Order no. 275/2005

of 26/09/2005
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approving the Norms for the monitoring of environmental radioactivity in the vicinity of a nuclear or radiological facility

In accordance with the provisions of the:

- Law no. 111/1996 on the safe deployment of nuclear activities, republished, with subsequent modifications and completions;
- Governmental Decision no. 1627/2003 approving the National Commission for Nuclear Activities Control internal rules, with subsequent modifications

CNCAN President issues the following order:

Art. 1. – There are approved the *Norms for the monitoring of environment radioactivity in the vicinity of a nuclear or radiological facility* provided in the annex which is integral part of the present order.

Art. 2. - The present order shall be published in the Romanian Official Bulletin, Part. I.

Art. 3. - The norms provided under art. 1 shall enter into force at the date of their publishing in the Romanian Official Bulletin, Part. I.

Art. 4. - Division for Radiation Protection and Radioactive Waste shall fulfill the provisions of the present order.

For the President of the National Commsission for Nuclear Activities Control
Anton Coroianu

Bucharest, 26 September 2005.
No. 275.

ANNEX

Norms for the monitoring of environmental radioactivity in the vicinity of a nuclear or radiological facility

Chapter I
Scope, Application

Article 1. - (1) The present norms set the requirements for the monitoring in receiving environments of radioactive effluents resulted following an authorized nuclear activity, under normal operation conditions and in case of nuclear or radiological emergency, in accordance with the provisions of the Law no.111/1996 on the safe deployment of nuclear activities, republished, with subsequent modifications and completions and the Fundamental Norms on Radiological Safety approved by Order no. 14/2000 of the President of the National Commission for Nuclear Activities Control (CNCAN).

(2) The present norms apply to nuclear power plants, nuclear research reactors, nuclear fuel production and reprocessing plants, units for the mining, preparation and milling of uranium and thorium ores, intermediate and final repositories for nuclear spent fuel and intermediate and final repositories for radioactive waste.

(3) The present norms also apply to certain radiological plants using unsealed radioactive sources, in accordance with the provisions of specific norms and/or authorization requirements.

Article 2. – (1) For all nuclear or radiological plants stipulated under article 1, paragraphs (2) and (3), the authorization applicant/holder shall determine starting with the design stage the possibility of any radiological impact of the plant in its vicinity, with special emphasis on:

a) Exposure ways of human to radiation, including food chains;
b) Radiological impact on local ecosystems;
c) Possible accumulation of radioactive materials in the environment;
d) Possibility of other unauthorized ways of emitting radionuclides into the atmosphere.

(2) Depending on the results of the preliminary evaluation of the radiological impact, CNCAN may ask within the authorization process that the authorization applicant/holder assure, besides the monitoring of radioactive emissions, the monitoring of the environmental radioactivity in the vicinity of the plant.

(3) The specific requirements for the monitoring of radioactive emissions of a nuclear or radiological plant that emits radionuclides into the environment are presented in the Norms for the monitoring of radioactive emissions from nuclear and radiological plants approved by Order no. 276/2005 of the CNCAN President.

Article 3. – (1) The general requirements on the limitation of doses for nuclear practices, dose estimation, operational radiation protection of occupational exposed personnel, radiation protection of the population in normal conditions, transfer into the environment of radioactive waste, radiation protection during interventions, records, reports and notifications are presented within the Fundamental Norms on Radiological Safety.

(2) The specific requirements on the limitation of radioactive effluents releases into the environment, the calculation of the dispersion of radioactive effluents released into the environment by a nuclear power plant, schedule for the on-site meteorological and hydrological measurements, are shown in the *Norms for the limitation of radioactive effluents releases into the environment*, approved by Order no. 221/2005 of the CNCAN President, the *Norms on the calculation of the dispersion of radioactive effluents released into the environment by a nuclear power plant*, approved by Order no. 360/2004 of the CNCAN President and the *Norms on the schedule for the on-site meteorological and hydrological measurements*, approved by Order no. 361/2004 of the CNCAN President, accordingly.

Article 4. – (1) In the purpose of applying the present norms, besides the terms and expressions defined in the Law no. 111/1996 on the safe deployment of nuclear activities, republished, with subsequent modifications and completions, as well as in the Fundamental Norms oN radiological safety, other specialty terms are used, as defined in the Appendix no. 1 to these norms.

(2) In the understanding of the present norms, *emergency* shall mean *nuclear or radiological emergency*.

(3) In the understanding of the present norms, *facility* shall mean *nuclear or radiological facility.*

Chapter II
General requirements and responsibilities

Article 5. The general requirements and responsibilities regarding the monitoring of the environment radioactivity are presented in Articles 5 – 20 of Chapters II and III of the „ Norms for the monitoring of radioactive emissions from nuclear and radiological plants", applicable both to radioactive emissions and to the radioactivity of the environment.

Chapter III
Programs for monitoring the radioactivity of the environment

Article 6. – The specific goals of the environmental radioactivity monitoring are:

a) the verification of the results of the program for monitoring the radioactive emissions and the associated models, with the view to verify the predictions provided by the models used;

b) the supplying of information necessary for the evaluation of the actual or potential doses to the members of the critical group, resulted out of practice or authorized sources;

c) the detection of any unforeseen modifications of the activity concentrations and the evaluation of long term tendencies of the radioactivity levels in the environment, as a result of radionuclides released into the environment;

d) providing information to the public.

Article 7. – (1) The environmental radioactivity monitoring program shall contain provisions regarding the environmental external dose rate and the activity concentrations of all relevant environment agents, foodstuffs and drinking water.

(2) The design the environmental radioactivity monitoring program requires primarily:

a) the identification of critical radionuclides;

b) the identification of critical exposure ways; and

c) the identification of critical group/groups.

(3) Based on these evaluations, there will be selected those radionuclides and those exposure ways that will mostly contribute to the dose for the population, so that the monitoring program can be focused on them.

Article 8. – Should there be several nuclear or radiological facilities with radiological impact on the same geographic areas and population groups, each authorization holder shall conduct its own environment radioactivity monitoring program, following to justify, on the basis of data concerning radioactive emissions, the obtained results.

Means of exposure

Article 9. - (1) Out of the total potential exposure ways, there will be selected on realistic bases those exposure ways important from the point of view of:

a) the radiological properties of the materials discharged in the environment (type of emitters, half-lives);

b) the physical (state of aggregation) and chemical (organic or anorganic form, state of oxidation) properties of the emitted materials, as well as their characteristics of migration;

c) the mechanisms of dispersion in the environment and the factors that influence the dispersion (the height of the shaft, meteorological conditions, etc.), as well as the characteristics of the environment (clime, type of biosphere, crop, etc.);

d) location, ages, diet and habits of the exposed individuals or population.

(2) The potential exposure ways to radiations of the population, following the discharge of radioactive materials in the environment are presented in the Appendix no. 2 to the present norms.

Article 10. – The environmental radioactivity monitoring program should refer at least to the main exposure ways of radiation, which are:

1. External exposure ways:

a) source → atmosphere / water → human being: exposure due to the immersion in the radioactive cloud from the atmosphere or lack of pollutant in the water;

tritium source → atmosphere → human being: absorption through skin of the tritium oxide from the radioactive cloud;

b) source → atmosphere / water → soil, sediment, building surfaces, vegetation → human being: exposure due to the radionuclides sedimented on the soil, sediments (on the shores of the rivers, lakes, or seas), the surfaces of buildings (walls, roofs, and floors) or vegetation (trees, forests, grass);

c) source → human being: direct exposure to ionizing radiation (radioactive source, nuclear or radiological facility);

d) source → atmosphere → human skin: exposure due to the contact of the radionuclides with the skin.

2. Internal exposure ways:

a) source → atmosphere → human being: inhalation of radionuclides from the radioactive cloud;

b) source → atmosphere / water → (soil / sediment) → vegetation and/or meat/milk/eggs or sea food → human being: radionuclides ingestion from foodstuffs or beverages;

c) soil / sediment → human being: inhalation of resuspended radionuclides.

Critical groups

Article 11. – (1) When drafting the environmental radioactivity monitoring program, the authorization applicant/holder shall select one or several critical groups.

(2) The critical group shall be selected so that proper attention is paid to the social, cultural and alimentary habits of the local population, as well as the ethnical and cultural minorities, if any.

(3) The selection of the critical group should be done so that the homogeneity requirement is fulfilled.

(4) In extreme cases, for the evaluation of the exposure of the population and for the verifying the anticipated doses as consequences of the radionuclides release into the environment in normal conditions of operation, the critical group can be defined as consisting of only one hypothetical individual.

Article 12. – In cases when certain individuals are members of several groups predilectly exposed in various ways, the critical group is defined on the basis of the calculated sum of the doses received through all the exposure ways.

Article 13. – In situations when changes occur in the distribution of the population and/or the methods of utilization of the fields situated near a plant, the authorization holder shall identify the new critical groups and/or exposure means; the environmental radioactivity monitoring program shall be modified accordingly.

Chapter IV
The routine monitoring of the environmental radioactivity

IV.1. The environmental radioactivity monitoring in various operational stages

Article 14. Since the objectives of the environmental radioactivity monitoring are different throughout the various stages of operating a plant, the authorization holder shall modify accordingly the nature and the ampleness of the environment radioactivity monitoring program, throughout the operational stages of the plant.

Preoperational stage

Article 15. – (1) In the preoperational stage the authorization applicant/holder shall ensure the conducting of studies designed to determine the following parameters:

a) the radiological characteristics of the emission source and the forecasted radioactive inventory;
b) the types and the activities of the radionuclides that will be launched, their physical and chemical form, the means and channels of emission, as well as the values of the radioactive emission.
c) the transfer mechanism of the radionuclides through the environment, taking into account the dispersion and reconcentration mechanisms, and the seasonal variations;
d) the natural and artificial characteristics of the environment, which influence the transfer of the radionuclides (geological, hydrological and meteorological conditions, vegetation, the presence of reservoirs or ports, etc.);
e) the ecology of water surfaces projected to receive liquid waste (flora and fauna, annual variability, stage of eutrophization, the forecasted changes of the ecosystems);
f) the way of environment utilization for agriculture, industry, dwelling and recreation, water reserves and existing foodstuffs;
g) the density of the population, the distribution on age groups, as well as the alimentary, occupational, home and recreational habits;
h) the possible critical groups;
i) the existent levels of radionuclides in the environment and their variability;
j) the existence of any other physical or chemical pollutant that could affect the transfer of radionuclides in the environment.

