grow in status and stature as a rock solid repository design today, just because it has been rendered more moveable than a mountain.

The turn to more flexible repository concepts giving a freer and more fluid relationship between the 'how' and 'where' questions, has taken place differently in Belgium, than in Sweden. While in Sweden the KBS 3 concept has been successfully presented as a flexible and robust concept *in advance* of a voluntary siting process, in Belgium, the notion of an 'integrated repository project' for low- and intermediate-level waste has allowed for the question of repository design to be left open until *after* volunteer sites have been identified. After candidate sites have been fixed, repository designs have then been completed in 'partnership' with the commuities concerned. Therefore, rather than pursuing a tailoring of the same design to multiple sites, multiple sites have been enabled to tailor their own repository designs in Belgium. This would appear to support an enlarged scale and scope for local stakeholder involvement in the Belgian case compared to the Swedish. Because SKB owns the KBS 3 concept, the 'how' question remains firmly in their hands, while a measure of ownership over the question has been devolved in the Belgian case as repository design has come to resemble a national architectural competition. As Bergmans and Van Steenberge (2006) describe the situation, volunteer communities have taken on the role of 'patrons' employing NIRAS/ONDRAF as the 'draughtsman' of their local waste facility. The 'patron' identity encompasses an appreciation on the part of the community of the invaluable contribution they are making to the advancement of Belgian nuclear waste management. A contribution warranting a transfer of powers of decision to the community over at least the outward form of a repository design, if not its most detailed technical content. Thus, in both Mol and Dessel, both surface and deep disposal repository design options were entertained leading eventually to both options being deemed acceptable in both locations.

What we witness in the Belgian case is a relative shift in the public mediation of not only, the 'where' question, but also the 'how' question. A shift from the mediation of these questions through firstly technical and political demonstrations, to their mediation through local consultations. To understand better the nature and significance of this shift, it is useful to return to the historical development of the Swedish case. As mention earlier, the Nuclear Stipulation Act turned the regulation of nuclear fuel safety in Sweden into a 'public theatre of proof'. The state obstensibly *withdrew* from active involvement in nuclear waste management and heaped responsibility for the solution of the waste problem on to the Swedish reactors owners. The reactor owners were tasked with showing 'how' and 'where' absolute nuclear fuel safety could be achieved, and the Swedish Nuclear Inspectorate and the government were installed as the ultimate expert witness and the final judge over the process. These arrangements were then further cemented through the Act on Nuclear Activities introduced in 1984. After this date, the quest for nuclear fuel safety in Sweden including the siting of a deep repository for the nation's spent fuel has continued firstly as an industry-driven research, development and *demonstration* project. Every three years, SKB is obliged to report and publicly demonstrate to SKI and the government the progress they are continuing to make in implementing their long-run project of nuclear fuel safety (KBS). While these arrangements have succeeded in allowing for the stable government of the 'what', 'why', 'who', 'when' and 'how' questions in Swedish nuclear waste management, they have been relatively unsuccessful in addressing the 'where' question. After a persistent wave of local protests across Sweden during the 1980s prevented SKB from credibly demonstrating where a KBS 3 repository could be best sited, it became accepted that an alternative mode of governance was required to address the 'where' question. Instead of solely through public demonstration, a space for local consultations was opened up in the KBS project after 1992 as the 'how' and 'where' questions were successfully prised apart. The 'how' question remained a matter to be demonstrated, while the 'where' question became transformed into a field for local stakeholder involvement through the medium of so-called feasibility studies.

