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- SADRWMS -

The International Project

on

SAFETY ASSESSMENT DRIVING RADIOACTIVE WASTE MANAGEMENT SOLUTIONS

Scope, Objectives, Content and Work Programme

Version 4.0, May 2005

-SADRWMS-

The International Project

on

SAFETY ASSESSMENT DRIVING RADIOACTIVE WASTE MANAGEMENT SOLUTIONS

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EXECUTIVE SUMMARY

The safety of radioactive waste management and disposal facilities can be evaluated by using safety assessment methodology. In this context safety assessment means evaluation of the actual and potential hazards to human health and the environment associated with the natural evolution of a radioactive waste management facility over time, and with events, both deliberate and accidental, which could affect its integrity. By means of such analysis it is possible to identify the strengths and weaknesses in the overall safety of such facilities and as necessary to develop actions to improve their status.

Work has been underway within the International Atomic Energy Agency (IAEA) for a number of years to develop safety standards in the form of a Safety Guide addressing safety assessment for facilities and activities associated with the management of radioactive waste prior to disposal. This process has led to the realisation that the approach to such safety assessment is very similar in nature to that required for many other nuclear fuel cycle facilities and for facilities that handle radioactive materials or make use of radiation sources. As such the Safety Guide developed (draft document DS284 *Safety Assessment for Nuclear and Radiation Facilities Other Than Reactors and Waste Repositories*) has been structured to cover all these facilities. Whilst there are many similarities, there are also significant differences and the guide emphasises the importance of ensuring that the extent and complexity of the assessment is commensurate with the nature of the activity or facility and its attendant risk.

The SADRWMS (Safety Assessment Driving Radioactive Waste Management Solutions) Project is an international programme of work to examine international approaches to safety assessment in aspects of predisposal radioactive waste management, including waste conditioning and storage. In comparing international approaches to safety assessment in these areas, it is anticipated that a body of safety assessment methodology will be developed which will be acknowledged as international best practice in these areas. The SADRWMS project will encompass all types of radioactive waste including disused sources, small volumes, operational waste and spent fuel, legacy and decommissioning waste, and large volume NORM residues.

Of particular relevance and importance is the application of safety assessment to the storage of radioactive waste. Due to the delays experienced in many countries in developing waste disposal facilities, waste has to be stored for increasingly longer periods. Some countries are also considering extended storage as an alternative to disposal. The IAEA has prepared an international position paper on this issue (*The Long Term Storage of Radioactive Waste: Safety and Sustainability – A Position Paper of International Experts 2003*), and this paper to a large extent supports the argument that indefinite storage is not a sustainable option, while acknowledging that storage is a necessary phase in safely managing most types of radioactive waste. It is clear that safety assessment of predisposal management activities needs appropriate and valid methodologies. Security concerns expressed over long-term surface storage were evident during the various discussions on the topic and again the need was emphasised to address physical security threats within the overall safety assessment process.

The objective of the SADRWMS project includes a review of safety assessment approaches and methodologies applied to activities and facilities associated with the management of radioactive waste prior to disposal by Member States. The project will also undertake a technical study aimed at improving and harmonising such approaches and methodologies, and will focus on safety assessment of longer-term storage of radioactive waste with a view to exploring the outcomes in respect of safety and sustainability. Underlying the SADRWMS programme is a recognition that safety assessment will always be an iterative process, taking into consideration changes in technologies, experience and environmental factors. And it is acknowledged that credibility with public and stakeholders is an essential outcome.

Participants in the SADRWMS Project (operators, regulators and other specialists) should be from organizations or regulatory bodies concerned with assessing and improving the safety and management of predisposal radioactive waste treatment and storage facilities in their own countries. They will be expected to contribute to the project by participating in technical discussions, applying methodologies to real problems, and taking part in the development of test cases. The participants will benefit from the exchange of information with experts from different countries facing similar problems on safety of radioactive waste management and disposal facilities.

CONTENT

1. INTRODUCTION

The International Atomic Energy Agency (IAEA) is a Specialist Agency within the United Nations family and amongst its main statutory functions are the establishment of safety standards for the protection of human health from the effects of ionising radiation [1], and to provide for the application of the standards. In discharging these functions, the IAEA has established a framework [1, 2] of internationally agreed standards on nuclear safety, radiation protection, transport and radioactive waste safety and a number of mechanisms for their application, such as peer reviews, technical assistance, exchange of scientific and technical information on peaceful use of atomic energy, training and research and development. Projects based on a series of Technical Meetings are one of the useful mechanisms for exploring the safe use of atomic energy and for improving the safety of radioactive waste management. This includes research projects on the safety of radioactive waste disposal [3, 4] and in particular, on long-term safety assessment methodologies for low and intermediate level radioactive waste disposal facilities.

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~~2.~~2. BACKGROUND

Safety assessment is a process which is used to evaluate the safety of radioactive waste management and disposal facilities. Such assessments, which are iterative in nature, evaluate the potential impact that such facilities could have on human health and the environment as a function of time in the future.

It is important that safety assessments are carried out in a traceable, transparent and consistent way in order to provide an assurance to stakeholders (such as governments, regulatory authorities, the general public and technical/scientific personnel) that the facility has been or will be sited, designed, constructed, operated and closed in such a manner that will provide a high level of assurance that human health and the environment is protected over the necessary long timescales.

Safety assessment is an important component in evaluating the acceptability of a radioactive waste management or disposal practice and plays a key role in the development of a safety case[1] for the life cycle of the radioactive waste management or disposal facility. Figure 1 illustrates the generic safety assessment process for predisposal radioactive waste management activities and facilities.

The IAEA's coordinated research project "Improving Long Term Safety Assessment Methodologies for Near-Surface Radioactive Waste Disposal Facilities" (ISAM) was launched in 1997 and completed in the year 2000 [5]. It provided an evaluation of the approaches and tools used in long-term safety assessment of near-surface disposal facilities, enhanced the approaches used, provided participants with practical experience in the implementation of the approaches, and contributed to the building of confidence in the approaches used in Member States. Three specific areas of methodological interest were defined: scenario generation and justification, model formulation and implementation, and confidence building [6].

[1] A safety case is a collection of arguments and evidence to demonstrate the safety of a facility or activity. This will normally include a safety assessment, but would also typically include information (including supporting evidence and reasoning) on the robustness and reliability of the safety assessment and the assumptions made therein [10]

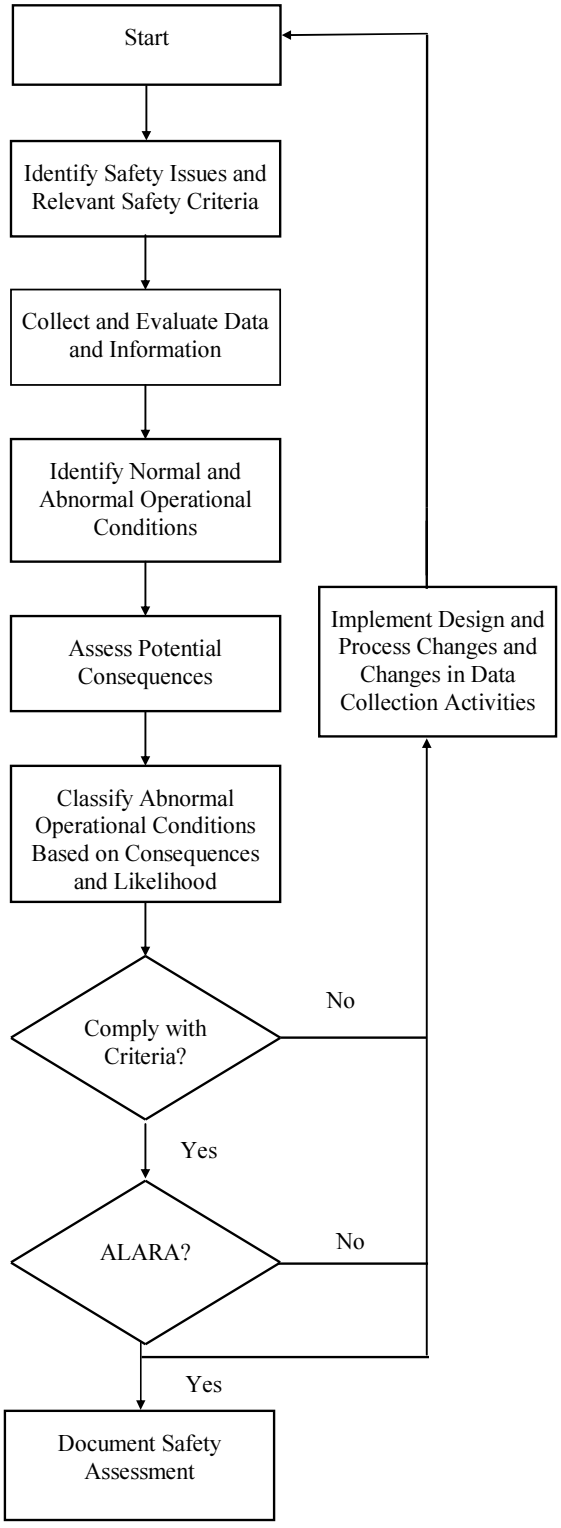

Fig. 1 Typical Safety Assessment Process (from DS284)

As part of the ISAM project, a consistent safety assessment methodology was developed for assessment of radioactive waste disposal facilities which has the following key components (Figure 2):

(a) specification of the assessment context;

(b) description of the radioactive waste management or disposal system;

(c) development and justification of scenarios;

(d) formulation and implementation of conceptual and mathematical models; and

(e) analysis of results and building of confidence.

Each of these components is discussed in Appendix F.

The ISAM project provided a forum for the exchange of information and good practices on safety assessment methodologies used worldwide. It provided an opportunity for reaching broad consensus on the methodologies used to perform safety assessments for near-surface disposal facilities. The ISAM methodology has found widespread acceptance, although, at the end of the ISAM project, it was recognised that the need existed to investigate further application of the ISAM methodology to a range of practical issues. This need related specifically to areas such as the depth and quality of safety assessment, the treatment of human intrusion, confidence building in safety assessment and the overall safety case. Activities that were identified to be of particular interest were licensing, upgrading, re-evaluation of safety of near-surface radioactive waste disposal facilities of different type (vault, radon, mining and mill tailings, etc.)

Taking this into consideration, the IAEA has prepared a new CRP "Application of Safety Assessment Methodologies for Near-Surface Radioactive Waste Disposal Facilities" (ASAM), which is now being implemented. It will build on the experience of the ISAM project, with special emphasis on the application of the ISAM methodology to address practical problems of interest in near-surface waste disposal facilities.

