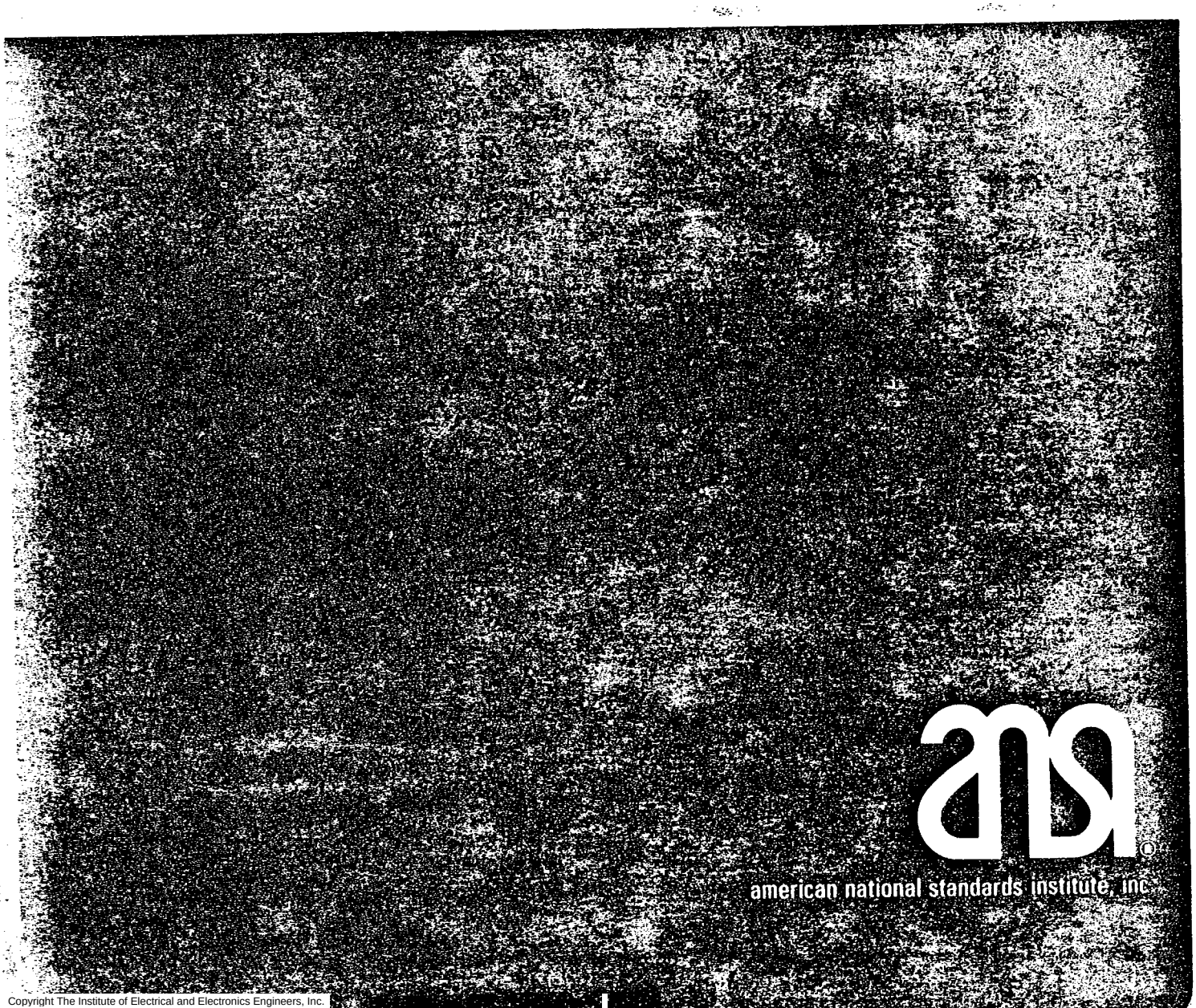
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American National Standard

performance specifications for reactor emergency radiological monitoring instrumentation



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ANSI N320-1979

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Secretariat for N42

Institute of Electrical and Electronics Engineers, Inc

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Foreword

(This Foreword is not a part of ANSI N320-1979, American National Standard Performance Specifications for Reactor Emergency Radiological Monitoring Instrumentation.)

