

**NUCLEAR REGULATORY AUTHORITY,
GHANA**



**DRAFT NRA REGULATIONS FOR SITE EVALUATION FOR NUCLEAR
INSTALLATIONS**

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Preliminaries

In exercise of the powers conferred on the Minister responsible for Nuclear Regulatory Authority (NRA) by Sections 36 - 38 of the Nuclear Regulatory Authority Act, 2015 (Act 895), these regulations are made on this day of _____

Application

1. (1) These regulations apply to nuclear installations as follows:
 - (a) nuclear power plants;
 - (b) research reactors including subcritical and critical assemblies and any adjoining radioisotope production facilities;
 - (c) storage facilities for spent fuel;
 - (d) facilities for the enrichment of uranium;
 - (e) nuclear fuel fabrication facilities;
 - (f) conversion facilities;
 - (g) facilities for the reprocessing of spent fuel;
 - (h) facilities for the predisposal management of radioactive waste arising from nuclear fuel cycle facilities; and
 - (i) nuclear fuel cycle-related research and development facilities.
- (2) In the implementation of these regulations, a graded approach shall be adopted to satisfy the requirements and the level of detail needed in an evaluation to satisfy the requirements established in these regulations will vary according to the type of installation being sited.
- (3) The documentation required under these regulations are for the purpose of the evaluation of those site-related factors that have to be taken into account to ensure that the site–installation combination does not constitute an unacceptable risk to individuals, the population or the environment over the lifetime of the installation.

General Requirements for Site Evaluation

2. (1) A person shall not establish a nuclear installation on any land in Ghana, unless that land has been subjected to a site evaluation process approved by the Authority.

(2) The person who intends to establish the nuclear installation shall give notice to the Authority of the intention of that person to undertake a site selection and a site evaluation process; and

(3) An applicant for authorisation shall ensure that

(a) a Site Approval Report, required in *Licensing Regulations*, unambiguously demonstrates that no exclusionary criteria that may affect the safe operation of the nuclear installation at the preferred site have been breached;

(b) a plan for investigations and studies to confirm that no exclusionary criteria are breached is outlined in the Site Approval Report; and

(c) the site evaluation takes into account all phases of the lifecycle of the facility, from site preparation to removal from regulatory control.

(4) The applicant shall

(a) conduct the site evaluation in a comprehensive, systematic, planned and documented manner in accordance with an adequate management system;

(b) consider the potential combined effect of multiple simultaneous events and events affecting multiple nuclear installations on the same site as well as on adjacent sites; and

(c) in accordance with Section 36(3) of the Act, ensure that evaluation of the suitability of a site for the construction and operation of a nuclear facility includes an assessment of

(i) the effects of external events occurring in the region, either of natural origin or human induced;

(ii) the characteristics of the site and its environment that could influence the transfer to persons and the environment of radioactive material that has been released; and

(iii) the population density and population distribution and other characteristics of the exclusion zone in so far as they may affect the

possibility of implementing preparedness and response and the need to evaluate the risks to individuals and the population.

- (5) The applicant has the prime responsibility for protection, safety and security and this responsibility cannot be delegated.
- (6) The applicant shall for the purposes of analysis of external hazards, consider both design-basis events and design extension condition events.
- (7) The applicant shall
 - (a) consider the potential for cliff-edge effects when analyzing external hazards, where a small change of conditions may lead to a sudden increase in the severity of consequences;
 - (b) make an assessment of the feasibility of implementation of preparedness and response taking into consideration all on-site and multiple installations in the assessment, with special emphasis on nuclear installations that could simultaneously experience accident conditions from a common cause hazard event, or as a consequence of an accident condition initiated in another installation;
 - (c) evaluate the consequential hazards associated with external events that are to be considered in the design of the nuclear installation, and in its safety assessment;
 - (d) use information on frequency and severity derived from the characterisation of external event hazards to establish the the design basis hazard level for the nuclear installation taking into account account uncertainties in the design basis;
 - (e) take adequate account of both aleatory and epistemic uncertainties in the evaluation of natural and human induced external hazards;
 - (f) base the decision to use deterministic or probabilistic methodologies in hazard evaluation on the nature of the hazard, the availability of data and the applicable requirements for safety assessment;
 - (g) assess the external hazards and the site characteristics in terms of their potential for change over time and evaluate the potential impact of the change with due consideration to uncertainties in the projections;

- (h) give consideration to the use of applicable probabilistic methodologies and the use of probabilistic hazard curves representing external events as an input to the probabilistic safety assessment for external hazards and develop the probabilistic hazard curves with reference to the specific site conditions.
- (i) define the parameters and the values of those parameters that are used to characterize external hazard event or a combination of events so as to ensure that they are suitable and sufficient for use in the design of the installation, and in its safety assessment;
- (j) evaluate the evolution of natural and human-induced factors in the region that could have a bearing on safety and security for a time period that encompasses the projected lifetime of the nuclear installation;
- (k) perform the analysis and assessment of the impact exerted on the nuclear installation safety by human-induced hazards, taking into account their distance from the installation;
- (l) give consideration to the effects of the combination of the hazards with the ambient conditions in the derivation of the hazards associated with external events;
- (m) in the analysis to determine the suitability of the site, give consideration to all nuclear activities that can take place on the site, including the storage and transport of input and output nuclear materials in the nature of fresh fuel, spent fuel and radioactive waste.
- (n) in the Site Evaluation Process, take into consideration the potential for
 - (i) explosion, chemical releases or thermal releases that might affect the safety of the nuclear installation or the dispersion of radioactive material shall be considered in the site evaluation process; and
 - (ii) interactions between radioactive and non-radioactive substances, including interactions due to heat or chemicals in radioactive liquid effluents;
- (o) in evaluating the site, make allowance for the combined radiological and non-radiological effect of the site on the nuclear installation during normal and accident conditions, based on both temporal (i.e., life-cycle), and spatial (i.e., regional, local and site) considerations;

- (p) evaluate the need for site protection measures where the projected design of the nuclear installation is not able to safely withstand the impact of natural and human induced external hazards, for the purpose of providing for
 - (i) the need for protection of the site against the effects of specific phenomena associated with natural and human induced external hazards considering adequate safety margins; and
 - (ii) the availability of adequate engineering solutions for implementing measures for site protection and where the engineering solutions are not available, declare the site unsuitable;
- (q) where measures for site protection are required to be implemented, assess the extreme values of parameters associated with design basis natural and human induced external hazards taking into account their uncertainties;
- (r) classify, design, build, maintain and operate measures for site protection in accordance with their safety significance;
- (s) for a nuclear power plant, determine the total nuclear capacity to be installed on the site as far as possible at the first stages of the siting process which is the site selection stage and where it is proposed that the installed nuclear capacity be significantly increased to a level greater than that previously determined to be acceptable, re-evaluate the suitability of the site; and
- (t) review the natural and human induced external hazards and site conditions at ten years interval, as part of the periodic safety review and as appropriate throughout the lifetime of the nuclear installation, taking due account of operating experience and new safety related information.

Public and Community Engagement

3. The applicant shall

- (a) ensure that the proposed site for the nuclear installation is properly acquired, with land title registration documentation to that effect; and

- (b) make arrangements to identify and make significant interactions and substantively engage with potentially affected target audience, community groups, in the site evaluation process.

