

Chain Reactions: Contractual Risk on Nuclear Projects

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I. Introduction

Australia's decision to acquire nuclear-powered submarines under the trilateral Australia-United Kingdom-United States ('AUKUS') agreement has set the stage for a nuclear future for Australia. While the 2025 Federal election result may be seen as a referendum on civilian nuclear power, if the AUKUS alliance succeeds in producing nuclear powered submarines, Australia will be responsible for management and storage of their radioactive waste.[5] Australia has an existing regulatory regime and some nuclear infrastructure, but the projects on the horizon are largely novel in Australia and present unique legal challenges extending beyond traditional construction risks.

Of those projects, the most immediate is AUKUS, which will be regulated by its own bespoke legislation, the *Australian Naval Nuclear Power Safety Act 2024* (Cth). The Commonwealth also has longstanding plans to build a National Radioactive Waste Management Facility to house radioactive waste from civilian sources, although that project is currently stalled.

Nuclear projects can be seen as simply mega-projects at the extreme end of the spectrum of risk for time overrun, regulatory change, design changes and social licence to operate. On nuclear projects these risks may pose existential risks to the viability of a project. Nuclear projects globally have consistently experienced time and cost overrun. But there are some distinctive features, including liability for catastrophic failure, broad-reaching environmental contamination and unprecedented long-term obligations for decommissioning and radioactive waste storage spanning decades, centuries, or millennia.

We draw from experience on mega-projects, global research, and case studies from nuclear generating countries to consider practical questions about the contractual allocation of risks across the entire project lifecycle.

II. Why are nuclear projects legally distinct?

(a) Scale and Duration

There is no doubt the construction of nuclear facilities in Australia would be costly and time-consuming. Lead time on nuclear generation projects in Australia (including the construction period plus planning, permits and financing) has been estimated to be at least 10-15 years.[6] While the precise construction cost of an Australian nuclear reactor is the subject of much debate, it is generally agreed that costs would be in the order of billions, if not tens of billions, of dollars.[7]

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1 We wish to thank Kirsty Braybon for her insightful comments on a draft version of this paper. The views expressed in this paper are the authors' own views and do not necessarily reflect those of LK Law. This paper is not intended to be, and should not be taken as, legal advice

2 Special Counsel at LK Law, Adelaide.

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5 *Agreement Among the Government of Australia, the Government of the United Kingdom of Great Britain and Northern Ireland, and the Government of the United States of America for Cooperation Related to Naval Nuclear Propulsion (not yet in force) art IV(D)* ('Agreement Among Australia, UKNI, and the US').

6 Paul Graham, Jenny Hayward and James Foster, *GenCost 2024–25: Final Report* (Report, July 2025); c.f. Nuclear for Australia, *Fact Sheet: Nuclear Power Economics* (March 2025) <https://assets.nationbuilder.com/nfa/pages/3082/attachments/original/1742784962/Nuclear_Economics_Fact_Sheet_March_2025_E.pdf?1742784962> ('Fact Sheet: Nuclear Power Economics'); International Atomic Energy Agency, 'Milestones Approach' (Web Page) <https://www.iaea.org/topics/infrastructure-development/milestones-approach>.

7 Smart Energy Council, 'Nuclear Fallout: $116–600 Billion to Build 7 Nuclear Reactors' (Web Page, 22 June 2024) <https://smartenergy.org.au/nuclear-fallout-116-600-billion-to-build-7-nuclear-reactors/>; Fact Sheet: Nuclear Power

Projects of this scale would be almost unprecedented in Australia, save for Australia's largest LNG projects. The Ichthys gas field off the coast of Western Australia, for example, took some 20 years from bid to commencement of gas production[8] and was reported to cost around USD45 billion.[9]

(b) Regulatory Overlay

Nuclear projects are unique in their scale and degree of regulation. Regulation at the State, Commonwealth, and international level touches on almost all stages and aspects of a nuclear project including procurement and supply chain, work force, design compliance, site security, construction standards, transport of materials, and decommissioning.

Constitutional limitations have created a two-tiered regime of regulation at the State and Commonwealth level, leading to a complex ecosystem of laws. As legislation develops, lawmakers will need to exercise great care to ensure minor changes do not disturb this ecosystem and give rise to inconsistencies or unintended consequences. In the AUKUS context, often described as a 'whole-of-nation undertaking' for Australia,[10] this risk is particularly pronounced.

Australian domestic law and regulations

Australian domestic law and regulations that govern nuclear activity broadly fall into three categories. First, there is the *Australian Radiation Protection and Nuclear Safety Act 1998* (Cth) ('ARPANS Act'), which establishes the Australian Radiation Protection and Nuclear Safety Agency ('ARPANSA'), regulating the use of radiation by Commonwealth entities, including licensing, compliance, inspection and enforcement. This regime also has equivalents at the State level for non-Commonwealth entities (e.g. *Radiation Protection and Control Act 2021* (SA)).

Second, there is the *Australian Naval Nuclear Power Safety Act 2024* (Cth) ('ANNPSA') (which also creates a Regulator ('ANNPSR')) which governs naval nuclear propulsion, including the Submarine Rotational Force in Western Australia and, relevantly, the construction of SSN AUKUS submarines. The operation of the ARPANS Act is expressly excluded in the context of AUKUS (see ANNPSA s 32).

