GUIDE YVL C.4

ASSESSMENT OF RADIATION DOSES TO THE PUBLIC IN THE VICINITY OF A NUCLEAR FACILITY

Definitions

Authorisation

According to Section 7 r of the Nuclear Energy Act (990/1987), *the Radiation and Nuclear Safety Authority (STUK) shall specify detailed safety requirements for the implementation of the safety level in accordance with the Nuclear Energy Act.*

Rules for application

The publication of a YVL Guide shall not, as such, alter any previous decisions made by STUK. After having heard the parties concerned STUK will issue a separate decision as to how a new or revised YVL Guide is to be applied to operating nuclear facilities or those under construction, and to licensees' operational activities. The Guide shall apply as it stands to new nuclear facilities.

When considering how the new safety requirements presented in the YVL Guides shall be applied to the operating nuclear facilities, or to those under construction, STUK will take due account of the principles laid down in Section 7 a of the Nuclear Energy Act (990/1987): *The safety of nuclear energy use shall be maintained at as high a level as practically possible. For the further development of safety, measures shall be implemented that can be considered justified considering operating experience, safety research and advances in science and technology.*

According to Section 7 r(3) of the Nuclear Energy Act, *the safety requirements of the Radiation and Nuclear Safety Authority (STUK) are binding on the licensee, while preserving the licensee's right to propose an alternative procedure or solution to that provided for in the regulations. If the licensee can convincingly demonstrate that the proposed procedure or solution will implement safety standards in accordance with this Act, the Radiation and Nuclear Safety Authority (STUK) may approve a procedure or solution by which the safety level set forth is achieved.*

With regard to new nuclear facilities, this Guide shall apply as of 1 April 2019 until further notice. With regard to operating nuclear facilities and those under construction, this Guide shall be enforced through a separate decision to be taken by STUK. This Guide replaces Guide YVL C.4 (17.03.2015).

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1 Introduction

101. The use of nuclear energy is prescribed for in the Nuclear Energy Act (990/1987) and Nuclear Energy Decree (161/1988). Under Section 7 q of the Nuclear Energy Act, the Radiation and Nuclear Safety Authority has issued regulations on the safety of a nuclear power plant (STUK Y/1/2018), the emergency arrangements of a nuclear power plant (STUK Y/2/2018) and the safety of disposal of nuclear waste (STUK Y/4/2018). The Radiation Act (859/2018) and the Government Decree on ionising radiation (1034/2018) contain general provisions for limiting radiation exposure. **[**2019-03-15 **]**

102. Section 6 of the Nuclear Energy Act (990/1987) stipulates that *the use of nuclear energy must be safe; it shall not cause injury to people, or damage to the environment or property.* **[**2015-03-17 **]**

103. Under Section 7 c of the Nuclear Energy Act (990/1987), *releases of radioactive materials caused by the use of nuclear energy shall be limited in compliance with the principle of optimisation of radiation protection laid down in section 6 of the Radiation Act* (859/2018). *In the optimisation of radiation protection, dose constraints in accordance with Section 9 of the Radiation Act* (859/2018) *shall be used.* Section 6 of the Radiation Act (859/2018) states that *to optimise radiation protection, occupational exposure and public exposure to ionising radiation shall be kept as low as is reasonably achievable.* **[**2019-03-15 **]**

104. Section 7 of the Radiation Act (859/2018) states that in radiation practices, *the radiation dose of members of the public may not be higher than the dose limit (principle of limitation).* The dose limits for members of the public are presented in Section 14 of the Government Decree on ionising radiation (1034/2018). Section 22 b of the Nuclear Energy Decree (161/1988) defines the constraints for the annual dose for an individual of the population during normal operation, anticipated operational occurrences and accidents at nuclear power plants. **[**2019-03-15 **]**

105. Section 4(1) of the STUK Regulation STUK Y/2/2018 states that *the licensee shall be prepared to carry out the measures required in emergency situations, the analysis of emergency situations and the consequences thereof, assessment of the anticipated development of emergency situations, the mitigatory actions needed to control or limit the accident, the continuous and effective exchange of information with the authorities, and communications to the media and the members of the public.*
Section 4(2) of the STUK Regulation STUK Y/2/2018 states that *when analysing the situation, the technical status of the plant and release of radioactive materials, or threat thereof, and the radiation situation inside the plant, in the site area and in the emergency planning zone, shall be*

assessed. **[**2019-03-15 **]**

106. Section 4(3) of the STUK Regulation STUK Y/2/2018 states that *in emergency situations, the licensee shall be prepared to carry out radiation monitoring in the site area and in the precautionary action zone. The licensee shall also take meteorological measurements and shall be capable of assessing the dispersion of radioactive substances and the resulting radiation exposure of the public in the emergency planning zone during an emergency situation.* **[**2019-03-15 **]**

107. Under Section 22 d of the Nuclear Energy Act (161/1988), *the constraint for the annual dose of an individual of the population, arising from the normal operation of a nuclear waste facility, is 0.01 millisievert.* The provisions of Section 22 b of the Decree on the constraints for the annual dose of an individual of the population during anticipated operational occurrences and accidents at nuclear power plants are also applied to nuclear waste facilities. Under Section 22 d of the Decree*, in any assessment period after the closure of the disposal facility, during which the radiation exposure of humans can be assessed with sufficient reliability and which shall extend at a minimum over several millennia: 1) the annual dose of the most exposed people shall remain below the value of 0.1 millisievert; and 2) the average annual doses to other people shall remain insignificantly low. During assessment periods after the period in question, average quantities of radioactive materials over long time periods, released into the living environment from the disposed nuclear waste, shall remain below the maximum values confirmed separately for each radionuclide by the Radiation and Nuclear Safety Authority.* **[**2019-03-15 **]**

108. Section 24(2)(6) of the Nuclear Energy Decree states that for each nuclear facility project, the application for a decision-in-principle from the Government shall be enclosed with *an environmental impact assessment report drawn up according to the Act on the Environmental Impact Assessment Procedure (252/2017).* A description of the effects of the nuclear facility on the environment must also accompany an application for a construction licence, as required under section 32(1)(7) of the Nuclear Energy Decree. **[**2019-03-15 **]**

109. The list of projects in the Appendix 1 of the Act on Environmental Impact Assessment Procedure (252/2017) states that the assessment procedure shall be applied to nuclear power plants and other nuclear reactors, as well as their dismantling or decommissioning, under Section 7 b, and plants designed for the processing of irradiated nuclear fuel or high-level waste and for the disposal of irradiated nuclear fuel under Section 7 d. Under the Government Decree on Environmental Impact Assessment Procedure (277/2017), the assessment report shall

contain, on a sufficient scale, *likely releases and residues* taking into account the utilisation stages of the project, including possible demolition (Section 4, paragraph 1 of the Decree), *an estimate of any accidents and their results* (paragraph 5), *an estimate and description of the likely significant environmental impact of the project and its reasonable alternatives* (paragraph 6) and *a proposal for action to avoid, prevent, mitigate and eliminate identified significant adverse environmental impact* (paragraph 10). **[**2019-03-15 **]**

