

# Proposal on Regulatory Guidelines for the Assessment of Human Intrusion Into a Radwaste Repository

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## 1. Introduction

Recently, IAEA has carried out the HIDRA (Human Intrusion in the Context of Disposal of Radioactive Waste) project [1] in order to derive an assessment methodology of human intrusion into radwaste disposal facility through extensive discussions among participants from member states. Since the methodology derived from the discussions could not reflect all legal and technical circumstances of each country, the application of this methodology to disposal facilities in our country might not work. Therefore, regulatory guidelines needed to make the methodology suggested in the HIDRA project work adequately to the disposal facility in Korea were proposed in this paper.

## 2. HIDRA Approach

Since HIDRA methodology for an evaluation of human intrusion is presented in detail in References 1 and 2, we describe only overall things related with this study.

The method for assessing human intrusion into a disposal facility is described in detail in Ref. 2, published by the author. To summarize, it is necessary to identify the stylized scenarios taking into account the regulatory requirements and the disposal facility, and to establish a protective measure against human intrusion. The ultimate goal is to reduce the likelihood of a human intrusion and to reduce the consequences when the intrusion occurs. Protective measures are continuously updated and optimized to increase robustness of the disposal facility [1, 2].

Assessment of a human intrusion begins with the description of the safety framework, which identifies the considerations on human intrusion for a given disposal facility, followed by description of site- and facility-specific human intrusion scenarios and potential measures. After site- and facility-specific scenarios and potential measures are identified, protective measures is derived by taking into account safety function, human and environmental impacts, economics, and cost. What is important is that no matter how effective it is in terms of prevention of human intrusion, if it jeopardizes the safety function,

it cannot be accepted as a protective measure against human intrusion [1, 2].

The procedure on how to derive a protective measure is described in References 2 in detail.

## 3. Disposal Facility

The disposal silos for low- and intermediate-level waste at Gyeongju repository [3] were considered in this study. This facility was completed in August 2015, and is now in operation.

Since the silo has already been constructed and is in operation, it is not possible to consider the potential measures to be applicable in the stage of site selection, facility design, and construction. Only the potential measures at the operational stage can be considered.

## 4. Discussions for Application of HIDRA Approach

The clauses for regarding human intrusion at LILW repository facility are only described in Notice No. 2016-25 of NSSC (Nuclear Safety and Security Commission) [4], describing “Human intrusion refers to all activities affecting the performance of isolation of radioactive waste, which results in radiation exposure to human being” and “After the institutional control period, the radiological effects by the human intrusion into a disposal facility should be maintained below the dose limit for the public as low as possible”.

The premises of the HIDRA methodology are as follows: First, the purpose of the human intrusion analysis is to reduce the likelihood of the intrusion and to optimize for increase in robustness of the disposal facility, not to determine whether dose limit is satisfied or not. Second, only those human actions that result in direct disturbance of the disposal facility (i.e. the waste itself, the contaminated near field or the engineered barrier materials) are considered as human intrusion. Third, a human intrusion is evaluated based on stylized scenarios to exclude uncertainty from detailed scenarios. Fourth, a deliberate human intrusion does not need to be considered, and even if an inadvertent human

intrusion occurs, human actions after recognizing the fact that there is hazardous material need not to be taken into account. Fifth, the time at which a human intrusion occurs is reasonable to assume to occur after promptly after the institutional control period. Sixth, it is reasonable to assume that the level of technology, eating and living habits of the future society are identical to those of the current society in order to exclude uncertainty.

According to the Notice of NSSC in Korea, the disposal facility for LILW should be designed to satisfy the exposure dose limit for all human activities near the disposal facility less than 1 mSv/yr based on the two clauses regarding human intrusion by NSSC. This could be interpreted that human intrusion scenario where the well is installed penetrating the disposal silo at Gyeongju repository should satisfy dose limit of 1 mSv/yr. However, according to the HIDRA methodology, installing a well through silo is considered to be the human intrusion to optimize the disposal system by adoption of a protective measure, rather than satisfying the dose constraint. There are obvious differences in the interpretation of human intrusion between domestic regulation and HIDRA methodology. Namely, there is too much conservatism in the domestic regulations on interpreting human intrusion issue. In addition, there is no description on a human intrusion scenario, the time of intrusion, the technology and habit of the future generations. Therefore, supplementary guidelines are needed to exclude ambiguities. Table 1 describes further guidelines concerning regulatory aspects of human intrusion assessment.

Table 1. Proposed Guidelines for HIDRA Approach

<u>Premises for Human Intrusion Assessment</u>
- Human intrusion into a disposal facility could be regarded as following three classes: (i) intrusion with full knowledge of the existence, location, nature and contents of the facility, (ii) Intrusion without prior knowledge of the disposal facility, (iii) Intrusion with knowledge on the underground facility but without understanding what it contain. Developer/operator should consider the second and third of these classes.
- Examples of classes that developers/operators should consider as human intrusion are as follows: (a) human intrusion directly into the disposal facility, (b) other human activities that damage the facility barriers or degrade their functions, such as closed tunnel excavation.
- Human intrusion in area of the above events should be optimized to increase robustness rather than to satisfy dose constraints.
- Human actions except above activities should satisfy the risk limit of $10^{-6}$ /yr.
<u>Human Intrusion Scenario</u>
- Human intrusion scenario should be separately considered from both scenarios: normal scenario considering an evolution of the disposal facility and abnormal scenario considering unforeseen events.

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- The human intrusion should be assessed based on the stylized scenarios that represent the typical activities that the future generations can carry out on the disposal facility. The custom and habits of the future generation considered in the scenario should be assumed to similar to those of the past and current generations.

Ways to Reduce Likelihood of Human Intrusion

- Developers/operators should consider all practical ways to reduce the likelihood of human intrusion and implement all these to the disposal facility. These kinds of measures should not compromise the safety performance of the disposal system.

Human Intrusion Impact Analysis on the Public

- Developers/operators should evaluate the radiation dose from human intrusion for the person living near repository.

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## 5. Summary and Conclusion

In this paper, regulatory guidelines were proposed to make the methodology suggested in the HIDRA project work adequately to the disposal facility in Korea. As a result, further guidelines regarding definition of the human intrusion, purpose of assessment of human intrusion, level of human intrusion scenario, and other premises were proposed.

It is expected that new guidelines proposed in this study could be useful when the guidelines regarding assessment of a human intrusion are established in Korea.

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