



قرار مجلس إدارة هيئة الرقابة النووية والإشعاعية

رقم (٢) لسنة ٢٠١٦

بإصدار وثيقة متطلبات تقييم مواقع المنشآت النووية

مجلس إدارة هيئة الرقابة النووية والإشعاعية:

بعد الإطلاع علي:

- قانون تنظيم الأنشطة النووية والإشعاعية الصادر بالقانون رقم (٧) لسنة ٢٠١٠،
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رئيس مجلس إدارة

هيئة الرقابة النووية والإشعاعية

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REGULATORY REQUIERMENT			

Site Evaluation Requirements for Nuclear Installation

متطلبات تقييم الموقع للمنشآت النووية

*Egyptian Nuclear and Radiological
Regulatory Authority
Cairo, Egypt*

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Geotechnical hazards	15
External human induced events	16
Other important considerations	17
4. Effects of the nuclear installation in the region	
Atmospheric dispersion of radioactive material	18
Dispersion of radioactive material through surface water	18
Dispersion of radioactive material through groundwater	19
Population distribution	19
Uses of land and water in the region	20
Ambient radioactivity	20
5. Monitoring of hazards	20
6. Management system for site evaluation	20
7. Definitions	20

1.4. This regulatory requirement does not specifically address underground or off shore installations

Scope

1.5. The scope of this regulatory requirement encompasses site related factors and site–installation interaction factors relating to operational states and accident conditions, including those that could lead to emergency response actions, and natural and human induced events external to the installation that are important to safety. The external human induced events considered in this Safety Requirements publication are all of accidental origin. Considerations relating to the physical protection of an installation against wilful actions by third parties are outside its scope.

1.6. The phrase ‘external to the installation’ is intended to include more than the external zone. In addition to the area immediately surrounding the site, the site area itself could contain objects that pose a hazard to the installation, such as an oil storage tank for diesel generators or another reactor on a multiunit site.

1.7. The siting process for a nuclear installation generally consists of an investigation of a large region to select one or more candidate sites (site survey), followed by a detailed evaluation of those candidate sites. This regulatory requirement is primarily concerned with the latter stage.

1.8. This regulatory requirement covers more comprehensive range of nuclear installations, with the use of a graded approach on the basis of the radiation risks that they pose to people and the environment. In some instances in this regulatory requirement a requirement is stated to apply to nuclear power plants. In these cases, the requirements are most appropriate for nuclear power plants, but they may also apply to other nuclear installations.

1.9. The level of detail needed in an evaluation to meet the requirements established in this regulatory requirement will vary according to the type of installation being sited. Nuclear power plants will generally require the highest level of detail. Depending on the level of risks posed by the installation, less detail and smaller areas of coverage may be sufficient to comply with the requirements established in this regulatory requirement.

1.10. This regulatory requirement is concerned with 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. Evaluation of the non-radiological impacts of a nuclear installation is not considered here.

1.11. As used in this regulatory requirement, the term ‘risk’ refers to the product derived from the multiplication of the probability of the occurrence of a particular event that results in the release of radioactive material by a parameter corresponding to the radiological consequences of this event. In concept, a comprehensive risk analysis includes all the sequential steps of analysing all the initiating events, following for each initiating event all the possible sequences

- (b) 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;
- (c) The population density and population distribution and other characteristics of the external zone in so far as they may affect the possibility of implementing emergency measures and the need to evaluate the risks to individuals and the population.

USES FOR SITE EVALUATION

2.2 In addition to providing the technical basis for the safety analysis report to be submitted to the nuclear regulatory body, the technical information obtained for use in complying with these safety requirements will also be useful in fulfilling the requirements for the environmental impact assessment for radiological hazards.

2.3 If the site evaluation for the three aspects cited indicates one of following rejection criteria or if subsequent reviews indicate that the site deficiencies cannot be compensated for by means of design features, measures for site protection or administrative procedures, the site shall be deemed unsuitable.