(2) During the preoperational program there will be identified the organisms or the indicating materials of certain radionuclides.

Article 16. – (1) During the preoperational stage, the authorization applicant/holder shall draft the environment radioactivity monitoring program, on the basis of the preoperational studies.
(2) The preoperational program can also be used for the training of the personnel, the testing of the equipments, methods and measurement procedures stipulated within the operational program of environment radioactivity monitoring.

Article 17. – The authorization holder shall initiate the preoperational program enough time before the plant starts to operate, so that the frames of reference of the radioactive concentrations in the environment can be detected, as well as their variability.

Operational stage

Article 18. – (1) The necessity and the scope of the environment radioactivity monitoring program will be determined primarily by the size of the doses predicted for the critical group.
(2) The measurements and the samplings are to be done in locations accessible to the public, situated off-site the plant.
(3) The measuring and sampling locations will be selected on the basis of the local characteristics of the environment in which the plant is located, so that it is possible:
a) the determination of radiation doses towards the population;
b) the identification of radionuclides-contaminated zones.

Article 19. – In order to verify the predictions made on the basis of the results of the radioactive emissions monitoring program and the evaluation of the doses received from the population, the environment radioactivity monitoring programs shall contain provisions referring to:
a) samplings and measurements in a number of locations chosen depending on the estimations of the waste dispersion models;
b) samplings taken on the basis of procedures conceived taking into account the habits and consumption rates of the critical group/groups;
c) food samplings from the closest production and manufacturing areas, or from the private manufacturers in the area.

Article 20. – In order to detect the tendencies of modification of radioactivity levels in the environment, the environment radioactivity monitoring programs should contain provisions regarding sampling and measurements of activity concentrations from indicating organisms or materials, natural or artificial, even though they are not part of the means of human exposure to radiation.

Article 21. – (1) At the beginning of the operation period, frequent and detailed measurements of environment radioactivity are to be conducted, in order to confirm the predictions regarding the behavior and the transfer of radionuclides in the environment.
(2) Throughout the operation of the plant, the authorization holder may reduce the ampleness of the environment radioactivity monitoring program, only by the approval of CNCAN.
(3) The proposal for reducing the monitoring program will be analyzed taking into account the possibility of modification of radionuclides release level in the environment or the appearance of unforeseen emissions, as well as the interest of the public.

Article 22. – (1) The authorization holder shall re-evaluate and modify accordingly the environment radioactivity monitoring program in the following situations:
a) the appearance of some modifications in the operating manner of the plant or in the nature of radioactive emissions;
b) the appearance of some important modifications of the environment, which can significantly affect the transfer of radionuclides in the environment and, therefore, the exposure means (like biological modifications of aquatic ecosystems, due to the thermal discharge or the general eutrophizations of the whole aquatic system, the redistribution of the population or its change of habits).
(2) The new environment radioactivity monitoring program will be subjected for approval towards CNCAN.

Plant decommissioning stage

Article 23. – (1) Taking into account that during the decommissioning process, the potential impact due to direct irradiation and radioactive emissions on the population situated in the vicinity of the plant will modify compared to the operational stage, the authorization applicant/holder shall evaluate the environment radioactivity monitoring systems existent in the operational stage, in order to establish if it is necessary to keep them and if it is opportune to change them.
(2) Once finished, the environment radioactivity monitoring requirements will be specified in the plant retirement project.

Article 24. – The authorization applicant/holder shall draft during the decommissioning period an environment radioactivity monitoring program, which should cover the same specific objectives as in the operating stage, taking into account:
a) the modification of the source-term and therefore the corresponding modification of the critical radionuclides, the critical exposure means and the critical groups;
b) the modification of the radionuclides release activities in the environment;

c) the possibility of appearance of radioactive emissions consisting in contaminated aerosols resulted following the decommissioning activities, which cannot be subjected to the existing systems of filtration and monitoring of gaseous waste.

Article 25. - The end of decommissioning activities does not entail the end of the environment radioactivity monitoring program, as some aspects of the environment monitoring can continue until the unrestrictive displacement from the authorizing regime, in accordance with the CNCAN requirements.

Monitoring of radioactive waste disposal facilities, after their closure

Article 26. – (1) The provisions of the present section represent the specific requirements on monitoring of surface radioactive waste disposal facilities (storing locations for waste raised from mining and milling of uranium and thorium ore), close to the soil surface (for low and intermediate activity radioactive waste), in specially conceived pits, deep or less deep and in very deep subsurface (geological deposits), following the ceasing of plant operation and closure.
(2) The provisions of the present section are to be applied together with the requirements stipulated in the other applicable chapters of the present norms.

Article 27. – (1) When drafting the monitoring program for the radioactive waste disposal facilities, it shall be taken into account the potential migration of the radionuclides in the atmosphere and, primarily, the geologic environment near the plant.
(2) The monitoring systems shall be designed so they do not interfere with the physical barriers destined to isolate the radionuclides.

Article 28. – The monitoring program for the radioactive waste disposal facilities after their closure should be conceived so that it corresponds to the following main objectives:
a) proving that it complies with the dose constraint established by CNCAN;
b) confirming as much as possible the relevant hypothesis of the plant safety analysis;
c) providing evidence about any malfunction of the radionuclides isolating system, which could lead to unforeseen emissions of radionuclides in the environment;
d) providing information regarding the safety of the plant, to the interested public.

Article 29. – (1) The monitoring of the definitive storage plants for the radioactive waste after their retirement will take place within the active institutional controlling program.
(2) The monitoring program will be conceived, implemented and periodically revised by the organization responsible with the institutional control.
(3) The monitoring program, as well as its subsequent revisions, shall be approved by CNCAN.

Article 30. – (1) Virtually, the monitoring of the radioactive waste disposal facilities will continue as long as the plant represents a potential danger of radionuclides emission in the environment.
(2) The monitoring period will be established by CNCAN, taking into account the half-lives by radioactive disintegration of the radionuclides contained by the radioactive waste, the results of the plant safety analysis and the results of environment radioactivity monitoring near the plant.

Radioactive waste disposal facilities placed on the surface and near the surface of the soil

Article 31. – (1) Whendesign a post-closure monitoring program, it shall be taken into account the hypothesis, models and conclusions of the storage plant security analysis, paying attention to specific local factors (location of the site, climatic, geological and geomorphologic conditions, the plant project and its confinements, the external environment, the repartition of the population).
(2) Any modification intervened in the security analysis will lead to the re-evaluation and consequent modification of the post-closure monitoring program.

Article 32. – (1) The post-closure monitoring programs shall contain provisions regarding the collection of samples from the mobile environment compartments (especially geological fields) and from the biosphere, by which the radionuclides migrate and can get across to the human being:
a) atmospheric air (in the case of radon emissions from the storage sites for waste come out of the extraction and manufacturing of uranium and thorium ore);
b) water from soil, depth water, surface water;
c) sediments;
d) plants and animals;
e) alimentary products.
(2) The monitoring locations of the surface water, sediments, plants, animals and alimentary products will be selected depending on the potential migrating means of the radionuclides, determined through preoperational and/or operational studies, conducted until the moment of shutting down the depository.

(3) Depth waters will be monitored through the shafts located on a sufficient depth around and downstream the depositing plant.
(4) The sampling and measuring frequencies will be determined so that they ensure the prompt detection of the significant changes occurred in the levels and emission rates of radionuclides, and the associated human exposure levels.

Article 33. – The monitoring programs for the sealed radioactive waste disposal facilities shall be adaptable to any modifications in the conditions of human exposure, taking into account that:
a) after closure of the storage plant, although the cover surface can minimize or even prevent the emission of radionuclides in the atmosphere, on the soil there might appear infiltrations, under the cover surface, through the engineer barriers;
b) on long term there might appear modifications of the climate and environment conditions (hydrological flows, depth waters chemistry), as well as social changes (land using, foodstuffs production technique).

Article 34. – In order to determine the occurrence of significant changes that took place or may take place, radionuclide levels measured within the monitored environment compartments shall be compared to adequate monitoring data gathered during the operation of the storage plant and to preoperational data, if available.

Article 35. – (1) Since upon closing time most of short-lived radionuclides shall have disintegrated almost completely, post-closing monitoring shall focus on the determination of medium and long-lived radionuclides.
(2) Post-closing monitoring shall envisage, mostly, the detection of radioisotopes from the most mobile elements; the detection of such elements within environment samples shall be interpreted both radiologically and as an immediate clue of the storage plant's loss of integrity.

Article 36. – (1) In order to check and validate the hypotheses of the safety analysis on the storage plant, sufficiently sensitive measurement methods shall be used, which are selected so that if results "below the minimally detectable activity" are obtained, they should provide evidence of the accuracy in the safety analysis.
(2) The minimally detectable activity of the measurement equipments and methods used for post-closing monitoring shall assure the measurement of radioactive levels significantly lower (by one or two sizes) than the levels that might lead to the CNCAN-imposed dose constraint.

Article 37. – (1) The post-closure monitoring program shall be designed so that the gathered data may be used as an indication of the need to investigate certain inadvertencies in the performance of the storage plant, as regards the assurance of protection against radiation exposure and the need for corrective actions.
(2) The investigations carried out in order to explain unexpected values shall involve repeated and extensive sampling and measurements.
(3) Additionally, long term variations of activity concentrations within the related environment compartments shall be evaluated during the investigations.
(4) The investigations shall continue until a satisfactory explanation is achieved, both for CNCAN and for the organization in charge of institutional control.
(5) The monitoring program shall be revisited and, if necessary, modified by the organization in charge of institutional control, so that it can be adapted to the new possible conditions radionuclide emission and migration into the environment.
(6) In order to make decisions on the required corrective actions, the results of the new safety analysis or of the current modified analysis shall be considered, as well as the results of the monitoring program.

