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Monitored this issue:

Nuclear is flatlining, No clear future for nuclear energy

Nuclear power remains stagnant and only an acceleration of China's nuclear program will save the industry from a global death spiral. Meanwhile, the growth of renewables is being turbocharged as countries seek to strengthen energy security. By Jim Green, Friends of the Earth Australia

The nuclear industry experience last year was the same as almost every other for the past 30 years: a small number of reactor start-ups and a small number of closures. There were seven reactor start-ups worldwide in 2022 and five permanent reactor closures, a net gain of just 4.2 gigawatts (GW) of electricity generating capacity.

The fleet of mostly young reactors 30 years ago is now a fleet of mostly ageing reactors. Due to the ageing of the reactor fleet, the International Atomic Energy Agency (IAEA) anticipates the closure of 10 reactors (10 GW) per year from 2018 to 2050. Over the past decade, from 2013–22, there were on average 6.5 reactor construction starts annually. That's a recipe for slow decline. There were 20 construction starts over the past two years, suggesting the possibility of a further period of stagnation.

China's nuclear program

Slight growth is also a possibility, if and only if China's nuclear program accelerates. The 2022 World Nuclear Industry Status Report notes that from 2002–2021, there were 50 reactor start-ups in China and no closures while in the rest of the world there was a net loss of 57 reactors.

China's nuclear program is modest – an average of 2.5 reactor start-ups per year from 2002–2021. But the pace has picked up with 11 construction starts over the past two years. China's nuclear program has picked up pace and then lost steam twice over the past 15 years, so only time will tell if the latest acceleration persists. Therefore, China is sparing the nuclear industry from a global death spiral.

But China has also shown the world how to grow the nuclear industry: with inadequate nuclear safety and security standards, inadequate regulation, media repression, whistleblower repression, the worst insurance and liability arrangements in the world, and rampant corruption. Even in the most optimistic scenario for the nuclear industry, its share of global electricity generation will continue to fall.

Nuclear power's contribution to global electricity generation has fallen 46 percent from a peak of 17.5 percent in 1996 to 9.4 percent now.

Stunning failures in the West

The growth of nuclear power in China contrasts with the stunning failure of reactor construction projects in the US, the UK and France.

In the US, the only reactor construction project is the Vogtle project in Georgia, which has two AP1000 reactors. The latest cost estimate of US$34 billion is more than double the US$14–15.5 billion estimate when construction began. Costs continue to increase and the project only survives because of multi-billion-dollar taxpayer bailouts. The V.C. Summer project in South Carolina, which had two AP1000 reactors planned, was abandoned in 2017 after the expenditure of around US$9 billion. In 2006, Westinghouse said it could build an AP1000 reactor for as little as US$1.4 billion – 12 times lower than the current estimate for Vogtle.

The golden rule of nuclear economics

In the late 2000s, the estimated construction cost for one EPR reactor in the UK was £2 billion. The current cost estimate for two EPR reactors under construction at Hinkley Point – the only reactor construction project in the UK – is £32.7 billion. Thus the current cost estimate is over eight times greater than the initial estimate of £2 billion per reactor.

The only current reactor construction project in France is one EPR reactor under construction at Flamanville. The current cost estimate of € 19.1 billion is nearly six times greater than the original estimate of €3.3 billion. Lower figures are cited by EDF and others - but these typically exclude finance costs.

The ballooning cost estimates in the US, the UK and France have increased 12-fold, 8-fold and 6-fold. Thus we can posit the golden rule of nuclear economics: add a zero to industry estimates and your estimate will be far closer to the mark than theirs.

'Turbocharged' renewables growth

Nuclear power's stagnation contrasts sharply with the growth of renewables. Renewable expansion of about 320 GW last year was 76 times greater than nuclear growth of 4.2 GW.

The same pattern was evident in 2021: nuclear capacity fell by 0.4 GW while renewable capacity growth amounted to 314 GW including 257 GW of non-hydro renewables.

Renewables, including hydro, accounted for 29.1 percent of worldwide electricity generation in 2022 according to the Electricity Market Report 2023 report by the International Energy Agency - more than three times nuclear's share of 9.4 percent.