110. Under section 35(1) of the Nuclear Energy Decree, when applying for a construction licence, the applicant shall submit to STUK *a preliminary safety analysis report, which shall include the general design and safety principles of the nuclear facility, a detailed description of the site and the nuclear facility, a description of the operation of the facility, a description of the behaviour of the facility during accidents, a detailed description of the effects that the operation of the facility has on the environment, and any other information considered necessary by the authorities.* **[**2019-03-15 **]**

111. Section 36 of the Nuclear Energy Decree states that when applying for an operating licence, the applicant shall submit to STUK a final safety analysis report and any other information considered necessary by STUK (including detailed descriptions of the calculation methods used). **[**2015-03-17 **]**

2 Scope of application

201. This Guide gives the detailed requirements applicable to the licence applicant and licensee for meteorological measurements at a nuclear power plant, and the calculations for assessing the dispersion of radioactive substances and radiation doses to the population in its surroundings. The requirements in the Guide shall also apply to other nuclear facilities, where applicable. STUK will, if necessary, issue a separate decision regarding how the requirements in this Guide should be applied to other nuclear facilities. **[**2015-03-17 **]**

202. This Guide applies to the design, construction, commissioning and operation of a nuclear facility. The Guide applies to a plant's normal operation as well as operational occurrences and accidents. **[**2019-03-15 **]**

203. Guide YVL D.4 "Predisposal management of low and intermediate level nuclear waste and decommissioning of a nuclear facility" applies to the decommissioning of a nuclear facility. **[**2019-03-15 **]**

204. Guide YVL C.3 "Limitation and monitoring of radioactive releases from a nuclear facility" presents the requirements for the limiting and monitoring of the emissions of radioactive substances from a nuclear facility and the radiation exposure of the population in its vicinity. The requirements for radiation monitoring systems and equipments are described in Guide YVL C.6 "Radiation monitoring at a nuclear facility". Guide YVL C.5 "Emergency arrangements of a nuclear power plant" presents the requirements for emergency preparedness arrangements at a nuclear power plant and for the radiation protection procedures to be followed in emergencies. The requirements for radiation monitoring of the environment of a nuclear facility are given in Guide YVL C.7 "Radiological monitoring of the environment of a nuclear facility". **[**2019-03-15 **]**

205. Guide YVL A.1 "Regulatory oversight of safety in the use of nuclear energy" deals in detail with the control of the safe use of nuclear energy. The requirements for regular reporting on the operation of a nuclear facility are given in Guide YVL A.9 "Regular reporting on the operation of a nuclear facility". **[**2019-03-15 **]**

206. The requirements for the design of the safety systems of a nuclear power plant are set out in Guide YVL B.1 "Safety design of a nuclear power plant", those for the classification of the systems, structures and equipments of a nuclear facility are given in Guide YVL B.2 "Classification of systems, structures and components of a nuclear facility", those for deterministic safety analyses are given in Guide YVL B.3 "Deterministic safety analyses for a

nuclear power plant", and those for preparing for internal and external hazards are given in Guide YVL B.7 "Provisions for internal and external hazards at a nuclear facility". Guide YVL E.7 "Electrical and I&C equipment of a nuclear facility" contains the requirements for electrical and I&C equipment. **[**2019-03-15 **]**

3 Meteorological measurements

3.1 General principles

301. During the construction and normal operation of a nuclear power plant, or in the event of operational occurences or accidents, the licensee shall conduct meteorological measurements in the vicinity of a nuclear power plant in such a way that the results and information relating to releases of radioactive materials serve to make estimates of the dispersion of the releases in the atmosphere and the exposure of radiation caused to the population inside the emergency planning zone, at a minimum. **[**2019-03-15 **]**

302. In order to allow an assessment to be made of the dispersion of radioactive substances and of radiation doses to the population, the meteorological measurements of the nuclear power plant shall be carried out to obtain, at a minimum, information on wind direction and speed, the stability of the atmospheric boundary layer, and precipitation. **[**2015-03-17 **]**

303. When a nuclear power plant is located on the seashore, information shall be obtained on the stability of the boundary layer at the site and that of the boundary layer above land and sea in the near-field of the plant. **[**2015-03-17 **]**

304. Archipelago, warm cooling water in the area and the land/sea breeze phenomenon may affect the measurements and their results. The effect of the different factors on the measurement shall be assessed and taken into account during the design of the system and the application of the measurement results. **[**2019-03-15 **]**

305. The meteorological measuring systems at a nuclear power plant shall have at least one sufficiently tall weather mast for the measurements. **[**2015-03-17 **]**

306. The need for additional masts and observation stations shall be assessed with reference to local environmental factors. The observations of other meteorological stations located in the near-field of the nuclear power plant can be used to assess the dispersion of radioactive materials in the environment. **[**2015-03-17 **]**

307. Meteorological measuring systems at a nuclear power plant and their data transfer systems shall function reliably with respect to mast measurements under exceptional environmental conditions. **[**2015-03-17 **]**

308. The structures of the equipment located on the weather mast and mast at a nuclear power plant shall withstand a load caused by very exceptional wind and freezing conditions in accordance with Appendix B. **[**2015-03-17 **]**

309. The nuclear power plant shall have in place a contingency plan for cases where the meteorological measurements are lost due to rare external events (DEC C), for example. **[**2015-03-17 **]**

310. The control room and the emergency centre of a nuclear power plant shall be fitted with displays of the meteorological measurement results necessary for dispersion calculations and of the quantities calculated on their basis. The results of measurements shall be processed in such a manner that they are also available to STUK and the Finnish Meteorological Institute, reliably and in real time. **[**2015-03-17 **]**

311. The measurement results shall be recorded in a way that enables the meteorological conditions at a given time to be examined subsequently, and that allows the results to be used as statistical data concerning different dispersion scenarios in probabilistic safety analyses. **[**2015-03-17 **]**

3.2 Technical requirements for the measuring instruments

312. Meteorological measurements in the vicinity of a nuclear power plant shall primarily be conducted with the aid of continuous-operation measuring instruments located on weather masts or a combination of weather masts and a system intended for weather measurements of the lower-level atmosphere carried out vertically. **[**2015-03-17 **]**

313. In most conditions, it is possible to obtain weather observations from considerably higher levels than with a mast, using a measurement system intended for vertical weather measurements of the atmosphere (for example, with a sounding system, Appendix A). Even when using such a measurement system, there shall also be at least one weather mast in the vicinity of the nuclear power plant. **[**2015-03-17 **]**