Article 38. – (1) The post-closure monitoring programs for surface repositories of waste raised from mining and milling ore (piles of attle) shall be designed considering the possibility of the waste changing on a medium or long term, due to natural (erosions, landslides, changes of surface waters) and anthropogenic (construction works, drillings for mineral resources or water, etc.) phenomena.
(2) The post-closure monitoring programs for surface repositories of waste raised from mining and milling ore that contain high amounts of ore shall include provisions concerning the monitoring non-radioactive dangerous materials.

Geological repositories

Article 39. – (1) Considering the design requirements of a confinement system for geological deposits, as well as the non-accessibility requirements for natural and human external factors, the safety of such radioactive waste final depositories does not rely on a continuous post-closing institutional control.
(2) Continued monitoring for the location and environment of a geological repository, after its closure, shall be determined by CNCAN, depending on the need to prove the assurance of geological safety, the need to confirm depository integrity, and the need to assure the control of nuclear warranties.

IV.2. Support programs

Article 40. – The environment radioactivity monitoring program shall be supplemented, where necessary, by support programs and/or studies, destined to other types of measurements and/or activities of gathering general information on the environment and data on population features.

Article 41. – (1) The authorization applicant/holder shall assure the monitoring of climate conditions both in the preoperational stage and during the operation of the plant.
(2) Additionally, both in the preoperational stage and during the operation of the plant, the hydrological features of rivers where liquid effluents are spilled or the hydrodynamic features of the aquatic environment, in the case of spillages into lakes or seas, shall be monitored.
(3) In the preoperational stage, local soils and hydrogeology, as well as the topo-geographical traits that may influence gaseous effluents, shall be monitored.
(4) The specific requirements concerning the monitoring of climate conditions and hydrological features are shown in "Norms for the meteorological and hydrological measurement on nuclear plants", approved by order no. 361/2004 of the CNCAN president.

Article 42. – (1) Within preoperational studies, the distribution (especially age) and features of the population in the vicinity of the plant shall be monitored, as well as its occupations and habits, the foodstuff consumption rates, the origin of consumed foodstuffs, and its leisures; in the operating period, al such data shall be checked by periodic inquiries.
(2) The agricultural and aquatic features (involved species, agricultural habits and customs), as well as gardening activities, shall also be monitored in the preoperational stage and checked periodically in the operational stage.
(3) The use of river water shall be monitored in the vicinity of the plant and downstream, up to the distance where the radioactive contamination is supposed to occur.

IV.3. Environment sampling and measurement techniques

Article 43. - (1) The authorization applicant/holder shall adapt the sampling strategy to the situation that needs to be monitored, so that it corresponds to the specific objectives of the monitoring program.
(2) The sampling locations and frequency shall depend on the purpose of the measurements, the type of emission, the radioactive inventory, and the foreseen exposure as a result of radioactive emissions.

Article 44. –
(1) Under normal operating conditions, the sampling sites shall be selected as follows:
a) In the vicinity of sites where maximum exposure to radiation or maximum depositing of radionuclides is forecasted, namely on the main wind direction, for atmospheric emissions (in the direction the wind blows) or downstream from the spillage point for liquid emissions, and
b) At the limit of the plant location, for direct irradiation from the source.
(2) Although the atmospheric and aquatic dispersion may register significant annual fluctuations, most samplings shall be carried out in the same sites in order to allow the annual comparison of results.
(3) In view of comparisons, sampling and measurements shall be carried out in localities in the vicinity of the plant location, as well as in the background areas (in the direction the wind blows and upstream from the source).

Article 45. – (1) Agricultural foodstuffs produced continuously, such as vegetables with edible leaves and milk, shall be sampled biannually or even more frequently, in case of an intended detection of short-lived radionuclides (e.g., radioactive iodine).
(2) The soil and the products to be cropped once per year shall be measured annually.

Article 46. – (1) The environment compartments located along the monitored means of exposure and the related sampling and measurement frequencies are shown in the table of appendix no. 3 to these norms.
(2) From the generic table shown in appendix no. 3, the specific compartments determined based on relevant radionuclides, on local weather conditions, and on the level of radioactive emissions, shall be chosen.

Article 47. – Given the inherent variability of radioactive concentrations in environment samples, the careful design of the sampling strategy is required. Thus:
a) For a suitable statistic evaluation of the measured values, a predefined sampling strategy shall be applied;
b) The specific sampling procedures for various environment specimens shall be selected so as to assure the representativity of the samples.

Article 48. – (1) The sampling frequency shall depend on the size to be measured, the time dependence, and the variability of the measured size.
(2) Sampling shall be more frequent in the following cases:
   a) Monitoring of areas where radiation levels are close to intervention or action levels;

b) Measurement of radioactive contamination for foodstuffs with short periods between cropping and consumption;
c) If the detection of a size with high variability in space and time is aimed;
d) If the detection of radionuclides with short half-life is aimed.

Article 49. – (1) Generally, the activity concentrations of radionuclides present in environment compartments shall be measured, except for such cases when the derivate emission limits are expressed in terms of global alpha or global beta activities.
(2) The sample measurement frequency shall be measured considering especially the half-life of tracked radionuclides and the level of radioactive emissions.
(3) A guide of the sampling and measurement methods in order to determine the various sizes significant for the routine monitoring of radioactive emissions is rendered in appendix no. 4 to these norms.

Article 50. – (1) The authorization applicant/holder shall select radiation measurement devices according to their purpose of use, considering the radionuclides that may be released, both under normal operation and in case of emergency.
(2) The authorization applicant/holder shall present within the authorization process all the technical features of the monitoring equipments that may influence the quality of the measurements, through the Radiological Safety Authorization issued by CNCAN or by other similar documents recognized by CNCAN, in accordance with the legislation in force.

Article 51. – (1) The authorization applicant/holder shall select the sampling and measurement equipments, the analysis techniques, and the procedures used so as to meet the minimal sensitivity requirements.
(2) The minimal sensitivity required for measurement equipments and methods shall be expressed in terms of minimally detectable activities.
(3) The minimally detectable activities of measurement equipments and methods shall be selected so as to allow the performance of measurements at levels substantially lower (at least one size) than those which might lead to the dose constraint, considering all the exposure means; foe every such monitored exposure mean, a certain fraction of the dose constraint shall be allocated; the minimally detectable activities shall be calculated so that they guarantee the detection of all possible contributions to the total dose.

Article 52. – The calculation procedure and the values of minimally detectable activities for each radionuclide or category of radionuclides released by each mean of release shall be explicitly presented in the environment radioactivity monitoring program.

IV.4. Specific requirements for environment radioactivity monitoring in the vicinity of a nuclear power plant

Article 53. – (1) The provisions of this section represent the specific environment radioactivity monitoring requirements under the normal operation of a nuclear power plant with CANDU-type reactors.
(2) The specific requirements for the monitoring of environment radioactivity in the vicinity of other nuclear or radiological plants shall be set by CNCAN for each plant, within the authorization process.
(3) The specific requirements for the monitoring of environment radioactivity in the vicinity of a nuclear or radiological plant shall be apply together with the general requirements comprised in the other applicable chapters of these norms.

Article 54. – (1) Within the environment radioactivity monitoring program, in order to study the behavior of each critical radionuclide or group of critical radionuclides, such radionuclide / environment compartment combinations shall be selected that are adequate for the environment monitoring of radioactive effluents, as follows:
a) For each group of critical radionuclides, a radionuclide or a group of radionuclides shall be selected that are representative for the identification of the emission;
b) For each means of exposure to such radionuclide or group of radionuclides, a representative and analytically sensitive environment compartment shall be selected.
(2) Appendix no. 5 to these norms contains a guide for the selection of radionuclide / environment compartment combinations related to critical radionuclides and the possible means of exposure for a nuclear power plant with CANDU-type reactors.
(3) Critical means of exposure, as well as representative environmental compartments shall be selected based on local characteristics of the environment and population in the vicinity of the nuclear power plant.

Article 55. – (1) Monitoring locations shall be selected as near to the end of the exposure means as possible.
(2) Additionally, the accessibility of certain monitoring locations shall not be of first importance in the selection of adequate monitoring locations.

Article 56. – (1) The indicator locations for gaseous emissions shall be selected outside the plant's facilities, considering the distribution of wind frequency and the distribution of population in the area.

(2) The method for selecting indicator locations for the direct exposure due to gaseous emissions (external and inhalation) from a nuclear power plant is shown in appendix no. 6 to these norms.

Article 57. – (1) In the vicinity of the nuclear power plant a sufficient number of dose meters and/or continuous measurement stations for the external gamma dose flow shall be located, in order to monitor the external exposure to radiations.
(2) Such equipments shall be installed:
a) In indicator locations for gaseous emissions, determined based on the method shown in appendix no. 6 to these norms;
b) At the limits of the plant's exclusion area, one equipment for each wind sector of 22.5 degrees, if possible; otherwise, they shall be located in accessible sites nearby, so that they ensure a suitable monitoring for all wind directions.
(3) Integrating dose meters shall be read on a monthly basis.
(4) The data gathered by automatic dose flow measurement stations shall be broadcasted in real time to the control chamber of the nuclear power plant and to local and central public authorities in case of emergency, in accordance with official arrangements and protocols concluded within the nationwide system of nuclear or radiological emergency response.

Article 58. – (1) Indicator locations for liquid emissions of a nuclear power plant located on a river bank shall be set in the following sites:
a) Drinkable water supply stations located within the area with a 20 km radius, around the plant, downstream, on both river banks;
b) Aquatic farms (natural fishing ponds, artificial farms, aquatic culture farms), if any, within the 20 km area around the plant;
c) In the vicinity of each spillage site (within the 1 km area around the spillage point).
(2) Additionally, underground drinkable water supply sources that may be influenced by the plant's radioactive emissions shall be monitored.