The space for the mediation of nuclear waste management through public consultation in Sweden has continued, however, to remain a minor local space in comparsion with the continuing dominance of mediation of the KBS project at large through public demonstration. Arguably, with government approval for, and local acceptance of, site investigations in Oskarshamn and Östhammar in 2001-2002, the continued need for mediation of the 'where' question through local consultations was no longer so great. From that point onwards, local

and national demonstrations by SKB, convincingly showing which site is the 'best fit' for a KBS 3 repository could gradually have taken command of the final settlement of the 'where' question. However, such a turn of events has been hindered by the growing importance of the on-going environmental impact assessment (EIA) process covering the siting of KBS 3. Environmental legislation after the introduction of the Environmental Code in 1999, has finally caught up with the KBS project after more than 25 years. The EIA process running in parallel with site investigations has introduced a significant degree of uncertainty regarding how the KBS project should be best mediated in future if its continued legitimacy is to be guaranteed. Thanks to the EIA process, both the 'how' and 'where' questions in particular, must now be accepted as domains for public consultation requiring the formation of public arenas reaching beyond the communities hosting site investigations. While mediation through demonstration has always encouraged an arm's length relationship between the practice of nuclear waste management and the public, environmental legislation advancing mediation through consultation has opened a window of opportunity for the growth of deeper and more intimate forms of public engagement with the KBS project in future. For all those actors gathered around the Act on Nuclear Activities and historically committed to the mediation of the KBS project through demonstration (SKB and SKI, in particular), the feeling appears to be that the pot has been cooking for too long for the EIA process to be allowed to lift the lid on it too high. However, it remains to be seen what combination of mediation through demonstration and consultation will prevail in future.

If the 'where' question has been the domain of decision where a turn to mediation through public consultation has been concentrated and largely contained within the Swedish and Belgian cases, the UK turn to public and stakeholder consultation has been more far-reaching and profound. After 1997, an attempt has been made to install mediation through consultation at the heart of UK nuclear waste management so that it assumes a position equivalent to the one held by mediation through demonstration within Swedish nuclear waste management. In this context, a key document in the UK, advancing the cause of consultation was the House of Lords Select Committee Report on Radioactive Waste Management published in 1999. Here the need for stimulating country-wide public support and acceptance of radioactive waste policy is raised as something which has to be addressed, before local acceptance can be sought for particular waste facilities in particular localities (Simmons, Bickerstaff and Walls 2006). Subsequently, the Managing Radioactive Waste Safely (MRWS) consultative process was launched by the UK Government in 2001. The object of this process is to address the

'how' question in the most general terms covering the total inventory of nuclear wastes to be found in the UK. So, here again, the 'how' question has been decoupled from the 'where' question, not in order to reform a specific on-going repository project, but rather, to facilitate a 'return to first principles', and the new build of UK radioactive waste policy upon consultative foundations.

At the centre of the MRWS process has been the Committee on Radioactive Waste Management (CoRWM) established in November 2003. This has been designed as a strong, independent advisory body tasked with publicly evaluating the complete range of 'available options' for the long-term management and disposal of the UK waste inventory. CoRWM's objective was stated in terms of starting 'with a blank sheet of paper' in the initiation of a new consultative approach, where 'each one of us living in the UK' is accepted as a stakeholder paying for the storing of wastes now, and bearing the financial costs of future decisions (Simmons, Bickerstaff and Walls 2006). Despite this framing of their brief, the 'what' and 'why' questions were not seriously addressed by CoRWM. Some discussion of the future handling of radioactive materials 'not currently classified as waste' in the UK was entertained, but a head-on engagement with the UK's future commitments to, for example, a closed versus an open nuclear fuel cycle was not included in CoRWM's 'return to first principles'. Instead, a rather exaggerated list of options for addressing the 'how' question was made a primary starting point for public consultation, including disposal in space, in ice sheets and under the sea-bed. Therefore, in the initial stages of its work at least, CoRWM was open to criticism for treating the simultaneously political and technical decisions characterising nuclear waste management as resembling a *smörgåsbord* of more or less exotic policy options for citizen stakeholders to pick and choose between (Simmons, Bickerstaff and Walls 2006). After the list of options for addressing the 'how' question had been considerably shortened, however, public discussion was able to focus on some of the more genuine choices that have to made in the development of facilities for the interim storage of wastes and their geological disposal.