Public Information and Disclosure

- 4. The applicant shall during the site selection stage develop and implement a public information and disclosure programme and submit as part of the Site Approval Report to the Authority.

Target Audience(s)

- 5.(1) The public information programme shall define the target audience; which shall include the individuals, groups and communities materially affected or likely to be directly affected by
 - (a) the preparedness and response;
 - (b) construction or operational activities;
 - (c) the consequences of the preparedness and response, or the construction or operation activities of the nuclear installation; or
 - (d) the nuclear installation.
- (2) The public information programme shall also document the rationale for exclusion of individuals or groups who may have expressed interest in becoming part of the target audience.

Requirements for Hazards Associated with External Natural Events

- 6.(1) An applicant shall
 - (a) investigate the proposed sites to determine the frequency and severity of the external natural events that could affect the safety and security features of the nuclear installation;
 - (b) determine and evaluate the potential external natural events and activities in the region of the proposed site, to establish their significance to the safe operation of the nuclear installation;
 - (c) collect, analyse and compile the prehistoric, historic and instrumentally recorded information and records of identified external events for the region, to establish their

reliability, accuracy and completeness and to provide a uniform database for assessment of the hazards;

- (d) adopt an appropriate method to establish the hazards associated with major external events and justify the appropriateness of the selected method by comparison to the modern practice applicable to nuclear installation sites internationally, and compatible with the characteristics of the region;
- (e) ensure that the size of the region used for establishing the hazards associated with external phenomena is large enough to include each source that could be relevant to determining the level of the hazards at the site of the nuclear installation;
- (f) ensure that in the determination of external hazards, site-specific data and where that data is not obtainable, data
 - (i) from similar regions that is sufficiently relevant to the region of interest, or
 - (ii) derived from appropriate and acceptable simulation techniques,is used in the determination of the hazards; and
- (g) develop a hazard model, taking into account possible combinations of the effects of several natural and human induced events.

Requirements for Hazards Associated with Human Induced Events

7. (1) An applicant shall

- (a) adequately investigate a proposed site with regard to frequency and severity of human-induced events that could affect the safety and security features of the nuclear installation;
- (b) in the selection of a site, take into consideration credible infrastructure development projections that may lead to significant changes in land use within the lifetime of the installation including the expansion of existing installations and human activities or construction of new hazardous installations;
- (c) in the preparation of the report in respect of a chosen site, express human induced phenomena in terms that can be used as input for deriving the hazard parameters associated with the nuclear installation; and

- (d) in the selection of a site, apply a systematic approach to identify all external, non-malevolent human-induced events over the lifecycle of the nuclear installation.

Requirements for the Radiological Impact of the Installation

- 8. (1) An applicant shall in the evaluation of a site to determine the potential radiological impacts on the region of a nuclear installation,
 - (a) take into consideration, operational states and accident conditions that could warrant emergency response actions and make appropriate estimates of expected or potential releases of radioactive material, taking into account the design of the installation and its safety features;
 - (b) where sufficiently accurate radiological impacts are not available at the time when the evaluation is performed, make bounding assumptions of potential radiological impacts and justify those assumptions and the impacts and any nuclear installation subsequently selected for the site must demonstrably be bounded by the assumed impacts; and
 - (c) identify and evaluate the direct and indirect pathways by which radioactive material released from the nuclear installation could potentially reach and affect people and the environment and ensure that the evaluation
 - (i) takes account of specific regional and site characteristics; and
 - (ii) pays special attention to the function of the biosphere in the accumulation and transport of radionuclides.

Nuclear Security and Safeguards Considerations

- 9. (1) An applicant shall
 - (a) perform a threat assessment of the site to identify vulnerabilities and provide appropriate security plans to mitigate malicious acts including terrorism according to the requirements of the Regulations on Nuclear Security and Safeguards of the Authority;
 - (b) compile the findings from the threat assessment into a Site Selection Threat and Risk Assessment report in respect of both new sites and nuclear installations on existing

sites, and may merge the contents of the Site Selection Threat and Risk Assessment report with the overall security programme of the authorised person after the licence to prepare the site has been granted.

- (c) ensure that the Site Selection Threat and Risk Assessment report includes comprehensive consideration of both physical protection concerns and transportation routes;
- (d) ensure that the proposed physical protection requirements provide for the appropriate detection, delay and take into account response considerations;
- (e) classify the Site Selection Threat and Risk Assessment report as prescribed information that is protected from release under access to information requests, on the basis of national security; and
- (f) provide site organisation with regard to Safeguards implementation.

Consideration of Future Connections to the Grid

10. An applicant shall

- (a) obtain from the owner or operator of the grid which is connected to the site of the nuclear installation
 - (i) confirmation that, with appropriate grid and plant mitigation measures in place, the location of the nuclear installation will not adversely affect the grid; or
 - (ii) a report that states the effect of the grid connection on the installation;
- (b) document the confirmation required under paragraph (a) and submit that documentation as part of the Site Evaluation Report.

Specific Requirements for Evaluation of Natural External Events

General Identification and Assessment of natural external events

11. An applicant shall

- (a) develop, document and implement a systematic approach for identifying and assessing all natural external events;
- (b) ensure that the assessment addresses the effects of natural external events on the environment throughout the lifecycle of the proposed facility; and
- (c) where the assessment of a specific hazard indicates that the hazard level is unacceptable and no practicable engineering solution is available, declare the site unsuitable.

Climate Change

- 12.** An applicant shall, in the evaluation of natural external events for site suitability and site evaluation, consider the potential effects of climate change on the nuclear installation over the projected lifecycle, including decommissioning.

Seismically Induced Ground Motion Hazards

13. An applicant shall

- (a) evaluate the seismological and geological conditions in the region and the engineering geological and geotechnical aspects of the proposed nuclear installation site;
- (b) collect and document information on pre-historical, historical and instrumentally recorded earthquakes in the region;
- (c) determine and assess the hazards associated with earthquakes by means of seismotectonic evaluation of the region with the use to the greatest possible extent of the information collected taking into account site-specific conditions;
- (d) assess the hazards due to earthquake-induced ground motion for the site taking into account, the seismotectonic characteristics of the region and the specific site conditions;

- (e) perform a thorough uncertainty analysis as part of the evaluation of seismic hazards and the vertical ground acceleration shall be at least two-thirds of the horizontal ground acceleration;
- (f) conduct an evaluation of ground motion hazards, to provide the input needed for the seismic design or safety upgrading of the structures, systems and components of the nuclear installation, as well as the input for performing the deterministic and or probabilistic safety analyses necessary during the lifetime of the nuclear installation;
- (g) assess the hazards due to earthquake-induced ground motion, by the methods used in the current international engineering practice;
- (h) take into consideration
 - (i) the effect of the vibratory ground motion in combination with other seismically induced events, if any; and
 - (ii) the potential for human induced seismicity;
- (j) identify and evaluate capable faults through methods that are sufficiently detailed to support safety-related decisions;
- (k) evaluate the potential effect of fault displacement on safety-related structures systems and components;
- (l) ensure that the evaluation of fault displacement hazards includes detailed geological mapping of excavations for safety-related engineered structures to enable the evaluation of fault capability for the site;
- (m) determine a proposed site to be unsuitable where reliable evidence shows the existence of a capable fault that has the potential to affect the safety of the nuclear installation;
- (n) where a capable fault is identified in the site of an existing nuclear installation and the safety of the nuclear installation cannot be demonstrated, declare the site to be unsuitable;
- (o) determine within an occurrence frequency range from 10^{-1} /year to 10^{-3} /year for the identification of the operational basis earthquake;

- (p) determine at least up to an occurrence frequency of 10^{-7} /year, for the earthquake hazard exposure and the hazard curve phenomena; and
- (q) account for the uncertainties in the determination of the earthquake hazards and use the median value for the hazard curve.

