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Editorial

SAPIERR-2 is the big news in this issue. The project, now formally contracted by the EC, begins on November 1st and will deliver its findings in late 2008. That will be an important milestone for Arius, as we will effectively be proposing the form of an organisation which, if implemented, would take over the helm, in terms of finding shared European solutions for radioactive waste management.

Of course, international fuel cycle initiatives are global, and solutions are needed elsewhere too – in some cases, rather more urgently than anywhere in Europe. This Newsletter continues the theme developed in our last issue, devoting considerable coverage to the recent security-driven demand for the establishment of international fuel banks or leasing schemes, within the framework of a rejuvenated worldwide need for nuclear power. This has been the main topic in several key international meetings over the summer. In particular, in the Topical Article, we look at the potential impact of these developments on back-end requirements.

*Neil Chapman
Baden-Dättwil*

Arius Internal News

2006 Extraordinary Assembly

The annual Extraordinary Assembly of Members will take place in Baden-Dättwil, Switzerland on 27th October 2006. This regular meeting takes place towards the end of each financial year and allows Members to discuss and direct the programme of work for the following year. The main Assembly takes place a few months later and covers the official business and annual reporting of the Association.

All Members, organisational and individual, are strongly encouraged to attend the October meeting

and to participate actively in the planning of the 2007 programme of activities.

SAPIERR-2 gets underway

After a protracted period of negotiations over the summer on the most appropriate organisational structure of the contract, the SAPIERR-2 project was finally approved by the European Commission, with a start date of November 1st 2006. Development of this follow-on to SAPIERR (completed last year) was driven by Arius, with strong support from the project members, especially COVRA (Netherlands). The scope and technical content of the project had been accepted very early in the negotiations and all parties saw this as a logical and necessary continuation and completion of the feasibility study concept of SAPIERR.

SAPIERR-1 (2003-5) was designed to help the European Commission clarify basic questions affecting the issue and to identify new research and technical developments that may be needed to implement regional solutions to European radioactive waste storage and disposal. Twenty-one organisations from fourteen countries took part in the project, which addressed legal aspects, inventory questions and possible options and scenarios for regional storage and disposal facilities.

The top level conclusions from SAPIERR-1 were:

- The potential benefits of multinational, regional facilities are recognized widely throughout the EU.
- The most obvious benefits are in the economic area, where shared repositories would lead to substantial reductions in expenditure throughout the Community.
- Many or most of the problems faced by regional repository initiatives are common to those being tackled by national disposal programmes, in particular concerning the task of siting the facility.
- If shared regional stores or repositories are to be implemented, even some decades ahead, efforts must already be increased now.
- Before greatly enlarging the scale of the work on regional stores or repositories, a structured framework should be established.

The objective of SAPIERR-2, also a two year project, is to develop the feasibility studies of SAPIERR-1 in order to propose a **practical implementation strategy** and **organisational structures** that will

enable a group of countries to create a formalised, structured organisation that could be established from 2008 for working on shared EU radioactive waste storage and disposal activities. The SAPIERR-2 objectives are:

- The development of an organisational framework and a project plan to facilitate debate on the establishment of a modestly sized, self-sufficient, European Development Organisation (EDO) that can work in parallel with national waste agencies.
- To make further studies of key issues related to economics, design, public and political attitudes and the safety and security of shared storage and disposal facilities.
- To achieve and document the consensus on a preferred way forward that could take place after 2008.

There are six main technical work packages within the project:

- preparation of a management study on the legal and business options for establishing an EDO
- study of the legal liability issues of international waste transfer within Europe
- study of the potential economic implications of European regional stores and repositories
- first considerations of the safety and security impacts of implementing regional repositories

- survey of public and political attitudes towards regional stores and repositories and of approaches to involving communities in decision making
- development of a strategy and a project plan for the work of the EDO

The immediate tasks of an EDO would be agreeing a progressive, slow, staged strategy that would lead to the definition of potential host countries and eventually, to potential storage or repository sites, and, in addition, defining a parallel science and technology programme that could be addressed by the EDO after its initiation.

The formal partners in the SAPIERR-2 project are ARAO (Slovenia), Arius (Switzerland), COVRA (Netherlands), Decom (Slovakia), ENEA (Italy), Enviro (Spain), RATA (Lithuania) and SAM (UK), but organisations from further European countries will be invited to participate in an associated working group. The official coordinator of SAPIERR-2 is COVRA, with the technical management being shared by Arius. Funding is being provided under Framework Programme 6 of the EC.

The project launch meeting for SAPIERR-2 will take place at the Arius offices in Switzerland on 29th November. Further details of the project can be obtained from Ewoud Verhoef of COVRA (e-mail: Ewoud.Verhoef@covra.nl) or from Arius.

In particular, we would welcome enquiries from any organisations interested in participating in the project.

	Work Packages	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Task 1	Legal and Business Options				D1				
Task 2	Legal liabilities Study			D2					
Task 3	Economic Study					D3			
Task 4	Safety and Security					D4			
Task 5	Public and Political Attitudes					D5			
Task 6	Strategy and Project Plan								D6
Task 7	Management & Dissemination								

SAPIERR-2 outline timetable. The project begins in November 2006, which means that Quarters 2 to 5 will effectively comprise 2007, with the project being completed in late 2008. The two Tasks being led by Arius are highlighted (3 and 6), although Arius is involved in all the tasks and shares management Task 7 with COVRA. Deliverables are indicated (D1 etc) but sub-task details are not shown.

International News

Assurance of nuclear fuel supply in an exclusively international regime

This month sees a major meeting taking place at the IAEA on the topic of assuring fuel supply in a multinational regime in which enrichment and reprocessing facilities are operated only by a small number of countries who would provide fuel to others who do not have such facilities. Opening the meeting on September 19th, IAEA Director General ElBaradei posed a number of questions for consideration:

- Who is going to provide the fuel?
- Who is going to pay for it?
- Is the fuel going to be under Agency custody?
- Where are we going to store the material if the Agency takes custody of it?
- What will govern liability concerns?
- Should the assurance only cover the supply of low enriched or natural uranium, or should it also cover the fabrication of uranium into fuel assemblies for reactor use?
- What criteria will we use to release the fuel?
- Who is going to decide in each case – is it going to be the Director General, or the Board?

The conference is, of course, focussed heavily on the front end. We could enumerate the same set of questions about storage and disposal facilities for spent fuel returned to a leaser, and it is important to ensure that these topics are not wholly lost in the current demands to sort out the front end, for security reasons.