Third, there are regulations regulating the storage and disposal of nuclear waste, including the *National Radioactive Waste Management Act 2012* (Cth) and the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

Operating concurrently with these streams is the *Nuclear Non-Proliferation (Safeguards) Act 1987* (Cth) and regimes regulating work health and safety[11] and planning and development.[12]

Economics (n 6); World Nuclear Association, 'Economics of Nuclear Power' (Web Page, updated 24 March 2026) < https://world-nuclear.org/information-library/economic-aspects/economics-of-nuclear-power>.

8 INPEX Corporation, 'Track Record', *Ichthys LNG Project Schedule* (Web Page) <https://www.inpex.com/english/ichthys/schedule.html>.

9 Offshore Energy, 'Total Drops 4% Interest in Ichthys Project for $1.6 Billion', *Offshore Energy* (Web Page, 13 December 2018) <https://www.offshore-energy.biz/total-drops-4-pct-interest-in-ichthys-project-for-1-6-billion/>; Angela Macdonald-Smith, 'Total Trims Stake in Ichthys LNG as Cost Blows Out to US$45b', *Australian Financial Review* (Web Page, 14 December 2018) <https://www.afr.com/companies/energy/total-trims-stake-in-ichthys-lng-as-cost-blows-out-to-us45b-20181214-h193z1>.

10 UK Government, 'Fact Sheet: Trilateral Australia–UK–US Partnership on Nuclear-Powered Submarines' (Web Page, 13 March 2023) <https://www.gov.uk/government/publications/joint-leaders-statement-on-aukus-13-march-2023/fact-sheet-trilateral-australia-uk-us-partnership-on-nuclear-powered-submarines>.

11 Both ANTSO and ARPANSA, for example, have work health and safety policies compliant with the *Work Health and Safety Act 2011* (Cth) and Safe Work Australia maintains a dedicated health monitoring guide for uranium, as does the South Australian EPA regarding mining of uranium and thorium.

12 In 2023 Plan SA commenced an assessment under section 108(1)(c) of the *Planning, Development and Infrastructure Act 2016* (SA) to provide approval for the construction of nuclear-powered submarine yards at Osborne in Adelaide. The project was approved by the South Australian Minister for Planning on 4 December 2025.

International Bodies

The International Atomic Energy Agency ('IAEA') is an independent organisation within the United Nations system which publishes standards and carries out reporting and verification activities. The OECD Nuclear Energy Agency ('NEA') is an intergovernmental agency that facilitates co-operation among countries with advanced nuclear technology infrastructures[13] and similarly publishes standards and guidance on nuclear issues. Australia is a member of both organisations.[14]

IAEA and NEA guidance documents are likely to form part of the suite of best practice documents with which contractors involved in nuclear projects must comply, and may form part of ARPANSA's consideration of international best practice.[15]

International treaty obligations

The IAEA lists twelve international legal instruments '*relevant to the establishment of a nuclear power programme.*'[16] At the forefront of public debate in respect of AUKUS is the Treaty on the *Non-Proliferation of Nuclear Weapons* (1970) and the associated Comprehensive Safeguard Agreement ('CSA') and IAEA Additional Protocol.

While AUKUS submarines will be conventionally armed, they will be fuelled by Highly Enriched Uranium ('HEU')[17], which Dr Alan J. Kuperman has described as '*weapons grade*' and '*identical to the HEU in US nuclear weapons*'.[18] The HEU provided to Australia by the UK and US will be housed in complete, welded power units and cannot be used in weapons without further chemical reprocessing, requiring facilities Australia does not have. [19]

Australia has set out its intention to negotiate an arrangement with the IAEA under Art 14 of the CSA,[20] which governs the use of nuclear material in a non-proscribed military activity.

(c) Relationship between regulation and contract

The regulatory landscape in Australia means that any activity involving radioactive material will be carried out pursuant to a licence under the ARPANS Act or equivalent State legislation for civilian activities, or ANNPSA for AUKUS activities. Any such licence will be subject to many detailed and non-delegable conditions. Parties will therefore not be contracting in a vacuum in which the allocation of risks and obligations between the parties is a matter for first instance negotiation.

Rather, the role of contracts is primarily to ensure that the conditions of the licence are implemented at every level of the contract chain. Downstream contractors must be alive to the likelihood of upstream contractors attempting to pass nuclear risk down the chain, notwithstanding that ultimate responsibility remains with the licence holder. It is also vital that contracts are consistent with the licence requirements to ensure compliance.

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13 OECD Nuclear Energy Agency, 'About Us' (Web Page) <https://www.oecd-nea.org/jcms/tro_5705/about-us>.

14 IAEA, 'The Members of the Agency' (Information Circular INFCIRC/2/Rev.93, 24 March 2026) < https://www.iaea.org/sites/default/files/2026-03/infcirc2r93.pdf>; OECD Nuclear Energy Agency, 'Member Countries' (Web Page, 15 June 2022) <https://www.oecd-nea.org/jcms/tro_6814/member-countries>.

15 ARPANSA, 'International best practice" (Web page) <https://www.arpansa.gov.au/regulation-and-licensing/regulation/international-best-practice>

16 International Atomic Energy Agency, Milestones in the Development of a National Infrastructure for Nuclear Power (Report, 2024) <https://www-pub.iaea.org/MTCD/Publications/PDF/PUB2073_web.pdf>.

