



The Siting of Nuclear Installations in the United Kingdom

Nuclear Safety Advisory Committee

3 July 2008

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Scope of the Paper

- Examines the background to the so-called Hansard (1988) demographic siting criteria in current usage.
- Explores how, and to what extent the Hansard criteria can be adapted and extended for application to new build nuclear facilities.
- Reflects HSE's updated Safety Assessment Principles (2006) and makes some comparison with International practise on siting nuclear facilities.
- Presents proposals for demographic siting criteria in the United Kingdom for application to:
 - new build nuclear facilities,
 - existing licensed nuclear power plants, and
 - existing licensed non-reactor nuclear facilities.

Siting Policy

- Siting policy takes advantage of the contribution which the selection of sites can make to the safety of the public from the operation of nuclear facilities.
- Siting is part of NII's defence in depth approach and facilitates emergency planning as well as reducing potential doses in the event of an accident.
- The selection of sites for new build nuclear facilities in the United Kingdom involves some judgement of the balance between safety, economics and amenity.
- The extent of the reduction in risk that can be achieved from a consideration of site selection alone is limited.

Siting a Nuclear Facility

In siting a nuclear facility, there are two main objectives:

- Protecting People & Society from the hazards of the nuclear facility through minimising any potential adverse impacts.
- Ensuring the technical and economic feasibility of the plant.

Site Evaluation - Factors (1)

- proximity to appropriate electricity transmission infrastructure,
- proximity to large centres of demand,
- proximity to transport infrastructure,
- access to large quantities of cooling water,
- population density, and the distribution of population around the site,
- geophysical, geological, hydrological, meteorological and seismotectonic issues,
- security risk,
- aesthetics, and sensitive ecological and heritage areas,
- geomorphological issues and the effects of landscape change,
- external hazards both natural and man-made, and the proximity of the site to other hazardous facilities, and military installations,
- economic and socio-economic factors.

Site Evaluation - Factors (2)

- A formal consideration of the above factors will invariably require input from a multi-attribute value analysis as an integral part of the overall site selection process.
- Where unfavorable physical characteristics of the site exist, the proposed site may nevertheless be judged to be acceptable if the design of the facility includes appropriate and adequate compensating engineering safeguards.
- The above set of circumstances would however, require robust justification on an ALARP basis.

Demographics (1)

Although a consideration of demographics is sometimes considered of secondary importance in relation to technical and economic factors because of the limited reduction in risk that can be achieved by site selection alone, it is nevertheless the only effective non-engineered means of controlling the exposure of the population in the event of an incident leading to a release of radioactive material into the environment.

Demographics (2)

- Need to consider the demographic make up around sites from the dual perspectives of limiting doses to individuals and groups, and ensuring that prompt evacuation can be undertaken should the need arise in the event of a nuclear emergency.
- The ability to implement prompt evacuation provides additional conservatism from a defence-in-depth perspective, and represents the final level of protection for members of the public.

Range of Demographic Interest

- Large population centres remote from a nuclear site can influence allowable limits for population growth in the immediate vicinity of the site.
- It is proposed that 30 kilometres be considered as the practical range of interest for demographic analysis to evaluate both the generic and site specific site characteristics (or its equivalent range in imperial units, 20 miles).
- Experience has shown that the potential for interaction is very limited beyond 30 kilometres (20 miles), and that large population centres will have negligible influence on estimates for allowable increments in population growth in the immediate vicinity of the site.

Design Basis Effective Dose Targets

- **Design Basis:** The range of conditions and events that should be explicitly taken into account in the design of the facility, according to established criteria, such that the facility can withstand them without exceeding authorised limits by the planned operation of safety systems.
- **Effective Dose Target:** Appropriate target limits for fault sequences within the Design Basis should not require implementation of countermeasures which are disruptive to the public.

Population Weighting Factors

For both reactor and non-reactor nuclear facilities, population weighting factors take the general form of an inverse power law relationship:

$$\text{Population weighting factors} \propto \frac{1}{r^{1.5}}$$

It is assumed that this relationship is applicable to all wind speed, atmospheric stability class combinations.

Site Population Factors

$$SPF(r) = \frac{\sum (w_j \times \Delta P_j)}{\sum (W_j \times \Delta \bar{P}_j)} \quad \text{for } \{ (j = 1, r), r = 1, n \}$$

- Generic evaluation of site demographic characteristics

$$w_j = W_j$$

- Site specific evaluation of site demographic characteristics

$$0 < \frac{w_j}{W_j} \leq 1.0$$

Population Density Constraint Limits

Population densities associated with the all around site population constraint limits are based universally on 3 x 30° sector limits for all nuclear facilities.

	30° Sector Population Density Limits		All Around Site Population Density Limits	
	Persons per square kilometre	Persons per square mile	Persons per square kilometre	Persons per square mile
Remote Site	1,000	2,590	250	647
Semi-Urban Site	5,000	12,950	1,250	3,237
New Build Site	1,667	4,317	417	1,079

Population densities in excess of those associated with the semi-urban 30° sector population constraint limit (5000 persons per square kilometre) define exclusionary criteria.

Summary of Key Points

- Proposed demographic siting criteria presented on a generic basis to cover reactor and non-reactor nuclear facilities.
- Revised siting criteria are consistent with the decisions made for existing nuclear facilities in the UK and updated to inform decisions for any proposed new developments.
- A comparison has been made with International practise.
- The methodology has been subject to peer review by appropriate specialists.