314. Weather masts and their measuring sensors and other weather measuring sensors shall be located in such a manner that the power plant buildings, mast structures, surrounding terrain and other buildings have no disturbing effect on the measurement results. **[**2015-03-17 **]**

315. The observation point shall be high enough to obtain representative wind values and to determine the stability of the boundary layer and, if necessary, the turbulence for dispersion studies. **[**2015-03-17 **]**

316. The air temperature, air pressure, relative humidity as well as precipitation and time of precipitation shall be measured near the ground surface. The measurements shall generally meet the international requirements for synoptic observations. **[**2015-03-17 **]**

317. The lowest mast measurements on the weather mast shall be carried out 2–3 times as high as the average height of the roughness elements (such as trees) in the surrounding area. The highest measuring height shall be no less than the height of the power plant's ventilation stack. **[**2015-03-17 **]**

318. The measuring sensors for temperature and wind measurements on the weather mast shall be located at one measuring height between the above-mentioned heights, at a minimum. **[**2015-03-17 **]**

319. Anemometers shall be located at each separate level in two directions at a disturbance-free distance from the mast, and their measuring sensors shall be fitted with a heating system to ensure their operation all year round. **[**2015-03-17 **]**

320. Temperature sensors shall be protected from the direct heating effect of the sun. **[**2015-03-17 **]**

321. The power supply to the measurement and data transfer systems for mast measurements shall be backed up by means of a secured system in the event of the loss of off-site power for 72 hours. **[**2015-03-17 **]**

322. The measurement systems shall meet the single failure criterion at least for measurements of wind direction and speed and determining the stability of the lower-level atmosphere. Furthermore, the measuring data transfer from the mast at the facility to the power plant site shall meet the single failure criterion. **[**2015-03-17 **]**

323. Weather measurement and data transfer systems on additional masts located further away shall be installed in such a way that they operate reliably and provide complementary data on the dispersion conditions in the vicinity. **[**2015-03-17 **]**

324. The weather mast and the measuring instruments on a weather mast shall be designed and implemented so that they comply with the requirements described in items B01, B02 and B03 of Appendix B. **[**2019-03-15 **]**

325. The measurement system shall be designed and installed in accordance with Guides YVL B.1 and YVL E.7. **[**2015-03-17 **]**

3.3 Maintenance of the measurement system

326. The meteorological measurement system and related instruments at a nuclear power plant shall be subjected to inspections and tests at regular intervals in accordance with a programme drawn up in advance. The calibration of the measurements shall be verified at intervals specified in the manufacturer's operating instructions and based on experience. The inspection and test results and details of repairs to, and maintenance of, the measuring instruments shall be documented. If the instruments are adjusted or replaced during inspection, documents shall be kept which contain the results of the inspection of both the instrument removed from the mast and the instrument installed on the mast. **[**2015-03-17 **]**

327. The measurement systems for temperature and humidity shall be designed and installed in such a manner that the measuring sensors can be checked and calibrated in accordance with the accuracy requirements given in the Appendix B. **[**2015-03-17 **]**

328. The weather mast's structural condition shall be checked regularly in accordance with a programme drawn up in advance. **[**2015-03-17 **]**

4 Assessing the dispersion of releases

4.1 General principles

401. The dispersion of radioactive releases from a nuclear power plant in the atmosphere and in water systems shall be observed by making calculations using reliable models and methods. **[**2019-03-15 **]**

402. The models, calculation methods and computer software used shall be verified and qualified. The qualification can be based on the qualification of models and methods presented in literature, or on the comparison of the calculation results with results achieved using models qualified earlier. **[**2015-03-17 **]**

403. For other nuclear facilities, a simplified model that deviates from the detailed requirements in this Guide can be used. It shall then be justifiably demonstrated that the model is conservative. **[**2015-03-17 **]**

4.2 Dispersion of radioactive releases in the atmosphere

404. To assess the dispersion of radioactive discharges in the atmosphere, radioactive substances release data and meteorological data affecting dispersion shall be known. Release data shall include the quantities of radioactive substances released to the atmosphere, the physical-chemical properties of substances affecting dispersion and deposition as well as the release height. **[**2019-03-15 **]**

405. In determining the release height, account shall be taken of the downwash caused by structures. The plume rise caused by the flow rate and heat content of discharge gases shall also be analysed, if necessary. Release heights shall be chosen conservatively and different heights examined. **[**2015-03-17 **]**

406. Using calculations, the licensee may, in safety analyses, estimate wind speeds at heights where no measurements are taken. **[**2015-03-17 **]**

407. As meteorological dispersion data, the following are required: wind direction and speed as well as dispersion parameters at diverse distances that depend on atmospheric turbulence and represent vertical and horizontal mixing. **[**2015-03-17 **]**

408. The parameters needed for dispersion calculations shall be determined either by direct turbulence measurements or, indirectly, by first determining the stability class. **[**2015-03-17 **]**

409. Stability classification may be based on temperature difference and wind speed measurements taken at different heights or on wind direction fluctuation measurements. A stability classification merely based on a temperature difference measurement may only be used temporarily should the priority classification method fail. The stability classification shall be based on a classification method generally considered to be sound. **[**2015-03-17 **]**

410. The licensee shall be prepared to perform separate stability classifications with the Pasquill method in situations where electronic observation and measurement systems cannot be used. **[**2019-03-15 **]**

411. Vertical dispersion parameter values corresponding to various stability categories shall be modified according to topography (roughness of terrain). **[**2015-03-17 **]**

412. When evaluating vertical dilution, the presence of a thermal boundary layer or an inversion layer shall be considered. In place of a model based on a vertical dispersion parameter, a model based on a vertical diffusion parameter may be applied. **[**2015-03-17 **]**

413. In selecting a dispersion parameter that depicts horizontal mixing, the duration of the release situation shall be considered. **[**2015-03-17 **]**

414. The effect of buildings on the mixing shall be taken into account when choosing dispersion parameters. **[**2015-03-17 **]**

415. When calculating radiation doses to the population in emergencies, it is recommended to use, in dispersion analyses, the observations of other weather stations farther away in addition to the licensee's meteorological measurement programme, if changes in weather parameters in coastal areas could significantly affect radiation doses. **[**2019-03-15 **]**

416. When assessing ground deposition, both dry and wet deposition shall be considered. If a simplified modelling, accordant with requirement 403, is chosen for deposition assessment, it shall be ensured that concentrations of radioactive substances in the air, ground deposition, or the collective dose further off the facility and especially under stable dispersion conditions are not underestimated. **[**2019-03-15 **]**

417. Radioactive decay and formation of daughter nuclides shall be considered prior to the start of a release, during dispersion and in deposited material. **[**2015-03-17 **]**