17 Corinne Kitsell, Ambassador and UK Permanent Representative to IAEA and Comprehensive Nuclear-Test-Ban Treaty Organization (Combined Statements of the Australia, the US, and the UK on AUKUS from the NPT PrepCom AUKUS Side Event, 1 May 2025) <https://austria.embassy.gov.au/vien/NPTPrepComSideEvent2025.html> ('Combined Statements on AUKUS').

18 Dr Alan J. Kuperman, '*AUKUS and nuclear non-proliferation*' (Speech, Lowy Institute, 14 March 2022).

19 Combined Statements on AUKUS (n 19).

20 Australian Submarine Agency, 'Fact sheet: AUKUS and non-proliferation' (October 2024) <https://www.asa.gov.au/sites/default/files/documents/2024-10/NonProliferation-Factsheet.pdf>.

(d) Workforce, capability and supply chain challenges

The capability of the Australian workforce to carry out this highly technical work remains unknown, with no widespread and established nuclear industry with the depth of experience and expertise the AUKUS project requires. Outside the AUKUS context, CSIRO has estimated that a 120% cost premium would apply to any Australian nuclear programme to compensate for this lack of skilled workforce and experience.[21]

The Australian Submarine Agency has estimated that 4,000 workers will be employed to design and build the submarine construction yard, with a further 4,000-5,500 direct jobs created to build the submarines.[22] Australia will need to balance the competing interests of securing a sufficient workforce while maintaining strict security clearance requirements, which may limit the capacity to draw on skilled migrants from non-AUKUS countries. It has been reported that one in 10 applicants to the AUKUS project are being rejected on security grounds.[23]

To the extent that Australia intends to draw on an international supply chain, these arrangements will need to accommodate physical remoteness, arrangements for secure transport, storage and handover and export control restrictions.[24]

(e) Native title / artefacts / heritage claims

Superficially, vast areas of uninhabited and agriculturally unproductive land may make Australia a prime location for nuclear waste storage. But this analysis has historically harmed Aboriginal and Torres Strait Islander peoples, most obviously with the testing of nuclear weapons in Maralinga in the 1950s.[25] The Royal Commission Into British Nuclear Tests in Australia found attempts to ensure the safety of Aboriginal people at Maralinga demonstrated '*ignorance, incompetence and cynicism*' and the test site '*was chosen on the false assumption that the area was not used by its traditional Aboriginal owners*.'[26]

Perhaps, unsurprisingly, opposition to nuclear facilities from native title holders remains to this day. In 2023, the Barngarla Corporation successfully challenged the Commonwealth's decision to build a facility to house low and intermediate-level nuclear waste, at Napandee, near Kimba in South Australia, with Charlesworth J setting aside the declaration on the basis of apprehended bias and lack of consultation.[27]

To ensure the success of nuclear waste facilities in Australia, '*First Nations engagement must be enshrined in the government's approach for the high-level nuclear waste repository siting.*'[28]

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21 CSIRO, 'The Question of Nuclear in Australia's Electricity Sector' (Web Page, 9 December 2024) <https://www.csiro.au/en/news/all/articles/2024/december/nuclear-explainer>; CSIRO, *GenCost 2025–26: Consultation Draft* (Report, December 2025) (*GenCost 2025–26*).

22 Australian Submarine Agency, 'Construction in South Australia' (Web Page) (estimating workforce numbers for submarine yard construction and submarine build) <https://www.asa.gov.au/aukus/construction-south-australia>.

23 Cameron Stewart, '*AUKUS Rejects Suspicious Applicants to Protect Nuclear Secrets*', *The Australian* (online, 16 November 2025) <https://www-theaustralian-com-au.cdn.ampproject.org/c/s/www.theaustralian.com.au/nation/aukus-rejects-suspicious-applicants-to-protect-nuclear-secrets/news-story/64ce821f30b6499d4539bbe45dc614a8>.

24 Noting the creation of an AUKUS licence-free environment between Australia, the UK and USA for certain goods and technology that would otherwise be subject to defence export controls: *Defence Trade Controls Act 2012* (Cth) s 5C.

25 National Museum of Australia, 'Maralinga' (Web page, updated 18 September 2024) <https://www.nma.gov.au/defining-moments/resources/maralinga>.

26 Royal Commission into British Nuclear Tests in Australia, Report (Australian Government Publishing Service, 1985) [8.4.101].

27 *Barngala Determination Aboriginal Corporation RNTBC v Minister for Resources* [2023] FCA 809.

28 Maria Rost Rublee, '*AUKUS: What to Do with Nuclear Waste?*' (Web Page*, The Interpreter*, Lowy Institute, 17 April 2023) <https://www.lowyinstitute.org/the-interpreter/aukus-what-do-nuclear-waste>

(f) Social licence to operate

A social licence to operate (an informal and intangible 'licence' based on acceptance of an activity by the community and stakeholders) is critical to the long-term viability of nuclear in Australia. AUKUS represents a multi-decade commitment involving substantial public expenditure, infrastructure development, regulatory reform and workplace transformation. Without sustained support, governments may face pressure to renegotiate, defer or scale back on commitments.

