Radioactive Waste Management in Non-Nuclear Countries – 13070

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ABSTRACT

This paper challenges internationally accepted concepts of dissemination of responsibilities between all stakeholders involved in national radioactive waste management infrastructure in the countries without nuclear power program. Mainly it concerns countries classified as class A and potentially B countries according to International Atomic Energy Agency. It will be shown that in such countries long term sustainability of national radioactive waste management infrastructure is very sensitive issue that can be addressed by involving regulatory body in more active way in the infrastructure. In that way countries can mitigate possible consequences on the very sensitive open market of radioactive waste management services, comprised mainly of radioactive waste generators, operators of end-life management facilities and regulatory body.

INTRODUCTION

According to international safety standards, namely IAEA documentation, every country using radioactive materials has to have clearly defined system for controlling radioactive materials and ionizing radiation sources from "cradle to grave" [1,2,3]. For main national regulatory framework, effectively it means there should be clear separation of responsibilities between policy makers (Ministries), regulators and users of radioactive materials along with technical support organizations and operators of radioactive waste management facilities. Necessary supporting national frameworks providing for safety when accidents occur, or when material is stopped to be used, are usually at best commensurate to national regulatory framework and almost never can offer more capacity than needed in the country. Among other participants in the national radiation protection infrastructure, major roles are taken by Regulatory Body (RB), Technical Support Organizations (TSO), Users of Radioactive Materials or Ionizing Radiation Sources (Users) and Radioactive Waste Treatment and Storage Facility Operator (Operator). RB can be represented by one institution or comprised of several organizations but in that case clear separation of regulatory responsibilities and tasks has to be demonstrated. International documents put paramount importance on the fact RB has to be fully separated from any promoters of nuclear energy, and for countries without nuclear program it goes down to separation from users of radioactive materials and sources in the fields of medicine, industry and research. Among other tasks and overall responsibility for functioning of national radiation protection infrastructure, including emergency response and radioactive waste management infrastructures, one of the tasks of the RB is usually management of national databases of practices, ionizing radiation sources and materials, personal dozimetry of workers, and

radioactive waste. Scope of work for RB is clearly defined by information from the national databases and its capacity for fulfilling tasks should be commensurate to throughput presented by national databases. In some countries RB can sometimes incorporate activities pertaining to control of ionizing radiation sources and radioactive materials, or different measurements for the purpose of licensing. But generally these activities are reserved for TSO. TSO are commonly companies recognized by RB as capable to requested standard to offer different radiation protection services to users of ionizing radiation sources and materials, or operators. They are players on an open market defined by Users, Operators and themselves. Users are typically performing their practices in the fields of medicine, industry or research in the countries without nuclear program. According to international standards they shell be separated from regulatory activities, and they are major radioactive waste generators. In order to fulfill legal requirements for safety and security they are typically using TSO services. As medical field along with industry and research field has its promoters in the national administrative structure, usually on the level of Ministries, user of radioactive materials and ionizing radiation sources can be supported by administrative bodies, but countries has to make proper administrative arrangements to assure this support is not compromised by involvement with RB activities. Operator is a corner stone of supporting national radioactive waste management infrastructure. Usually it is a role given by Government to a company proposed by RB, for a facility located at a site dedicated by Government and accepted by public [2,3,4]. It's financing arrangement and capacity is to be assured by Government and its work is surveyed by RB. The main role of the Operator is to safely manage radioactive wastes produced by waste generators, and to provide for a safe end of life for radioactive materials and ionizing radiation sources. Operator's financial arrangement should ideally allow for waste generators to manage safely their radioactive wastes without financial overburden. Second major role of the operator is to prepare proposal on National Strategy on Radioactive Waste Management. According to international standards, Operator has to be structured in a way to allow for separation in responsibilities pertaining to radiation protection tasks, quality management/quality assurance tasks, radioactive waste packages handling/preparation/reception and facility management [5]. Effectiveness of the national radiation protection infrastructure, as well as its long term sustainability, highly depends on interrelations between four groups of stakeholders described above in the light of providing for end of life for radioactive materials and ionizing radiation sources. There is no overarching mechanism to assure ideal relations between major stakeholders in the national radiation protection infrastructure in the long term. Basis for preconditions that will allow for forming appropriate relations between major stakeholders can only be assured through long term policy and strategy pertaining to radioactive waste management that will be periodically revised. Important is that the policy should provide for making necessary financial arrangements between stakeholders based on national economy, allowable disposal options and the roles of stakeholders. RB's role is to make sure Policy and Strategy can be implemented in the long term, making sure disposal option will be implemented.