4.3 Dispersion of radioactive releases in the aquatic environment

418. To assess the dispersion of radioactive releases in water systems, the input data for the release of radioactive substances shall be known. The input data includes the quantities and characteristics of liquid radioactive substances, the flow rate and temperature of cooling water as well as the structures of the release point. **[**2015-03-17 **]**

419. When assessing the dispersion of radioactive releases in water systems, account shall be taken of natural water movements and flows caused by the facility's operations, turbulent mixing, the location of the release point, the size, topography and shape of the bottom of the receiving body of water, cooling water recirculation and its temperature, sedimentation and resuspension, the prevailing weather conditions and ice situation, radioactive decay, and the formation of radioactive daughter nuclides. **[**2019-03-15 **]**

420. Release dispersion shall be examined by means of hydrodynamic flow modelling. A simplified conservative model adapted to the receiving body of water or transport model, which takes account of the conditions in the water system more realistically, may be used in the dispersion calculation based on the results for hydrodynamic flow modelling. **[**2015-03-17 **]**

421. The results thus obtained are to be compared, insofar as possible, with those obtained by hydrographic measurements (flow measurements, fluctuating water level, recirculation, etc.) of the receiving body of water. **[**2015-03-17 **]**

4.4 Analyses of the dispersion of releases in licence applications

4.4.1 Normal operational conditions

422. Analyses of the dispersion of radioactive substances as they relate to normal operational conditions in the preliminary and final safety analysis report for a nuclear power plant shall employ release estimates, based on operational experience feedback from nuclear power plants and the features of the facility in question. **[**2015-03-17 **]**

423. The dispersion analyses in the preliminary safety analysis report for a nuclear power plant shall employ long-term statistical data concerning meteorological observations of the site and its surroundings. Alternatively, observations from other meteorological stations located in the near-field of the nuclear power plant may be used if the nuclear power plant lacks its own weather mast. **[**2019-03-15 **]**

424. The dispersion analyses in the final safety analysis report for a nuclear power plant shall employ long-term statistical data concerning meteorological observations of the site and its

surroundings. Observations at other meteorological stations located in the near-field of the nuclear power plant may be used as supplementary data. **[**2019-03-15 **]**

4.4.2 Operational occurrences and accidents

425. In the analyses to justify the technical solutions at the nuclear power plant in the preliminary and final safety analysis report, radioactive releases during operational occurrences and accidents shall be estimated in accordance with Guide YVL B.3. **[**2019-03-15 **]**

426. In the assessment of the dispersion of releases caused by operational occurrences and accidents at a nuclear power plant, the effective release height shall be separately selected for each release situation. **[**2019-03-15 **]**

427. When selecting dispersion situations for detailed analysis, statistical computation methods shall be used to cover diverse dispersion situations; assessment quantities most significant for each situation shall be evaluated at various distances. The situations and dispersion distances to be analysed in detail shall be chosen such that they represent every operational occurrence, accident, and release height examined. The situations analysed shall include at least those representative of the average statistical distribution of the quantity (such as dilution factor or total dose) on which the selection was based as well as the upper fractile of 95%. The form of representation and the scope of analysis of the results shall be illustrative and sufficiently versatile. **[**2019-03-15 **]**

4.5 Dispersion analyses of releases during operation

428. Dispersion analyses made while a nuclear power plant is in operation shall employ measured releases and the results of meteorological measurements taken at the plant site. **[**2015-03-17 **]**

429. Dispersion analyses during the operation of a nuclear power plant shall be statistical and based on the frequency of occurrence of quantities (dispersion direction and speed, stability, occurrence of rain) representing weather conditions in the period under analysis. Alternatively, weather situations covering the analysis period may be systematically reviewed (by the hour, for example) in which case each weather situation shall be depicted by hourly parameter mean values. In such a case, coupled dispersion and dose calculations are recommended in order to facilitate a more careful consideration of seasonal variations of the exposure pathways of the doses. This is especially important when assessing doses accumulating from foodstuffs. **[**2015-03-17 **]**

430. When atmospheric releases during the normal operation of a nuclear power plant are analysed, their even distribution over an analysis period of not more than one year may be assumed. To assess the dispersion of releases in exceptional situations, the actual period corresponding to the release situation shall be taken as the analysis period. **[**2019-03-15 **]**

431. The dispersion and dose estimates made in connection with the nuclear power plant's design and licensing shall be updated during the plant's operation at regular intervals, as the data on dispersion conditions accumulates. **[**2015-03-17 **]**

4.6 Assessment of dispersion of radioactive releases during an accident

432. The licensee shall be capable of assessing the dispersion of atmospheric releases of radioactive substances in real time by means of calculations during an accident at a nuclear facility. **[**2015-03-17 **]**

433. It shall also be possible to assess the dispersion in bodies of water if effluents might pass into a water system in the event of an accident. **[**2015-03-17 **]**

434. When assessing the consequences of imminent releases, the typical dispersion situations prevalent during an accident and in the period following it shall be employed as well as release data adapted to the event's progression. The removal of atmospheric radioactive substances from the release plume by means of dry or wet deposition shall be assessed. **[**2015-03-17 **]**

435. The release height shall be estimated for each accident situation according to the actual scenario. **[**2015-03-17 **]**

436. The results shall be assessed on the basis of corresponding results obtained for the closest release heights, unless a system for the real-time calculation of dispersion and dose during an accident or the results of advance calculations for a certain release height are available. **[**2015-03-17 **]**

5 Radiation dose assessment

5.1 Analysis methods

501. The methods for assessing radiation doses to the population around a nuclear power plant shall be reliable and conservative. **[**2015-03-17 **]**

502. The models, calculation methods and software used shall be verified and qualified. The qualification can be based on the qualification of models and methods presented in literature, or on the comparison of the calculation results with results achieved using models qualified earlier. **[**2015-03-17 **]**

503. The calculation parameters shall be suitable for conditions around the plant site. **[**2015-03-17 **]**

504. For other nuclear facilities, a simplified model that deviates from the detailed requirements in this Guide can be used. It shall then be justifiably demonstrated that the model is conservative. **[**2015-03-17 **]**

505. The analyses shall include studies on the sensitivity of the results regarding the main parameters used. **[**2019-03-15 **]**

5.2 Definition of the representative person

506. The models for assessing the radiation dose to the surrounding population cannot fully consider all differences between individuals and their habits. Therefore, the representative person shall be defined, someone who, on the basis of age and habits, represents the most exposed small population group. Dose limits shall be compared with this representative person’s dose. **[**2015-03-17 **]**

507. The representative person shall be chosen in accordance with the criteria given in this Guide, taking account of the principles set forth in reference [10]. The values of other calculation parameters for dose calculations (such as data on habits, living environment and eating habits) shall be similarly chosen. **[**2019-03-15 **]**

