

Implementing borehole disposal of disused sealed radioactive sources in Ghana, the Philippines and Malaysia

1. Project objective

To enhance safety and security by reducing the risk of accidents and malicious acts. This will be achieved through the permanent disposal of all disused sealed radioactive sources (DSRS) in the three target Member States.

2. Project background and rationale

Sealed radioactive sources are widely used throughout the world for beneficial purposes, in industry, medicine and research. Regulatory and physical control of the majority of sealed radioactive sources is ensured during manufacturing, distribution and regular use. However, the IAEA has recognised that when sources become disused, and especially where regulatory infrastructure is ineffective and/or financial resources are limited, there is the possibility that control over these sources will be lost. In other circumstances, repatriation of DSRS to countries manufacturing and supplying sealed radioactive sources may not be possible, in which case interim or long-term storage of the DSRS is required. But in Member States without an adequate radioactive waste management infrastructure, the management of DSRS in storage may also be extremely weak. In order to overcome these difficulties and assist its Member States the IAEA supports various initiatives aimed at improving management and control over sources. Included in this assistance is the development of technologies for the storage and final disposal of DSRS.

The IAEA has developed the Borehole Disposal Concept (BDC) which is now ready to be implemented. Suitable storage and disposal solutions are available in many countries with existing infrastructure, but the same cannot be said for those countries with limited financial and human resources and that have other more pressing priorities. The BDC was specifically developed to support these countries by providing a safe, robust and cost effective disposal option for the management of DSRS and thus solve the problem of poor control over sources that are stored at user premises and at national storage facilities in countries that need sustainable long term solutions.

A pilot project has been initiated in Ghana to dispose of lower activity DSRS in a borehole. When successful, this pilot project will go a long way towards instilling confidence in the practical application of the BDC. Malaysia and the Philippines have expressed a firm interest in disposing of their DSRS and have initiated actions to bring this about. In respect to technical planning they are not as far along as Ghana, where the IAEA's Technical Cooperation Department has already invested financial resources, and these two member States will therefore need more financial support.

3. Planned activities and project steps

The BDC will be implemented in three countries. In Ghana the major activities will include the following:

- Drilling up to 3 boreholes to a nominal depth of 100m. These boreholes are needed to characterize the already selected disposal site. One of the boreholes will likely be used for the final disposal of DSRS.
- Conduct the long term safety assessment and present the safety case.
- Finalize other necessary studies such as the inventory review, environmental impact assessment, operational safety assessment, etc.
- Finalize procedures for the packaging and disposal of DSRSs in the disposal borehole in Ghana.

- Design the conditioning and disposal facilities.
- Submit the license application to the regulator.
- Construct the facility.
- Implement the disposal operation.

BDC projects will be initiated in Malaysia and the Philippines where preliminary reviews of competencies and evaluation of the capacity to undertake borehole disposal have already been carried out. The next steps will entail detailed planning for the entire project followed by the review of DSRS inventories, the identification and characterisation of potential disposal sites, the conditioning of DSRS, the design and construction of conditioning and disposal facilities and the strengthening of competencies to support site specific safety assessment modelling. Attention will also be paid to public acceptance issues. After these various studies are completed, a license application for construction and disposal will need to be submitted, followed in due course by the actual disposal operation. All of the activities are unlikely to be completed by end 2016 in Malaysia and the Philippines. However, significant progress will be made towards ensuring enhanced safety and security in these Member States.