Volcanic Hazards

14. An applicant shall in respect of assessment of volcanic hazards

- (a) identify and evaluate capable volcanoes taking into consideration the volcanic characteristics of a region of sufficient size to ensure that potentially hazardous volcanic phenomena are considered appropriately;
- (b) evaluate the hazards of capable volcanoes to provide the input needed for determining the site-specific design parameters or for re-evaluating the site, as well as for deterministic or probabilistic safety analyses performed during the lifetime of the nuclear installation;
- (c) declare a proposed site to be unsuitable if reliable evidence shows the existence of a capable volcano that has the potential to affect the safety of the nuclear installation, and which cannot be compensated for by means of a combination of measures for site protection and design features of the nuclear installation;
- (d) evaluate volcanic hazards by using appropriate information, methods and models which take adequate account of the uncertainty; and
- (e) take into consideration the effect of volcanic phenomena in combination with other volcanically induced hazards including volcanic ashfall.

Meteorological Hazards

15. An applicant shall

- (a) evaluate meteorological phenomena that have the potential to affect the safety of the nuclear installation including wind, precipitation, air and water temperature, humidity, drought, storm surges and sand storms, tropical cyclones, tornadoes as well as their credible combinations, for their extreme values based on available records;

- (b) apply appropriate methods for the evaluation of meteorological hazards, taking into account the available datasets including both measured data and historical data and known past changes in relevant characteristics of the region;
- (c) evaluate the potential for the occurrence and the frequency and severity of lightning for the site vicinity;
- (d) assess the potential for the occurrence of tornadoes in the region of interest, on the basis of detailed historical and instrumentally recorded data for the region;
- (e) in the assessment of the hazards related to tornadoes, take into consideration missiles that could be associated with tornadoes in the near region; and
- (f) evaluate the potential for the occurrence of rare meteorological events, including severe thunderstorms, severe tornadoes, and cyclones, and information on their severity and frequency.

Flooding Hazards

16. An applicant shall

- (a) assess the region to determine the potential for flooding as a result of natural and human induced events including their possible combinations that may affect the safety of the nuclear installation; and
- (b) ensure that
 - (i) the parameters used to characterize the hazards arising from flooding include the water level, the height and period of the waves, the warning time for the flood, the duration of the flood and the flow conditions; and
 - (ii) the maximum probable flood is estimated through the use of historical data.

17. (1) An applicant shall evaluate the potential for flooding that

- (a) may occur in the region surrounding the site as a result of
 - (i) one or more natural causes, including storm surge, wind-generated waves, rare meteorological events, tsunamis or seiches, or extreme precipitation or a combination of these events; or
 - (ii) a common cause; or

(b) has a relatively high frequency of occurrence.

(2) The applicant shall

- (a) develop appropriate meteorological, hydrological and hydraulic models to determine the flooding hazards for the site, including secondary effects in the nature of debris and sediments, among others, where available;
- (b) use relevant information from studies of historic and prehistoric floods to inform estimates of the frequency and magnitude of riverine and coastal floods; and
- (c) investigate the potential for instability of a coastal area or river channel due to erosion or sedimentation.

18. An applicant shall ensure that

- (a) the data on hazards associated with tsunamis or seiches are derived from historical records and any available information on prehistoric floods, as well as from physical or analytical modelling;
- (b) the evaluation of the hazards includes potential draw-down and run-up that could result in physical effects on the site;
- (c) the hazards associated with tsunamis or seiches are evaluated as appropriate for the region, using nearshore bathymetry and coastal topography, with account taken of any amplification due to the coastal configuration including artificial structures; and
- (d) deterministic and probabilistic hazard evaluations are performed and the rationale for the determination of design basis flood parameters are presented in accordance with the current engineering practice.

19. An applicant shall

- (a) analyse upstream water control structures including dams to determine the potential hazard associated with the failure of one or more of the upstream structures and determine the impact of any failure on the nuclear installation; and

- (b) examine flooding and associated phenomena caused by an accumulation of water due to a blockage of rivers upstream or downstream or due to a change in land use.

Adequacy and Quality of Water Supply for Ultimate Heat Sink and Emergencies

20. An applicant shall

- (a) evaluate the adequacy and quality of water supplies to the nuclear installation site for the purpose of plant cooling; and
- (b) ensure that the evaluation of the adequacy and quality of water supplies includes consideration of the potential effects of debris and fouling, additional water requirements for emergency cooling or process needs, effects on contaminant transportation, fluctuations in water temperature that could affect heat sinks, and effects on firefighting capability.

Groundwater Hazards

- 21. An applicant shall use a programme of hydrogeological investigations, based on groundwater probing, pumping tests, monitoring data, and numerical modelling, to assess the potential effects of the groundwater flow system as well as groundwater level and water quality on the nuclear installation and vice versa.**

Geotechnical and Geological Hazards

22. An applicant shall

- (a) investigate the geotechnical characteristics and geological features of subsurface materials and derive from the investigation, a soil and rock profile for the site that considers the variability and uncertainty in subsurface materials;
- (b) establish the static and dynamic geotechnical characteristics and geological features of subsurface materials at the site, including any backfill;
- (c) use laboratory and field-based methods in conjunction with appropriate sampling techniques and sufficient repetition of each test, to characterize each parameter of the subsurface materials at the site;

- (d) assess the stability and bearing capacity of foundation materials including consideration of the potential for excessive settlement under static and dynamic as well as seismic loading; and
 - (e) study through the use of appropriate methods and by taking into account the evaluation of the subsurface material at the site, the physical and the geochemical properties of the soil and groundwater.
- 23. An applicant shall evaluate the geotechnical and geological hazards, including soil and rock stability, slope instability, collapse, subsidence or uplift, physical properties of the materials underlying the site, ground disruption, effects of vibratory ground motion and soil liquefaction potential, and their effect on the safety of the nuclear installation.
- 24. An applicant shall
 - (a) evaluate the nuclear installation site and the site vicinity to determine the potential for slope instability including landslides, rockfall and avalanches caused by natural or human-induced phenomena, which could affect the safety of the nuclear installation;
 - (b) ensure that in the evaluation of slope
 - (i) instability, the configuration of the site during and after site preparation activities is addressed; and
 - (ii) stability shall also take into account extreme meteorological conditions and rare meteorological events; and
 - (c) evaluate the potential for slope instability resulting from seismic loading, by using parameters appropriate for describing the seismic hazards and the soil and groundwater characteristics at the site.
- 25. An applicant shall
 - (a) use a detailed description of surface conditions obtained from reliable methods of investigation to evaluate the potential for collapse, subsidence or uplift of the surface that could affect the safety of the nuclear installation over its lifetime;
 - (b) examine geological maps and other appropriate information for the region to determine the existence of natural features including caverns, karstic formations and human-made features in the nature of mines, water wells and oil wells among others;

- (c) where the evaluation under paragraph (a) shows that there is a potential for collapse, subsidence or uplift of the surface that could affect the safety of the nuclear installation, provide practicable engineering solutions or declare the site to be unsuitable; and
- (d) where a practical engineering solution is available under paragraph (c), develop a detailed description of subsurface conditions obtained by reliable methods of investigation for the purposes of the determination of the hazards to the nuclear installation.