508. When calculating the dose to the representative person, mean values shall be employed for parameters that are dependent on the habits of the members of the most exposed population group. **[**2015-03-17 **]**

509. The doses calculated shall be representative of the average radiation exposure among the members of a small population group sufficiently homogenous in terms of age and habits. **[**2015-03-17 **]**

510. The representative person shall, if necessary, be chosen separately for normal operational conditions, on the one hand, and analyses of transients and accidents in accordance with Guide YVL B.3, on the other. **[**2019-03-15 **]**

511. Assumptions concerning the representative person selected during the plant design and licensing phase for calculation of doses shall be reviewed during the operation of the nuclear power plant, taking into consideration local conditions. **[**2015-03-17 **]**

5.3 Exposure pathways examined in dose calculation

5.3.1 General principles

512. In dose calculation, doses caused by external radiation from the facility shall be considered as well as doses from atmospheric and aquatic discharges of radioactive materials. **[**2015-03-17 **]**

513. When evaluating radiation doses to the population, both external and internal exposure shall be considered. Internal exposure must be represented by committed effective dose. **[**2015-03-17 **]**

514. In addition to doses received by the representative person through various exposure pathways, collective doses to the population shall be calculated. **[**2019-03-15 **]**

515. It shall be specified by analyses what nuclides significantly contribute to the doses through each exposure pathway and to the total dose. **[**2015-03-17 **]**

5.3.2 Radiation doses from atmospheric discharges of radioactive materials

516. Table C01 in Appendix C lists the radiation dose exposure pathways that shall be taken into account in different analyses when radioactive substances that have been released into the atmosphere are examined. **[**2015-03-17 **]**

517. Doses from external radiation caused by radioactive materials in the atmosphere shall be calculated approximately one metre above ground. **[**2015-03-17 **]**

518. Doses of external radiation caused by radioactive substances deposited on the ground shall be examined approximately one metre above ground level. The deposition shall be examined taking into account dry and wet deposition. **[**2015-03-17 **]**

519. When estimating concentrations of radioactive substances in flora, radioactive substances deposited on them directly and by resuspension from soil, and those taken up from the soil by them, shall be taken into account. **[**2019-03-15 **]**

520. When estimating concentrations of radioactive substances in milk and meat, radioactive substances deposited on grazing grass and taken up by grass from the soil shall be taken into account. It shall be taken into account that, along with the grass, the grazing animal may also ingest contaminated soil. **[**2019-03-15 **]**

521. Radiation exposure caused by the ingestion of natural products like wild berries and mushrooms shall be examined from the viewpoint of the individual dose in particular. **[**2015-03-17 **]**

522. When examining doses incurred via plant and animal products, differences in growth and grazing periods in relation to other periods shall be taken into account with reference to the average conditions prevalent in the plant's geographical location. The estimates shall also consider the potential use of contaminated fodder. **[**2019-03-15 **]**

5.3.3 Radiation doses from aquatic discharges of radioactive materials

523. Table C02 in Appendix C lists the radiation dose exposure pathways that shall be taken into account in different analyses when radioactive substances that have been released into water systems are examined. **[**2015-03-17 **]**

524. With regard to shorelines, the accumulation of radioactive substances to the shores shall be estimated using transfer factors equivalent to local conditions and taking account of the transfer mechanisms of radioactive substances from water to shore. **[**2019-03-15 **]**

525. Concentrations of radioactive substances in fish shall be estimated on the basis of concentrations of radioactive substances in water, using concentration factors. **[**2019-03-15 **]**

5.4 Individual dose assessment

526. When examining radiation doses to individuals in the population in the surroundings of a plant while it is in operation, the actual population distribution can be selected as the basis for the distances of the individuals. **[**2015-03-17 **]**

527. The time fraction spent outdoors by the representative person as well as indoor and outdoor protection factors shall be chosen to be more unfavourable than the average conditions. The group's exposure to external radiation received on the shores of a receiving body of water shall be assumed for a certain average yearly. **[**2019-03-15 **]**

528. When calculating internal exposure from inhaled radioactive substances, the same activity concentration in air shall be assumed both indoors and out. **[**2019-03-15 **]**

529. The representative person shall be assumed to consume plants grown and fish caught in the plant's vicinity, locally produced milk and products occurring naturally in the wild. The milk and other animal products may be assumed to originate in the nearest processing plant. **[**2015-03-17 **]**

5.5 Collective dose assessment

530. An examination of the collective radiation doses to the population in the surroundings of a nuclear power plant shall take account of the same exposure pathways as with individual dose assessment. Calculations shall be based on assumptions that are as realistic as possible. **[**2019-03-15 **]**

531. When calculating the collective dose to the population in the surroundings of the plant, the effects of radiation shall be examined in an area extending at least 100 kilometres from the plant. The area may be divided into subareas. The population in the area shall be divided into age groups, if necessary. Calculation parameters depicting the adult population only may be used when doses received during normal operation are examined. **[**2019-03-15 **]**

532. When calculating collective doses from external radiation caused by a release plume, account may be taken of the protection afforded by residential buildings. **[**2015-03-17 **]**

533. When calculating collective doses from foodstuffs, the volume of foodstuffs produced in the area shall be taken into account. **[**2015-03-17 **]**

5.6 Dose assessment in connection with licence applications

5.6.1 Individual dose assessment

534. In individual dose analyses in the preliminary and final safety analysis report, the distance shall be assumed to be the closest place immediately outside the site where permanent settlement is possible. The analyses shall involve the examination of doses in both adults and children. **[**2015-03-17 **]**

5.6.2 Normal operational conditions

535. The analyses in the preliminary and final safety analysis report shall assess the doses to the representative person and the collective doses to the population caused by radioactive releases into the atmosphere or water systems. **[**2019-03-15 **]**

5.6.3 Operational occurrences and accidents

536. Analyses of transients and accidents shall be presented in the nuclear facility's preliminary and final safety analysis report. Transient and accident analyses in accordance with Guide YVL B.3 and emergency response-related analyses in accordance with Guide YVL C.5 shall broadly examine the radiation doses to a representative person and, in emergency response-related analyses, to various age groups via different exposure pathways. Long-term environmental contamination shall also be analysed. **[**2019-03-15 **]**

537. The analyses shall examine the contribution to the total dose of various exposure pathways and dominant nuclides at different distances. When evaluating acute effects, the effect of inhaled or ingested nuclides shall also be examined alongside the external exposure. **[**2019-03-15 **]**

538. Radiation dose assessments relating to accident analyses shall not include the effect of counter-measures to limit public exposure. **[**2015-03-17 **]**

539. When estimating doses from internal radiation caused by inhaled radioactive substances, it shall be assumed that the representative person stays within examination distance for the entire duration of the release period following the accident. **[**2019-03-15 **]**