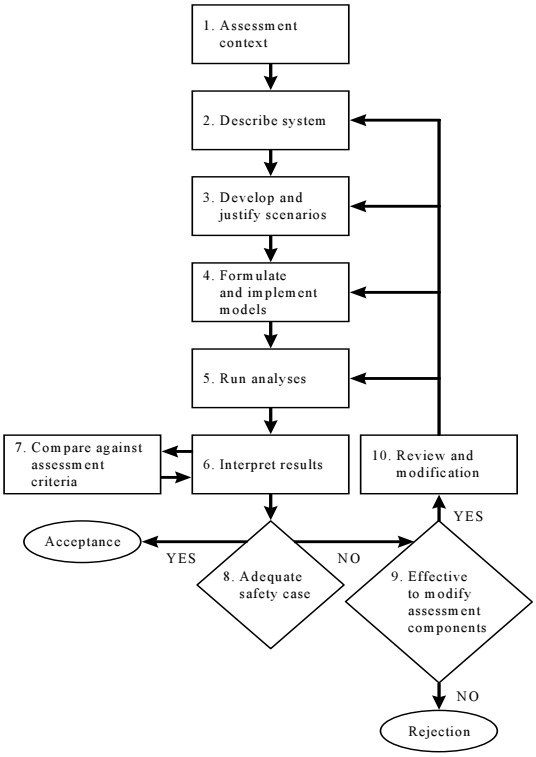

Fig. 2. Typical ISAM Safety Assessment Methodology

As well, work has been underway for a number of years to develop safety standards in the form of a Safety Guide addressing safety assessment for facilities and activities associated with the management of radioactive waste prior to disposal. This process has led to the realisation that the approach to such safety assessment is very similar in nature to that required for many other nuclear fuel cycle facilities and for facilities that handle radioactive materials or make use of radiation sources. As such the Safety Guide developed (draft document DS284 *Safety Assessment for Nuclear and Radiation Facilities Other Than Reactors and Waste Repositories*) has been structured to cover all these facilities. Whilst there are many similarities, there are also significant differences and the guide emphasises the importance of ensuring that the extent and complexity of the assessment is commensurate with the nature of the activity or facility and its attendant risk.

Safety assessments for these various types of facilities have been carried out for many years now, but there have not been any international efforts to compare the techniques and methods applied in such assessments. Nor has consideration been given to how the results of these assessments are interpreted and used in decision making on design development or modification, safety upgrades, periodic safety assessment or licensing activities. The inter-comparison exercises for safety assessment methodology for near-surface disposal facilities clearly identified significant differences in the approaches used and results obtained, and this led to the ISAM and ASAM CRP's. These CRP's have developed improved and harmonised approaches and methods for post-closure safety assessment for near-surface disposal facilities, which have since found widespread international acceptance. The need for approaches to predisposal

safety assessment being compared internationally and programmes investigated to develop international harmonisation has been recognised at a number of international forums in recent years, particularly the December 2002 conference on issues and trends in radioactive waste management (ref).

Of particular relevance and importance in this context is the application of safety assessment to the storage of radioactive waste. Due to the delays experienced in many countries in developing waste disposal facilities, waste has to be stored for increasingly longer periods. Some countries are also considering extended storage as an alternative to disposal. This issue was debated at the 2000 Cordoba Conference (ref), where the sustainability of such an option was seriously questioned, and resulted in the issue being featured in the Waste Safety Action Plan (2003). The IAEA Secretariat has held a number of meetings to explore and debate this issue widely and an international position paper has been published (*The Long Term Storage of Radioactive Waste: Safety and Sustainability – A Position Paper of International Experts 2003*). To a large extent the paper recognises that indefinite storage is not a sustainable option, while acknowledging that storage is a necessary phase in safely managing most types of radioactive waste. It is clear that safety assessment of predisposal management activities needs appropriate and valid methodologies. Security concerns expressed over long-term surface storage were evident during the various discussions on the topic and again the need was emphasised to address physical security threats within the overall safety assessment process.

The draft Safety Guide DS284 provides guidance on performing a safety assessment for facilities and activities associated with the management of radioactive waste prior to disposal. Under the Joint Convention, such a safety assessment will be required for all new facilities prior to implementation. DS284 has evolved to cover a wide variety of facilities, including environmental restoration & radioactive waste stores (but not a waste repository, which is covered elsewhere). DS284 results from a recognised need for the same rigour in storage as in disposal - and will ensure the adequacy of safety assessment methodologies, including security aspects.

In view of this background, it was deemed appropriate to bring together specialists and regulators responsible for these assessments to discuss the various approaches adopted and to reach agreement on how to undertake the process. A Technical Meeting for this purpose was held from 26 to 30 May 2003. In structuring the meeting, particular emphasis was given to waste storage and all related aspects concerned with longer-term storage including security.

The objective of the first meeting was to review safety assessment approaches and methodologies applied to activities and facilities associated with the management of radioactive waste prior to disposal by Member States. The review was for two purposes; the first was to formulate proposals for a technical project aimed at improving and harmonizing such approaches and methodologies. The second was to focus on safety assessment of longer-term storage of radioactive waste with a view to exploring the outcomes of such assessments in respect of the safety and sustainability.

An aim of the project is to distil from the Safety Guide DS284 the practical aspects of safety asessment that will be useful for specific situations, such as a small facility (eg. a hospital managing its radioactive waste), a waste store, a remediation of some legacy waste, or the treatment into acceptable waste forms (a conditioning process). The

meeting noted that safety assessment will always be an iterative process, taking into consideration changes in technologies, experience, and environmental factors. And that credibility with public and stakeholders is essential. Among specific questions to be considered is that when a full and proper safety assessment is performed, what will it tell us about the relative safety (and security) of a centralised store *vis a vis* a multitude of small stores scattered around a country?

The meeting mapped out a project (SADRWMS) with the objective of developing and harmonising approaches to safety assessment of activities and facilities for management of radioactive waste prior to disposal, with the aim of driving forward towards disposal solutions.

3. OBJECTIVES OF THE SADRWMS PROJECT

Objectives of the SADRWMS project are:

- To develop a harmonised common approach for safety assessment for radioactive waste management:
    - focussed towards predisposal management of wastes;
    - building confidence for all stakeholders;
    - based upon justification of activities within a safety case.
- To encourage application of safety-assessment methodology for radioactive waste management in a proportionate and effective manner commensurate with the type of material, for:
    - disused sources, small volumes, operational waste and spent fuel, legacy and decommissioning waste, and large volume NORM residues.
    - new facilities;
    - existing facilities;
    - storage facilities;
    - assistance to regulators and operators in conducting review of safety assessments.
    - To facilitate early passivity and hazard reduction.
- To establish holistic and integrated approaches to safety and security giving consideration to interdependencies, by examining:
    - written justification / acceptability (or not) of all stages.

4. SCOPE OF THE SADRWMS PROJECT

The SADRWMS project will consider practical application of the developed safety assessment methodology to all types of radioactive waste management practices and facilities, involving:

- all aspects of legacy and decommissioning waste including waste from rehabilitation;
- large volume NORM / TENORM waste arisings;

- interim storage (especially considering integrity of waste and facilities);
- the predisposal storage of spent fuel;
- overview of operational waste (establishing the point of reference);
- small amounts / disused sources; and
- both new and existing facilities, together with those in need of upgrading.

The application of safety assessment methodology to radioactive disposal is outside the scope of the SADRWMS Project. However, the SADRWMS Project will complement the ISAM/ASAM project, which considers application of safety assessment methodology to near surface disposal facilities.

5. ORGANISATION, WORK PLAN AND OUTCOMES

5.1 ORGANISATION

The organisation structure of SADRWMS is presented in Figure 3 and the main components are described below.

~~8~~a) The Steering Group

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The SADRWMS Steering Group will consist of a Chairperson, the leaders of the five working groups and the IAEA Scientific Secretary. Its role will be to coordinate the activities of the individual working groups, identify and solve common issues of a technical and organisational nature that need to be resolved as part of the project, prepare and coordinate the topics, agendas and summaries of the Coordinating and Working Group Meetings, and coordinate the preparation and review the SADRWMS documents and materials.

~~8~~b) The IAEA Scientific Secretary

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The IAEA Scientific Secretary will provide coordination with the IAEA and technical and administrative assistance to the project. The Scientific Secretary will also make the necessary arrangements for planning, conducting meetings and other working group activities in accordance with the SADRWMS work plan, as well as for documentation of the proceedings of the meetings, working group activities and final outcomes of the project.

~~8~~c) Working Groups

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The working groups will prepare the material needed for the presentation, discussion, and documentation of the technical issues which will be addressed by the project; help organise the technical sessions of Technical and Working Group meetings; and support the Coordinating Group as required in production and reviewing the SADRWMS documentation. Each working group will consist of a Working Group Leader, a Deputy Leader, a Secretary and a number of participants who will actively contribute to the work undertaken by the working group.

Members of the Working Group will possess real experience of the practical and regulatory aspects of dealing with management of radioactive materials of all types. Each participant will be part of an application working group as well as of one of the

cross-cutting groups. This ensures that care is taken of interdependencies and that feedback is provided between the groups.

The scope and terms of reference for the five working groups are described in Section 6.

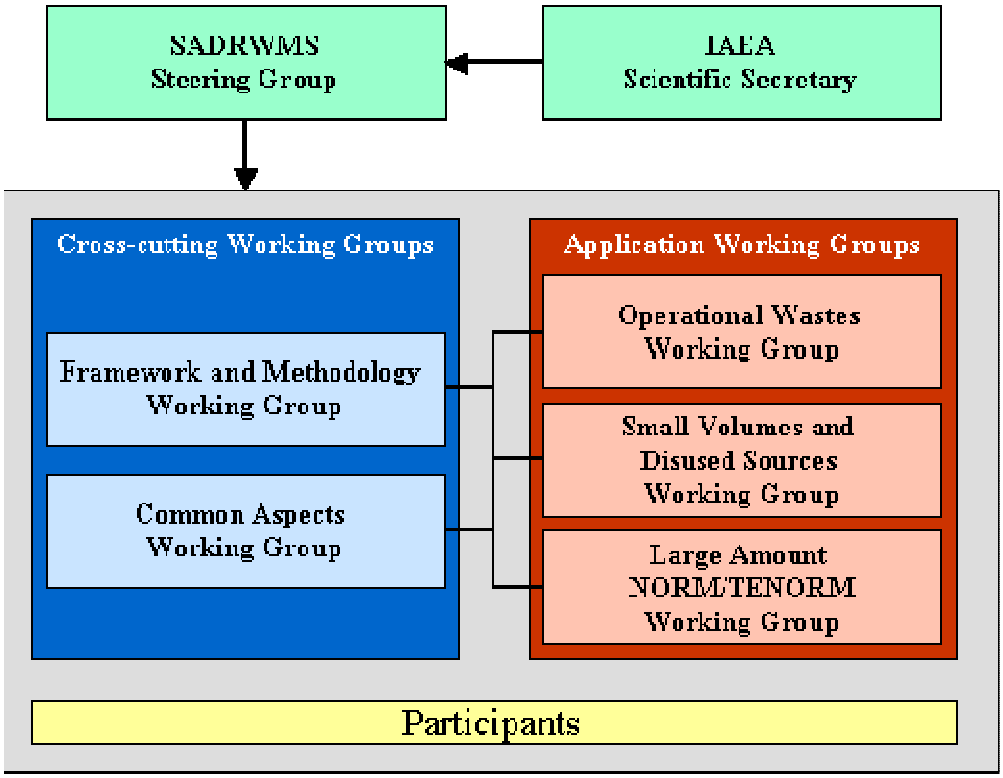

Figure 3: Organisational Structure of the SADRWMS Project

~~8~~d) Participants

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The SADRWMS project is open to professionals from Member States who undertake technical activities related to safety assessment or predisposal management of radioactive waste. Participants can be from regulatory bodies, facility operators or developers, technical support organizations or research organisations. They will be expected to actively contribute to the project by participating in technical discussions, applying methodologies to real problems and taking part in the development of test cases. Participants will be able to participate in two SADRWMS working groups (i.e. in one of the Application Working Groups and one of the Cross-Cutting Working Groups). In addition, they will have the opportunity during the topical sessions of Coordinating Meetings to give oral or poster presentations describing the safety-assessment related work that they have undertaken within their own national programmes or related projects.

