A list of books for further reading

M. Gowing, *Britain and Atomic Energy, 1939–1945*, Macmillan, 1964.

M. Gowing, *Independence and Deterrence—Britain and Atomic Energy, 1945–1952*, Macmillan 1974.

R. F. Pocock, *Nuclear Power: Its Development in the United Kingdom*, Unwin Brothers and the Institution of Nuclear Engineers, 1977.

R. Williams, *The Nuclear Power Decisions*, Croom Helm Ltd., 1980.

G. Greenhalgh, *The Necessity for Nuclear Power*, Graham & Trotman, 1980.

'Nuclear Power and the Environment', Sixth Report of the Royal Commission on Environmental Pollution, Cmnd 6618, 1976.

D. R. Poulter (ed.), *The Design of Gas Cooled Graphite Moderated Reactors*, Oxford University Press, 1963.

A. F. Henry, *Nuclear Reactor Analysis*, M.I.T. Press, Cambridge, Mass., 1975.

A. M. Judd, *Fast Breeder Reactors*, Pergamon Press, 1980.

J. R. Lamarsh, *Nuclear Reactor Theory*, Addison-Wesley, 1966.

J. Lewins, *Nuclear Reactor Kinetics and Control*, Pergamon Press, 1978.

R. L. Murray, *Nuclear Energy* (2nd Edition), Pergamon Press, 1980.

T. J. Connolly, *Fundamentals of Nuclear Engineering*, Wiley, 1978.

S. Glasstone and **A. Sesonske,** *Nuclear Reactor Engineering*, Van Norstrand Reinhold Company, 1981.

S. Rippon, *Nuclear Energy*, Heinemann, 1984.

'Nuclear Energy: a professional assessment', Watt Committee on Energy, Report No. 13, 1984.

W. Marshall (ed.), *Nuclear Power Technology* (3 vols), Clarendon Press, 1984.

E. E. Pochin, *Nuclear Radiation: Risks and Benefits*, Oxford University Press, 1983.

E. Addinall and **H. Ellington,** *Nuclear Power in Perspective*, Kogan Page, 1982.

'Chernobyl — A Technical Appraisal', British Nuclear Energy Society, Thomas Telford, 1987.

'Advances in Power Station Construction', Central Electricity Generating Board, Barnwood, Pergamon, 1986.

F. R. Farmer (ed.), *Nuclear Reactor Safety*, Academic Press, 1977.

J. F. Flagg (ed.), *Chemical Processing of Reactor Fuels*, Academic Press, 1961.

J. H. Fremlin, *Power Production — What Are The Risks?*, Oxford University Press, 1987.

N. J. McCormick, *Reliability and Risk Analysis — Methods and Nuclear Power Applications*, Academic Press, 1981.

L. E. J. Roberts, *Nuclear Power and Public Responsibility*, Cambridge University Press, 1984.

J. R. Thomson, *Engineering Safety Assessment — an Introduction*, Longman, 1987.

Constants and conversion factors

Avogadro's number	$6{\cdot}023 \times 10^{26}$ atoms/kilogram atom (molecules/kilogram mole)
Boltzmann's constant	$1{\cdot}38 \times 10^{-23}$ joule/Kelvin
Speed of light	$2{\cdot}998 \times 10^{8}$ metres/second
Proton mass	1·007 277 unified atomic mass units
Neutron mass	1·008 665 unified atomic mass units
Electron mass	0·000 549 unified atomic mass units
Electron charge	$4{\cdot}8 \times 10^{-10}$ electrostatic unit
	or $1{\cdot}602 \times 10^{-19}$ coulomb
Energy:	1 MeV = 10^{6} eV = $1{\cdot}602 \times 10^{-13}$ J = $1{\cdot}602 \times 10^{-6}$ erg
Mass:	1 u = $1{\cdot}6604 \times 10^{-27}$ kg
Mass-Energy:	1 u = 931 MeV
Power:	1 W = 1 J/s
Burnup:	1 MWd = $8{\cdot}64 \times 10^{10}$ J
Cross-section:	1 barn = 10^{-24} cm^2
Radioactivity:	1 becquerel = 1 disintegration/second
	1 curie = $3{\cdot}7 \times 10^{10}$ disintegrations/second
Radiation absorbed dose:	1 gray = 1 J/kg
Radiation dose equivalent:	1 sievert = 1 J/kg

Cross-sections and other data for materials used in nuclear engineering

Fuels

	Density g/cm^3	σ_c barns	σ_f barns	σ_s barns	ν	η
Natural uranium	18·9	3·4	4·2	8·3	—	1·32
^{235}U	18·7	101	579	10	2·42	2·07
^{238}U	18·9	2·72	0	8·3	—	—
^{239}Pu	19·6	266	742	9·6	2·93	2·12

Moderators

		Density g/cm^3	σ_c barns	σ_s barns	ξ	$\bar{D}$ cm	L^2 cm^2	$L_s^2(\tau)$ cm^2
Water	H_2O	1·0	0·66	~50	0·920	0·16	8·1	27
Heavy water	D_2O	1·1	0·001	10·6	0·509	0·87	30 000	131
Graphite	C	1·6	0·0045	4·7	0·158	0·84	2650	368
Beryllium	Be	1·85	0·0092	6·1	0·209	0·50	480	102

Structural, control and other materials

	Density g/cm^3	σ_c barns	σ_s barns
Boron	2·3	759	4
Nitrogen	gas	1·85	10
Oxygen	gas	0·0002	3·8
Sodium	0·97	0·53	4
Magnesium	1·74	0·063	4
Aluminium	2·7	0·232	1·4
Sulphur	2·07	0·52	1·1
Iron	7·87	2·56	11
Zirconium	6·8	0·182	8

Notes: Cross-sections for capture and fission are 2200 m/s values. Scattering cross-sections are values for thermal neutrons and are in general (with the exception of H_2O and D_2O) constant at thermal energy.

The capture cross-sections of graphite and heavy water (and hence also their diffusion lengths) are very sensitive to impurities. The value of σ_c given for graphite is for commercial reactor grade graphite which has minor impurities. The value of σ_s given for D_2O is for pure material.

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