For example, in 2016, a '*Citizens Jury*' of 350 members convened following a Royal Commission into the nuclear fuel cycle held in South Australia, by a two-third majority, considered that the opportunity to '*store and dispose of nuclear waste from other countries*' should not be pursued under any circumstances.[29] Research from the Lowy Institute in 2024 suggests that the majority of the community supports nuclear power and the acquisition of nuclear-powered submarines, but that support is far from unanimous.[30]

III. Schedule and Cost Risk

Nuclear projects have historically encountered significant delays, often in the scale of years or decades, with associated cost increases, posing existential threats to nuclear projects.

A 2025 study of 348 nuclear projects (including new plants, decommissioning, and waste storage projects) found that 99% of projects were affected by cost or schedule overrun.[31] Statistics such as these have caused some to describe nuclear projects as '*structurally prone to overrun*'.[32]

The construction of nuclear facilities is also marked by '*negative learning*', where construction over time is getting slower, not faster.[33] In the 2025 World Nuclear Industry Status Report, it was observed that '*there has been a clear global trend towards increasing construction times*', in part because earlier '*units were smaller, and safety and environmental regulations were less stringent.*'[34] As design and safety standards become more demanding, opportunities for replication and productivity by experience are lost.[35]

Notwithstanding these trends, '*nuclear industry, government, and research agencies continue to forecast cost reductions in nuclear construction*'.[36]

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29 South Australia's Citizens' Jury on Nuclear Waste, South Australia's Citizens' Jury on Nuclear Waste: Final Report (Report, November 2016) <https://newdemocracy.com.au/wp-content/uploads/2016/05/docs_activeprojects_sanuclearjury_Final-Report-SA-Citizens-Jury-on-Nuclear-Waste_2.pdf>.

30 Lowy Institute, 'Australia Using Nuclear Power to Generate Energy' (Web Page, *Lowy Institute Poll,* 2024) <https://poll.lowyinstitute.org/charts/australia-using-nuclear-power-to-generate-energy/>; Lowy Institute, 'Acquiring Nuclear-Powered Submarines' (Web Page, *Lowy Institute Poll,* 2025) <https://poll.lowyinstitute.org/charts/acquiring-nuclear-powered-submarines/>.

31 Alexander Budzier and Harvey Maylor, 'Anatomy of a Unicorn: How Systemic Program Management Delivered a Nuclear Power Plant on Time and on Budget', *Energy Research & Social Science* 130 (2025) 104424.

32 Naomi J Brookes and Giorgio Locatelli, 'Power Plants as Megaprojects: Using Empirics to Shape Policy, Planning and Construction Management' (2015) 36 *Utilities Policy 57*.

33 Brian Potter, 'Nuclear Power Plant Construction Costs' (Web Page, *Institute for Progress*, 1 May 2023) <https://ifp.org/nuclear-power-plant-construction-costs/> ('Nuclear Power Plant Construction Costs').

34 Mycle Schneider Consulting, *The World Nuclear Industry Status Report 2025* (Report, 2025); see also Jan Barták and Noël Camarcat, 'The Challenges of Building Modern Nuclear Power Plants in the 21st Century' (Web Page, NucAdvisor) <https://www.nucadvisor.com/post/the-challenges-building-modern-nuclear-power-plants-the-21st-century>.

35 Nuclear Power Plant Construction Costs (n 35).

36 Philip Eash-Gates et al, 'Sources of Cost Overrun in Nuclear Power Plant Construction Call for a New Approach to Engineering Design' (2020) 4 *Joule* 2348.

(a) Case studies: schedule and cost risk during construction

The unique scale and duration of nuclear projects, and their complexity and propensity to run late, is apparent from international experience.

i. In Finland, the Olkiluoto 3 power plant took almost 16.5 years, rather than the forecast 4.5 years.[37] In a 2010 presentation by the Director General of Finland's Radiation and Nuclear Safety Authority, the main reasons for the delay included an original schedule that was too ambitious for a plant that was first of its kind, inadequate completion of design and engineering work prior to construction start, shortage of experienced designers, and worldwide shortage of qualified equipment manufacturers.[38]

ii. In France, construction of the Flamanville-3 EPR nuclear plant began in 2007. Quality deviations were discovered in 2018 during a comprehensive quality inspection, requiring reworks which added some 3 years and €1.5bn to the project.[39]

iii. In the US, construction began on a nuclear plant in Georgia in 2013 at a projected total cost of USD14 billion for completion in 2016 and 2017.[40] Instead, the units completed in 2023 and 2024, costing around USD30 billion.[41] The US Department of Energy identified the root causes of delay as incomplete design, inadequate detail in program, inflexible timelines, and improper documentation standards, among others.[42]

iv. The construction of two reactors in South Carolina was cancelled in 2017 after costs rose from an estimated USD9.8 billion to USD17.9 billion.[43] It has recently been reported that this project may restart.[44]

Structurally prone to overrun does not mean doomed to fail. Success stories do exist, with several projects delivered on time and on budget in the US throughout the 1980s, and more recently two projects in South Korea completed with only '*relatively minor cost overruns.*'[45]

Australia also has form with timely completion of nuclear projects, with the OPAL reactor at Lucas Heights being built in just four years and four months from construction start to first criticality in 2006.[46]

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37 Mycle Schneider Consulting, *The World Nuclear Industry Status Report 2023* (Report, 2025).

