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HIDRA II

The International Intercomparison and Harmonisation Project

on

Human Intrusion in the Context of Disposal of Radioactive Waste - Applications

TERMS OF REFERENCE

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1 Background

International intercomparison and harmonization projects are one of the mechanisms developed by the IAEA for examining the application and use of safety standards, with a view to ensuring their effectiveness and working towards harmonization of approaches to the safety of radioactive waste management. The IAEA has published safety requirements for disposal of radioactive waste [1], safety guides on near-surface and geologic disposal, respectively [2,3] and a safety guide on safety assessment and the safety case [4].

The IAEA has convened a number of **international intercomparison and harmonization projects** on the safety of radioactive waste management; in particular on the issues related to safety assessment, carried out in support of developing the safety case for radioactive waste disposal facilities. Safety assessment considerations have been addressed in projects such as Safety Assessment of Near Surface Radioactive Waste Disposal Facilities (NSARS), Improvement of Safety Assessment Methodologies for Near Surface Disposal Facilities (ISAM), and Application of Safety Assessment Methodologies for Near Surface Disposal Facilities (ASAM). More recently there has been increased emphasis on the broader concept of the safety case, including the project on the Practical Illustration and Use of the Safety Case Concept in the Management of Near-Surface Disposal (PRISM) and the follow-on PRISMA project addressing practical applications of the results from PRISM. For geologic disposal, the safety case is being addressed in a series of projects on Demonstrating the Safety of Geologic Disposal (GEOSAF).

These safety assessment and safety case related projects provide a practical framework in which safety assessments can be conducted and for the use of safety assessment and other considerations for decision-making during the development of the safety case for a disposal facility.

1.1 HIDRA Project

In the field of radioactive waste management and more specifically directed at consideration of inadvertent human intrusion (IHI) an international project HIDRA (Human Intrusion in the Context of Disposal of Radioactive Waste) was organized and formally initiated in 2013 [5]. The objectives of the HIDRA project were to:

- Share experience and practical considerations for the development and regulatory control of activities to consider potential IHI during development of the safety case
- Provide a structured approach for identifying and selecting protective measures and scenarios that are applicable for site-specific safety assessments
- Describe the role of assessments of IHI for decision making throughout the lifecycle of the safety case
- Provide suggestions for communication strategies to describe the rationale for assessments of future human actions and for interpretation of the conclusions of those assessments for the public
- Provide recommendations for the Waste Safety Standards Committee (WASSC) and Radiation Safety Standards Committee (RASSC), as

appropriate, for clarification of existing IAEA requirements and guidance relevant to the consideration of human intrusion.

There were close links to the PRISM project from the perspective of the role of IHI as part of development of the safety case and for decision-making throughout the lifecycle of a disposal facility. The HIDRA project addressed specific considerations associated with the possibility of a disruption of the disposal facility (IHI), occurring after closure and following the loss of institutional control for a properly closed facility. IHI considerations for each of the components of the safety case [4] and at different stages in the lifecycle were described.

HIDRA was organized with a coordinating group and three Working Groups addressing the following specific areas of interest (see Figure 1):

- Societal Factors
- Stylised Scenarios, and
- Protective Measures.

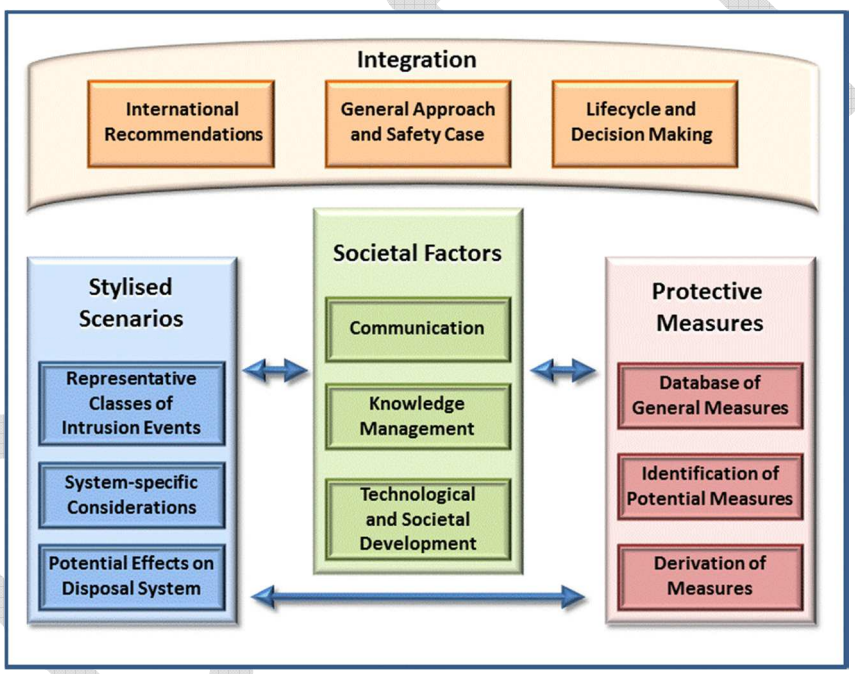

Fig. 1. Summary of Working Groups in the HIDRA Project.