Coinciding with the opening of the meeting, Sam Nunn of the Nuclear Threat Initiative (NTI: a US-based charitable body) announced that it will contribute \$50 million to the IAEA to help create a low-enriched uranium stockpile to support nations that choose not to build their own nuclear fuel cycle capabilities. Mohamed ElBaradei said that this would jump start the nuclear fuel bank initiative and provide impetus to IAEA efforts to establish mechanisms for non-discriminatory, non-political assurances of supply of fuel for nuclear power plants. Nunn said:

"A country's decision to rely on imported fuel, rather than to develop an indigenous enrichment capacity, may pivot on one point: whether or not there is a mechanism that guarantees an assured international supply of nuclear fuel on a non-discriminatory, non-political basis to states that are meeting their non-proliferation obligations"

The NTI contribution has two conditions, to be met within the next two years: the IAEA takes the necessary actions to approve establishment of the reserve and one or more Member States contribute an additional \$100 million in funding or equivalent value of low enriched uranium to jump-start the reserve.

All other aspects of the arrangement (structure, location, conditions for access) would be for the IAEA and its Member States to decide.

Sam Nunn said that the NTI envisages that the fuel stockpile will be available as a 'last-resort' reserve for nations that have made the sovereign choice to develop their nuclear energy based on foreign sources of fuel supply services and thus have no enrichment facilities of their own.

"The goal... is to help make fuel supplies from the international market more secure by offering customer states, that are in full compliance with their nonproliferation obligations, reliable access to a nuclear fuel reserve under impartial IAEA control should their supply arrangements be disrupted".

Active debate continues in Australia

In our last Newsletter we reported at length on the growing debate in Australia on the mining of uranium, the possibility of a national nuclear power programme and the place of Australia as a key player in an internationalised nuclear fuel cycle that could involve the country providing both front-end and back-end services, including an international geological repository. This debate grew and continued over the spring and early summer.

In late April, John Ritch, Director General of the WNA visited Australia. In an interview with the Melbourne *Age* newspaper, he said that Australia's political and geological stability made it an ideal home for a nuclear waste repository, being *"beautifully positioned to be a world leader in the full nuclear fuel cycle"*. He commented that Australia should not be the only country involved. Other countries, for example the United States, should perform services to the world: mining of uranium, enrichment and manufacture of nuclear fuel and management of waste. Some of these concepts had initially been advanced in late 2005 by former Prime Minister Bob Hawke, in a statement that effectively started the current debate (see Newsletter 11).

In May, however, Prime Minister John Howard was still taking a cautious view, saying that Australia "had no plans" to take back wastes ultimately arising from the export of uranium, but noting that he had asked the United States to keep Australia fully informed about international fuel cycle initiatives (such as GNEP: see Newsletter 12) and that he wanted a *"full-blooded debate"* on the nuclear issue. At the same time, during a visit to Washington DC, he acknowledged that Australia might consider a nuclear power programme of its own if the economics were right. However, he appeared more in favour of Australia simply continuing to sell uranium, rather than taking part in a fuel leasing scheme, even though Deputy Prime Minister, Mark Vaile, said elsewhere that people should be open-minded about the take-back issue.

Opposition politicians saw the floating of the idea, followed by the apparent partial withdrawal, as being

the start of a 'softening-up' process. Commentators were sceptical, however, with Ian Hore-Lacy of the Uranium Institute saying that it was unlikely that a fully fledged leasing scheme would get underway within 20 years. Meanwhile, there is still considerable distrust on the federal government's handling of nuclear issues on the part of politicians at State level, indicating that the siting of any fuel cycle facility is likely to be problematic.

In June, John Howard announced a prime ministerial review of 'Uranium Mining, Processing and Nuclear Energy', run by an appointed review panel. The review is expected to be completed by November this year and a draft report to be issued that month.

Would Australia do more than act as a supplier of uranium? At the front end, according to some commentators, it is not certain that Australia, stable and internationally trusted country though she is, would be admitted readily to the 'club' of fuel manufacturers (i.e. develop enrichment facilities). Meanwhile, at the back-end, Australian industrial interests continue to express enthusiasm for the concept of an international repository, with the submission this month of the views of the Institute of Public Affairs (a 'free market think-tank') to the prime ministerial review panel. In this report¹, Tom Quirk of the IPA argues strongly for Australia to host an international repository, saying:

"It is not only a significant business but also a major enabling step for the use of nuclear power, an important contribution to nuclear safety, countering proliferation and a major contribution to our region."

We certainly expect the debate to continue.

The Winds of Change: a Slovenian perspective

In a recent article in *Nuclear Energy*, Andrej Stritar, Director of the Slovenian Nuclear Safety Administration and Member of Board of Governors of the IAEA, discusses whether attitudes to regional repositories are now changing.

Noting that the nuclear power resurgence (see our Topical Article in this issue) is impacting both practicalities and opinions, he observes that smaller countries, with only few reactors and small territories, face much bigger technical and economical issues than the larger countries, which are prohibitive for finding a reasonable solution in the short term. Slovenia is a small country, about half the size of nearby Switzerland and with only one operating power reactor, where most of the territory is karstic and quite densely populated, making geological repository site selection difficult. Even with a site, disposal costs per kWh of electricity produced during the life time of the plant would be prohibitively high.

The illogicality of the proposition that wastes must always be disposed of within national borders, commented upon frequently in our Newsletter, is brought home clearly in Stritar's article. He observes that the territory of capital city Ljubljana has lain within seven different States in only the last 100 years. In the past century, Ljubljana was politically in the same State as territories from as far away as the north of Germany to the south of Sicily, from the Belgian border in the west to the Ukraine in the east - even without considering Slovenia's current membership of the European Union!

Stritar believes that waiting for solutions from 'the big players' with major national repository programmes is likely to lead nowhere for smaller countries. The so-called 'Ljubljana Initiative', reported in our early Newsletters, was officially outlined in Slovenia's report to the first review meeting of the IAEA Joint Convention in November 2003. At the time, there was little enthusiasm, but Stritar detects a significant change today, following the second Convention review meeting this May. After discussion among the parties, the summary report stated:

The subject of regional repositories was mentioned by several Contracting Parties. It could be appropriate for some countries to join their efforts and resources for a common solution for final disposal.

Stritar is optimistic about the future of shared regional solutions. He concludes by saying:

"It is definitely not optimal to look for 16 high-level waste repositories in 16 countries operating nuclear power plants in Europe, just as it is not optimal for Slovenia to make such a repository for its one and only reactor - this would be as ridiculous as asking France to make 59 repositories for its 59 reactors."

World Nuclear Association: the industry and international fuel cycles

As described in several places in this issue, the WNA has developed strong backing for IAEA initiatives on multi-national approaches to the nuclear fuel cycle. In May, a WNA working group recently produced a report entitled "*Ensuring Security of Supply in the International Nuclear Fuel Cycle*" that:

".....recognized and welcomed the objective of avoiding the spread of sensitive technologies and facilities through a credible assurance of access to enrichment and reprocessing/recycling services and, in the longer term, through the establishment of multilateral nuclear fuel cycle centres."

