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"Ukrainian Approach on Guidelines for Assessment of Radiological Impacts for Sites with Multiple Existing and/or New Storage/Disposal Facilities and Decision-Making Criteria"

Introduction

- State Nuclear Regulatory Inspectorate of Ukraine (SNRIU), with involvement of the State Scientific and Technical Centre for Nuclear and Radiation Safety (SSTC) and RISKAUDIT IRSN/GRS International, is developing Guidelines for assessment of radiological impacts for Vector and Radon sites and identification of decision-making criteria.
- This work is funded by the EU (INSC Project UK/TS/39)[1].
- The report represents the Ukrainian approach to development of these Guidelines. The process of the development is ongoing.

[1] Disclaimer. The opinion expressed in this publication is the sole responsibility of the authors and can in no way be taken to reflect the views of the European Commission

Introduction

Vector site facilities:

- technological complex for radioactive waste treatment (facilities for sorting, compaction, incineration and cementation);
- long-term storage facilities for long-lived and high-level RW;
- centralized storage facility for sealed radiation sources;
- disposal facilities for Chernobyl-origin RW (about 550,000 m^3 in total);
- disposal facilities for RW from NPPs and Radon enterprises.

Introduction

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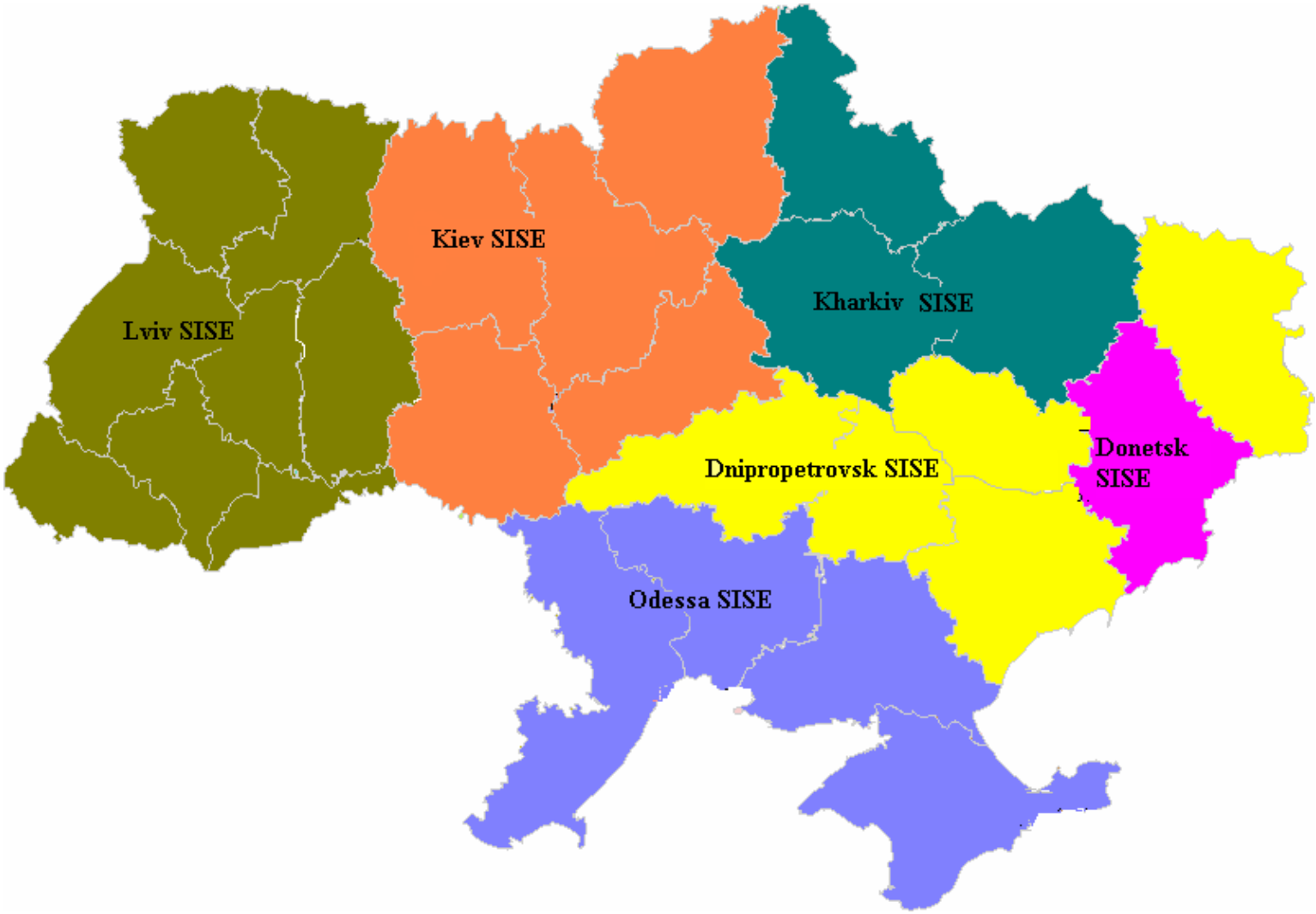
Radon State Interregional Specialized Enterprises:

- created in the 60-s of XX century;
- initially designed as radioactive waste disposal sites (RWDS);
- storage of RW from enterprises, institutions and organizations of non-nuclear cycle;
- licensed by SNRIU for certain types of activities (collection, transportation, storage);
- re-equipment and conversion for collection and temporary container storage of RW;
- removal of RW from RWDS, conditioning and transfer to Vector site.

Introduction



Introduction

- The Guidelines will establish requirements on scope and contents of forecast assessments of radiological impacts on public and environment from Radon RWDS and from facilities at Vector site as a whole.
- According to the results of the assessments, decisions can be made, in particular, as regards:
  - urgent or delayed RW removal from RWDS of Radon enterprises or leaving RW inside RWDS;
  - placement of RW into storage or disposal facilities at the Vector site.
- The Guidelines are based on requirements of the Ukrainian legislation and provisions of IAEA documents and take into account the peculiarities related to location of the Vector site in the contaminated Chernobyl exclusion zone, as well as to the history of Radon RWDS.

Guideline for Vector site – Approach

The Operator of Vector site has to carry out:

- initial and regular assessments of overall radiological impacts of Vector site facilities;
- detailed safety analysis of specific facilities, taking into account assessments of overall impact of the Vector site.

The Guideline sets forth:

- approaches to assessment of overall impacts of the Vector site;
- application of regulatory requirements;
- detailed requirements for assessment.

Guideline for Vector site – Approach

Safety assessment of overall Vector site covers the following issues:

- Vector site characterisation;
- potential exit points and pathways of radioactivity release;
- selection of critical groups of the public;
- development of scenarios;
- assessments of radiological impacts.

Guideline for Vector site – Approach

The overall impact is assessed for three periods of existence of the Vector site:

- Period I. Operation and/or decommissioning of facilities (approximately 200 years).
- Period II. Until the end of active and passive control (approximately 500 years).
- Period III. After the completion of control (taking into account existence and gradual reduction of the exclusion zone).

Guideline for Vector site – Approach

Critical groups:

- Public living:
  - outside the exclusion zone;
  - at the Vector site when exclusion zone no more exists.
- Staff of adjacent facilities – staff working at facilities within the exclusion zone but not on the Vector site.
- Staff of the Vector site – staff working on the Vector site.

Guideline for Vector site – Regulatory requirements

Dose limits for current exposure

Period	Dose limits, individual annual effective dose		
	Critical group of the public	Staff of adjacent facilities	Staff of Vector site
I	0.3 mSv – total for all facilities[1)] 0.08 mSv – for individual facilities for RW treatment and storage 0.04 mSv – for individual RW disposal facilities	2 mSv	20 mSv
II	0.3 mSv – total for all facilities 0.04 mSv – for individual RW disposal facilities	2 mSv	20 mSv
III	0.3 mSv – total for all facilities 0.01 mSv – for individual RW disposal facilities exempt from regulatory control	-	-

1) dose limit 0.3 mSv/year is not governed by regulations. It is recommended to use this limit or show that dose limit of 1 mSv/year is not exceeded, taking into account all radiological impacts (not only from Vector site).