Article 59. – (1) Control locations shall be used together with indicator locations to determine the average dilution factor as a function of the distance to a plant, for a given monitoring period, in order to independently evaluate the calculations fro atmospheric dispersions gaseous effluents.
(2) The method for the determination of the average dilution factor is described in appendix no. 7 to these norms.
(3) For each nuclear power plant, at least on control location for atmospheric emissions shall be set, which shall be located in the sector with the highest wind frequency, at a longer distance than the indicator location, but at less than 20 km from the plant.

Article 60. – (1) Background locations shall be set in areas that are remote from the influence of the plant, at a distance beyond 20 km, in the direction the wind blows and upstream from the plant.
(2) Background locations shall be chosen in sites that are geographically similar to plant's location.
(3) For a nuclear power plant, at least one background location shall be chosen for air and one for water, locations in which the same representative radionuclide / environment compartment combinations shall be monitored, as in the indicator locations.

Article 61. – (1) Sampling frequencies shall be determined in accordance with the average lifetime of the radionuclide representative for a means of exposure.
(2) The sampling frequency calculation methodology, as well as the recommended frequencies for the environment monitoring of radioactive effluents from a nuclear power plant with CANDU-type reactors can be found in appendix no. 8 to these norms.

Article 62. – Additionally, upon selecting sampling frequencies, the following shall be taken into account:
a) Required measurement accuracy, which is imposed by the significance of the doses: the higher the radiation doses, the larger the required accuracy, especially in case the doses are nearer in terms of value to the dose constraint imposed by the CNCAN; in such cases, mediated time measurements, continuous measurements, or integrated measurements shall be necessary, very frequently;
b) Radioactive effluent emission rate: emission sources relatively constant in time shall not need high monitoring frequencies;
c) Likelihood of emissions under abnormal or emergency functioning conditions, which is directly proportional with the monitoring frequency. \

Article 63. – (1) Measurement frequencies shall be set in accordance with:
a) Minimally required sensitivity;
b) Analytical sensitivity of the measurement method that has been used;
c) Annual number analytical results per radionuclide / environment compartment combination , necessary to generate a valid set of statistical data;
d) Level of radioactive emissions.

(2) The analysis equipments and methods shall be chosen so that analytical sensitivity is better than the minimally required sensitivity.
(3) The considerations on the setting of measurement frequencies are comprised in appendix no. 9 to these norms.

Article 64. – The measurement of radioactive concentrations within environment samples consists of the quantitative identification and determination of all present radionuclides, especially critical radionuclides.

Chapter V
Environment radioactivity monitoring in case of emergency

Article 65. – (1) The provisions of this chapter apply to nuclear plants in which cases of emergency may occur that involve radioactive emissions into the environment requiring the implementation of protection measures to the exterior of the location, namely nuclear power plants and research nuclear reactors.
(2) The specific environment radioactivity monitoring conditions in case of emergency in the vicinity of other nuclear or radiological plants shall be determined by CNCAN for each plant, within the authorization process.

Article 66. – The general requirements concerning the environment radioactivity monitoring in case of emergency are shown in articles 60 – 63 of chapter V of the "Norms for the monitoring of radioactive emissions from nuclear and radiological plants", applicable both for radioactive emissions and environment radioactivity.

Article 67. – The emergency environment radioactivity monitoring program shall be designed so as to assure the fulfillment of the following specific goals:
a) Supply in due time accurate data on the level and extent of dangers resulted from a nuclear emergency and especially on the levels of radiations and radioactive contamination of the environment;
b) Assure, by its results, the compliance with the requirements of the personnel involved in the making of decisions with respect to protection and corrective actions;
c) Supply information necessary for the protection of the personnel involved in the intervention;
d) Supply information on the extent of the existing danger for the population;
e) Supply information necessary to identify the persons that shall require long term medical surveillance.

Article 68. – (1) Upon designing the emergency environment radioactivity monitoring program, the authorization applicant/holder shall consider, above all, the fact that in the first stages of a nuclear emergency, the contributions of the means of exposure to the doses received by the population may differ and be transitory, as compared with the status of the radioactive emissions in case of normal operation.
(2) In order to obtain a realistic evaluation of the doses received by the population in cases of emergency, the selected critical groups within the emergency monitoring program shall be focused on actual individuals, considering the true pattern of radioactive deposit and contamination of the environment, foodstuff, and victuals produced and used by the population from affected areas.

V.1. Preparation for emergency monitoring

Article 69. – (1) The authorization applicant/holder shall make from the preoperational stage the arrangements to promptly evaluate the radioactive contamination, emissions, and doses in the emergency planning areas, with respect to the equipments and personnel necessary for the prompt monitoring of the environment and of the contamination of persons within affected areas.
(2) Additionally, for emergency planning areas the necessary arrangements shall be made so as to monitor the radioactive contamination of vehicles, persons, and goods coming in and out of the contaminated areas, in order to control the spread of the contamination, in reference to the determination of operational criteria for monitoring results, criteria that shall indicate the adequacy of contamination or decontamination control.

Article 70. – (1) In order to quickly detect and monitor the radioactive polluting cloud, continuous automatic dose flow measurement stations shall be installed around the nuclear plant, which shall transmit the results to an emergency center.
(2) The authorization applicant/holder shall determine the locations in which the automatic station provided under paragraph (1) hereof shall also be capable of taking air samples to count the relevant radionuclide concentration and/or continuous monitoring systems for relevant radionuclides (iodine monitors, noble gas, or tritium).

Article 71. – (1) In order to clarify monitoring priorities, radioactive cloud dispersion modeling programs shall be used, based on the source term and weather conditions.
(2) Populated areas, characterized by high contamination likelihoods, shall have monitoring priority.
(3) In that view, maps of preselected sampling sites and on-site measurements shall be prepared.

Article 72. – (1) In the planning stage, the arrangements necessary for a quick evaluation of the environment radioactivity monitoring results shall be made, in order to initiate the measures to protect the personnel involved in the intervention.

(2) Such arrangements shall include the methods to interpret instrumental observations in terms of operational levels of intervention, which shall be specific for the plant, its location, and all types of possible emergencies.

V.2. Environment radioactivity monitoring during an emergency

Pre-emission stage

Article 73. – (1) In case a radioactive emission has not yet occurred, but is likely to occur, priority shall be given to gathering information on the likely composition of the material to be released and getting weather information, indicating the area to be contaminated.
(2) Upon designing the emergency environment radioactivity monitoring program, the authorization applicant/holder shall consider the need to quickly gather the following data:
a) Wind speed and direction, stability of atmospheric mixture layer, amount and geographical extension of precipitations, in case of atmospheric emissions;
b) Hydrological features of rivers and lakes, for both liquid and gaseous emissions.

Article 74. – (1) In the pre-emission stage, the environment radioactivity monitoring teams meet and travel on-site, to the locations preset in the nuclear emergency intervention plan.
(2) Depending on the expected composition of the radioactive emission, the monitoring teams shall assure, before going on-site, that the available detection tools are adequate for measurements and function normally.

Environment radioactivity monitoring during emission

Article 75. – In the initial stage of an emergency, the intervention shall be based on identifying such affected areas that are significantly contaminated (or areas where radiation levels reach or exceed the intervention levels), rather than on quantitative analyses.

Article 76. – (1) Initial measurements shall be carried out quickly, by means of simple and robust instruments, in order to immediately determine the nature of the emergency.
(2) Measurement locations shall include some of the locations predefined for such purpose, based on the locations where a maximum impact has been forecasted for accidental radioactive emissions, but they shall be decided by weather information.

Article 77. – (1) In the initial stage of a severe nuclear accident involving air contamination, quick measurements of the external gamma dose flow within the radioactive cloud and of the external gamma dose flow in the air , resulted from the deposit of radionuclides onto the ground.
(2) Such measurements shall be repeated frequently, at least once per hour in the locations where an intervention might be necessary.
(3) If possible, such measurements shall be carried out by means of a duly equipped flight device, in accordance with the provisions of article 78.
(4) If such is not possible, measurements shall be carried out from the ground by the monitoring teams equipped for such with usual bet-gamma radiation detection and measurement devices.

Article 78. – (1) If possible, or if arrangements have been made for a flight device, it shall be used during an emergency to measure the gamma dose flow in the air, take air samples for specific laboratory analyses, and/or monitor relevant radionuclides.
(2) For such the flight device shall be equipped with:
a) Gamma dose flow meters;
b) High-volume suction pumps, fitted with filters made of materials that hold relevant radionuclides and/or other special devices destined to take air samples in order to determine the content of specific radionuclides.
c) Continuous monitoring systems for relevant radionuclides (iodine, noble gas, or tritium monitors).
(3) The air samples that have been taken shall be analyzed in the laboratory as quickly as possible, in order to determine the composition and concentration of radionuclides within the radioactive cloud.

Article 79. - (1) In order to monitor deposits of radioactive materials on the ground and of resuspended radionuclides, in the case of deposits of plutonium or other actinides, air sampling systems shall be installed at ground level.
(2) The samples shall then be analyzed in the laboratory in order to determine the activity concentration of specific radionuclides.

Article 80. – (1) In order to evaluate the accidental radiation exposure of the population and to recommend food restrictions, if necessary, samples of milk, foodstuffs, water, and pasture vegetation shall be taken and measured.
(2) In the case of accidental tritium emissions, tritium measurements shall be mandatorily carried out on pasture vegetation.

(3) In the case of accidental radioactive iodine emissions, iodine measurements shall be mandatorily carried out on milk.

Environment radioactivity monitoring in the post-emission stage

Article 81. – After the end of the emission and the stabilization of radioactive deposit levels, on-site gamma-spectrometer measurements and external gamma dose flow air measurements shall be carried out, to be jointly used for the determination of deposited gamma-emitting radionuclide densities.