This standard was prepared under the joint sponsorship of the American National Standards Committee N42 on Radiation Instrumentation and the American National Standards Committee N13 on Radiation Protection. The members of both N42 and N13 reviewed and approved this standard.

The performance specifications herein were developed by Battelle Northwest Laboratory through collaboration with principal manufacturers and industry as well as with acknowledged experts in principal government laboratories. The work was performed under USAEC contract.

At the time it approved this standard, the American National Standards Committee on Radiation Instrumentation had the following personnel:

Louis Costrell, *Chairman* **David C. Cook,** *Secretary*

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American Conference of Governmental Industrial Hygienists	Jesse Lieberman
American Industrial Hygiene Association	*Vacant*
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American National Standard Performance Specifications for Reactor Emergency Radiological Monitoring Instrumentation

1. Scope

This standard defines, for various types of instrumentation, the essential performance parameters, and general placement for monitoring the release of radionuclides associated with a postulated serious accident at a reactor facility. *This standard does not specify which of the instruments or systems are required nor does it consider the number or specific locations of such instruments.* This standard also does not address *single failure criteria* associated with nuclear safety instrumentation. For the purpose of this standard, the predominant consideration in the assessment of radiation emergencies is the measurement of fission products promptly enough to permit timely emergency decisions to be made.

Where instruments utilized for routine operations fulfill the criteria herein, they need not be duplicated in order to have separate emergency instrumentation. Dual purpose instrumentation must meet the requirements of this standard.

1.1 Introduction. Regulatory agencies require the development of comprehensive emergency plans for nuclear reactor facilities. Such plans must include the provision of adequate radiological instrumentation to detect and quantify accidental releases of radioactivity from these facilities. This standard presents performance criteria for instrumentation for detecting and quantifying such release of radioactive materials. The criteria are based on estimates of the quantity and characterization of radioactive material that could escape as a result of a postulated accident at a reactor facility (see definitions for auxiliary building(s), calibrate, and check). Throughout these criteria, three verbs have been used to indicate the degree of rigor intended by the specific criterion. The word *shall* is used to denote a requirement, the word *should* to denote a recommendation, and the word *may* to denote permission, neither a requirement nor a recommendation.

It is important that instruments, systems, or individual components intended for emergency application be:

(1) Qualified for use under extreme conditions

(2) Preoperationally tested over the entire range of operation

(3) Periodically checked and calibrated according to an appropriate calibration program

The criteria herein apply only to instrumentation installed or located at the reactor facility and intended for use by facility personnel in the conduct of emergency operations. *Instrument selection will of necessity be determined on a case by case basis considering individual facility emergency plans and site specific parameters.* These plans involve several elements including measurement of meteorological parameters, establishment of communications, arrangement for off-site work support personnel, identification of capabilities, capability of detecting emergency conditions, and quantifying releases.

2. Definitions

auxiliary building(s). Building(s), near or adjacent to the reactor containment building in which primary system support equipment is housed.

calibrate. To determine the response or reading of an instrument relative to a series of known radiation values over the range of the instrument.

check. To determine if the detector and all electronic components of a system are operating satisfactorily by determining consistent response to the same source.