CoRWM published its final report in July 2006. Its recommendations included a focus on geological disposal combined with robust interim storage. A voluntary siting process was also supported encompassing community benefits packages. The continuing need for public and stakeholder engagement activities was also emphasized as a means of maintaining widespread trust and confidence in the chosen management and disposal strategies (CoRWM 2006). In

October 2006, the UK Government published their response largely endorsing CoRWM's main recommendations. This has been followed by a new consultative document from the government setting out their proposals for the design and delivery of a geological repository, including a siting process supporting voluntarism and a partnership approach (Defra 2007). Responses are currently being collected to this document in preparation for the next step, and the announcement of a framework for implementing geological disposal. CoRWM itself is being reconstituted in order to provide 'independent scrutiny and advice' to the UK Government on the proposals, plans and programmes for waste management as they emerge. Skills and expertise to be represented on the new CoRWM include nuclear science, radiation protection, social science, environmental law, geology/geochemistry, finance, ethics and civil engineering. Again, organizing public and stakeholder engagement activities will be a key task.

While it is clear that the UK is currently open to learning from Sweden and Belgium concerning their approaches to repository design and voluntary siting processes, elements of the CoRWM experience are currently subject to imitation in Sweden. CoRWM could be described as the organization, that KASAM (Swedish National Council for Nuclear Waste) has had trouble becoming. Founded in 1985 as an independent committee under the Swedish Ministry of the Environment, this body like CoRWM is intended as an advisory body to government also tasked with stimulating public debate and discussion around waste issues. Until recently, however, KASAM has been a largely dormant organization existing very much on the sidelines of Swedish nuclear waste management (Elam and Sundqvist 2007). This has changed as the EIA process for the siting of KBS 3 has progressed. While SKB remains the official co-ordinator of the EIA process, KASAM are rapidly developing into its unofficial guardian. Due to their historical commitments to the public mediation of nuclear waste management through demonstration, SKB are finding the consultative challenge posed by an EIA process in respect of the Swedish Environmental Code hard to embrace. Inevitably, in the preparation of an Environmental Impact Statement (EIS), SKB must consult with the public regarding alternative methods for the disposal of spent fuel, including a so-called zero alternative spelling out what would result if no development took place. Furthermore, the site selection process must again be laid open to public scrutiny. As far as SKB are concerned, however, this is only asking them to go over old ground, questioning decisions the soundness of which they have already successfully demonstrated.

Recognizing SKB's difficulties in living up to the demands being made upon them by environmental legislation, a rejuvenated KASAM has made itself into a new locus for the mediation of the KBS project through public consultation. In the last two years, KASAM have organized public hearings in Stockholm on issues such as; how comprehensive an EIS should be when addressing alternative methods and sites (KASAM 2006); the implications of a bifurcated decision-making process for the siting of KBS 3 in respect of two different framing laws: the Act on Nuclear Activities and the Environmental Code (KASAM 2007a) and deep boreholes as an alternative disposal method to KBS 3 (KASAM 2007b). Building upon this belated enthusiasm for the mediation of the KBS project through public consultation, KASAM have also recently initiated a 'transparency' project expanding the space for citizen stakeholder involvement in Swedish nuclear waste management further (Andersson 2007). So through KASAM's efforts we can witness the partial CoRWMisation of the Swedish nuclear waste scene today. The difference remains that the foundations of Swedish nuclear waste management remain unchanged, with the overriding position of mediation through demonstration guaranteed. Interestingly, we can see KASAM today assuming the role played by the Municipality of Oskarshamn during the 1990s. After SKB's turn to voluntarism in 1992, it was Oskarshamn who emerged out of the shadows and ultimately took responsibility for the tending and the caring of the new space for mediation through consultation that had opened up. This means that it was, arguably, they rather than SKB or SKI, who contributed most to the success of a voluntary siting process. The pattern is being repeated again today. While environmental legislation has made SKB into the official co-ordinator of an EIA process, it is KASAM who are emerging out of relative anonymity to become the genuine tenders and carers for the new space for mediation through consultation that has opened up.