5. Financing Plan

Description	Estimated Direct Cost in US \$	PSC	Total
BDC pilot project in Ghana (Completion at end 2016).			
Continue site investigations – 2013	50 000	3 500	53 500
Complete field investigations, design disposal borehole – 2014	60 000	4 200	64 200
Complete safety assessments and present safety case to the regulator – 2015	60 000	4 200	64 200
Undertake final conditioning and packaging for disposal. Complete disposal operations - 2016	100 000	7 000	107 000
BDC project in Malaysia (Completion at end 2016)			
Undertake inventory review, initiate siting – 2013	60 000	4 200	64 200
Identify preferred site, establish drilling contracts and commence drilling and other site investigation activities, develop proficiency in safety assessment modelling - 2014	250 000	17 500	267 500
Complete field investigations, design and construct pre-disposal and disposal facilities, undertake safety assessment modelling – 2015	250 000	17 500	267 500
Complete safety assessments and present safety case to the regulator – 2016	40 000	2 800	42 800
BDC project in Philippines (Completion at end 2016)			
Undertake inventory review, initiate siting – 2013	60 000	4 200	64 200
Identify preferred site, establish drilling contracts and commence drilling and other site investigation activities, develop proficiency in safety assessment modelling - 2014	250 000	17 500	267 500
Complete field investigations, design and construct pre-disposal and disposal facilities, undertake safety assessment modelling – 2015	250 000	17 500	267 500
Complete safety assessments and present safety case to the regulator – 2016	40 000	2 800	42 800
	1 470 000	10 290	1 572 900

Grand Total: \$1 572 900

Note – the costs estimated above are obtained from reference [1]

6. Expected outcomes

DSRS will be cost effectively disposed of in Ghana, the Philippines and Malaysia, resulting in a significant reduction in security and safety risks.

7. References

[1] Maphisa, E.B. and Smith, S.W., *Borehole Disposal Concept for Disused Sealed Radioactive Sources – Techno-economic study*. Internal Report of the South African Nuclear Energy Corporation (Necsa), (Feb 2004)

Conduct regional practical workshops on technologies for the conditioning of disused sealed radioactive sources (DSRSs) for long-term storage

1. Project objective

When radioactive sources become disused, they need to be safely and securely kept for long periods of time. Many countries have limited capabilities to do this. There therefore exists a need to train people in these less developed countries to identify, characterize, condition and manage these DSRs in order to minimize their safety and security risks.

2. Project background and rationale

Training courses are often given by the IAEA on a regional or national level to teach staff from IAEA Member State institutions to deal with disused sealed radioactive sources (DSRSs). There has in the recent past been a lack of practical training to dismantle, characterize and condition DSRs. This initiative will involve the identification of partner organizations in the various regions that are capable and have the necessary technology to host regional practical training events. The training courses will involve theory but will have a practical bias so that delegates can themselves do dismantling, characterization, conditioning and packaging for storage of DSRs. At least four courses are envisaged. The existing Technical Cooperation Department coordination mechanisms will be used to deliver the courses.

3. Planned activities and project steps

The project will therefore include:

4.1 Development of the training material and identification of the counterparts and host organizations.

4.2 Delivery of the courses to the participants in four different regions (SE Asia, Africa, Latin America and the Former Soviet Union) with three to be funded from this project. The courses will last for at least two weeks and involve from ten to fifteen participants.

4. Financing Plan

Description	Estimated Direct Cost (\$)	PSC	Total
Develop training material for workshops/training courses (by end 2013)	85 000	5 950	90 950
Deliver three training courses (2014 to 2015)	243 750	17 063	260 813
	328 750	23 013	351 763

Grand Total: \$351 763

5. Expected outcomes

Core groups of practically trained technicians will be available in the different regions who will be able to manage DSRs in their respective countries safely and securely. The long term sustainability of the storage of DSRs will be enhanced. The training material developed during this project will be used for further training courses after 2014.

Proposal to request extra budgetary funding to INT2010016 from the US
Peaceful Uses Initiative

INT2010016: Connecting the Network of Networks for Enhanced Communication and Training

Objectives:

To provide enhanced capabilities and capacity in Member States in the field of radioactive waste management through (1) the exchange of expertise and knowledge using internet-based technologies and (2) the development of distance training with a particular focus on countries with emerging or less developed programmes.

