Order no. 361/2004

of 20/10/2004
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Approving the Norms on meteorological and hydrological measurements at nuclear installations

According to the provisions of:
• Law **no. 111/1996** on the safe deployment of nuclear activities, republished, with subsequent modifications and completions;
• Government Decision **no. 1.627**/2003 approving the internal rules of the National Commission for Nuclear Activities Control, with subsequent modifications,

The president of the National Commission for Nuclear Activities Control issues the following Order:

Art. 1. – The Norms on meteorological and hydrological measurements at nuclear installations, provided in the annex which is integral part of this Order, are approved.
Art. 2. - This Order shall be published in the Official Law Bulletin of Romania, Part.
Art. 3. - The Norms provided in art. 1shall enter into force on the date of their publishing in the Official Law Bulletin of Romania, Part I.
Art. 4. - The Division of Radiation Protection and Radioactive Waste within the National Commission for Nuclear Activities Control shall fulfil the provisions of this Order.

The President of the National Commission for Nuclear Activities Control,
Lucian Biro

Bucharest, 20 October 2004.
No. 361.

Annex to the Order

Norms on meteorological and hydrological measurements at nuclear installations

CHAPTER I

General considerations, purpose, definitions

Art. 1. - **(1)** These norms apply to nuclear installations and set the general requirements regarding the progress of the meteorological and hydrological measurement programs for the site and the area of influence of the nuclear plant or of other nuclear installations, under normal operation or in case of nuclear accident, in compliance with the provisions of Law **no. 111/1996** on the safe deployment of the nuclear activities, republished, with subsequent modifications and completions, and of the Fundamental Norms on Radiological Safety, approved by the Order of the President of the National Commission for the Control of Nuclear Activities **no. 14/2000**, with subsequent modifications.
(2) These norms apply also to radiological installations that can, in normal operation or in case of accident, discharge radioactive effluents in atmosphere or surface waters.
(3) Radiological installations provided in paragraph (2) are set by the National Commission for the Control of Nuclear Activities (CNCAN) in the framework of the authorization process.
(4) For the radiological installations provided in paragraph (2), with the approval of CNCAN, meteorological and hydrological data provided by the national system of meteorology and hydrology can be used.
Art. 2. - **(1)** The authorization holder, respectively the applicant, shall, starting from the design phase of the nuclear installation, permanently asses the exposure to radiations of employed staff and of population, as well as the impact upon the environment following the discharges of radioactive materials in the environment, under normal operation, in case of transient situation or nuclear accident.

(2) In this respect the authorization holder, respectively the applicant, shall achieve a program of meteorological and hydrological measurements on site and a program of hydrological measurements within the area of influence of the nuclear installation.

Art. 3. - (1) The programs of meteorological and hydrological measurements made on site and around the nuclear installation shall provide all information required in the assessment of the atmospheric dispersion, respectively aquatic, of the radioactive material discharged in the environment by the nuclear installation, under normal operation, transient situations or nuclear accident.

(2) The results of the meteorological and hydrological measurement programs represent entry data in the calculation templates of the dispersion of radioactive effluents in the environment and contribute to the evaluation of the additional radioactive discharges to population, under normal operation, transient situations or nuclear accident.

Art. 4. - (1) These norms describe the content of the meteorological and hydrological measurement programs, on site, and respectively within the area of influence of the nuclear installation, that shall be accomplished by the authorization holder, respectively the applicant, in compliance with the provisions of art. 2 par. (2).

(2) The calculation of the dispersion of radioactive effluents in atmosphere and, respectively, in water environment is presented in the Norms on the dispersion calculation of radioactive effluents discharged in the environment by nuclear installations, approved by the Order of the President of the National Commission for the Control of Nuclear Activities **no. 360/2004**.

(3) The calculation of the actual discharges and of the equivalent discharges, individual and collective, is presented in the Norms on the calculation of the additional radioactive discharges to population within the area of influence of the nuclear installations.

Art. 5. - With the purpose of implementing these norms, besides the specialized terms and expressions defined by Law **no. 111/1996**, republished, with subsequent modifications and completions, and by the Fundamental Norms on Radiological safety, with subsequent modifications, the specialized terms specific to these norms are also defined in attachment no. 1.

