

# Hewlett and Sloan Foundations

## *Abstract of Final Report: February 2016*

**Period: July 2013 to December 2015**

### **1 Background**

Since 2010, the William and Flora Hewlett Foundation and the Sloan Foundation have each authorized grants for projects designed to build upon successful European experience in promoting regional, shared solutions for the safe management and disposal of used nuclear fuel by assessing whether the concept could also be applied in the countries in the Middle east and North Africa (MENA) and in South East Asia (SEA). In the current and final phase of the initiative from 2013 to 2015 the Arius work has had three main elements:

1. Consolidating the gains made towards establishing regional groups with the capability to explore shared solutions for used fuel and radioactive waste management problems.
2. Providing input and support to regional groups that wish to assess the benefits and drawbacks of potential nuclear fuel leasing and take-back initiatives.
3. Providing high-level exposure and publicity to the global security value of the regionalization concepts, in order to build further support amongst international bodies and also major national disposal programs.

This final report documents progress during the entire project and incorporates information delivered in the required interim reports that have been submitted.

### **2 Activities Summary**

Over the past several years, Arius has become recognized as virtually the only international organization dedicated to promoting multinational cooperation in the management of used nuclear fuel and radioactive wastes. Accordingly, Arius has often been requested to present the status of such initiatives at events throughout the world devoted to discussions on the future of nuclear power. An important outcome of information dissemination activities of Arius has been a significant rise in interest in the issue of multinational disposal and, as will be described below, the initiation of a number of new multinational studies and projects on this topic. All activities summarized in this section are directly related to the Foundation project, but full costs of attending some of the meetings mentioned have normally not been charged to the Foundation project: contributions have been provided by the organizers.

#### **2.1 European interactions**

Although the Sloan-Hewlett projects explicitly exclude efforts in Europe, the basic concept of regional sharing of nuclear back-end facilities is based on the work that Arius initiated in Europe and the European work continues to serve as a role model for other regions. Accordingly, a brief account of the progress in Europe during the period covered by this report is given here. During the past two years, the most significant advances in cooperation within the EU were made by Arius, working as the secretariat of the ERDO-WG. In addition to providing on its website [www.erdo-wg.eu](http://www.erdo-wg.eu) explicit written advice on how EU Member States might mutually benefit from regional cooperation, Arius participated in 2013 in two meetings of the European Nuclear Energy Forum (ENEF) Working Group on waste management. Most importantly, in December 2013, the ERDO-WG and Arius organised, together with the European Commission staff, a meeting in Brussels that was attended by representatives from more than half of the 28 EU Member States. The meeting report contained specific proposals for further cooperation activities in the management of spent fuel and radioactive wastes. In June 2014, Arius was invited to present the regional disposal concept to experts from the European Parliament. In November 2014, the EC held a workshop on “National Programmes for the Management of Spent Fuel and Radioactive Waste in EU Member States” at which concepts for regional multinational repositories were directly discussed, with input from Arius on its global activities, including the Foundation funded work in the MENA and Asian regions. Throughout 2015, the ERDO-WG through its secretariat at Arius has been pressing for the EC to devote more resources to encouraging radioactive waste management cooperation at the strategic level rather than funding projects exclusively in the area of R&D which is of lesser importance for the less advanced Member States. This has involved interactions with officials at the

Commission during which it has been pointed out that the European activities of the ERDO-WG and Arius provide the role model for the work outside Europe which has been supported by the Sloan and Hewlett Foundations.

## 2.2 IAEA Interactions

The EC is an important organisation for Arius because the formal framework for interactions between the 28 Member States makes it more straightforward to launch initiatives for cooperation in waste management. However, the IAEA has many more Member States across the globe, including many in the MENA and Asian regions which are the focus of the present project. Accordingly, Arius maintains close ties with the Agency and participates in activities related to regional cooperation. During the final two years of the Foundation project, the following developments have taken place.