EGYPTIAN REJECTION CRITERIA

- a) Areas that show evidences or have potential for fault displacement at or near the site. Preference should be given to sites located at a sufficient safety distance from capable faults (at least the site and site vicinity must show the absence of capable faults).
- b) Areas covered with, deep unsuitable soil where soil has a potential for ground collapse e.g karstic hazard or cavities.
- c) Areas containing extensive and important ground/ surface drinking water (e.g. Nile Valley and Delta).
- d) Areas subjected to high flood events and not compensated by practical engineering solution.
- e) Areas where a feasible emergency plan cannot be implemented.
- f) Areas that are possibly affected by volcanic hazard (e.g. fall of pyroclastic deposits) or active mud volcanism.

GENERAL CRITERIA

2.4. Site characteristics that could affect the safety of the nuclear installation shall be investigated and assessed. Characteristics of the natural environment in the region that might be affected by potential radiological impacts in operational states and in accident conditions shall be investigated. All these characteristics shall be observed and monitored throughout the lifetime of the installation.

2.14. For nuclear power plants, the total nuclear capacity to be installed on the site shall be determined as far as possible at the first stages of the siting process. If it is proposed that the installed nuclear capacity be significantly increased to a level greater than that previously determined to be acceptable, the suitability of the site shall be re-evaluated.

2.15. An assessment shall be made of the feasibility of implementation of emergency plans. All on-site and collocated installations shall be considered in the assessment, with special emphasis on nuclear installations that could experience concurrent accidents.

REQUIREMENTS FOR HAZARDS ASSOCIATED WITH EXTERNAL NATURAL AND HUMAN INDUCED EVENTS

2.16. Proposed sites shall be adequately investigated with regard to all the site characteristics that could be significant to safety in external natural and human induced events.

2.17. Possible natural phenomena and human induced situations and activities in the region of a proposed site shall be identified and evaluated according to their significance for the safe operation of the nuclear installation. This evaluation shall be used to identify the major natural phenomena or human induced situations and activities in association with which potential hazards are to be investigated.

2.18. Foreseeable significant changes in land use shall be considered, such as the expansion of existing installations and human activities or the construction of high risk installations.

2.19. Prehistoric, historical and instrumentally recorded information and records, as applicable, of the occurrences and severity of major natural phenomena or of human induced situations and activities shall be collected for the region and shall be carefully analysed for reliability, accuracy and completeness.

2.20. Appropriate methods shall be adopted for establishing the hazards that are associated with major external phenomena. The methods shall be justified in terms of being up to date and compatible with the characteristics of the region. Special consideration shall be given to applicable probabilistic methodologies. It should be noted that probabilistic hazard curves are generally necessary to conduct probabilistic safety assessments for external events.

2.21. The size of the region to which a method for establishing the hazards associated with major external phenomena is to be applied shall be large enough to include all the features and areas that could be of significance in the determination of the natural and human induced phenomena under consideration and for the characteristics of the event.

- (a) For operational states of the installation the exposure of the population remains as low as reasonably achievable and in any case is in compliance with national requirements, with account taken of international recommendations;
- (b) The radiation risks to the population associated with accident conditions, including those that could lead to emergency response actions being taken, is acceptably low.

2.30. If, after thorough evaluation, it is shown that no appropriate measures can be developed to meet the aforementioned requirements, the site shall be deemed unsuitable for the location of a nuclear installation of the type proposed.

2.31. Nuclear Power Plant shall be located away from very densely populated centers. Areas of low population density are generally preferred.

2.32. As an aid in evaluating a proposed site, an applicant shall assume a fission product release from the core, the expected demonstrable leak rate from the containment and the meteorological conditions pertinent to his site to derive an exclusion area, a low population zone and population center distance. For the purpose of this analysis, which shall set forth the basis for the numerical values used, the applicant should determine the following:

(i) An exclusion area of such size that an individual located at any point on its boundary for two hours immediately following onset of the postulated fission product release would not receive a total radiation dose to the whole body in excess of 250 mSv or a total radiation dose in excess of 3000 mSv to the thyroid from iodine exposure.