CHAPTER II

Requirements for the on site meteorological measurement program

Art. 6. - (1) The on site meteorological measurement program shall be initiated starting from the design period of the nuclear installation, in order to obtain local specific meteorological parameters, required in the evaluation of the atmospheric dispersion of the radioactive effluents discharged in the environment by the nuclear installation.

(2) The meteorological parameters specific to the site shall be obtained through local meteorological investigations that are both continuous and long-termed.

Art. 7. - The meteorological measurement program shall continue over the entire operating period of the nuclear installation and over the decommissioning period, until the issue of the CNCAN approval for the unrestricted use of the site.

Art. 8. - (1) The results of the meteorological measurement program shall be used:

a) in order to prove that the chosen location for building the nuclear installation is suitable and in compliance with the requirements imposed by CNCAN;

b) in order to choose dispersion patterns that are in accordance with the specific character of the site;

c) in order to set the derived limits of the emission for the gaseous radioactive effluents discharged into the atmosphere by the nuclear installations;

d) in order to assess the radiological consequences of the emission of gaseous radioactive effluents for the population and environment;

e) as support in drawing up of a radioactivity surveillance program for the environment within the area of influence of the nuclear installation;

f) as support in drawing up of intervention plans for the nuclear installation in case of nuclear accident.

(2) The meteorological data obtained during the period before the building of the nuclear installation shall be compared with the data obtained after its building, but before its commissioning, in order to consider the possible changes intervened in the local meteorological conditions and to make, if necessary, certain modifications of the design bases or the calculation templates.

Art. 9. - Nature, the collecting frequency and the accuracy of meteorological data shall be compatible with the mathematics templates and the calculation techniques in which data shall be used as entry parameters for the evaluation of dispersion and additional discharges to population, under normal operation, transient situations or nuclear accident.

Art. 10. - The meteorological measurement program shall include the obtaining of the following types of meteorological data:

a) wind speed and direction;

b) specific indicators of the atmospheric turbulence;

c) precipitation;

d) air temperature;

e) atmospheric humidity;

f) air pressure.

Art. 11. - (1) The results of the local meteorological measurement program shall allow both the characterization of a momentary situation and the medium and long-term prognosis.

(2) Medium and long-term prognoses shall be obtained on the basis of statistical analyses on meteorological data sets collected over a period of at least one year.

(3) In the long-term characterization of the local meteorological conditions, the specificity of meteorological data obtained on site shall be verified by comparison with data obtained in time (during a 30-year period) by the stations of the national network of meteorology, situated in the proximity of the nuclear installations.

Meteorological measurement equipment

Art. 12. - Meteorological measurements are obtained by operating in a continuous mode the instruments and sensors characteristic to meteorology.

Art. 13. - (1) Meteorological equipment shall be installed in such a manner so as to produce data specific to the conditions of dispersion at the emission sources of the nuclear installation.

(2) Before installing the measurement equipment, the area shall be examined, within a radius of several kilometers around the site, and the aspects related to the topography and orography of the terrain, that might influence the result of the meteorological measurements shall be evaluated.

(3) The equipment shall be installed on top of a meteorological tower, at different levels from the ground, in optimal operating and physical protection conditions.

Art. 14. - (1) In addition to the equipment installed on top of the meteorological tower, for characterizing the wind vector the system Doppler Sodar can be used.

(2) The Doppler Sodar system shall yet be supplemented with equipment installed on the meteorological tower for determining meteorological parameters close to ground level.

Art. 15. - (1) The meteorological tower and the sensors shall be placed on the nuclear installation platform so as the buildings on the platform, the tower specific structures and the relief of the area do not influence the results of the measurements.

(2) The Doppler Sodar system for atmospheric sounding shall be installed in an isolated site, situated near the nuclear installation, sufficiently far from tall buildings and acoustical sources, which can perturb the functioning of the system.

Art. 16. - (1) The meteorological tower shall be designed and built sufficiently tall so as to allow the registering of the wind speed at representative heights and the determining of specific indicators of atmospheric turbulence.

(2) The height of the meteorological tower shall be at least equal to the height of the tallest ventilator chimney of the nuclear installation.

Art. 17. - Systems and measurement devices shall be maintained in perfect operating condition, periodically tested, metrological checked, and repaired, as necessary, in compliance with the provisions of the Quality Assurance program.

