fukushima – it is a moral issue

Andrew Blowers argues that the nuclear disaster at Fukushima in Japan brings us back to the overarching moral question about nuclear electricity generation – namely, given its attendant risks, are there any circumstances in which it would be acceptable to continue with the development of nuclear power?

Above

The Fukushima Daichi plant before the accident – 'The fact that an accident on this scale has unknown, indeed unknowable, consequences urges us to reconsider some ethical questions about our relationship to the future of human society and, indeed, to the planet'

The earthquake and tsunami that overwhelmed the Fukushima Daichi nuclear plant on 9 March 2011 came virtually 25 years after the meltdown of reactor No. 4 at Chernobyl in the Ukraine on 26 April 1986. That accident, ranked at level 7, the highest level on the International Atomic Energy Agency scale, led to a massive release of radiation, creating contamination over a wide area and literally incalculable deaths and long-term health impacts.

At Fukushima, the inundation caused the loss of cooling to its six reactors, triggering partial meltdown and exposure of spent fuel stores and the consequent release of radiation into both atmosphere and ocean. This accident, too, has been rated level 7, although the total release of radioactivity, impacting a large surrounding area, is still a matter of conjecture, and it will be many years, if ever, before the total release and its consequences will be known. Although there were only a handful of deaths immediately attributable to the accident, the ultimate toll is incalculable, and over 100,000 people have been displaced indefinitely from homes and livelihoods.

By any reckoning, Fukushima, like its Ukrainian predecessor, was a cataclysmic event, creating widespread ecological devastation, displacement of

Box 1
Contours of a disaster

Fukushima Daichi had six reactors, developed between 1971 and 1979. At the time of the accident three reactors (Nos 1-3) were operating, one (No. 4) was under inspection, with all its fuel off-loaded to its pond, and two (Nos 5 and 6) were shut down.

As a result of the loss of cooling there was some fuel meltdown, hydrogen explosions and exposure of spent fuel, causing large radioactive releases within the plant and to the surrounding environment. Estimates of the extent of releases vary, with, for example, a recent international study (published in *Nature*[i]) suggesting much higher releases of caesium-137 and xenon-133 than previously calculated in Japanese official forecasts. The area within 20 kilometres of the plant has been totally evacuated. In the area beyond, advisory restrictions are gradually being lifted.

i 'Fallout forensics hike radiation toll'. *Nature*, 25 Oct. 2011, No. 478, 435-6

population, economic catastrophe, social disruption and psychological trauma. And it is becoming clear that these impacts, like those of Chernobyl, are unlikely to be transitory but will persist far into the future. The fact that an accident on this scale has unknown, indeed unknowable, consequences urges us to reconsider some ethical questions about our relationship to the future of human society and, indeed, to the planet.

It is in this ethical context that the Fukushima tragedy re-ignites the debate about the morality of nuclear energy itself. Until this point the nuclear industry was making a remarkable, if patchy, comeback – vigorous in the Far East and Southern Asia, slow but apparently under way in Europe and North America (despite cost over-runs and delays), and increasingly optimistic intimations elsewhere. This 'nuclear renaissance' seemed to be gathering momentum when the tsunami struck. An increasingly confident nuclear industry was proclaiming the necessity, if not the inevitability, of a nuclear future. Governments were caught up in the idea of nuclear as the solution rather than a problem. For instance, the UK Government provided a bold pro-nuclear pronouncement of the multiple virtues of new nuclear:

> *'Nuclear power is low-carbon, economic, dependable, safe and capable of increasing diversity of energy supply and reducing our dependence on any one technology or country for our energy or fuel supplies.'*[1]

In the post-Fukushima context such claims, already under challenge from the anti-nuclear movement, were exposed to wider questioning by experts, politicians and journalists. The notion of nuclear as 'low carbon' appeared less attractive when front-end activities, notably uranium mining, were factored in. The case for nuclear as a cost-effective and competitive alternative source of electricity was already under scrutiny as the 'appraisal optimism' of projects was exposed and the costs and timelines of specific projects (notably new reactors in Finland and France) were exceeded. The opportunity costs in terms of diversion of resources and effort from alternative (usually renewable) energy sources was also an issue.