26.(1) An applicant shall

- (a) evaluate the potential for liquefaction and non-linear effects of the subsurface materials at the site through the use of appropriate parameters;
- (b) ensure that the evaluation includes the use of international best practice for soil investigation and analytical methods to determine the hazards; and
- (c) where the potential for soil liquefaction is found to be unacceptable and there is no practical engineering solution available, declare the site to be unsuitable.

27. An applicant shall

- (a) investigate the geotechnical characteristics of the subsurface materials, including the uncertainties in them and determine a soil profile for the site in a form suitable for design of the nuclear installation;
- (b) assess the stability of the foundation material under static and dynamic conditions including seismic loading conditions;
- (c) study the groundwater regime and the chemical properties of the groundwater;
- (d) obtain from on-site measurements, factors important to hydrological radionuclide transport including soil, sediment, and rock characteristics, adsorption and retention coefficients, ground water velocity, and distances to the nearest surface body of water; and
- (e) investigate geotechnical hazard for which no proven engineering solutions or measures can be taken to improve the characteristics of the site, where the probability of the hazard is not higher than 10^{-6} /year, taking into account the cliff edge effect.

Biological Hazards

28. An applicant shall in undertaking site evaluation take into consideration,

- (a) any biological phenomena that may pose a risk to the safe operation of the nuclear installation;
- (b) the potential for unusual weather events which may increase the risk of
 - (i) the ventilation and cooling intake systems being clogged by biota;
 - (ii) the potential for the colonization and excessive growth of algae, mussels, or clams within these systems; and
 - (iii) the clogging of intake structures by large quantities of biological material including aquatic plants, fishes, and jellyfish;
- (c) the potential for the rapid growth of pathogens in the ultimate heat sink and other elements of the cooling system that may pose a potential risk to both human and non-human biota; and
- (d) biological hazards including those that may be posed by rodents and birds and that may damage or disrupt electrical or other systems within the facility.

Other Considerations

29. (1) An applicant shall

- (a) investigate other natural phenomena that are specific to the region and that could generate external hazard events which have the potential to affect the safety of the nuclear installation;
- (b) evaluate, subject to general criteria in regulation 7, a hazard found from the investigation to have a potential significant effect on safety; and
- (c) make special considerations in the evaluation of all hazards that could affect the availability and reliability of the ultimate heat sink, through the evaluation of air temperature and humidity, water depth and temperature, water quality characteristics and availability as well as sustainability of the water flow.

Specific Requirements for Evaluation of Human Induced Events

Identification and Assessment of Human Induced Events

30. An applicant shall

- (a) develop, document and implement a systematic approach for identifying and assessing human induced events;
- (b) ensure that an assessment under paragraph (a), addresses the effects of human induced events on the environment throughout the lifecycle of the proposed facility;
- (c) ensure that the characteristics necessary for the determination of the parameters to be included in the design basis, if structures or engineering measures are required to ensure protection against the effect of human-made external events, are identified for a recurrence interval of 10^{-4} to 10^{-7} /year; and
- (d) where an assessment indicates that the hazards are unacceptable, and where no practicable solutions are available, declare the site unsuitable.

Aircraft crash

31. An applicant shall

- (a) assess the potential for aircraft crashes on the site taking into account, to the extent practicable, of potential changes in future air traffic and aircraft characteristics;
- (b) where the assessment shows that there is a potential for an aircraft crash on the site that could affect the safety of the nuclear installation, assess the hazards; and
- (c) ensure that the hazards associated with an aircraft crash that are to be taken into consideration include the impact of associated hazards resulting from fire and explosions.

Electromagnetic Interference Hazards

32. An applicant shall evaluate

- (a) electromagnetic emitters in the region during normal and abnormal operations, with respect to their potential to affect the safe operation of the nuclear installation; and
- (b) the potential effects of electromagnetic interference, eddy currents in the ground and where the effects of these phenomena and occurrences would produce an unacceptable hazard and no practicable solution is available, declare the site unsuitable.

Other Transportation Hazards

33. An applicant shall evaluate present and proposed land and water transportation routes in the region with respect to their potential for collisions with structures, systems and components, generation of explosions, chemical and radiological hazards, and fires.

Fires and Explosions

34. An applicant shall evaluate each potential fire and explosion event in the region that could affect the safe operation of the nuclear installation, including

- (a) the direction and force of fire pressure waves and their effects on the structures, systems and components and unprotected personnel;
- (b) temperature effects on the structures, systems and components and unprotected personnel;
- (c) potential secondary fires and explosions generated by the primary explosion or fire;
- (d) release of volatile gases, asphyxiants, or chemicals that could affect the safe function of the structures, systems and components or harm unprotected personnel;
- (e) missiles that could affect the structures, systems and components; and
- (f) effects that could render offsite power supplies unavailable.

Chemical and Radiological Hazards

35. An applicant shall evaluate all chemical and radiological hazards in the region that could affect the safe operation of the nuclear installation, with particular focus on

- (a) activities that involve the handling, processing, transport, and storage of materials with the potential for explosions, or the production of radioactive materials, volatile and reactive gases, or asphyxiants;
- (b) effects of the activities under paragraph (a) on the structures, systems and components and unprotected personnel, including estimates of overpressure, toxicity, and transport characteristics in air; and
- (c) secondary chemical interactions on the structures, systems and components.

Requirements for Establishing Site Baseline Data and Potential Radiological Impact of Nuclear Installations in a Region

Baseline Data

36. An applicant shall

- (a) document and demonstrate a systematic process for gathering baseline data, and include analysis of variability and uncertainties;
- (b) capture the baseline data within auditable quality assurance programme;
- (c) identify valued components in the existing environment and use them as specific assessment end-points and measure the end-points, as appropriate;
- (d) select the parameters to be included in the environmental baseline data collection programme based on the understanding of the contaminants of potential concern prior to collecting environmental baseline data;
- (e) verify the baseline data collected in the initial assessment in subsequent periodic assessments carried out over the life of the nuclear installation;
- (f) take into account archeological, paleontological, and prehistoric data as well as historic and instrumentally recorded sources; and
- (g) assess the ambient radioactivity of the atmosphere, hydrosphere, lithosphere, and biota in the region, including an assessment of ambient radionuclide activity levels in ingested water and food used in the human pathways modelling.

Biological Data

37 An applicant shall

- (a) identify, document and use the biotic characteristics of the proposed site in the site evaluation;
- (b) include descriptions of vegetation communities, birds, mammals, reptiles, fish, and invertebrates to be used for the environmental effects monitoring and risk assessment purposes; and
- (c) use the information in Regulation 37 (b) to:
 - (i) identify likely interactions between the project and the biota in the area;
 - (ii) predict potential environmental effects;
 - (iii) identify mitigation measures;
 - (ix) evaluate the significance of the residual effects once the mitigation measures are applied; and
 - (x) develop a follow-up monitoring programme.