Guideline for Vector site – Regulatory requirements

Main dose limits of potential exposure

Period	Dose limits D – annual effective dose P – probability of critical event		
	Critical group of the public	Staff of adjacent facilities	Staff of Vector site
I	$D \leq 50$ mSv, $P \leq 1 \times 10^{-2}$/year		$D \leq 100$ mSv, $P \leq 1 \times 10^{-2}$/year
II	$D > 50$ mSv[1)], $P \leq 2 \times 10^{-5}$/ year		$D > 100$ mSv, $P \leq 2 \times 10^{-4}$/year
III	$D \leq 1$ mSv[2)], $P \leq 10^{-2}$/year	-	-

1) probability of events that may lead, within a short period of time, to lethal doses must not exceed 5×10^{-7}/year

2) $D \leq 50$ mSv for making a decision on principal possibility of RW disposal based on conservative scenarios

Guideline for Vector site – Assessment for Period I

Current radiological impacts:

- Releases/discharges from all facilities should be considered, taking into account distribution of their life stages with time.
- Annual effective current doses should be assessed:
  - for the critical group of public living near the exclusion zone;
  - for the staff of adjacent facilities near the Vector site;
  - for the staff working at Vector site.

Guideline for Vector site – Assessment for Period I

Potential radiological impacts:

- The following extreme natural events should be considered: maximum design earthquakes (MDE), extreme wind, tornado of class F 3.0.
- For each extreme event, the following should be assessed:
  - possible damage/destruction of safety barriers and associated emergency release from each facility;
  - total emergency release at the Vector site taking into account distribution of the facilities' life stages with time;
  - maximum potential doses for the population near the exclusion zone and staff of adjacent facilities near the Vector site.

Guideline for Vector site – Assessment for Periods II and III

- Conservative assessment of long-term safety for Periods II and III after closure of all disposal facilities is carried out.
- Assessment is based on ISAM methodology.
- Conservative assessments are carried out on the basis of simplified models.
- Location of the disposal facilities in the exclusion zone and expected period of its reduction and existence for limitation of access to the Vector site should be taken into account.

Guideline for Vector site – Assessment for Periods II and III

- Transfer of radionuclides in the geosphere by ground and surface waters should be taken into account.
- Engineering barriers will degrade, which can have consequences on ground water discharge at the exit point for the critical group of the public and on people working occasionally at the Vector site.
- For Period II, integrity of the upper cover of the disposal facilities has to be maintained. This excludes the release of solid radioactive materials to the surface.
- For Period III, release of solid radioactive materials to the surface (e.g. as a result of erosion, etc.) and transfer with wind and tornado should be considered.

Guideline for Vector site – Assessment for Periods II and III

- The exclusion zone will still exist and, depending on the evolution of the contaminated territories, will be reduced to a restricted area under passive control. Hence, human intrusion should be excluded (or essentially limited).
- For the time when the exclusion zone no more exists, the possibility for unrestricted human access to the Vector site without any limitations for land use is taken into account.

Guideline for Vector site – Results of assessment

According to results of assessment of overall impacts, the Operator determines:

- suitability of the Vector site for placement of all planned RW into the storage and disposal facilities;
- restrictions for placement of certain RW for storage or disposal (limitations of activities of specific radionuclides);
- correction of distribution of dose limitation quotas among different facilities;
- optimisation of the strategy for development of the Vector site.

Guideline for Radon RWDS – Approach

- SAR for all activities on RW management at each Radon enterprise is developed by the Operator.
- In SAR, safety analysis for existing RWDS is generalized (due to lack of initial data, special research, etc.).
- For making justified decisions about the timeframe and sequence of RW removal from RWDS, safety reassessments should be carried out for RWDS as detailing of SAR concerning RWDS.