(ii) A low population zone of such size that an individual located at any point on its outer boundary who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage) would not receive a total radiation dose to the whole body in excess of 250 mSv or a total radiation dose in excess of 3000 mSv to the thyroid from iodine exposure.

(iii) A population center (containing more than about 25,000 residents) distance of at least one and one-third times the distance from the reactor to the outer boundary of the low population zone. For this purpose, the boundary of the population center shall be determined upon consideration of population distribution. Political boundaries are not controlling in the application of this guide. Where very large cities are involved, a greater distance may be necessary because of total integrated population dose consideration.

2.33. For sites of multiple nuclear installations, consideration shall be given to the following:

(i) if the installations are independent to the extent that an accident in one plant would not initiate an accident in another, the size of the exclusion area, low population zone and population center

Surface faulting

3.5. The potential for surface faulting (i.e. the fault capability) shall be assessed for the site. The methods to be used and investigations to be made shall be sufficiently detailed that a reasonable decision can be reached using the definition of fault capability.

3.6. A fault shall be considered capable if, on the basis of geological, geophysical, geodetic or seismological data, data (including paleoseismological, geomorphologic data etc). One or more of the following conditions applies:

- (a) It shows evidence of past movement or movements (significant deformations and/or dislocations) during Quaternary of a recurring nature within such a period that it is reasonable to infer that further movements at or near the surface could occur. In highly active areas, where both earthquake data and geological data consistently reveal short earthquake recurrence intervals, periods of the order of tens of thousands of years may be appropriate for the assessment of capable faults. In less active areas, it is likely that much longer periods will be required.
- (b) A structural relationship with a known capable fault has been demonstrated such that movement of the one could cause movement of the other at or near the surface.
- (c) 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.

3.7. Where reliable evidence shows the existence of a capable fault that has the potential to affect the safety of the nuclear installation, an alternative site shall be considered.

METEOROLOGICAL EVENTS

3.8. The extreme values of meteorological variables and rare meteorological phenomena listed below shall be investigated for the site of any installation. The meteorological and climatologically characteristics for the region around the site shall be investigated.

Extreme values of meteorological phenomena

3.9. In order to evaluate their possible extreme values, the following meteorological phenomena shall be documented for an appropriate period of time: wind, precipitation, snow, temperature and storm surges.

3.10. The output of the site evaluation shall be described in a way that is suitable for design purposes for the nuclear installation, such as the probability of exceedance values relevant to design parameters. Uncertainties in the data shall be taken into account in this evaluation.

3.20. The possible combinations of the effects of several causes shall be examined. For example, for coastal sites and sites on estuaries, the potential for flooding by a combination of high tide, wind effects on bodies of water and wave actions, such as those due to cyclones, shall be assessed and taken into account in the hazard model.

3.21. The hazards for the site due to flooding shall be derived by the use of appropriate models.

3.22. The parameters used to characterize the hazards due to flooding shall include the height of the water, the height and period of the waves (if relevant), the warning time for the flood, the duration of the flood and the flow conditions.

3.23. Design basis flooding event shall be selected to mean annual frequency of exceedance 10⁻⁴ for nuclear power plant.

3.24. The potential for instability of the coastal area or river channel due to erosion or sedimentation shall be investigated.

3.25. Site flooding

(i) Flooding from local intense precipitation shall be mitigated by the site drainage system.

(ii) Following requirements shall be satisfied in the design of site drainage:

(a) Drainage system shall be capable of discharging floodwater resulting from value of precipitation corresponding to 10⁻² annual frequency of exceedance for overall site.

(b) The safety related systems and components, waste storage/ management areas and escape routes or entrance/exit roads to safety related areas shall not be flooded from the quantum of precipitation corresponding to annual frequency of exceedance of (10)⁻⁴.

Water waves induced by earthquakes or other geological phenomena

3.26. The region shall be evaluated to determine the potential for tsunamis or seiches that could affect the safety of a nuclear installation on the site.

3.27. If there is found to be such a potential, prehistorical and historical data relating to tsunamis or seiches affecting the shore region around the site shall be collected, and critically evaluated for their relevance to the evaluation of the site and their reliability.