Management of Radioactive Waste in Non-nuclear Countries

Countries without nuclear program usually do have long tradition of utilization of RM and IRS in the country, which is followed by different radiation protection infrastructures in different countries. Because there is usually no overarching financial arrangement between stakeholders, relations and position on the open market of radioactive waste services changes periodically based on temporary interests of the stakeholders. To avoid such situations, long term political dedication is need and it has to be enforced through RB and sustained primarily by adequate financial arrangements between stakeholders. This fact is even more important for the non-nuclear countries having "only" institutional radioactive waste because level of threat born by institutional radioactive waste has a tendency to be neglected within governmental administrative bodies, but it always raises significant public concern. On the other hand, radioactive waste originating from nuclear facilities is taken to be "dangerous by fact", and it is generally actively addressed among technical and political communities in finding a proper final solution that is supported by predisposal management period, compared to institutional radioactive waste. Because countries give institutional radioactive waste issues different importance, and the fact long existing ways of dealing with issues within national administrative infrastructure is not easy to change in a short time, main stake holders can experience many changes with periods where their role will not be in line with expected international standards in force. Typical problems RB can experience is connected to its independence, due to a fact its range of work might not be acknowledge as big enough to warrant full independence and internal structure. Therefore RB can be seen as a part of already existing administrative structure in the country. Effectively that is most often demonstrated in budgeting and promulgation of legislative acts or imposing of administrative surveillance over the work of the RB. Second part of typical problem is usually connected to a need for RB to overtake for a certain period of time some activities foreseen for other stakeholders, especially TSO and Operator. Due to inertness of the administrative system, such instances have a tendency to last for too long periods of time when relations between major stakeholders are disturbed. TSO problems are usually related to their position on the open market of radiation protection services. Provision of radiation protection services often depends largely on availability of Operator or on possibility for TSO to provide for storage of radioactive materials or ionizing radiation sources which is not intended for further use. TSO organizations can gain advantage over other TSO organizations if incorporates some roles of Operator. This aspect can cause significant misbalance on otherwise small market of radiation protection services in countries with no nuclear program. Other TSO activities are commonly condition to satisfying technical requirements and standards in order to be able to offer radiation protection services to Users, and fulfillment of these requirements largely depend on TSO themselves. Users are directly impacted by possible disorders on the market because they largely depend on TSO services. In extreme conditions they too can be forced to incorporate some activities normally expected within scope of work of other major stakeholder. That is the least preferable

solution to any problem that may arise in national radiation protection infrastructure, especially when is connected to management of radioactive materials and ionizing radiation sources at the end of life. It may lead to loss of institutional knowledge and mistakes in national databases and overall weakening of the institutional control which commonly ends with increase in number of orphan sources, or better said increase in number of abandoned or lost sources and radioactive materials. Being a cornerstone of open market of radiation protection services, Operator should be organized in a way that it does not suffer from market disorders. It is not possible to plan long term sustainable radiation protection national infrastructure without having firm political decision on Operator and a location of radioactive waste treatment and storage facility. One of the most important roles of RB is to make all necessary arrangements for Operator, and therefore national radioactive waste management infrastructure, to operate in optimal way in long term. That task largely depends on financial arrangement that has to be in place between major stake holders and its periodical revision. This is major task that has to account for national economy, legal obligations transferred into financial costs and human resources and long term prospective that will have grounds on realistic assumptions, because institutional radioactive waste management infrastructure is usually not financially self sustained practice in non-nuclear countries.

Organization of RadWaste Management and Processing Technology

Main internationally accepted conditions for the Operator are to be adequately resources, clearly separated from RB activities and to have explicit obligation to manage radioactive wastes from all waste streams in the country. The easiest way to achieve first two conditions is to choose Operator form the set of existing major radioactive waste generators in the country where adequate know-how for radioactive waste management is expected to be. Operator's explicit obligation to manage wastes from all waste streams in the country is an administrative issue that gives basis for dedicated legal entity to become an Operator. Widely existing organizational structure for radioactive waste management in the countries without nuclear power programs rely on centralized systems where corner stone of the national radioactive waste management infrastructure is centralized radioactive waste processing and storage facility. It is understood that fragmentation of end life management system in IAEA class A or B [5] countries may lead to less favorable situation in the country cost-benefit wise, compared to centralized approach. Significant part of radioactive waste management activities in non-nuclear countries can be performed at Users site.