38 Aaron Larson, '*Finnish Nuclear Plant Under Construction Since 2005 Faces Yet Another Delay*', *POWER Magazine* (online, 16 June 2022) <https://www.powermag.com/finnish-nuclear-plant-under-construction-since-2005-faces-yet-another-delay/>.

39 'Flamanville-3 reaches full power', *American Nuclear Society: Nuclear Newswire* (Web Page, 18 December 2025) <https://www.ans.org/news/article-7625/flamanville3-reaches-full-power/>.

40 Reuters, 'Southern Co's Long-Delayed Vogtle Unit 4 Nuclear Reactor Enters Commercial Operations' (Web Page, 30 April 2024) <https://www.reuters.com/business/energy/southern-cos-long-delayed-vogtle-unit-4-nuclear-reactor-enters-commercial-2024-04-29/> 126-127; Mycle Schneider Consulting, *The World Nuclear Industry Status Report 2019* (Report, 2019) 126-127.

41 Ibid; Reuters, 'How Two Cutting-Edge U.S. Nuclear Projects Bankrupted Westinghouse' (Web Page, 2 May 2017) <https://www.reuters.com/article/world/how-two-cutting-edge-us-nuclear-projects-bankrupted-westinghouse-idUSKBN17Y0C7/>.

42 United States Department of Energy, *Pathways to Commercial Liftoff: Advanced Nuclear* (March 2023) 42 <https://www.uraniumresourcesfund.li/ws/media-library/58f2547ccab54e4d8dd78edaef8aa043/doe---pathways-to-commercial-liftoff---advanced-nuclear---march-2023.pdf>.

43 Mark Holt, 'Rising Costs and Delays Doom New Nuclear Reactors in South Carolina' (Congressional Research Service IN10750, 10 August 2017) <https://www.congress.gov/crs_external_products/IN/PDF/IN10750/IN10750.2.pdf>.

44 Josie Frost, ''Things are moving along': Santee Cooper says VC Summer restart plan is going as scheduled', *WLTX* (online, 14 April 2026) <https://www.wltx.com/article/news/local/vc-summer-restart-plan-update/101-f9dbd489-9242-47d8-9fae-1630a0c91555>.

45 Nana Menya Ayensu, 'Nuclear energy: The decade of deliverability', *American Nuclear Society: Nuclear Newswire* (Web Page, 20 September 2025) <https://www.ans.org/news/article-7317/nuclear-energy-the-decade-of-deliverability/>.

46 Fact Sheet: Nuclear Power Economics (n 6).

(b) Major delay risks on nuclear projects

The following major delay risks are likely to arise on any nuclear project:

i. **Regulator intervention: inspection and licencing**. ANNPSA gives broad powers to the ANNPSR,[47] including the power to carry out inspections and tests, and seize evidential material,[48] and ANNPSR is immune from civil or criminal proceedings.[49] Changes to plans or designs for regulated activity may trigger requirements to notify or seek approval from ANNPSR. ANNPSR can also suspend or cancel licences following investigations.

ii. **Regulatory change**. Nuclear regulations and guidelines are beyond the control of private parties. Changing regulations can cause existing designs to become non-compliant. Given long lead times from bid designs to completion, it is almost invariable that nuclear best practice will change during the life of the project.

iii. **Coordination and information sharing**. The AUKUS project is '*based on a UK design, incorporating cutting edge Australia, UK and US technologies.*'[50] Notwithstanding that secure information sharing is a key pillar of AUKUS, parties will need to ensure information is shared in a way that is co-ordinated, timely and ensures design integration.

iv. **Performance testing and commissioning**. Commissioning can expose fundamental design failings which require significant reworks. The IAEA describes commissioning duration as '*difficult to predict*' and notes poor commissioning scheduling '*can put the facility or personnel at risk*', particularly in relation to overlapping construction and commissioning activities.[51]

IV. Catastrophic Liability: Case Studies

Consistent with their position at the extreme end of the spectrum for time, cost, and health risks, nuclear projects carry a liability profile that stands apart from any other infrastructure sector. The consequences of a catastrophic failure can include sovereign-scale compensation obligations, the contamination of environmental and human health for generations, and decades-long litigation, as demonstrated through the below case studies. These risks have led to the development globally of insurance models that feature liability caps for operators and government indemnification or pooled compensation schemes for amounts beyond the cap.[52]

(a) Mazzocchio v Cotter Corporation

Mallinckrodt Chemical Works processed uranium in downtown St Louis, Missouri, USA, in the early 1940s.[53] Radioactive waste was transported to a nearby site which was eventually taken over by Cotter Corporation ('CC').[54] CC certified that the site was decontaminated, but in fact

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47 *Australian Naval Nuclear Power Safety Act 2024* (Cth) s 102.

48 *Australian Naval Nuclear Power Safety Act 2024* (Cth) ss 41, 43 and 48.

49 *Australian Naval Nuclear Power Safety Act 2024* (Cth) s 121.

50 Australian Government, 'AUKUS Nuclear-Powered Submarine Pathway' (Media Release, 14 March 2023) <https://www.minister.defence.gov.au/media-releases/2023-03-14/aukus-nuclear-powered-submarine-pathway>.