Discussing the back-end, the report makes some interesting comments on the industry view on the differing non-proliferation and safeguards aspects of international repositories for spent fuel and vitrified HLW:

¹ http://www.ipa.org.au/files/quirk_nuclear.pdf

"If, for a given State, spent fuel is considered as a final waste form to be disposed of, then the existence of regional or international repositories must be favoured from a global non-proliferation viewpoint in order to limit in the long-term the dissemination of "plutonium mines", and to reduce and optimize international safeguards resources.

On the other hand, waste immobilized via vitrification following reprocessing does not pose any risk of proliferation, although close control by the national authorities of the highly radioactive waste will still be necessary for security reasons. Since a repository for vitrified wastes does not require safeguards by the IAEA standards, it may be feasible to implement such a facility in any State possessing a suitable geological site and industrial facilities. The development of international waste repositories not requiring safeguards (i.e. specifically for vitrified HLW) could be an incentive for certain countries to choose reprocessing if associated services for waste disposal were offered. Such a system should allow the fuel user to make the choice of disposal destination."

Readers of this Newsletter may be interested to know that the WNA has a useful webpage dedicated to international repositories. Both this, and the report quoted above, can be found (respectively) at: <http://www.world-nuclear.org/info/inf21.htm> and <http://www.world-nuclear.org/security.pdf>

International Meetings

Multinational Approaches at the IAEA Spent Fuel Meeting

The IAEA held its regular meeting on *Management of Spent Fuel from Nuclear Power Reactors* in Vienna from June 19th to 23rd. The meeting was attended on behalf of Arius by Neil Chapman, and an Arius paper was presented as a poster on *"The Role of Spent Fuel Storage in Multinational Approaches to the Backend of the Fuel Cycle."* In this report we look at those aspects of the conference that dealt specifically with multinational approaches (MNAs).

Opening the conference, **Yuri Sokolov** (IAEA) said that this meeting has been held every four or five years for the last 20 years and has usually focussed on spent fuel (SF) storage technologies. This meeting was intended to take a much broader view of SF management in the light of potential MNAs to the fuel cycle (FC) that are now being discussed worldwide. **Jacques Bouchard** (CEA, France) observed that there are now about 200,000 tonnes of SF stored in generally satisfactory conditions worldwide, but current predictions are for a three-fold increase in nuclear power by 2050, leading to potentially 1 Mt of SF in storage, with ~10,000 t of Pu. Consequently, the emphasis today is more on strategic than technical

issues, with proliferation resistance being a key concern. Although closed FCs with Pu and other actinide burning in fast reactors are pointing to a more sustainable nuclear energy system, most of the NPPs that will be operating by 2050 will be conventional (Generation III) thermal reactors.

Hans Forsström (IAEA) noted that most countries are still in a 'wait and see' situation with regard to SF disposition (storage, re-use, disposal etc), at a time when we are producing about 10,000 tHM every year. Long-term storage is consequently becoming more of a reality and, although storage is now a mature technology, it must now accept both higher fuel enrichments and higher burn-ups. More fuel is going to be stored for longer periods, maybe even ~100 years. This will make the long-term management of information a key matter. The IAEA now has a wide range of interests and programmes in the international fuel cycle arena (from innovative FC studies through to consideration of international FC centres – such as the current Russian proposals) and welcomes multinational initiatives, being willing to help Member States if they request assistance. The potential for increased SF transports if MNAs are adopted is going to be a key issue.

The second Joint Convention review meeting had been held in Vienna just prior to this conference. Forsström observed that 97% of countries with HLW/SF are now signatories, although this only comprises 30% of Member States. Among issues arising were the need for a fresh look at the IAEA Safety Standards for SF (the storage one now being ten years old, for example), the matter of emergency preparedness and response centres for long-distance SF transports that pass through non-nuclear power States and the need for improved international standards for FC facilities and strategies, whilst maintaining national independences. He concluded by stating that MNAs would require international oversight. He set the question of what the IAEA's role in such oversight could be before the conference, noting that guidance would be valuable.

The fact was pointed out (**T. Tanaka**, OECD/NEA) that storage *per se* is not a sustainable end-point and is inconsistent with the Joint Convention – but, nevertheless, we have to face the reality and implications of extended storage periods. **Bruno Pellaud** (Switzerland) presented the MNA study (described in detail in the Topical Article in our Newsletter No. 10) and commented on developments since it was concluded in February last year. Noting that there is currently no international SF storage capacity (apart from the possibilities being explored by Russia) he foresaw a possible need for regional storage facilities but believed that geological repositories are possibly a better candidate than storage for a MNA. The question of which countries might be hosts for such facilities is often asked – Russia is often identified as a potential host and countries with stable geological environments (such as Australia) are certainly likely to be of interest. He noted, however, that the USA has not expressed an interest in storing imported SF and felt that they have a responsibility to think about this. Eventually, Pellaud

believes, there will only be a few geological repositories on each continent.

The concept of 'ship and forget' (to an international facility) is unacceptable, said Pellaud. Such facilities will need to be monitored and the IAEA would be a proper organisation for doing this, as soon as there are more than a couple of MNA facilities in existence. Under Article 33 of its charter, the IAEA could take a technical role in such monitoring. He also felt that the OECD/NEA should be taking a more active role in the broader matter of MNAs. He pointed out that the new Swiss nuclear law requires that a facility exists before fuel can be exported to it – and it also requires an agreement to repatriate waste 'in case of necessity' (with a mirror clause that allows waste to be imported).

There was a lively discussion on what needs to be monitored in terms of MNA facilities and what kind of assurances could be provided as a result of such monitoring. Pellaud believes that monitoring will be largely technical: standards related to safety, design and operation to exclude accidents, security and financial management (the sound use of invested resources). Safeguards monitoring is not relevant for facilities located in nuclear weapons States and normal safeguards procedures would be applied to those in non-weapon States. It was suggested (**Abel González**, Argentina), that one can only monitor things that are legally binding – such as matters dealt with in the Joint Convention. However, Pellaud did not agree, considering that monitoring would actually be promoted by the contracting countries using the FC facilities and that they may request the IAEA to do this on their behalf as a paid service – this would not, then, be 'international oversight'.