5.2 WORK PLAN

The main activities of the SADRWMS projects are summarized in the following.

a) Meetings

Three main types of meetings are proposed within the SADRWMS project:

- Plenary Coordinating Meetings (CM);
- Working Group (WG) Meetings; and
- Meetings of the Steering Group (SG).

The tentative schedule of the meetings planned to take place during the project is presented in Table 1. Additional WG meetings will be held to develop and document their work programme and associated findings. Details on the current planning of the individual working groups is given in Section 6.

Table 1. Tentative Schedule of SADRWMS Activities

Date	Activities
May 2003	Steering Group (SG) meeting, Vienna, Austria
May 2003	Scope, Objectives, Content and Work Programme Document
Feb 2004	Steering Group (SG) meeting, Vienna, Austria
Feb 2004	Initial Working Group Document
Nov 2004	1st CM, Vienna, Austria
Dec 2004	Updated Working Group Document
Jan – Sep 2005	Working Groups (WG) and SG meetings (draft WG documents)
Oct 2005	2nd CM (draft WG documents)
	WGs and SG meeting (draft WG documents)
	WGs and SG meeting (draft WG documents)
	3rd CM meeting; WG documents final drafts
	Final SADWRMS reports

There will be a number of coordinating meetings (CMs) during the SADRWMS Project, which will be organised and hosted by the IAEA. These meetings will have a pivotal role in discussing, and agreeing the focus, direction and outcomes of the SADRWMS Project.

A first Plenary CM took place in November 2004. At this meeting, proposals for the work plan to be undertaken were discussed and agreed. Subsequent meetings will review progress with the various working group activities and agree the way forward, together with any necessary adjustments to the project. The final meeting will review the outcome of the project and its documentation.

The meetings also provide SADRWMS participants with the opportunity to exchange knowledge, experience and information on a range of issues relating to safety assessment through topical presentation sessions either orally or by posters. This has proven to be fruitful in giving directions to the project at the first CM and is intended to be continued at subsequent CMs.

b) Development of SADRWMS Documents and Materials

It is envisaged that several main groups of documents/materials will be produced during the SADWRMS project.

- An ***introductory document*** describing the scope, objective, content and work programme of SADRWMS (this document).

- A ***detailed document*** describing the proposed technical focus of each working group (the current document, which has been discussed during 2004 Coordinating Meeting).

- ***SADRWMS Newsletters*** reflecting the progress made by the individual working groups and summarising the issues of interest to the SADRWMS participants. These will also provide useful information on the related IAEA activities in the field of safety assessment and radioactive waste management. The newsletters will be produced regularly on an as-needed basis.

- ***Working Group documents*** will be produced by each working group as the SADRWMS project develops and will establish the basis for the final SADRWMS reports.

- ***Summary of each meeting***. A summary of the Coordinating Meetings will be produced by the IAEA Scientific Secretary after each meeting and will include: a brief summary of main topics, conclusions and recommendations of the meeting, as well as information on the current status of the project and its future. The SADRWMS Chairperson and working group leaders will follow the same procedure after completion of Steering Group and each Working Group Meeting.

- ***SADRWMS final technical reports*** summarising the work undertaken and results achieved and lessons learned during the project.

- ***SADRWMS CD-ROM*** including the final technical reports and other relevant supporting information presented, collected, developed or provided by the participants during the project.

- A ***SADRWMS website*** will be maintained to facilitate the coordination of the working groups' activities, and to provide the individual participants access to

the up-to-date SADRWMS documentation and additional useful IAEA and other information. The website will be part of the IAEA RasaNet website and will be developed for the use of the SADRWMS participants and public access.

- A ***SADRWMS web based learning environment*** will be maintained to provide a forum for information exchange between SADRWMS members and other experts. It is intended to use a bulletin board for this purpose which will allow registered users to ask questions, to provide answers and to download and upload files. This website will also be hosted by the IAEA, but its detailed organisation still has to be decided.

5.3 OUTCOMES

It is envisaged that the main outcomes of the project will be:

- improved mechanisms for application of safety assessment methodologies for predisposal management of radioactive materials:
- illustration and practical advice on application of safety assessment methodologies using the master flowchart and case studies taken forward through three application working groups.
- development of an integrated and graded approach to addressing a large variety of radioactive materials management challenges.
- to enhance confidence and public acceptability of the pre-disposal management practices by scientific safety assessment approach
- coordinated approaches to regulatory and peer review and justification of safety assessment and development of associated procedures, reflecting state-of-the-art international practice for predisposal management of various types of radioactive waste.

The project is expected to complement the ISAM safety assessment methodology. It will also improve the knowledge of participants and provide technical input to the IAEA's RADWASS Programme.

6. WORKING GROUPS

6.1 SCOPE

The work plan for the SADRWMS project will be implemented through five working groups (see Section 5.1).

Two working groups (referred to as Cross-Cutting Working Groups) are associated with overall issues:

- overall framework and methodology for safety assessments in pre-disposal waste management (Framework and Methodology Working Group); and
- common aspects relevant for all types of wastes considered (Common Aspects Working Group).

Three additional working groups (referred to as Application Working Groups) are associated with the testing of approaches proposed by the cross-cutting groups and the development of practical application cases based on real sites. These groups will focus on:

- operational waste, spent fuel, legacy and decommissioning wastes (Operational Waste Working Group);
- small amounts of wastes and disused sources; (Small Volumes and Disused Sources Working Group); and
- large volume wastes (NORM /TENORM) (Large Amount NORM/TENORM Working Group).

The rationale, proposed scope and objectives, and anticipated outcomes of each of these working groups were agreed upon in the first CM are outlined in the following sub-sections. Details are given in Appendices A through E for each of the working groups. In defining the work programmes for the groups, account was taken of the level of interest and willingness to participate actively in the working groups and their proposed activities. It was attempted to ensure that the level of ambition of the SADRWMS project is set consistent with the resources available.

6.2 OVERALL GOALS

The overall goals of the working groups are:

- To develop a harmonized common approach to methodologies required for the safe management of the predisposal management of radioactive materials in a wide range of circumstances
- Through the use of specific case studies, demonstrate the application of the methodologies in a proportionate and effective way, which facilitates achieving early hazard reduction, increased passivity, confidence building and public acceptability associated with predisposal management of radioactive materials.

A key purpose of this work, whilst justifying the acceptability of predisposal management activities, is to encourage the timely processing, conditioning and storage of wastes that meet criteria for eventual disposal. However the potential need for processing and storage facilities will be specifically addressed, in the context of these classes of materials to retain proportionality in the application of the methodologies.

In carrying out this work the groups will adopt a holistic and integrated approach to safety and security. In particular the existence of uncertainties and interdependencies will be important when justifying the acceptability of the stages in the process of achieving hazard reduction.

The potential need for upgrading safety assessment of processing and storage facilities will be specifically addressed.

Guidance will be developed on regulatory review arrangements, documentation and presentation of safety cases.

6.3 APPROACH

Information will be collected with regard to typical practices currently adopted by Member States in dealing with predisposal management and safety assessments of radioactive wastes of all types. In support of this activity, the IAEA will produce a digest of relevant information from INIS or other sources of the Agency on current practices in Member States. This will be supplemented by a search of other published data and, if working groups decide to use this option, by appropriate questionnaires sent to Member States. The information collected will be presented using, as a starting point, the matrix given in Attachment 2 of Appendix F.

The Framework and Methodology Working Group will produce generic flowcharts covering all pre-disposal waste management steps (see Appendix F). The main aim of these flow charts is to establish a framework for the safety assessment process, allowing for the identification of those process steps which require the preparation of a safety assessments. On this basis, the necessary scope of the safety assessments to be conducted at the different process stages will be derived and documented.

For the identified steps in the generic flowchart, methodologies which support the stages and route to safer management of radioactive materials will be derived with the main intent to reference the minimum safety requirements as well as information on good practice across Member States.

The application working groups as well as the Common Aspects Working Group will apply the common approach developed by the Framework and Methodology Working Group in the context of specific attributes of the materials and situations under consideration. The focus will be on the proportionate and effective use of the methodologies, the prompt and structured identification and documentation of the safety case and the need to address any deficiencies. Potential improvements in waste management practices will be examined, which may be appropriate preferably beyond the minimum safety requirements taking into account good practice and wider issues such as confidence building, public acceptability and cost benefits.

Based on the feedback from the other working groups, the Framework and Methodology Working Group will examine potential improvements which may be appropriate in their methodologies in order to improve the effectiveness of their use in improving safety and regulatory review arrangements.

The application working groups will apply the framework and methodologies to *Case Studies* in order to check their applicability and completeness. The Working Groups will draw conclusions and from these will make appropriate recommendations to improve safety.

In order to cover all aspects of pre-disposal management relevant for Member States, guidance and procedures will be developed for regulatory and peer review of predisposal management practices and facilities, applicable to the various types of radioactive waste.

Details of the work planning for the individual working groups, developed during the first CM with the goal to implement this overall approach, are provided in the Terms of Reference for the working groups (see Appendices A through E).

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APPENDIX A

Terms of Reference
for
Framework and Methodology Working Group

A1. Participants

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Deputy Chairperson: Wolfgang Goldammer
Secretary: Phil Hallington

A2. Scope

The scope of this working group is to develop a framework for the overall processes of predisposal waste management, which allows for the identification of required safety assessments. Furthermore, methodologies for conducting these safety assessments will be derived using existing approaches. The actual execution of safety assessments is outside the scope of this working group.

The methodology working group will develop guidelines for the application of existing safety assessment methodologies and the identification of what is needed in

the way of safety justification. The emphasis will lie on waste orientated activities, not considering aspects such as political considerations, engineering aspects etc.

The framework proposed, as well as the safety assessment guidelines will be tested by three application working groups.

A3. Objectives

The overall objective of the working group is to develop a harmonized common approach to methodologies required for the safe management of the predisposal management of radioactive materials in a wide range of circumstances. This approach should provide a basis to demonstrate the application of the methodologies in a proportionate and effective way, which facilitates achieving early hazard reduction, increased passivity, confidence building and public acceptability associated with the predisposal management of radioactive materials.

The potential need for upgrading safety assessment of existing processing and storage facilities will be specifically addressed. Guidance will also be developed on regulatory review arrangements, documentation and presentation of safety cases.

In carrying out this work, the group will adopt a holistic and integrated approach to safety and security. In particular, recognition of the need for public confidence in the arrangements being proposed, or implemented, and for the appropriate inclusion of cost benefit considerations will be important when judging the acceptability of stages in the process of achieving hazard reduction.

The main steps in developing the overall framework and the guidance on the safety assessment methodologies are:

- Production of a flow chart covering all predisposal phases of radioactive waste management;
- Identification of main safety issues for each step;
- Identification of criteria applicable to each step;
- Identification where safety assessments are necessary;
- Identification which safety assessment approach should be used.

A4. Outcomes

The outcomes of the working group will be:

1. Update of flow chart to represent overall approach to deal safely with radioactive waste including the use of examples to see if flow chart is fit for purpose.
2. Guidance on implementation of flow chart; addressing aspects such as the following:
    - Overall approach;
    - Identification of required safety assessments;
    - Assessment context for these safety assessments.

