# Order no. 276/2005

*of 26/09/2005*
*Published in the Romanian Official Bulletin, Part I no. 923 of 17/10/2005*

approving the *Norms for the monitoring of radioactive emissions from nuclear and radiological facilities*

*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 radioactive emissions from nuclear and radiological facilities*, provided in the annex which is integralpart 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. 276.

**ANNEX**

# Norms for the monitoring of radioactive emissions from nuclear and radiological facilities

## Chapter I
## Scope, Application

**Article 1. -** (1) These norms set the requirements for monitoring at the emission source of radioactive effluents resulted from an authorized nuclear activity, under normal operation and in cases of nuclear or radiological emergency, in accordance with Law no. 111/1996 on the safe deployment of nuclear activities, republished, with subsequent modifications and completions, and on the Fundamental Norms on Radiological Safety approved by Order no. 14/2000 of the President of the National Commission for Nuclear Activities Control.

(2) These norms apply to nuclear power plants, nuclear research reactors, nuclear fuel production and reprocessing plants, units for the mining, preparation, and processing of uranium and thorium ores, intermediate and final repositories for nuclear spent fuel, intermediate and final repositories for radioactive waste, as well as all radiological facilities using unsealed radioactive sources.

(3) These norms apply also to certain radiological facilities using sealed radioactive sources, in accordance with the provisions of specific norms and/or authorization requirements.

**Article 2.** – (1) For all nuclear or radiological facilities stipulated under article 1, paragraph (2), the authorization applicant/holder shall determine from the design stage the possibility of any radiological impact of the plant in its vicinity, with special reference to:

a) human exposure ways to radiation, including food chains;

b) radiological impact on local ecosystems;

c) potential accumulation of radioactive materials in the environment;

d) Possibility of existence of other unauthorized emission ways of radionuclides into the atmosphere.

(2) Depending on the results of the preliminary evaluation of the radiological impact, the National Commission for Nuclear Activities Control, hereinafter referred as CNCAN, may ask within the authorization process that the authorization applicant/holder assure, besides the monitoring of radioactive emissions also the monitoring of the environmental radioactivity in the vicinity of the facility.

(3) The specific requirements for the monitoring of environmental radioactivity in the vicinity of the nuclear or radiological facility which release radionuclides into the environment are presented in the Norms for monitoring environmental radioactivity in the vicinity of a nuclear or radiological facility, approved by Order no. 275/2005 of the CNCAN President.

**Article 3.** – (1) The general requirements on the limitation of doses for nuclear practices, dose estimation, operational radiation protection of professionally 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 in 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 facility, schedule of meteorological and hydrological measurements for the nuclear facility site, 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 plant approved by Order no. 360/2004 of the CNCAN President, and the Norms on the schedule of meteorological and hydrological measurements for the location of the nuclear plant, approved by Order no. 361/2004 of the CNCAN President, accordingly.

**Article 4.** – (1) In the purpose of applying these norms, besides the terms and expressions defined in 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 specific/specialised terms are used, as defined in Appendix no. 1 to these norms.

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

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

## Chapter II
## General requirements, Responsibilities

**Article 5.** As regards to maintain the control over the release of radionuclides into the environment, the authorization applicant/holder shall ensure:

a) Prevention of any unacceptable risk of irradiating or contaminating the population, following the releases of radioactive substances into the environment;

b) Compliance with CNCAN specific requirements;

c) Reporting to CNCAN of any modification in the activity of releasing of radioactive substances into the environment.

**Article 6.** – (1) In order to fulfill the obligations stipulated under Article 5, the authorization applicant/holder shall assure the routine monitoring of radioactive effluents.

(2) The routine monitoring of radioactive effluents shall be performed based on a routine monitoring programme.

(3) In order to perform the routine monitoring of radioactive effluents, the authorization applicant/holder shall:

a) Perform all the required pre-operational investigations;

b) Design, draft the required operational procedures and develop a proper monitoring programme for radioactive effluents, during and after the plant operation is ceased, in order to prove that there are no unexpected radioactive releases and that the radiation doses received by the population is below the dose constraints level imposed by CNCAN;

c) Periodically report to CNCAN the results of radioactive effluent monitoring programmes;

d) Immediately notify CNCAN on any significant changes of the level of radioactive releases into the environment and any increases of the levels of radiation fields into the environment or of radioactive contaminations of the environment, in accordance with the requirements set-out by CNCAN in the authorization process.

**Article 7.** The type, size and complexity of the routine monitoring programme for radioactive effluents shall be in accordance with the emission sources characteristics at the current or foreseen rates of radioactive emission, the radionuclides composition of effluents, the comparative significance of exposure ways and the level of potential or foreseen radiation doses for the population.

**Article 8.** – (1) In case of nuclear or radiological emergency, the authorization holder shall carry-on the emergency monitoring of radioactive effluents, both at the emission source and at directly in the radioactive-contaminated environment.

(2) The emergency monitoring of radioactive effluents shall be based on an emergency monitoring program.

(3) In order to carry on the emergency monitoring of radioactive effluents, the authorization applicant/holder shall set the required arrangements for:

a) Monitoring the radiation, sampling and measurement of samples from the environment and interpreting the results;

b) Rapid evaluation of any radioactive contamination, radioactive emissions and radiation doses;

c) Timely monitoring of radioactive soil contamination, sampling, measurement and analyzing of foodstuffs and water samples.

**Article 9.** The type, size, and complexity of the emergency monitoring programme for radioactive effluents shall be in accordance with the emission sources characteristics at the current or foreseen rates of radioactive emission, the radionuclides composition of effluents, the comparative significance of exposure ways and the level of potential or foreseen radiation doses for the population.

**Article 10.** – (1) The monitoring at the emission source of radioactive effluents shall be developed based on monitoring programmess for radioactive emissions both in routine and emergency cases.