Nuclear has been overtaken by non-hydro renewables and has fallen below 10 percent for the first time in decades.

The growth of renewables is being turbocharged as countries seek to strengthen energy security, the IEA said in December when releasing its *Renewables 2022* report.

Renewables soon to overtake coal and gas

The IEA projects that in 2025, renewable electricity generation will account for 34.6 percent of total global generation and renewables will have overtaken coal and gas.

The IEA projects that in 2027, renewable electricity generation will have grown to 38 percent of total global generation with declining shares from 2022-27 for all other sources: coal, gas, nuclear and oil.

Wind and solar PV are projected to more than double to account for almost 20 percent of global power generation in 2027.

The IEA projects that China will install almost half of new global renewable power capacity from 2022–2027, with growth accelerating despite the phaseout of wind and solar PV subsidies.

In China in 2021, wind (656 terrawatt-hours – TWh), solar (327 TWh) and hydro (1300 TWh) combined generated six times more electricity than nuclear (383 TWh).

China, the US and India to double renewable power generation

The IEA projects that China, the US and India will all double their renewable generating capacity from 2022–27, accounting for two-thirds of global growth.

IEA Executive Director Fatih Birol said in December 2022: “Renewables were already expanding quickly, but the global energy crisis has kicked them into an extraordinary new phase of even faster growth as countries seek to capitalise on their energy security benefits.

“The world is set to add as much renewable power in the next five years as it did in the previous 20 years.

“This is a clear example of how the current energy crisis can be a historic turning point towards a cleaner and more secure energy system. Renewables’ continued acceleration is critical to help keep the door open to limiting global warming to 1.5°C.”

Nuclear risks in Ukraine

Meanwhile, there is an ongoing risk of a nuclear catastrophe in Ukraine. The International Atomic Energy Agency (IAEA) has released a report noting that several of Ukraine’s five nuclear power plants and other facilities have come under direct shelling over the past year.

The IAEA report states: “Every single one of the IAEA’s crucial seven indispensable pillars for ensuring nuclear safety and security in an armed conflict has been compromised, including the physical integrity of nuclear facilities; the operation of safety and security systems; the working conditions of staff; supply chains, communication channels, radiation monitoring and emergency arrangements; and the crucial off-site power supply.”

Loss of off-site power, and thus reliance on diesel generators to power reactor cooling, dramatically increases the risk of nuclear fuel meltdown and significantly increases the risk of a nuclear disaster.

The IAEA report further states:

“Shelling, air attacks, reduced staffing levels, difficult working conditions, frequent losses of off-site power, disruption to the supply chain and the unavailability of spare parts, as well as deviations from planned activities and normal operations, have impacted each nuclear facility and many activities involving radioactive sources in Ukraine.

“The reliability of the national power infrastructure necessary for the safe and secure operation of the nuclear facilities has also been affected and, for the first time since the start of the armed conflict, all [nuclear power plant] sites, including the [Chernobyl] site, simultaneously suffered a loss of off-site power on 23 November 2022.”

In addition to the horrors that a nuclear catastrophe would inflict on Ukrainians, it would surely result in a global death spiral for nuclear power.

Dr Jim Green is the national nuclear campaigner with Friends of the Earth Australia *and lead author of a* detailed submission *to a current* Senate inquiry *into nuclear power in Australia.*

This article was originally published in https://theecologist.org/2023/mar/01/nuclear-flatlining

Small Modular Reactors, the last-chance saloon for the nuclear industry

Prof Steve Thomas, Greenwich University, critically assesses the current enthusiasm for Small Modular Reactors in the UK and elsewhere. Will they help in the struggle against climate change, or will they sound the death knell for nuclear fission in the power sector?