Near-surface and geological radioactive waste disposal facilities were the primary focus, but discussions included Very Low Level Waste (VLLW) facilities, facilities for Low Level and Intermediate Level Waste (L/ILW), High Level Waste (HLW), Spent Nuclear Fuel (SF) as applicable, and boreholes. Participants provided experience from regulatory and implementation perspectives for facilities with a broad spectrum of designs, waste characteristics, regulatory frameworks and from differing levels of development of national radioactive waste management programmes. The influence of these different considerations on regulatory and implementation aspects of addressing IHI was a key topic for the project. Approaches for considering IHI as part of decision-making in the context of the safety case throughout the lifecycle of a disposal facility (e.g., siting, design, waste acceptance criteria) and the links with the PRISM project were a particular emphasis.

1.2 Results from HIDRA

The first phase of the HIDRA project developed a general approach for the consideration of IHI (Figure 2) as part of a safety case, highlighting differences between geological and near-surface disposal facilities. Specific approaches were also provided to customize on a facility-specific basis the representative IHI scenarios and protective measures identified by the working groups (Figures 3 and 4). The approach developed to consider IHI is intended for application in an iterative manner that supports decision-making throughout the lifecycle of a disposal facility. The general focus of the approach is to identify and consider the effectiveness of different measures that may be adopted to reduce the potential for and/or consequences of IHI to improve the robustness of the disposal facility.

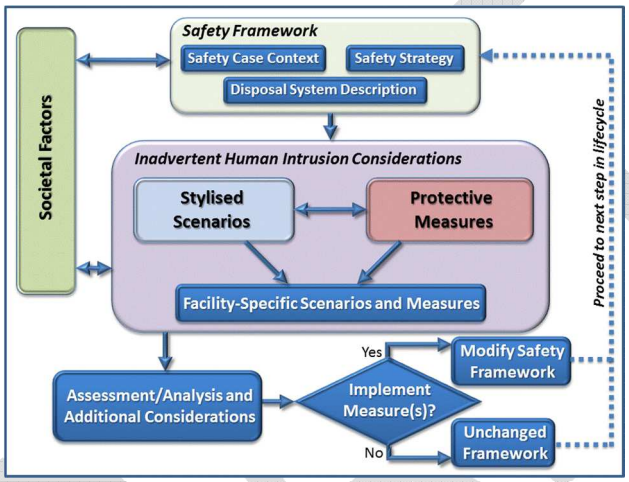

Fig. 2. General Approach to Identify Scenarios and Measures at Each Step in the Lifecycle.

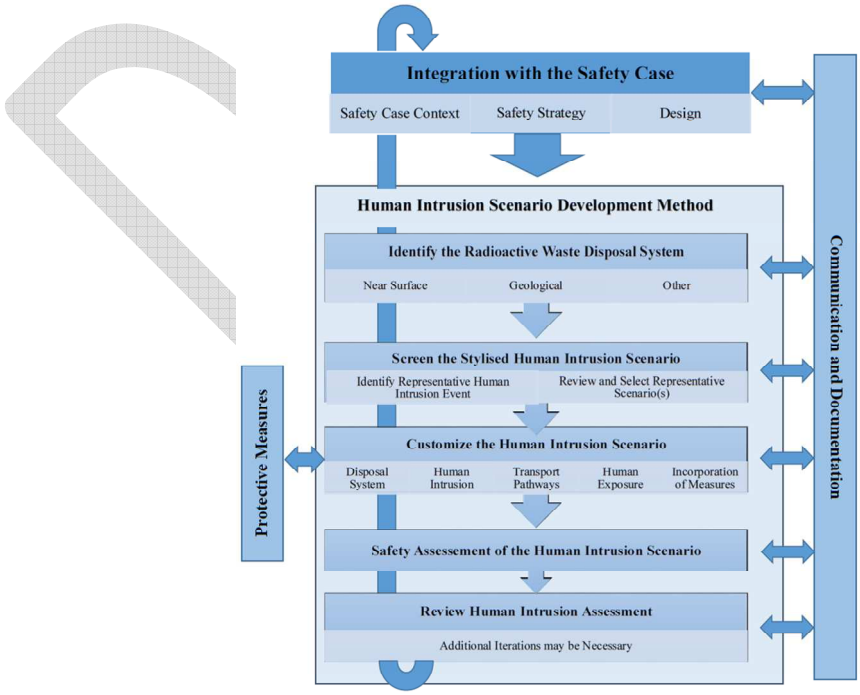

Fig. 3. Approach to Develop Facility-Specific Stylised Scenarios.