540. In severe accidents, short- and long-term doses in diverse weather and dispersion situations shall be separately examined. The contribution of various exposure pathways and significant nuclides shall be specified. With regard to short-term doses, an assessment shall be carried out of the extent to which intervention levels for initiating protective measures for the population are exceeded. In the assessment of long-term doses, examination periods exceeding three months shall be used. **[**2015-03-17 **]**

541. When assessing public exposure from accidents, calculations may statistically consider the variability of weather-dependent dispersion conditions as well as any seasonal differences in radiation doses accumulating through food chains. The results shall be given in the form of appropriate distributions as well as averages and fractiles. When determining compliance with dose constraints in accordance with the Nuclear Energy Decree (161/1988) and Guide YVL C.3

in various accidents, dose estimates representing the 95% fractile shall be used. **[**2019-03-15 **]**

5.7 Assessment of radiation doses caused by normal operation

542. When assessing doses from releases measured during normal operation, the calculation methods and site-specific data applicable to the plant site under 5.1−5.5 shall be used. **[**2015-03-17 **]**

5.8 Dose assessment during accidents

543. Provisions shall be made for accidents at a nuclear facility with estimates made of dispersion and dose values. In case of a nuclear power plant, release situations caused by highly unlikely severe accidents shall also be included. **[**2019-03-15 **]**

544. There shall be computer software available for dose predictions for the period immediately following an accident at a nuclear facility, as well as a readiness for a simplified calculation on the basis of dispersion diagrams. **[**2019-03-15 **]**

545. Release estimates based on measurements that are descriptive of accident conditions shall be used in the calculations. When assessing the effects of imminent release situations, postulated releases applicable to the progression of the event in question shall be examined and corresponding dose forecasts shall be drawn up. **[**2015-03-17 **]**

6 Documents to be submitted to STUK

6.1 Meteorological data and measurements

601. The preliminary safety analysis report for a nuclear power plant shall present a description of the area's meteorological conditions, the mesoclimate and water areas. The description shall present the statistical distributions of wind direction and speed, atmospheric stability, the occurrence of precipitation and mixing height values during different seasons. **[**2015-03-17 **]**

602. Furthermore, the preliminary safety analysis report for a nuclear power plant shall include a plan for the meteorological measurements to be conducted at the plant site and in its vicinity. The justifications set out in the plans shall show that the objectives and requirements described in this Guide can be met using the system. The plan can also be presented as a topical report as part of the preliminary safety analysis report. **[**2015-03-17 **]**

603. A nuclear power plant's final safety analysis report shall contain an updated version of the data in the preliminary report on the area's meteorological conditions, the mesoclimate and water areas. **[**2015-03-17 **]**

604. The final safety analysis report shall also contain a description of the meteorological conditions in the area, on the basis of measurements taken during a period of at least three years and other available data. The data contained in the safety analysis report shall be complemented at regular intervals on the basis of meteorological measurements carried out in the vicinity of the nuclear power plant. **[**2015-03-17 **]**

605. The final safety analysis report shall also contain a description of the meteorological measurements conducted at the plant site and in its vicinity, and their connection to the observation and data systems used by the authorities. **[**2015-03-17 **]**

606. The final safety analysis report shall present a reliable procedure for the transfer of meteorological measurement data for use by the on-site emergency organisation at the plant and STUK. **[**2015-03-17 **]**

607. The documents concerning the meteorological measurement system of a nuclear power plant shall be submitted to STUK in accordance with Guide YVL B.1. With regard to a nuclear power plant that is being operated, the pre-inspection documentation for any changes to the measurement system shall be submitted to STUK for information. **[**2015-03-17 **]**

6.2 Dispersion analyses

608. When applying for a nuclear facility's construction or operating licence, and during its operation, STUK shall be provided, for approval, with descriptions of the methods used in assessing radioactive releases. The reports shall deal with the dispersion of airborne and waterborne radioactive substances and describe the methods used for defining atmospheric turbulence and stability class. They shall contain a description of how the models are qualified and their suitability for on-site conditions. **[**2015-03-17 **]**

6.3 Radiation dose assessment

609. When applying for a decision-in-principle in respect of a nuclear facility, descriptions of the facility options in question shall be submitted to STUK. For each facility option, a summary of the safety analyses shall be presented, including analyses of environmental radiation doses in a worst case scenario accident. **[**2015-03-17 **]**

610. When applying for a nuclear facility's construction licence, STUK shall be provided, for approval, with descriptions of the methods used in assessing radioactive doses to the population in the immediate area of the nuclear facility at the design stage. The results of the analyses shall be submitted to STUK for approval in accordance with Guide YVL B.3. **[**2015-03-17 **]**

611. When applying for a nuclear facility's operating licence, and during its operation, STUK shall be provided, for approval, with descriptions of the calculation models used in assessing radioactive doses to the population in the immediate area of the nuclear facility. **[**2015-03-17 **]**

612. The descriptions of the assessment of radiation doses in a nuclear facility's construction and operating licence applications shall state the parameter values used in the calculations. The descriptions shall also state how the validity (qualification) of the models and applicability of the calculation parameters for the conditions in the plant site's environment have been assured. The choice of the representative person used in the dose calculations shall also be justified. **[**2019-03-15 **]**

7 Regulatory oversight by the Radiation and Nuclear Safety Authority

701. The contact authority for the environmental impact assessment for nuclear facilities is the Ministry of Employment and the Economy. STUK issues a statement on the environmental impact programme and report for a new nuclear facility. The statement focuses attention on radioactive releases caused by the nuclear facility and radiation exposure to the population during operation and in the event of an accident. **[**2015-03-17 **]**

702. STUK compiles a preliminary safety assessment for the nuclear facility's application for a decision-in-principle; it assesses the safety analyses for the proposed plant option, including the analysis of the environmental radiation doses caused by the worst case scenario accident. **[**2015-03-17 **]**

703. STUK inspects the plans for meteorological measurements on site and close to the plant when processing the construction licence application for a nuclear power plant. When processing the operating licence application, STUK checks the documents relating to the meteorological measuring system for the plant as part of the final safety analysis report. For this, STUK may use the expertise of other authorities, such as the Finnish Meteorological Institute and the Finnish Environment Institute. **[**2015-03-17 **]**

704. STUK assesses the reports on the area's meteorological conditions, the mesoclimate and water areas in connection with the checking of the preliminary and final safety analysis reports. For this, STUK may also use the expertise of other authorities. **[**2015-03-17 **]**

705. STUK assesses the analyses of the dispersion of radioactive substances and the doses they give rise to in connection with the checking of the preliminary and final safety analysis reports. **[**2015-03-17 **]**

706. During its supervision of the construction and operation of the nuclear facility, STUK inspects the functionality of the dispersion and dose calculation methods intended for accident conditions and their maintenance at the plant site. **[**2015-03-17 **]**