Above all, the theoretical costs arising from a major accident, in terms of lost output, replacement, insurance, safety measures and compensation, became palpable in the wake of Fukushima as plants were shut down or subject to safety reappraisals, not only in Japan but across the world.

Some countries have turned their back on new nuclear plans, with Germany, Switzerland, Belgium and Taiwan opting for a phase-out of existing plants, Italy voting overwhelmingly by referendum against a nuclear option, and other countries, including Japan and the United States, pausing to take stock of the safety and financial implications of a future nuclear programme. A handful of countries, mainly in Asia but also France, Finland and especially the UK in Europe, are still pressing ahead, at least for the present. A report on the implications of Fukushima for the UK by the Chief Inspector of Nuclear Installations identified a raft of safety issues but did not consider a need for a change of policy.[2]

Almost without hesitation the Government confirmed its policy in the National Policy Statements on Energy, which were nodded through Parliament with little debate. The UK remains on course to deploy a number (depending on how many the nuclear industry can manage) of mega-reactors (each up to 1.6 gigawatts of generating capacity) on some or all of the eight sites now confirmed as 'potentially suitable' for new nuclear development. EDF, the French nuclear operator, is first in the field, with its application for planning consent for two reactors at Hinkley Point in Somerset. Fukushima, so far at least, appears to have had little impact on the UK's embrace of the nuclear option.

Is Fukushima a turning point – a moment of truth – for the nuclear renaissance, or merely a blip, a traumatic interlude, before business as usual resumes? The outcome, resurgence or relapse, will depend in part on how the ethical issues about what is acceptable and what is not are arbitrated and resolved.

In particular, Fukushima invites us once again to consider the overarching moral question about nuclear power – namely, are there any circumstances in which it would be acceptable to continue with the development of nuclear as an energy option? If the answer to this question turns out to be no, then it is clear the nuclear industry should be abandoned. However, if the answer is yes, then there is enormous scope for debate and equivocation on the level of risk that may be deemed acceptable. It is already clear that, in the post-Fukushima context, the debate has once again been engaged.

It couldn't happen here.. until it does

Fukushima occurred at a time of nuclear revival, when pro-nuclear sentiments were in the ascendant. Post-Fukushima, the nuclear industry and its scientific and political support is engaged in a defensive battle of damage limitation, while its opponents are hoping the accident will prove a decisive blow. Each side has quite different approaches to the ethical issues, always present but given greater prominence by Fukushima. This is immediately evident in the differential interpretations of the nature and implications of the accident. On the pro-nuclear side there are two lines of defence.

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The first, the starting position of the pro-nuclear case, appears to be that the accident was a unique, one-off, unrepeatable event. 'It could not happen here' is the initial response. Certainly the chances of an earthquake registering almost 9 on the Richter scale followed by a massive tsunami taking out a six-reactor nuclear plant are vanishingly small. However, a major accident caused by flooding is not so improbable.

Given nuclear's thirst for water (nuclear plants require about 46 gallons per kilowatt-hour of electricity produced – more than any other electricity generating system), power plants must be sited on coasts or on major rivers. For instance, the eight sites proposed for the UK's fleet of new nuclear stations are all on coastal sites, low lying and, in most cases, potentially vulnerable to inundation from the impacts of sea level rise and storm surges resulting from climate change over the next century or so.[3]

But inundation is not the only potential cause of a failure in the cooling system. In previous cases, such as Chernobyl and Three Mile Island, meltdown was brought about by a combination of interactive causes, including component failure, misunderstanding of what was happening, unanticipated events, and incomprehensibility on the part of operators. While it is highly unlikely that the circumstances of Fukushima will be replicated, it is quite conceivable that another major accident will occur some time, somewhere brought about by a combination of unforeseen (and unforeseeable) circumstances.

Charles Perrow, writing in the wake of Three Mile Island, suggested that the characteristics of high-risk technologies make accidents inevitable.

> *'This is not good news for systems that have high catastrophic potential, such as nuclear power plants… It suggests that the probability of a nuclear plant meltdown with dispersion of radioactive materials to the atmosphere is not one chance in a million a year, but more like one chance in the next decade.'*[4]

Given that Chernobyl occurred within the decade following Three Mile Island and Fukushima happened 25 years later, he was not far off the mark.

