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Infrastructure and methodologies for the justification of nuclear power programmes

Edited by
Agustín Alonso

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More than three decades ago, an American movie called ‘The China Syndrome’ popularized the image of a nuclear power plant as a catastrophe waiting to happen. The actor Jack Lemmon won an Academy Award as a whistle-blower saving the world from a dangerous technology controlled by a gang of moral and environmental thugs. Unfortunately, time and events have done too little to diminish that dire impression in the public mind.

Since then, our world has become increasingly aware of another China Syndrome that is both more real and far more serious. It can be seen in a satellite photo of the world’s most populous nation and its burgeoning economy under a vast cloud of pollution. That cloud and others like it – a symbol of the consequences of world economic development today – signify both severe health damage to citizens below and a dangerously thickening canopy of greenhouse gases above. These clouds now hover over our planet’s future.

The world’s response to this menace has been slow. But in the past decade, we have seen the beginnings of action as dozens of nations, representing much of humankind, reviewed their policies and came inexorably to the same conclusion. For reasons of energy independence, human health and environmental responsibility, they determined that nuclear power must play a central role in their national energy strategies for the twenty-first century.

The calamity at Fukushima has compelled people everywhere to ask whether these policies should now be revised. But in fact Fukushima has been educational, primarily in reinforcing truths we knew already – about nuclear technology and public perceptions.

1. *Inevitability of nuclear events*. First and most elementally, nuclear accidents happen. This is not a trivial observation. Even as we strive for impeccable management of nuclear facilities, we can never have confidence that we will succeed absolutely. Nor can we expect the public to believe that we have. We must concede that human beings make
mistakes, individually and collectively. This in itself is not debilitating. Our problem lies in how this reality is construed.

Right now, most people continue to assume that nuclear power carries a low probability of a highly lethal event. In fact, Fukushima itself offers strong evidence to the contrary, but few in the public have perceived it thus. The future of nuclear energy will rest on fragile foundations as long as the perception of heavy risk to human well-being remains. Those who believe in nuclear power must accept the burden of explaining to the public that even worst-case nuclear events are not only extremely low in probability but also increasingly small in consequence as nuclear technology continues to advance. This is true and must be presented believably.

2. The universal necessity of reliable back-up cooling. Second, every nuclear reactor requires reliable post-shutdown cooling. Some advanced reactor designs will soon accomplish this using the natural physical principle of convection. But for the world’s current reactor fleet, post-shut-down heat removal depends on external power. Back-up cooling systems are a critical non-nuclear aspect of nuclear technology, and Fukushima has imprinted on us indelibly how essential this function is to the safety and future of nuclear power. For those who are the custodians of nuclear power – which includes both regulators and operators in dozens of nations – the commitment to ensuring its reliability of this function, in every reactor everywhere, must be absolute.

3. The essential safety of nuclear power. Third, despite widespread impressions to the contrary, Fukushima underscores the essential safety of nuclear power. This was truly a worst-case nuclear event. Yet, even with substantial releases, so precautionary are Japan’s safety standards and evacuation policies that it is still reasonable to predict that not a single radiation fatality will result from Fukushima, even amidst a natural disaster that has claimed some 25,000 lives. This is not a statement of complacency or indifference, but of simple fact.

Nor should this come as a surprise. If Fukushima were to produce a radiation fatality, it would be the first ever to occur in the nuclear power history of Japan, America or France – nations that account for half the world’s power reactors. Indeed, apart from Chernobyl, the World Nuclear Authority (WNA) is not aware of a single radiation fatality that has occurred in the entire history of nuclear power, spanning some 14,500 reactor-years of nuclear electricity generation in some 30 nations worldwide. This impressive truth remains colossally unappreciated by the public and the media.

Meanwhile, we know that each year many thousands of people continue to die worldwide either in the mining of fossil fuels or from the health consequences of fossil combustion. Viewed in that context of real,
large-scale and ongoing lethality, what is now commonly called the ‘nuclear disaster’ at Fukushima invites a less hyperbolic description.

4. Media frenzy is today’s norm. A fourth truth from Fukushima is that present-day media coverage is more inclined to frenzy than to balance in any event involving nuclear energy. In today’s context, the terms ‘meltdown’ and ‘radiation leak’ are too titillating to resist, and we must expect this tendency to persist so long as we have failed to demythologize nuclear energy. Achieving that would mean creating much wider public understanding of radiation as a ubiquitous natural phenomenon and of the limited consequences of radioactive release likely to result even from worst-case events.