(2) The monitoring of radioactive effluents in receiving environments shall be developed based on monitoring programs for environment radioactivity both in routine and emergency cases.

**Article 11.** - (1) In order to elaborate the radioactive emission monitoring programme, the environmental radioactivity monitoring programme, the routine monitoring programme and the emergency monitoring programme, the authorization applicant/holder shall consult an accredited radiation protection expert, in the area of expertise and specialty suitable for the facility that requires the monitoring of radioactive effluents.

(2) All monitoring programmes are approved by CNCAN within the authorization process.

**Article 12.** – (1) In order to fulfill the responsibilities on the monitoring of radioactive effluents, the authorization applicant/holder shall ensure the setting, implementation, development and maintenance in adequate operation status of equipment and appropriate monitoring programmes, both in the operational and the post-operational stage, as well as in case of emergency.

(2) The authorization holder shall assure the monitoring of radioactive effluents in a radioactivity measurement laboratory recognized by CNCAN.

**Article 13.** - In the operational stage, the authorization holder shall periodically check the validity of hypotheses in the preliminary evaluation of the facility's radiological impact and implement the necessary corrections, accordingly.

## Chapter III
## Radioactive effluents monitoring programmes, general provisions

**Article 14.** – (1) The radioactive effluent monitoring programme shall ensure the fulfillment of the following general objectives:

a) Proving the conformity of the levels of radioactive releases with the derivate emission limits and with any other CNCAN requirements concerning the impact against the population and environment, due to the normal operation of the facility;

b) Providing information and data necessary for the evaluation of the exposure or potential exposure of critical groups and population, due to the presence in the environment of radioactive materials or radiation fields resulted from the normal operation of a facility, from an emergency or from the cease of nuclear activities;

c) Allowing the verification of operating conditions and the opportunity to control radioactive effluents, and, also, allowing the observation of the occurrence of unusual or unexpected conditions in the activity of release of radionuclides into the environment, and, if necessary, initiating an additional programme to monitor radioactive effluents.

(2) Additionally, the radioactive effluent monitoring programme shall ensure the fulfillment of the following secondary objectives, accordingly:

a) Providing the information to the public;

b) Maintaining a continuous record of the impact of the nuclear facility or nuclear activity on the environmental radioactivity levels;

c) Checking the predictions provided by patterns of transferring radionuclides into the environment and modifying patterns accordingly, if necessary.

**Article 15. -** In order to fulfill the general and secondary objectives, the radioactive effluent monitoring programmes shall contain measures regarding:

a) The measurement of radiation and gathering of necessary information;

b) The evaluation of radiation doses received by the population due to the presence of radioactive materials in the environment;

c) The demonstration of the conformity with derived emission limits for such practice.

**Article 16.** – (1) When both the monitoring of radioactive emissions and the monitoring of environmental radioactivity is necessary, the authorization applicant/holder shall elaborate the two monitoring programmes, so that they supplement each other, remaining however interdependent one to other.

(2) In order to reduce uncertainties in the evaluation of doses, the authorization holder shall ensure the validation of dose calculations carried on based on the results of the radioactive effluent monitoring programme.

(3) Where the activities of emitted radionuclides or dose levels into the atmosphere in respect of the monitored factors are very low and cannot be determined as significant values in the measurement process, the radiation doses received by the population due to the operation of the nuclear facility shall be calculated exclusively based on the results provided by the radioactive emission monitoring programme.

**Article 17. -** Upon designing the radioactive effluent monitoring programme, the authorization applicant/holder shall consider:

a) Radioactive inventory and radionuclide composition of the emission source;

b) Space and time characteristics of the radiation fields around the emission source;

c) Radioactive emission rates and authorized derived emission limits;

d) Possible contributions of any other radiation sources or nuclear activities in the vicinity of the facility, ways to release radioactive effluents into the atmosphere, ways of human exposure to radiations, characteristics of the environment in the facility site, characteristics and habits of the population in the vicinity of the facility;

e) The probable value of the annual individual average dose for critical group(s) and of the environmental radioactivity, due to planned and possible radioactive emissions.

**Article 18.** – (1) The authorization applicant/holder shall elaborate the radioactive effluent routine monitoring programme so that it becomes a solid basis for emergency monitoring. In such case, the arrangements necessary for monitoring shall have the required flexibility in order to rapidly shift from normal to emergency operation.

(2) Additionally, the routine monitoring programme shall comprise provisions regarding the additional monitoring that might be necessary during planned operations or in the event of unusual yet predictable situations, when increases of radiation exposure may occur.

**Article 19. -** The design of radioactive effluent monitoring programme shall be the result of an optimization process in which the authorization applicant/holder considered the relative importance of various exposure ways, activity and dose levels against the dose constraints imposed by the CNCAN, as well as the availability of necessary monitoring resources.

**Article 20.** – (1) After the implementation of the radioactive effluent monitoring programme, the authorization holder shall review the program periodically, in order to make sure that the measurements continue to be relevant for the intended purpose and that no important environmental emission or transfer ways or significant exposure ways have been omitted.

(2) Additionally, when review the monitoring programme, the authorization holder shall consider the gained experience and the progresses in the field of monitoring techniques.

(3) The radioactive effluent monitoring programme shall be reviewed every five years and whenever necessary.

## Chapter IV
## Routine monitoring of radioactive emissions

**Article 21.** – (1) The authorization applicant/holder shall design the radioactive emission monitoring programme so that it ensures at least the measurement of **dose rate** (debit de doze) at the emission source and/or radioactive emission rates.

(2) Within the radioactive effluent monitoring programme, the adequate sampling and measurement locations, the necessary monitoring type (continuous or periodical) and the adequate specimen sampling and measurement frequency shall be chosen for each emission source type and for each potential exposure way, also determining the necessity to obtain additional information.