Article 82. – (1) The results obtained by on-site gamma spectrometry shall be complemented as quickly as possible by taking representative soil samples from the contaminated areas
(2) The results of laboratory analyses on soil samples shall be used, first of all, for the confirmation of on-site gamma spectrometry analyses, but also for the determination of suspect deposits of radioactive material that cannot be detected through field gamma spectrometry (pure alpha-emitting or beta emitting radionuclides).

V.3. Specific emergency monitoring techniques

Article 83. – In the case of an emergency, the subsequent sampling and measurement of environment specimens shall supply data on the levels, time dependence, and space distribution of radionuclides in the air, soil, plants, foodstuffs, and fodder, in order to evaluate the doses received by the critical group and to support the intervention and protection decisions.

Article 84. – (1) The emergency sampling locations shall cover the whole area in the vicinity of the nuclear plant and more remote areas.
(2) In the initial stage of an emergency, sampling and measurements shall be carried out in al directions, with preference to the main wind direction, in the case of an atmospheric emission, or downstream from the spillage point, in the case of a liquid emission.
(3) In the next emergency stages, sampling locations shall be selected based on the space distribution of air gamma dose flows.
(4) Monitoring activities shall generally be condensed in areas with the highest radioactive contamination, also considering the usage of lands.

Article 85. – (1) The environment compartments belonging to means of exposure relevant for emergency monitoring, as well as the related frequencies of sampling and measurements and the recommended locations, are stipulated in appendix no. 10 to these norms.
(2) From that generic table, the compartments specific for relevant means of exposure shall be chosen, as set based on relevant radionuclides, local weather conditions, and the level of accidental radioactive emissions.
(3) A guide of sampling and measurement methods for the determination of various significant sizes in terms of emergency environment radioactivity monitoring are rendered in appendix no. 4 to these norms.

Chapter VI.
Environment radioactivity monitoring in cases of chronic radiation exposure

Article 86. – (1) The provision of this chapter are specific environment radioactivity monitoring requirements in cases of chronic radiation exposure, in areas contaminated with long-lived radionuclides that include:
a) Outer areas of closed nuclear or radiological plants, characterized by high levels of natural radionuclides from the series of uranium and thorium;
b) Outer areas of closed nuclear or radiological plants, contaminated with artificial radionuclides (Cs-137, Sr-90, Plutonium, etc.) due to accidents and/or past radioactive emissions.

(2) The provisions of this chapter apply together with the requirements stipulated in the other applicable chapters of these norms.
(3) The responsibility to monitor environment radioactivity in the cases shown under paragraph (1) hereof belongs to the authorization holder.

Article 87. – The environment radioactivity monitoring program in areas contaminated with long-lived radionuclides shall be designed so as to respond to the following specific goals:
a) Check the radiological status of the areas, in order to compare them with radiological criteria and to identify areas that require detailed monitoring;
b) Identify areas where the application of corrective actions is justified radiologically;
c) Supply information necessary to estimate actual or forecasted doses for the members of the critical group and wider groups of population;
d) Detection of changes and evaluation of long term trends as regards the levels of environment radioactivity, as a result of natural processes and human activities, including the intervention;

Supply information to the public.

Article 88. – (1) The environment radioactivity monitoring program in areas suspected to be contaminated with long-lived radionuclides shall be structured in two stages:
a) Initial, quick monitoring, destined to determine the need to implement area repair actions;
b) In case the results of the initial monitoring show that area repair actions are required, a detailed monitoring of the contaminated area shall be carried out.
(2) The full monitoring program shall be unfolded both during and after the implementation of the corrective actions, in order to assess the effectiveness of the taken actions.
(3) Considering that the environment presence of long-lived radionuclides makes the rapid modification of the environment activity in the area unlikely, environment radioactivity monitoring in such areas shall have a low frequency (annual or once every few years).
(4) The environment radioactivity monitoring program in areas contaminated with long-lived radionuclides shall focus on the following critical means of exposure:
a) External exposure due to long-lived radionuclides deposited onto the soil;
b) Ingestion of foodstuffs contaminated by radicular absorption;
c) Inhalation of radon or contaminated soil particles in wind suspension, in case of contamination with alpha-transmitters.

Article 89. – A guide of the methods to take and measure samples in order to determine various sizes significant in terms of the environment radioactivity monitoring in areas contaminated with long-lived radionuclides are shown in appendix no. 4 to these norms.

Article 90. – The support programs for area contaminated with long-lived radionuclides shall be focused on the description of the terrestrial environment and the population, by monitoring:
a) Local circuit of water (precipitations and evaporation, local surface and in-depth waters and links between them, affluents and effluents of main rivers);
b) Soil features;
c) Population features and distribution, as well as its habits and especially consumption rates of local foodstuffs;
d) Agricultural and gardening habits;
e) Water usage, locally and upstream;
f) Features of ethnical and cultural minorities, as compared to the local population, accordingly.

VI.1. Monitoring of external exposure in areas contaminated with long-lived radionuclides

Article 91. – (1) The monitoring of human exposure to external radiation sources shall be carried out by measuring external gamma dose flows in the air, in locations accessible to the public.
(2) In order to evaluate the contribution of area radioactive contamination within the effective dose, the background dose flow shall be estimated and afterwards subtracted from the measured values.
(3) For evenly contaminated areas, the measured values of the dose flow shall be mediated for the entire monitored area.

Article 92. – (1) For the initial monitoring of areas characterized by an extensive environment contamination, external gamma dose flows in the air shall be measured above the undisturbed (uncultivated) soil.
(2) For a detailed monitoring of external radiation fields in inhabited areas, external gamma dose flows in the air shall be measured in typical areas accessible to the public (homes, public buildings, production areas, parks, gardens, beaches, and other leisure areas).

Article 93. – In areas significantly contaminated with radionuclides, the external exposure of critical groups may also be measured by means of individual dose meters fro gamma radiations, born by members of the critical group during several days of weeks.

VI.2. Monitoring of internal exposure in areas contaminated with long-lived radionuclides

Article 94. – (1) The monitoring of human exposure to internal radiation sources shall consist of measuring activity concentrations of radionuclides from environment samples, drinkable water and foodstuffs, as sampled from the compartments of critical means of internal exposure.
(2) Due to the complexity of the migration of radionuclides into the environment, the various possible means of exposure shall be investigated in the initial area stage.

Article 95. – In inhabited areas contaminated with radium or plutonium or other actinides, air samples shall be taken and measured on a regular basis in order to determine the radiation dose due to the inhalation of radionuclides.

Article 96. – (1) The accumulation of radionuclides into the soil and sediments shall also be monitored on a regular basis, in order to estimate the concentrations of radionuclides within plants, animals, and, above all, foodstuffs.

(2) In case of radioactive contamination of extended areas with the radioisotopes of mobile chemical elements (cesium, strontium, radium, and uranium), samples of drinkable water and all major groups of foodstuffs – vegetal products, animal products, natural foodstuffs (fish, game, mushrooms, berries, etc.) – shall be taken and measured on a regular basis.
(3) A special concern shall be given to foodstuffs consumed by the population in large amounts and to those with high concentrations of radionuclides.
(4) In rural areas, samples of local origin foodstuffs shall be taken, especially; in the cities, samples of foodstuffs shall be taken from marketplaces, shops, and public houses.

Article 97. - In areas with sandy or organic soil (e.g., forest soils), the monitoring program shall be determined considering that the transfer of radionuclides from soil to plants and animals is significant, which should lead to an increased internal exposure of the local population.

Article 98. – In order to determine the loading of the human body and evaluate doses due to the internal exposure of critical groups in areas significantly contaminated with radionuclides or in those characterized by a quick transfer of radionuclides from the soil to plants and animals, the technique of measuring the whole body may also be applied.

Chapter VII
Results of the environment activity monitoring program

Article 99. – The authorization holder shall present the results of the environment radioactivity monitoring program in terms of:
a) radiation levels and radionuclide concentrations within the environment;
b) dose received by individuals within critical groups or by the population, under normal operation;
c) forecast dose for individuals within critical groups, in emergency cases.

Article 100. - (1) Under normal operating conditions, the results of the environment radioactivity monitoring program shall be used to check the compliance with CNCAN-imposed dose constraints.
(2) In cases of emergency, the data supplied by the environment radioactivity monitoring program shall be used as input data in the decision-making process concerning protection and corrective actions, by comparison with:
a) generic and/or specific action levels for the radionuclide concentrations with the environment or foodstuffs;
b) generic and/or specific action levels for the dose received by individuals within the critical group.
(3) In case of the population's extensive exposure to radiations, the results of the environment radioactivity monitoring program shall be sued to justify the corrective actions and long term countermeasures, after comparing them with:
a) generic or specific action levels for concentrations of radionuclides in the environment ;
b) generic or specific action levels for the dose received by individuals within the critical group.

Article 101. – (1) The monitoring of environment radioactivity can also be used as a method of checking independently the functioning of a nuclear or radiological plant and especially of detecting any radioactive emission, means of emission, or increases of the levels of unplanned radiations.
(2) The interpretation of such variations shall require the comparison of detected radioactive levels with historic levels or with results of measurements carried out in the wind's direction of upstream the spilling site for liquid effluents (or in other reference sites), in order to determine whether such plant is the cause of the detected variations.
(3) Additionally, for a quick measurement of the variations from normal conditions, the results of measurements on radionuclides concentrations from indicator samples shall be used.

Article 102. – The requirements for the accurate interpretation of the environment radioactivity monitoring program results are the same as the requirements for the interpretation of the radioactive emission monitoring program results, as stipulated in articles 72 – 75 of the Norms for the monitoring of radioactive emissions from nuclear and radiological plants.

Chapter VIII
Environment radioactivity monitoring quality management

Article 103. – The requirements for the quality management in the field of environment radioactivity monitoring are the same as in the field of radioactive emission monitoring, as stipulated in articles 76 – 81 of chapter VII of the Norms for the monitoring of radioactive emissions from nuclear and radiological plants.

