HIDRA II – Closing Discussion

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First Plenary Meeting of the Second Phase International Project on Human Intrusion in the Context of Disposal of Radioactive Waste (HIDRA) - TM-51533

January 15, 2016
Rationale

- Radioactive waste management is conducted in a manner that considers factors not addressed in other industries
  - Consideration of inadvertent human intrusion (IHI)
    (not considered for hazardous waste)

- There is a lack of consistency in approaches and the purpose is not well understood by interested parties

- The role of IHI and methods to consider IHI in decision-making for the safety case need to be better understood and communicated
Background - Expectations

IAEA, ICRP and OECD/NEA

- Protect inadvertent intruder, not deliberate intruder
- Limited stylized scenarios, current habits
- Intrusion considered in the context of intervention and optimization
- Reduce the potential for and/or consequences of inadvertent human intrusion (IHI)
Accomplishments This Week

- Developed Terms of Reference for HIDRA II
  - Objectives for Project
  - Scope
  - Identified Working Groups and Working Group Leads
  - Work Plans
  - Outcomes

- Working groups began efforts to develop project report

- Project path forward
Scope

- HIDRA II will provide a forum for practical application of approaches to address IHI as part of development of the safety case.
- Hypothetical examples for near-surface and geological disposal facilities will be developed.
- Applicable methods and experiences from HIDRA and other IAEA/NEA efforts related to safety assessment and the safety case will be considered (e.g., ISAM/ASAM, PRISM/PRISMA, GEOSAF, RK&M, IGSC).
- The examples 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).

IAEA
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 and identify changes and refinements to the HIDRA approaches
- As applicable, provide recommendations to WASSC for future updates of safety standards.
Iterative approach for IHI consideration

Safety Framework (Chapter 5)
- Safety Case Context
- Safety Strategy
- Disposal System Description

Inadvertent Human Intrusion Considerations
- Stylised Scenarios (Chapter 8)
- Potential Measures (Chapter 9)

Facility-Specific Scenarios and Measures

Assessment/Analysis and Additional Considerations

Implement Measure(s)?
- Yes
- Modify Safety Framework
- No
- Unchanged Framework

Proceed to next step in lifecycle (Chapter 6)
Iterative approach for scenario development
Derivation of protective measures

1. Definition of the framework
   - Acts, rules and guidelines

2. Compilation of general measures
   - Database

3. Identification of potential/ inherent measures
   - Site
   - Disposal concept
   - Design, Layout

4. Derivation of protective measures
   - Additional Considerations

- Literature, Projects
- Consulting experts

- Agreements, conditions and provisions
- Waste characterization
- HI Scenarios
- Analysis

- Waste characterization
- HI Scenarios
- Analysis
Topics to 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
IAEA SSG-23 Safety case components

- A. Safety case context
- B. Safety strategy
- C. System description
- D. Safety assessment
- E. Iteration and design optimization
- F. Management of uncertainty
- G. Limits, controls and conditions
- H. Integration of safety arguments

Involvement of interested parties and the regulatory body
Safety case evolution over facility lifetime

Evolving Safety Case

Disposal Concept
Site Selection and Design
Need for Action

Construction
Operation
Closure
Passive Institutional Control

Institutional Control
Operation

Role and Responsibility
Government
Regulator
Operator

Waste Manager
Operator
Interested parties' involvement throughout the process is encouraged

Time Line
License Termination?
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)
### Database Structure