List of the Member States:

The project will be open to all interested Member States

TC Field of Activity:

19 - Radioactive waste management, decommissioning and environmental remediation

Justification:

INT2010013 is part of a collaborative effort to develop, put into place and operate a global electronic platform (CONNECT) intended to integrate within a single framework the existing electronic platforms IDN, DISPONET, LABONET, URF Net and ENVIRONET¹ and future horizontal cooperation ventures in all areas of radioactive waste management. CONNECT will draw on the experience gained in the operation of the existing networks and will provide organizations of Member States dealing with radioactive waste with appropriate electronic means and tools to share information, knowledge and experience and facilitate the preparation and delivery of distance training, particularly to staff of organizations in countries with emerging programmes – including newcomers to nuclear power – or with less developed programmes for radioactive waste management.

CONNECT was conceived as joint effort between the IAEA - involving the Regular and the Technical Cooperation programmes - and the Instrument of Nuclear Safety Cooperation of the European Union. The IAEA started the preparatory work in 2010 under the Regular Programme. The European Union approved in November 2010 a €500 000 allocation to fund the construction of the foundations of the electronic platform. This allocation is already available and will be subjected to tender procedures in the first half of 2011.

The IAEA technical cooperation programme (TCP) will contribute through the proposed interregional project concept INT2010016, which will be specifically designed to organize activities related to the preparation of training material and to support the participation of candidates from countries which

¹ IDN = International Decommissioning Network, DISPONET = International Low Level Radioactive Waste Disposal Network, LABONET = International Network of Laboratories for Nuclear Waste Characterization, URF Net = Underground Research Facilities Network, ENVIRONET = Network of Environmental Management and Remediation.

are beneficiaries of activities, such as training courses, seminars and workshops, organized under the umbrella of CONNECT. The specific design of INT2010016 will be determined bearing in mind the availability of funds, both from the technical cooperation fund (TCF) and extra-budgetary resources.

Participation of additional partners was envisaged from the onset. The US SANDIA National Lab has already stated its intention to cooperate with the IAEA by providing and constructing a pilot version of the elementary structure of CONNECT that will be used for testing and as a reference tool for the actual construction of the final architecture of the platform by contractors. Other potential partners from different countries have already announced interest in exploring possible ways of cooperation. A Steering Committee will be established to ensure coordination of present and future partners.

Support from PUI funds to INT2010016 would help consolidate the joint efforts of the IAEA regular and TC programmes and the EU. In particular, the development of training material using state of the art audio-visual techniques and arranging hands-on training events, including practical exercises, are areas of work where additional extra-budgetary funding on top of TCF funds will be very important in getting CONNECT ready to be used with significant content and training materials as soon as possible.

The request is considered justified for the following reasons:

1. Radioactive waste management is one of the thematic areas eligible for support under the PUI..
2. The initiative is intended to foster worldwide safe, secure, environmentally friendly and technological sound management of radioactive waste, including storage, disposal, decommissioning and environmental remediation and rehabilitation by facilitating experience sharing, providing e-learning tools and providing access to high quality and comprehensive documentation in all areas of safe management of radioactive waste.
3. Developing the radioactive waste management infrastructure is one of the 19 issues to be addressed by newcomers² and a key element for sustaining a nuclear power programme.
4. CONNECT will be an excellent platform for the IAEA to foster a global safety regime in the field of radioactive waste management, promote the use of IAEA safety standards and technical documents and encourage adherence to international instruments connected to safe management of radioactive waste.
5. The CONNECT initiative has already secured support from the European Union under the Instrument of Nuclear Safety Cooperation and will offer an excellent opportunity to create synergies between the IAEA regular programme and the TCP in the field of radioactive waste management.
6. The initiative has already a US partner, Sandia National Laboratories, and there are good prospects for attracting other partners and donors from countries around the world, including state and private entities.
7. The CONNECT initiative is an excellent example of how to create synergies and ensure linkages between the IAEA's regular programme and the technical cooperation programme. The design, development and operation of CONNECT will be carried out under the regular

² *Milestones in the Development of a National Infrastructure for Nuclear Power*, IAEA Nuclear Energy Series No. NG-G-3.1, 2007.

programme, while the TCP contribution will be mainly used to develop the content of the platform and support its deployment by the beneficiaries of the programme.