Article from Responsible Science journal, no.5; advance online publication: 14 March 2023

https://www.sgr.org.uk/resources/small-modular-reactors-last-chance-saloon-nuclear-industry

In January 2023, the UK government announced that six more Small Modular Reactor (SMR) vendors had applied for their designs to be formally assessed with a view to commercialisation in Britain. In this, they join a Rolls Royce-led consortium (see Table 1). The process is called Generic Design Assessment (GDA),[1] and is carried out by the UK's Office of Nuclear Regulation (ONR) by looking in exhaustive detail at reactor designs proposed for construction. Designs that successfully complete the process, expected to take 4-5 years, are then in principle ready to be built anywhere in the country subject to meeting site-specific requirements. This situation adds further weight to the claim by nuclear advocates that all that is holding back construction of these SMRs is government infighting preventing the necessary public funding being offered.[2] However, the counterview is that the obstacles to deployment – including technical, economic, safety, security and environmental problems – are so great that it is unlikely they will ever be built.

This article delves into the debate by asking six key questions:

- Why do we need new reactor designs?
- What are SMRs and what is the basis for the claim to be cheaper than large reactors?
- Are there SMR designs ready to be built?
- How can the economics of SMRs be tested?
- Which designs are being pursued in the UK?
- Will SMRs be a major contributor to meeting UK's climate change targets?

Table 1. UK reactor designs requesting Generic Design Assessment [3]

Design	Vendor	Reactor type	Size (MW)*
SMR	Rolls Royce	Pressurised Water	470
Xe-100	Cavendish/X-Energy	High-temperature gas-cooled	80
BWRX-300	GE-Hitachi	Boiling Water	300
Nucell	GMET Nuclear	Lead-cooled Fast	100
SMR-160	Holtec	Pressurised Water	160
MiniLFR/ Small LFR	Newcleo	Lead-cooled Fast	30/200
?	UK Atomics	Thorium Molten Salt	30

* Of electricity

Why do we need new reactor designs?

For the past 40 years or more, a key argument the nuclear industry has had for not giving up on nuclear power was that a new generation of reactor designs was just round the corner that would solve the problems that existing designs had suffered. Around the turn of the century, people began to talk about Generation III+ designs that would be based on the designs that dominated existing capacity, Pressurised and Boiling Water Reactors (PWRs and BWRs). But they would be simplified, use passive safety, and rely on factory work rather than site engineering. These features would make them safer, but cheaper and easier to build. There was also talk of Generation IV designs, such as Lead-cooled Fast Reactors (LFRs) and Very High Temperature Reactors (VHTRs) that would use reactor technologies not yet built on a commercial scale. It was claimed these designs would use fuel more efficiently, reduce waste production, be economically competitive, and meet stringent standards of safety and proliferation resistance. [4]

The results of the few Generation III+ orders placed were uniformly poor, with reactors invariably late and overbudget. In the worst cases, such as the notorious Olkiluoto (Finland) and Flamanville (France) projects, construction periods of 18 years and costs of three to four times the expected level are being seen. Generation IV designs seem no closer to deployment than when they were first mooted 20 years ago.

What are SMRs and what is the basis for the claim to be cheaper than large reactors?

The new 'saviours' for the nuclear industry are Small Modular Reactors (SMRs). This category embodies a range of technologies, uses and sizes but relies heavily on features that were the selling points for Gen III+ and Gen IV designs. They are smaller than typical Gen III+ designs which produce 1,200 to 1,700 megawatts (MW) of electricity, but the sizes range from 3MW to about 500MW. The Rolls Royce design is a 470MW PWR [5] – bigger than one of the reactors at Fukushima in Japan that suffered serious damage in the 2011 Tsunami. The smallest reactors are usually targeted at isolated communities and mineral extraction facilities or hydrogen production, while the larger ones would mainly just supply power to the grid. The technologies encompass scaled down versions of the dominant existing technologies, PWRs and BWRs, to Gen IV technologies that are not commercially available. The large number of PWRs and BWRs in service worldwide suggests SMR versions of these might be reliable electricity generators.