<table>
<thead>
<tr>
<th>Entry (No.)</th>
<th>Reference</th>
<th>Explanation</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Objective</td>
<td>Reduction of the possibility of intrusion</td>
<td>Measures with focus on a specific objective</td>
</tr>
<tr>
<td>1.2</td>
<td>Position</td>
<td>Reduction of the radiological consequences</td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>Action</td>
<td>External measures</td>
<td>reference on measures outside the disposal system or be applied</td>
</tr>
<tr>
<td>2.2</td>
<td>Action</td>
<td>Internal measures</td>
<td>reference on measures inside the disposal system or be activated</td>
</tr>
<tr>
<td>3.1</td>
<td>Action</td>
<td>Passive measures</td>
<td>reference on measures which need no further actions and maintenance if they are once</td>
</tr>
<tr>
<td>3.2</td>
<td>Action</td>
<td>Active measures</td>
<td>reference on measures which need sometimes or continued updates and maintenance</td>
</tr>
<tr>
<td>4.1</td>
<td>Type</td>
<td>Regulative measures</td>
<td>mandatory measures provided by authorities</td>
</tr>
<tr>
<td>4.2</td>
<td>Type</td>
<td>Constructive measures</td>
<td>measures which require a design layout</td>
</tr>
<tr>
<td>4.3</td>
<td>Type</td>
<td>Planning measures</td>
<td>measures which require a planning realisation regarding implementation and place of installation</td>
</tr>
<tr>
<td>4.4</td>
<td>Type</td>
<td>Conceptual measures</td>
<td>measures which have to be considered in the disposal concept</td>
</tr>
<tr>
<td>5.1</td>
<td>Characteristic</td>
<td>Delaying</td>
<td></td>
</tr>
<tr>
<td>5.2</td>
<td>Characteristic</td>
<td>Deterring, preventing, restricting</td>
<td></td>
</tr>
<tr>
<td>5.3</td>
<td>Characteristic</td>
<td>Indicating, informing, warning</td>
<td></td>
</tr>
<tr>
<td>5.4</td>
<td>Characteristic</td>
<td>Aggravating, hindering, defending</td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>Characteristic</td>
<td>Controlling, guarding</td>
<td></td>
</tr>
<tr>
<td>6.1</td>
<td>Dependence</td>
<td>Depending on the spec. human action</td>
<td>measures which are connected to a specific human action</td>
</tr>
<tr>
<td>6.2</td>
<td>Dependence</td>
<td>Independent of the spec. human action</td>
<td>measures which are not connected to a specific human action</td>
</tr>
<tr>
<td>7.1</td>
<td>Basic action</td>
<td>Borehole drilling</td>
<td></td>
</tr>
<tr>
<td>7.2</td>
<td>Basic action</td>
<td>Creation of a cavern</td>
<td></td>
</tr>
<tr>
<td>7.3</td>
<td>Basic action</td>
<td>Construction of a mine</td>
<td></td>
</tr>
<tr>
<td>7.4</td>
<td>Basic action</td>
<td>Excavation/ Blasting/ Others</td>
<td></td>
</tr>
<tr>
<td>7.5</td>
<td>Basic action</td>
<td>General</td>
<td>no reference to a specific basic action</td>
</tr>
<tr>
<td>8.1</td>
<td>Assessment: benefit/ cost</td>
<td>High</td>
<td>evaluation of the effectiveness of respective measures</td>
</tr>
<tr>
<td>8.2</td>
<td>Assessment: benefit/ cost</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>8.3</td>
<td>Assessment: benefit/ cost</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td>9.1</td>
<td>Assessment: effort</td>
<td>Great</td>
<td>evaluation of the expected effort in conjunction with respective measures</td>
</tr>
<tr>
<td>9.2</td>
<td>Assessment: effort</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>9.3</td>
<td>Assessment: effort</td>
<td>Little</td>
<td></td>
</tr>
<tr>
<td>10.1</td>
<td>Assessment: availability</td>
<td>Long-term</td>
<td>evaluation of the temporal availability of respective measures (for deep geological disposal e.g. from few thousand years to the demonstration period and longer)</td>
</tr>
<tr>
<td>10.2</td>
<td>Assessment: availability</td>
<td>Medium-term</td>
<td>evaluation of the temporal availability of respective measures (depending of the disposal facility e.g. from loss of the memory to several hundred years up to a few thousand years)</td>
</tr>
<tr>
<td>10.3</td>
<td>Assessment: availability</td>
<td>Short-term</td>
<td>evaluation of the temporal availability of respective measures (from closure to the loss of memory e.g. few hundred years)</td>
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<tr>
<td>11.1</td>
<td>Optimisation conflict</td>
<td>Existing</td>
<td>assessment of the measure regarding optimisation conflicts (e.g. the measure might compromise the safety of the disposal system)</td>
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<tr>
<td>11.2</td>
<td>Optimisation conflict</td>
<td>Explanation</td>
<td>explanation of the reasons in case of an optimisation conflict</td>
</tr>
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</table>
# Example Measures