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check source. A radioactive source, not necessarily calibrated, which is used to confirm the continuing satisfactory operation of an instrument.

containment. A structure or vessel which encloses the components of the reactor coolant pressure boundary or which serves as a leakage limiting barrier to radioactive material that could be released from the reactor coolant pressure boundary, or both.

effluent. Liquid or airborne radioactive materials released to the environs.

environs. The uncontrolled area at or near the site boundary.

extracameral. Pertaining to that portion of the instrument exclusive of the detector.

precision. The degree of agreement of repeated measurements of the same property, expressed quantitatively as the standard deviation computed from the results of the series of measurements.

range. The set of values lying between the upper and lower detection limits.

reactor. As used in this standard, reactor means a nuclear reactor designed for and capable of operation at a steady state reactor power level of $\geqslant 1\ MW_{th}$.

reactor facility. The structures, systems and components used for the operation of a nuclear reactor. If a site contains more than one nuclear reactor, reactor facility means all structures, systems and components used for operation of the nuclear reactors at the site.

readout. The device that conveys information regarding the measurement to the user.

3. References

When the following American National Standards referred to in this document are superseded by a revision approved by the American National Standards Institute, Inc, the latest revision shall apply.

ANSI C18.1-1972, American National Standard Specifications for Dry Cells and Batteries.

ANSI N13.1-1969, American National Standard Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities.

ANSI N13.5-1972, American National Standard Specifications for Direct Reading and Indirect Reading Pocket Dosimeters for X- and Gamma Radiation, Performance.

ANSI N323-1978, American National Standard Radiation Protection Instrumentation Test and Calibration.

4. General Consideration for Emergency Instrumentation

The criteria contained herein concern the basic elements of an emergency radiological instrumentation program. This standard does not specify which of the instruments or systems are required nor does it consider the number of specific locations. These determinations are made by qualified individuals and regulatory authority. A distinction is made between instrumentation essential to inplant monitoring and that for monitoring in the environs. Primary emphasis is placed on the selection of instruments and instrument systems and on their ability to provide data rapidly as basis for making appropriate emergency action decisions. The instrumentation should include both installed systems, herein referred to as systems, with appropriate readouts and portable instruments, since either portable or installed instrumentation alone may provide incomplete information.

4.1 Instrumentation for Monitoring Emergency Conditions within the Reactor Facility. Several types of emergency instruments or instrumentation systems should be available at the reactor facility to characterize severity and extent of an accident. These should include:

(1) Installed instrumentation systems with remote readout to a safe location capable of characterizing releases to containment and auxiliary buildings and the radiological problems associated with evacuation and reentry. These systems should be provided with a remote readout at a location which will be habitable under accident conditions.

(2) Portable survey instruments to supplement installed instrument systems to permit estimation of exposure to persons, to locate radiation sources and determine their distri-

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bution, and to make radiological measurements that may become of *ad hoc* interest at locations not covered by installed instrumentation.

In determining the type of instrumentation required, the following apply:

4.1.1 Continuous measurement of airborne radioactivity in the containment is necessary.

4.1.2 Where appropriate, air sampling systems shall be consistent with the requirements stated in ANSI N13.1-1969, American National Standard Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities.

4.1.3 Remote area monitoring systems are necessary for measuring the ambient radiation field at points within the reactor facility. The system should be capable of measurement over a wide spectrum of energies and range of exposure rates.

4.1.4 High range monitoring systems are necessary for assessment of effluent radioactive material.

4.1.5 High range portable survey instruments and personnel dosimeters are necessary to permit rapid assessment of high exposure rates and time-integrated dose.

4.1.6 Instrumentation should be capable of performing as intended, considering the total environment to which the instrumentation will be exposed during emergencies. Physical protection is usually necessary.

4.2 Instrumentation at or near a Reactor Facility for Assessing a Radioactive Material Release Resulting from an Emergency Condition. The following general considerations apply to installed and portable instrumentation for the evaluation of the quantity of radioactive material released from a reactor facility during accident conditions.

4.2.1 For direct measurement of channeled releases, such as those in a stack, the range capability should be consistent with potential accident release levels including an appropriate margin.

4.2.2 The measurement capability should be unaffected by expected high radiation fields and other adverse environmental conditions.

4.2.3 In the absence of capability for direct measurement of the release rate from the primary containment, total release rates may be estimated using instruments or systems which have been located at or near the reactor facility.