Art. 18. - The uncertainties associated to meteorological measuring equipment shall, depending on the measurement system used, fall within the limits stipulated in attachment no. 2.

Collection, analysis and presentation of meteorological data

Art. 19. - (1) Meteorological data shall be measured, submitted and recorded automatically, in real time, by specific systems, and shall be stored into the database, on computers that are adequate from the point of view of technical performances.

(2) Primary meteorological data, stored in databases shall be subject to evaluation and calculation processes and statistical analyses.

(3) Hourly average values of all recorded meteorological parameters shall be stored and kept over the entire operating period of the nuclear installation.

Art. 20. - (1) The meteorological observations made at the closest level to the ground shall observe the international requirements for the synoptic observation.

(2) In this regard:

a) the temperature, pressure and humidity of the air as well as the precipitation are measured at 1-2 meters above ground level;

b) the direction and speed of the wind are measured at 10-30 meters from the ground, depending on the particularities of the terrain.

Art. 21. - (1) The equipment for measuring the speed and direction of wind shall be installed at 3 different heights: at 10-30 m (depending on the particularities of the terrain), on top of the meteorological tower and at an intermediate level.

(2) The measurement devices for wind speed shall be placed on two sides of the meteorological tower, so as to allow the correct measuring no matter where the wind blows from.

(3) The wind direction and the speed, as well as the air temperature shall be recorded with a frequency of at least once per hour.

(4) Air pressure and humidity shall be recorded with a frequency of once per hour.

Art. 22. - (1) For determining atmospheric turbulences, depending on the method used, sensors shall be placed on the meteorological tower, at different levels, correlated with the levels at which the wind sensors are placed.
(2) If, for determining the atmospheric turbulence, vertical temperature gradients are used, then the frequency, duration and moment of the measuring of temperature gradients shall coincide with frequency, duration and moment of recording wind data.
(3) If atmospheric stability is determined by visual observations of the percentage of cloud coverage at different times of the day, the observation hours of the cloud coverage and height of cloud formation shall be correlated with the recording hours of wind data.

Art. 23. - (1) Precipitation shall be recorded hourly.
(2) Intensity measurements, quantity and type of precipitation must be used in the evaluation of their impact on air and ground concentrations of the radioactive material released into the atmosphere.

Art. 24. - The meteorological data analysis shall comprise two stages:
a) determining average values of meteorological parameters on regulate intervals of time; and
b) statistical analysis of average values.

Art. 25. - (1) The averaging interval for temperature and wind characteristics (direction and speed) shall be of one hour at the most, while for the other meteorological parameters the averaging period shall be of one hour.
(2) Wind direction shall be averaged as a vectorial quantity, and the wind speed shall be averaged as a scalar quantity.

Art. 26. - Statistical analyses shall be used for the calculation of dispersion under normal operation (continuous emissions) and in case of nuclear accident (for prognosis, before the beginning of the emission or in case of prolonged or long-term emissions).

Art. 27. - (1) Meteorological parameters required in dispersion calculations shall be permanently displayed in the control chamber of the nuclear plant, for a rapid visualization in case of nuclear accident.
(2) In case of nuclear accident, meteorological data shall be available at the emergency response center of the nuclear installation, so as to be used in dispersion calculations.
(3) The authorization holder shall ensure the possibility of real-time transmission of meteorological data towards other responsible institutions in case of nuclear accident.

Art. 28. - In case of nuclear accident or in situations characterized by complex meteorological conditions, the meteorological data obtained locally shall be completed with relevant data from the national meteorological network.

CHAPTER III

Requirements for the program on hydrological measurements in the area of influence of the nuclear installations

Art. 29. - (1) Before launching the program on hydrological measurements, the potential ways of radioactive contamination of the surface waters and underground waters must be identified, by geological and hydrological studies in the region.
(2) The extension of the hydrological network and the possible connections between surface waters and underground waters, in the area of influence of the nuclear installation, shall be identified.
(3) In case of connections between surface waters and underground waters, the exchange mechanisms between the surface water and underground water systems shall be determined, and the exchanged amount of water shall be estimated.