4. Concluding Discussion: The Interrelations of National and Local Stakeholder Involvement and the Rebirth of 'Nuclear Parks'

If nuclear waste management is a combined task of technical and political collection and isolation, it can be thought of as implying the stepwise resolution of nuclear waste as a both a physical and a political problem. Writing in 1973, the atomic scientist and science policy advisor, Alvin Weinberg argued that, 'the price exacted by permanent disposal of wastes may

be a commitment to a priesthood that will tend the vaults for times unimaginably longer than the time scale of any previous human endeavour'. Solving the waste problem can be compared, therefore, with achieving something approximating a safe and secure technocratic end state. While, following the CoRWM philosophy, everyone living in the CARL countries can be seen as a stakeholder in the task of nuclear waste management today, the hope is that this will not be the case tomorrow. Stakeholder involvement in nuclear waste management, therefore, is different from that found in many other fields, as its objective can be said to be to advance legitimate public *disinvolvement*. It is about holding nuclear waste managers publicly accountable, so that we can get phased public disinvolvement with nuclear waste right. During the latter stages of this process there may be a risk for public over-involvement and an excess of 'public voice' disrupting progress, while in the early stages a serious problem may be public under-involvement and premature 'public exit' from site selection processes, for example, and the public discussions surrounding them.

Again, the Swedish case can be used to open up discussion and illustrate the challenge of achieving phased public disinvolvement with nuclear waste. No other country has been as divided over the nuclear waste issue as Sweden during the 1970s. An attempt was made by an anti-nuclear movement to wield the waste issue (the issue of nuclear fuel safety – KBS) like a sword capable of slaying Sweden's nuclear power programme. This unprecedentedly adversarial setting had a profound effect on how nuclear waste management was 'governmentalized' in Sweden. The climate was not right at the end of the 1970s for a broadly consultative approach as the situation was so polarized which led to faith being placed in independent expert adjudication. What was introduced through the Nuclear Power Stipulation Act resembled a courtroom setting. The nuclear industry was put in the dock and publicly accused of having no solution to the waste problem. The government authorities, SKI and SSI, were asked to take the part of public prosecutors, while the nuclear industry appointed SKBF becoming SKB to co-ordinate their defence. The government of nuclear waste thus became a 'public theatre of proof' where the nuclear industry were required to *demonstrate* their innocence, and their unquestionable ability to master the waste problem by showing how and where it could be solved. After the Stipulation Act was repealed, the 1984 Act of Nuclear Activities modified what was agreed to be an unreasonable and 'unscientific' demand for 'absolute safety' (safety beyond all doubt), to the more appropriate one of 'sufficient safety' (safety beyond reasonable doubt) and cemented the public theatre of proof as a governmental setting. Sweden's reactor owners remain in the dock to this day, not free to leave the

courtroom until a KBS-3 repository is eventually closed (future features, events and processes permitting).

These arrangements in Sweden have implied a delegation of public voice to SKI and SSI. The public have been encouraged to place themselves behind these bodies as those most qualified to represent their interests in a public contest with SKB deciding over the latter's ability to guarantee nuclear fuel safety. In other words, the mediation of the waste problem through public demonstration has always implied a tactical *withdrawal* of the public from direct involvement in the waste issue in Sweden. Arguably, this withdrawal has been successful in allowing Sweden to prosecute the 'who', 'what', 'why', and 'how' questions, and to some extent the 'when' question, in the nuclear fuel safety case. However, when it comes to the 'where' question, this tactical withdrawal of the public has mutated into a *premature public desertion* of the question. Asked to stand behind SKI and SSI, the vast majority of citizen stakeholders in Sweden have then been unprepared, and averse, to having the bedrock under their feet used by SKB's in their attempts to make their 'safety case'. Due to a wave of local public protest and non-cooperation in connection with test drillings in the 1980s, SKB were deprived of the means and the opportunity to politically and geoscientifically demonstrate where KBS 3 could be most safely sited nationally. Thus, the public trial of KBS 3 risked being suspended due to a lack of sufficient geological evidence. Hence, the turn to a siting strategy based on voluntarism in 1992. However, this move also proved unsuccessful initially as the waste problem was still publicly framed and generally understood as the nuclear industry's problem alone to solve – it was still they and no one else standing in the dock accused of lacking a solution. Given this framing, it seemed largely inconceivable that any communities lacking all previous connection with the nuclear sector could be justifiably implicated in the solution of the waste problem. Thus, just because public mediation of the waste problem through demonstration had worked so well in forcing the nuclear industry to go so far in treating the waste problem as their own, there was both publicly and geophysically nowhere for the industry to go when the 'where' question came to the fore.