3. Generation of questions which have to be addressed by the safety assessments at the various stages of the overall process (sources for these questions will be the input from all working groups and the questionnaires developed by the IAEA for relevant Safety Standards).
4. Guidance on additional issues relevant for conducting safety assessments and preparing safety cases:
   - Time frame/institutional control;
   - Safety case;
   - Decision making;
   - Stakeholder involvement.
5. Guidance on safety assessment methodologies for the relevant steps in predisposal waste management, using existing methodologies (DS284, ISAM/ASAM) as starting points and proposing modifications as necessary.
6. Documentation of outcomes of Tasks 1 – 5: This will be part of a combined document produced by this working group and the Common Aspects Working Group (see Appendix B); the structure of this combined report will be decided upon later (in particular it will be decided which elements should be presented in appendices).

   Based on feedback received from the application working groups, this document will be updated as necessary.
7. Guidance on regulatory review of graded safety case.
8. Analysis of results from the application working groups including update of flow chart if necessary.

A5. Work Plan

No.	Task	Deliverable	Who	When	Comments
1	Finalise flow chart	Prepare draft version	WG	03/12/04	Comments from all working groups by 10/12/04
		Prepare final version		31/12/04	
2	Guidance on implementation of flow chart	Prepare draft version	WG, WB	31/01/05	Comments from all working groups by 28/02/05
		Prepare final version		31/03/05	
3	Questions to be addressed by safety assessments	Generation of questions	All groups	28/02/05	In order to reduce redundancies, the process of generating questions will use the website
		Compilation of questions	IS	31/03/05	
4	Guidance on additional issues	Prepare draft version	PB, PH, WG	31/03/05	Comments from working group
		Prepare final version		31/05/05	
5	Generic guidelines for methodologies identified at certain stages	Prepare draft version	RA (lead), AG, BN, MD, AS, WB	30/06/05	Comments from working group
		Prepare final version		31/08/05	
	Meeting of working group			Nov 05	
6	Final documentation	Final editing of contributions to joint report with Common Aspects Working Group	??	Dec 05	Use of this report by application working groups
		Revision as necessary based on feedback by application groups	??	Jun 07	
7	Guidance on regulatory review		??	2006	
8	Analysis of results from the application working groups		??	2007	
	Meeting of working group			Jun 07	
	Final document		??	2007	

A6. Results of Working Group Meeting in Nov 2004

The working group has discussed the flow chart for the overall framework and produced a draft version which will has been submitted to all SADRWMS participants during the CM. A clean version is being distributed as part of Task 1 and is included in Appendix F of this document.

Task 3 will encompass a cross-cutting effort in which all SADRWMS participants are invited to contribute questions which have to be addressed by the safety assessments at the various stages of the overall process. These questions are intended to form part (possibly as an appendix) of the joint document developed together with the Common

ssues Working Group. This report will contain a chapter developed in Task 2 and describing the overall framework (i.e. providing explanations to the flow charts). This chapter should have the structure proposed in the following:

Chapter X. Framework for the Overall Process

X.1 Introduction

Purpose of this chapter and description of scope and background (see above explanations).

X.2 Framework

This section will cover the following elements:

- Description of processes according to flow charts;
- Identification of necessary safety assessments;
- Decisions which have to be made based on these safety assessments and for which, consequently, the safety assessments have to provide a basis;
- General aspects for assessment context of these safety assessments (to be further detailed as part of Task 5).

X.3 Questions

This section will compile the relevant questions to be addressed by the safety assessments at the various stages. Depending on the number of questions identified it may be decided at a later stage to present these questions within an appendix.

Sources for these questions will be contributions from all working groups and the questionnaires developed for the relevant IAEA Safety Standards.

Questions will be categorized into:

1. General Questions (for all pre-disposal activities)
2. Specific Questions (for specific pre-disposal activity)
3. Specific Questions (for specific waste types)

Questions in each subgroup will be further divided into questions addressing

a. Safety aspects including, amongst others, regulatory criteria, acceptance criteria, assessment endpoints, timeframes, etc. (these questions would be needed to develop the safety assessment methodology and would be captured in the assessment context);
b. Good practice to be addressed in the work from the Common Issues group and from the Application groups;
c. Decision making aspects to be addressed at a later stage by the Framework and Methodology Working Group and related to similar efforts undertaken by the ASAM group.

APPENDIX B

Terms of Reference
for
Common Aspects Working Group

B1. Participants

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Chairperson: Milena Christoskova
Deputy Chairperson: Nadja Zeleznik
Secretary: Chris Fisher

B2. Scope

The aim of the SADRWMs International project is to develop a harmonized common approach for the safety assessment of pre-disposal management of:

- Operational waste, spent fuel, legacy and decommissioning wastes;
- Small amounts of radioactive waste and disused sources;
- Large volume (NORM/TENORM and site rehabilitation) wastes.

In this process there are a number of common aspects to be considered:

- Characterisation /Identification/ Classification;

- Collection /Recovery;
- Treatment /Conditioning;
- Storage;

The purpose of the working group is to identify these common aspects and to establish a common approach to the identified issues. This will include investigating the applicability of the framework and safety assessments methodologies developed by the first working group (see Appendix A).

The investigation of these steps requires to address the following common aspects for each step:

- Justification;
- Uncertainties;
- Timescale – lifetime extension, ageing management;
- Periodic review/continual improvement process;
- Quality Assurance, quality/condition of material in storage, inspection of material – quality control;
- Transport and material handling;
- Maintenance;
- Non-radiological hazards;
- Retrievability /Reversibility;
- Emergency procedures (internal and external) /contingency plans;
- Inventory control;
- Control;
- Transfer of information/ documentation/ responsibility /knowledge management;
- Training certification;
- Peer review;
- Physical protection/security;
- Public acceptance/consultation/confidence building;

In addition to these aspects, the working group will address definitions in the *Radioactive Waste Management Glossary,* e.g. institutional control for storage and the development of a learning environment (management of the website).

B3. Objective

The overall objective of the working group is to identify common aspects of predisposal radioactive waste management and to develop guidance on the application of safety assessments to these waste management facilities. The working group will consider a range of facilities, from very small and simple to very complex, in order to identify the common aspects.

The working group will produce guidelines for the application groups as far as the identified common aspects are concerned. This framework is intended to facilitate the activities of the application groups and to avoid duplications of work within these groups.

The outcome should also enable the application groups to decide on the level of assessment needed for different types of waste and practices (taking into consideration the level of detail of the overall project).

A further objective of the working group is to create and then manage the learning processes via the internet for the SADRWMS platform. This should support the exchange of information and of worked examples where the methodology has been applied.

An important difference between SADRWMS and ISAM to be taken account of in the work planning is that the facilities considered by ISAM do not require human intervention, whereas SADRWMS facilities are those that require management. Consequently, types of operation required and operational safety are important aspects of SADRWMS.

It will be decided later whether the working group will consider test cases. A candidate would be the waste storage in Slovenia. In addition, other examples could be used, bearing in mind different type of wastes (HLW,ILW, spent fuel, hospital waste) and differences in storage arrangements. Worked examples could be presented in an appendix to the working group report. This would be very helpful but would require a significant amount of work.

B4. Outcomes

The working group will produce a report that will describe practical experience including:

1. Reference documents giving practical guidance on safety assessment to be considered in:
   - Characterisation /Identification/ Classification;
   - Collection /Recovery;
   - Treatment /Conditioning;
   - Storage.

   The guidelines produced by this working group will set the framework and provide a set of checklists that should be used by the application groups and others as a tool in developing the safety assessment.
2. Overall documentation of Task 1: As decided in the CM, this document will be produced jointly with the Framework and Methodology Working Group to also include chapters on the overall framework and the safety assessment methodology (see Appendix A).

   Based on feedback received from the application working groups, this document will be updated as necessary.

3. Electronic aid to the learning environment, e.g. and IAEA supported bulletin board.

B5. Work Plan

No.	Task	Deliverable	Who	When	Comments
1	Guidance document	Introduction, scope and background chapters	PL, GW	31/01/05	
		Characterisation / identification / classification	SA, PQM, LK	31/03/05	
		Collection / recovery	FA, VL	31/03/05	
		Treatment / conditioning	KR, CF	31/03/05	
		Storage	NZ,MDV, SK	31/03/05	
		Checklists / discussion / conclusions / recommendations / reference documents	??	??	
		Draft of working group report	??	30/06/05	Review by working group
	Meeting of working group			Nov 05	
2	Final documentation	Final editing of contributions to joint report with Framework and Methodology Working Group	??	Dec 05	Use of this report by application working groups
		Revision as necessary based on feedback by application groups	??	Jun 07	
	Meeting of working group			Jun 07	
3	Learning environment	Develop a website based on the DESA structure	IAEA	31/12/04	
		Structure for learning environment	??		
		Feedback from all working groups on usefulness	All	30/06/05	
	Final document		??	2007	

B6. Results of Working Group Meeting in Nov 2004

B6.1 Report structure

The working group has discussed the structure of the report to be developed. Where the chapters to be provided by the Framework and Methodology Working Group are to be included will be decided at a later stage. For the parts of the report provided by this working group the following structure has been agreed upon:

Summary

Introduction

- Information on SADRWMS (can use *SADRWMS Scope, Objectives, Content and Work Programme*)

Scope & Objectives

- Identification of Safety Assessments / type of facilities covered
- Identify differences between SADRWM and ISAM, i.e. the facilities considered by ISAM do not require human intervention, whereas SADRWM facilities are those that require management.

Background

- Common aspects of safety assessment

Characterisation /Identification/ Classification

- Description (Where possible this should use IAEA documentation already published, see IAEA website. Draft document 284 may be helpful, we should use this in developing our work.).
- General approach (Common aspects which are relevant to all waste types).
- Specific approach i.e. sites or sources (Identification of approaches that are specific to a waste type. We could give guidance in this section with the application groups providing the detail).
- Other relevant activities/topics (See list at the end of attachment 2 in SADRWMS Scope, Objectives, Content and Work Programme if not already addressed).

Collection /Recovery

- Description
- General approach
- Specific approach i.e. sites
- Other relevant activities

Treatment /Conditioning

- Description
- General approach
- Specific approach i.e. sites
- Other relevant activities

Storage

- Description
- General approach
- Specific approach i.e. sites
- Other relevant activities

Checklists

Discussion

Conclusions

Recommendations

Reference Documents

B6.2 Issues to be Considered in Safety Assessments

The working group discussed issues to be considered in safety assessments for the four main areas to be addressed. The issues identified so far are:

- Methodology
- Why, purpose
- Regulatory framework
- Time – how long (timescale – lifetime extension, ageing management)
- Data
  - Waste
  - Location environment
  - Building + technical instrumentation
  - Administrative procedures and instructions
- Identification of initiating events - FEPs
- Identification of possible scenarios (normal and abnormal)
- Selection of relevant scenarios
- Dose/impact analysis
- Limitation and operational constraints
- Other relevant issues (QA, QC, emergency planning, monitoring, etc.)
- Transport / material handling
- Maintenance
- Non-radiological hazards
- Retrievability / reversibility
- Control (who does this - the government, international or operator/owner organisation; the level of control will depend on inventory)
- Transfer of information / documentation / responsibility / knowledge management
- Training / certification
- Physical protection / security
- Public acceptance / consultation / confidence building

APPENDIX C

Terms of Reference
for
Operational Waste Working Group

C1. Participants

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Chairperson: Kanwar Raj
Deputy Chairperson: Peter Lietava
Secretary: Chris Fisher

C2. Scope

The Operational Waste Working Group will consider the management of operational including legacy wastes, decommissioning waste and spent fuel. The methodology, framework, common aspects and flow charts provided by the crosscutting groups, together with existing safety assessments, will form the basis of the work for this working group.