A report drafted a year ago with Charles McCombie as one of the principal authors has been published by the IAEA. The title is “Framework and Challenges for Initiating Multinational Cooperation for the Development of a Radioactive Waste Repository” and it is intended to build on all previous IAEA work by providing to politicians and decision makers concise information on overarching issues. The report directly addresses the risks facing a multinational disposal project and considers the approaches that may mitigate these risks. Some key conclusions noted are as follows:

- *There are almost no challenges faced by multinational disposal initiatives that are not also faced by purely national disposal programmes in democratic countries*
- *The technical and economic challenges may be more easily addressed by multinational partners than by a single, possibly small, nation on its own*
- *A multinational repository is not only a viable undertaking, but could offer substantial benefits to the countries involved.*

In June 2015, the IAEA hosted a major Spent Fuel Conference following on a previous event in 2010. Arius presented a paper on “Regional Cooperation on Spent Fuel management Status and Prospects in Europe, Arab Regions and Asia”. The most valuable direct input from this meeting for our Sloan-Hewlett project was establishing or renewing contacts with key persons in the countries that we are focussed on (including Vietnam, Malaysia, UAE, Jordan, etc.).

An IAEA INPRO Dialogue Forum on “Multilateral Cooperative Approaches to the Back End of Nuclear Fuel Cycle: drivers and legal, institutional and financial impediments” was held in May 2015. In October 2014, Charles McCombie attended a consultants’ meeting to prepare the agenda for the 2015 event. The 2015 agenda consisted of plenary talks covering the drivers for, and impediments to, multinational cooperation. These talks were followed by topical sessions looking in more detail at key issues affecting the feasibility of multilateral cooperation at the back-end. Participants included representatives of countries directly targeted by the Foundation project (e.g. Egypt, Indonesia, South Korea, Malaysia, Thailand and Vietnam). In November 2015, a further INPRO consultancy meeting was attended by Charles McCombie. At this meeting, proposals were developed for a major 3 year IAEA study on “Cooperative Approaches to the Back End of the Nuclear Fuel Cycle (NFC): Drivers and Institutional, Economic and Legal Impediments”. This is one of the several multinational initiatives that are currently being carried on or initiated on the multinational disposal concept. A summary list of these is included in the conclusions of the present report.

## 2.3 Arab Atomic Energy Agency (AAEA)

Cooperation between Arius, the AAEA and the IAEA has grown over the past few years. Arius interests in the MENA regions focus on both the Gulf region, where the GCC countries are progressing faster and on the other Arab countries which are further behind with their nuclear plans. For the latter group, the AAEA provides a useful framework within which the safety and security of radioactive waste management can be promoted. Arius has, within the scope of the Foundation work, cooperated in earlier project phases with the AAEA in a series of meetings aimed at assessing the feasibility of adopting the European ERDO-WG model to other global regions. In June 2013, Arius was invited to an AAEA Expert Meeting on “*Technical and economic feasibility for the introduction of nuclear power plants*”. About fifty experts from 16 Arab countries participated in the meeting: Tunisia, Jordan, United Arab Emirates, Bahrain, Qatar, Saudi Arabia, Kuwait, Sudan, Iraq, Libya, Egypt, Yemen, Oman, Algeria, Morocco, and Lebanon. One important conclusion was that cooperation and coordination between the Arab states is

needed in numerous areas, including ways to handle security and disposal of waste and creating regional waste management systems.

## 2.4 AAAS-GNF

The Arius efforts in the MENA and Asian regions are supported by both the Sloan and the Hewlett Foundations. Both Foundations are also supporting a parallel project, run as part of the Global Nuclear Futures (GNF) initiative of the American Academy of Arts and Sciences (AAAS), which focuses on the merits of regional *storage* centers for used nuclear fuel, in particular in South East Asia. Arius work has concentrated on the feasibility of regional *disposal*. However, centralized regional storage and disposal both have safety, security and economic advantages. Moreover, disposal of used fuel will always be preceded by a long storage period and finding willing hosts for a storage facility will be difficult without a credible final disposal strategy, so that the two topics are strongly linked.