NOTE: If this type of assessment is employed, it is important to provide an evaluation method to relate the instrument measurements to the release rate and to translate the information via dispersion calculations to predicted downwind concentrations.

4.3 Instrumentation at a Distance from a Reactor Facility for Assessing the Radioactive Material Released During an Emergency Condition. Assessment of radioactive material away from the reactor facility is accomplished primarily with portable instruments or laboratory analysis of samples since it is impractical to instrument and monitor continuously more than a few locations of particular interest with fixed ac power instruments. Nonportable instrumentation installed in specially equipped vehicles may be deployed as occasion demands.

5. Criteria for Radiological Instrumentation Systems

The following criteria are generally applicable to all emergency radiological instrumentation systems specified in Sections 6, 7.2 and 8.

5.1 A normally active internal audit circuit which tests both the detector and electronics shall be provided and shall present an appropriate signal at a centrally manned location in the event of a malfunction or failure.

NOTE: While outside the scope of this standard, it is recommended that all monitoring systems outside of containment be calibrated at least annually with a source. Systems in containment should be calibrated with a source on a schedule compatible with outages, but no less frequently than every 18 months.

5.2 Instrument systems operating on ac should be capable of operation over the range 103-130 V AC and 50 or 60 Hz ± 3 Hz as appropriate for the installation.

5.3 Emergency power shall be provided for all systems and shall be automatically implemented when required. Instrumentation shall be capable of automatically returning to normal operation after undergoing switching transients.

5.4 When responding to radiation levels in excess of the maximum range and confirmed by a test up to 10 times that value, the instrument system under test shall continue to read out and remain full upscale until the source is removed and shall then return to the ambient level within 1 minute.

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5.5 Switches and other controls shall be protected to avoid inadvertent deactivation or inadvertent maloperation of system.

5.6 The ranges of emergency instrumentation systems should overlap the ranges of instrumentation systems for routine or nonemergency monitoring. (The minimum ranges specified herein generally assume a one decade overlap.)

5.7 Overall system accuracy (does not include sample accuracy) shall be within ± 40 percent at the 95 percent confidence level over the entire operating range, with precision within ± 15 percent for any single measurement level.

NOTE: Geometry and shielding factors that cannot be simulated when determining accuracy should be accounted for by a documented error analysis using appropriate calculational methods.

5.8 Overall electronic system response time (10 to 90 percent of the true reading) on the maximum range shall be ⩽ 3 seconds. On all other ranges the system response time shall be no greater than 5 seconds.

5.9 There shall be no deleterious effect to the system from radiofrequency field intensities to 100 V/m using a spark discharge method for testing, microwave exposures to 10 mW/cm^2, or external electrostatic fields of 500 V/cm.

5.10 The emergency instrumentation shall be capable of withstanding the radiation levels existing post accident at their location for the length of time the instrument is required as indicated by the safety analysis for the facility. In the absence of such analysis, components located outside the containment shall function such that there shall be no deleterious effects from photon exposures of up to 5×10^5 R, referenced to the energy range between 0.6 and 1.3 MeV. Components located inside the containment shall be capable of withstanding exposures of up to 10^8 R, referenced to the same energy range.

5.11 The system shall operate within specifications for the temperature extremes anticipated. Where the instrumentation may be exposed directly to ambient outside temperatures, the 50 year extremes shall be applied and temperature build-up inside protective enclosures shall be accommodated.

5.12 For the anticipated operation temperature range the temperature coefficient shall be ⩽ 0.5 percent per degrees Celsius. The variations with temperature over the anticipated operating range should not produce a deviation of more than ± 15 percent from the reference value obtained at 20°C. Where the temperature range has a temperature span greater than 60°C, environmental protection should be provided, if necessary, to assure proper operation.

5.13 The instrument system shall function within specifications over all anticipated combinations of temperature and humidity.