C3. Objective

The Working Group will test the applicability of the provided methodology, framework and common aspects from the crosscutting groups as well as the flow charts. This will contribute to the development of a harmonized common approach for the safety assessment of the predisposal management of operational waste, legacy waste, decommissioning waste and spent fuel destined for disposal.

Through the use of specific case studies, the application of the methodology, developed by crosscutting groups, will be demonstrated. Emphasis will be on a proportionate and effective application, which facilitates safety of the operation staff, the facility and the environment as stipulated by the regulations.

A key purpose of this work is to ensure that relevant pre-disposal waste management facilities are designed, constructed, commissioned and operated to meet the safety objectives. The potential need for upgrading safety of existing facilities will be specifically addressed.

In carrying out this work, the group will adopt a graded approach to safety assessment increasing in scope, detail and rigor according to the complexity and hazard of the facility or activity.

The working group will utilize the developed safety assessment methodologies in one or more test cases.

C4. Outcomes

The following outcomes are intended from the work of the Operational Waste Working Group:

1. Documentation on current practices concerning safety assessments for operational wastes, involving the following subtasks:
    - The agency to compile from the INIS database a list of relevant information applicable to operational wastes by the end of Jan ’05.
    - Participants to compile their experience in safety assessment of selected pre-disposal facilities.
    - Test the applicability of the flow charts with appropriate examples and provide feedback on the applicability of the flow charts for operational wastes.
    - Develop guidance on safety justification/ assessment for operational waste, which is to be revised and extended as necessary after test case work has been completed.
2. Identification of test cases to be used for testing of the overall framework and the developed methodologies. The following candidates for test cases were already identified:
    - Ion Exchange Resins treatment at NPP Ignalia (Lithuania);
    - Legacy wastes (UK);
    - Waste processing and storage at Vinca Institute in Belgrade (Serbia).
3. Use one or more test cases and associated available information to work through the flow charts and develop or adapt applicable safety assessments as indicated in the flow charts. During this exercise improvements will be highlighted and addressed.
4. Produce a report, indicating the work done by the Operational Waste Working Group, including conclusions and lessons learned.
5. Present results and propose further work.

C5. Work Plan

No.	Task	Deliverable	Who	When	Comments
1	Documentation on current practices	Compilation of relevant information applicable to operational wastes from a search of the INIS database.	IAEA	31/01/05	
		Participants to identify which areas they will address	All	20/12/04	
		Development of guidance on what is required in the documentation	PB	20/12/04	
		Description of practices used in safety assessment within the participants country (normal practices, what has worked well, where improvements have been made, availability of data, etc.)	All	28/02/05	
		First write-up of draft guidance on safety justification/ assessment for operational waste.	All	Nov 05	
2	Identification of test cases	Identification of possible test cases to be used to test the flow charts	All	30/09/05	
		List possible test cases	KR	15/10/05	
		Flowcharts/checklists available on the website	All	Nov 05	
	Meeting of working group (Vienna)			Nov 05	
3	Assessment of test cases	List of required information for test cases	All	Nov 05	During Working Group Meeting in Vienna in Nov 2005
		Gathering & compilation of required information	All	Feb 06	
		Use of flow charts	All	2006	
		Develop/adopt applicable safety assessments as indicated	All	Jun 06	
		Address/highlight deficiencies	All	Oct 06	
	Meeting of working group			Apr 06	
	Meeting of working group			Oct 06	
4	Prepare final report	Draft version	All	Jun 07	
		Final version	??	Sep 07	
5	Meeting of working group (Vienna)			Nov 07	Present results and propose further work

C6. Results of Working Group Meeting in Nov 2004

During the Working Group Meeting in Nov. 2004, scope and objectives were discussed and finalized. Approach to achieve these objectives was identified along with action plans and expected deliverables. A summary of results is presented here :

1. It was agreed that the Operational Waste Working Group would develop a harmonized common approach for safety assessment of pre-disposal management facilities meant for various types of operational waste including legacy waste, decommissioning waste and spent fuel destined for disposal. Upgrading safety of existing facilities will be specifically addressed.

2. Application of SADRWMS methodology, framework and common aspects developed by Cross-Cutting Groups will be tested and feedback will be provided for their finalization/further refinement. This will be done with the help of specific case studies. Three such cases were identified.

3. Approach to meet the stated objectives was finalized as “a graded approach increasing in scope, detail and rigor according to the complexity and hazard of the facility or activity”.

4. A work plan was prepared spanning over three-year period. This includes:

    - Identification of various targets/deliverables
    - Responsibility/scope of individual member of WG
    - Schedule of achieving deliverables/future meetings

APPENDIX D

Terms of Reference
for
Small Volumes and Disused Sources Working Group

D1. Participants

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Chairperson: Rodolfo Avila
Deputy Chairperson: Walter Blommaert
Secretary: Vasiliki Kamenopoulou

D2. Scope

The working group will consider the predisposal management of waste originated from hospitals, industry and research. This includes also waste from research reactors (excluding spent fuel). Disused and orphan sources will be also considered, independent of their origin.

D3. Objective

The objective of this working group is to test and validate the framework and guidelines developed in the crosscutting working groups for the specific types of waste within the scope of this group. The working group will provide feedback to the two crosscutting groups, including suggestions for modification of the framework and guidelines produced. A technical report will be delivered with results of the validation of the framework and the results of application in test cases.

D4. Outcomes

The working plan will be accomplished from November 2004 till November 2007.The work is divided in seven tasks as follows:

1. Identification of the waste: In this task the waste from different applications will be described in terms of: radionuclides, activity, physical-chemical form, etc.

   According to the scope of this working group, these applications are referred:

   - Research and training reactors;
   - Hospitals;
   - Industry and research;
   - Disused sources.

   Parameters concerning the information to be collected for waste identification identified during the working group meeting is given in Section D6.1.

2. Description of the waste streams taking into account all waste management stages including: a brief description and special features of stages usually needed in practice for the considered waste:

   - Identification (activity, form, isotope, quantity, composition);
   - Collection/recovery (location, packaging, status, monitoring occupational exposure, shielding);
   - Treatment/conditioning (retrieval, dismantling, existing technologies and corresponding acceptance criteria, process selection procedure, final state and packaging);
   - Transport (acceptance criteria);
   - Storage (acceptability of storage facility, limits, control and conditions including waste acceptance criteria, monitoring, periodical review etc,);
   - Conditions/criteria and procedure for re-use;
   - Conditions/criteria and clearance procedures.

   The flow chart developed in the crosscutting groups will be tested for each specific kind of waste with the aim of identifying:

   - The stages that are usually passed through and which stages are not necessary for certain situations;
   - The questions that need to be answered for safety justification;
   - The specific safety assessment needed.

3. Identification of test cases: The test case will focus on the predisposal management of the waste from nuclear applications (hospitals, industry, universities and research reactors). The content of the test case proposal is shown in Section D6.2.

4. First workshop to implement the methodology and discuss test cases. Chile is recommended, since the workshop can be combined to a visit in a storage facility

covering all the predisposal stages of interest for the tasks of this working group. The workshop can take place between June and December 2005.

5. Applying the framework to the test case: The framework and guidelines developed in the crosscutting working groups will be applied to the specific types of waste and in specific test cases. This work will start after the second plenary coordinating meeting, planned for November 2005.
6. A second workshop should be held in 2006 to discuss the results of the work and the first draft of the Technical Report.
7. Produce the technical report including:
   - Introduction;
   - Waste identification;
   - Description of waste steams using the flow charts developed by the crosscutting working groups;
   - Description of the test case;
   - Application of the framework and guidelines for safety assessment in the test case;
   - Conclusions and recommendations.

D5. Work Plan

No.	Task	Deliverable	Who	When	Comments
1	Waste identification	Research reactors	SK, VK	Feb 05	
		Hospitals	VK, RG		
		Industry and research	AS, PM		
		Sources	AG, RA		
2	Waste streams	Research reactors	SK, VK	Aug 05	
		Hospitals	VK, RG		
		Industry and research	AS, PM		
		Sources	AG, RA		
3	Proposal of test case		AS, NZ	Aug 05	
4	First workshop		AS, RA (org), All		Second half of 2005, Chile proposed
5	Application of the framework in test case			May 07	Participants to be defined later
6	Second workshop		AG, RA (org), All		Middle of 2007, Moscow proposed. After workshop the draft-report will be circulated
7	Preparation of Technical Report		RA (resp), All	Nov 07	

D6. Results of Working Group Meeting in Nov 2004

D6.1 Waste Identification

During the work group meeting the following parameter were being identified as relevant for the identification of wastes defining the scope of required safety assessment activities:

- Waste generator;
- Waste type;
- Waste description;
- Mass;
- Volume;
- Radioisotopes;
- Activity concentration;
- Chemical composition;
- Dose rate.

D6.2 Test Cases

The following information was identified as being required for the evaluation of a test case:

1. Purpose of the Test case;
2. The safety approach;
3. Site analysis;
4. Radioactive waste management:
   - Waste characteristics and streams.
   - Technical characteristics of the facility;
5. Safety analysis:
   - Context,
   - Scenarios generation,
   - Modeling,
   - Calculations,
   - Results evaluation;
6. Organization measures for construction and testing;
7. Organization measures for commissioning and normal operation;
8. Operational conditions and limitations;
9. Radiation protection services;
10. Review emergency plans;
11. Quality assurance program;
12. Security/ physical protection;
13. Organization measures for decommissioning.

APPENDIX E

Terms of Reference
for
Large Amount NORM/TENORM Working Group

E1. Participants

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Chairperson: Isabel Steyn
Deputy Chairperson: Farid Asgharizadeh
Secretary: Geoff Williams

E2. Scope

The Large Amount NORM/TENORM Application Working Group will only consider the management of NORM/TENORM waste. The framework and flow charts provided by the crosscutting groups, and body of safety assessment methodology as modified by the crosscutting groups, together with existing safety assessments, will form the basis of the work for this working group

E3. Objective

The Working Group will test the applicability of the provided methodology and framework from the crosscutting groups as well as the flow charts (See Appendix A) to large amount NORM/TENORM waste. The working group will also attempt to provide a straightforward, harmonised method to deal with the management activities of NORM/TENORM waste, and guidance on all aspects of safety assessment relevant specifically to the management of large volume waste.

In its work, the working group will utilize existing safety assessments, and only to the extent necessary and possible conducts new safety assessments for NORM/TENORM.

E4. Outcomes

The following outcomes are intended from the Large Amount NORM/TENORM Application Working Group:

1. List of all international (IAEA) available documentation applicable to NORM/TENORM.
2. Produce a table containing the typical sources associated to NORM/TENORM, grouped together in accordance with their origins and including a list of management options. This will also include a generic characterization of the identified sources.
3. Test the applicability of the flow charts with appropriate examples and provide feedback on the applicability of the flow charts for Large Amount NORM/TENORM.
4. Develop draft generic guidance on the execution of safety assessments for NORM/TENORM. (Including guidance on appropriate, realistic data to be used to improve the safety assessment.)
5. Use two test cases and associated available information to work through the flow charts and develop or adopt applicable safety assessments as indicated in the flow charts. During this session, all deficiencies will be highlighted or addressed.
6. Produce a report, indicating the work done by the Large Amount NORM/TENORM Application Working Group, including conclusions and lessons learned. (List of things done and the outcome).
7. Present results and propose further work.