Nuclear accidents which cause off-site releases are not uncommon, and 'incidents' (the term used for unforeseen events and equipment failures which are contained within sites) are commonplace in the nuclear industry. Sovacool[5] reveals 76 substantial accidents involving either loss of life or more than $50,000 of damage in the half century 1947-2008, 40 since Chernobyl. He cites studies showing high numbers of serious incidents and accidents in the United States, France and other countries.

Sovacool, like Perrow, concludes that the risk and scale of accidents is likely to increase as bigger reactors with new untested designs are introduced. He also claims that the pressure to sustain power supply and make profits, in a privatised and competitive system of production, makes it

necessary to keep plants online as much as possible, with possible compromise to safety. In the wake of major accidents there is always a flurry of inquiries, seeking out the cause, attributing blame and making recommendations to avoid repetition. But although safety is axiomatic within the nuclear industry, Perrow observes that no amount of lessons learned, regulatory requirements or precautionary principles can be proof against the myriad of things that can go wrong in such complex, high-tech, high-risk systems.

Nuclear accidents are what Perrow calls 'normal accidents'. Nuclear energy is produced by highly complex, interactive material and organisational

Above

The stricken plant after the accident – 'No amount of lessons learned, regulatory requirements or precautionary principles can be proof against the myriad of things that can go wrong in such complex, high-tech, high-risk systems'

systems. They involve the 'tight coupling' of interdependent components of the system. This opens up the prospect of multiple potential failures, virtually impossible to foresee and difficult to comprehend. Failures occur in the material components (leaking, cooling, heating, etc.) and in human organisation (monitoring, inspection, control, maintenance, etc.). With such system characteristics, 'multiple and unexpected failures are inevitable'.[6] They are unpredictable but not impossible, so the claim that 'It could not happen here' is only true until it does.

On this basis the only moral answer is to limit the possibility of further major accidents by abandoning the nuclear option as soon as possible. An immediate shutdown of all plant would obviously be too drastic operationally and impractical politically, and legacy wastes will have to be managed for a long time in any case. But a gradual phasing-out of existing plants and rejection of new build would seem to be a reasonable response in the circumstances.

There is no alternative... or is there?

The second line of defence put forward by nuclear's supporters is to shift from this absolutist position that accidents are unlikely to be repeated to the relative argument that nuclear is a necessary part of the future energy mix. The idea promoted is that nuclear is a risk worth running, evident in such phrases as, 'Nuclear is necessary to prevent the lights going out', or 'We need nuclear to save the planet'.

Setting aside for the moment the question of whether such statements are true, this argument depends on what is an 'acceptable risk'. Instead of arguing that 'It could not happen here', the pro-nuclear case now rests on the claim that the risk from nuclear activity is acceptable when compared with the risks from some other forms of energy production. On the one side are those who claim, for instance, that deaths from coal-mining far, far exceed those from nuclear, while on the other there are those who, like Sovacool, counter that, in terms of fatalities, 'nuclear power ranks as the second most fatal source of energy supply (after hydroelectric dams) and higher than oil, coal, and natural gas systems'.[7]

The evidence is voluminous but, given the assumptions, sources and selectivity involved, impossible to interpret to provide realistic comparisons. The evidence is contested and controversial, and, in the case of Chernobyl, there are vast differences in estimated deaths and other health effects.

Estimates of the health and social impacts of Fukushima can only be speculative at this stage. While the tsunami accounted for over 20,000 deaths and widespread destruction, the nuclear accident caused no immediate deaths from radiation, although widespread contamination presumes unknown future health effects. The imposition of the exclusion zone creates long-term, possibly permanent, disruption and dislocation for the tens of thousands of people who have abandoned their homes, communities, livestock and livelihoods at short notice. The scale and severity of a nuclear accident is not only measured in the number of deaths or the illnesses that arise, but also in the traumatic effects it has on those surviving but no longer able to live in their own homes and neighbourhoods.

