Hinkley Point C could be replaced by energy efficiency and renewable energy systems more cheaply, more quickly and without radioactive discharges to the environment or the generation of radioactive waste.

Summary

Discharges from the proposed Hinkley Point C nuclear Power station could cause around 200 deaths across the globe over its 60-year lifetime.

The radioactivity of spent fuel from Hinkley Point C would amount to around 80% of the radioactivity of waste already produced in the UK.

This could be stored at the Hinkley Point C site until around the year 2185. A major fire in a spent fuel pond "*could dwarf the horrific consequences of the Fukushima accident*."

Energy efficient improvements could reduce the energy consumed in UK households each year the equivalent to the output of six nuclear power stations the size of Hinkley Point C.

Offshore wind and solar are now both able to generate electricity more cheaply than nuclear power. If the UK had continued renewable expansion at the same rate as between 2010 and 2015 it could have achieved an all-renewable UK electricity supply by 2025.

Preface

The Dutch nuclear regulator ANVS has started a procedure in the Netherlands under the Espoo Convention for public participation regarding the proposed Hinkley Point C (HPC) nuclear power station in the UK.

Submissions need to be made by 20th October directly to the Department of Business, Energy and Industrial Strategy (BEIS) in the UK. beiseip@beis.gov.uk. This is a hard deadline.

The link to the announcement you can find here:

https://www.autoriteitnvs.nl/actueel/nieuws/2017/09/08/publieksconsultatie-over-mogelijke-grensoverschrijdende-milieueffecten-in-nederland-vanwege-de-nieuwe-kerncentrale-hinckleypoint-c-in-groot-brittannie

The consultation concerns the potential cross-border environmental impacts in the Netherlands caused by the proposed nuclear power station.

The link to the documentation is here:
https://www.autoriteitnvs.nl/documenten/publicatie/2017/08/09/07

ANVS says the British competent authority has, so far, failed to carry out a cross-border environmental impact consultation, because it was concluded that there is no chance of potentially significant adverse environmental impacts in other countries. Whether this judgment is right or not is currently subject to a Complaint procedure with the Compliance Committees of the Espoo and Aarhus Treaties.

The UK government is, therefore, offering everyone the opportunity to make submissions and review the environmental impact report and the accompanying documents for possible cross-border environmental impacts.

Germany, Luxembourg, the Netherlands and Norway are participating in the procedure, though we assume that members of the public from other countries will also be able to participate under Aarhus art. 3.9, where the UK recently was found in non-compliance regarding Hinkley Point C.

Hinkley Point C Environment Impact Assessment

Research from around the globe, for instance the KIKK Study from Germany, has shown that there is unquestionably a strong link between proximity to nuclear power stations and childhood cancer. Independent consultant on radioactivity in the environment, Dr Ian Fairlie says:

"*I can think of no other area of toxicology (eg asbestos, lead, smoking) with so many studies, and with such clear associations as those between NPPs and child leukemias*." (1)

This must surely mean that if cleaner ways to generate electricity are available which do not discharge radioactive wastes into our atmosphere and seas or generate radioactive waste these should be used in preference.

Collective Doses

In 1991, the International Commission on Radiological Protection (ICRP) adopted a linear, no threshold model for radiation's effects. Thus no dose of radiation, no matter how small is without some added level of risk. Collective dose is an important measure of the total exposure of a population over time from a given release of radionuclides and it is an indicator of total detriment to health. The collective dose is, to a first approximation, the average individual dose in an exposed population multiplied by the size of the population. Collective dose represents an attempt to quantify the radiological impact of radioactive discharges to populations larger than the critical group. Collective doses are measured in person-sieverts (person Sv).

Collective doses are sometimes calculated for UK or European populations, but for radionuclides which have long half-lives and become globally dispersed, including tritium, carbon-14, krypton-85 and iodine-129, it is internationally accepted practice to calculate their global collective doses. Calculating the global collective dose can also be seen as morally important when one considers the fact that no-one outside the UK is receiving a countervailing benefit from discharges.