Chapter IX
Reporting of the environment radioactivity monitoring program results

IX.1. Recording of monitoring program results

Article 104. – (1) In order to prove by documents the levels of radiation exposure and radionuclide concentrations in the environment in the vicinity of the plant, the authorization holder shall ensure the recording of environment radioactivity monitoring data.
(2) For such purpose, the authorization holder shall design a record safeguarding system that would allow the retention of all relevant information concerning individual sampling, measurements, and related uncertainties, as well as all summery periodical reports.

Article 105. – Other requirements concerning the recording of the environment radioactivity monitoring program results are shown in articles 83 and 84 in chapter VIII of the "Norms for the monitoring of radioactive emissions from nuclear and radiological plants", applicable both for the monitoring of radioactive emissions and for the monitoring of environment radioactivity.

IX.2. Summary periodical reports

Article 106. – (1) The provisions of this section only apply to nuclear power plants.
(2) The authorization holder shall draft, on a quarterly basis, summary environment radioactivity monitoring reports to be forwarded to CNCAN in the quarter to follow the reporting quarter.
(3) Summary reports shall comprise the environment radioactivity monitoring program results, shown in such a form as to allow the comparison with usual levels detected in environment factors.
(4) The reports shall also comprise the interpretation of results and explanation of their significance, in the case of values that show significant variations from the usual values.

IX.3. Detailed annual reports

Article 107. – (1) The authorization holder shall draft and forward to CNCAN, on an annual basis, a detailed environment radioactivity monitoring report, to contain:
a) brief description of the environment radioactivity monitoring report;
b) results of environment radioactivity monitoring, shown in terms of radiation levels and concentrations of radionuclides in the environment, as well as doses received by critical groups, for both the preceding year and all the past years in which the plant was operational;
c) other relevant information concerning environment radioactivity in the vicinity of the plant.
(2) The annual detailed environment radioactivity monitoring report shall be forwarded to CNCAN in the first quarter of the year to follow the reporting year.

IX.4. Notifications

Article 108. – (1) The authorization holder shall immediately notify to CNCAN of any significant increase of the levels of radiation fields or radioactive concentrations in the environment.
(2) Within 30 days from the detection and validation of measurement results, the authorization holder shall draft and forward to CNCAN a preliminary report to include, besides the detected radioactive levels, a description of the carried on investigations, investigation results, taken actions, and futures actions.

Chapter X.
Check carried out by the regulatory body

Article 109. – (1) The authorization holder shall provide CNCAN inspectors with the necessary documents for them to check the compliance with the requirements of these norms.
(2) The authorization holder shall provide CNCAN inspectors with the documents proving the accuracy of the environment radioactivity monitoring program results.
(3) Upon CNCAN's request, the authorization holder shall suitably modify its programs for routine, emergency, and quality management monitoring, following independent periodical revisions or inspections carried out by CNCAN.
(4) Upon CNCAN's request, the authorization holder shall provide CNCAN inspectors the possibility to check monitoring data supplied by the holder in the reports it drafted.

Article 110. – The authorization holder shall prove the fulfillment of the necessary capacity to monitor environment radioactivity in case of emergency by supplying to CNCAN inspectors the documents to certify the accurate implementation of the emergency response preparation activity.

Article 111. – In the case of nuclear or radiological plants that may have a significant environmental impact, as well as in case there are several nuclear or radiological plants with a radiological impact on the same area or population groups, CNCAN may deploy its own environment radioactivity monitoring program in the vicinity thereof, in order to

check the truthfulness of the results supplied by the authorization holders and to confirm the maintenance or the public's exposure to radiations below the dose constraints set by CNCAN.

Chapter XI
Transitory and final provisions

Article 112. – The provisions of these norms no not exclude the compliance of authorization holders with any other requirements stipulated by specific regulations in force.

Article 113. - These norms come into force upon their publication in Monitorul Oficial al României.

Article 114. - The holders of authorizations valid at the effective date of these norms shall meet the provisions thereof within no longer than 12 months after their effective date.

Article 115. - Appendices no. 1 - 10 are an integral part of these norms.

Definitions

- **Severe nuclear accident**. – deviation from normal operation, more severe than a basic project accident and involving a serious degradation of the reactor core*.*
- **Global activity.** – total response of a detection system to the measurement of an unknown mixture of radionuclides.
- **Minimally detectable activity**. – radioactivity which, if present in a sample, produces a counting rate that is detected (i.e., considered above the background) with a certain confidence level (usually, 95%).
- **Arrangement.** – integrated set of infrastructure elements necessary to assure the capacity to fulfill specific functions or tasks, such as: authorities and responsibilities, organization, coordination, personnel, planning, procedures, units, equipments, training.
- **Critical (significant) means of exposure.** – course taken into the environment by radionuclides and/or radiations, from the emission source to humans, on which the highest radiation exposure of an average member of the critical group is most likely to happen.
- **CNCAN.** – National Commission for Nuclear Activities Control.
- **Activity concentration.** – activity per weight unit of one radionuclide or activity per weight or volume unit of a material in which radionuclides are distributed evenly.
- **Countermeasure.** – action meant to reduce the radiological consequences of an accident; forms of accident intervention, countermeasures may be protection actions (measures) or repair actions (measures).
- **Radioactive effluents.** – radioactive substances resulted from a source following a practice, which are released into the environment under the form of gas, aerosols, liquids, or solids, generally in view of dilution or dispersion.
- **Release of radionuclides into the environment.** – planned and controlled emission of gaseous or liquid radioactive materials into de environment, as a legitimate practice, within the limits authorized by CNCAN, following the normal operation of authorized nuclear or radiological plants.
- **Eutrophization.** – accelerated development of algae and superior vegetal species, caused by the enrichment of water with nutritive elements, mostly compounds of nitrogen and/or phosphorus, that may result in disturbances of the balance of present organisms, as well as of water quality.
- **(Measurement) accuracy.** – degree of conformity between the result of a measurement and a true value of the measurand.
- **Critical group.** – group of population members, reasonably homogenous as regards its exposure to given radiation source and exposure mean, the individuals of which receive from a given source the highest effective dose or an equivalent dose, if applicable, by the given means of exposure.
- **(Measurement) uncertainty.** – parameter associated with the result of a measurement (e.g., a standard error) that characterizes the distribution of values which reasonably might be assigned to the measurand.
- **Measurement interval.** – module of the difference between the two limits of a nominal domain (or domain of indications that may be obtained within a given configuration of a measurement mean orders).
- **Indicator locations.** – monitoring sites located outside the facilities of the nuclear or radiological plant, in areas where the population's most significant exposure (either directly or indirectly) to radiations takes place.
- **Control locations.** – monitoring sites used together with indicator locations in order to determine the dilution factor, as a function of the distance to the emission source.

- **Background locations.** - monitoring sites located outside the facilities of the nuclear or radiological plant, used to determine the level of natural radiation background.

- **Pattern.** – analytical representation or quantification of an actual system and of the means by which phenomena within such system take place, used to forecast or evaluate the system's behavior in certain specified (often hypothetical) conditions.

- **Monitoring.** – measurement of the radiation dose or radioactive contamination in order to evaluate or check the exposure to radiations or radioactive substances, as well as interpretation of measurement results.

- **Monitoring of radioactive emissions.** – monitoring at the emission source of radioactive effluents, consisting of the measurement of the activity of the radioactive materials to be released into the environment or of the external dose flows due to radiation sources within the nuclear or radiological plant.

- **Monitoring of environment radioactivity.** – monitoring of radioactive effluents in receiving environments, consisting of the environment measurement of dose flows due to radiation sources or of radionuclide concentrations within environment compartments.

- **Routine monitoring.** – regular monitoring of radioactive effluents, under normal operating conditions of a nuclear or radiological plant, in order to prove that working conditions, including individual dose levels, are satisfactory and regulatory conditions are fulfilled.

- **Emergency monitoring. –** special type of monitoring (designed for the investigation of a special situation in which there isn't enough data to prove an adequate check, by supplying detailed information necessary to clarify any problem and elaborate future procedures), carried out following a nuclear or radiological accident.

- **Action level.** – level of the dose flow or activity concentration beyond which repair or protection actions need to be taken, in cases of chronic exposure to radiations or in cases of nuclear or radiological emergency.

- **Intervention level.** – level of the avoidable dose at which a certain protection or repair action is taken, in cases of chronic exposure to radiations or in cases of nuclear or radiological emergency; operational intervention level means a value calculated for the sizes measurable by means of instruments or determinable by laboratory analyses, corresponding to an intervention level or to an action level.

- **Confidence level**. **–** likelihood to cover a confidence interval (defining, around the measurement result, an interval comprising a certain fraction of the likelihood distribution).

- **Normal operation (functioning)**. – operation of a nuclear or radiological plant within the operational limits and conditions specified in the design.

- **Abnormal operation (functioning).** – operational process deviated from the normal operation of a nuclear or radiological plant, which is expected to occur at least once during the plant's lifetime under exploitation and which, considering the provisions of the design, does not significantly effect nuclear safety issues or does not lead to a nuclear accident.

- **Benthonic organism.** – Organism living at the bottom of waters.

- **Critical radionuclide.** – radionuclide which, released into the environment, leads to the highest radiation dose for a critical group.

- **Source term.** – amount and isotopic composition of the released material (or postulated to be released) of a nuclear or radiological plant; term used in the modeling of radionuclide emission into the environment, mostly in the context of accidents within nuclear or radiological plants or of emissions from radioactive waste final depositories.