Meteorological Data and Atmospheric Dispersion of Radioactive Material

38. An applicant shall for the purpose of making a meteorological description,

- (a) collect meteorological data for at least two years after the site selection and ensure that the data collected includes wind speed and direction, air temperature, precipitation, humidity, atmospheric pressures, temperature inversions and the regional topography;
- (b) draw up a meteorological programme, evaluate the data collected under paragraph (a), by using instruments capable of recording the meteorological variables at appropriately justifiable locations and elevations for the minimum of two years before the construction of the nuclear installation and during the lifetime of the nuclear installation; and
- (c) undertake an atmospheric dispersion assessment, use the site-specific data obtained from investigations to assess the atmospheric dispersion of radioactive material, during operational states and accident conditions, and in that regard apply appropriate and justifiable models taking into account, the characteristics of the nuclear installation.

Surface Hydrological Data and Dispersion of Radioactive Material through Surface Water

39. An applicant shall

- (a) describe the surface hydrology by using the characteristics of both natural and artificial water bodies, major structures for water control and locations of water intake structures and include in the description, information on delineation of drainage basins and the use of water;
- (b) undertake a surface hydrology programme of investigation, by using both deterministic and probabilistic methods of investigations, that involve the measurements and prehistoric and historic recording of hydrological data including surface water quality, surface water levels and flow rates;
- (c) as part of the investigation under paragraph (b), determine the extent of dilution and dispersion of radionuclides in water bodies together with the re-concentration ability of sediments and biodata as well as the transfer of radionuclide mechanisms in the hydrosphere and exposure pathways; and
- (d) undertake a surface hydrology assessment by using an appropriate and justifiable model together with the information, investigations and data gathered, to assess the potential for contamination or change, inflow and chemistry, of the site surface hydrology.

Dispersion of Radioactive Material through Groundwater

40. An applicant shall

- (a) provide a description of the groundwater hydrology by using the physical and geochemical characteristics of water-bearing formations and their interactions with surface hydrology;
- (b) develop a groundwater hydrology programme that involves the investigation of the movement, retardation, dilution and dispersion of radionuclides within the aquifers;
- (c) ensure that the investigation under paragraph (b) is not limited to the migration and retention characteristics of soils and the physiochemical and geological properties of groundwater that aid the movement of radionuclides and other contaminants; and

- (d) conduct a ground hydrology assessment by using an appropriate and justifiable model together with the information, investigations and data gathered from the programme, to assess the potential for contamination or change, inflow and chemistry, of the site surface hydrology.

Population Distribution

41. (1) An applicant shall obtain from the appropriate authority,
- (a) the population distribution of the region where the nuclear installation site is to be located
 - (b) the existing population and projections of population distribution including both residential and transient population, before the commissioning of the nuclear installation and periodically; and
 - (c) at least within every five years, during the life span of the nuclear installation, an update of the population and the population distribution, including both residential and transient population;
- (2) The authorised person shall collaborate with the appropriate authority to carry out a special census in the absence of any national census data or extrapolated population distributions.
- (3) The applicant shall
- (a) ensure that the nuclear installations is located in a low population density area as part of the pursuit of defense in depth;
 - (b) within 5 km circumference to where the nuclear installation is located, define a justifiable exclusion area for the purposes of emergency planning and monitor and assess activities within that radius; and
 - (c) cooperate with the appropriate authority to ensure that the data on population density and distribution of the exclusive area is collected with particular attention to the immediate surroundings within the population centres and densely populated areas.
- (4) The authorised person shall on the basis of the population data and population density predictions, conduct an assessment of the potential for the effect of radiological discharges

for the purpose of developing emergency planning for the nuclear installation site, preparedness and evacuation procedures as required by the regulations on Emergency Preparedness and Response of the Authority.

Uses of Land and Water in the Region

42. An applicant shall ensure that

- (a) the facilities and operations of the nuclear installation are designed and managed in a manner that minimizes the impact of the installation on the original use of and habitation of the land and water bodies by living organisms so far as is reasonably practicable;
- (b) changes to the local topography and forest vegetation features are minimized as far as is reasonably practicable;
- (c) the existing topography and forest and overall vegetation features are used to aesthetically improve the views around the nuclear installation, operations and transmissions;
- (d) the aesthetic improvements under paragraph (c), include site redress, restoration of natural vegetation, creative landscaping and integration of the environment with the nuclear installation structures to mitigate adverse visual impacts;
- (e) an assessment is conducted for land use for nuclear installations at areas where specialty crops are cultivated or where endangered species that may not thrive elsewhere have a niche, for the purpose of minimizing the impact of the nuclear installation development on these activities and species; and
- (f) an assessment and a justification are conducted for the location of nuclear power stations, transmission lines and transportation corridors adjacent to places marked by state for public use such as scenic and recreational areas, natural resource reserves.

Monitoring of Site-Specific Hazards

43.(1) An authorised person shall monitor

- (a) the characteristics of site-specific hazards, whether natural or human-induced, addressed in these regulations that are shown to significantly affect safety and security, from the site characterization stage through the operational stage, to after decommissioning of the nuclear installation;
- (b) the site or regional characteristics including demography, meteorological and hydrological conditions and any other condition that has the potential to affect the safety of the nuclear installation, throughout the lifetime; and
- (c) the hazards and conditions that are considered in these regulations and that are pertinent to the licensing and safe operation of the installation.

(2) The authorised person shall, at least, at intervals of every ten years or at a shorter interval that the Authority may require in the event of an accident, incident, extreme event, abnormal operational experience or on the realization of a short-fall in initial or previous evaluation, review and update the site-specific hazards addressed in the safety requirements.

(3) The applicant shall

- (a) submit to the Authority as part of the Site Evaluation Report, a comprehensive monitoring plan of site-specific hazards, site conditions and site characteristics that
 - (i) identifies the parameters to be monitored for each external hazard and site or regional characteristic; and
 - (ii) demonstrates how the plan is to be used to support the conclusion that the site can safely host a nuclear installation and that the nuclear activities on the site are safe;

- (b) where nuclear installations or units are collocated, monitor the effect of the transport, processing or storage of the accessories or materials of one unit, facility or installation on the other; and
- (c) store and use as the basis for any future work or periodic review assessment, information, data and trends obtained in the monitoring process.

Seismic Monitoring

44. (1) An applicant shall install

- (a) a seismic monitoring network system from the very beginning of the site evaluation stage; and
 - (b) a local seismological network of high sensitivity seismometers, at the preferred site.
- (2) The applicant shall install and operate the network system in the near region around the nuclear installation site and within the site itself and ensure that the seismometers have the capability of recording micro-earthquakes and sufficiently high frequencies.
- (3) The authorised person shall ensure that
- (a) the design of the seismic monitoring network system is suitable for the geological setting and for assessing the seismic hazards at the site;
 - (b) the data obtained from the operation of the system is used as a supporting tool in decisions regarding the capability of faults;
 - (c) the network is operational for the lifetime of the installation;
 - (d) the operation and data processing of the seismological monitoring network are linked to existing regional and national seismic monitoring network systems to enable the possibility for common interpretation;
 - (e) strong motion accelerographs are installed at some of the seismological monitoring stations in order to acquire more detailed information on path effects, validity of Ground Motion Prediction Equations and site response; and

(f) the data from the seismic monitoring is used to

- (i) demonstrate periodically that the safety case remains valid or prompt modifications; and
- (ii) initiate recovery, emergency, or inspection actions if seismic activity above a certain threshold levels is detected that might reasonably be expected to challenge established safety limits.