The long-term social implications of a major nuclear accident are apparent in the exclusion zone around Chernobyl. The World Health Organisation Report speaks of 'loss of economic stability, and long term threats to health in current and possibly future generations… feelings of helplessness and lack of control over their future'.[8]

These impacts from major nuclear accidents can hardly be accounted as small; rather they constitute the sacrifice of large areas of land, nature and

people. But, it may still be argued that, relative to other impacts, they are tolerable. After all, these nuclear impacts are regional, not global (although radioactivity may be diffused around the world); they most affect people in the vicinity now and in the future but have limited impact on more distant populations. Compared with the potentially global devastation that predictably might be caused by the effects of climate change (through flooding, drought, migration, loss of biodiversity, and so on), these sacrifices might be deemed acceptable.

Thus, taking nuclear energy in the context of climate change, an ethical case can be constructed which posits that nuclear provides vital benefits in terms of providing electricity while saving carbon and thereby helping to save the planet. These benefits outweigh the detriments to health and environment which arise from the possibility of nuclear accidents and the problem of managing highly dangerous nuclear wastes into the far future.

This, essentially, is the position adopted by the UK Government in its reasons for justifying the development of new nuclear power stations. While 'conscious of the significant detriments to health and the environment that could result from an accident or terrorist attack at a nuclear power station',[9] the Government believes the likelihood of such an unplanned release is 'negligible in the UK'.[10]

This point is made quite explicit in regard to the dangers of nuclear waste (a demonstrable problem at Fukushima, where spent fuel rods in reactor building 4 became exposed owing to loss of cooling water). The Government recognises the 'important ethical issues to consider around whether to create new nuclear waste, including the ethical implications of not allowing nuclear power to play a role, and the risks of failing to meet long-term carbon emissions targets', and takes the view that 'the balance of ethical considerations does not require ruling out the option of new nuclear power'.[11]

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Seductive as this argument appears to be, this ethical stance may be challenged on three counts. One, nuclear energy is an ethical issue in its own right, posing dangers of proliferation, risks of disease and death. It is difficult to compare with climate change, not least because of the very long timescales involved. By suggesting that nuclear new build should be discussed in terms of the need to address climate change, the discussion is framed in a particular way, one that is intended to make the case for nuclear expansion.

The second count is predicated on the premise that nuclear is an essential part of the mix of low-carbon sources that are necessary to meet carbon targets and to avert the worst consequences of climate change. The merit of developing new nuclear is, of course, a contested issue, one that will not be considered in detail here. Suffice it to say that the 'official' argument in many countries is that nuclear is needed now to plug the gap in energy supplies and to help meet carbon targets.

Conversely, there is a range of studies that suggest it would be possible to meet most, if not all electricity demand from renewables by mid-century. The energy mix all depends on the assumptions that are made about targets, demand, supply, efficiency, availability of technology, investment costs and price, lifestyles, inequalities and other variables.[12] A mix of renewables would probably require heroic attention to energy efficiency and the deployment of a range of technologies both existing and in development. It would also require political will to facilitate, plan and mobilise requisite investment, diverting it from nuclear and fossil fuels.

Even if renewables cannot meet the target, it does not necessarily mean that nuclear is needed as, obviously, the target could be lowered or the timescale lengthened, or natural gas (fossil fuel but lower carbon output than coal) could make up the deficit. This appears to be the most feasible and deployable alternative to nuclear, in any event. The point is that nuclear would reduce some risks but increase others. But if nuclear is not essential, then the ethical argument based on there being no alternative falls.

The third reason why the nuclear option must be ruled out on ethical grounds is its continuing association with the possibility of deliberate devastation through nuclear weapons and the persistent dangers of diversion and proliferation. The ultimate risks were encapsulated in Ulrich Beck's apocalyptic vision of the *Risk Society*.[13] A 'risk society' is one where ecological risks from technology are pervasive and potentially global; where control depends on experts who may themselves be unable to control major accidents; and where individuals feel powerless and fatalistic in the face of incomprehensible risks. In the circumstances of *Risk Society* those most affected, local communities and future generations, have relatively little influence on the key decisions.