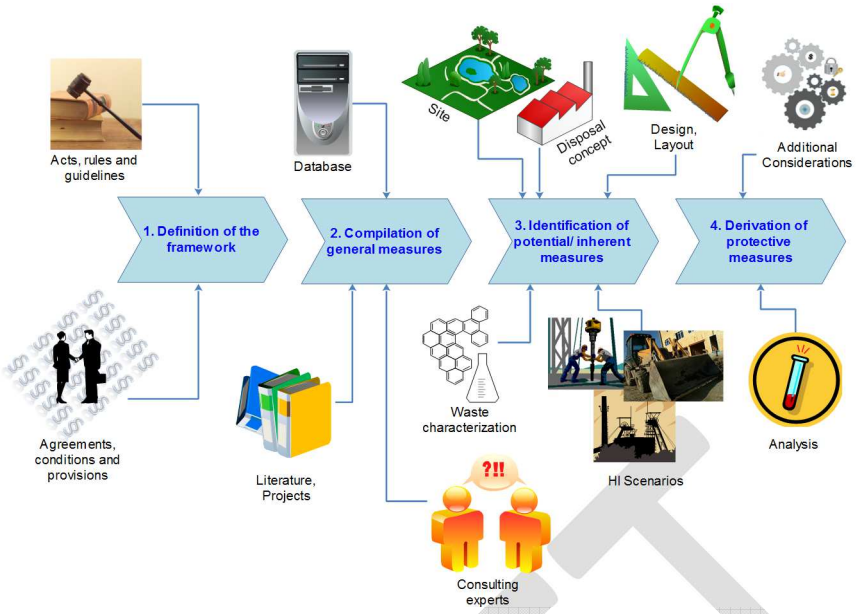

Fig. 4. Schematic of Four Steps to Identify and Derive Effective Protective Measures.

Some of the key outcomes from the working groups included: information on effective communication regarding human intrusion, approaches to enhance the duration of knowledge of the disposal facility, a set of stylised scenarios that can be considered as a starting point for a safety assessment, a database of measures that can be considered to help reduce the potential for and/or consequences of IHI and general approaches to develop site-specific scenarios and identify protective measures that would be effective for a disposal facility. An initial set of country specific examples were also provided for consideration during the second phase of the project.

2 Description of the project

2.1 Scope of the project

HIDRA II will test and refine the general approaches and concepts described in the first phase of the HIDRA project by applying those approaches to generic near-surface and geologic disposal facilities, respectively. The generic examples will follow the general safety assessment and safety case considerations described in Section 1 (e.g., ISAM, PRISM, GEOSAF) with an emphasis on considering how to address the influence of IHI considerations on decisions made while developing and updating a safety case at different steps during the lifecycle of a disposal facility. This will be accomplished by using the representative stylized scenarios developed for HIDRA and customizing those scenarios by considering hypothetical, site-specific conditions and implementation of select measures from the database of measures developed in HIDRA.

The near-surface example will address considerations for IHI associated with the different depths of disposal, but will focus on disposal to depths no greater than a few tens of meters. The examples for near-surface and geologic disposal will only consider properly operated and closed facilities (e.g., excluding facilities that were abandoned or discontinued operations prior to full completion of the lifecycle).

2.2 General objectives of the project

HIDRA II will address the following objectives:

- Share experience and practical considerations for the development and regulatory control of activities to consider potential IHI during development of the safety case
- Develop hypothetical working examples to test and illustrate practical application of the approaches identified in the HIDRA project (i.e., Figures 2,3,4) and identify changes and refinements to the HIDRA approaches
- As applicable, provide recommendations to WASSC for future updates of safety standards.

When developing working examples, the following topics will be addressed:

- Consideration of IHI within the PRISM/PRISMA decision-making process and safety case considerations
- Development of the regulatory framework to address IHI (e.g., prescriptive/flexible, criteria, quantitative/qualitative)
- Effective approaches for communication and consultation related to IHI at different steps in the lifecycle
- Customization of the representative scenarios from HIDRA for a hypothetical facility
- Use of the measures database from HIDRA to identify measures for a specific facility and associated customization of IHI scenarios for the hypothetical facility as applicable
- Practical implementation of optimisation to reduce the potential for and/or consequences of IHI using the representative scenarios and measures developed for the hypothetical examples
- Role of passive/in-direct controls/oversight to determine timing of IHI (consideration of ICRP and IAEA terminology).