Accordingly, both topics were presented and discussed in the framework of an AAAS meeting held in Vietnam in November 2012 on “*Emerging Nuclear Power in Regional Contexts: Southeast Asia*”. This led to increased cooperation between the two projects and Arius was involved in the AAAS follow-up meeting in Indonesia in January 2014. This meeting included key Asian high-level contacts from Indonesia, Singapore, Vietnam, Malaysia, Japan, Philippines and the ASEAN Foundation. More direct co-operation concepts arose as a result of these two workshops. A joint agenda for a Gulf region meeting was presented to UAE Ambassador Hamad Alkaabi at a meeting in Vienna in February 2014. The scope and participation at this meeting was discussed through the year with Ambassador Alkaabi, and with the staff at the UAE regulatory body, FANR, which agreed to host the event. In January 2015, a series of briefing meetings took place in Abu Dhabi. Arius hosted a workshop on back-end solutions including a panel with members of FANR. The AAAS study is currently looking at the business case for consolidated multinational storage. This is a follow on from the Rosner-Malone AAAS study on multinational storage. An external consultant, Robert Sloan, has been tasked by the AAAS with preparing a report and Arius has already provided him with relevant documentation

## 2.5 NTI

Arius was requested in 2014 to attend an invitation-only workshop on “*New Approaches to the Nuclear Fuel Cycle*” co-hosted by the Nuclear Threat Initiative (NTI) and the Proliferation Prevention Program at the Center for Strategic and International Studies (CSIS). The meeting took place in Taipei in June 2014. A paper was prepared on future nuclear power development in small Asian states and on their spent fuel management options. The Taipei meeting was coupled with an CSIS-NTI Workshop focusing on proliferation issues associated with multinational back-end initiatives. Asian Participants included Atsu Suzuki, Japan Atomic Energy Agency, Il Soon Hwang, Seoul National University, Le Ba Thuan, Ministry of Science and Technology, Vietnam and Mohd Abd Wahab Yusof, Malaysian Nuclear Agency. A presentation was given by Charles McCombie on “*Regional Spent Fuel Management Approaches in Asia and Their Implications*”. A paper on the Asian situation was also prepared and this will be attached to the final report sent to the Foundation. From the long list of conclusions drawn at the meeting, the following are particularly relevant for the present Hewlett-Sloan funded project of Arius:

- *All agreed that regional efforts should not substitute for national plans and that all countries had to move forward on national plans for waste storage and disposal with international options as a possible back-up.*
- *Regional collaboration has the potential to spread economic costs and potentially improve security.*
- *The creation of an ‘Asian Group on Coordination of Spent Fuel Management,’ consisting of experts from government, industry, academia, research institutes and NGOs with political support from senior government officials, technical support from the national centers of expertise and sustainable funding, would send a very powerful signal of commitment to the region and internationally.*

A subsequent NTI meeting, held in Singapore in December 2015, brought together senior nuclear leaders from Australia, China, Japan, South Korea, Taiwan, and the U.S.A. Their conclusions included agreement that regional cooperation should integrate technical, political, and security challenges since addressing these in a comprehensive way would offer significant benefits and improve chances of success. Further workshops are planned, with the focus is on identifying specific spent fuel management topics for cooperation; but it is unclear how close the countries are to establishing a regional grouping.

## 2.6 International Framework for Nuclear Energy Cooperation RNFSWG

Following a Workshop in Bucharest, Romania, in May 2014 (at which Arius was invited to present its work), the Reliable Nuclear Fuels Services Working Group (RNFSWG) of the IFNEC project decided to launch a study on “Exploring the Consideration of an International Repository”. The Chairmen are Daniel Iracane of CEA, France and Hamad Alkaabi of the UAE. At the follow up meeting in October 2015, Arius was requested to moderate a session intended to solicit views of attendees on the highest priority items related to multinational disposal initiatives. Participants from MENA and Asian countries submitted ranked lists of issues. Arius has been requested to continue providing the RNFSWG with advice on which countries should be directly approached for interviews and how the discussions should be structured.

## 2.7 Questionnaire to Asian Countries

In mid-2015, Arius distributed to a number of Asian-Pacific nations a short questionnaire to gather information on how consideration of shared regional activities influences their national radioactive waste management programs. Questions were included on whether multinational facilities are considered in national policies and strategies and on whether initiatives beyond current cooperation arrangements would be welcomed. Responses were received from Australia, China, Indonesia, Japan, Thailand, and Vietnam. All of these countries support cooperation with their Asian neighbours, but mostly they regard the current arrangements (e.g. conferences, ASEAN and FNCA coordination, IAEA TC/RCA programmes, etc.) as adequate for encouraging regional/multinational cooperation in radioactive waste management.