(3) In order to describe the releases of radionuclides into the environment, there is necessary to obtain information on the chemical form, the density and **flow of the effluent**, as well as other information concerning the receiving environment for radioactive effluents.

**Article 22. -** Because the objectives of radioactive emission monitoring are different in various stages of the operation of a nuclear or radiological facility, the authorization holder shall accordingly modify the nature and size of the monitoring programme throughout the operational stages of the facility.

## IV.1. Monitoring radioactive emissions in various stages of operation

### *Pre-operational stage*

**Article 23.** – In the pre-operational stage, the authorization applicant/holder shall develop studies for:

a) Measuring the levels of radiation and radioactive concentrations in the environment in order to subsequently detect the emission source's impact on the environment;

b) Evaluating radioactive inventories foreseen during the operation of the facility, the potential emission ways and the probable amounts of radionuclides to be released into the environment, considering, accordingly, the effluent treatment systems to be installed;

c) Determining the local factors that might influence the values of radiation doses received by the population (meteorological and hydrological, hydro-biological conditions of the aquatic environment, population distributions, rates of food consumption, employment factors, usage of various environmental compartments, etc.).

**Article 24.** – (1) Based on the results of pre-operational studies, the authorization applicant/holder shall establish the first conditions and derived limits for the release of radionuclides into the environment.

(2) Additionally, during the pre-operational stage, the authorization applicant/holder shall design the radioactive effluent monitoring programmes, based on the results of the performed pre-operational studies.

(3) In order to check the hypotheses and validate the results of the initial nuclear safety analysis, the radioactive effluent monitoring programmes designed by the authorization applicant/holder shall specifically focus on the critical of exposure ways and critical radionuclides.

### *Operational stage*

**Article 25. -** The monitoring of radioactive emissions shall consist of determinations of specific radionuclides and/or global measurements, as follows:

a) generally, the activity concentrations of radionuclides existing in the effluents shall be measured;

b) where the derived emission limits are given in the form of global activities, such emitted global activities shall be measured.

**Article 26.** – (1) For both gaseous effluents and liquid effluents, the authorization applicant/holder shall envisage the following:

a) continuous monitoring of emissions;

b) continuous sampling and laboratory measurement of activity concentrations of the radionuclides present in effluent samples; and/or

c) periodically sampling and laboratory measurement of activity concentrations of the radionuclides present in effluent samples.

(2) The authorization applicant/holder shall select the procedures for sampling and measuring specimens depending on:

a) characteristics and amounts of released radionuclides;

b) accuracy of measurement systems;

c) time variation of radioactive emission rates, if any;

d) likelihood of unplanned emissions.

**Article 27. -** The radioactive effluent monitoring programme elaborated by the authorization applicant/holder shall also include provisions concerning:

a) the accurate determination of the volume of material released into the environment as depending on time, so that the overall activity released in a certain period of time is calculated based on the measurement of the activity concentration;

b) the determination of the following parameters necessary to describe radioactive effluents: chemical form and solubility of released radionuclides, distribution of gaseous effluents according to particle size, pH of liquid effluents.

**Article 28.** – When determining the requirements for the instruments necessary to monitor radioactive emissions and process data, the authorization holder/applicant shall consider possible emissions both under normal and abnormal operation conditions, so that the measurement intervals of instruments are wide enough to allow the detection of high radioactivity levels issued in the conditions of a severe nuclear accident, warning systems are adequate and data analysis can be carried out quick enough.

**Article 29.** – The authorization holder shall assure the registration and keeping of data records supplied by the radioactive emission routine monitoring programmes, in order to use them during emergencies, in post-emergency evaluations and for the medical long-term monitoring of the personnel involved in the intervention and of the members of the population that may be affected.

**Article 30.** – (1) During the operation of the facility, the authorization holder may reduce the extent of the radioactive emission monitoring programmes only under the approval of CNCAN.

(2) The proposal to reduce the monitoring programme shall be analyzed considering the possibility to modify the regime of radionuclide release into the environment or occurrence of some unpredicted emissions, as well as the public interest.

**Article 31.** – (1) In case there are changes in the operation of the facility or in the nature of radioactive emissions, the authorization holder shall reevaluate the radioactive emission monitoring program so that the continuity of its validity is assured.

(2) Additionally, the authorization holder shall modify the radioactive emission monitoring program accordingly, in case the derived emission limits are changed.

(3) The new radioactive emission monitoring programme shall be submitted to CNCAN for approval.

***Decommisioning stage of the facility***

**Article 32.** – (1) Since during the decommissioning process, the potential impact on the population in the vicinity of the facility due to direct irradiation and radioactive emissions shall be modified in comparison with the operation stage, the authorization applicant/holder shall evaluate the opportunity to maintain the monitoring systems used in the operation stage, as well as the need to modify them, accordingly.

(2) The authorization applicant/holder shall specify in the decommissioning plan the monitoring requirements for radioactive emissions.

**Article 33.** – (1) The authorization applicant/holder shall design a radioactive emission monitoring programme during the decommissioning period, that would respond to the same specific objectives as during the operation period, considering that:

a) the activities of releasing radionuclides into the environment and hence the external radiation fields around the sources shall be changing;

b) there is the possibility of radioactive emissions consisting of contaminated aerosols, resulted from the decommissioning activities, that cannot be processed through the existing gaseous effluent filtering and monitoring systems.

(2) Throughout the decommissioning, the authorization applicant/holder shall review and adapt the radioactive emission monitoring programme in order to continue to ensure the checking of conformity with derived emission limits and other criteria set by CNCAN.

**Article 34.** – The authorization holder shall cease the deployment of the radioactive emission monitoring programme after the decommissioning process ends.