51 International Atomic Energy Agency, *Commissioning Guidelines for Nuclear Power Plants* (IAEA Nuclear Energy Series No NP-T-2.10, 2018) < https://www-pub.iaea.org/MTCD/Publications/PDF/P1742_web.pdf>.

52 World Nuclear Association, 'Liability for Nuclear Damage' (Web Page, 15 March 2021) <https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/liability-for-nuclear-damage>.

53 "Allison Kite, 'St Louis Radioactive Waste Records' (Web Page, *Missouri Independent*, 12 July 2023) <https://missouriindependent.com/2023/07/12/st-louis-radioactive-waste-records/>.

54 Ibid; *Mazzocchio v Cotter Corporation,* 120 F.4th 565, 567 (2024) ('Mazzocchio v Cotter').

contamination was continuing to pollute the surrounding areas.[55] CC was later bought by Commonwealth Edison Company ('CEC').[56]

Eventually, claims were brought against CEC and CC by people who lived in the area and developed cancer, alleging their illness resulted from the contamination.[57]

The defendants moved to dismiss the claim on the ground that federal law pre-empted the plaintiffs' state-law claims.[58] The motion was denied in the court of first instance and was appealed to the Eighth Circuit Court of Appeals,[59] which affirmed the lower court's decision.[60] While acknowledging that states could not enact and enforce '*before-the-fact nuclear safety*' statutes or regulations, the Court held that the rules of state tort law were not pre-empted.[61]

This stands in contrast to other circuits to have considered the matter. Consequently, a petition for a writ of certiorari is currently pending before the United States Supreme Court.[62]

(b) Three Mile Island

In 1979 at Three Mile Island nuclear power plant in Harrisburg, Pennsylvania, USA, there was a partial meltdown. A registry of more than 30,000 residents in the area was maintained for 18 years after the incident and more than a dozen studies were undertaken to investigate potential health effects. None of them found any evidence of any abnormal number of cancers[63] or any effects on animal or plant life in the area.[64] Clean up efforts took 14 years, until 1993, and cost approximately USD1 billion.[65]

Various litigation resulted in a USD25 million settlement of civil claims in 1985,[66] a USD45,000 fine and creation of a USD1 million emergency fund,[67] and a class action that was eventually dismissed in 2002.[68]

(c) Chernobyl

The April 1986 explosion and fire at the Chernobyl Nuclear Power Plant in Soviet Ukraine remains the most severe nuclear accident in history. The immediate blast and subsequent radiation exposure killed plant workers and first responders, while the radioactive plume contaminated large areas of what is now Ukraine, Belarus, and Russia, and spread fallout across much of Europe. Hundreds of thousands of people were evacuated from the surrounding exclusion zone, which remains largely uninhabited.[69]

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55 Ibid.

56 Mazzocchio v Cotter at 567.

57 Mazzocchio v Cotter at 566-7.

58 Mazzocchio v Cotter at 566-7.

59 The relevant intermediate appellate court in this region of the US.

60 Mazzocchio v Cotter.

61 Ibid at 568.

62 *Cotter Corporation v Mazzocchio*, Petition for Writ of Certiorari dated 18 March 2025 (No 24-1001). The petition is contested by the plaintiffs in the underlying litigation (see Brief in Opposition dated 26 June 2025) and certiorari has not yet been granted as at the date of this paper.

63 World Nuclear Association, 'Three Mile Island Accident' (Web Page, 23 March 2026) <https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/three-mile-island-accident>.

64 United States Nuclear Regulatory Commission, 'Backgrounder on the Three Mile Island Accident' (Fact Sheet, April 2022) <https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html>.

65 Associated Press, '14-Year Clean Up at Three Mile Island Concludes', *The New York Times* (15 August 1993), <https://www.nytimes.com/1993/08/15/us/14-year-cleanup-at-three-mile-island-concludes.html>.

66 Associated Press, 'Lawsuits over TMI Are Dead, Lawyers Say', *The Morning Call* (28 December 2002) A28.

67 *Ottawa Citizen*, 'Three Mile Island Plant Operator Faked Leak Records' (29 February 1984).

68 *In re Tmi Cases Consol. II Levin*, 53 Fed. Appx. 648.

69 World Nuclear Association, 'Chernobyl Accident 1986' (Web Page, 24 March 2026) <https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/chernobyl-accident>.

By December 1986, the then-Soviet Union had reportedly paid USD1.12 billion in compensation to victims, with an official death toll of 31.[70] From 1990, recovery efforts have been coordinated at an international level.[71] More than 40 nations contributed to the funding for the Shelter Implementation Plan, the centrepiece of which is a new containment structure that was completed in 2019, at a total cost of USD2.7 billion.[72] The new structure is designed to last 100 years, with ongoing cleanup efforts expected to take until 2065.[73]

(d) Fukushima

In March 2011 the Great East Japan Earthquake triggered a meltdown at the Fukushima Daiichi plant operated by Tokyo Electric Power Company ('TEPCO'), resulting in the release of radionuclides into surrounding areas. Radionuclides were later found in food, drinking water and some non-edible items. Approximately 100,000 people were evacuated from the immediate area.[74]