NOTE: Testing will normally be conducted at a relative humidity within the range of 40 percent to 95 percent over a temperature range of 15°C to 65°C. The instrument system shall continue to operate properly after being cycled through the dewpoint at 20°C ± 10°C.

5.14 The system shall be able to withstand mechanical stress equivalent to the seismic requirements for the facility.

If located within the containment, the system shall also be able to withstand mechanical stress equivalent to the design peak overpressure requirements for the facility.

5.15 Logarithmic, quasilogarithmic, or digital readout scales should be considered. If multiple scales are used, automatic range changing shall be provided and the range that is in operation shall be clearly displayed.

5.16 Readout capability and alarms shall be provided in the control room. Readout and alarms should also be provided at or near the detector.

5.17 All units of similar function, including detectors, electronic modules, readout and display devices and power supplies, should be interchangeable. Operable spare units shall be available.

5.18 The units of the system should be capable of being functionally tested without removal from the instrument system.

5.19 Instrument systems shall be equipped with alarms capable of being externally set to alarm at any selected point within the stated range and shall continue to operate above the selected alarm points. Audible alarms shall be incapable of reset without active acknowledgements. Such acknowledge-

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ments shall retain the visual alarm until the signal is below the alarm setting. If the audible is not acknowledged, decrease of the signal below the trip setting shall not reset the visual alarm.

5.20 Unless otherwise specified, systems shall operate continuously, except during brief periods (generally less than 8 hours) when undergoing maintenance, calibration or repair, and then only if equivalent monitoring is provided by other instrumentation during this period.

6. Systems for Monitoring Conditions within the Reactor Facility

The criteria listed below are in addition to those presented in Section 5.

6.1 Containment Monitoring Systems for Radioactive Noble Gases

6.1.1 Systems for assessing concentrations of radioactive noble gases in the containment shall have continuous measurement capability.

6.1.2 The lower detection limit for noble gases shall be no greater than 10^{-2} Ci/m^3 ($10^{-2}\mu$Ci/cm^3). The upper detection limit shall be related to the steady state thermal power level and shall be no less than the value specified in Table 1.

6.2 Containment Monitoring Systems for Airborn Radiohalogens and Particulates

6.2.1 General. Monitoring for these materials normally involves a sequential filter system. The first stage is a particulate filter. This is followed by a second stage halogen adsorbing cartridge or filter. If the samples are to be collected at a location remote to the containment, attention shall be given to maintaining primary containment integrity, and to minimizing sample loss or distortion in transport tubing. Monitoring for particulates and halogens need not be accomplished on a continuous basis. If samples are to be removed from containment, extreme caution must be exercised to minimize personnel exposure and environmental contamination.

6.2.2 Sample System

6.2.2.1 Provision should be made to change filters periodically to maintain background at a practical minimum.

6.2.2.2 The system shall be designed to collect a representative sample.

Table 1
Upper Detection Limit for Noble Gases within the Reactor Containment and for Radioactive Material Released to the Environs via the Stack

Maximum Steady State Thermal Power Level, MW	Minimum Upper Detection Limit Ci/m^3
1001 to 5000	10^5
101 to 1000	10^4
11 to 100	10^3
1 to 10	10^2

6.2.2.3 The sample collection and delivery system should be designed in accordance with guidance provided with ANSI N13.1-1969.

6.2.2.4 Sample flow rate shall remain within ± 25 percent of the desired rate. An appropriately calibrated airflow meter shall continuously verify flow rate, and shall be accurate to within ± 10 percent.

6.2.3 Monitoring System

6.2.3.1 For particulate radioactivity the lower detection limit shall be no greater than 10^{-3} Ci/m^3 ($10^{-3}\mu$Ci/cm^3). The upper detection limit shall be related to the steady state thermal power level, and shall be no less than the value shown in Table 2.

6.2.3.2 For radiohalogens, the lower detection limit shall be no greater than 10^{-3} Ci/m^3 ($10^{-3}\mu$Ci/cm^3). The upper detection limit shall be related to the steady state thermal power level, and shall be no less than the value specified in Table 2. Both concentration and accumulated activity should be determined.