### IV.2. Radioactive emission sampling and measurement techniques

**Article 35.** – (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 programme.

(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 36.** – (1) The authorization applicant/holder shall establish the sampling frequency in accordance with the results of the previous monitoring of the facility or of a similar plant, in order to assure the required sensitivity to determine any changes in the effluents' radionuclide composition.

(2) The sampling frequency shall depend on the amount to be measured, the required measurement accuracy and the time variation of the measured amount.

(3) The sample measurement frequency shall be set considering the half-time of the tracked radionuclides.

(4) Appendix 2 to these norms shows a guide of the sampling and measurement types and frequencies in order to determine the various significant **size (marime)** for the routine monitoring of radioactive emissions.

**Article 37.** – (1) For all nuclear and radiological facilities that require the monitoring of radioactive emissions, authorization holders/applicants shall draft at least one minimal radioactive emission monitoring programme that would consist of the continuous measurement of the gamma dose flow and/or of the beta-global activity in the release points (exhaust chimney, for gaseous effluents, and spill pipe, for liquid effluents).

(2) When the determination of the composition of radioactive effluents is required, the radioactive emission monitoring programme shall include provisions regarding continuous or periodical effluent sampling at the release points, before the dilution, followed by specific radioactivity measurements for the taken samples.

(3) The sizes to be measured, as well as the sampling and measurement types and frequencies shall be determined by CNCAN within the authorization process.

**Article 38.** – (1) The authorization applicant/holder shall select the equipment to measure radiation in accordance with the purpose of their use, taking into account the radionuclides that may be released under both normal and emergency operation.

(2) The authorization applicant/holder shall present, as part of the authorization process, all technical characteristics of the monitoring equipment 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 39.** – (1) The authorization applicant/holder shall select the sampling and monitoring equipment, the analytical techniques and the procedures used in order to meet the minimum sensitivity requirements.

(2) The minimum sensitivity of measurement equipment and methods shall ensure the detection with a confidence level of at least 95% for radioactivity levels at least one size rank smaller than the derivate emission limits for each radionuclide released into the environment.

**Article 40.** – (1) The minimum sensitivity required for measurement equipment and methods shall be expressed in terms of minimal detectable activities.

(2) The calculation procedure and the values of minimal detectable activities calculated for each radionuclide or category of radionuclides released by each release way shall be explicitly presented in the radioactive emission monitoring programme.

### IV.3. Specific requirements for the monitoring of radioactive waste and spent nuclear fuel storage facilities

**Article 41.** - (1) Any radioactive waste or spent nuclear fuel storage facility shall be designed so as to allow the implementation of a monitoring programme destined to check the retention capacity of the storage system, during the operation of the facility and after its closure, in the case of radioactive waste final storage facilities.

(2) The arrangements for monitoring the radioactive emissions shall be set so as not to compromise the long term storage capacity of the storage system.

(3) The provisions of this section shall apply together with the requirements included in the other applicable chapters of the present norms.

### IV.4. Specific requirements for the monitoring of radioactive emissions in a nuclear power plant

**Article 42.** – (1) The provisions of this section represent the specific monitoring requirements for gaseous and liquid radioactive emissions, in conditions of normal operation of a nuclear power plant with CANDU type reactors.

(2) The specific requirements for the monitoring of radioactive emissions in other nuclear or radiological facilities shall be set by CNCAN for each facility within the authorization process.

(3) The specific requirements for monitoring of radioactive emissions in a nuclear or radiological facility shall be apply together with the requirements included in the other applicable chapters of the present norms.

**Article 43.** – (1) The radioactivity content of gaseous and liquid effluents shall be measured continuously by means of gaseous and liquid effluent monitors and, periodically, by effluent sampling and subsequent laboratory measurement.

(2) The authorization applicant/holder shall select the measurement methods in order to guarantee a minimal sensitivity of the measurement equipment and an **exactity** of measurement as close as possible to the most modern existing techniques.

***Monitoring of gaseous radioactive emissions***

**Article 44.** – (1) The authorization applicant/holder shall ensure continuous sampling and monitoring of representative specimens in terms of the composition of the released material and of the dynamics of the exhaust process, by means of an adequate gaseous effluent sampling and monitoring system (hereinafter *"gaseous effluents monitor"*).

(2) The gaseous effluent monitor shall ensure, also, the representative gathering of effluent samples from the main stream, on adequate sampling environment located on sampling pipes, for subsequent measurements and laboratory analyses of radioactive substances in a form distinct from the gaseous form (particles, aerosols).

(3) The gaseous effluent monitor shall be redundant, at least as regards all its active functions (flow pipes containing pumps and valves, radioactivity monitoring systems, sampling filters, etc.).

**Article 45.** – The gaseous effluent monitor shall fulfill the following functions:

a) continuous monitoring of global beta/gamma activity of radioactive particles, global gamma activities of iodine radioisotopes and of the activity of released noble gas radioisotopes;

b) assuring a warning signal in case there is any increase in the radioactivity of radioactive particles, iodine radioisotopes or noble gas radioisotopes in gaseous effluents higher than the related warning thresholds;

c) sampling of effluents on adequate filters for laboratory analysis, in order to determine the content of radioactive particles and iodine radioisotopes;

d) gathering samples for determination in the laboratory of the total tritium content and the total carbon-14 content in gaseous effluents, by means of adequate sampling systems.

**Article 46.** - The authorization applicant/holder shall ensure the measurement of radioactive noble gas emissions by means of a fixed system of continuous gamma-spectrometer monitoring which allow the continuous measurement of radioactive emission rates in all noble gas radioisotopes present in the released gaseous effluents.

**Article 47.** – (1) Samples for determination of iodine radioisotopes shall be performed continuously, on filters characterized by an adequate retention factor for the fixation of iodine molecular and organic compounds.

(2) The filters shall be analyzed by laboratory gamma spectrometry, on a daily basis and whenever necessary (for events in which the composition or the amount of radioactive effluents has changed or is supposed to change), in order to determine the activity concentrations of all the iodine radioisotopes present in the released gaseous effluents.