The advanced designs are not new. For example, sodium cooled fast reactors and high temperature reactors were built as prototypes in the 1950s and 1960s but successive attempts to build demonstration plants have been short-lived failures. It is hard to see why these technologies should now succeed given their poor record. Other designs have been talked about for decades but have not even been built as prototype power reactors – so again it is hard to see why the problems that prevented their deployment to date will be overcome. A particular usage envisaged for some of the technologies is production of hydrogen. However, to produce hydrogen efficiently, reactors would need to provide heat at 900°C, a temperature not yet achieved in any power reactor and not feasible for a PWR or BWR, and one that will require new exotic and expensive materials.

Are there SMR designs ready to be built?

Developers of SMRs give the impression that their designs are ready to build, the technology proven, the economic case established and all that is holding them back is government inactivity. However, taking a reactor design from conception to commercial availability is a lengthy and expensive process taking more than a decade and perhaps costing more than £1bn. Several Gen III+ designs underwent a large amount of development work but were found to be unsaleable and the cost written off.

The main steps required to bring a design to commercial availability include:

- Developing the design from broad concept to a level detailed enough to be assessed by a safety regulator.
- Establishing a supply chain including the production lines for the components. The small number of reactor orders globally in the past two decades means that the number of accredited suppliers capable of meeting the exacting quality standards required has fallen dramatically and few suppliers would be willing to invest in setting up a production line unless there was a guarantee of a full order book.
- A customer to build the first of a kind. The days when a utility could place an order for an untested design, secure in the knowledge it could pass on the costs to consumers are gone. Utilities must risk their own cash now and will want to see a successfully operating demonstration plant in the vendor's home market before they commit to it.
- A large engineering company partner with experience of integrating a reactor design into an overall power plant design and building commercial power plants.

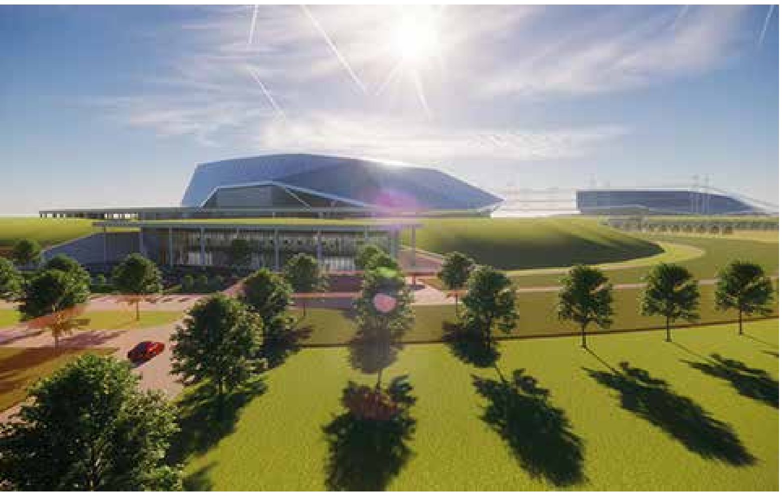
The only SMR design that comes close to meeting these requirements is the 77MW US-based NuScale PWR. This has been under development for 20 years, it has been reviewed successfully by the US Nuclear Regulatory Commission, its developer is backed by a large long-established engineering company, Fluor, and a demonstration project, the Utah Associated Municipal Power System (UAMPS) is planned. However, there are problems with all these elements. The design was originally conceived of as clusters of 12 reactors each of 35MW. Then this has been progressively uprated to try to improve the economics to 40MW, 50MW, 60MW and now 77MW offered in clusters of four or six reactors. Regulatory approval was given in 2021 for the 50MW design but by that time, it had been uprated twice and, as the 50MW design was not going to be offered, significant regulatory issues did not need to be resolved. An application was made in late 2022 for the 77MW design but given the 50% power increase and the unresolved issues, the review will effectively have to start from scratch. The UAMPS project was set up in 2016 and continues to be financially supported by the US Department of Energy which has agreed to pay for some of the project costs. However, rapidly increasing cost estimates mean it is struggling to find enough investors to buy the 476MW (six reactors) of capacity proposed.[6]

How can the economics of SMRs be tested?