The project will also provide country-specific examples of regulation and assessment of IHI as case studies.

3 Working Methodology

HIDRA II will be implemented with two working groups in parallel, addressing near-surface and geological disposal, respectively. The co-chairs and working group leads will be responsible for integration of the products from the working group activities and preparation of the final report. Development or refinement of existing country-specific examples will be encouraged for both working groups.

A first plenary meeting was used to develop the plans for the project, identify working group leads and establish the working groups. The project will be implemented with 2-3 additional plenary meetings and a combination of other working meetings for the leadership team and individual working groups as needed to complete the project.

3.1 Near-Surface Disposal Working Group

The Near-Surface Disposal Working Group will develop a generic example based on the sites described in the PRISMA project. Two concepts, surface and near surface, will be considered for the reference residential excavation and drilling scenarios from the HIDRA project. The scenarios will be developed in a relatively detailed quantitative form in order to evaluate potential exposures. The measures identified in the database from HIDRA will be consulted and will be used along with customized versions of the reference scenarios to demonstrate possible ways to optimise the disposal system. The different measures that are considered for the different scenarios will be documented and discussed. Potential measures that would be considered at different steps in the lifecycle will also be addressed as part of the full lifecycle.

Prescriptive and non-prescriptive regulatory frameworks will be considered and differences will be compared and contrasted. The quantitative scenario will be focused on one step in the lifecycle for the purposes of testing the general approach, but considerations related to IHI for decision-making in a safety case will be addressed for all steps in the lifecycle. Emphasis will be placed on documenting the questions considered, the process and reasoning for the decisions taken throughout the lifecycle, and a list of IHI-specific aspects that need to be considered at each time.

Considerations related to effective communication, consultation and knowledge management will be documented throughout the lifecycle based on the hypothetical example application. The role of interested parties during the lifecycle will be described.

3.2 Geological Disposal Working Group

The Geological Disposal Working Group will develop a generic example for a site situated in a clay formation with the potential to consider other formations if time permits. The facility will be a generic case to consider IHI using the approaches from HIDRA, but may include information based on conditions at specific sites. Emphasis will be placed on documenting the questions considered, the process and reasoning for the decisions taken at each step in the lifecycle, and a list of IHI-specific aspects that need to be considered at each time. The PRISM/PRISMA projects and decision-making examples will be considered, but are not a focus for the geologic example. A generic list of information to be considered during development of the regulatory framework and a customized framework for the example will also be included. The task will not address responsibilities since regulators or operators may have different responsibilities in different countries.

Considerations related to effective communication, consultation and knowledge management will be documented for each step in the lifecycle as the example application is developed. The role of interested parties during the lifecycle will be described. The measures identified in the database from HIDRA will be consulted and will be used along with customized versions of the reference scenarios for a demonstration of optimisation from the perspective of IHI. The different measures

that are considered at different steps in the lifecycle will be documented and relative importance will be discussed.

4 Outputs

The project aims at developing a report with examples and recommendations regarding the consideration of IHI as part of development of the safety case and decision-making. Emphasis will be placed on: (1) communication of IHI within the safety case, and (2) identification of measures to reduce the potential for and/or the consequences of IHI within the context of an optimization process. As appropriate, recommendations will also be provided for potential clarification or modifications to the HIDRA approaches and in future updates to Safety Requirements and Guides related to disposal and the safety case.

5 Role of Participants

Participants in the project include regulators, operators and representatives from technical support organizations. Each participant will be expected to participate in discussions and emphasize their individual perspective regarding considerations related to IHI as part of decision-making. Country-specific examples are also encouraged from the participants.

6 References

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Disposal of Radioactive Waste, IAEA Safety Standards Series No. SSR-5, IAEA, Vienna (2011).

[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Near-Surface Disposal Facilities for Radioactive Waste, IAEA Safety Standards Series No. SSG-29, IAEA, Vienna (2014).

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Geological Disposal Facilities for Radioactive Waste, IAEA Safety Standards Series No. SSG-14, IAEA, Vienna (2011).

[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Case and Safety Assessment for the Disposal of Radioactive Waste, IAEA Safety Standards Series No. SSR-23, IAEA, Vienna (2012).

[5] HIDRA reports:

- Project report (IAEA web page)
- SEITZ, R., Y. KUMANO, L. BAILEY, C. MARKLEY, E. ANDERSSON, AND T. BEUTH, Role of Human Intrusion in Decision-Making for Radioactive Waste Disposal – Results of the IAEA HIDRA Project, WM 2016, 6-10 March 2016, Phoenix, AZ (2016).