**Article 48. –** (1) Samples for determination of radioactive particles shall be performed continuously, on filters characterized by a retention factor adequate for the fixation of various radioactive particles present in gaseous effluents.

(2) The filters shall be analyzed by laboratory gamma spectrometry, on a daily basis and whenever necessary (for events in which the composition or the amount of radioactive effluents has changed or is supposed to change).

(3) Additionally, each filter shall be analyzed beta-globally also.

(4) If the weekly sum of beta-global activity is higher or equal to the level foreseen in the radioactive emission monitoring programme, radioactive strontium analyses shall be carried out on the set of filters cumulated for that week.

**Article 49.** – (1) Samples for the determination of total tritium (tritium water vapors and gaseous tritium) shall be performed continuously, based on a gathering system fitted with a selective absorption medium, characterized by a high retention efficiency, to ensure a sample purity corresponding to liquid scintillator analyses.

(2) The tritium content shall be measured twice a week and whenever necessary (for events in which the composition or the amount of radioactive effluents has changed or is supposed to change), by means of beta-spectrometry with liquid scintillator.

**Article 50.** – (1) Samples for the determination of total carbon-14 (carbon dioxide, carbon monoxide, and organically-bound carbon) shall be performed continuously, based on a gathering system fitted with a selective absorption medium, characterized by a high retention efficiency, to ensure a sample purity corresponding to liquid scintillator analyses.

(2) The carbon-14 content shall be measured on a weekly basis and whenever necessary (for events in which the composition or the amount of radioactive effluents has changed or is supposed to change), by means of beta-spectrometry with liquid scintillator.

**Article 51.** – The official reports of the authorization holder shall consist of:

a) gaseous effluent monitor readings, for noble gas radioisotopes;

b) laboratory analyses results, for the content of iodine radioisotopes, radioactive particles, total tritium, and total carbon-14.

**Article 52.** – (1) The authorization applicant/holder shall ensure the monitoring of radioactive emissions into the atmosphere all throughout permanent and transitory regimes of normal and abnormal operation, by means of both fixed continuous monitoring systems and by sampling followed by specific laboratory analyses.

(2) The authorization holder shall implement the necessary arrangements for the effluent sampling and measurements in case of abnormal radioactive gaseous emissions in order to obtain a suitable level of data confidence for the emissions.

(3) The total activity released until the alarming shall be evaluated based on the results of laboratory analyses and on the values supplied by the gaseous effluent monitor.

### *Monitoring of liquid radioactive emissions*

**Article 53.** – In order to make sure that the exhausting of a liquid radioactive waste gathering tank does not lead to the exceeding of the derived emission limits, the following operations shall be carried out before the spill:

a) recirculation of the water inside the tank, in order to assure an adequate homogenization of the tank content;

b) sampling water from the tank to be spilled, for specific laboratory analyses;

c) the taken sample shall be analyzed in terms of:

- global-gamma in order to determine the global activity of gamma-releasing radionuclides;
- beta-spectrometry, through liquid scintillator method, in order to determine the tritium content.

**Article 54. –** During the spill, the authorization holder shall ensure the continuous monitoring of the ways of spilling of liquid radioactive effluents, through a fixed monitoring system *("liquid effluent monitor"*), with the following functions:

a) continuous monitoring of released global-gamma and/or global-beta activity;

b) providing a warning signal and stopping the spill in case high activities occur, exceeding the set threshold.

**Article 55.** – (1) At the same time, the authorization holder shall ensure the sampling of representative specimens from the main liquid effluent stream, integrated during the spill, by one of the following methods:

a) automatic sampling, assured by a special device attached to the liquid effluent monitor;

b) sampling from the tank.

(2) The sample thus taken shall be analyzed in the laboratory:

a) by gamma-spectrometry, in order to determine the activity concentrations of gamma-emitting radionuclides;

b) by beta-spectrometry, based on liquid scintillator method, in order to determine the content of tritium and carbon-14;

c) in order to determine the content of radioactive strontium, when the case requires such.

(3) The results of such laboratory analyses shall represent official reports of the authorization holder.

**Article 56.** – (1) In order to confirm that no high liquid emissions took place, the authorization holder shall assure the sampling of an integrated specimen from the **spill channel**.(canal de deversare)

(2) The taken sample shall be analyzed:

a) by gamma-spectrometry, in order to determine the content of gamma-emitting radionuclides;

b) by beta-spectrometry, based on the liquid scintillator method, in order to determine the content of tritium and carbon-14.

**Article 57.** – (1) The liquid effluent monitor shall order the shutdown of the spill pipe in case the measured activity exceeds the set warning threshold or if the monitoring system is out of order.

(2) The overall exhausted activity until the warning shall be evaluated based on the laboratory analysis results.

**Article 58.** – In case exceptional spilling ways are identified (secondary or intermediate circuits), the authorization holder shall assure their monitoring by means of sampling systems and of adequate specific laboratory analyses.

## Chapter V

## Monitoring of radioactive emissions in case of emergency

**Article 59.** – (1) The provisions of this chapter apply to nuclear plants in which emergency situations may occur that involve radioactive emissions into the environment and that require the implementation of the off-site protection measures, namely nuclear power plants and research nuclear reactors.

(2) The specific radioactive emission monitoring requirements in case of emergency for other nuclear or radiological plants shall be determined by CNCAN, for each plant, within the authorization process.

**Article 60. –** (1) The authorization applicant/holder shall establish an emergency monitoring and remediation strategy that would take into account the specific local conditions of the nuclear plant location, the emission sources and the possible exposure ways.

(2) The emergency monitoring strategy shall be designed so as to meet the case evaluation requirements, the decision-making requirements for protection measures, and the necessary remedial and practical emergency response actions.