Monitoring of Ground and Soil

45. An applicant shall,

- (a) before the commencement of the operational stage of the nuclear installation, submit to the Authority for approval the method to be used to monitor and assess ground and soil characteristics;
- (b) ensure that the method to be submitted under paragraph (a), includes a geotechnical investigation of the site that is sufficient to demonstrate the adequacy of the site to provide foundation support to the nuclear installation during construction and through its projected lifetime;
- (c) ensure that a geodetic monitoring network is established and the results used to confirm the suitability of the site;
- (d) at least at intervals of every ten years, assess and monitor
 - (i) the potential for surface faulting of existing faults, with particular attention to movements on the site and its immediate environments, as well as the effects of movements of other faults close to the site shall also be assessed and monitored;
 - (ii) the site and its immediate environments, for new faults and their capabilities;
 - (iii) the liquefaction potential of the soil on the site and its environment using site-specific ground motions which are either historical or monitored; and

- (iv) the settlement or uplift of major safety related structures on site;
- (e) ensure that for the purpose of monitoring the potential collapse, subsidence and uplift of existing caverns, voids, wells, and the development and discovery of new ones, geotechnical investigations conducted during the lifetime of the nuclear installation as part of monitoring include the assessment of the presence and formation of caverns, karst and man-made voids in the nature of wells and mines among others;
- (f) ensure that the site and its environs are monitored and assessed for the potential of slope instability including landslides and rockslides;
- (g) ensure that at least at the interval of every ten years the stability of the soil at the site is monitored under static and seismic load;
- (h) ensure that the soil characteristics and its constituents are continually monitored for changes that may arise as a result of chemical contamination; and
- (i) ensure that the ambient radioactivity of the lithosphere is first measured at the commissioning of the nuclear installation and continually monitored and reported to assess the effect of the nuclear installation in the region.

Monitoring of Air and Water

46. (1) An applicant shall,

- (a) before the commencement of the operational stage of the nuclear installation, submit to the Authority for approval the method to be used to monitor air and water quality;
- (b) ensure that water quality monitoring includes both surface and groundwater monitoring; and
- (c) ensure that air quality monitoring includes meteorological and climatological characteristics monitoring.

(2) The authorised person shall ensure that

- (a) during the lifetime of the nuclear installation, meteorological and climatological characteristics are monitored to support the periodic safety review process;
 - (b) the selection of characteristic parameters for monitoring and the frequency, duration and type of monitoring are selected to support the safety related claims made in respect of meteorological and flooding hazards;
 - (c) the parameters monitored include as a minimum, wind speed and direction, precipitation, temperature of both sea water and air, humidity and sea level;
 - (d) the site is continually monitored for rare meteorological events including cyclones, tornadoes and severe lightening;
 - (e) the ambient radioactivity of the atmosphere and hydrosphere are first measured at the commissioning of the nuclear installation and continually monitored and reported to assess the effect of the nuclear installation in the region;
 - (f) groundwater and surface water of the site and its environs are continually assessed for the potential of flooding and inundation of the nuclear installation;
 - (g) the monitoring under paragraph (f) includes the height of tides for coastal sites, the wind effects on water bodies and wave actions for coastal sites; and
 - (h) groundwater and radionuclides in groundwater are monitored for changes in their constituents, from the commissioning of the nuclear installation to decommissioning.
- (3) The authorised person shall, in collaboration with the appropriate authorized agencies,
- (a) monitor upstream water control structures including dams and water storages for their intakes and releases to ensure that the releases whether planned or accidental, are within limits of control for downstream nuclear installations; and
 - (b) ensure that erosion of a coastal site due to precipitation and surface runoff, and the effects of the marine environment and coastal processes are monitored to assess the effect on the nuclear installation site.

Ecological Monitoring

47. (1) An authorised person shall monitor the potential of clogging of inlets and outlets of nuclear installations by sea water debris, aquatic plants, and other marine organisms to justify the safety case on the ultimate sink, and submit a report of the ecological monitoring activities to the Authority annually.
- (2) The authorised person shall at the start of the preoperational stage of the nuclear installation, identify, document and at least at intervals of every six months, monitor the various plant and animal species on the nuclear installation site and within five kilometres radius of the site, during the lifetime of the nuclear installation, to provide information for the assessment of the effect of site activities and nuclear installation on the region.

Population Monitoring

- 48.(1) An authorised person shall, before the commencement of the operational stage of the nuclear installation,
- (a) submit to the Authority the method to be used for the monitoring and assessment of the population size and distribution in the vicinity of the site and the region; and
 - (b) ensure that the method includes the provision of liaison arrangements with relevant Government organisations and stakeholders.
- (2) The authorised person shall, in collaboration with the appropriate agencies of government, ensure that
- (a) the population growth and distribution of the region around the nuclear installation is monitored and confirmed with the suitability of the existing emergency plan and other attendant variables and plans throughout the life time of the nuclear installation;
 - (b) as part of the monitoring, at every given time of the year, an accurate estimation of the population of the vicinity of the site, densely populated areas, residential institutions including schools, hospitals and prisons around the nuclear installation are known as part of monitoring activities;

- (c) the transient population in the region of the nuclear installation and its immediate vicinity is monitored and reported throughout the lifetime of the nuclear installations;
- (d) the airspace of the nuclear installation site is continuously monitored for the potential of accidental aircraft craft crashes; and
- (e) the activities in the environment of the nuclear installation site are monitored for the presence of toxic and over-pressured chemicals, whether in transit or stored, which are capable of causing an explosion or detonation and deflagration of gas clouds.

Management Systems for Siting

49. An applicant and authorised person shall

- (a) for site selection and evaluation activities, establish a comprehensive, systematic, planned and documented management system consistent with the requirements of the Integrated Management System Regulations;
- (b) submit to the Authority before the commencement of the siting activities, a Quality Assurance Programme for the site selection and evaluation process consistent with the overall integrated management system of the authorised person;
- (c) ensure that the Quality Assurance Programme
 - (i) provides for studies, evaluations and analyses of site related characteristics important to safety to be undertaken in an effective and efficient manner and are correctly performed and for making decisions about siting;
 - (ii) specifies documented procedures, instructions, work plans and drawings that include or reference appropriate quantitative or

qualitative acceptance criteria for determining whether a prescribed activity has been satisfactorily accomplished; and

(iii) describes the activity required to be performed to a level of detail commensurate with the complexity of the activity and the need to assure consistent and acceptable results;

(d) establish written procedures for the qualification of personnel, and for the assurance that only those personnel who meet the requirements are permitted to perform these activities;

(e) ensure that personnel performing or managing siting activities receive indoctrination in their job responsibilities that includes general criteria, technical objectives, requirements of applicable codes and standards, regulatory commitments, company procedures, and quality assurance program requirements;

(f) ensure that contractors, consultants and suppliers of services within the siting project are subject to evaluation and selection by the authorized person that is documented and includes