E5. Work Plan

No.	Task	Deliverable	Who	When	Comments
1	International Documentation	Identification of International available documentation.	All	31/03/05	
		List all available documents	IS	15/04/05	
2	Typical Sources	Identification of typical sources	All	31/05/05	
		Grouping of identified sources			
		Generic characterization			
		Identify waste management options			
3	Test of flow charts using examples	Identification of possible examples to be used to test the flow charts.	All	30/09/05	
		List possible examples.	IS	15/10/05	
		Test flow charts with identified examples.	All	Nov 05	During working group meeting in Vienna
		Provide feedback on applicability of flow charts, including proposals on shortcomings if necessary.	All	15/01/06	
	Meeting of working group (Vienna)			Nov 05	
4	Draft guidance on Safety Assessment for NORM/TENORM.	First write-up of document to be revised and extended as necessary after test case work has been completed.	All	31/03/06	
5a	Test Case number 1 PBC – South Africa	List of required information.	All	Nov 05	
		Gathering & compilation of required information.	IS	Feb 06	
		Use of flow charts	All	Apr 06	During working group meeting in Pretoria, SA
		Address/highlight deficiencies.	All	Apr 06	
		Develop/adopt applicable safety assessments as indicated.	All	Sep 06	
	Meeting of working group (Pretoria, South Africa)			Apr 06	
5b	Test Case number 2 Saghand Yazd - Iran	List of required information.	All	Nov 05	
		Gathering & compilation of required information.	FA	Feb 06	
		Use of flow charts	All	Oct 06	During working group meeting in Teheran, Iran
		Address/highlight deficiencies.	All	Oct 06	
		Develop/adopt applicable safety assessments as indicated.	All	Apr 07	
	Meeting of working group (Teheran, Iran)			Oct 06	

No.	Task	Deliverable	Who	When	Comments
6	Preparation of Report	Conclusions	All	Jun 07	
		Lessons learned			
		Draft Report		Sep 07	
		Final report (including finalized guidance from Task 4)		Nov 07	
7	Meeting of working group (Vienna or Australia)			Nov 07	Present results and propose further work

E6. Results of Working Group Meeting in Nov 2004

During the meeting of the working group a compilation of relevant documents of the IAEA was produced as part of Task 1.

APPENDIX F

Tentative Outline of the Safety Assessment Methodology

F1. Overview

This appendix summarises some results obtained so far concerning the development an overall framework for the project and for safety assessments required in pre-disposal waste management. In particular, the following information is provided:

- Section F2 presents flow charts developed during the first CM depicting the overall process of pre-disposal waste management.
- Section F3 summarises key elements of safety assessments as specified in DS284.
- Section F4 lists important issues identified for various situations in pre-disposal waste management which have to be addressed in the safety assessments.

F2. Overall Framework

During the first CM an outline of the overall processes in pre-disposal waste management was developed. The diagrams produced for this purpose are given in Figures F-1 to F-6.

Figure F-1 provides an overview of the process and contains references to the five detailed flow charts developed for the following process steps:

- Remedial action;
- Clearance;
- Treatment;
- Storage;
- Disposal.

The main aim of these diagrams is to identify those process steps which require the preparation of a safety assessments. These steps are indicated by a shaded background in the boxes. The finalization of these diagrams will be performed in Task 1 of the Framework and Methodology Working group. The next task of this working group will consist in providing a write-up explaining these diagrams in details and deriving the necessary scope of the safety assessments to be conducted at the different process stages.