Requested funding level and activities:

Technical Cooperation Fund

Requested funding: €600 000 over four years (2012-15) with the following allocation:

Content Development	=	15%
Deployment	=	80%
Infrastructure Acquisition	=	5%

(Note: project concept INT2010016 will be subjected to TC design procedures and to the approval of the Board of Governors in 2011)

Peaceful Uses Initiative

2011:

- To contract vendor or consultant to develop outreach materials for use in raising awareness of the CONNECT platform to ensure a solid and growing user base. (\$25,000)
- To contract multiple vendors for development of video-based training materials in decommissioning, environmental remediation, and waste management activities. (\$150,000 in 2011; this is a multi-year task)

2012:

- To recruit at P-4/P-5 level consultant (or CFE) for 36 months to assist in the development of eLearning materials and to coordinate the training of Member State organizations in how to produce such materials in their country. (\$130,000 in 2012)
- To contract multiple vendors for development of video-based training materials in decommissioning, environmental remediation, and waste management activities. (\$150,000 in 2012; this is a multi-year task)

2013:

- Continuation of the CFE support contract through 2013. (\$130,000 in 2013)
- Support to regional workshops to raise awareness of Member State representatives from various waste management institutions in the use of the system, benefits to Member States, and to train them to develop usable content for the eLibrary (\$70,000).
- To contract multiple vendors for development of video-based training materials in decommissioning, environmental remediation, and waste management activities. (\$100,000 in 2013; this is a multi-year task)

2014:

- Continuation of the CFE support contract through 2013. (\$130,000 in 2014)

- Support to regional workshops to raise awareness of Member State representatives from various waste management institutions in the use of the system, benefits to Member States, and to train them to develop usable content for the eLibrary (\$160,000)
- To contract multiple vendors for development of video-based training materials in decommissioning, environmental remediation, and waste management activities. (\$160,000 in 2014; this is a multi-year task)
- Procurement of recording equipment (i.e., HD semi-professional video cameras and software for video editing) to be distributed on an as-needed basis to the less-advantaged Member State institutions to support recording of unique events leading to the development of universally available video for the eLibrary content and eLearning course materials. (\$100,000)

Proposed funding distribution per project year (US\$):

Source of funding	2011	2012	2013	2014	2015
EC	-	363 000	362 000	-	-
TCF	-	145 000	145 000	290 000	290 000
PUI	175 000	280 000	300 000	550 000	-
Total	175 000	788 000	807 000	840 000	290 000

PUI	2011	2012	2013	2014
Subtotal (per year)	175 000	280 000	300 000	550 000
PSC (7%)	12 250	19 600	21 000	38 500
Total	187 250	299 600	321 000	588 500

Grand Total: \$1 396 350

Strengthening “cradle to grave” control of radioactive sources in the Mediterranean region

Rationale:

Radioactive sources are widely employed throughout the world for many different uses in industry, medicine, agriculture and research. Accidents involving radioactive sources and reports of illicit trafficking of radioactive materials had led to greater awareness of the safety and security risks posed by sources that are outside effective regulatory control –or “orphaned”. In particular, the Mediterranean region is characterized by an intense maritime trade using the Mediterranean Sea as an avenue to enable the movement of persons and goods among seaside countries and from them to interior countries of Europe, Asia and Africa. Associated to this intense traffic, multiple occurrences have been reported at borders and inland of trade accidentally involving radioactive sources or contaminated materials which needed to be properly addressed upon positive detection. In some cases, radioactive orphan sources have reached industrial processes resulting in inadvertent release of considerable amount of radioactivity to the environment.

To protect the public from the hazards of ionizing radiation, “cradle to grave” control of radioactive sources is essential. For many years the IAEA has been helping Member States to strengthen their national management and regulatory infrastructures to ensure that the radioactive sources are properly regulated at all times, including accountancy, licensing, inspection procedures of practices involving the use of radiation sources, controlling export–import operations of sources and training and equipping law enforcement and border control bodies.