Larry Brown (USDOE) presented the GNEP initiative proposed by the current US administration (see Newsletter No. 12). He was challenged by a number of speakers. For example, some felt that restricting the spread of enrichment and reprocessing was not really compatible with the concept of 'building partnership consensus' and there was a need, instead, to explain how fuel supplies could be assured for would-be users. Others felt that GNEP was just a way of solving the waste problem in the USA, with other countries believing that waste is not a problem but ensuring a sustainable FC is. One specific challenge was that GNEP looks like a vehicle for exporting US reactor technology. There was also concern that GNEP will not survive a change of administration in the USA. Some pointed comments were made about an underpinning requirement for GNEP being US participation in an international nuclear safety regime – and the need to use the same units of measurement! Nevertheless, Brown noted that, in the last 12 months, the US had held technical discussions about GNEP with Russia, France, Republic of Korea, UK, China and Canada.

Turning to the Russian MNA proposals, a presentation by **A. Zrodnikov** (State Scientific Centre, Institute for Physics and Power Engineering, Obninsk) outlined the Russian 'offer' as comprising expert training, the sale and construction of VVER reactors,

the supply of fresh fuel and return of SF and the *temporary* storage of SF in Russia. Russia would offer these services to all non-proliferation treaty countries, although it seemed that the best co-operation would be with countries with large-scale fast reactor, closed FC programmes. When asked whether the FC centres in Russia would be managed internationally, he said the matter was open for discussion. On the issue of whether a country could lease fuel from Russia and then send it elsewhere for reprocessing, he said there was currently no such option being considered.

Interestingly, Zrodnikov made no mention of disposal of wastes within Russia and gave a very different impression of what Russia is currently considering in terms of international provisions, compared to the 2005 IAEA-Rosatom conference in Moscow (see Newsletter No. 11), suggesting that the whole MNA issue there is in a state of policy flux at present.

Florence Fouquet (Ministry of Economics, Finance and Industry, France) described the implications of the new nuclear law (adopted June 15th 2006) for French involvement in MNA activities. France is one of the world's main exporters of nuclear electricity and a strong proponent of reprocessing, which, he said, accounts for only 3% of electricity production costs. The new law reaffirms the importance of reprocessing and recycling and defines the requirement for reversible geological disposal of HLW with a repository site being selected and authorised by 2015 and operational by 2025.

From the MNA perspective, Fouquet said that, under strict conditions, France would support such initiatives, with the exception of disposal of foreign wastes in France. A clear condition for the French public is 'no imported wastes' and this has been reinforced by the new law. This is the only aspect of MNA that is forbidden, but France would nevertheless consider roles in regional repositories that involve expert training, co-operation on safety and co-operation on repository construction and engineering. This is the first time that France has expressed a direct (and clearly commercial) interest in being involved in regional solutions – presumably because the new law now gives them a defensible 'but-not-in-France' platform from which to work.

A topic that is likely to have far-reaching implications for any MNA facilities is the availability of appropriate *international safety standards* and the way in which these are related to possible evolution of the IAEA Joint Convention (JC). This issue was presented forcefully by **Abel González** (Argentina). He sees the JC as largely an 'incentive' rather than an effective convention, as no reassurance of compliance is currently possible and, following the May, second JC review meeting, there was no common view on possible modifications that would strengthen the mechanisms it contains. The existence of a set of international safety standards would clearly be one way in which the JC could be strengthened. The

preamble to the JC refers to such standards and the IAEA mandate says that it is entitled to establish them and provide for their application. The recent approval of a unified set of 'Fundamental Safety Principles'² (for anticipated adoption by the IAEA this year), is seen as a step in the right direction.

González believes that the IAEA transport regulations are a good model for establishing a wider nuclear safety regime and that safety standards would be better if they were effective in this way, rather than just an incentive. The safety standards for SF management are acknowledged to be incomplete – a complete suite would help appraisals (e.g. of MNA facilities) by the IAEA. He envisaged a stronger JC that includes all Member States and a system whereby States are invited to make use of an effective set of safety standards, using the IAEA as an appraisal service.

Closing the conference, as President, **Jacques Bouchard** observed that, regardless of FC approach, in all cases we shall need geological repositories. Storage is only an interim solution. He believes that the risks of closed FCs are no greater than those of open cycles and there are clear security advantages. MNAs are going to be important, especially for smaller countries, and there should be more work in this area, with the IAEA acting as a driving force. The international safety regime will be more transparent and easier to apply when all countries have similar policies – and MNAs are pushing in this direction.

Arius in demand at nuclear events

As expanded on at length in a further article, there is a marked worldwide revival of interest in nuclear power. This has led to numerous meetings being arranged on the subject – and, today, the nuclear community fully realises that no discussion can neglect the important topic of waste management. For this reason, Arius has been involved in various conferences throughout the summer, often as a guest speaker putting the case for geological disposal in general as well as for multinational cooperation as a means to ensuring that such disposal is available to all nations, however small. These meetings are additional Arius activities beyond the scheduled participation in waste management specialist meetings like those in Berkeley and Las Vegas, which are described elsewhere.

The first of these special events was the IBC Conference on *"Radioactive Waste Management: the next step – confidence, safety and implementation"* which took place in London from 12th to 14th June, 2006. The invited speakers included key figures from national waste management programmes in Belgium, Canada, Finland, Germany, Sweden, Switzerland, the Republic of Korea, UK and USA, as well as representatives of the IAEA and the NEA. Days two

and three were chaired by Charles McCombie of Arius, who also presented a paper on *"Internationalising the Back-End of the Fuel Cycle"* (available on the Arius web-site). This was coupled with an interesting paper by Tom Isaacs of LLNL and the two papers together served as a discussion basis for animated exchanges with the audience.

Shortly afterwards, a further invitation led to an Arius talk on 27th June in Paris at the *"Conference on the Role of the Private Sector in Financing and Building Next Generation Nuclear"*. The paper presented was titled *"The dependence of nuclear energy expansion on national and multinational progress in waste management"* and it served as background for a panel discussion on waste management, during which Arius was able to highlight the huge economies of scale that can result from shared repository implementation projects.

A rather different opportunity to communicate the merits of geological disposal and also of multinational cooperation arose in July, at the annual Summer Institute of the World Nuclear University, which was held this year in Stockholm. Around 70 Fellows from over 40 countries take part in the 6 week course and the block of lectures on technical aspects of waste management was delivered by Charles McCombie of Arius. Since these Fellows are a highly selected group of leading young professionals from industry and universities, the Institute presents a valuable forum for making them aware of waste management challenges in all countries - big or small, nuclear or non-nuclear.

Another unusual opportunity to put waste disposal and multinational cooperation into a wider context occurred in August, at a special workshop organised in Sicily within the scope of the 36th Session of the International Seminars on Planetary Emergencies. The session on *"Global Nuclear Power Future"* included invited specialists on all aspects of the fuel cycle. The experts produced a document with final conclusions, including the remark that:

"Ultimately, geologic repositories with or without reprocessing will be required for disposal of spent fuel or high level waste. These could include international facilities operated jointly or by private firms regulated both by environmental agencies and by IAEA."

and recommending that:

"Nations should move urgently to develop a viable international regime for fuel leasing and take-back under satisfactory non-proliferation and environmental standards".