Table 2
Upper Detection Limit for Radiohalogens or Particulate Radioactive Material within the Reactor Containment

Maximum Steady State Thermal Power Level, MW	Minimum Upper Detection Limit Ci/m^3
1001 to 5000	10^4
101 to 1000	10^3
11 to 100	10^2
1 to 10	10

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6.3 Systems for Monitoring Exposure Rate within the Reactor Facility

6.3.1 General. The system shall be capable of measuring the gamma dose rate over a range of photon radiation energies from 100 keV to 3 MeV with an accuracy of ± 20 percent.

6.3.2 Exposure Rate Monitoring within the Reactor Containment

6.3.2.1 The minimum detection limit for photons shall be no greater than 1 R/h. The minimum upper detection level shall be related to the steady state thermal power level, and shall be no less than the value specified in Table 3.

6.3.2.2 Extracameral response should be less than 1 percent in photon fields of 1 R/h to 10^7 R/h at approximately 1 MeV energy.

6.3.3 Exposure Rate Monitoring in the Auxiliary Building, Where Required

6.3.3.1 The instrument system shall have a measurement range for photons of 10^{-1} to 10^4 R/h. If an integration mode is provided, its operation should be simultaneous with the rate mode and its range should be 10^{-1} to 10^5 R.

6.3.3.2 Extracameral response should be less than 1 percent in photon fields of 10^{-1} to 10^4 R/h at approximately 1 MeV energy.

Table 3
Upper Detection Limit for Exposure Rate within the Reactor Containment

Maximum Steady State Thermal Power Level, MW	Minimum Upper Detection Limit, R/h
1001 to 5000	10^7
101 to 1000	10^6
1 to 100	10^5

7. Instrumentation Systems for Detecting and Quantifying the Release to the Environs

The criteria listed below are in addition to those presented in Section 5.

7.1 Plume Detection. A method shall be readily available for estimating the quantity of airborne radioactive material released. This estimate may be accomplished using data from a monitoring system located in the environs which may also satisfy requirements in Section 8.

7.2 Stack Effluent Monitoring System. Stack monitoring instrumentation systems are of two types: (1) direct measurement; and (2) collection of a representative sample followed by monitoring of the sample. While direct measurement is less complicated, calibration is extremely difficult and for this reason it should be used only as a supplemental system. The criteria in 6.2.3 apply in addition to the criterion stated below; if the system involves sampling, the criteria in 6.2.2 also apply.

For the radioactive gaseous fraction, minimum detection limit shall be no greater than 10^{-2} Ci/m^3 (10^{-2} μCi/cm^3), and the maximum detection limit shall be related to the steady state thermal power level, and shall be no less than that specified in Table 1.

8. Installed Systems for Monitoring Conditions in the Environs

The criteria listed below are in addition to those presented in Section 5.

8.1 Air Monitoring. The system should be designed to collect a representative sample. The sampling should be free from the influence of unusual micrometeorological or other conditions (for example, proximity of large buildings, vehicular traffic) which could result in artificially high or low estimate of contaminant concentrations in air.

8.1.1 The field measurement shall have a range for particulate activity of 10^{-7} to 10^{-1} Ci/m^3 (10^{-1} μCi/cm^3) gross beta (100 keV and above).

8.1.2 For radioiodines, the field measurement shall have a range of 10^{-8} to 10^{-2} Ci/m^3 (10^{-2} μCi/cm^3).

8.2 Exposure Rate Monitoring. The criteria established for exposure rate monitoring in the environs are the same as those in 6.3.3 except the lower detection limit should be extended to 10^{-3} R/h.

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9. Portable Instrumentation

9.1 Rate Survey Instruments

9.1.1 In recognition of the difficulties in design and construction of a single detector or instrument, or both, with a broad range, two detectors or instruments are permissible, assuming that all the other criteria specified in this section are met, and that at least one decade overlap in range is provided.