3.28 On the basis of the available prehistoric and historical data for the region and comparisons with similar regions that have been well studied with regard to these phenomena all pertinent tsunaminigenic origins and sources and their maximum potential shall be identified, and the frequency of occurrence, magnitude and height of regional tsunamis or seiches shall be estimated and shall be used in determining the hazards associated with tsunamis or seiches, with account taken of any amplification due to the coastal configuration at the site.

3.38. Geological maps and other appropriate information for the region shall be examined for the existence of natural features such as caverns and karsts formations and human made features mines, water wells and oil wells. The potential for collapse, subsidence or uplift of the site surface shall be evaluated.

3.39. If the evaluation shows that there is a potential for collapse, subsidence or uplift of the surface that could affect the safety of the nuclear installation, practicable engineering solutions shall be provided or otherwise the site shall be deemed unsuitable.

3.40. If there do seem to be practicable engineering solutions available, a detailed description of subsurface conditions obtained by reliable methods of investigation shall be developed for the purposes of determination of the hazards.

Soil liquefaction

3.41. The potential for liquefaction of the subsurface materials of the proposed site shall be evaluated by using parameters and values for the site specific ground motion.

3.42. The evaluation shall include the use of accepted methods of soil investigation and analytical methods to determine the hazards.

3.43. If the potential for soil liquefaction is found to be unacceptable, the site shall be deemed unsuitable unless practicable engineering solutions are demonstrated to be available.

Behaviour of foundation materials

3.44. The geotechnical characteristics of the subsurface materials, including the uncertainties in them, shall be investigated and a soil profile for the site in a form suitable for design purposes shall be determined.

3.45. The stability of the foundation material under static and seismic loading shall be assessed.

3.46. The groundwater regime and the chemical properties of the groundwater shall be studied.

EXTERNAL HUMAN INDUCED EVENTS

Aircraft crashes

3.47. The potential for aircraft crashes on the site shall be assessed with account taken, to the extent practicable, of characteristics of future air traffic and aircraft.

3.48. If the assessment shows that there is a potential for an aircraft crash on the site that could affect the safety of the installation, then an assessment of the hazards shall be made.

3.49. The hazards associated with an aircraft crash that are to be considered shall include impact, fire and explosions.

(c) Available flow of water, minimum water level and the period of time for which safety related sources of cooling water are at a minimum level, with account taken of the potential for failure of water control structures.

3.58. Potential natural events and human induced events that could cause a loss of function of systems required for the long term removal of heat from the core shall be identified, such as the blockage or diversion of a river, the depletion of a reservoir, an excessive amount of marine organisms, the blockage of a reservoir or cooling tower by freezing or the formation of ice, ship collisions, oil spills and fires. If the probabilities and consequences of such events cannot be reduced to acceptable levels, then the hazards for the nuclear installation that are associated with such events shall be established.

3.59. If the hazards for the nuclear installation are unacceptable and no practicable solution is available, the site shall be deemed unsuitable.

4- EFFECTS OF THE NUCLEAR INSTALLATION IN THE REGION

ATMOSPHERIC DISPERSION OF RADIOACTIVE MATERIAL

4.1. A meteorological description of the region shall be developed, including descriptions of the basic meteorological parameters, regional topography and phenomena such as wind speed and direction, air temperature, precipitation, humidity, atmospheric stability parameters, and prolonged inversions, land sea breeze, fog and calm

4.2. A program for meteorological measurements shall be prepared and carried out at or near the site with the use of instrumentation capable of measuring and recording the main meteorological parameters at appropriate elevations and locations. Data from at least one full year shall be collected, together with any other relevant data that may be available from other sources.

4.3. On the basis of the data obtained from the investigation of the region, the atmospheric dispersion of radioactive material released shall be assessed with the use of appropriate models. These models shall include all significant site specific and regional topographic features and characteristics of the installation that may affect atmospheric dispersion.