Yet another invitation for Arius resulted in September in participation in a Wilmington Media two day conference on the *"European Nuclear Power Debate"*, held in London in the same week as the annual Symposium of the World Nuclear Association, of which Arius is a member. The activities involved at the Conference included participation in three different panel sessions, one of which allowed Arius to show the now well-known overhead illustrating vividly the

² <http://www-ns.iaea.org/downloads/standards/drafts/ds298.pdf>

unthinkably high number of separate repositories that Europe will need if there are no shared projects. This led to information being requested on the EU SAPIERR-2 project which is described in a separate Newsletter article.

To round out the public events with invited Arius presence, there will be two papers presented in October at the *Pacific Basin Nuclear Conference*. One is an invited keynote talk on the global status of radioactive waste disposal, which provides the basis for the associated article in this Newsletter. The other is a joint paper "*Managing Australian Radioactive Wastes in an International Framework*", prepared by Neil Chapman and Charles McCombie of the Arius staff, together with individual Australian member, Marcis Kurzeme.

Despite the work load resulting from the concentration of public events, Arius active participation is essential to maintain the high profile which is essential if we are to continue to expand our support basis. The conference attendances are backed up by presented papers that are available on the Arius web-site. Often these papers can lead to publications in refereed journals. The latest prominent example of this is the paper in the new *International Journal of Nuclear Law*, on "Multinational repositories: ethical, legal and political/public aspects". The principal author here is Christina Boutellier of Arius, with contributions from Charles McCombie and our Slovenian member, Irena Mele. Today, nuclear waste management in most countries of the world tends to be in the hands of national State organisations which are not totally free to give their own independent opinions on the status of programmes elsewhere. By often acting as spokesman, Arius is therefore providing a valuable service to the general nuclear community and to the specific waste management community – while at the same time getting across its core messages concerning the benefits of multinational cooperation in this area.

Topical Article

The Nuclear Renaissance and Waste Disposal³

Charles McCombie

For many years, nuclear supporters have been talking of a possible nuclear power renaissance. Today there are definite signs that this is finally beginning to happen. Today there are 442 nuclear power plants (NPPs) in operation worldwide, 28 under construction and a further 222 on order, planned or proposed. New NPPs are being discussed or planned in countries

that already use nuclear power, such as China, Russia, India, Japan, Korea, Finland, France, the UK, Switzerland, Romania, Brazil, Mexico, and South Africa. In the USA alone, over 20 new units are being proposed. Countries like Vietnam, Indonesia, Poland, the Baltic States and even Australia are choosing or debating initiating a nuclear programme. Finally, nuclear phase-out policies are being rethought in countries like Sweden, Belgium and Germany.

Support for these nuclear power developments will be strongly influenced by the progress of waste management programmes, especially final disposal. Conversely, the growing realisation of the potential global benefits of nuclear power may well lead to increased support, effort and funding for initiatives to ensure that all nations have access to safe and secure waste management facilities. This implies that large nuclear programmes must make progress with implementation of treatment, storage and disposal facilities for all of their radioactive wastes. For small nuclear programmes (and for countries with nuclear applications other than power generation) such facilities are also necessary. However, for economic and other reasons, these small programmes may not be able to implement all of the required national facilities. Multinational cooperation is needed. This can be realised by large countries providing back-end services such as reprocessing and disposal, or by small countries forming regional or international partnerships to implement shared facilities for storage and/or disposal.

This article traces through the past decades the mutual interactions between programmes in nuclear power and in waste management. The relevant issues of concern for both include radiological safety, environmental impacts, costs and, most topically, non-proliferation and security. Debates on these issues have strongly affected national efforts to implement power plants and repositories, and also influenced the international debate on multinational cooperation in each area.

The article therefore complements the introductory brief summary of the status of nuclear power developments with a review of how national waste management programmes are progressing (or not progressing) and of how the credibility of multinational concepts is being enhanced by a number of current initiatives. These include Russian proposals for international facilities, the recent GNEP initiative of the USA, studies on regional repositories in the SAPIERR project and IAEA and EC support for both types of initiative.

A brief look back at nuclear power

Unfulfilled promise: Nuclear energy had an uneasy birth period, since the public first became aware of the power locked in the atom through its use in the atomic bombs used to end World War II. Shortly afterwards, however, nations realised the immense potential for peaceful uses and the first power reactors to produce electricity were opened to great public and media acclaim. Fuel elements with a volume of only a few cubic metres could produce 1000 MW of electricity for

³ This article is based on an invited presentation to be given in October at the 2006 Pacific Basin Nuclear Conference in Sydney

a year, release little to the atmosphere and generate only small quantities of waste. With coal, 2000 rail cars are required to generate the same amount of energy and hundreds of thousands of tons of gases and ash are produced. The economics of nuclear power were also expected to be very favourable – resulting in the infamous prediction of Lewis Strauss in 1954 that nuclear electricity would be “too cheap to meter”.

The promising new energy source did not, however, live up to expectations. Reactors took longer than predicted to build, performance was often far below design targets and the costs escalated, in part because long delays led to huge interest fees on the high capital investments needed. Already in the 1970s, this led to a large drop in new plant orders in the USA and then Europe, although developments continued in Asia. Next, however, came some serious accidents – Windscale in the UK, Browns Ferry in the USA and then the catastrophe of Chernobyl, Russia. Parallel to all this, opposition to all kinds of nuclear activities was growing in many countries.

The opposition has diverse causes: a widespread fear of radiation (enhanced perhaps by its original military use); a general growing suspicion of “big technologies” over which the individual felt he had no control; and in addition four specific arguments that have recurred repeatedly over the past decades. These arguments are:

- the operational safety of nuclear power plants
- the economics of nuclear power
- the fear of proliferation of nuclear weapons and
- the “unsolved problem” of radioactive waste disposal.

Opponents of nuclear have chosen to stress different arguments in this list at different times. Today, all these objections can be countered by pro-nuclear persons in such a convincing way that a global renaissance of nuclear power is an undeniable prospect. The following section summarises the current position on each point before narrowing in to the prime focus of this paper – namely the mutual impacts of radioactive waste management programmes and nuclear power development.

Increasing support for nuclear power

Some of the main arguments brought by nuclear opponents have been disproved by the documented experience with nuclear power plants. The safety of their operation is proven by over 12000 reactor-years of electricity production by over 400 power plants in 37 countries. The only really large accident was at Chernobyl – and this was caused by highly unusual experiments being incompletely carried out on a special reactor type that has far less safety features than normal facilities. The health consequences of Chernobyl are large – but much less than originally postulated [1].