Management steps	**Equipment, tools, materials of facilities**	**Remarks**
Identification and	• Dose rate monitor • Contamination monitor	This instrument can be rented for measurement and for

characterization	• Portable gamma spectrometer • Long tongs • Basic radiation protection equipment	handling of waste
Collection and segregation	• Plastic bags • Refuse cans	10-50 pieces
Decontamination	• Tissues, cotton, detergents, masks, protective clothing	Secondary waste should be conditioned together with other solid waste
Conditioning	• Silica gel, activated charcoal • Shovels, etc. for manual cement-water-sand mixing • Cement, sand, water • Steel drums (200l)	Standard hardware items
Handling and storage	• Simple lifting device • Building, room or shipping container	Lifting capacity 500 kg
Transport	Container Type A or Type B as required	

Table 1. Equipment needed for the management of waste generated in class A countries [5].

It is favorable to use already available communal waste management technological options, but under strict supervision, for radioactive waste conditioning. It has to be kept in mind that conditioning for predisposal management should be done in such a way to assure safe possibly long-term storage, and simple final processing to prepare for implementation of chosen disposal option. Major part of radioactive waste inventory in non-nuclear countries belongs to disused sealed radioactive sources. No matter how limited level of nuclear applications in a country is, it is highly unlikely that complete radioactive waste inventory can be disposed of in a repositories not including deep disposal.

Half life	**Activity Bq**	**Preferred option**		**Alternative option**	
		Processing	Final step	Processing	Final step
< 100 d	All	Decay	Clearance	Conditioning in a standard waste package	Disposal in a near surface repository

>100 d < 30 a	$< 10^6$	Conditioning in a standard waste package	Disposal in a near surface repository	Packaging for transport	Return to the supplier (or other export)
>100 d < 30 a	$>10^6$	Packaging for transport	Return to the supplier (or other export)	Conditioning in a special waste package	Disposal in a deep repository
>30 a	$< 10^3$	Conditioning in a standard waste package	Disposal in a near surface repository	Packaging for transport	Return to the supplier (or other export)
>30 a	$>10^3$	Packaging for transport	Return to the supplier (or other export)	Conditioning in a special waste package	Disposal in a deep repository

Table 2: Indication of preferred options for the management of disused sealed sources [5].

Public concern in choosing best possible available disposal options can play an important role, and can decide on end-life points for the country that are ideally institutionalized through radioactive waste management Policy documents. It is recommended that such documents are accepted by Government and confirmed by Parliament, in order to assure political commitment to radioactive waste management issues. Implementation programs for Policy document should be accepted by Government for the time periods of at least that of the expected ruling time of the party in power. In such a way it is taken that ruling Government and relevant ministries will have to address radioactive waste management issues as programmed in the long-term over decades, which is important because radioactive waste issues tend to be of secondary interest to political community in non-nuclear countries. In order to fully comply with recognized international practice, Policy document should incorporate statement that disposal is only acceptable final solution for the radioactive waste, and it should go step forward and foresee also mechanism that will assure implementation of the best available disposal option, ideally based on radiological hazards born by radioactive waste inventory. Accounting for public concern and limited but expectably adequate available resources in the country, it is advisable to minimized number of disposal sites and facilities in the country.

DISCUSSION

To picture expected Operators scope of activities and its throughput, it is important to say that it's typical Quality assurance program is limited, compared to Quality assurance programs for Operators in Class C, D and E countries [5]. Main concern for national radioactive waste end-life management infrastructure is to make it long term sustainable. Therefore careful development of financial scheme over long periods of time for predisposal and disposal management of

radioactive waste in the country is warranted. It is reasonable to assume utilization of already existing technical and human resources in the country is advisable. When developing financial scheme it is necessary to keep in mind cradle-to-grave approach for control of radioactive material in the country. This approach can be easily compromise, in otherwise very sensitive environment of market relations between all stakeholders as explained above, if Government does not interfere to assure adequacy of financial burden to Users for predisposal and disposal management in the country.

CONCLUSION

In making national radioactive waste end-life management infrastructure long term sustainable, country should make use of available technical and human resources as much as possible and avoid fabrication of new resources. New resources that are developed solely for national radioactive waste management infrastructure outside existing technical environments in the country are expected to be least sustainable in the long term, mainly because of needed additional financial support. Any kind of additional financial burden for the country is not favorable because radioactive waste management infrastructure in non-nuclear countries is in general not self sustainable. It needs Governmental support for long term sustainability purpose. As radioactive waste management activities can be largely performed at Users sites, with a help of TSO's, and as it is expected that RB will always exist in the country once it is established, it is advisable to consider involving RB more actively in national radioactive waste management infrastructure in the country. Level and scope of involvement of RB will have to reflect country's situation, accounting for a fact that RB can provide for so needed sustainability. In doing so, political environment should be open minded and governed by solutions proposed by RB, with a goal of establishing a long term sustainable national radioactive waste management infrastructure.

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