**Article 61.** – (1) Monitoring of radioactive effluents, both at the emission source and in receiving environment, is compulsory in the case of any nuclear or radiological emergency.

(2) The methods and the extent of emergency monitoring shall depend on the severeness of the situation and on its potential or actual consequences.

(3) In order to assure the quickest application of protection measures and necessary remediation actions, the authorization applicant/holder shall elaborate a such strategy to assure the rapid detection of the exposure levels of the population and the personnel involved in the intervention.

**Article 62.** – Emergency monitoring shall end when control over the emission source is regained or when the levels of exposure or environment contamination have decreased below the generic levels of intervention and action, respectively.

**Article 63.** – (1) When designing the emergency monitoring programme, the authorization applicant/holder shall firstly consider the determined emergency types.

(2) In this respect, the authorization applicant/holder shall make the necessary arrangements to prepare the whole domain of possible emergencies, sampling, preparation and analysis techniques, interpretation of results, evaluation of doses, systems and means of communication and receipt of support from other institutions, if necessary.

(3) Additionally, upon determining the emergency monitoring programme, the authorization applicant/holder shall envisage the assurance of the most efficient use of necessary resources for emergency monitoring.

**Article 64.** – The authorization holder shall accurately implement the arrangements necessary for the rapid shift to emergency monitoring, in order to assure an automatic response to the emergency, based on a suitably designed radioactive emission emergency monitoring programme.

**Article 65. –** Given that in case of emergency radioactive emissions may occur through the exhaust points of radioactive effluents under normal operating conditions, the authorization holder shall:

a) install continuous or discontinuous monitoring systems (for liquid effluents collected in tanks) on all exhaust chimneys and in all liquid spill points, characterized by a measurement interval wide enough to be used in order to define a radioactive emission in case of emergency;

b) establish, starting from the preoperational stage, the methods for the evaluation of radioactive emissions in case of emergency, for all routine ways of exhaust (atmospheric and liquid);

c) take into account that there may always be additional radioactive emissions through other points that those destined for routine spills.

**Article 66.** – (1) In any case of emergency when the locations of possible or actual radioactive emissions are known or identifiable, on-site measurements of the radiation fields associated with the state of emergency shall be carried out, using adequate portable measurement tools.

(2) In a case of emergency when the radioactive emission originates in an unmonitored point, or in case the personnel involved in the intervention cannot access the emission site, emission monitoring shall reduce to drawing dose flow contour lines around the emission point.

**Article 67.** – If a radioactive emission took place by an unpredicted mechanism, such as an explosion, emission monitoring shall consist of the identification of the radioactive material that might be involved; in case the emission continues, emission rate measurement actions shall be considered.

**Article 68.** – Since the knowledge of the source-term, in case of emergency is essential for the determination of the required countermeasures, the authorization applicant/holder shall design and implement a radioactive emission emergency monitoring programme that would provide at least data on the most important radionuclides from radiological point of view.

**Article 69.** – (1) Given that for the evaluation of radiological consequences the most often determination of released radionuclide composition is very important, the authorization holder, in the case of an emergency, shall use the same monitoring systems and radioactive emission measurement methods as in the case of normal operation, the sampling and measurement frequency being modified in accordance with the rapid evaluation requirements.

(2) Appendix 2 to these norms shows a guide of the sampling and measurement types and frequencies in order to determine the various significant sizes for the emergency monitoring of radioactive emissions.

## Chapter VI

## Results of the radioactive emission monitoring programme

**Article 70.** - The authorization holder shall present the results of the radioactive emission monitoring programme in terms of:

a) radiation levels at the emission source and radionuclide concentrations within effluents;

b) real dose received by individuals within critical groups or by the population, under normal operation, in the cases stipulated under Article 16, paragraph (3) of the present norms.

**Article 71.** – (1) Generally, in order to make sure that no unmonitored radioactive emissions have taken place, time-integrated values of the continuous measurements of radiation or continuous sampling shall be used.

(2) For radionuclide emissions that are not spilled in large amounts or that are not significant radiologically, average values of the measurements or periodical samplings may be accepted, if no high emission variations are foreseen, in which case periodical variability checks shall be carried out.

**Article 72.** – In order to avoid a wrong interpretation of the data supplied by the monitoring programme, the authorization holder shall make sure of the exact and full understanding of the sampling and measurement conditions, which include:

a) geographical localization of sampling sites;
b) date and time of sampling;

c) sampling duration;
d) sampling and measurement procedures used;
e) accurate understanding of the measured physical size;
f) level of the radiation background.

**Article 73.** – Upon interpreting the results of the monitoring program, the authorization holder shall give due attention to the accuracy of data, taking into account:

a) The accuracy of sampling and measurements;

b) Representativity of sampling and measurement;

c) Measurement of total activity requiring other assumptions on the radionuclide composition;

d) Interpretation of measured values that are below the minimum detection limit for the measurement equipments and methods used;

e) Interpretation of measured values ranging outside the distribution interval of a set of measurements.

**Article 74.** – (1) The radioactive emission monitoring programme shall contain:

a) Clear procedures for inclusion among results of the measured values ranging below the detection limit of the measurement equipments and methods used;

b) Clear interpreting procedures for the measured values ranging outside the distribution interval of a set of measurements.

(2) The authorization holder shall present, jointly with the results of the monitoring programme, the interpretation procedure for the measured values ranging below the detection limit of the measurement equipment and methods used, and the interpretation procedure for the measured values ranging outside the distribution interval of a set of measurements, in such a form as to justify the selected choice.