The main claim for SMRs over their predecessors is that being smaller, they can be made in factories as modules using cheaper production line techniques rather than one-off component fabrication methods and delivered to the site on a truck essentially as a 'flat pack'. This would avoid much of the site-work that is said to be difficult to manage and is a major cause of the delays and cost over-runs that large reactor projects suffer from.

However, any savings made from factory-built modules will have to compensate for the scale economies lost.[7] Reactor sizes have increased to gain scale economies. In simple terms, a 1,600MW reactor ought to be much cheaper than 10 reactors of 160MW. It will be expensive to test the claim that production line techniques will compensate for lost scale economies.

The first reactor built will need to be built using production lines if the economics are to be tested but once the production lines are switched on, they must be fed. Rolls Royce assumes its production lines will produce two reactors per year and that costs will not reach the target level until about the fifth order. So, if we assume the first reactor takes five years to build, there will be another nine reactors in various stages of construction before a single unit of electricity has been generated from the first, and the viability of the design tested, and perhaps about 15 under construction before the so-called 'nth of a kind' settled down cost is demonstrated. There will be pressure on the government to continue to place orders before the design is technically and economically proven, so the production lines do not sit idle.



But it will not be sufficient for SMRs just to be more economic than large reactors. Given how poorly large reactors compare in cost terms with other low-carbon technologies such as wind and solar technologies or many energy efficiency measures, it is these technologies SMRs will have to beat.

Which designs are being pursued in the UK?

The British government began to target development of SMRs in 2016[8] but these efforts came to little. In 2019, the government made another attempt to launch UK development of SMRs. Over the following year, it allocated £18m to the Rolls Royce SMR for early development of its design,[9] and £10m each to two advanced designs, a Westinghouse 450MW LFR,[10] and 3MW HTGR, U-Battery.[11,12] These latter two technologies were talked about in connection with hydrogen production although the proposed designs are only expected to operate at 750°C – not hot enough to produce hydrogen efficiently. These two designs are not well enough developed to be submitted for a GDA and they remain, at most, a long-term possibility. Given that none of the six new SMR designs put forward for the GDA process in January 2023 (see Table 1) has received support from the UK government, they must be regarded as long shots. The most realistic contender for orders in the next decade is the Rolls Royce design, which Rolls Royce claims is essentially ready to be built.

The Rolls Royce design was announced in 2017 with few design details revealed. In evidence to a UK parliamentary select committee, the cost and risk of getting from a conceptual design to a saleable design was made clear in the conditions they demanded the government met if they were to proceed with the design. These included:[13]

- Match funding (at a minimum) up to the end of the licensing phase.
- A GDA slot.
- A suitable site to develop a First of a Kind.
- A guaranteed UK electricity market of 7GW.

It also asked that only one SMR technology be pursued and that, if an overseas technology was chosen, Rolls Royce should be the UK partner. Agreeing to these conditions – especially the need for 7GW of orders which realistically could only be given by the government for reactors owned by them – would represent an extraordinary gamble on a design that is still in its infancy. In November 2020, the government allocated its £18m, matched by the Rolls Royce consortium, to develop a concept design. This phase was concluded a year later when the project moved to a second phase, to further develop the concept reactor design enough to allow it to pass through the GDA process. This phase was backed by a £210m grant from the government matched by £250m from private sector investors. In April 2022, the government instructed the nuclear regulator, the ONR, to begin the GDA. While this funding has kept the project going so far, it represents only a small fraction of the cash needed to bring the design to commercial status. The government will be increasingly unwilling to commit more money to the technology while its economic and technical viability remains unproven, while the Rolls Royce-led investors will be reluctant to commit more of their own funds unless there is a guaranteed market.[14]

Rolls Royce appears to have recognised the implausibility of its demands and was reported to be requiring guarantees from the government for only four orders claiming it could supplement this with export orders. It is hard to believe that export customers would place orders before the technology had been well demonstrated in the UK. Giving Rolls Royce exclusive rights to the UK market was clearly not politically credible. Nevertheless, Rolls Royce is ramping up its promotional effort aimed at convincing the public its reactor design was ready to go. Committing to this would release a bonanza of jobs, the company claims, at the construction sites[15] and at the sites where the production lines would be installed, and would open up a large export market.[16] By the start of 2023, the UK government had not agreed to Rolls Royce's demand that it guarantee orders.