The UN reported that no adverse health effects directly attributable to the disaster had been documented.[75] However, approximately 2,313 people were reported to have died from trauma brought about by the disaster and delays in medical care because of the enormous destruction caused by the earthquake and tsunami.[76]

2017 estimates put clean up and compensation costs at ¥22 trillion, with TEPCO contributing ¥19 trillion, and the rest coming from the government-affiliated Nuclear Damage Compensation and Decommissioning Facilitation Corp and the government directly.[77]

By 2015, there were 30 lawsuits pending.[78] That same year, the Japanese government was found liable in negligence for contributing to the disaster.[79] In 2022 the Supreme Court of Japan held that the government was not liable, but it affirmed a finding of liability against TEPCO and upheld an order that TEPCO pay damages of ¥1.4 billion to about 3,700 people.[80] Also in 2022, the Tokyo district court found four of TEPCO's former executives liable to the company and ordered them to pay ¥13 trillion to the company.[81] As of January 2021, evacuees had received a total of ¥9.7 trillion personal and property compensation.[82]

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70 United Press International, 'Moscow Pays Chernobyl Disaster Victims $1.12 Billion', Los Angeles Times (14 December 1986) <https://www.latimes.com/archives/la-xpm-1986-12-14-mn-3265-story.html>.

71 United Nations, 'Chernobyl Disaster Remembrance Day: Background' (Web Page, 26 April 2025) <https://www.un.org/en/observances/chernobyl-remembrance-day/background> (accessed 6 Apr 2026).

72 Bechtel, 'Chornobyl New Safe Confinement' (Web Page) <https://www.bechtel.com/projects/chornobyl-new-safe-confinement/>.

73 Aria Bendix, 'The Massive Concrete Sarcophagus Built After the Chernobyl Disaster Is Being Taken Apart' (Web Page, Business Insider, 20 September 2019) <https://www.businessinsider.com/chernobyl-disaster-sarcophagus-construction-dismantling-2019-9>.

74 International Atomic Energy Agency, *The Fukushima Daiichi Accident: Report by the Director General* (2015).

75 World Nuclear Association, 'Fukushima Daiichi Accident' (Web Page, 27 February 2026) <https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-daiichi-accident> ('Fukushima Daiichi Accident').

76 Ibid.

77 Ibid. Approx AUD260bn.

78 Justin McCurry, 'Japanese Government Liable for Negligence over Fukushima Daiichi Nuclear Disaster, Court Rules' (Web Page, *Guardian*, 17 March 2017) <https://www.theguardian.com/world/2017/mar/17/japanese-government-liable-negligence-fukushima-daiichi-nuclear-disaster>.

79 Ibid.

80 Yukiko Nishimura, 'Japan's Top Court Says Government Not Responsible for Fukushima Damage' (Web Page, *Reuters*, 17 June 2022) <https://www.reuters.com/world/asia-pacific/japans-top-court-says-govt-not-responsible-fukushima-damage-media-2022-06-17/> (accessed 2 Apr 2026) (Approx AUD15bn).

81 Sam Nussey, 'Tokyo Court Orders Ex-TEPCO Executives to Pay ¥95 Billion in Damages over Fukushima Disaster' (Web Page, *Reuters*, 13 July 2022) <https://www.reuters.com/business/environment/tokyo-court-orders-ex-tepco-execs-pay-95-bln-damages-over-fukushima-disaster-nhk-2022-07-13/>.

82 Fukushima Daiichi Accident (n 79) (Approx AUD116bn).

V. Decommissioning, Waste Management, and Intergenerational Obligations

Every nuclear facility will eventually reach the end of its operating life and require decommissioning. Some will also produce radioactive waste over their operating lives. Safe storage and management of radioactive material is therefore critical, and decommissioning and ongoing waste management will always be central issues on any project involving storage or disposal of radioactive waste.

In reports published by the Commonwealth of Australia and the UK Government, decommissioning of nuclear submarines is described as '*the most complex aspect of the submarine's lifecycle*' which requires '*bespoke facilities, significant support infrastructure and a highly experienced workforce*.'[83] This observation may also be applied to decommissioning civilian nuclear facilities.

(a) Regulation of decommissioning and waste management

As with every other aspect of the nuclear cycle,[84] decommissioning and waste disposal is heavily regulated from the inception of the project. In order to obtain any facility licence under the ARPANS Act or the ANNPSA, the applicant must develop, maintain, and regularly update decommissioning and waste management plans.[85]

Further, when the time to decommission comes, the licensee will require a further licence to commence decommissioning activities. Obtaining that facility licence is itself a lengthy process. For example, the original High Flux Australian Reactor at Lucas Heights is currently undergoing decommissioning after shutting down in 2007 after 50 years of operation. According to ANTSO, the planning phase alone for Phase A (stage 1) of decommissioning took some ten years, with further stages of Phase A and Phase B still to come requiring additional regulatory approvals.[86]

(b) Decommissioning: key features

There are many similarities between the decommissioning of nuclear and other complex facilities, such as offshore oil and gas facilities, the key aspects of which include:

i. dismantling of structures;

ii. site remediation and contamination removal;

iii. treatment, removal, or transfer of stored waste; and

iv. achievement of agreed end-state criteria.