Figure F-1: Overall process

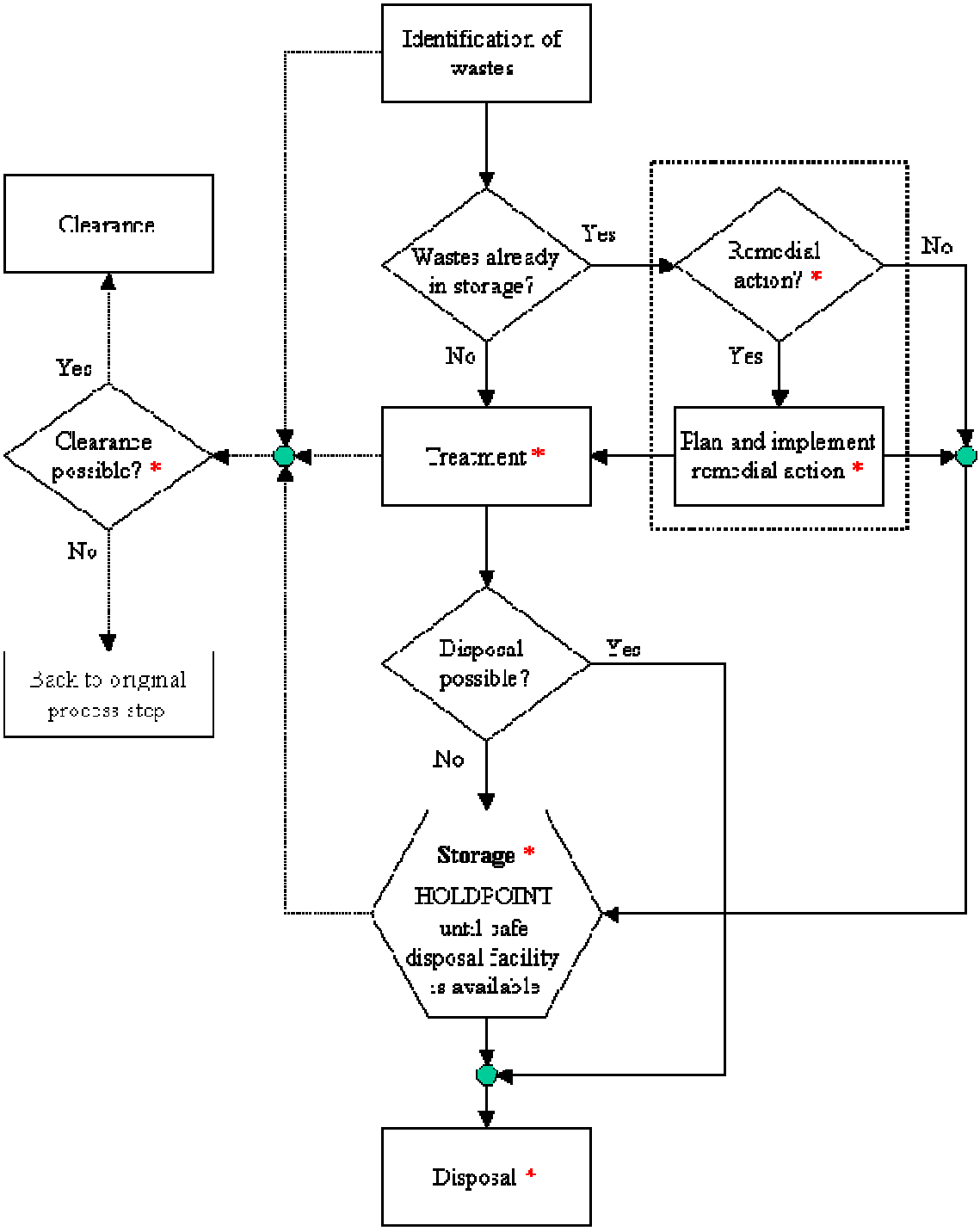


Figure F-2: Remedial action

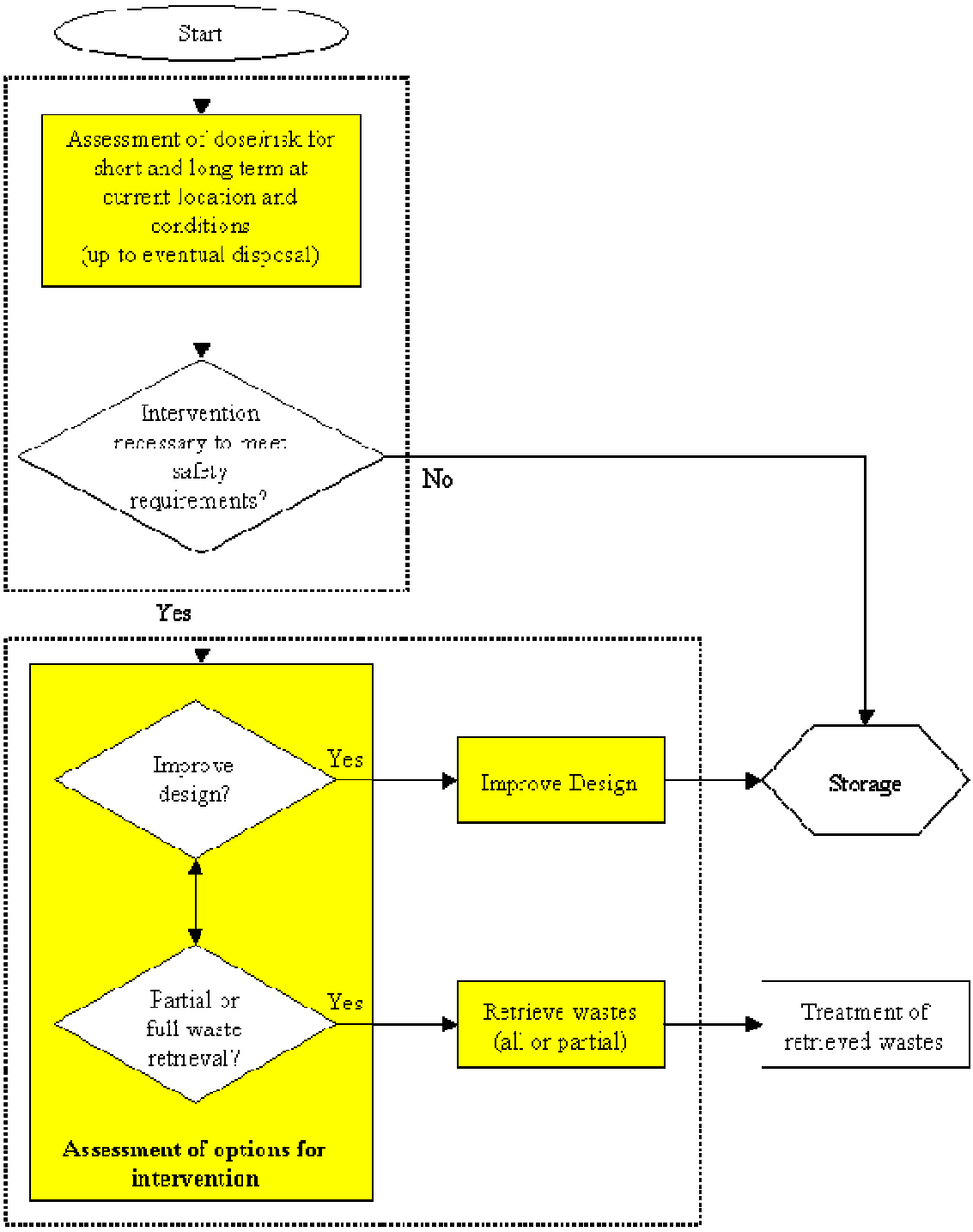


Figure F-3: Clearance

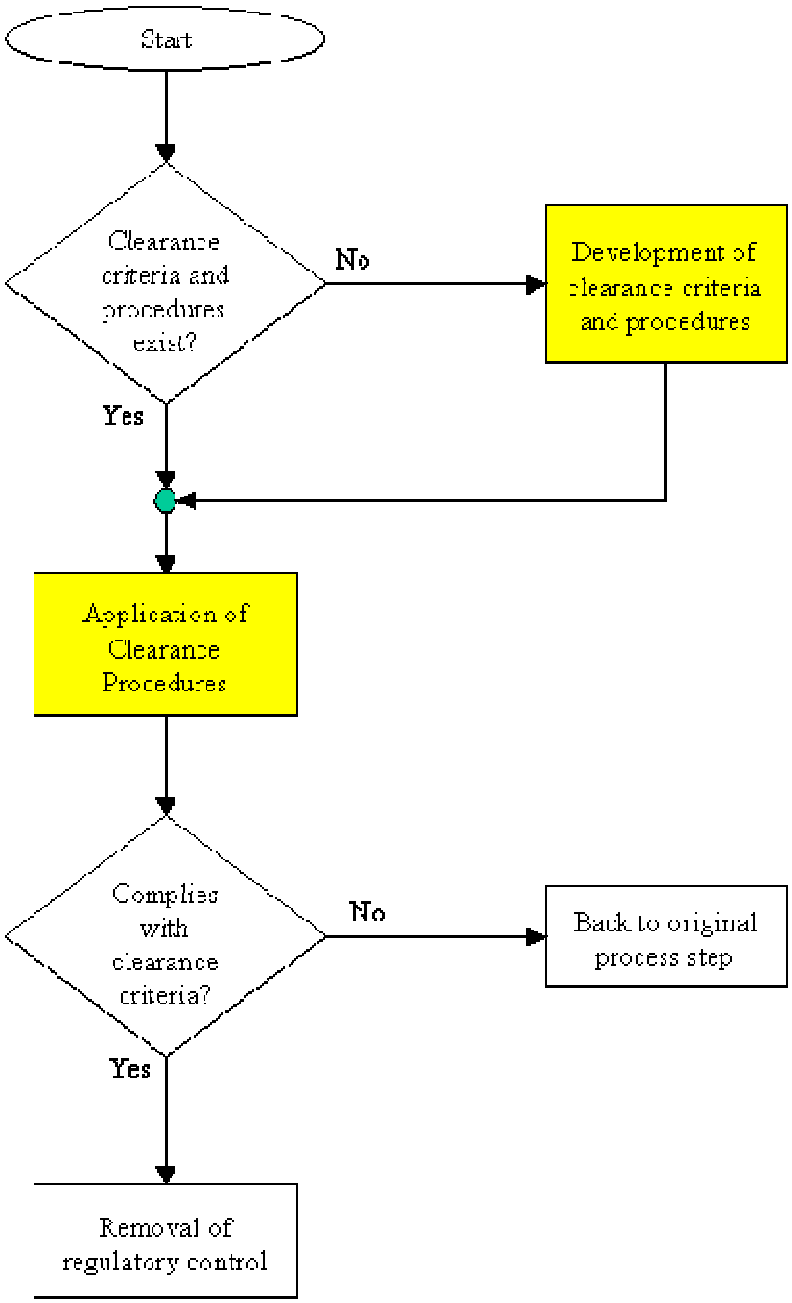


Figure F-4: Treatment

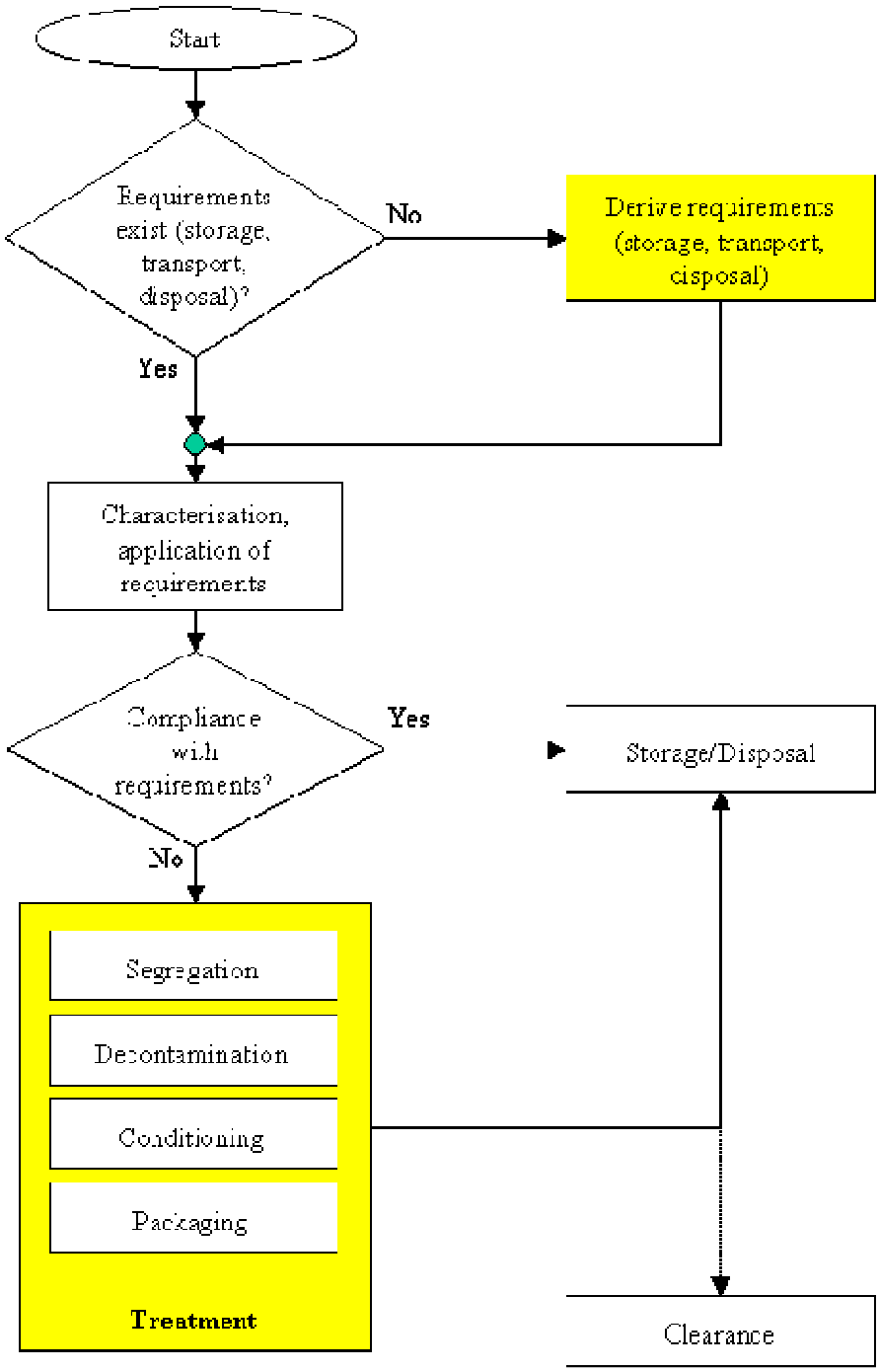


Figure F-5: Storage

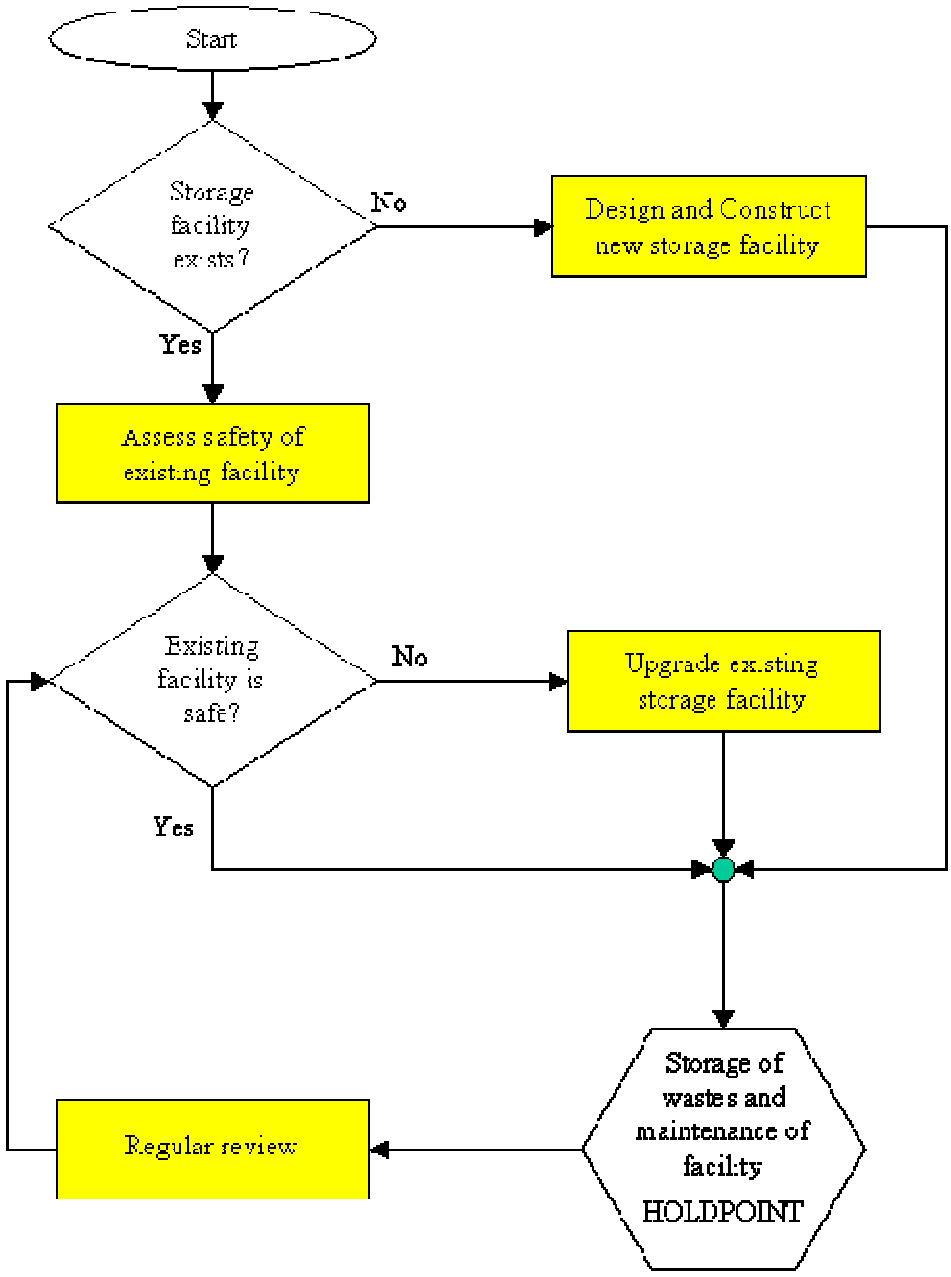
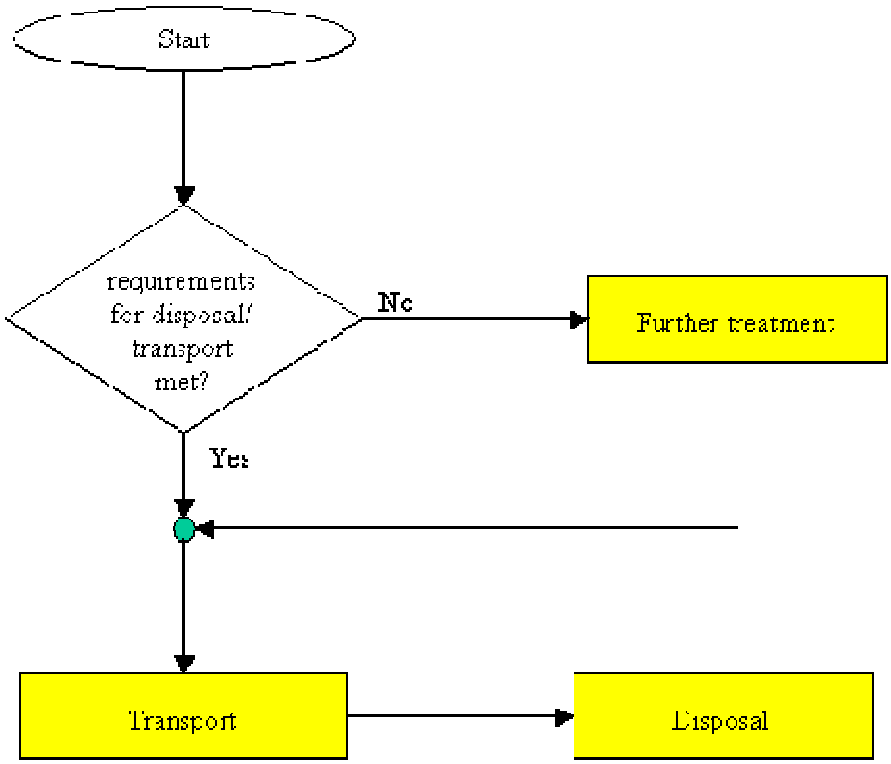