707. During its supervision of the nuclear power plant's operation, STUK inspects the use and maintenance of the weather measurement system at the plant site. **[**2015-03-17 **]**

708. STUK inspects the validity of the dispersion and dose analyses during the periodic safety assessment of the nuclear power plant. **[**2015-03-17 **]**

8 Appendix A Examples of sounding meteorological measuring equipment

8.1 Doppler systems

A01. The Doppler Sodar system is an acoustic measurement system with a minimum of three sound sources in different measuring directions. In each direction, the air velocity in the measuring beam direction is determined with the aid of the Doppler phenomenon. Combining measurements conducted in different directions, the system determines the wind components of the mixing layer at intervals of at least 50 metres in the vertical direction, up to the highest possible height in each weather situation. The wind direction and speed, deviation of the wind direction as well as the deviation parameters and the height of the potential inversion layer, necessary for dispersion calculations, are determined on the basis of the measurement results. **[**2019-03-15 **]**

A02. The Lidar system is an optical remote sensing device that uses a laser beam and measures the distance of an object by pulsing the laser beam and recording the travel time of pulse return. **[**2019-03-15 **]**

A03. The wind scanner is a radar set operating in the VHF or UHF range in which the measuring beam is usually formed by a phased antenna field. While measuring, the air velocity in the beam direction is determined by means of the Doppler phenomenon. Combining measurements conducted vertically and in at least three oblique directions, the wind scanner determines the wind components of the mixing layer at intervals of at least 100 metres, up to the highest possible height in each weather situation. The wind direction and speed, deviation of the wind direction and the deviation parameters necessary for dispersion calculations are determined on the basis of the measurement results. **[**2019-03-15 **]**

A04. The wind scanner can be fitted with an RASS (Radio Acoustic Sounding System). The propagation of the acoustic pulse transmitted by the RASS is monitored by the wind scanner, thus determining the velocity of propagation at different heights. The temperature profile and the height of the potential inversion layer are established in this manner. **[**2019-03-15 **]**

A05. The weather radar is a radar set operating in the GHz range (5.6 GHz in Finland) that is fitted with a fully steerable parabolic antenna. While measuring, the scanner rotates at a steady speed in the horizontal direction (round the vertical axis) and the measurement is repeated at several elevation angles. The three-dimensional wind field and the precipitation (mm/h) are determined at intervals of 200 metres on the basis of the measurement results. In the

summertime, the wind profile of the mixing layer is obtained even in dry weather, but in general the determination of the wind profile requires rainy weather. **[**2019-03-15 **]**

9 Appendix B Requirements for meteorological measurements

B01. The requirements to be set for the measuring instruments depend on the system applied. The following define the accuracy requirements for the measuring instruments on a weather mast under laboratory conditions:

Wind speed:
±0.2 m/s at wind speeds of less than 2 m/s (lowest detection limit of the measurement 0.4 m/s)
±5% at wind speeds higher than 2 m/s

Wind direction:
±5°

Temperature:
±0.15 °C

Temperature difference:
±0.2 °C/100 m

Precipitation:
±0.2 mm

Time of precipitation:
±5 min

Air pressure:
±0.3 hPa (mbar)

Relative humidity:
±5% **[**2015-03-17 **]**

B02. When using turbulence measurement, the required time resolution of the measuring sensor is less than 0.5 seconds (the wind direction and speed are defined at the above accuracies). **[**2015-03-17 **]**

B03. The structures of the weather mast shall withstand a maximum load caused by the extremely exceptional wind and freezing conditions (there is a 95% probability that the frequency of occurrence is as high as or higher than the statistically calculated load once in a hundred years). **[**2015-03-17 **]**

10 Appendix C Exposure pathways examined in dose calculation analyses

C01. Exposure pathways to be considered in analyses of atmospheric discharges. Table.

External exposure	
Direct and scattered radiation from onsite radiation sources and transportation	N, O, VL, VP
Radioactive substances in a release plume	N, O, VL
Radioactive substances deposited on the ground	N, O, VL, VP
Radioactive substances deposited on bare skin, hair or clothing	O[1], VL[1]
Radioactive substances resuspended into the air	O[1], VP[1]
Internal exposure	
Inhalation of radioactive substances in a release plume	N, O, VL
Ingestion of plants and products occurring in the wild that contain radioactive substances originating in deposition	N, O, VP
Ingestion of contaminated milk, meat and game	N, O, VP
Radioactive substances directly deposited on surface waters or subsequently filtering from drainage areas in case the water is used for drinking or in case aquatic plants or animals are ingested	O[2], VP[2]
Inhalation of radioactive substances transported into the air through resuspension	VP[1]

N = Normal operation

O = Operational occurrences and accidents

VL = Emergencies, short term

VP = Emergencies, long term

[1] not normally significant

[2] may be significant in single doses

[2015-03-17 **]**

C02. Exposure pathways to be considered in analyses of aquatic discharges. Table.

External exposure	
Radioactive substances accumulated on shorelines	N, O
Radioactive substances in water during boating or swimming activities	N[1]
Internal exposure	
Radioactive substances in fish	N, O
Inhalation; via resuspension from substances accumulated on shorelines or via oversplash from a receiving body of water	N[1]
Radioactive substances in drinking water in case water from a receiving body of water is used for drinking	N[1]
Contamination of foodstuffs in consequence of the potential use of water from a receiving body of water for drinking water for cattle and for irrigation	N[1]
Contamination of pastures or arable land as well as their produce through oversplash from a receiving body of water, or through other ways of accumulation	N[1]

N Normal operation

O Operational occurrences and accidents

[1] not normally significant **[**2015-03-17 **]**

11 References

1. Nuclear Energy Act (990/1987). **[**2015-03-17 **]**

2. Nuclear Energy Decree (161/1988). **[**2015-03-17 **]**

3. Radiation and Nuclear Safety Authority Regulation on the Safety of a Nuclear Power Plant (STUK Y/1/2018). **[**2019-03-15 **]**

4. Radiation and Nuclear Safety Authority Regulation on the Emergency Arrangements of a Nuclear Power Plant (STUK Y/2/2018). **[**2019-03-15 **]**

5. Radiation and Nuclear Safety Authority Regulation on the Safety of Disposal of Nuclear Waste (STUK Y/4/2018). **[**2019-03-15 **]**

6. Radiation Act (859/2018). **[**2019-03-15 **]**

7. Government Decree on Ionising Radiation (1034/2018). **[**2019-03-15 **]**

8. Act on the Environmental Impact Assessment Procedure (252/2017). **[**2019-03-15 **]**

9. Government Decree on the Environmental Impact Assessment Procedure (277/2017). **[**2019-03-15 **]**

10. ICRP 101a. Assessing dose of the Representative Person for the Purpose of Radiation Protection of the Public and The Optimisation of radiological protection. ICRP Publication 101, Annals of the ICRP 2006; 36 (3). **[**2015-03-17 **]**

Definitions

Committed dose

Committed dose shall refer to the radiation dose caused by the intake of a radioactive substance on one occasion within a certain period. The integration time is 50 years for adults and up to the age of 70 years for children.