As with critical group doses, estimates of the risks associated with a particular collective dose are fraught with uncertainties and unknowns. The behaviour of radionuclides in the global environment must be predicted over long time-scales and the computer models used to do so are unlikely to be validated by comparison with sufficient data. Future human behaviour and the behaviour of each radionuclide in the human body must also be predicted and estimation of the dose-risk factor in itself involves a large number of assumptions and several models all with uncertainties attached which have to be multiplied together. Such risks from collective doses are underestimates as they do not include detrimental human health effects other than fatal cancers (e,g. skin cancers) and genetic effects.

Of course collective dose/risk estimates neglect detriment to ecosystems, organisms and species. It is sometimes argued that collective doses should be truncated to 500 years, because after that the uncertainty becomes too great. However, just because there is uncertainty does not seem to be a good enough reason to assign a zero risk.

To convert from collective doses to fatal cancers, the ICRP's absolute fatal cancer risk of 10% per Sv can be used, although some analysts apply a dose and dose rate reduction factor (DDREF) which reduces the number of estimated fatal cancers in Europe by a factor of 2, and in the US by 1.5. However, many epidemiology studies offer little support for the use of such a factor, certainly for solid cancers. Also, the recent WHO (2013) report on risks from Fukushima recommends that a DDREF should not be used for longer term exposures. (2)

The radiation protection community is usually reluctant to translate collective dose into numbers of deaths. This seems to stem from the Greenpeace campaign during the THORP public consultation in 1993-4 when it was argued that THORP would cause 600 deaths (calculated using a 5% risk factor). But Sumner and Fairlie argue that radiation protection should be about protecting people, not the industry from criticism. (3)

The Environment Agency of England and Wales (EA) refer to an estimate made by EDF and AREVA of collective doses to UK, Europe and world populations truncated at 500 years using a computer model known as PC CREAM 98. These collective dose estimates were revised in the EA's Supplement to its Decision Document (4) but, in fact the collective dose to the world population remained at 16.9 person Sievert (Sv) per year. (See table below).

Bearing in mind that EDF Energy is proposing to build two EPR reactors at HPC, the total collective dose would be in the region of 33.8 person Sv per year of discharge. By applying the risk factor of 10% per sievert we can calculate that this means there will be around 3.4 deaths somewhere in the world for every year the station operates. Over 60 years, the total would be 204 deaths.

Uncertainties

There are many uncertainties in current estimates of radiation doses and risks and larger uncertainties exist with internal radiation.[1] These arise mainly from the many steps used to derive doses, and partly from lack of statistical precision in deriving risks from epidemiology studies. The size of these

[1] The following sequential stages are used for the estimation of fatal cancer risks from internal emitters:
(a) biokinetic models to estimate radionuclide concentrations within organs/tissues;
(b) dosimetric models to estimate absorbed dose in organs/tissues per unit concentration of each nuclide, ie dose coefficients derived principally from Specific Effective Energies (SEEs);
(c) weighting of absorbed dose by radiation weighting factors (wR) to take account of the biological damage from each type of radiation. These are estimated from experimentally-derived RBEs;
(d) weighting of equivalent dose (in sieverts) in each organ/tissue by tissue weighting factors (wT) summed to obtain whole-body effective doses; and
(e) derivation of fatal cancer and other risks (per Sv) from epidemiological studies, predominantly from Japanese bomb survivors.
The threefold uncertainties (ie arising from RBEs, dosimetric models, and risk estimates) mean that the uncertainties in dose coefficients from internal emitters can be very large in particular instances. Such large uncertainties have implications for radiation protection practices and procedures, especially (but not only) in assessing doses to individuals.

uncertainties has been estimated by a number of expert dosimetrists: for some nuclides these are very large. A report by the UK Government's Committee Examining Radiation Risks of Internal Emitters (CERRIE) recommended that uncertainties should be acknowledged and dealt with by the government. Its parent committee, the Committee on Medical Aspects of Radiation in the Environment COMARE, backed these findings. (5) A 2001 Consultation Paper from the Department for Environment Food and Rural Affairs summed up the view which prevailed at the time:

"*The unnecessary introduction of radioactivity into the environment is undesirable, even at levels where the doses to both humans and non-human species are low, and on the basis of current knowledge are unlikely to cause harm*" (6)

Table 13.4b EDF and AREVA's revised estimate of collective doses and per person dose from one year's discharges at maximum expected annual discharges (revised after the consultation)

Population	Collective dose manSv (for one year of discharge)	Per person dose nSv (for one year of discharge)
UK	0.31	5.6
Europe	2.46	3.5
World	16.9	1.7

Nuclear Waste

Spent nuclear waste fuel from HPC could be stored in wet storage ponds on the site in Somerset for up to 160 years. By the time the station closes around 2085 the radioactive content of the waste will amount to the equivalent of 80% of the waste which already exists in the whole of the UK. The consequences of a fire in the Hinkley storage ponds could dwarf the accident at Fukushima.

There has been virtually no discussion about what will happen to the nuclear waste, despite the fact that the UK still has no concrete plan for the waste its nuclear industry and weapons programme has already created. After more than 60 years of a civil nuclear power programme, the UK is still seeking a long-term solution for dealing with its higher activity radioactive waste. Government policy is that most higher activity waste (HAW) should be buried deep underground in what is known as a Geological Disposal Facility (GDF). But in January 2013 Cumbria County Council rejected plans to undertake preliminary work on an underground radioactive waste dump somewhere in the west of the County. That rejection sent the plans back to the drawing board and left the UK once again without even a potential site for a GDF.

In the absence of any concrete plans it is not clear what the transboundary impacts of waste generated by the proposed HPC will be.

Unlike the spent fuel from Hinkley Point B (HPB) which is transported by train to Sellafield in Cumbria for reprocessing, the Government does not expect spent fuel from HPC to be treated that way. In fact the Thermal Oxide Reprocessing Plant (THORP) at Sellafield which reprocesses the spent fuel from HPB is due to close in 2018, and there are no plans to replace it. (7)

A GDF is not expected to be ready to receive waste until around 2040. Waste from new reactors like HPC is not expected to be emplaced in the GDF until after all currently existing waste has been. emplaced which is expected to take around 90 years – around 2130. This means that spent fuel from HPC could remain on the site in Somerset for at least the next 100 years. (8) The other factor which needs to be taken into account is that HPC is expected to use high-burn up fuel which could require up to 100 years of cooling before it will be cool enough to be emplaced in a GDF. (9)

So assuming HPC comes on stream around 2025, with an expected reactor life of 60 years, this means spent fuel may need to be stored in Somerset until about 2185.

How much waste will Hinkley Point C generate?

The UK nuclear industry and government repeatedly claim that the volume of nuclear waste produced by new reactors will be small, approximately 10% of the volume of existing wastes; implying this additional amount will not make a significant difference to finding an underground dump for the wastes the UK's nuclear industry has already created. The use of volume as a measure of the impact of radioactive waste is, however, highly misleading. (10)

Volume is not the best measure to use to assess the likely impact of wastes and spent fuel from a new reactor programme, in terms of its management and disposal. The 'high burn-up fuel' which Hinkley Point C is expected to use will be much more radioactive than the spent fuel produced by existing reactors like Hinkley Point B. So rather than using volume as a yardstick, the amount of radioactivity in the waste, which affects how much space will be required in a deep geological repository, are more appropriate ways of measuring the impact of nuclear waste from new reactors.

According to Radioactive Waste Management Ltd, the radioactivity from existing waste (i.e. not including new reactors) is expected to be 4,770,000 Terabecquerels (TBq) in the year 2200.

The radioactivity of the spent fuel alone (not including other types of waste) generated by a 16GW programme of new reactors is expected to be around 19,000,000TBq. HPC would be a 3.2GW station, so the amount of radioactivity in the spent fuel from HPC in the year 2200 would be 3,800,000TBq – or about 80% of the radioactivity in existing waste. (11)

How will spent fuel be stored at Hinkley?