The economics of nuclear power have changed due to improved performance of the plants as well as to the alarming ramping up of fossil fuels. A recent NEA study [2] showed that nuclear was more competitive than fossil fuel for 7 out of the 10 countries considered, even with a relatively high discount rate of 10%. The exceptions are coal-rich countries that are prepared to tolerate very large CO₂ emissions. In free market economics, older nuclear plants are fetching high prices because of the large revenues they can generate. Purely economic consideration today favour producing electricity by nuclear power – and rationalising and shortening the long, complex procedures would make the case even more clear.

Perhaps the strongest motivation for nuclear today, however, is its environmental advantages. The effects on global climate of CO₂ emissions are now very widely recognised, as are the catastrophic effects on human civilisations that a changed climate could cause. This issue has led to prominent environmentalists publicly changing their earlier attitudes towards nuclear power. Patrick Moore, a co-founder of Greenpeace International, is convinced that the ideological opposition of that organisation to nuclear power itself now posed an environmental hazard. James Lovelock, the father of the Gaia thesis of global environmental balance, argues that we need nuclear power to avert catastrophic climate changes. In Australia, the popular scientist and author, Tim Flannery, also favours nuclear.

The key remaining concerns about nuclear power concern security/non-proliferation issues and the not yet fully resolved challenge of long-term waste management. These are to some extent, linked issues since the HLW and spent nuclear fuel that must be managed for long times can certainly present security and proliferation problems if appropriate measures are not taken. The most urgent security concerns, however, are related to technologies for uranium enrichment and for fuel reprocessing since both of these can produce weapons quality materials.

These concerns have led to a series of recent initiatives intended to control existing weapons materials and to prevent the production of further quantities. The USA and Russia have both repatriated fissile materials (primarily HEU from research reactors) from a number of countries across the world. Spent sealed sources have also been collected. Steps are taken to hinder the spread of enrichment and reprocessing facilities, e.g. by offering to guarantee such services. New initiatives from Russia [3, 4] and from the USA [5], aim to allow nuclear power to be used ever more widely, while at the same time minimising security and proliferation problems.

All of the above developments have contributed to the above-mentioned recent sharp increase in the interest in nuclear power. In any country that uses or plans to use nuclear power, decisions will be strongly influenced by the reality of, and the perception of, the availability of safe, secure and environmentally benign approaches to managing the resulting radioactive wastes. In fact, even those countries with no nuclear plants must be interested in safe radioactive waste

management since almost all these countries do produce radioactive wastes from some of the very many peaceful applications of nuclear technology. Accordingly, the remainder of this article is devoted to describing how radioactive waste management concepts have developed over the years, what the global situation is today and how we can ensure that safe management technologies (especially final disposal) can be made available to all nuclear countries, large or small.

A brief look back at waste management

The concept of geological disposal is a logical consequence of the easily observable decay of radioactivity with time, which leads to a continuous reduction in toxicity of these wastes. Finite hazardous lifetimes (and low volumes of wastes) led to:

- development of concepts where environmental protection could be aimed at by isolating wastes from man's surroundings for long enough to allow such decay to occur and
- a search for environments which showed sufficient stability for the time periods involved - namely thousands or even hundreds of thousands of years.

There are not many environments for which we have evidence of their evolution and their stability over hundreds of thousands of years. Old, deep geological formations are the most obvious candidate environments that can be accessed with today's technology. Other options have, in fact, been considered. A comprehensive document on all these options was published already in 1974 [6]. Concepts that have been examined (more than once) include disposal in space, under ice caps, in subduction zones, etc., but all have been judged infeasible or unsafe. Transmutation is still being studied in various countries. In the view of most experts, it may eventually change the nature or quantity of radioactive wastes to be disposed, but transmutation will not remove the need for geological disposal.

Consequently, concepts for geological disposal under the continental earth's crust have been developed over many years and the concept of disposal in deep geological formations was recognised by the US National Academy of Sciences as early as 1957 [7] to be the most promising form of confinement for long-lived wastes from the nuclear fuel cycle.

Despite the above historical facts, accusations that nuclear power was started without any consideration having been given to the management of its wastes have often been made by anti-nuclear groups. These opponents have likened the construction of the first nuclear power plants to "building a house with no toilet". The experts in the nuclear community see this differently. They point out also that for many years, or even decades, there was no technical need for disposal. The quantities of high level waste or spent fuel were too small to justify implementing repositories and, in any case, a cooling time of around 40 years was the sensible technical choice.

In retrospect, however, there was indeed too little effort invested into organising long-term management and disposal; most attention was devoted to implementing practical measures for handling and storing radioactive wastes safely. This is now recognized as a mistake. With time, however, things changed; dynamic waste disposal initiatives were started - and, paradoxically, the nuclear opponents were in large measure to thank for this. Because they asserted that lack of demonstrated safe technologies for disposal should preclude the use of nuclear power, governments were pressured to demand specific projects that could provide this demonstration. There are also striking counter-examples, i.e. cases where nuclear opponents have slowed or stopped any progress in disposal. The reasons for opposition to progressing repository programmes are diverse. Some people genuinely believe that the safety of deep geological disposals has not been demonstrated sufficiently and that allowing years or decades for further work will produce some as yet undefined better solution - a "magic bullet". Others object for tactical reasons - an accepted waste disposal solution would remove one of their last anti-nuclear arguments, now that operational safety and economics are both clearly favourable.

A real danger resulting from those tactical manoeuvres of opponents is that an "unholy alliance" could result. This would mean that indefinite storage could become the common solution that satisfies both the nuclear opponents (who wish to block a real final solution) and extremists in the nuclear industry (who know very well that the storage option is much less costly than implementing geological repositories). The losers, in this case, are our children and grandchildren, the future generations who then inherit an unsolved problem passed on to them by us because we did too little to clear up our own mess.

Where are we today on all of the issues influencing efforts made towards implementing deep geological disposal? Unfortunately for the world in general, but productively for waste management, a new and frightening aspect has kept to the forefront. This is the growing concern about the misuse of nuclear materials by nations that are intent on gaining nuclear weapons capabilities, or even more worrying, the possibility of nuclear terrorist acts. In the recent past - in particular since the terrorist attacks on the USA in 2001 - the security issues associated with management of nuclear materials, including wastes, have assumed high profile.