As of today, a good deal of countries of the Mediterranean region have already in place a reasonable national infrastructure for the control of radioactive sources and are implementing the provisions of the Code of Conduct on the Safety and Security of Radioactive Sources. Nevertheless, overall the situation cannot be considered fully satisfactory and there is wide room for improving the control of radioactive sources until comprehensive and harmonized “cradle to grave” management systems of radioactive sources will be achieved across the Mediterranean region. In particular, several countries are still in need of completing their national regulatory framework addressing all elements related to the use, storage and disposal of radioactive sources. Moreover, while much attention has been paid to the safe and secure utilization of the sources while in use, prominent gaps and/or weaknesses have been identified in many areas of the back-end part of cycle, once the sources have reached the end of its usable life. At that stage of the cycle the sources cease to be assets and become a burden and a financial

liability. The unavailability of a sound national policy for managing disused sources, including appropriate disposal routes, makes necessary to store spent sources in temporary locations, sometimes under poor safety and security conditions and supervision. Cases have been reported of radioactive sources accidentally or purposely eliminated through conventional disposal routes or simply abandoned in the environment.

Storing and disposing of radioactive sources is not only a matter of resources; it requires careful assessment and planning, including sound strategy and policy, effective institutional framework, comprehensive operational procedures and appropriate human and financial resources. Regrettably, at the present stage not all the countries of the Mediterranean region have developed and enforced national policies and strategies and corresponding capabilities for the long-term management of disused radioactive sources. In addition, there is wide room to improve international cooperation and exchanges among the seaside countries of the region to share experience in tackling common interest problems associated to regulated and unregulated movement of sources and radioactively contaminated materials, in matters including, but not limited to, notification, authorization and denial of shipments, import and export of sources, repatriation of radioactive sources and contaminated material detected at borders and conditions while in transit. Bearing in mind that there are multiple operations and shipments crossing on a daily basis the Mediterranean Sea, promoting the establishment of harmonized approaches to deal with the management of disused sources from a region-wide perspective will definitively contribute to reinforce safety and security of trade across the Mediterranean region.

Significant contribution to the safe, secure and sustainable disused source management is also provided by the technical solutions for the conditioning, storage and disposal of radioactive sources that the IAEA has developed. One of these is the Borehole disposal of disused Sealed Sources that includes the Borehole Disposal Concept and a conditioning system for preparing the disposal packages. Another technical solution developed by the IAEA is the Mobile Hot Cell used to condition high activity sources for long term storage in the country or for repatriation to a supplier country. The two technologies need to be merged to allow high activity sources to be disposed of in a borehole and the approach to be adjusted as needed, to the situation (number and type of disused sources) of selected countries in the Mediterranean region.

Project Description: This proposal is intended to assist participating countries to set up appropriate national policies and strategies aimed to achieve sustainable “cradle to grave” control of radioactive sources by reinforcing the present regulatory and management capabilities and fostering international cooperation among the countries of region to address

matter of common interest associated to the use of the Mediterranean Sea as a trade avenue. It will also contribute, to the possible extent, to define and put into place region-wide harmonized policies, strategies and practices for the safe and secure management of the radioactive sources at all stages including a well-defined end-point for DSRS and improved technology (merging of BOSS and the MHC) for implementing the disposal end-point for all DSRS.

In cooperation with the European Commission (within the scope of the Instrument of Nuclear Safety Cooperation), the IAEA is currently engaged in an interregional project for the next TC cycle specifically aimed to address all the elements of the management of radioactive sources - with special emphasis on the back-end part of the cycle - in countries surrounding the Mediterranean region. Compared to previous efforts at national and regional scales on the same topic, this interregional project TC project has begun to systematically roll out a comprehensive series of activities to reinforce management of radioactive sources in a complete geographical region taking into consideration the specific conditions, taxonomy and peculiarities of the target countries. Furthermore, the design of the project also reflects a One-House approach to deal with this critical matter, involving the Department of Nuclear Safety and Security and the Department of Nuclear Energy, to deal respectively with safety matters – including synergies between safety and security – and technological solutions, within the scope of a interregional project managed by the Department of Technical Cooperation. Consultations with and involvement of the Office for Legal Affairs to provide legal advice will also be exercised when necessary during project implementation.