## 2.8 South Australia Royal Commission

A surprising new development is that the South Australian Government has established a Royal Commission (RC) to examine if/how South Australia should get more into nuclear activities, including the possibility of offering international storage and disposal facilities to foreign customers. If Australia were to embark on such a project, it would have considerable impact on spent fuel planning in many of the potential user countries we are evaluating – the Asian countries in particular. It could effectively provide a global solution and the importance of its potential impact cannot be overstated. The Commission published a paper on waste storage and disposal international options and Arius submitted a lengthy document commenting on this. Subsequently the RC issue a call for tenders for studies looking in detail into the potential benefits of hosting nuclear storage or disposal facilities and Arius staff members (outside of the Association work programme) are now involved in such studies, together with the Australian office of Jacobs Engineering.

## 3 Promoting regional concepts

The issue of regional cooperation to ensure safe and secure back-end strategies has been presented on a number of occasions during the reporting period and at different levels.

### 3.1 Presentations

- *International Approaches to Spent Fuel Management*, Developing Spent Fuel Strategies Workshop Paris 9/10<sup>th</sup> December 2013
- *Strategy and Programme for RWM in New Nuclear Power Countries*, AAEA Meeting Expert meeting on Technical and Economical Feasibility of NPP in Arab countries, Hammamet, Tunisia, 17-19 June 2013
- *Multinational Cooperation at the Back-end of the Fuel Cycle: options for small and new nuclear countries*, IAEA Workshop Dec 16-18, 2014, ARAO, Ljubljana
- *Response to: The Back-End of the Nuclear Fuel Cycle: An Innovative Storage Concept* Emerging Nuclear Energy in the ASEAN Region: A Path Forward to a Safer, More Secure Future, Bali, Indonesia, January 2014
- *Spent Fuel Management in Asian Newcomer Countries*, Developing Spent Fuel Strategies Workshop Taipei, Taiwan, June 24<sup>th</sup>/26<sup>th</sup> 2014
- *International cooperation for long term management of radioactive wastes*, IFNEC Workshop, May 5th - 7th, 2014, Bucharest, Romania
- *Multilateral Cooperation on Long-term Management of Radioactive Wastes An overview of the status of ongoing initiatives*, INPRO Consultancy, Oct 28-31, 2014, IAEA, Vienna, Austria
- *Multinational Developments at the Back-End of the Nuclear Fuel Cycle: Update on Status and Prospects in*

*Europe, Arab Regions and Asia*, Erice International Seminars on Planetary Emergencies Erice, Sicily, August 2015

- *Multinational Cooperation at the Back-end of the Fuel Cycle: options for small and new nuclear countries*, AAAS Meeting Jan 2015 Abu Dhabi, UAE
- *Regional Cooperation on Spent Fuel management Status and Prospects in Europe, Arab Regions and Asia*, Conference on Management of Spent Fuel from Nuclear Power Reactors: An Integrated Approach to the Back End of the Fuel Cycle, 15<sup>th</sup> – 19<sup>th</sup> June 2015, IAEA, Vienna, Austria
- *Past and present status of initiatives to promote cooperation at the back-end of the fuel cycle*, INPRO Dialogue Forum Cooperative Approaches to the Back End of the Nuclear Fuel Cycle 26<sup>th</sup>-29<sup>th</sup> May 2015, IAEA, Vienna, Austria

### 3.2 Publications (2013-2016):

- McCombie C., Chapman N.A and Verhoef E, *Multinational Disposal of Radioactive Wastes: from taboo subject to topical issue*, Nuclear Engineering International (2016) In press (copy to be attached to final Foundation) report
- McCombie C., Chapman N.A, *Regional Cooperation on Spent Fuel Management Status and Prospects in Europe, Arab Regions and Asia*, IAEA Spent Fuel Conference (2015).
- Chapman N., McCombie N., Kickmaier W. and Scourse E., *Developing a Spent Fuel Management Strategy for a Newcomer Nuclear Power Country*, IAEA Spent Fuel Conference (2015).
- McCombie C. (principal author), IAEA NE Report: *Options for Management of SNF and Radioactive Waste for Countries Developing Nuclear Programme*, NW-T-1.24, (2013).
- Chapman N.A., McCombie C. and Verhoef E (2013) *Towards a European Regional Geological Repository*, ICEM (2013).
- McCombie C., Chapman N.A., Kickmaier W. and Scourse E.M. (2013). *Planning an integrated waste management strategy for new nuclear nations*. IHLRWM International High Level Radioactive Waste Management. 28 April-2 May 2013. Albuquerque USA.