The turn to communities already hosting nuclear facilities in Sweden as the only places left to turn to perpetuate the public trial of KBS 3 after 1995 can be seen, therefore, as resembling a pre-programmed outcome of the mediation of the waste problem through demonstration. Mediation through demonstration made existing nuclear communities into the natural inheritors of 'where' question for KBS 3, and voluntarism has only reinforced this situation,

rather than modified it. It is only in communities already hosting nuclear activities that the trial of KBS 3 has had a local precedent in the form of local committees focussing on reactor safety. These communities were, therefore, already accustomed to having SKI and SSI cross-examine the nuclear industry about nuclear safety locally. While these communities are also encouraged to delegate voice to SKI and SSI, allowing them to act as 'their' (local) public prosecutors of nuclear safety, there remains no way for them to deny that the problem of reactor safety is in part *their own,* and one they intimately share with the nuclear industry. Given this situation, the same reasoning can, and has been reasonably extended to the management and disposal of spent nuclear fuel, as there is again no denying the existence of spent fuel at reactor sites, and in interim storage in CLAB. Here then, a possibility for successfully transferring the national show trial of the KBS project to a small number of local settings and candidate sites has been both recognized and realized during the last 12 years.

Voluntarism in Sweden, therefore, did not encourage communities nationwide to freely participate in a site selection process, so much as it interpellated communities already hosting nuclear activities into recognizing themselves as 'local stakeholders' and the only places for the siting process for KBS 3 to feasibly go. Ultimately, it has been the palpability of the problem of spent fuel disposal more than anything else that has led communities to believe that the public trial of KBS 3 has a place in their community. As soon as the physical palpability of the issue fades, so the incomprehensibility of locally participating in its final resolution grows. So, for example, although the Muncipality of Västerås (Finnslätten) has been the site of nuclear fuel element fabrication in Sweden since 1966 (Westinghouse 2007), it has still yet to be connected to the siting of KBS 3 even as a local observer. Only for two fleeting historical moments have non-nuclear communities actively participated in the siting process for KBS 3. This was with the early rise and fall of the first two feasibility studies in the isolated communities of Storuman and Malå, and then during the period 1998-2001 when a more authentic consultative format encouraged two neighbouring communities to Östhammar, and one to Oskarshamn to host feasibility studies (Elam and Sundqvist 2006, SOU 2002: 46). A primary focus on Östhammar and Oskarshamn, on the other hand, as sites for high-level waste/spent fuel disposal was already explicitly discussed and recommended in the report of the 1976 Swedish Government Committee on Radioactive Waste (SOU 1976: 32 p 81-82).