9.1.2 The instrument(s) shall be capable of measuring photon exposure rates over the range 0.1 to 10^4 R/h.

9.1.3 Photon energy dependence should be within ± 20 percent over the range 100 keV to 3 MeV.

9.1.4 The instrument(s) should be capable of identifying the contribution from beta radiation and low energy photons over the range of 0.1 to 10^4 rad/h.

9.1.5 The beta energy dependence should be within ± 30 percent over the range 0.3 to 2 MeV E_{max} (β).

9.1.6 Overall accuracy shall be within ± 40 percent at the 95 percent confidence level for any level over the entire operating range, with precision within ± 10 percent for any single measurement level.

9.1.7 Overall instrument response time (10 to 90 percent of true reading) shall not exceed 3 seconds after a warmup time of 1 minute. This does not preclude the inclusion of variable response time capability. When the radiation field is removed, the instrument shall indicate within 3 seconds not more than 10 percent of the total reading in the field.

9.1.8 Instrument stability, at constant temperature and pressure, shall be within ± 3 percent of full scale or decade for a period of 3 hours after a 10 minute warmup.

9.1.9 For the operating temperature range the temperature coefficient shall be $\leqslant$ 0.5 percent per degrees Celsius. The variations with temperature over the anticipated operating range should not produce a deviation of more than ± 15 percent from the reference value obtained at 20°C.

9.1.10 The operating temperature range of the instrument shall encompass the extremes anticipated. Where the instrument may be exposed directly to ambient outside temperatures, the 50 year extreme shall be applied.

9.1.11 The instruments shall be watertight. They shall function within specifications over a range of 5 percent to 100 percent relative humidity over the temperature range of −30°C to +50°C. The instrument reading should not vary more than ± 10 percent when tested at relative humidities ranging from 40 percent to 95 percent over the temperature range of −30°C to +50°C. The instruments shall continue to operate properly after being cycled through the dewpoint at 20°C ± 10°C.

9.1.12 When responding to levels in excess of the maximum specified range, the instrument shall read and remain full upscale.

9.1.13 Extracameral response should be less than 1 percent in photon fields of 0.1 to 10^4 R/h at approximately 1 MeV energy, and to beta fields providing an air dose of 10 rad/h at approximately 2 MeV E_{max} (β).

9.1.14 The system shall be unaffected by magnetic fields with intensity up to 10 Oersteds.

9.1.15 The system shall be capable of withstanding harmonic g loadings applied to each of three mutually orthogonal axis in the frequency range of 1 to 33 Hz with no lasting detrimental effects. The magnitude of the g loading shall be the larger of 1 g or the maximum g forces anticipated in the individual project siting specifications.

9.1.16 There shall be no deleterious effect to the system from radio-frequency field intensity of 100 V/m using a spark discharge method for testing, microwave exposure to 10 mW/cm^2, photon exposure to 10^4 R at an energy of approximately 1 MeV and external electrostatic fields of 500 V/cm.

9.1.17 The instrument shall be designed to be powered by readily available cells or batteries such as AA, C, or D cells or 9-volt batteries meeting specifications in ANSI C18.1-1972, American National Standard Specifications for Dry Cells and Batteries. Compatibility with alkaline, Ni-Cd or mercury cells should be considered.

9.1.18 Minimum battery lifetime should be 100 hours of operation at an exposure level of 10 percent of the maximum full scale reading at temperatures from −30°C to +50°C. At temperatures below 0°C, alkaline batteries should be used.

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9.1.19 The instrument shall be equipped with a battery check switch and indicator of battery condition.

9.1.20 Change in reading with spatial orientation (geotropism) shall be ⩽ 3 percent of full scale reading.

9.1.21 Sensitivity shall be ⩽ 5 percent of midscale or the midpoint of each decade, where sensitivity is defined as the minimum detectable change in response.