The third goal of the present project defined in Section 1 is “providing high-level exposure and publicity to the global security value of the regionalization concepts”. At the technical level, this has been achieved by publications, conference presentations and responding to invitations from other groups studying the potential impacts of multinational disposal concepts. At the level of the general public, the Swiss documentary film, “Journey to the Safest Place on Earth”, in which Charles McCombie assisted the film team and appears, with various other waste management experts, as an advocate of the advantages of regional repositories continues to be shown in cinemas and film festivals around the world. It has also in 2015 been shown on prime time television in Switzerland and has been released as a DVD through Amazon. In mid-2014, the Japanese television network NHK put out a two-part documentary on global nuclear issues; in this, the work of Arius on global cooperation initiatives was reportedly a prominent feature.

## 4 Conclusions

It is clear that the three project goals reproduced in Section 1 have been met to differing degrees. There has been relatively little direct progress made towards establishing formal groupings in the MENA and Asian regions. A major obstacle to progress has been the delays and hesitation of many potential new nuclear power countries in Asia and in the MENA regions following the negative aftermath of the Fukushima accident. In the Asian countries, attention has focused on ‘front-end’ reactor safety issues that are those most emphasized by the IAEA in its advice on developing nuclear power. Some Asian nations view existing back-end cooperation possibilities as being adequate at the present time. From the work we have carried out, we consider that this situation is only likely to change as these (mostly) very young programs become better established and the importance of making credible ‘back-end’ arrangements gains priority. The planning and economic drivers for waste management can appear distant; the example shown by many advanced nuclear programs (including the USA) which have pushed repository implementation dates out to the

far future has not helped. However, we believe more rapid progress in new nuclear programs may take place as a result of continued pressure from the security drivers and also because of the work we have carried out to establish the importance of having a credible back-end strategy among key decision-makers.

In practice, many MENA nations would prefer intensified coordination, but their resources to implement this are lacking for the least advanced (e.g. North African) nations and the ongoing oil price crisis is not helping the larger players. Another important contributing cause in many of the Arab and North African countries with which Arius has built up contacts over the course of the present study is the continuing social and political unrest in parts of the MENA region, which has led to changed priorities and reduction of funding for any long-term developments. Nevertheless, during the course of the project, Arius has been able to organize or participate in a series of regional meetings focused on examining the multinational storage/disposal concept and has made many of the key decision makers aware of the importance of early organization of disposal options for radioactive wastes.

The most encouraging evidence of the impact of the multinational efforts that Arius has been able to make as a result of this project funding is perhaps the series of related initiatives that have sprung up, in part as a result of the impetus from our work and our involvement. The organisations directly working on multinational or regional disposal now include the IAEA (INPRO section and Waste Technology section), the EC (IGD-TP sub group), IFNEC, the AAAS, NTI and most recently the Royal Commission established by the government of South Australia. Arius is the only organisation that is routinely informed by all these others and it has been actively encouraging all of these initiatives to coordinate their activities better. In fact, the most effective use of the last tranches of funding in the present Sloan-Hewlett project was judged to be contributing constructively to these initiatives and to ensuring that the progress made to date is highlighted to the greatest possible degree.

The funding provided by the Hewlett and Sloan Foundations has helped raise global awareness of the necessity for multinational disposal options for spent fuel and long-lived radioactive wastes. It has also enabled Arius to maintain its position as a global leader in the topic of multinational and regional cooperation in used fuel and radioactive waste management. The ambitious goals of initiating formal regional cooperation bodies in the Gulf region and in Asia are still some way off, but the concept is receiving ever more attention. Meetings and workshops in both target areas have involved a diverse list of participants from all of the organisations that must be involved in the establishment of such bodies. Multinational initiatives continue to be a complex area, characterised by slow progress requiring constant reinforcement in the political arena. This project has assisted considerably in maintaining this progress and, at the end of the work, the global profile and potential for actual implementation of multinational solutions is considerably greater than it was four years ago.