(i) the current capability and history of the supplier for providing an identical or similar product that performs satisfactorily in actual use;

(ii) the current quality records of the supplier, supported by documented qualitative and quantitative information that can be objectively evaluated; and

(iii) the technical and quality capability of the supplier, as determined by a direct evaluation of the facilities, personnel, and the implementation of the quality assurance programme of the supplier;

(g) ensure that tools, gages, instruments, and other measuring and test equipment used for siting activities are controlled, calibrated at specific periods, adjusted, and

maintained to required accuracy limits and that records are established and maintained to indicate calibration status and the capability of measuring and test equipment to satisfactorily perform its intended function;

- (h) establish corrective action plan for the siting activities including conditions leading to initiation of corrective action and documentation and reporting requirements;
- (i) generate quality assurance records furnishing documentary evidence that items or activities meet specified requirements;
- (j) ensure that quality assurance records are identified, generated, authenticated, and maintained, and their final disposition specified and that the record control requirements and the responsibilities for the activities are documented;
- (k) perform audits to verify compliance to quality assurance program requirements, demonstrate that performance criteria are met, and determine the effectiveness of the program; and
- (l) ensure that the audits are performed in accordance with written procedures and checklists by personnel who do not have direct responsibility for performing the activities that are audited;
- (m) ensure accuracy, validity, integrity over time, and maintainability of data that relates to nuclear safety including data used for derivation of design bases parameters.
- (n) ensure that verification and validation are performed on data series used for engineering analysis resulting in site parameters;
- (o) ensure the establishment of non-conformance control and corrective action process shall that defines how the errors in data collection, recording or reporting; calculations, reasoning, assumptions and conclusions are dealt with and how non-conformance with procedures and specifications sare to be documented and assessed ;

- (p) ensure that a participatory peer review of the evaluation is conducted, where site parameters for design cannot be established or confirmed with inspection, tests and direct verification because the situation involves scientific modelling;
- (q) ensure that the peer review is conducted in a manner that adequately enables the evaluation or hazard analysis to effectively capture the center, body, and range of technically defensible interpretations of the larger technical community.

(2) The authorised person shall ensure that

- (a) the peer review is conducted by persons who are independent of the evaluation multidisciplinary team of experts and that the review provides assurance that
 - (i) a proper process has been duly followed in conducting the analysis;
 - (ii) the analysis has addressed and evaluated the uncertainties, both epistemic and aleatory, involved; and
 - (iii) the documentation is complete and traceable.
- (b) the verification and validation documentation is in place for computer software programs used for establishing the site parameters that demonstrate that the software systems meet specifications and requirements and fulfill their intended purpose;
- (c) site investigations including laboratory results, in situ test, geoscience investigations and engineering analyses are well documented in the Site Selection Report and Site Safety Report to be submitted to the Authority;
- (d) the reports standalone and include all pertinent data to allow for an easy independent review;
- (e) other records of work conducted during the site evaluation process are well documented in adherence to the quality assurance goals and objectives.

Miscellaneous

Penalties

50. A person who contravenes any of the provisions of these Regulations commits an offence and is liable to penalty provision in Regulation 80 of the *Basic Ionising Radiation Control Regulations*.

Appeals

51. A person who is not satisfied with a decision taken by the Authority may appeal in accordance with sections 81, 82, 83, 84 and 85 of the Nuclear Regulatory Authority Act, 2015 (Act 895).

Interpretation

52. In these Regulations unless the context otherwise requires

“Aleatory Uncertainty”	It is an uncertainty that arise from a random process such as random failures of items of equipment. It is taken into account by representing a phenomenon in terms of a probability distribution model;
“Applicant”	An organisation or entity backed by legal support with the intention of developing or constructing a nuclear installation and follows up to formally seek authorisation from the NRA to undertake any site evaluation related activity;
“Assessment”	The process, and the result, of analysing systematically and evaluating the hazards associated with sources and practices, and associated protection and safety measures;
“Atmosphere”	A layer of gases surrounding the earth that is held in place by gravity;
“Authorisation”	This includes the granting by the Nuclear Regulatory Authority or other governmental body written permission for an operator to perform specified activities as applicable either by licensing, certification or registration;

<i>“Authority”</i>	Means the Nuclear Regulatory Authority;
<i>“Best Practice”</i>	This is an approach, method or technique generally accepted by the relevant informed technical community and demonstrated as efficient, prudent and superior to any other course of action in a given activity. This approach, method or technique can be employed at the time of use, and if superseded, the obligation is on the licensee or authorised person to establish whether the change is significant to nuclear safety or security, and act accordingly to change or maintain such practice;
<i>“Biosphere”</i>	The regions of the surface and atmosphere of the earth occupied by living organisms;
<i>“Candidate Site”</i>	This is a site that has been selected from a site survey analysis;
<i>“Capable Fault”</i>	A capable fault is a fault which has exhibited one or more of the following characteristics: (a) Movement at or near the ground surface at least once or recurring in nature within a reasonable period that gives the indication that further movements would occur soon. (b) The maximum potential earthquake associated with a seismogenic structure is sufficiently large and at such a depth that it is reasonable to infer that, in the geodynamic setting of the site, movement at or near the surface could occur. A structural relationship to a capable fault according to characteristics (1) or (2) of this paragraph such that movement on one could be reasonably expected to be accompanied by movement on the other;
<i>“Capable Volcanic”</i>	

The concept of a ‘capable’ volcano or volcanic field denotes those volcano(es) and/or volcanic field(s) that are potentially capable of producing hazardous phenomena that may affect the site of a nuclear installation.

A capable volcano or volcanic field is one that:

- (i) has a credible likelihood of experiencing future activity during the lifetime of the installation and
- (ii) has the potential to produce phenomena that may affect the site of the installation;

“Core Damage”

Exposure and heat up of the reactor core to the point at which prolonged oxidation and severe fuel damage are capable of causing release of fuel products from the fuel cladding, and or release of fuel products into the containment of a nuclear power plant;

“Emergency Measures”

Plans, procedures, checklists and any other measures prepared and implemented to prevent or minimize the occurrence or impact of an emergency, including an Emergency Response Plan;

“Emergency Preparedness”

The capability to take actions that will effectively mitigate the consequences of an emergency for human health and *safety*, quality of life, property and the environment;

“Emergency Response”

The performance of actions to mitigate the consequences of an *emergency* for human health and *safety*, quality of life, property and the environment. It may also provide a basis for the resumption of normal social and economic activity.