Art. 30. - (1) The hydrological measurement program executed on the surface waters in the area of influence of the nuclear installation shall be initiated starting from the design period of the nuclear installation, in order to obtain local specific hydrological parameters, required in the evaluation of the aquatic dispersion of the radioactive effluents discarded in the environment by the nuclear installation.
(2) For the evaluation of the radiological impact of the nuclear installation on underground waters, besides hydrological measurements of surface waters, underground water samples shall be drawn and analyzed periodically and also in special circumstances from drilling and wells, but also from locations in which underground waters reach the surface, like springs or natural depressions.

Art. 31. - The hydrological measurement program shall continue over the entire operating period of the nuclear installation and over the decommissioning period, until the issue of the CNCAN approval for the unrestricted use of the site.

Art. 32. - (1) The results of the hydrological measurement program shall be used:
a) in order to prove that the chosen location for building the nuclear installation is suitable and in compliance with the requirements imposed by CNCAN;
b) in order to choose dispersion patterns that are in accordance with the specific character of the site;
c) in order to set the derived limits of the emission of the liquid radioactive effluents discharged into the environment by the nuclear installations;
d) in order to assess the radiological consequences of the emission of liquid radioactive effluents for the population and environment;

e) as a support in drawing up of a radioactivity surveillance program for the environment within the area of influence of the nuclear installation;
f) as a support in drawing up of intervention plans for the nuclear installation in case of nuclear accident.
(2) The hydrological data obtained during the period before the building of the nuclear installation shall be compared with the data obtained after its building, but before its commissioning, in order to consider the possible changes intervened in the local hydrological conditions and to make, if necessary, certain modifications of the design bases or the calculation templates.

Art. 33. - The frequency of sample drawing, the nature, and the accuracy of hydrological data shall be compatible with the mathematics templates and the calculation techniques in which data shall be used as entry parameters for the evaluation of aquatic dispersion and additional discharges to population, under normal operation, transient situations or nuclear accident.

Art. 34. - The hydrological measurement program for surface waters (represented by river and canal-like hydraulic structure) shall allow the obtaining of all hydrological parameters provisioned by the Norms on the dispersion calculation of radioactive effluents discharged into the environment by the nuclear power plants.

Art. 35. - **(1)** The hydrological data analysis shall comprise two stages:
a) determination of the average values of hydrological parameters on regulate intervals in time; and
b) statistical analysis of average values.
(2) Monthly average values of all recorded hydrological parameters shall be stored and kept over the entire operating period of the nuclear installation.

CHAPTER IV

The control of the National Regulatory Authority

Art. 36. - **(1)** The meteorological measurements program and the hydrological measurements program shall have been previously approved by CNCAN.
(2) In order to obtain the approval mentioned at par. (1), the authorization holder shall justify the content and quality of the meteorological (on site) and hydrological (in the area of influence of the nuclear installation) measurement programs.

Art. 37. - In the preliminary safety analysis, the Preliminary Safety Analysis Report and Final Safety Analysis Report of the nuclear installation, the way in which the requirements of these norms were implemented shall be presented.

Art. 38. - **(1)** The on site meteorological and hydrological conditions, respectively in the area of influence of the nuclear installation, shall be revised and permanently amended based on meteorological and hydrological local measurements, made during the entire operating period of the nuclear installation.
(2) The results of the on site meteorological and hydrological measurements shall be periodically transmitted to CNCAN for information.
(3) The periodicity of the reports shall be approved by CNCAN as part of the authorization process of the nuclear installation.

CHAPTER V

Transitory and final provisions

Art. 39. - These norms enter into force on the date of their publishing into the Official Law Bulletin of Romania, Part I.

Art. 40. - The holders of authorizations for nuclear installations, valid at the date of entry into force of these norms, shall integrate themselves with the provisions within 12 months at the most.

Art. 41. - Attachments no. 1 and 2 are an integral part of theset norms.

ATTACHMENT No. 1(to norms)

DEFINITIONS

The National Commission for Nuclear Activities Control (CNCAN) – the competent national authority in the nuclear field that exercises the regulatory, authorization and control attributions according to Law no. 111/1996 on the safe deployment of nuclear activities, republished, with subsequent modifications and completions.
Wind direction – the direction from which the wind blows and it is appreciated (counterclockwise, starting from the geographic North) according to the 16 sectors of the horizon.
Dispersion:
- the tendency of particles (for example radioactive particles) of spreading into the respective fluid because of the variations at small scale of the fluid speed;
- scattering of air constituents, such as atmosphere pollutants.