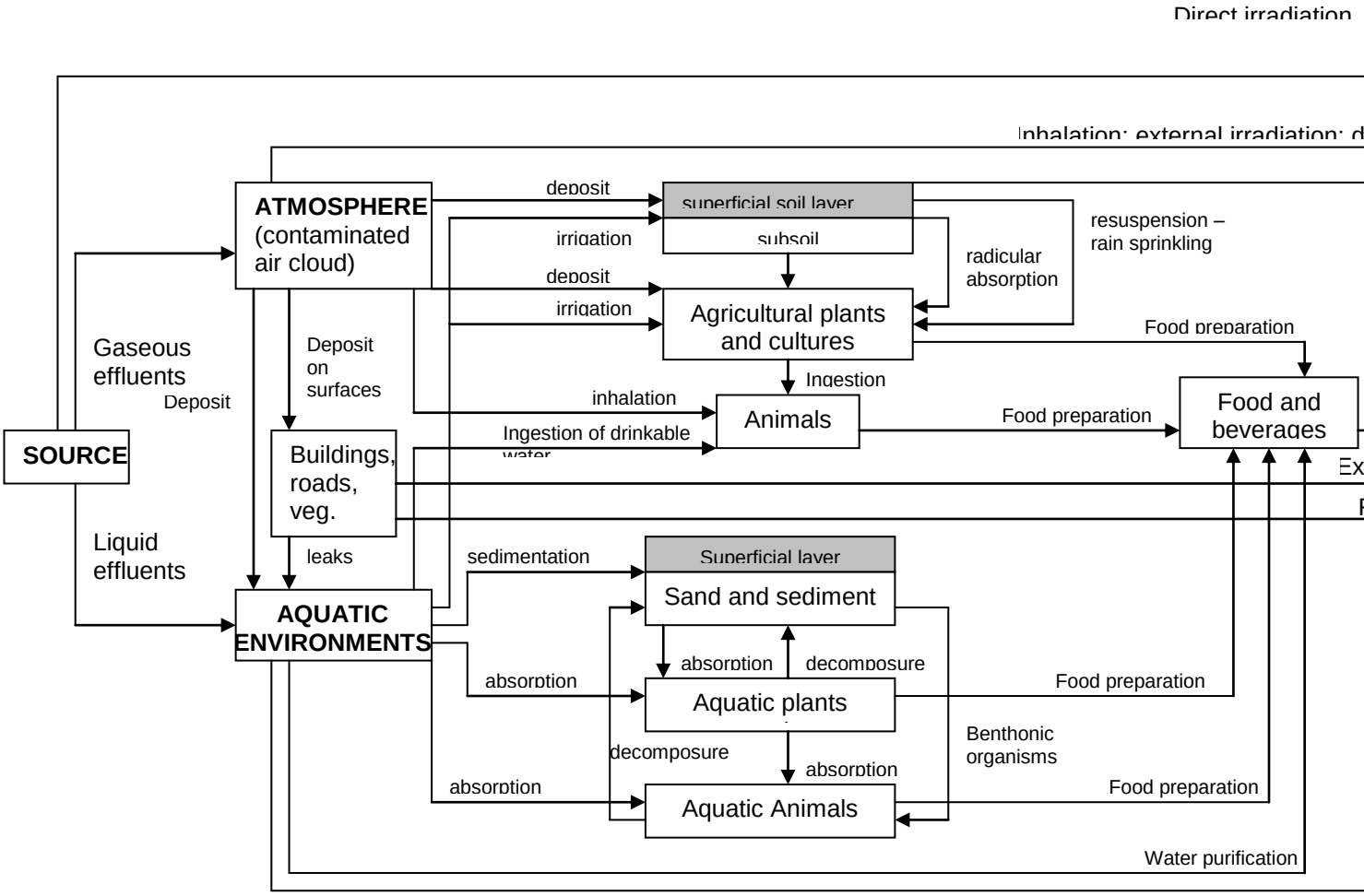
- **(Radioactive) half-life.** – timeframe in which the activity of a radionuclide decreases, through radioactive disintegration, by half.

- **Nuclear or radiological emergency.** – such emergency (unusual situation or event that requires prompt actions to reduce dangers and negative consequences on human health and safety, life quality, property, or the environment) in which there is (or is perceived to be) a danger due to the energy resulted from a

chain nuclear reaction or from the disintegration of the products of a chain reaction or due to radiation exposure.

APPENDIX No.2
to the norms

Potential means of population exposure to radiations, following spills of radioactive materials into the environment



Appendix no.3
to the Norms

Sampling and measurement frequencies for environment compartments located along the monitored means of exposure, under the normal operating conditions of a nuclear or radiological plant

Environment compartment/ means of exposure		**Sampling / measurement frequency**
A. Gaseous radioactive emissions		
External irradiation	Gamma dose flow	Continuously
	Integrated gamma dose	Twice per year
	Neutron dose flow	Continuously
	Integrated neutron dose	Twice per year
Air, deposit	Air	Continuous sampling, weekly or monthly measurement
	Rain	Continuous sampling, monthly measurement
	Deposit	Continuous sampling, monthly measurement
	Soil	Annually
Foodstuffs, ingestion	Vegetables with edible leaves	Monthly, in the cropping period
	Other fruits and vegetables	Certain selected samples, upon cropping
	Grains	Certain selected samples, upon cropping
	Milk	Monthly, in the grazing period
	Meat	Certain selected samples, biannually
	Drinkable water and/or depth water	Twice per year
Terrestrial bioindicators	Grass	Monthly, in the grazing period
	Lichens, moss, fungus	Certain selected samples, annually
B. Liquid radioactive emissions		
Aquatic dispersion	Surface water	Daily sampling, correlated with the spill, monthly measurement
	Sediment	Annual
Aquatic foodstuffs	Fish	Certain selected samples, annually
	Mollusks (with shell)	Certain selected samples, annually
Aquatic bioindicators	Algae, sea sponges	Certain selected samples, biannually
	Benthonic organisms	Certain selected samples, biannually

Appendix no.4
to the Norms

Measured sizes, sampling and measurement types, applications

Measured size	**Sampling and measurement type**	**Applications**
Gamma dose flow above the soil	On-site measurements (with fixed or mobile devices)	Normal operation Emergency Chronic exposure
Radioactivity of aerosols in the air	Sampling on filters, spectrometry analyses	Normal operation Emergency Chronic exposure
Radioactive iodine in the air	Sampling specific for the physical/chemical form of radioisotopes, spectrometry analyses	Normal operation Emergency
Radioactivity in precipitations	Sampling in the precipitation collector, spectrometry analyses	Normal operation Emergency

Radioactivity deposited on surfaces	On-site gamma-spectrometry or sampling through the of wiping a surface and spectrometry analyses	Normal operation Emergency
Radioactivity in the soil	On-site gamma-spectrometry or on-site sampling and spectrometry analyses	Normal operation Emergency Chronic exposure
Radioactivity in foodstuffs and fodders, waters, and sediments	On-site sampling, spectrometry analyses	Normal operation Emergency Chronic exposure

Appendix no. 5
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Combinations of radionuclide / environment compartment related to critical radionuclides and possible critical exposure means for a nuclear power plant with CANDU reactors

mission pe (1)	**Critical radionuclide** (2)	**Possible critical exposure means** (3)	**Representative radionuclide** (4)	**Representative environment compartment** (5)
mospheri emission	Tritium water vapors	Inhalation and skip absorption	H-3	Air
		Absorption within plants → ingestion of vegetables and fruits, dairy products, beef chicken, etc.		Edible parts of most common vegetables and fruits cultivated for consumption; milk, meat
	Noble gas	External irradiation from the immersion into the radioactive cloud	Ar-41, Xe, Kr	Air (external gamma dose flow)
	Iodine-131	Deposit on pastures → ingestion of milk	I-131	Milk
		Inhalation		Air
	Radioactive particles	Deposit on fruit, vegetables / pastures → ingestion of vegetables, fruits / milk, beef	Cs-134, Cs-137, Co-60, Zr-95, Nb-95	Dry and wet deposit
		Inhalation		Air
		External irradiation from soil deposit		Soil (external gamma dose flow)
	Gaseous Carbon-14 (CO_2)	Absorption within plants → ingestion of vegetables, fruits, milk, etc.	C-14	Products with maximum carbon content in edible parts
		Inhalation		Air
mospheri emission	Gaseous Carbon-14 (CO_2)	External skin irradiation from immersion in the radioactive cloud	C-14	Air (external beta dose flow)
quid nission	Tritium water	Ingestion of drinkable water	H-3	Drinkable water
		Fish absorption → fish ingestion		Fish water

		Field irrigation → ingestion of agricultural and animal products		Edible parts of most common vegetables and fruits cultivated for consumption; milk, meat
	Suspension and dissolved radionuclides, other than tritium	Fish absorption → fish ingestion	C-14, Cs-134, Cs-137, Co-60, Zr-95, Nb-95	Edible fish meat
		External irradiation from coast deposits or dragged sediments		Beach sands (external gamma dose flow)

Method for the selection of indicator locations for direct exposure due to gaseous emission (external and inhalation) from a nuclear power plant

In order to select indicator locations, the area around the plant shall be divided into 16 angular sectors of 22,5 degrees each, matching the sectors of the wind rose, and circular rings with inner radiuses of 2, 5, 10, 15, 20, and 25 km and outer radiuses of 5, 10, 15, 20, 25, and 30 km, respectively.

Each sector shall be characterized by two factors: wind frequency in that sector and number of residents of that sector.

Likelihood B_i that sector "i" should lie in the wind direction is given by:

$$B_i = \frac{K_i}{\sum K_i}$$

where K_i is the wind frequency in sector "i" (the case of stillness is not considered).

The significance of the number of persons residing in sector "i" is rendered by the ponderate factor:

$$P_i = \frac{1}{N_p} \cdot \frac{\sum_j n_{ij} / r_j}{\sum_j 1 / r_j}$$

where: n_{ij} is the number of residents in circular ring "j" of sector "i"
r_j is the inner radius of circular ring "j"
N_p is the regulatory factor, equal to:

$$N_p = \sum_i \frac{\sum_j n_{ij} / r_j}{\sum_j 1 / r_j}$$

Hence, the value W_i of a sector shall be rendered by:

$$W_i = \frac{P_i \cdot B_i}{\sum_i P_i \cdot B_i}$$

The selection of indicator locations shall be made so that the sum of values in the sectors where locations have been chosen should be at least 70%:

$$\sum_i W_i \geq 0{,}7$$

Method for the determination of the average dilution factor

Atmospheric dispersion at distances beyond several kilometers is described by the following equation, (1):

$$X_i(r) = \frac{C}{r^a}$$

where X_i (r) is the average concentration of r km from the source in sector "i" (3 km < r < 20 km),
C is a constant,
a is a constant with a value range between 1 and 2.