5. Weak support where nuclear is an ideological issue. A fifth reality underscored by Fukushima is the bizarre weakness of support for nuclear power in a few technologically advanced European countries. As Europe’s leading economic power, Germany is particularly remarkable. Acting in the name of environmentalism, Germans will now begin to burn more lignite, coal and gas, while reverting when necessary to importing nuclear power.

6. Solidity of support in many key nations. A sixth truth is the solidity of policy support for nuclear power in most countries now using it. This is especially true in those countries planning major programmes of nuclear new-build, led by China, India, Russia, Britain, South Africa and South Korea. In other major nations too, including Brazil, France, Poland, Ukraine, Canada and the USA, we see little evidence of lost momentum.

7. Thinness of public understanding. A seventh and countervailing reality is that public understanding of nuclear power in many countries remains thin and readily susceptible to misimpression. Where we see constancy in policy support for nuclear power, it relies mainly on consensus among policymakers and on nuclear power not becoming, in the country’s politics, an ideological litmus test.

Nonetheless, Fukushima has plainly cast a far-reaching negative effect. In nations around the world, the common impression that Japan’s natural catastrophe was compounded by a manmade disaster has weakened public confidence in nuclear power. Once again we have learned that ‘radiation’ ranks high as one of the most potent and evocative words in any language.

8. Continuing power of the Chernobyl myth. A closely related truth, vividly underscored by media coverage of Fukushima, is that the myth of Chernobyl retains a powerful hold on public consciousness and remains a main journalistic reference point with respect to the perceived dangers of nuclear power. I refer to the ‘myth’ of Chernobyl because so few people understand that the Chernobyl reactor that exploded and caught
in 1986 bears little relevance to any reactor now operating and because the real, scientifically analysed consequences of Chernobyl differ so drastically from the public impression.

In truth, there is a strong scientific consensus that the radiation fatalities from Chernobyl are strictly limited – to several dozen ‘liquidators’ severely irradiated while fighting the reactor fire and to a small number of members of the public in the Chernobyl vicinity, statistically thought to be some 16 in number, who should be assumed to have died from thyroid cancer caused by radioactive iodine emitted by the burning reactor.

As many Chernobyl authorities will attest, the allegation of any other radiation fatalities depends solely on the so-called ‘collective dose’ hypothesis, which is scientifically unfounded and also defies common sense. Those able and willing to say so include the chairman of the UN Scientific Committee on the Effects of Atomic Radiation and the head of the Chernobyl Tissue Bank in London. But little of this is commonly understood.

Also misunderstood are the ratings on the International Nuclear Event Scale. When Fukushima reached level 7 as a ‘Serious Accident’ on the INES Scale – a number hitherto assigned only to Chernobyl – these misunderstandings coalesced, and millions around the world concluded they were witnessing a human catastrophe of immense proportions.

9. Nuclear economics remain paramount. A final truth, underscored as we contemplate the potential worldwide policy and regulatory response to Fukushima, is that the economics of nuclear power remain crucial to its future. It is well known that, compared to other major power technologies, nuclear is expensive to build and cheap to operate. In the past decade, even amidst growing confidence in nuclear power’s worldwide future, we have seen the industry struggle to limit capital costs while venturing to build the next generation of reactors. In this context, it is crucially important that regulatory actions taken in response to Fukushima have demonstrable benefit arising from any increased costs.

Against this backdrop, Professor Agustín Alonso’s book provides a superb demonstration of the sophistication of today’s nuclear profession and the extensive infrastructure of standards and regulation that now surrounds the use of this invaluable technology. The 36 authors who have contributed to this work reflect the wide geographical reach of today’s nuclear profession and an impressive range of expertise.

This excellent book will prove valuable in the training of engineers and administrators engaged in nuclear development, and will serve also as an authoritative reference for experts and decision makers in govern-
ment, regulatory bodies, educational institutions, and the nuclear industry itself.

The calamity at Fukushima has shaken the confidence of many people in nuclear power. But in truth this tragic event has done nothing to alter the stark realities that led so many different nations in recent years to a common nuclear path.

- Global population will continue its explosive growth – from 3 billion in 1960 to almost 7 billion today, and then upward towards 9 billion by 2050.
- World electricity demand will continue to grow even faster, tripling by 2050.
- Earth-systems science will continue to warn that we must cut carbon emissions by 80% – or risk radical changes in the Earth’s climate posing a threat to all civilization.
- It will continue to be true that our world can achieve a clean-energy revolution only with a vastly expanded use of nuclear power.

These realities remain as momentous and fundamental as they were before Japan’s historic natural disaster. Thus, the custodians of nuclear power hold a duty that remains unaltered: to do all possible to enable this immensely valuable technology to play its central and necessary global role. Professor Agustín Alonso’s book is a notable contribution to this proud and invaluable vocation.