Dose limit

Dose limit shall refer to the radiation dose arising from ionizing radiation which may not be exceeded during a specific period of time. (Radiation Act 859/2018)

Dose constraint

Dose constraint shall refer to a constraint on the individual radiation dose of a person other than a patient arising from ionizing radiation during a specific period of time, used to optimize radiation protection in radiation practices. (Radiation Act 859/2018)

Representative person

Representative person shall refer to an individual in the population group most highly exposed to a given radiation source, whose radiation dose represents the doses received by such a population group (ICRP Publication 101). The term is equivalent to, and replaces, the previous term ‘average member of the critical group’.

Effective dose

Effective dose shall refer to the weighted sum of the equivalent doses in tissues and organs exposed to radiation, where equivalent dose denotes the product of the mean energy imparted by radiation to tissue or to an organ, per unit mass, and a weighting factor specified for the radiation. Effective dose is presented as a formula in the Government Decree on Ionising Radiation (1034/2018).

System

System shall refer to a combination of components and structures that performs a specific function.

Validation

Validation shall refer to confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled. (ISO 9000)

Collective dose

Collective dose shall refer to the sum of the effective radiation doses in a given period of time by individuals exposed to radiation.

Licensee

Licensee shall refer to the holder of a licence entitling to the use of nuclear energy. (Nuclear Energy Act 990/1987)

Normal operating conditions

Normal operating conditions shall refer to the planned operation of a nuclear facility according to the operating procedures. Normal operating conditions also include testing, plant start-up and shutdown, maintenance and the replacement of nuclear fuel. (STUK Y/1/2018)
YVL Guides also use the term normal operation, which means the same as normal operating conditions.

Anticipated operational occurrence

Anticipated operational occurrence shall refer to such a deviation from normal operation that can be expected to occur once or several times during any period of a hundred operating years. (Nuclear Energy Decree 161/1988)

Postulated accident

Postulated accident shall refer to a deviation from normal operation which is assumed to occur less frequently than once over a span of one hundred operating years, excluding design extension conditions; and which the nuclear facility is required to withstand without sustaining severe fuel failure, even if individual components of systems important to safety are rendered out of operation due to servicing or faults. Postulated accidents are grouped into two classes on the basis of the frequency of their initiating events: a) Class 1 postulated accidents, which can be assumed to occur less frequently than once over a span of one hundred operating years, but at least once over a span of one thousand operating years; b) Class 2 postulated accidents, which can be assumed to occur less frequently than once during any one thousand operating years. (Nuclear Energy Decree 161/1988)

Design extension condition

Design extension condition shall refer to:
a. an accident where an anticipated operational occurrence or class 1 postulated accident involves a common cause failure in a system required to execute a safety function;
b. an accident caused by a combination of failures identified as significant on the basis of a probabilistic risk assessment; or
c. an accident caused by a rare external event and which the facility is required to withstand

without severe fuel failure.
(Government Decree 717/2013)

Accident

Accident shall refer to postulated accidents, design extension conditions and severe accidents. (Nuclear Energy Decree 161/1988)

Verification

Verification shall refer to confirmation, through the provision of objective evidence, that set requirements have been fulfilled.

External events

External events shall refer to exceptional situations or incidents occurring in the vicinity of a nuclear facility that could have a detrimental effect on the safety or operation of the plant.

Severe accident

Severe accident shall refer to an accident in which a considerable part of the fuel in a reactor or the spent fuel in a fuel pool or storage loses its original structure. (Nuclear Energy Decree 161/1988)

Severe reactor accident

Severe reactor accident shall refer to an accident in which a considerable part of the fuel in a reactor loses its original structure. (STUK Y/1/2018)

Emergency situation

Emergency situation shall refer to an accident or event during which the nuclear power plant's safety has deteriorated or is in the danger of deteriorating or requires enhanced preparedness to act in order to ensure plant safety; emergency situations are classified on the basis of their severity and controllability as follows:

- an alert is a situation where the safety level of a nuclear power plant needs to be ensured in an exceptional situation.
- a site area emergency is a situation during which the nuclear power plant's safety deteriorates or is in the danger of deteriorating significantly.
- a general emergency is a situation during which there is danger of radioactive substance releases that may require protective measures in the vicinity of the nuclear power plant.

(STUK Regulation Y/2/2018)

Emergency planning zone

Emergency planning zone shall refer to an area extending to a distance of approximately 20

kilometres from the nuclear power plant and for which authorities shall draft an external rescue plan referred to in Section 48(1)(1) of the Rescue Act (379/2011). (STUK Y/2/2018)

Failure criterion (N+1)

(N+1) failure criterion shall mean the same as the single failure criterion.
Single failure criterion (N+1) shall mean that it must be possible to perform a safety function even if any single component designed for the function fails.

Site area

Site area shall refer to an area in use by nuclear power plant units and other nuclear facilities in the same area, and to the surrounding area, where movement and stay are restricted by the Decree of the Ministry of the Interior issued under Chapter 9, Section 8 of the Police Act (872/2011). (STUK Y/2/2018)

Annual dose

Annual dose shall refer to the sum of the effective dose arising from external radiation within the period of one year, and of the committed effective dose from the intake of radioactive substances within the same period of time. (Nuclear Energy Decree 161/1988)

Nuclear facility

Nuclear facility shall refer to the facilities used for the generation of nuclear energy, including research reactors, facilities for the large-scale disposal of nuclear waste, and facilities for the large-scale production, use, processing or storage of nuclear material and nuclear waste. However, nuclear facility shall not refer to:
a) mines or ore processing plants intended for the production of uranium or thorium, or premises and locations including their precincts where nuclear wastes from such facilities are stored or deposited for final disposal; or
b) facilities and premises that have been permanently closed and where nuclear waste has been disposed in a manner approved as permanent by the Radiation and Nuclear Safety Authority; or
c) premises or parts of a nuclear facility that have been decommissioned in a manner approved by the Radiation and Nuclear Safety Authority. (Nuclear Energy Act 990/1987)

Nuclear power plant

Nuclear power plant shall refer to a nuclear facility for the purpose of electricity or heat production, equipped with a nuclear reactor, or a complex consisting of nuclear power plant units and other related nuclear facilities located at the same plant site. (Nuclear Energy Act 990/1987).

Single failure

Single failure shall refer to a failure due to which a system, component or structure fails to deliver the required performance.

Single failure criterion

Single failure criterion (N+1) shall mean that it must be possible to perform a safety function even if any single component designed for the function fails.