**Article 75. –** In order to accurately interpret the results of the radioactive emission monitoring programme, the authorization holder shall take into account the correlations between:

a) Results of the environment monitoring programme and the results of the radioactive emission monitoring programme results;

b) Measurement of radiation levels and measurement of radionuclides concentrations;

c) Measurement of integrated parameters (global gamma, global beta measurements) and measurement of specific radionuclides;

d) On-site measurements and sample measurements in the laboratory;

e) Continuous and periodical measurements;

f) Measurement of radioactivity and measurement of other parameters (such as weather conditions).

## Chapter VII

## Radioactive emission monitoring quality management

### VII.1. Uncertainty of the data supplied by monitoring programmes

**Article 76.** – (1) The uncertainties related to the results of the monitoring programme shall be determined considering the uncertainties due to sampling methods, preparation methods,

and sample measurement methods, as well as the uncertainties due to the calibration of monitoring equipment.

(2) The uncertainties related to the results of the monitoring program shall be considered conservatively in the evaluation of doses and in the interpretation of the results of the monitoring programme.

**Article 77.** – (1) If the calculation of the uncertainties associated with the sampling methods and the sample preparation methods is not possible, only the uncertainties related to the sample measurement methods shall be calculated, provided that all uncertainties be maintained to the lowest extent possible, by setting and implementing adequate monitoring quality management procedures.

(2) In the case shown in paragraph (1), the results shall be presented jointly with the measurement uncertainty, also specifying:

a) Sampling location and method, with the uncertainty related to such method, if calculable;

b) Sample preparation method, with the uncertainty related to such method, if calculable;

c) Analysis method, with the main technical specifications of the used detection devices;

d) Measurement unit, in the International System of Units;

e) Confidence level for which the indicated measurement uncertainty has been calculated (or number of standard errors represented by the indicated measurement uncertainty);

f) For values ranging below the minimum detection limit, the value of the minimum detection limit shall be specified.

### VII.2. Quality management system

**Article 78.** – (1) The authorization applicant/holder shall establish, develop and maintain a quality management system to prove that the requirements of Norms concerning the quality management systems applied to nuclear power plants, issued by CNCAN by Orders no. 65-76/2003 of the CNCAN President are implemented in accordance with the deployed activity.

(2) The quality management system shall be authorized by CNCAN.

(3) The quality management system shall include quality management specific requirements and also assure that:

a) CNCAN requirements for monitoring of radioactive emissions are fulfilled;

b) Adequate sampling, preparation and measurement methods are used;

c) Sampling and measurement sites and frequency are suitably chosen;

d) Inter-laboratory comparisons of the monitoring methods and tools are carried out at a national and international scale.

**Article 79. –** The quality management system shall comprise specific provisions regarding:

a) Design and implementation of monitoring programmes, including the selection of adequate equipment, sampling and measurement locations and procedures and technical documentation;

b) Proper maintenance, testing and calibration of equipment and tools in order to assure the accurate operation thereof;

c) Use of traceable standards under national and international standards;

d) Quality control mechanisms and procedures, in order to review and evaluate the overall efficiency of the monitoring schedule;

e) Analysis of uncertainties associated with the results of the monitoring programme;

f) Requirements for keeping data records;

g) Education and training of personnel, suitable for the facilities in which they work.

### VII.3. Theoretical and practical personnel training

**Article 80.** – (1) The authorization holder shall implement the strategy for the development of theoretical and practical training necessary in the field of radioactive emission monitoring, based on specific requirements set by the CNCAN within the authorization process.

(2) In this respect, the authorization holder shall ensure the theoretical and practical training, initially and periodically, at an adequate level, of a suitable number of persons involved in the monitoring of radioactive emissions.

**Article 81.** – (1) The training of the personnel involved in the monitoring of radioactive emissions shall be carried out based on a training schedule.

(2) Training programmes shall include courses on the required theoretical knowledge, basic principles and requirements on radiation protection, relevant legislation and regulations, development of monitoring techniques, as well as presentations of the practical expertise gained by other authorization holders, based on case studies.

(3) Training programs shall also include practical demonstrations of the monitoring equipment, simulations of sample gathering, preparation and measurement techniques, interpretation of measurement results, exchanges of expertise in the field of emission monitoring cu other similar plants and professional training under the supervision of qualified specialists.

(4) Training programs shall be periodically reviewed and improved in order to include technological innovations in this area and the expertise recently gained by monitoring system operators, following the analysis of human errors and malfunctions that may occur in such cases.

## Chapter VIII

## Reporting of radioactive emission monitoring programme results

### VIII.1. Recording of monitoring programme results

**Article 82.** – In order to prove by documents the radiation emission levels and rates, as well as the types, amounts and emission rates of spilled radionuclides, the authorization holder shall ensure the recording of radioactive emission monitoring data. For such purpose, the following shall be kept:

a) Detailed records on the radiation exposure rate measurements (locations, dates, tools, information on the calibration of the used tools);

b) Detailed information on the measurement of aerially and liquidly-released radionuclides (spill points, sampling period, analysis procedures, used tools, information on the calibration of the used tools);

c) Detailed records on the spill flow measurements, in correlation with radionuclide measurements, as well as information on the calibration of the used measurement tools.

**Article 83. -** (1) The authorization holder shall assure the possibility of verification of monitoring data, by keeping records of all relevant intermediate results during analyses, as well as of the parameters used in the calculation of the reported data, and of the interpretation of the monitoring results.

(2) Additionally, all records of investigations carried out if unusual results are obtained shall be safeguarded.

**Article 84.** – (1) The records of radioactive emission monitoring programme results shall be kept for the validity period of the authorization, as well as for the retirement period and the subsequent 30 years.

(2) The authorization holder shall ensure the recording of radioactive emission monitoring program results both in hardcopy (paper) version and in electronic version (computerized database).

**VIII.2. Summary periodical reports**

**Article 85.** – (1) The authorization holder shall draft and forward to CNCAN, on a quarterly and annual basis, summary radioactive emission monitoring reports.