Guideline for Radon RWDS – Approach

The Guideline covers the following issues:

- safety principles and criteria to be applied to existing RWDS;
- contents and scope of safety reassessment;
- possible measures for increase of safety level of RWDS;
- possible options and measures for removal of RW from RWDS, waste conditioning and transfer to Vector site;
- making decisions about timeframe, sequence and options of RW removal from RWDS or leaving RW inside RWDS.

Guideline for Radon RWDS – Approach

Safety reassessment of RWDS covers the following issues:

- characterization of RWDS site;
- characterization and condition of RW in RWDS;
- characterization and condition of engineering barriers of RWDS;
- assessment of radiological impacts for population;
- measures for control of RWDS condition, environmental monitoring and maintenance of the safety level of RWDS;
- assessment of RW removal from RWDS and further RW management.

Guideline for Radon RWDS – Approach

Safety reassessment is carried out iteratively:

- **Stage 1.** To determine necessity for immediate removal of RW from RWDS.
- **Stage 2.** To determine necessity for delayed removal of RW from RWDS.
- **Stage 3.** To determine expediency of removal of RW from RWDS or waste leaving inside RWDS.

Guideline for RWDS – Safety reassessment – Stage 1

Urgent removal of RW from RWDS:

- RW contains chemically active, explosive and self-igniting substances and/or substances, incompatible with material of engineering barriers;
- engineering barriers in their current state do not ensure isolation/retaining of RW.

At Stage 1, the following reassessment is carried out first of all:

- characteristics and condition of RW in RWDS;
- characteristics and condition of engineering barriers of RWDS.

Guideline for Radon RWDS – Safety reassessment – Stage 2

Delayed removal of RW from RWDS:

- Radon site is characterized by exclusion criteria for site selection for disposal;
- safety level for the entire period of RW potential hazard is not ensured by RWDS passive systems;
- engineering systems of RWDS ensure current isolation/retaining of RW, but do not ensure this in case of design natural events with probability of $\geq 10^{-2}$ per year;
- radiological criteria are not complied with for the period after the end of passive control.

Guideline for Radon RWDS – Safety reassessment – Stage 2

At Stage 2, the following reassessment is carried out first of all:

- characterization of RWDS site;
- characterization and condition of RW in RWDS;
- characterization and condition of engineering barriers of RWDS jointly with natural barriers;
- assessment of radiological impacts for population.

Guideline for Radon RWDS – Safety reassessment – Stage 3

For Stage 3, full-scope safety reassessment is carried out:

- characterization of RWDS site;
- characterization and condition of RW in RWDS;
- characterization and condition of engineering barriers of RWDS;
- assessment of radiological impacts for population;
- measures for control of RWDS condition, environmental monitoring and maintenance of the safety level of RWDS;
- assessment of removal of RW from RWDS and further RW management.

Guideline for Radon facilities – RW removal

Conceptual design solutions must be developed for:

- Technological stages:
  - opening of RWDS;
  - RW removal from RWDS;
  - characterization and sorting of removed RW;
  - RW treatment and conditioning;
  - transportation of RW packages to Vector site;
  - dismantling of contaminated engineering barriers of RWDS and management of secondary RW;
  - removal of contaminated soils and remediation.

- Radiation protection:
  - prevention of spreading of radioactive substances outside the working areas;
  - radiation monitoring in the working areas, Radon site and environment, dosimetry monitoring of staff;
  - radiation protection of staff.

Guideline for Radon facilities – Comparison

Comparison of options for RW removal from RWDS or leaving inside RWDS (applied at Stage 3):

1. estimated collective doses for staff;
2. estimated resources;
3. suitability of Radon site for other purposes;
4. social factors (habitation at the adjacent territory).

Factors 3) and 4) give essential preference to the option of RW removal and transfer to Vector site, because Vector site will not be used for other purposes, and there is no population at the adjacent territory).

Thank You for Attention!