DISPERSION OF RADIOACTIVE MATERIAL THROUGH SURFACE WATER

4.4. A description of the surface hydrological characteristics of the region shall be developed, including descriptions of the main characteristics of water bodies, both natural and artificial, the major structures for water control, the locations of water intake structures and information on water use in the region.

4.5. A programme of investigation and measurement of the surface hydrology shall be carried out to determine to the extent necessary the dilution and dispersion characteristics for water bodies, the reconcentration ability of sediments and biota, and the determination of transfer mechanisms of radionuclides in the hydrosphere and of exposure pathways.

USES OF LAND AND WATER IN THE REGION

4.14. The uses of land and water shall be characterized in order to assess the potential effects of the nuclear installation in the region and in particular for the purposes of preparing emergency plans. The investigation shall cover land and water bodies that may be used by the population or that could serve as a habitat for organisms in the food chain.

AMBIENT RADIOACTIVITY

4.15. Before commissioning of the nuclear installation the ambient radioactivity of the atmosphere, hydrosphere, lithosphere and biota in the region shall be assessed so as to be able to determine the effects of the nuclear installation. The data thus obtained are intended for use as baseline data in future investigations.

5. MONITORING OF HAZARDS

5.1. The characteristics of natural hazards and human induced hazards as well as the demographic, meteorological and hydrological conditions of relevance to the nuclear installation shall be monitored over the lifetime of the nuclear installation. This monitoring shall be commenced no later than the start of construction and shall be continued up until decommissioning. All the hazards and conditions that are considered in this Safety Requirements document and are pertinent to the licensing and safe operation of the installation shall be monitored.

5.2. Site specific hazards shall be periodically reviewed using updated knowledge, typically every ten years, and shall be re-evaluated when necessary. A review after a shorter interval shall be considered in the event of evidence of potentially significant changes in hazards (for example, in the light of the feedback of operating experience, a major accident or the occurrence of extreme events). The implications of such a review of site specific hazards for the safe operation of the nuclear installation shall be evaluated.

6. MANAGEMENT SYSTEMS FOR SITE EVALUATION

6.1 Adequate management system shall be established to control the effectiveness of the execution of the site investigations and assessments and engineering activities performed in the different stages of the site evaluation for the nuclear installation.

6.2 The management system for site evaluation shall be conducted and managed as part of integrated management system for the nuclear installation, to comply with the national regulatory requirements (ENRRA-GE/RR/MG-00), Management System requirements for regulated facilities and activities). The management system shall be established at the earliest

Definitions

Applicant	The organization that applies for formal granting of a license to perform specified activities related to the siting, construction, commissioning, operation and decommissioning of a nuclear power plant.
Assessment	The process, and the result, of analyzing systematically the hazards associated with sources and practices, and associated protection and safety measures. It aims at quantifying performance measures for comparison with criteria.
Atmospheric stability	Intensity of turbulence and atmospheric diffusion that are strongly dependent upon a property of the atmosphere.
Authorization	The granting by a regulatory body or other governmental body of written permission for an operator to perform specified activities. Authorization could include, for example, licensing, certification and registration.
Capable fault	A fault that has a significant potential for relative displacement at or near the ground surface.
Commissioning	The process during which systems and components of facilities and activates, having been constructed, are made operational and verified to be in accordance with the design and to have met the required performance criteria
Decommissioning	Administrative and technical actions taken to allow the removal of some or all of the regulatory controls from a facility (except for a repository which is closed and not decommissioned).
Design basis external events	The external event(s) or combination(s) of external events considered in the design basis of all or any part of a facility.
Design basis precipitation	The estimated depth of precipitation for a given duration, drainage area and time of year, for which there is a specified probability of exceedance. The design basis flood for a given duration and drainage area should approach and approximate the maximum value that is considered to be physically possible.
Design basis flood	The flood selected for deriving a design basis for a nuclear power plant.
Deterministic method	A method for which most of the parameters used and their values are mathematically defined and may be explained in terms of physical relationship.
Dispersion	Spreading of a solute through a porous medium resulting from convective transport and diffusion.