(2) Summary periodical reports shall comprise the radioactive emission monitoring programme results, shown in such a form as to allow the comparison with derivate emission limits.

(3) The reports shall also comprise the interpretation of results and the explanation of the significance thereof, especially in the case of values that show significant variations as compared to the usual values.

(4) The reports shall include, if necessary, other relevant information, according to CNCAN-specific requirements determined within the authorization process.

**Article 86.** – (1) Quarterly summary reports shall comprise radioactive emissions in the reporting quarter and in the previous quarter(s) of the current year, presented both in terms of activity released in that quarter and overall activity released from the beginning of the year and in terms of percentages from the applicable derivate emission limits.

(2) Annual summary reports shall consist of the year's fourth quarterly summary report, also including annual emissions of the preceding functioning years.

(3) Quarterly summary reports shall be forwarded to CNCAN in the first month of the quarter to follow the reporting quarter.

**VIII.3. Detailed annual reports**

**Article 87.** – (1) The authorization holder shall draft and forward to CNCAN, on an annual basis, a detailed radioactive emission monitoring report, to contain:

a) brief description of the radioactive emission monitoring report;

b) annual summary radioactive emission monitoring report;

c) other relevant information concerning radioactive emissions in the preceding year(s).

(2) The annual detailed radioactive emission monitoring report shall be forwarded to CNCAN in the first quarter of the year to follow the reporting year.

**Article 88.** – In case the authorization holder develops programme for both radioactive emissions and the environment, the results of the two monitoring programmes shall be presented together, in such a form as to prove the compliance with the dose constraint set by the CNCAN.

### VIII.4. Notifications

**Article 89.** – (1) The authorization holder immediately notify to CNCAN any excess in the daily/spill, weekly, monthly, or quarterly derivate emission limits.

(2) Within no longer than three days from the spills, the authorization holder shall draft and forward to CNCAN a preliminary report to include, besides the level of the radioactive emission and a description of the carried on investigations, the immediate actions that have been taken and the actions foreseen for the near future.

## Chapter IX

## The control carried out by the regulatory body

**Article 90.** – (1) Authorization holders shall provide CNCAN inspectors with the necessary documents for them to check the compliance with the requirements of these norms.

(2) Authorization holders shall provide CNCAN inspectors with the documents proving the accuracy of the radioactive emission monitoring programme results.

(3) Upon CNCAN's request, authorization holders shall suitably modify their programs for routine, emergency, and radioactive effluent monitoring quality management monitoring, following independent periodical revisions or inspections carried out by CNCAN.

(4) Upon CNCAN's request, authorization holders shall provide CNCAN inspectors the possibility to check monitoring data supplied by the holders in the reports they drafted.

**Article 91.** – Authorization holders shall prove the fulfillment of the necessary capacity to monitor radionuclide releases into the environment in case of nuclear or radiological emergency by supplying to CNCAN inspectors the documents to certify the accurate implementation of the emergency response preparation activity.

## Chapter X

## Final and transitory provisions

**Article 92.** – The provisions of these norms no not exclude the compliance of authorization holders with any other requirements stipulated by specific regulations in force.

**Article 93.** – These norms come into force upon their publication in the Romanian Official Bulletin.

**Article 94.** – 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, except for article 46, in which case the fulfillment period is within 24 months from the effective date of these norms.

**Article 95.** – Appendices no. 1 and no. 2 are an integral part of these norms.

## Definitions

- **Minimally detectable activity** – activity 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%).
- **Severe nuclear accident** – deviation from normal operation, more severe than a design basic accident and involving a serious degradation of the reactor core.
- **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, equipment, training.
- **Critical (significant) means of exposure** – the way taken into the environment by radionuclides and/or radiation, from the emission source to human beings, on which the highest radiation exposure of an average member of the critical group is most likely to occur.
- **Spill channel –** term used in the sense of these norms for the intermediate channel, located between the spill pipe and the receiving water medium, for the employed emission way.
- **CNCAN** – National Commission for Nuclear Activities Control.
- **Countermeasure** – action dedicated 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.
- **Calibration** – measurement or adjustment of an instrument, part, or system, in order to make sure that its accuracy or response are acceptable.
- **(Measurement) accuracy** – compliance degree 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).
- **CNCAN-certified radioactivity measurement laboratory** – term used in these norms to define a laboratory that deploys activities in the field of radioactivity measurements and meets all the technical requirements specified in these norms, as regards the measurement of radioactive effluents.
- **Quality management –** all the activities coordinated to orient and control an organization with respect to quality.

- **Monitoring** – measurement of the radiation dose or radioactive contamination in order to evaluate or control the exposure to radiation 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.
- **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.
- **Radioactive emission rate** – term used in these norms to describe the activity released within a time unit.
- **Continuous monitoring system** – device for the measurement of activity in air or water, that continuously measures the emissions of radionuclides passing through the counting chambers located in the effluent flow or the radionuclides collected in various sampling media located in the effluent flow.
- **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-time.** – timeframe in which the activity of a radionuclide decreases, through radioactive disintegration, at 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.

**Measured sizes, sampling and measurement types and frequencies, applications**

| **Measured size** | **Sampling and measurement types and frequencies** | **Applications** |
|---|---|---|
| Gamma dose flow at the emission source | Fixed continuous monitoring system | Normal operation<br>Emergency |
| Radioactivity of gases released into the atmosphere | Fixed continuous monitoring system | Normal operation<br>Emergency |
| Radioactivity of aerosols released into the atmosphere | Fixed continuous monitoring and/or sampling system, followed by periodical specific laboratory analyses (spectrometry, alpha-global or beta-global) | Normal operation<br>Emergency |
| Radioactivity of liquids released into the aquatic environment | Fixed continuous monitoring and/or sampling system, followed by periodical specific laboratory analyses (spectrometry, alpha-global or beta-global) | Normal operation<br>Emergency |