The acid test for the new consultative approach to the government of nuclear waste currently being pursued in the UK will come with the onset of the site selection process and the search for volunteers to participate in the programme for geological disposal. Experiences from Sweden, Belgium, Slovenia and Finland have shown that voluntarism is a very clumsy tool for achieving phased public disinvolvement with nuclear waste management. Rather than serving to generate or uphold a broad level of public engagement and involvement in the waste question, voluntarism in itself, firstly encourages a spontaneous public desertion of the waste problem by all but a precious few. Among this precious few there are typically several who are already hosts to nuclear facilities and nuclear waste in some form or another, and several who are not. After a further period of time, maybe extending to several years, the non-nuclear communities who have volunteered eventually withdraw from the siting process, or are excluded for one reason or another. Thereafter, the siting issue reverts into the issue of how to address nuclear waste *in situ* on those sites, or on a subset of those sites, where it continues to arise and is already found.

Given that this 'natural trajectory' for site selection to follow after the adoption of voluntarism is already recognized and known, it would appear appropriate to embrace it within the UK consultative approach today as an important issue for future discussion and debate. In other words, if the UK is set on adopting a siting process based on voluntarism, an important issue for continued citizen stakeholder involvement must be the one of whether or not geological disposal is being pre-programmed to be pursued on a site/several sites already hosting nuclear facilities.

Local stakeholder involvement advancing waste disposal on sites where waste arises in Sweden, Belgium and Finland appears to breath new life into the vision of nuclear activities clustered in so-called 'nuclear parks'. Alvin Weinberg authored this vision in the U.S. at the beginning of the 1970s when he both recommended and foresaw the emergence of new growth centres resembling small nuclear city-states (Weinberg 1971, 1973). A nuclear park would be an area 'in which are clustered several 1000-Mw nuclear reactors, together with the necessary chemical reprocessing and other ancillary facilities' (Weinberg 1971: 6). These parks would then attract energy-intensive industrial processes and large-scale agriculture into their immediate vicinity. Weinberg left geological repositories for nuclear waste *out* of his vision of nuclear parks as he still presumed that the search for ideal geological conditions would dominate their siting (the Kansas salt deposits were his own personal preference).

Local stakeholder involvement in Oskarhamn, Östhammar, Mol, Dessel and Eurajoki today, however, appears to signal a renaissance for the future-oriented vision of nuclear parks where reprocessing has been largely taken out of the picture (for now, at least), and the development and siting of major waste facilities has been put in. Eurajoki is perhaps the best example of this phenomenon as both nuclear new build and the development of a modified KBS 3 repository for Finland's spent fuel are currently being pursued simultaneously in direct connection with each other. Historically, Östhammar, Oskarshamn, Mol and Dessel have all been touched by recurring visions of themselves as future nuclear parks of one kind and another, and the siting of major waste facilities is serving to nourish these visions anew.

The nuclear parks that Östhammar, Oskarshamn, Mol, Dessel and Eurajoki have become, or are aspiring to become, today are very different from the 'peripheral communities' described by Blowers and Leroy (1994, see also Blowers 1999). While they remain communities set apart from those surrounding them, they are not so much victims of a core-periphery model of development, as co-creators of growing transnational networks in nuclear waste management and disposal. The KBS project has already outgrown Sweden and, through collaboration between SKB and Posiva, evolved into a Baltic platform of geological disposal technology. In doing so it may well have given us a taste of things to come. Voluntary siting processes go hand in hand with flexible repository concepts that can form the foundation for new patterns of international business development in the waste management and disposal field. Voluntary siting processes also open the way for nuclear sites experiencing decommissioning to open the door on to a new kind of nuclear future. Legacy wastes may still be nuclear resources making the communities that host them, into those communities most likely to transform themselves into the new-look nuclear parks of the future. Silk purses may genuinely be made out of sows' ears.

However, addressing waste problems *in situ* in future and centring the development/regeneration of nuclear parks partly around large-scale geological repository projects cannot be seen as negating the need for continued broad citizen stakeholder involvement in nuclear waste management. The ability of the nuclear industry to conveniently and productively solve the waste problem in 'their own backyard' must, in accordance with environmental legislation for example, be kept under the closest public scrutiny. Just because voluntarism tends to advance the final disposal of nuclear waste where it is already found, this should not then allow the task to proceed broadly unnoticed and undiscussed.

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