The European Commission has already pledged a 1.3 million contribution to the next cycle TC interregional project, primarily to support the non-EU countries of the region and to further develop certain IAEA methodologies and tools. The IAEA contribution from the TC Fund will be focused on backbone critical activities of the project design to ensure sound implementation and balanced participation. However, with additional resources the project would have better opportunities to successfully implement critical parts of the design, in particular those activities which are more intimately connected to enabling transnational cooperation, fostering the implementation of the provisions of the Code of Conduct and promoting adherence to the Joint Convention. The funding under the Peaceful Uses Initiative (PUI) would help build up a strong cooperation framework involving MS, the IAEA, EU and donor countries within the scope of an unprecedented initiative under a TC project. The additional resources that are requested are essential to enable the successful implementation of all elements in the design and to ensure a comprehensive approach to the problem.

Planned Activities

1. Formulation of national DSRS management policy and strategy, including safety and technology
2. Establishment of a national DSRS policy and strategy implementation plan, including safety and technology
3. Establishment of DSRS tracking system
4. Elaboration of a model system (formal and technical infrastructure) for managing DSRS in a country
5. Verification of DSRS management practices and facilities, including safety and technology
6. Formulation of recommendation for national strategy implementation
7. Predisposal management of DSRS
8. Selecting of a DSRS disposal options
9. Managing high activity DSRS(including merging the BOSS with the BDC)
10. Preparation of training materials for regulatory matters
11. Completing regulatory framework
12. Reinforcing safety assessment capabilities using SAFRAN and support to licensing installations
13. Establishing and sustaining a management system
14. Reinforcing capabilities to implement the Joint Convention
15. Reinforcing capabilities to implement the Code of Conduct
16. Introducing the project, ensuring regional approach, coordinating activities and following progress

Cooperation under the Peaceful Uses Initiative will be particularly needed for implementing several inputs corresponding to activities 5, 6, 8, 9, 12, 14 and 15.

(Note: detailed design of a four year INT project – including tentative allocation of budget - is already available and involves around 60 inputs distributed across the 16 activities listed above).

Outcomes/Outputs

Objective: To ensure an adequate and permanent control over radioactive sources at State level, benefiting from the use of a harmonized regional approach consistent with IAEA safety standards and other international best practice.

Outcomes:

- Enhanced regulatory framework and radioactive waste management policy, strategy and infrastructure of participating countries covering all necessary aspects to ensure safe management of disused sealed sources.
- Regional cooperation mechanisms aimed to facilitate a harmonized approach to the problem and collaboration in areas of common interest for the safe movement and management of radioactive sources (across and inside and outside the Mediterranean region) established.

Specific outputs are:

1. National policy and strategy for DSRS management revised, including an action plan for its implementation
 2. Improved and licensed source management system in operation
 - 3 Human capabilities and capacities in managing DSRS consolidated
 4. Capacities of national regulatory authorities to license and exercise regulatory control over facilities and activities for the safe management of disused sealed sources upgraded and reinforced
 5. The safety of all components of the management of disused sealed sources (from generation up to disposal) and required national regulatory framework is strengthened in accordance with the IAEA safety standards
 6. Technical support capacities upgraded to fulfill the requirements of the Joint Convention and the provisions of the Code of Conduct
 7. Regional collaboration ensured and project implemented in a coordinated fashion
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Estimated Budget per year:

	2013			2014			2015		
	EU	IAEA	PUI	EU	IAEA	PUI	EU	IAEA	PUI
€	377	638	168	398	637	200	0	128	0
\$	559	945	249	590	944	296	0	190	0

Notes:

- \$/€ exchange rate = 0.675.

- EU contribution is meant to contribute to certain IAEA activities (improving tools and methodologies to be used in the project, expert advice for certain inputs and supporting project implementation) and to support the participation of non-EU countries (also countries that are candidates to the EU are excluded from direct support).

- PUI budget refers to planned activities for which PUI funding is requested as extra budgetary contribution to TC project INT9176.

PUI	2013	2014
Direct Costs (\$)	249 000	296 000
PSC	17 430	20 720
Total	266 430	316 720

Grand Total: \$583 150