The concerns about the spread of sensitive technologies such as enrichment and reprocessing have correctly taken front place. These concerns have led directly to the Russian and American fuel cycle initiatives described later. However, the back-end of the nuclear fuel cycle cannot be neglected when we are trying to minimise security concerns. Spent nuclear fuel and HLW must be kept away from persons, organisations or governments that might misuse it. A very effective way to make these materials inaccessible is to employ them in a limited number of highly controlled national or multinational underground facilities. The latter of these options is discussed in more detail later in this article. First,

however, a brief overview is given of how national programmes are progressing with implementation of safe, secure and environmentally friendly final repositories for spent nuclear fuel and HLW.

Status of Geological Disposal Programmes

For at least 25 years after the original 1950's publications on the concept of geological disposal, the validity of this approach was not questioned. It was formally adopted as a final goal, through policy or legal decisions, in many countries, including the USA, Canada, Sweden, Finland, Belgium, Switzerland, France, Spain, South Korea, and Japan. As mentioned above, several of these countries initiated active scientific and technical programmes aiming at implementing disposal, usually some 20 years or so into the future. International organisations such as the OECD/NEA, the IAEA, and the EC established working groups and networks of the organisations involved. Special journals started up. Innumerable conferences were organised around the world; for example the major annual International Waste Management Conference in Tucson, Arizona, USA was held in 2006 for the 32nd time.

However, virtually every geological waste disposal programme in the world ran into difficulties in keeping to originally proposed schedules. For example, in the US programme, in 1982 [8], a target date for repository operation of 1998 was set. In stages afterwards, the target for a US repository at Yucca Mountain was moved back to 2010 because of unresolved technical, licensing and legal issues – and today the official target date specified by USDOE is 2017. Other programmes have also been compelled to move target dates back. Through to the present, the only active programme that met its early deadlines has been Finland.

Slippages in deadlines, however, are common in large projects; disposal programmes are not unusual in this respect. Less common are decisions of the type taken in some countries – namely to indefinitely postpone implementation of geological repositories. This has happened several times, in each case due to public opposition leading to governmental decisions to halt siting processes. In a few countries, there has been a still more radical political reaction to problems encountered by geological disposal programmes. Backing off from the choice of geological disposal as the preferred national strategy took place in France, the UK and Canada. In all three, extensive public and political consultation exercises, took place. In all cases, however, the resulting recommendations were that geological programmes should move ahead, although in an extended staged process. (see www.corwm.org.uk and www.nwmo.ca)

The above rather sobering look at the slow progress of geological repositories in some countries contrasts with the advances made in some other parts of the world. In the USA, the WIPP deep repository for transuranic wastes has been operating successfully for some years and has recently been recertified to continue doing so. Furthermore, since the US congress has decided that a licensing application

should be prepared for the Yucca Mountain Project in Nevada, a deep repository for used nuclear fuel may well be constructed and operated in the United States in the foreseeable future (although significant hurdles are still faced). In the Scandinavian countries, Finland and Sweden, the deep repository programmes are very advanced and steering towards definitive dates for implementation. More influential, perhaps, than the technical developments that have been initiated in these countries, are the societal processes that have been invoked to try and ensure that the repository has a sufficient level of acceptance. In most other countries of the world, the combined technical and societal approaches employed in the Scandinavian countries are looked upon as role models for how things might be arranged also in other programmes.

In the European Union, a 2002 draft directive instructed all European Union member states that specific deadlines for siting repositories and for implementing these facilities must be set. Although the over-ambitious deadlines proposed in the initial draft were dropped, the thrust of the initiative will likely remain. This thrust confirms, at least for the European Union, that deep geological disposal is indeed the preferred waste management strategy for used nuclear fuel and high-level wastes.

The current status of national geological disposal programmes is thus well documented and it illustrates that progress is being made in many countries – but that this is a slow process. For some countries national repositories may be difficult or infeasible because of the lack of favourable geological formations, shortage of technical resources, or unacceptably high costs. For these multinational repositories are a potential solution and, in recent years, there has been a rapid increase in interest in this possibility as described in the following section.

Multinational initiatives

In the early years of nuclear development, the concept of nuclear fuel cycle centres, including international repositories, was topical. The IAEA charter itself allowed the Agency to be involved in centralized plutonium storage and management. Various studies were performed on regional nuclear fuel cycle centres and on international spent fuel management. These are documented in [11].

The past five years have seen a continual growth in the interest of many national waste management programmes – especially those of small countries – in the concept of multinational or regional disposal facilities. The prime drivers were originally the economic and political problems that might be lessened by being shared between countries facing the same challenges. The potential safety and safeguards benefits were also recognised at this early stage. Increasingly – in particular after the terrorist attacks in the USA in 2001 and in connection with nuclear proliferation concerns – attention focused on the security advantages that could result. The most recent manifestation of this is the Global Nuclear Energy Partnership (GNEP) promoted currently by the US Government. The IAEA, has not neglected to point

out that these risks can also be important at the "back-end of the back-end" of the nuclear fuel cycle, i.e. not only in enrichment and reprocessing but also in storage and disposal, in particular of spent fuel.

In its publications in this area and in recent statements of representatives of the IAEA, two potential routes to achieving international disposal have been described. One of these, the "add on approach", is the inclusion of disposal within a broader scheme of internationalised fuel-cycle services provision. The other, which does not require global strategic developments and agreements, is the "partnering scenario", in which a number of countries agree to look for a common disposal solution involving one or two shared repositories. These should be sited in locations to be decided by the multinational participants in the same democratic, consensual approach that has been used by potential siting communities in the more successful national programmes.

In both potential disposal approaches to multinational disposal, significant progress is being made. Below, we describe the add-on approach, using the topical examples of Russia and then examine the partnering scenario, using experience gained in the SAPIERR project of the EC.

The add on option: A single country, or a network of countries with appropriate facilities working together, by providing extended fuel-cycle services to countries adhering to the NPT and wishing to use nuclear power, could limit the spread of those sensitive technologies that are allowed under the Treaty, namely enrichment, reprocessing and storage/disposal of fuel. Crucial pre-requisites would be security of supply of services to all co-operating users (as emphasised by the Multilateral Approaches Group established by the IAEA [16]) and close international monitoring by the IAEA. The whole concept has been raised again very recently by IAEA Director General, Mohammed ElBaradei [17, 18]. It is very topical because of the concerns with nations such as Iran expanding their nuclear capabilities to include fuel enrichment.

Although emphasis is on the front end of the fuel cycle, where most security concerns arise, back-end services would also be offered as part of this suite of provisions, either by countries establishing new, dedicated multinational storage and disposal facilities to fit into the scheme or by countries with existing facilities that could be extended for international use.