Will SMRs be a major contributor to meeting UK's climate change targets?

The selling point for nuclear is that it is a relatively low-carbon source of power that can replace fossil fuel electricity generation in the UK and elsewhere. However, by the time SMRs might be deployable in significant numbers, realistically after 2035, it will be too late for them to contribute to reducing greenhouse gas emissions. Electricity will be the easiest sector to decarbonise and, if the whole economy is to reach net zero emissions by 2050, then this sector will have to reach that point long before then. So SMRs appear to be too little, too late.[17]

However, despite the past failures of nuclear power, there remains an appetite in the British government to give the industry just one more chance despite increasing public scepticism. Pursuing SMRs will require massive underwriting by consumers and taxpayers, and it remains to be seen whether the government follows its instinct to continue supporting the sector or whether the amount of public money at risk makes such a decision politically impossible.

The claims being made for SMRs will be familiar to long-time observers of the nuclear industry: costs will be dramatically reduced; construction times will be shortened; safety will be improved; there are no significant technical issues to solve; nuclear is an essential element to our energy mix. In the past such claims have proved hopelessly over-optimistic and there is no reason to believe things would turn out differently this time. Indeed, the nuclear industry may well see itself in the 'last-chance saloon'. The risk is not so much that large numbers of SMRs will be built, they won't be. The risk is that, as in all the previous failed nuclear revivals, the fruitless pursuit of SMRs will divert resources away from options that are cheaper, at least as effective, much less risky, and better able to contribute to energy security and environmental goals. Given the climate emergency we now face, surely it is time to finally turn our backs on this failing technology?

Steve Thomas is Emeritus Professor of Energy Policy at Greenwich University, UK. He has researched and written on nuclear power policy issues for 40 years. His article was originally published in *Responsible Science* journal, no.5, March 2023, Scientists for Global Responsibility, https://www.sgr.org.uk/publications/responsible-science

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3. As note 1.
4. See, for example: https://www.gen-4.org/gif/jcms/c_59461/generation-iv-systems
5. https://www.rolls-royce-smr.com/
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17. The Boris Johnson government had a target to decarbonise the electricity sector by 2035, the Labour Party has a target to reach this by 2030 while the UK's National Grid Company scenarios foresee decarbonisation by 2032-34.

For European nuclear safety Russia must withdraw its military and ROSATOM personnel from Zaporizhzhia nuclear power plant

Greenpeace demands: sanction ROSATOM and 'War Stress Tests' required all of European nuclear power plants

The attack, seizure and occupation of the Zaporizhzhia nuclear power plant in southern Ukraine by Russian military forces which began one year ago have major implications for the safety and security of nuclear reactors worldwide, Greenpeace Central and Eastern Europe (CEE) warned today. The environmental organization calls for industry Fukushima-like stress tests to be applied to the global nuclear industry.[1]

Together with Russia's state nuclear agency, ROSATOM, the unprecedented attack on Europe's largest nuclear plant, continues to threaten a major nuclear event with potentially severe radiological consequences. Greenpeace safety assessments[2] from 12 months ago and today[3] conclude that the only way to safely secure the nuclear plant is for the complete withdrawal of Russian military forces as well as all ROSATOM personnel and an end to the war. Meanwhile ROSATOM has so far been spared of international sanctions[4] and continues its nuclear trade with Europe and the rest of the world despite its direct role in the seizure and occupation of the Zaporizhzhia reactors.

"The threat to the safety of the Zaporizhzhia nuclear plant will continue so long as the Russian military and ROSATOM remain at the site. And the military threat to all of Ukraine's nuclear plants will end only when Russia ends its war against Ukraine. The only legitimate authority at Zaporizhzhia is Ukraine's nuclear regulatory authority, SRNIU and the plant operator Energoatom. There should be no further delay in applying sanctions against ROSATOM which are long overdue and must be comprehensive including an end to all companies still trading with the Russian nuclear industry," said Denys Tsutsaiev, campaigner with Greenpeace CEE in Kyiv.