Figure F-6: Disposal



F3. Safety Assessment Methodology

The following description of a generic safety assessment methodology is taken from DS284. This will be further adapted and expanded in the Framework and Methodology Working Group.

F3.1 Assessment Context

Safety assessment of a radioactive waste predisposal activity or facility is generally undertaken to provide an assurance to stakeholders (such as government, regulatory authorities, the general public and technical/scientific personnel) that the system is managed and operated in such a manner as to ensure protection of humans and the environment over operational timescales.

The safety assessment context is intended to clarify what is going to be assessed and why is it going to be assessed. In addressing the assessment context, information should be provided concerning the following key aspects that need to be considered at the start of the safety assessment. It should be noted that many components of the assessment context are inter-related, and decisions relating to one component can influence other components. For example, the end-points assessed should be appropriate for the timeframes considered in the assessment.

(a) Purpose

Most safety assessments of radioactive waste practices have the principal, objective to demonstrate that an acceptable level of protection of human health and the environment will be achieved both now and in the future. In addition to this overall demonstration of safety there can be a variety of additional purposes.

In any specific case, however, the purpose of conducting an assessment may vary from simple calculations to test initial ideas to support a licence application for predisposal activities or for upgrading the safety of an existing facility requiring detailed, site-specific safety indicator assessment against regulatory criteria. In addition there can be a variety of additional purposes, such as derivation of quantitative acceptance criteria.

The audience to whom the results of the safety assessment will be presented should be identified. The general purpose and the target audience (e.g. regulators, operators; waste producers; local, regional and national politicians) may play a key role in defining relevant assessment end-points, key assumptions concerning the disposal system and in the identification and justification of the assessment scenarios.

(b) Regulatory Framework

In undertaking an assessment it is necessary to consider the regulatory framework that is relevant to the safety assessment. At one extreme this might be a detailed, prescriptive framework, at the other it might be non-prescriptive or may not have been fully developed. While national regulatory frameworks vary considerably, they mostly have some link to international recommendations such as relevant IAEA and ICRP publications.

(c) Assessment Goals

The goals of an assessment need to be well defined, correspond with the safety assessment purpose and the associated regulatory framework, and take into account the assessment assumptions made concerning time scales and critical groups.

An additional consideration is that the trend in safety case development is not to rely on evaluation of just a single factor, such as individual dose. Multiple lines of reasoning may be useful since regulatory bodies and others may use a wide range of arguments and aspects to help determine the adequacy of a safety case. A variety of indicators may be used as alternatives in addition to dose and risk

(d) Assessment Philosophy

The assessment philosophy is an expression of the extent to which the assessment is designed to provide a "realistic" estimate of potential impacts for comparison with the assessment goals, or whether more cautious, or pessimistic assumptions should be adopted for the purposes of demonstrating compliance with safety requirements.

F3.2 Description of the Radioactive Waste System

This aspect of the safety assessment is important as it provides the information on the characteristics of the radioactive waste being considered in the safety assessment. Therefore it is necessary to ensure that the data collected are pertinent to the assessment context. The limited availability or adequacy of data is an important factor in many safety assessments and hence when developing the system description, it is important to be aware of and to document the assumptions made and the associated uncertainties.

F3.3 Development and Justification of Scenarios

The safety assessment for a predisposal waste practice or facility must address the performance of the system under both present (normal and abnormal) and future conditions, including anticipated and less probable events. This means that many different factors (eg. conceptual model and parameter uncertainty) must be taken into account and evaluated in a consistent way, often in the absence of quantitative data. A very broad range of combinations can result from these considerations, which need to be addressed in a manageable way (ref. DS284). This is often achieved through the formulation and analysis of a set of scenarios. The selected scenarios need to provide a comprehensive picture of the system and its possible future performance based on the assessment context and system description. The choice of appropriate scenarios and associated conceptual models is very important and strongly influences the subsequent safety assessment of the predisposal waste management system.

There are several methods that can be used to generate scenarios. These may involve expert judgement, fault tree and event tree analysis. A common element in many scenario generation methodologies is the systematic identification and consideration of Features, Events and Processes (FEPs) that can directly or indirectly affect the release and transport of radionuclides from a waste management facility. Whatever approach is selected it is necessary to ensure that the scenario generation process is systematic, comprehensive, logical and transparent. By doing so a defensible representation of the system and its likely variation over time can be developed. This will aid in building public and stakeholder confidence.

F3.4 Formulation and Implementation of Models

Once the scenarios have been developed, their consequences in terms of the assessment context must be determined. First a conceptual level model representing

each scenario may be established depending on the complexity of the situation. It is necessary to ensure that the selected models and associated data correspond to the assessment context and represent adequately the waste management system.

F3.5 Analyses of Results and Confidence Building

Once the scenarios, and associated appropriate conceptual and mathematical models have been developed and implemented in software tools and the associated data collated, calculations can be undertaken to assess the impacts of a waste management facility. The results will have to be compared with criteria defined in terms of the specific assessment context. These will in most cases include regulatory criteria, although design and economic constraints may also be a major consideration. When analysing the results from an assessment, consideration should be given to various sources of uncertainty (e.g. scenario, model, data uncertainty).

The final results of the assessment often have to be presented to different audiences and for different purposes. Therefore it is also important that due care is given to the selection of approaches and means for presentation of results appropriate for the audience under consideration.

It is very important that the various parties who make use of the results have a reasonable degree of confidence in them and the underlying assessment. Confidence in the results is strongly related to the confidence in the consistency, logic and transparency of the overall safety assessment methodology used. Decisions often have to be made based on interpretation and analysis of the results as to whether the safety case is adequate.

It is important to underline that the entire safety assessment process is iterative and the first pass through the process should usually be followed by one or more iterations. This promotes consideration of improvements to the waste management system regardless of how favourable results initially appear. Subsequent iterations will often contribute to confidence that the safety case is acceptable or whether there is a need for further improvements.

F4. Issues for pre-disposal safety assessments

Table F-1 summarizes key issues which have to be addressed by safety assessments performed for different steps in pre-disposal waste management. In addition to the aspects identified in Table F-1, the following issues are relevant for all stages:

- Justification;
- Uncertainties;
- Periodic review, continual improvement of processes
- Quality assurance;
- Transport;
- Maintenance;
- Non-radiological hazards;
- Retrievability, reversibility;
- Emergency procedures (internal and external), contingency plans;
- Institutional control, transfer of information, documentation, responsibility, knowledge management, training certification.

Table F-1: Aspects to be considered in safety assessments of pre-disposal radioactive waste management

	Disused Sources	**Small Amounts**	**Large Volume**	**Operational Waste**	**Decommissioning Waste**	**Legacy Waste**	**Spent Fuel for Disposal**
Characterization Identification/ Classification	Activity; Form; Quantity; Isotope.	Activity; Form; Isotope; Quantity; Chemical/Biological Composition.	Origin; Concentration; Volume; Radionuclides; Chemical Composition; Leachability.	Concentration; Volume; Radionuclides; Chemical Composition;	Activity; Form; Quantity; Isotopes; Objectives.	Origin; Activity; Form; Volume; Radionuclides; Chemical Composition; Unknowns; Objectives/Criteria.	Burn-up; Cooling period; Type; Quantity; Integrity; Safeguards.
Collection/ Recovery	Shielding; Packaging; Location; Status; Occupational Exposure.	Location; Packaging; Monitoring.	Practicability; Transfer; Cost-Benefit Analysis.	Minimization. Part of Normal Practice, e.g. Containment; Transfer; Surveillance.	Accessibility; Dismantling; Decontamination; Occupational Exposure.	Cost-Benefit Analysis; Transfer; Segregation; Accessibility; Occupational Exposure; Criticality.	Accessibility; Life-time Arisings; Transfer; Criticality; Safeguards.
Treatment Conditioning	Re-use; Dismantling and Retrieval; Infrastructure; Immobilization Packaging.	Acceptance Criteria; Process Selection; Segregation; Immobilization; Packaging.	Process selection; Feasibility; Segregation; Conditioning; Packaging; Secondary Waste.	Acceptance Criteria; Design from Outset, e.g.: Segregation; Conditioning; Packaging; Secondary Waste.	Acceptance Criteria; Size Reduction; Segregation; Immobilization; Recycling/ Re-use; Secondary Waste; Technology; Compatibility.	Acceptance criteria; Process Selection; Feasibility; Segregation; Conditioning; Packaging; Secondary Waste.	Acceptance Criteria; Process Selection; Segregation; Conditioning; Packaging; Secondary Waste; Cooling; Criticality; Safeguards.

	Disused Sources	Small Amounts	Large Volume	Operational Waste	Decommissioning Waste	Legacy Waste	Spent Fuel for Disposal
Interim Storage	Decay; Facility Structure; Sustainability; Surveillance/ Monitoring; Security; Documentation.	Decay; Facility Structure; Sustainability; Surveillance/ Monitoring; Security; Documentation.	In situ; Facility Structure; Sustainability; Surveillance/ Monitoring; Documentation.	Facility Structure; Sustainability; Surveillance/ Monitoring; Security; Documentation.	Facility Structure; Sustainability; Surveillance/ Monitoring; Security; Documentation.	In-situ; Facility Structure; Sustainability; Criticality; Surveillance/ Monitoring; Security; Documentation	Wet Storage; Dry Storage; Cooling; Facility Structure; Criticality; Sustainability; Surveillance/ Monitoring; Safeguards; Security; Documentation.
Disposal	Return to Supplier;. Urban Landfill; Near Surface; Bore Hole; Public Issues.	Free Release; Urban Landfill; Near Surface; Public Issues.	In-situ; Near Surface; Public Issues.	Free Release; Near Surface; Geological/Deep Public Issues.	Free Release; Urban Landfill; In-situ; Near Surface; Geological/Deep Public Issues.	In-situ; Near Surface; Bore Holes; Geological/Deep Public Issues.	Return to Supplier; Geological/Deep; Public Issues.