Direct radiation from Britain's ageing Magnox stations represents a serious health risk to workers, and the public and the reactors cannot be operated within new radiation limits, argues IAN FAIRLIE of the Socialist Environment and Resources Association (SERA) energy group.

Magnox gamma shine

OPERATING Magnox stations expose workers and those living within a kilometre to direct radiation: gamma from carbon dioxide (CO_2) cooling gases (nitrogen-16 disintegrations); gamma from argon in the air used to cool the biological shields (argon-41 disintegrations); and neutrons emanating from unshielded roofs of reactor buildings and scattered back to earth through collisions with atoms in the air — the little-known phenomenon of 'skyshine' which can result in appreciable radiation fields.

The older Magnox designs result in relatively large radiation fluxes. For example, they use steel pressure vessels and air to cool their biological or concrete shields, thereby activating the naturally-occurring argon in air. This radioactive argon spreads downwind of the reactors, irradiating members of the public. Also, the CO_2 cooling ducts of early Magnox reactors are outside their biological shields, exposing nearby residents and nuclear workers to gamma radiation. This radiation is particularly energetic and can travel relatively large distances in air.

It is widely believed that because Magnox reactors are up to 36 years old the increased radioactive inventories of their shields, moderators, and pipework result in increasing doses to the public. This is not correct, though doses to workers have increased slightly. Strong radiation fields have existed near these reactors since they started operating. The problem is not increased exposure, but that radiation limits have been reduced; now the radiation fluxes from the older Magnoxes substantially exceed newly recommended limits, as shown in the table. They represent the dose that would be received if one lived at the fence 24 hours a day, 365 days a year.

All of the dose rates given could result in the public being exposed to doses which exceed the National Radiological Protection Board's (NRPB) new 0.3 mSv per year limit. They could exceed other limits, such as the principal limit set by the International Commission on Radiological Protection (ICRP) for the general public of 1mSv per year. [5,6] They could also exceed the NRPB's recommended target dose of 0.5mSv for current discharges from a single site[7] and the NRPB's proposed dose constraint of 0.3mSv to members of the critical group for current operation of a single site.[8]

Three groups in the main are at risk. First, although few people live at the perimeter fence where the above maximum doses occur, a handful of households are situated very close to the perimeter fence at Dungeness and Bradwell and would receive doses near the maxima in the table. Second, there are more homes (10 to 100) slightly further away (100 to 1,000m) at the other stations. Third, are those passers-by who may frequent the stations environs. Until the mid-'80s, the Nuclear Installations Inspectorate calculated doses to passers-by by dividing the maximum annual dose at the perimeter fence by 30. If this were done now, it would result in half of the above stations exceeding the recommended limits for passers-by alone.

Under the recommendations, workers can be exposed to up to 20mSv per year. Because gamma fields intensify as you get nearer the source, it would appear that workers receive larger doses than those at the perimeter fence. However, measurements from workers' gamma and neutron badges suggest smaller exposures. This inconsistency is unexplained, even considering that workers present for only 2,000 hours annually compared to 8,760 hours for those living nearby. It may have to do with doses from neutrons, as the extent to which correct doses are included in workers' reported exposures are not known. It remains difficult to detect, measure or calculate doses from neutrons for a number of technical reasons, and until recently these were not measured but calculated as a fraction of the gamma dose.

Put simply, the Magnoxes are obsolete and should be closed immediately. When built they were considered to conform to then existing radiation limits. Our knowledge of the dangers of radiation in the intervening years has grown by leaps and bounds and the public limit has been repeatedly tightened. The Magnoxes clearly can't be operated within this new limit. ❑

MAXIMUM DOSE RATE AT PERIMETER FENCE
Equivalent dose/annum (mSv/yr)

Calder Hall[1]	22
Chapelcross[1]	20
Bradwell[2]	14.6
Hinkley Point A[2]	11.7
Hunterston A[3] (closed, 1991)	8.3
Sizewell A[2]	3.4
Berkeley (was 16.6 in 1977)[4] closed in 1988/89 — rate now[2]	2.5
Dungeness A[2]	2.0
Trawsfynydd[2]	1.5
Wylfa[2]	1.1
NRPB recommended limit	**0.3**

At Hinkley, Sizewell and Dungeness, there are AGRs near the Magnoxes. Although most direct radiation emanates from Magnoxes, there are some AGRs with appreciable fluxes

Calder Hall and Chapelcross are owned and operated by BNFL, and Hunterston A by Scottish Nuclear. The rest are Nuclear Electric's.

This table only states external doses: nearby residents are also subject to smaller internal doses from ingested radionuclides.

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