9.1.22 Angular dependence shall be within ± 15 percent in a 2π steradian frontal direction, referenced to photons with energies in the region 0.6 to 1.3 MeV. This is not a requirement for instruments designed for a directional response.

9.1.23 Readout shall be direct and in units of dose or exposure per hour. However, high range instruments intended exclusively for rescue work may be calibrated in units of R/min or rad/min, and if so, the instrument and readout shall be clearly and distinctively marked. The readout should be such that multipliers (for example, X10, X100) shall be included.

9.1.24 Instrument calibration shall conform to ANSI N323-1978, American National Standard Radiation Protection Instrumentation Test and Calibration.

9.1.25 The total weight of a fully assembled hand-held survey meter, including batteries, should not exceed 3.5 kg (7.7 lb).

9.1.26 If the survey instrument is to be operated while carried (other than hand held), the following apply:

(1) The instrument should be capable of and designed for, convenient transportability by a single person. This criterion does not preclude the use of back packs, neck or shoulder straps, belts or other means of attachment to the body.

(2) The weight of the total instrument, including power source, should not exceed 22.5 kg (50 lb).

9.1.27 If the survey instrument is to be operated while mounted in an airplane, motor vehicle, or boat (mobile) the following should apply:

(1) Any of the instrumentation that may be used in an airplane should be designed to operate properly at the selected altitude and should be qualified so as not to interfere with radio and navigation instruments.

(2) Mobile instrumentation should be designed to provide a continuous recordable readout signal.

(3) Each separate portion of a mobile instrument should weigh less than 22.5 kg (50 lb).

9.2 Portable Air Samplers

9.2.1 The sampler shall be designed for use with a portable survey meter.

9.2.2 To simplify calibration, operation, and interpretation, a fixed sampling rate should be used. Sampling rate shall remain constant to within ± 25 percent during normal operation.

9.2.3 The unit shall be compatible with the filter media used for air sampling.

9.2.4 The power supply should be adequate for at least 4 hours under load.

9.2.5 Air flow rate shall be continuously indicated with an accuracy ± 20 percent by an appropriate clearly marked gage.

9.3 Direct Reading Dosimeters

9.3.1 Direct reading dosimeters shall meet the performance specifications established in ANSI N13.5-1972, American National Standard Specifications for Direct Reading and Indirect Reading Pocket Dosimeters for X- and Gamma Radiation, Performance.

9.3.2 The direct reading dosimeter shall have a range of 0 to 200 R where used for personnel involved in rescue work in which exposures to 100 R may be incurred. If used for other purposes, such as protection of property, the range shall be appropriate to the maximum permitted exposure.

9.3.3 The deviation of the sensitivity as a result of recombination shall not exceed 10 percent at a rate of 10^4 R/h.

9.4 Personal Alarm Dosimeters

9.4.1 Personal alarm dosimeters shall meet the criteria set forth in 9.1.1, 9.1.3, 9.1.6, 9.1.9, 9.1.10, 9.1.11, 9.1.17, 9.1.18, 9.1.19 and 9.1.20.

9.4.2 The personal alarm dosimeter shall have a range from 0 to 200 R.

9.4.3 A meter or other visual readout shall continually register the accumulated dose, and shall remain full upscale for exposures in excess of 200 R and confirmed by a test up to 2000 R.

9.4.4 An audible alarm should be presettable to any level over the range specified in 9.4.2. An external adjustment shall be provided along with external reset capability, protected from inadvertent operation.

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9.4.5 An alarm test position or switch shall be provided.

9.4.6 The weight of the dosimeter shall not exceed 300 g (10.5 oz).

10. Bibliography

[1] Technological Considerations in Emergency Instrumentation Preparedness — Phase II-A, Emergency Radiological and Meteorlogical Instrumentation Criteria for Reactors, BNWL-1635, May 1972.

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[3] DiNUNNO, J. J., ANDERSON, F. D., BAKER, R. E., and WATERFIELD, R. L. Calculation of Distance Factors for Power and Test Reactor Sites, TID-14844, 1962.

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