Within this international fuel cycle scheme, the fuel leasing component is certainly the closest to being an accepted practice. This is almost the practice followed by the former USSR with its satellite States. More recent global concerns about security have led to it being the universally preferred solution, if nuclear power plants are to be operated in countries such as Iran and North Korea. Recent proposals from the US Government have indicated its support for such a scheme. Should it come to pass, the gate will be opened for other large nuclear fuel suppliers to improve the attractiveness of their fuel services, while

at the same time enhancing global security. Potential network partners in internationalising the fuel-cycle would all have to be NPT signatories and could clearly include the major suppliers of uranium or of fuel cycle services or of power reactors, i.e. the list includes countries such as Argentina, Australia, Canada, France, Japan, Russia, the UK and the USA.

The most likely country to offer to act as host in this add-on scenario is recognised to be the Russian Federation. Support has been expressed at Government level. The law currently allows import of spent fuel for storage or for reprocessing with return of residues. However, there is Russian support for expanding this service to include final acceptance of fuel or even high level radioactive wastes (and, it is acknowledged, also strong opposition). Moreover, once a first move is made, it is not impossible that competition could even arise. Supporters of hosting an international repository have spoken up in Kazakhstan and China in the past and recently again in Australia. Acting as a host is economically attractive for Russia since it would provide either income from provision of services or fuel for the future, or both. However, as has been recently pointed out [19], the law would have to be changed and a number of other conditions would have to be fulfilled if a range of important international stakeholders are to be comfortable with what is offered and the conditions attached.

The recent GNEP proposal from the USA is primarily aimed at making the nuclear fuel cycle more secure. This should be achieved by restricting sensitive the processes of enrichment and reprocessing to a restricted number of trustworthy countries (or existing weapon States) that should then provide services to other countries wishing to use nuclear power for peaceful purposes. For this to be attractive to these customer countries there must be sufficient incentives and the supply of services must be guaranteed. One incentive would be to have no HLW or spent fuel to be managed long-term and ultimately disposed. This requires the fuel suppliers to take back the spent fuel – probably under a leasing arrangement – or for a third party, trustworthy country to offer storage and disposal services. Proposals to host an "international nuclear waste dump" have, not unexpectedly, led to public and political opposition. However, offering a global service that enhances world security, and is for the host country both safe and profitable, maybe more acceptable [20].

A fundamental point is that purely unilateral initiatives (whether they are in Russia, the USA or elsewhere) will very probably not succeed – a proper multinational approach is absolutely essential. The time is now ripe for initiating such an approach by bringing the key players together in a free and open discussion to develop plans for how a specific project can be established.

The partnering approach – SAPIERR: The second option for implementing multinational repositories - partnering by smaller countries - has been particularly supported by the European Union through its promotion of the potential benefits of regional solution,

i.e. facilities shared by contiguous or close Member States. For the “partnering” scenario, in which a group of usually smaller countries cooperate to move towards shared disposal facilities, exploratory studies have been performed most recently by the Arius Association, which also co-manages the European Commission SAPIERR projects on regional repositories [21].

The Support Action: Pilot Initiative for European Regional Repositories (SAPIERR) project finished at the end of 2005 after 2 years of work involving organisations from 14 different countries. This will be succeeded by a follow-on SAPIERR-2 project (Strategic Action Plan for Implementation of European Regional Repositories – Stage 2). This would establish a dedicated multinational organisation that would develop the shared repository option in a staged process similar to that favoured by national programmes. The SAPIERR-2 project looks in more detail at the following topics: multinational legal and business structures; legal liabilities; economics (costs, benefits); safety and security; public and political attitudes.

Conclusions

The conclusions that can be drawn from this review of the past history and present status of geological disposal can be summarised as follows:

- Nuclear power did not live up to early expectations: it was technically more complex than assumed, economically less attractive than expected and socially became progressively less supported after its promising start.
- Opposition stopped or slowed growth: the nuclear industry did not make sufficient efforts to inform and consult with the public, leaving the field open for intensive and effective lobbying by anti-nuclear forces.
- The list of counter-arguments (often recycled) focussed on reactor safety, economics, security and waste management
- Despite some severe setbacks, nuclear power over some decades proved itself increasingly to be reliable, safe and economic; many of the objections were thus countered.
- In addition the positive environmental aspects of nuclear power are becoming increasingly recognized by a public that is becoming ever more aware of the catastrophic consequences that can result from unabated consumption of fossil fuels.
- Despite the widening acceptance or support for nuclear, serious reservations continue to be expressed on two issues – nuclear security and long-term waste management.
- These issues are linked and are both being addressed today by intensifying efforts to ensure that all hazardous radioactive materials (and in

particular fissile materials) are being moved into well safeguarded storage facilities.

- In parallel, many nations are trying to progress plans and projects for implementing deep geological repositories that will be needed to provide long-term safety and security in any credible waste management system.
- For some countries, it will be infeasible or impossible to implement the costly deep repositories that will be needed to safely store their relatively small quantities of hazardous long lived wastes and/or spent fuel.
- Therefore national efforts must be complemented by multinational cooperative initiatives that will make appropriate storage and disposal facilities available to all countries that make use of nuclear technologies.
- Implementation projects that arise from such cooperation could bring huge and mutual benefits to both host countries and user countries of shared multinational repositories.

At the origin of nuclear power development, too little attention was devoted to the challenges of ensuring safe long-term management of the resulting radioactive wastes. For some long time now, however, the proponents of nuclear power, as well as the opponents, have realised that continued use or expansion of nuclear power is justified only if there is a consensus that the wastes can be safely managed. This realisation has, of course, led opponents to sometimes use the “unsolved” waste issue as a tool to attack the nuclear industry. It has also, however, spurred the industry on to try to implement safe solutions – in particular geological repositories. The recent rapid growth in recognition of the potential environmental benefits of nuclear energy, together with the alarming rises in fossil fuel prices, has led to increased interest in expanding nuclear power. Hopefully, this will encourage the industry to maintain its efforts to prepare for geological disposal and will also cause the opponents to help rather than hinder progress towards a safe and responsible waste management system that protect humans and the environment and will thus help to remove the last barrier to expanded use of safe and non-polluting nuclear energy.

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Upcoming Conferences

This section of the newsletter highlights upcoming conferences that are specifically relevant to Arius activities and objectives.

October	
15 th – 20 th	15 th Pacific Basin Nuclear Conference, Sydney, Australia
January 2007	
23 rd – 25 th	Safety Cases for the Deep Disposal of Radioactive Waste: Where do we stand? NEA, Paris
February	
25 th - 1 st Mar	Waste Management '07, Tucson, USA
April	
17 th – 20 th	World Nuclear Fuel Cycle, WNA-NEI, Budapest
September	
2 nd – 6 th	ICEM'07, Bruges, Belgium
16 th – 19 th	European Nuclear Conference, Brussels