It can be the result of molecular diffusion, of turbulent mixture or of average tearing of the wind.
Radioactive emission - the process of discharging the radioactive effluent into the environment.
Temperature gradient – a vector that characterizes the decrease in temperature of the atmosphere on the distance unit, oriented with respect to the surface normal in isotherms.
The cloud coverage of the sky:
- the total amount of the clouds observed on the sky;
- the degree of coverage with clouds of the sky, expressed in tens of covered sky.
Synonym: nebulousness.
Synoptic observation – meteorological observation made simultaneously at all stations on the planet in order to obtain an image of the weather conditions at a given moment; it is made at standard synoptic hours.
Orography of the terrain—part of the physical geography that deals with description, classification and study of relief on land.
Atmospheric precipitation – all products of condensation and crystallization of water vapors in atmosphere, that usually fall from the clouds and reach the ground surface under liquid, solid or both forms at the same time.
Atmospheric pressure – the force exercised by the weight of the atmosphere against the horizontal surface, being equal to force on a surface unit (1 cm^2) of the vertical column of air, which lasts from the given surface to the superior limit of the atmosphere; the unit of measure in the IS is Newton/m^2; in the meteorological practice there are used the millibar (mb), hectopascal (hPa) and the millimeter of mercury (mm Hg).
Wind rose – graphic representation of the frequency of winds in different directions.
Synonym: the wind condition to the ground level.
Doppler Sodar system – Doppler system with emission-reception of acoustic waves.
Air temperature – a quantity that characterizes the heating or cooling status of the atmosphere, close to the ground surface. In meteorology, the air temperature is one of the most important parameters of the air status, a direct result of the interaction between circulation and radiation processes with the ground surface.
Topography – detailed description of a place, dealing with setting, configuration, etc; way in which the elements of a whole are disposed in space.
The transport of radionuclides – the movement (migration) of radionuclides in the environment; it can include processes like advection, diffusion, sorption and incorporation.
Atmospheric turbulence – status of fluid (air) characterized by a turbulent movement.
Air humidity – water vapor quantity contained in a unit of measure of the air volume.
Wind – air movement against ground surface; usually, the horizontal component is taken into consideration; it is defined by two elements: direction from which the wind blows and speed, both extremely variable in time and space. Wind as horizontal movement appears under the action of baric gradient force, being then deviated by the friction force, Coriolis force and centrifuge force.

ATTACHMENT No. 2 to norms

UNCERTAINTIES

associated with the specifications of meteorological measurement equipment

Uncertainties associated with the specifications of meteorological measurement equipment are due both to internal factors that depend on the measurement devices, and to external factors that are determined by variations in atmospheric conditions throughout the year.
When dispersion parameters are calculated based on the temperature gradient and wind measurements, the accuracy of the measurements must fall within the following limits:
Wind speed:
> ±0,2 m/s, if wind speed <2 m/s (minimum speed indicated by anemometer is of 0,4 m/s);
> ±5%, if wind speed >2 m/s.
Wind direction: ±5°
Temperature: ±0,15°C
Temperature gradient: ±0,2°C/100 m
Precipitation quantity: ±0.2 mm
Precipitation period: ±1 min.
Atmospheric pressure: ±0,3 hPa (mbar)
Relative humidity: ±5%.
When wind vanes are used for determining horizontal fluctuation of wind, the accuracy of measurement must be of ±1°.
Sensors measure wind direction on the meteorological tower with an accuracy of ±5°.
Temperature sensors and the measuring system of the temperature gradient are measured at the meteorological tower with an accuracy of ±0,3°C.
Doppler Sodar system must be oriented with a precision of ±3°. Its manipulation must be calibrated and the directions of transmission-reception must be verified at least once a year. The system calculates the components of

the wind in the mixture stratum at least every 50 meters, until a maximum height that depends on meteorological conditions is reached. Data are converted into speed and wind direction, fluctuation of wind direction, dispersion parameters and height of the inversion stratum.
Instruments and measuring systems must be protected against external factors such as: solar radiation, lightning, ice, storms and corrosive agents.
Instruments must be regularly checked and tested, according to a previously established schedule.
The results of verifications and tests made, as well as any information regarding possible repairs, must be registered and kept.