Although EDF Energy says it is possible that spent fuel might start to be transported off site during the lifetime of HPC, the Company says it is prudent to plan to store all of the lifetime arisings of the two reactors which are planned. The plan is to store spent fuel from HPC in spent fuel storage ponds. EDF is planning to be able to extend the life of the storage ponds for up to 100 years after the reactors close. (12)

A recent study in the US detailed how a major fire in a spent fuel pond "*could dwarf the horrific consequences of the Fukushima accident*." The author Frank von Hippel, a nuclear security expert at Princeton University, who teamed with Princeton's Michael Schoeppner on the modelling exercise said "*We're talking about trillion-dollar consequences*." (13) This would clearly involve major transboundary radioactive releases.

Alternatives to Hinkley Point C

Clearly there are cleaner ways to generate electricity available which do not discharge radioactive wastes into our atmosphere and seas. These should be used in preference to building HPC. The evidence is stacking up to show that, in the words of Professor Keith Barnham, author of '*The Burning Answer: A user's guide to the solar revolution*' the UK "*…doesn't need a new generation of expensive nuclear reactors or a dash for shale gas to keep the lights on. An all-renewable electricity supply can provide energy security*." (14)

The Environmental Impact Assessment for HPC should compare the potential impact of building two new EPR reactors in Somerset, England, with improving energy efficiency or supplying energy from alternative sources such as renewable energy. The EDF Energy Environment Statement doesn't do that.

According to the UK Energy Research Centre (UKERC), energy efficient improvements to home heating, insulation, lighting and appliances could reduce the energy consumed in UK households each year the equivalent to the output of six nuclear power stations the size of Hinkley Point C saving consumers £270 off the average household energy bill of £1,100. (15) In fact, when the UK government first endorsed Hinkley Point C, (HPC) it was projecting an increase in electricity consumption of 15% by now, whereas in practice the UK is consuming 15% less than a decade ago. In other words Government projections were out by 30 %. (16)

The price of £57.50 per megawatt hour unveiled recently for two giant wind projects, off the coast of the UK is almost half the level expected to be paid for HPC - £92.50/MWh at 2012 prices (which by now will be around £100/MWh). What is more the offshore wind payments only continue for 15 years compared with nuclear payments which continue for 35 years.

According to the *Daily Telegraph* Britain could theoretically produce up to 595GW from offshore wind at competitive cost, an order of magnitude more than Britain's entire power needs, even at peak times in the dead of winter (53GW). Some excess power could be sold to Europe through interconnectors, and some could be turned into hydrogen through electrolysis and used to replace fossil gas. (17)

Solar power, once so costly it only made economic sense in spaceships, is becoming so cheap that it will push coal and even natural-gas plants out of business faster than previously forecast according to the Bloomberg New Energy Finance (BNEF) outlook. (18) According to the 100% renewable utility, Good Energy, the wholesale price of electricity in the UK is falling, mainly due to the rise in solar photovoltaics (PV) and wind power. (19) Emeritus Professor Keith Barnham says if renewable expansion had continued at the same rate it did between 2010 and 2015 we could have achieved an all-renewable UK electricity supply by 2025.Why cull such popular and successful industries? The UK has more than 32GW of renewable power, 10 times the power the Hinkley Point C nuclear plant may achieve in 2030. Hinkley's power is not only almost irrelevant; its inflexible nature will make it redundant. Once operating, a nuclear reactor should run with constant output, 24/7, month to month, but power that complements wind and PV has to vary in less than one hour. What the UK needs is flexible, not continuous baseload power generation to back up wind and PV power. (20)

Clearly, the electricity which HPC is expected to generate could be replaced by energy efficiency measures and renewable energy systems more cheaply, more quickly and without radioactive discharges to the environment or the generation of radioactive waste. The risk that the UK and European public will be subjected to by the construction of HPC can, therefore, no longer be justified.

Pete Roche 27th September 2017

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(10) For example, Dr Peter Bleasdale who went on to become Managing Director of the National Nuclear Laboratory said: "Already there are significant volumes of historic wastes safely stored, and a programme of new reactors in the UK will only raise waste volumes by up to 10%." BBC 13th May 2008 http://news.bbc.co.uk/1/hi/sci/tech/7391044.stm
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