“Epicenter”

The geographical point on the surface of earth vertically above the focus of an earthquake;

<i>“Epistemic uncertainty”</i>	Is an uncertainty that arises as a result of the lack of knowledge or incomplete knowledge about a phenomenon, which affects the ability to model it. It is reflected in a range of viable models, multiple expert interpretations and statistical confidence;
<i>“Expert Judgment”</i>	Information provided by a technical expert, in the expert’s area of expertise, based on opinion, or on an interpretation based on reasoning that includes evaluations of theories, models, or experiments;
<i>“External Events”</i>	Events unconnected with the operation of a facility or the conduct of an activity that could have an effect on the safety of the facility or activity;
<i>“External Events of Natural Origin”</i>	Events that originate outside the machinery and operation of the nuclear installation, and arise from forces of nature and not from human activities;
<i>“External Zone”</i>	The area immediately surrounding a proposed nuclear installation site in which population distribution and density, and land and water uses, are considered with respect to their effects on the possible implementation of emergency measures;
<i>“Exclusion Area”</i>	That area surrounding the installation, in which the Authorised Person has the authority to determine all activities including exclusion or evacuation of personnel and property from the area. This area may be traversed by a highway, railroad, or waterway, provided these are not so close to the installation as to interfere with normal operations of the installation, and provided appropriate and effective arrangements are made to control traffic on the highway, railroad, or waterway. In case of emergency, to protect the public health and safety, residence within the exclusion area shall normally be prohibited. In any event, residents

shall be subject to ready removal in case of necessity. Activities unrelated to the operation of the installation may be permitted in an exclusion area under appropriate limitations, provided that no significant hazards to the public health and safety will result;

“Fault”

A tectonic structure along which differential slippage of the adjacent earth materials has occurred parallel to the fractured plane. It is distinct from other types of ground disruptions such as landslides, fissures, and craters;

“Graded approach”

For a system of control, such as a regulatory system or a safety system, a process or method in which the stringency of the control measures and conditions to be applied is commensurate, to the extent practicable, with the likelihood and possible consequences of, and the level of risk associated with, a loss of control;

“Hydrosphere”

The total amount of water on earth. The hydrosphere includes water that is on the surface of the earth, underground and in the air;

“Indoctrination”

The process of inculcating a person with ideas, attitudes, cognitive strategies or professional methodologies;

“Justification/Justifiable”

The process of determining whether a practice or proposed action is likely, overall, beneficial; that is, whether the expected benefits to individuals and to society from introducing or continuing the practice or proposed action outweigh the harm or cost resulting from the practice or action;

<i>“Karst”</i>	Topography formed from the dissolution of soluble rocks such as limestone, dolomite, and gypsum. It is characterized by underground drainage systems with sinkholes and caves;
<i>“Meteorological Variables”</i>	The various quantities that describe weather characteristics in the atmosphere;
<i>“Near Region”</i>	A geographical area around the nuclear installation site that is bigger than the site vicinity but less than the region. This is an area which defines where some hazard studies take place and are typically not less than 25 km;
<i>“Nuclear Installation Location Area”</i>	Territory including the nuclear installation site on which phenomena, processes and factors of natural and human origin, capable of affecting the facility safety, can possibly occur;
<i>“Nuclear Installation Site”</i>	The territory within the limits of the guarded perimeter where the structures and other facilities reside that contain nuclear or radioactive material. The territory where activities covered by the Licence are permitted to take place. This is a geological area covering not less than 1km in radius;
<i>“Off-Site”</i>	Outside the boundary of a nuclear installation site;
<i>“On-Site”</i>	Within the boundary of a nuclear installation site;
<i>“Operating Basis External Event”</i>	A postulated external event for which the structures, systems, and components are designed to remain operational;

<i>“Protection System”</i>	A system that monitors the operation of a nuclear installation, and which, on sensing an abnormal condition, automatically initiates actions to prevent an unsafe or potentially unsafe condition;
<i>“Precipitation”</i>	Any product of the condensation of atmospheric water vapour that falls under gravity. The main forms of precipitation include drizzle, rain and hail;
<i>“Principal Parties”</i>	Persons or organisation having the main responsibilities for the applications of these regulations. The principal parties shall be Authorised Personpersons, employers of workers in relation to occupational exposure; and those persons or organisations designated to deal with emergency or existing exposure situations;
<i>“Quality Assurance”</i>	Planned and systematic actions necessary to provide adequate confidence that an item, process or service will satisfy given requirements for quality; for those prescribed in the license
<i>“Region”</i>	This is the geographical area of interest in the study of external hazards and for the characterisation for the proposed nuclear installation site. This area extends beyond the External Zone and its size depends on the specific external hazard under study. This would typically cover a geographical area of not less than150km radius;
<i>“Risk”</i>	A multiattribute quantity expressing hazard, danger or chance of harmful or injurious consequences associated with exposures or potential exposures. It relates to quantities such as the probability that specific deleterious consequences may arise and the magnitude and character of such consequences;

<i>“Run-up”</i>	The maximum vertical extent of wave uprush on a beach or structure above the still water level;
<i>“Seiche”</i>	A standing wave in an enclosed or partially enclosed body of water. Seiches and seiche-related phenomena have been observed on lakes, reservoirs, swimming pools, bays, harbours and seas;
<i>“Seismic”</i>	Relating to earthquakes or other vibrations of the earth and its crust;
<i>“Seismotectonic Area”</i>	A geographic area characterised by similarity of geological structure and earthquake characteristics;
<i>“Seismotectonic”</i>	A relationship between the earthquakes, active tectonics and individual faults of a region;
<i>“Site Survey”</i>	The process that is used to identify candidate sites for nuclear installations on the basis of safety and other considerations;
<i>“Site Vicinity”</i>	Smaller than a region and larger than the nuclear installation site (typically covering a geographical area not less than 5 km in radius);
<i>“Site Evaluation Process”</i>	The analysis of factors at a site that could affect the safety of a facility or activity at a site. This includes site characterization and consideration of factors that could affect the safety features of the facility or activity so as to result in a release of radioactive material, and/or could affect the dispersion of such material in the environment, as well as population and access issues relevant to safety (e.g. feasibility of evacuation, location of people and resources);
<i>“Siting Process”</i>	This ‘generally’ consists of an investigation of a large region to obtain potential sites, these are evaluated to obtain one or more candidate

sites. The unsuitable candidate sites are rejected and the preferred sites are assessed by screening and comparing them on the basis of safety and other considerations to arrive at the preferred candidate sites;

“Site Selection”

This is the stage in the siting process at which selected candidate sites obtained from the site survey stage are ranked using suitability criteria to determine preferred site(s) for the construction of a nuclear installation;

“Structures, Systems and Components (SSC)”

A general term encompassing all the elements of an installation or activity, which contributes to protection and safety. Structures are passive elements such as building, vessels and shielding. A System comprises several components assembled in such a way as to perform a specific active function, and a Component is a discrete element of a system;

“Soil Liquefaction”

Describes a phenomenon whereby a saturated or partially saturated soil substantially loses strength and stiffness in response to an applied stress, usually earthquake shaking or other sudden change in stress condition, causing it to behave like a liquid;

“Storm Surge”

The rising of the sea as a result of wind and atmospheric pressure changes associated with a storm;

“Tectonic”

Relates to the structure of the earth's crust and the large-scale processes which take place within it. Typically used herein to refer to earthquakes caused by natural crustal processes;

“Tropical Cyclones”

Localized, very intense low-pressure wind systems, forming over tropical oceans and with winds of hurricane force;

“Tornadoes”

A mobile, destructive vortex of violently rotating winds having the appearance of a funnel-shaped cloud and advancing beneath a large storm system;

“Tsunami”

A series of waves in a water body caused by the displacement of a large volume of water, generally in an ocean or a large lake. Earthquakes, volcanic eruptions and other underwater explosions, landslides, glacier calving, meteorite impacts and other disturbances above or below water, all have the potential to generate a tsunami;

“Valued Component”

The fundamental elements of the physical, biological or socio-economic environment, including the air, water, soil, terrain, vegetation, fish, wildlife, birds and land use that may be affected by a proposed project;