Risk to the far future

The ethical case against the further expansion of nuclear energy is compounded when the issues of inter-generational equity are brought into the equation. With the emphasis on new nuclear to provide energy and to save carbon has come an ethical shift. The pressure to support new nuclear gives emphasis to contemporary needs, the production of energy, investment in jobs, and development of big technology to increase supply. The risks from emissions, accidents, nuclear waste, and even proliferation become more acceptable in an ethical discourse which speaks the language of progress, economic growth and modernisation. It is in these circumstances that the answer to the question whether nuclear expansion is acceptable becomes affirmative.

'It is especially striking how little attention is being paid to the risks faced in the far future, when decaying facilities and dangerous nuclear wastes may well remain in locations that will be increasingly vulnerable'

Nevertheless, the burden of risk from radioactivity is imposed on places where new nuclear is developed and on the generations in the future who will be affected by decisions taken now. It is especially striking how little attention is being paid to the risks faced in the far future, when decaying facilities and dangerous nuclear wastes may well remain in locations that will be increasingly vulnerable. There is virtually no consideration of the social and economic conditions that may pertain. Social stability and institutional continuity as well as some economic growth seem to be necessary criteria for the management of sites into the far future. These are, implicitly, assumed although little serious attention seems to be paid to the social challenges that lie beyond a hundred years or so.

The risks associated with nuclear energy and the wastes it produces extend well beyond a hundred years; indeed the risks are unbounded in both time and space. By developing new nuclear it may prove difficult to meet the sustainability criterion proposed by the International Atomic Energy Agency (IAEA), that future society should be protected 'in such a way that the needs and aspirations of the present generation are met without compromising the ability of the future generations to meet their needs and aspirations'.[14]

Fukushima, like Chernobyl and other accidents before it, provides a vision of an unsustainable future, at least for places where nuclear accidents spread danger and contamination. Supporters of nuclear energy will continue to argue that this is a necessary sacrifice to ensure the sustainability of energy and environment now and in the more immediate future. But Fukushima provokes a pause for thought, for consideration whether the modest gains in carbon saving and power supply are worth compromising the far future. The ethic of inter-generational equity suggests there are ways forward but that none of them is nuclear.

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Notes

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2 *Japanese Earthquake and Tsunami: Implications for the UK Nuclear Industry*. Chief Inspector of Nuclear Installations, Interim Report (May) and Final Report (Sept.). Office for Nuclear Regulation, 2011

3 A. Blowers: 'Why dump on us?'. *Town & Country Planning*, 2009, Vol. 78, Jan., 33-7

4 C. Perrow: *Normal Accidents: Living with High-Risk Technologies*. Princeton University Press, New Jersey, USA, 1999, pp.3-4 (first published 1984, by Basic Books)

5 B. Sovacool: 'Critically weighing the costs and benefits of a nuclear renaissance'. *Journal of Integrative Environmental Sciences*, 2010, Vol. 7 (2), 105-23; and B. Sovacool: *Contesting the Future of Nuclear Power*. World Scientific, Singapore, 2011

6 *Normal Accidents* (see Note 4), p.5

7 'Critically weighing the costs and benefits of a nuclear renaissance' (see Note 5), p.109

8 *Health Effects of the Chernobyl Accident: An Overview*. Fact Sheet 303. World Health Organisation, 2008

9 *The Justification of Practices Involving Ionising Radiation Regulations 2004: Consultation on the Secretary of State's Proposed Decisions as Justifying Authority on the Regulatory Justification of the New Nuclear Power Station Designs Known as the AP1000 and the EPR*. Department of Energy and Climate Change, 2009, p.147

10 *The Justification of Practices Involving Ionising Radiation Regulations 2004. The Reasons for the Secretary of State's Decision as Justifying Authority*. Department of Energy and Climate Change, 2010, p.120

11 *Meeting the Energy Challenge: A White Paper on Energy*. Cm 7124. Department of Trade and Industry. TSO, 2007, p.200

12 See, for example, J. Skea, P. Ekins and M. Winskel: *Energy 2050 – Making the Transition to a Secure Low-Carbon Energy System*. UKERC. Earthscan, 2010; and *The UK Low Carbon Transition Plan*. HM Government. TSO, 2009

13 U. Beck: *Risk Society: Towards a New Modernity*. Sage, 1992

14 *Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management*. Information Circular INF/146. International Atomic Energy Agency, 1997, Article 1