The Russian attack and seizure of the Zaporizhzhia and Chornobyl nuclear plants and threats to Ukraine's other reactors are a unique event in the 70-year history of nuclear power. Warnings of major vulnerability of nuclear reactors to armed attack, including risks to the electrical grid and cooling functions of reactor core and spent nuclear fuel pools, for decades were ignored by the global nuclear industry and regulators.[5] As the West European Nuclear Regulators Association (WENRA) stated in August 2022, "No nuclear power plant has ever been designed to consider potential war-induced damage in its safety demonstration."[6]. While the nuclear industry plans to operate nuclear reactors for 60 years and beyond, acts of war towards nuclear installations can never be excluded and safety and security in times of war cannot be guaranteed.

"The elephant in the room that the nuclear industry does not want to talk about is that reactor safety is severely compromised and at risk of catastrophic failure in the event of war. Ignoring the lessons from Zaporizhzhia and Chornobyl nuclear sites and threats to the other nuclear reactors during Russia's war against Ukraine is not an option. There needs to be stress tests for all operating European nuclear power stations, and we join the call for the European Commission and the European Nuclear Regulators Group to conduct "War Stress Tests", comparable to the EU post-Fukushima nuclear stress tests from the last decade," said Jan Haverkamp, nuclear specialist at Greenpeace Netherlands.

The 'War Stress Tests', should include assessments on the vulnerability of reactors to loss of offsite electrical power and impact on essential reactor functions, such as cooling systems.

For further information: Greenpeace

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Notes

1. As a result of the Fukushima Daiichi nuclear disaster in March 2011, nuclear regulators in Europe and North America applied stress tests to assess the safety vulnerability of nuclear power plants and other facilities to major external hazards. See for example, "Critical Review of the EU Stress Test performed on Nuclear Power Plants", 2012, https://www.greenpeace.org/static/planet4-netherlands-stateless/2018/06/Greenpeace-stress-test-report-final.pdf and "European post-Fukushima nuclear stress tests 2015 review of National Action Plans", https://www.greenpeace.org/static/planet4-slovenia-stateless/2019/03/75adc1a6-75adc1a6-20150304_briefing_eu_stress_tests.pdf
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3. The Greenpeace CEE March 2023 briefing contains a timeline of nuclear risks during the 12 months of occupation of Zaporizhzia and looks into issues that were raised over the year concerning nuclear safety, all relevant for other nuclear power stations operating worldwide. The analysis is based on day-by-day monitoring carried out by Greenpeace nuclear specialists since February 2022, the reporting of the Ukraine nuclear agency SNRIU and over 150 updates on the situation from the International Atomic Energy Agency (IAEA). https://greenpeace.at/uploads/2023/03/russian-attack-on-zaporizhzia-nuclear-plant.pdf
4. "EU Commission scratches Russia nuclear sanctions plans", 16 February 2023, https://www.politico.eu/article/rosatom-russia-ukraine-volodymyr-zelenskyy-vladimir-putin-eu-executive-scratches-russia-nuclear-sanctions-plans/
5. See for example, Bennett Ramberg, "Military Sabotage of Nuclear Facilities: the Implications", 1985 https://www.annualreviews.org/doi/pdf/10.1146/annurev.eg.10.110185.002431; Oda Becker, "Terrorist attacks with armor-piercing weapons (AT-14 Kornet-E) on German nuclear power plants" Report, public version, Greenpeace Germany e.V., Foreword by Heinz Smital, September 2010, see https://www.greenpeace.de/publikationen/KURZ_Panzerbrechende_Waffen_14092010_0.pdf, Greenpeace France, "Report Summary, "Security of nuclear reactors and spent fuel pools in France and Belgium and related reinforcement measures", October 2017, see https://cdn.greenpeace.fr/site/uploads/2017/10/Summary-of-the-report.pdf
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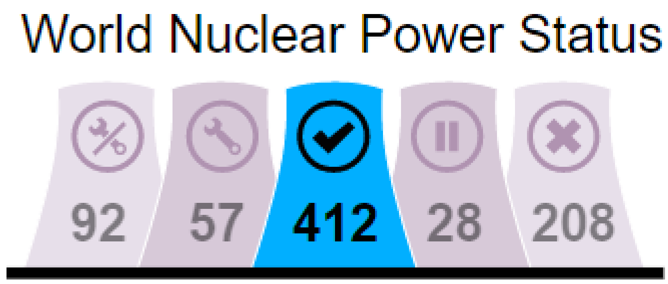
NUCLEAR NEWS



