USNRC Site Safety Considerations for Assessing Site Suitability

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USNRC Regulations and Guides

- **10CFR Part 100, Reactor Site Criteria, establishes approval requirements for proposed sites for stationary power and testing reactors.**
- **Regulatory Guide 4.7, General Site Suitability Criteria for Nuclear Power Stations, discusses the major site characteristics related to public health and safety and environmental issues that the NRC staff considers in determining the suitability of sites for LWR nuclear power stations.**

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USNRC Regulations and Guides

- **Regulatory Guide 1.165, Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion.**
- **Regulatory Guide 1.59, Design Basis Floods for Nuclear Power Plants.**
- **Regulatory Guide 1.132, Site Investigations for Foundations.**
- **Regulatory Guide 1.23, On-site Meteorological Programs.**

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USNRC Regulations and Guides

- **Appendix A of Reg. Guide 4.7 provides a checklist of site safety characteristics, relevant regulatory guides, and regulatory experience and positions for assessing site suitability for nuclear power stations.**
- **Appendix B of Reg. Guide 4.7 summarizes environmental considerations related to site characteristics that should be addressed in the early site selection process.**

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Geology and Seismology

- Geologic and seismic characteristics of a site, such as surface faulting, ground motion, and foundation conditions (including liquefaction, subsidence, and landslide potential, may affect the safety of a nuclear power station.
- Where the potential for permanent ground deformation, such as faulting, folding, subsidence or collapse exists at a site, the NRC staff considers it prudent to select an alternative site.

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Geology and Seismology

- **Sites should be selected in areas for which an adequate geologic data base exists or can be expeditiously developed through site-specific investigations. Delay in licensing can result from the need for extensive investigations. Conservative design will be required if the data base is questionable.**
- **Sites with competent bedrock generally have good foundation conditions. Alternatively, it is prudent to select sites having low liquefaction and subsidence potential.**

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Atmospheric Dispersion

- Atmospheric conditions at a site should provide sufficient dispersion of radioactive materials released during a postulated accident to reduce the radiation exposures of individuals at the exclusion area and low population zone boundaries to allowable values.
- Unfavorable design basis atmospheric dispersion conditions can be compensated for by engineered safety features.

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Exclusion Area and Low Population Zone

- In the event of a postulated accident, radiological consequences for individual members of the public outside the station must be acceptably low.
- NRC requires an ‘exclusion area’ in which the licensee has the authority to determine all activities, and a ‘low population zone’ surrounding the exclusion area. The LPZ contains residents of a number and density such that protective measures could be taken in the event of a serious accident.

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Exclusion Area and Low Population Zone

- **Limits to radiation exposure from a postulated release of fission products are prescribed:**
  - **For an individual at any point on the exclusion area boundary, not over 25 rem TEDE in a 2 hour period following the onset of release;**
  - **For an individual on the outer boundary of the LPZ, not over 25 rem TEDE during the entire period of passage of the radioactive cloud (assumed to be 30 days).**

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Exclusion Area and Low Population Zone

- **The required distances to the exclusion area boundary and the outer boundary of the LPZ will depend on the plant design and on the atmospheric dispersion characteristics of the site.**

Population Considerations

- Locating reactors away from densely populated centers is part of NRC's defense-in-depth philosophy. It facilitates emergency planning and preparedness, and reduces potential doses and property damage in the event of a severe accident.
- The least distance to the boundary of a densely populated center containing more than 25 000 residents must be at least 1-1/3 times the distance from the reactor to the outer boundary of the LPZ.

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Population Considerations

- A reactor should preferably be located such that at the time of site approval and for about 5 years thereafter, the population density averaged over any radial distance out to 20 miles (32 km) does not exceed 500 persons per square mile (195 persons per km^2). If the population density exceeds this value, but is not well in excess, consideration will be given to safety, environmental, economic and other factors and the site may be found acceptable.

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Emergency Planning

- The characteristics of a site should not preclude development of plans for adequate measures to protect the public in the event of an emergency.
- Emergency planning zones are required:
  - A plume exposure pathway EPZ having an area about 16 km (10 miles) in radius;
  - An ingestion pathway EPZ having an area about 80 km (50 miles) in radius.

Emergency Planning

- **Site characteristics that could pose significant difficulties in taking protective actions, such as limitations on egress from areas surrounding the site, should be identified. Special population groups having special needs during an evacuation should also be identified.**
- **An evacuation time estimate should be performed to estimate the time needed to evacuate various sectors of the plume EPZ, and the whole EPZ.**

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Security Plans

- The site characteristics should not preclude development of adequate security plans.
- Generally, a distance of about 110 meters to any vital structure or equipment is sufficient to provide required security measures (e.g., protected area barriers, detection equipment, isolation zones, vehicle barriers, etc.).

Hydrology - Flooding

- Precipitation, wind or seismically-induced flooding (e.g., resulting from dam failure, river blockage or diversion, or seismically generated sea waves, etc.) can affect the safety of a nuclear power plant.
- To evaluate sites in river valleys, on flood plains or along coastlines where there is a potential for flooding, the studies described in Reg. Guide 1.59 (“Design Basis Floods for NPPs”) should be carried out.

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Hydrology – Water Availability

- A safety-related water supply is required for normal or emergency shutdown and cooldown.
- A highly reliable system of water supply sources should be available under postulated natural phenomena and site-related accidents or combinations thereof as discussed in Reg. Guide 1.59.
- There must be reasonable assurance that permits for water use and consumption can be obtained.

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Hydrology – Water Quality

- Contamination of ground water and surface water by radioactive materials discharged from nuclear stations could cause public health hazards.
- Concentrations of radionuclides discharged to ground water or surface water must be within permissible limits.

Industrial, Military and Transportation Facilities

- Accidents at present or projected nearby industrial, military and transportation facilities may affect the safety of a nuclear power plant.
- Potentially hazardous facilities within 8 km (5 miles) and major airports within 16 km (10 miles) should be identified. Potential hazards from shock waves and missiles, flammable vapor clouds, toxic chemicals or incendiary fragments should be investigated.

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Industrial, Military and Transportation Facilities

- **Acceptability of a site depends on:**
  - **Showing that an accident at a nearby facility or transportation route will not result in radiological consequences that exceed dose limits for the exclusion area or LPZ; or**
  - **Showing that an accident is sufficiently unlikely that there is no undue risk; or**
  - **The NPP can be designed such that its safety will not be affected by the accident.**

Industrial, Military and Transportation Facilities

- **Design basis events should include each postulated accident for which a realistic estimate of the probability of an excessive dose exceeds about 10^{-7} per year.**