<table>
<thead>
<tr>
<th>No.</th>
<th>Possible optimisation measures</th>
<th>Sub-category</th>
<th>Reference</th>
<th>Relates to a specific disposal facility</th>
<th>1. Objective</th>
<th>2. Position</th>
<th>3. Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>Waste types and characteristics</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td>Reducing the waste volume</td>
<td>E1 Waste reduction</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>E2</td>
<td>Waste conditioning (general)</td>
<td>E1 Waste reduction</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>E3</td>
<td>Transmutation (general)</td>
<td>E1 Mitigate toxicity</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>E4</td>
<td>Waste acceptance criteria (general)</td>
<td>E1 Regulations</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>E5</td>
<td>Waste recycling (general)</td>
<td>E1 Mitigate toxicity</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>E6</td>
<td>Selection of radioactive waste inventory</td>
<td>E1 Regulations</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
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<tr>
<td>E7</td>
<td>Waste emplacement strategy</td>
<td>E1 Mitigate toxicity</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>D</td>
<td>Siting</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>D1</td>
<td>Alteration of the landscape (difficult to develop)</td>
<td>D1 Site Alteration</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D2</td>
<td>Choose regions with sparse population</td>
<td>D1 Site Conditions</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D3</td>
<td>Choose underdeveloped regions, rough terrain</td>
<td>D1 Site Conditions</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D4</td>
<td>Locating disposal boreholes at a site with an existing security infrastructure, e.g. at an existing NPP (Ref. SSG-1)</td>
<td>D1 Site Alteration</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D5</td>
<td>Avoiding of resources (minerals)</td>
<td>D1 Avoiding Resources</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D6</td>
<td>Avoiding of resources (groundwater)</td>
<td>D1 Avoiding Resources</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D7</td>
<td>Avoiding of resources (crude oil)</td>
<td>D1 Avoiding Resources</td>
<td>no mention</td>
<td></td>
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<td>X</td>
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<tr>
<td>D8</td>
<td>Avoiding of resources (gas, shale gas)</td>
<td>D1 Avoiding Resources</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D9</td>
<td>Avoiding of resources (geothermal energy)</td>
<td>D1 Avoiding Resources</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D10</td>
<td>Avoiding of resources (natural mineral deposits)</td>
<td>D1 Avoiding Resources</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D11</td>
<td>Avoiding of resources (historical places)</td>
<td>D1 Avoiding Resources</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D12</td>
<td>Avoiding of resources (area of outstanding natural beauty)</td>
<td>D1 Avoiding Resources</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D13</td>
<td>Selection of host rocks (geological formations) with self healing properties</td>
<td>D1 Site Conditions</td>
<td>Underground Disposal Facility</td>
<td>no mention</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D14</td>
<td>Adding substances to potential resources to make them useless</td>
<td>D1 Site Alteration</td>
<td>no mention</td>
<td></td>
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<td>X</td>
<td>X</td>
</tr>
<tr>
<td>D15</td>
<td>Development of the site as a recreational area that might be preserved by future generations</td>
<td>D1 Site Alteration</td>
<td>no mention</td>
<td></td>
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<td>X</td>
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<tr>
<td>D16</td>
<td>Avoiding sites which are prone to erosion</td>
<td>D1 Site Conditions</td>
<td>Underground Disposal Facility</td>
<td>no mention</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>C</td>
<td>Knowledge management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>Preservation of information and knowledge</td>
<td>C11 Preserving and Archiving</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>C2</td>
<td>Establishment of an information center at the site</td>
<td>C11 Providing Information</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>C3</td>
<td>Archiving and documentation (local, regional, national, global)</td>
<td>C11 Preserving and Archiving</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>C4</td>
<td>Implementation of a commemoration day</td>
<td>C11 Organising and Structuring</td>
<td>no mention</td>
<td></td>
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<td>X</td>
</tr>
<tr>
<td>C5</td>
<td>Adoption of the issue in the education programme</td>
<td>C11 Organising and Structuring</td>
<td>no mention</td>
<td></td>
<td></td>
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<td>X</td>
</tr>
<tr>
<td>C6</td>
<td>Creation/maintenance of strong conditions for the preservation of information and knowledge (organisational structure, financing, requirements, national agreements, int. agreements)</td>
<td>C11 Organising and Structuring</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>C7</td>
<td>Verify preserved information regarding potential changes in language and provide a translation document</td>
<td>C11 Preserving and Archiving</td>
<td>no mention</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
HIDRA Report

- Current version of HIDRA Report will be sent to participants after the meeting - comments requested by the end of February.

- HIDRA Report will be finalized and submitted to the IAEA publication process (End of March).
General Work Plan

➢ Project will include 2 more plenary meetings

➢ Working groups will have independent meetings as needed

➢ IAEA Secretariat, co-chairs and working group leads will have planning meetings in advance of each plenary
Tentative Schedule

- Terms of Reference – Final (end of January)
- Tentative outline for project report (end of February)
- Co-chairs and WG leads meeting (Fall/Winter 2016)
- Second Plenary (January/February 2017)
- Third Plenary (2018)
HIDRA File Server

http://gnssn.iaea.org/sites/auth/r
tws/hidra/SitePages/Home.aspx

Username: Hidrauser
Password: Hidra123$
Concluding Remarks

➢ Thank you to Javlon for his assistance

➢ Thank you to Eva and Amelie for volunteering to serve as Working Group Leads

➢ Thank you to all of the Participants for the active participation and feedback

➢ Project approach will provide good feedback for the IAEA and we have made more progress than expected for a first meeting