Number of Reactors
(as of February 2023)

Source: https://www.worldnuclearreport.org/

Closure

In Belgium the nuclear reactor Tihange-2 was closed. Together with another reactor, Doel-3 these two were called the crack-reactors for the thousands of small cracks that were discovered in the reactor vessel. The closure of the 5 remaining nuclear power plants was planned in 2025, but is heavily debated. The Belgian government already decided to leave two of the five open after 2025.

Increased cardiovascular disease risk after exposure to low dose radiation

In an important new study in the British medical Journal, (BMJ), the authors conclude, inter alia, "Our findings suggest that radiation detriment might have been significantly underestimated, implying that radiation protection and optimisation at low doses should be rethought." And also "This finding has considerable implications for the system of radiological protection, assuming that the extrapolation is permissible, even, for example, over the restricted dose range 0-0.5 Gy. This added risk would nearly double the low dose detriment."

The scientists report the results of a large meta-analysis of 93 studies evaluating associations between a range of cardiovascular diseases and exposure to radiation in various settings (mostly radiotherapy and occupational exposures, but also diagnostic radiology and environmental exposures). The authors found robust evidence for a dose dependent increase in cardiovascular risks across a broad range of radiation doses. Key findings included a higher relative risk per dose unit at lower dose ranges (<0.1 Gy), and also for lower dose rates (protracted exposures over hours to years). The studies included in the meta-analysis were published mainly during the past decade. This new meta-analysis strengthens the evidence linking low dose radiation to risk of circulatory diseases and these risks should now be carefully considered in protection against radiation in medicine and elsewhere.

https://www.bmj.com/content/380/bmj-2022-074589

ANTI-NUCLEAR NEWS

Japan; Don't Nuke the Pacific

On April 13, 2021, the Japanese government announced that it will start discharging more than 1.3 million metric tons of radioactive "treated" wastewater from the Fukushima Daiichi into the Pacific starting from the spring of 2023. The dumping will continue for three decades or more. The "treated" water contains radioactive isotopes due to some being used to cool the highly radioactive melted cores of nuclear reactors. Tritium and carbon-14 cannot be filtered out at all. Three independent human rights experts appointed by the UN Human Rights Council expressed deep regret at Japan's decision. Fukushima residents, fisheries associations, most of Fukushima's districts, and many anti-nuclear groups in and outside Japan expressed their opposition to the plan. Henry Puna, Secretary General of the Pacific Islands Forum, calls for the Japanese government to hold off on any such release.

The dumping practice will set a bad precedent, and other nuclear power plants across the globe might follow the practice.

Join #StopTepco global campaign to demand "Don't Nuke the Pacific!" by sending postcards to 3 key officials in Fukushima who support the radioactive water dumping into the Pacific and demand they halt the outrageous dumping plan! The first deadline is May 1, 2023. The addresses of the three officials are:

Mayor Shiro Izawa
Futaba-machi townhall
Machinishi 73-4, Nagatsuka, Futaba-machi
Futaba-gun, Fukushima 979-1495
Japan

Mayor Jun Yoshida
Okuma-machi townhall
Minamidaira, Ogawara, Okuma-machi
Futaba-gun, fukushima, 979-1306
Japan

Governor Masao Uchibori
Fukushima Prefectural Hall
2-16 Sugitsuma-cho,
Fukushima-city, Fukushima 960-8670
Japan

More information;
https://mp-nuclear-free.com/Fukushima/20230229.html