Control locations, jointly with indicator locations, are used to determine the value of a. By applying equation (1) for the indicator location, equation (2) shall result:

$$X_i(r_1) = \frac{C}{(r_1)^a}$$

where r_1 is the distance from the indicator location to the source,
X_i (r_1) is the concentration of radioactive material measured in the indicator location.

By applying equation (1) for the control location, equation (3) shall result:

$$X_i(r_2) = \frac{C}{(r_2)^a}$$

where r_2 is the distance from the control location to the source,
X_i (r_2) is the concentration of radioactive material measured in the control location.

By dividing equation (2) to equation (3), equation (4) shall result:

$$\frac{X_i(r_1)}{X_i(r_2)} = \frac{r_2^a}{r_1^a} = \left(\frac{r_2}{r_1}\right)^a$$

Resulting that constant a can be determined, according to (5):

By substituting the value of a in one of equations (2) or (3), constant C may be determined.

$$a = \frac{\ln\left(\frac{X_i(r_1)}{X_i(r_2)}\right)}{\ln\left(\frac{r_2}{r_1}\right)} = \frac{\ln X_i(r_1) - \ln X_i(r_2)}{\ln(r_2) - \ln(r_1)}$$

Thus, for any monitoring period or average of several monitoring periods, the value corresponding to constants a and C may be determined. Then, using equation (1), the average concentration of radioactive material X_i (r) can be calculated for any distance r, when 3 km < r < 20 km, in any sector "i".

Knowing the average concentration of radioactive material for distance r, X_i (r), and the total activity of radioactive material released by the source (or the activity of the source), X_0, the average dilution factor may be determined as the ratio between the concentration of radioactive material in the receiving point (located at distance r from the source) and the total activity released at the source:

$$\chi = \frac{X_i(r)}{X_0}$$

Calculation of sampling frequency

Sampling frequency (f) is inversely proportional to the average lifetime (T_m) of a representative radionuclide in a means of exposure:

$$f / an = 1 / T_m$$

where T_m is expressed in years.

The average lifetime depends on the average residence time (T_p) of the radionuclide in the vicinity of the sample (or near the monitoring site) and on the radionuclide's average radiological lifetime (T_r), as follows:

$$T_m = \frac{T_r \cdot T_p}{T_r + T_p}$$

The radionuclide's average radiological lifetime is linked to the half-life ($T_{1/2}$) by the ratio:

$$T_r = \frac{T_{1/2}}{0{,}693}$$

The average residence time of the radionuclide in the vicinity of the sample depends on the mobility of the sampled environment and on the physical and chemical features of the radionuclide. The values shown in table 1 shall be used for calculation.

With the given T_p values, T_m values can be calculated and thus the sampling frequencies. The sampling frequencies for the selected combinations radionuclide / environment compartment are shown in table 2. Cesium-134 may be selected as representative for the emission category "air particles" and "dissolved and solid particles, others than H-3 and C-14", because the having times of the other radionuclides in this category do not significantly modify the average lifetime T_m, so the sampling frequency shall be the same.

Table 1

Recommended values for average residence time (T_p)

Environment		**Average residence time in environment (T_p)**
Air		Minutes – hours
Water	Drinkable water	~ one day
	Gross water (lakes)	~ one day
	Gross water (rivers)	Minutes – hours
	Surface leaks	2 – 4 weeks
	In-depth water	Years
Plants (vegetables / fruit)		Growth season ~ 3 months
Foodstuffs	Beef	~ 2 years
	Milk	~ 5 days
	Eggs	~ 8 days
	Chicken	~ 40 days
	Fish	~ 2 years *

Soils	Surface deposit	2 – 4 weeks
	Superficial soil layer	~ 2 months
	Sand	~ 2 months

(*) fish grown in fishery farms has an average lifetime of ~ 2 – 3 months.

Notes:

1. Radionuclides released into the air quickly reach monitoring sites, where they stay for an even shorter period. To monitor air, T_p shall be expressed in hours. For radionuclides with $T_r >> T_p$ it results that $T_m = T_p$, which means a sampling frequency of a few hours. For such a large frequency, continuous sampling systems shall be considered.
2. Additionally, in the case of drinkable water T_p is short, of one or two days, depending on the distance from the water treatment plant and on its storage capacity. To monitor tritium, the case of $T_r >> T_p$, shall also result in $T_m = T_p$, which shall require a daily sampling frequency.
3. Some environment compartments have considerably larger half-lives, as is the case of vegetation, for instance, which has a T_p of 2-3 months. For long-lived radionuclides, $T_r >> T_p$ and the sampling period shall be of ~ 2 – 3 months. However, except for greenhouse products, the growth season occurs once per year and therefore it is suitable to take samples annually, in the growth period. For greenhouses producing more than one crop per year, the recommended sampling frequency is the production frequency.
4. As regards fish, what is interesting is Cs-134, which is present in the environment only due to the operation of a nuclear reactor and has a $T_{1/2}$ of ~ 2 years. Except for migrating fish, fish reside in the vicinity of the plant between 2 and 5 years, depending on the species. Supposing that T_p = 2 years, it results a fish sampling frequency for annual Cs-134 detection.

Table 2

Environment sampling frequencies in the vicinity of a nuclear power plant with CANDU-type reactors

Radionuclide	Half-life ($T_{1/2}$)	Sampling environment	Average resistance time (T_p)	Average lifetime
Tritium (H-3)	12,3 years	Air	Minutes	Minutes
		Vegetables / fruit	3 months	3 months
		Milk	5 days	5 days
		Drinkable water	1 day	1 day
		Gross water	1 day	1 day
Noble gas	Days	Air	Minutes	Minutes
Iodine-131	8 days	Milk	5 days	4 days
		Air	Minutes	Minutes
Cesium-134	2 years	Milk	5 days	5 days
		Air	Minutes	Minutes
		Surface deposit	2 –4 weeks	4 weeks
		Superficial soil layer	2 months	2 months
		Drinkable water	1 day	1 day
		Fish	2 years	1 year
		Beach sand	2 months	2 months
Carbon-14	5730 years	Milk	5 days	5 days
		Vegetables / fruit	3 months	3 months
		Air	Minutes	Minutes
		Fish	2 years	2 years
		Drinkable water	1 day	1 day

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Considerations on the setting of environment sample measurement frequencies

The measurement frequency is determined by the following:
- Minimal required sensitivity;
- Analytical sensitivity of the laboratory that carries on the analyses;
- Number of annual results per radionuclide / exposure means combination, needed to generate a valid set of statistic data.

The ration of the first two parameters is called sensitivity factor and is rendered by:

$$K = \text{minimal required sensitivity / analytical sensitivity}$$

The value of K shall be higher or equal to 1. Otherwise, a more sensitive analytical method needs to be selected. The number of samples (N) that may be composed to generate an analytical result is rendered by:

$$N = [T_p / (T_p - T_m)] (\ln K), \text{ for } K > 1 \text{ and } T_p \neq T_m$$

where T_p = average residence time of the radionuclide in the vicinity of the sample
T_m = average lifetime of a radionuclide in a means of exposure

For K = 1, in which case the analytical capacity meets the minimum sensitivity requirement, the number of samples that may be composed is null and the measurement frequency corresponds to the sampling frequency.

In case $T_p = T_m$, the above formula cannot be applied, yet if $T_p = T_m$ then the radiological lifetime of the radionuclide $T_r >> T_p$ and $T_r >> T_m$. This means the sample loss by radioactive disintegration may not be considered for several monitoring periods. In this case, the third parameter, the number of analytical results generated in one year that leads to a valid set of statistic data shall determine the number of samples that can be cumulated and, therefore, the frequency of measurements.

An example in this case is the determination of tritium content from drinkable water. Drinkable water is sampled daily, which leads to 365 samples that need to be analyzed. In this case, $T_p = T_m$ = 1 day and $T_r >> T_p$. The number of analytical results shall depend on the measurement uncertainty, but, as a statistic rule, it has to be higher than, or equal to, 30 (most statistic tests require at least 30 data). Therefore, the maximum number of analytical results is 30 per year, whence the maximum number of water samples that can be cumulated is 12. Consequently, a convenient measurement frequency for drinkable water samples is weekly (weekly measurement of samples consisting of 7 daily samples).

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Sampling and measurement locations and frequencies for environment compartments belonging to exposure means monitored in cases of emergency

Monitored exposure means/environment compartment		**Frequencies**	**Locations**
A. Atmospheric radioactive emissions			
Measurements carried out during the passage of the radioactive cloud			
External irradiation	Gamma dose flow	Continuously	In the vicinity and further on site, flow meter mapping
	Neutron dose flow	Continuously	Only in the vicinity, if neutron emissions are forecasted
Air	Air	Continuous collection, measurement every 2 h	In the vicinity and further on site
	Precipitations	Continuous collection, measurement every 2 h	In the vicinity and further on site

Measurements carried out after the passage of the radioactive cloud			*In contaminated areas*
External irradiation	Gamma dose flow	Continuously	External flow meter mapping
Deposit	Sol	One single time	Mapping of contamination with relevant radionuclides
Foodstuffs / ingestion	Leaved vegetables	Daily	Suitable indicator for vegetal products
	Milk	Daily	Suitable indicator for animal products
	Other fruit and vegetables	Upon cropping	
	Grains	Upon cropping	
	Meat	Representative samples	
	Drinkable and in-depth water	Representative samples	
Terrestrial bio-indicators	Grass	Daily	
	Lichens, moss, fungus	In the growth period	

B. Liquid radioactive emissions			
Measurements carried out after emissions stopped			*Affected areas and waters are limited*
Aquatic dispersion	Surface water	Continuous sampling, daily measurement	
	Sediments	Weekly	
Aquatic foodstuffs	Fish	Selected samples	
	Mollusks	Selected samples	
Aquatic bio-indicators	Algae	Selected samples	