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83 Commonwealth of Australia, 'The AUKUS Nuclear-Powered Submarine Pathway: A Partnership for the Future' (Report, 2023) <https://www.asa.gov.au/sites/default/files/documents/2024-10/00.%20Public%20Report.pdf>; United Kingdom, 'The AUKUS Nuclear-Powered Submarine Pathway: A Partnership for the Future' (Report, 2023) <https://data.parliament.uk/DepositedPapers/Files/DEP2023-0234/AUKUS_nuclear-powered_submarine_pathway_A_partnership_for_the_future.pdf>.

84 See the discussion above at section II(b)

85 See for example *Australian Radiation Protection and Nuclear Safety Regulations 2018* (Cth) (**ARPNS Regs**) reg 46(1)(d), which requires that the applicant for a facility licence to submit, among others, radioactive waste management and decommissioning plans for the facility, and regs 60 and 61 which require that the holder of a facility licence maintain implement those plans and update them every three years. Decommissioning and storage of radioactive waste are both regulated under the *Australian Naval Nuclear Power Safety Act 2024* (Cth) ss 11 and 14, and the *Australian Naval Nuclear Power Safety Regulations 2025* (Cth) (**ANNPS Regs**) Parts 2, 3, and 4 set out the application process and conditions that may be applied by the ANNPSR to a licence

86 Australian Radiation Protection and Nuclear Safety Agency, *Statement of Reasons: Licence Issued to ANSTO to Decommission the HIFAR Facility* (Commonwealth of Australia, 2024). <https://www.arpansa.gov.au/sites/default/files/documents/2024-12/HIFAR%20-%20Decommission%20-%20Statement%20of%20reasons.pdf>; World Nuclear News, 'ANSTO Begins Decommissioning Australia's First Reactor' (Web Page, *World Nuclear News*, 6 August 2024) <https://www.world-nuclear-news.org/articles/ansto-begins-decommissioning-australias-first-reactor>.

As already noted, these matters will be the subject of detailed licence conditions. But the work to complete those tasks will be performed by a variety of contractors along various contractual chains. Each of those contracts must be prescriptive enough that obligations are clear, flexible enough to allow for inevitable changes in standards and technology over the decades that the facility will operate and centuries of waste storage, and in conformity with all licence conditions.

One of the most critical matters is financial provisioning for decommissioning,[87] including:

i. establishment of a segregated, ring-fenced decommissioning fund;

ii. protection of funds from insolvency or corporate restructuring; and

iii. that the fund be used exclusively for decommissioning and waste management.

Payment obligations should arise during operation, not be deferred until closure, reducing intergenerational cost shifting and the risk of non-compliance at contract end. Failure to adequately provide for decommissioning on any project involving private entities risks leaving the State exposed to substantial costs of carrying out decommissioning itself.[88]

(c) Radioactive waste storage

Used nuclear fuel and other high-level nuclear waste requires isolation and containment for at least 100,000 years, and takes about 300,000 years to reach the radiotoxicity level of natural uranium ore.[89] Radiotoxicity decreases at roughly an exponential rate, with the most radioactive elements decaying in the first 500 years, and the first 10,000 years being the most critical period during which isolation and containment must be assured.[90]

Radioactive waste is generally split into three categories: low-level, intermediate and high-level, each with its own treatment and storage options. Used nuclear fuel, such as that used to power nuclear submarines, is considered high-level.[91]

High-level waste generates intense heat and must be kept in cooling ponds for at least 5 years to prevent combustion. Once sufficiently cooled, it is often encased in an insoluble glass or ceramic matrix, placed in corrosion resistant containers and transferred to a temporary storage facility.[92]

Long term waste disposal involves deep geological repositories: facilities located hundreds of metres underground that use engineered and natural barriers to isolate waste and prevent contamination. These repositories are designed to remain stable for thousands of years without active human control, while allowing future retrieval of waste if required.[93]

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87 ANNPS Regs 60(1)((k) requires that regulated activities be carried out pursuant to an Insolvency Plan, which must eliminate or reduce the risk to nuclear safety from potential insolvency, by making effective arrangements for the insolvency of the licence holder.

88 See *World Nuclear Industry Status Report 2019* (n 44) 22-23, which described decommissioning costs as 'soaring' and cited case studies.

89 Nuclear Fuel Cycle Royal Commission (SA*), Nuclear Fuel Cycle Royal Commission Report* (Government of South Australia, 2016) ('Nuclear Fuel Cycle Royal Commission Report') at [67]; Anatomically modern humans have existed for about 300,000 years see Smithsonian National Museum of Natural History, 'Homo Sapiens' (Web Page) <https://humanorigins.si.edu/evidence/human-fossils/species/homo-sapiens>, and agriculture has existed for around 12,000 years: 'How agriculture and domestication began', *Britannica* (Web Page at 16 April 2026) <https://www.britannica.com/topic/agriculture/How-agriculture-and-domestication-began>.

90 Nuclear Fuel Cycle Royal Commission Report (n 95) at [67]

91 Agreement Among Australia, UKNI, and the US (n 5) 5.11.

92 World Nuclear Association, 'Radioactive Waste Management' (Web Page, updated 22 November 2025) <https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-waste/radioactive-waste-management>.

93 Nuclear Energy Agency (OECD), *Post-Closure Safety Case for Geological Repositories: Nature and Purpose* (2004) NEA No 3679 12; Nuclear Energy Agency, *Reversibility and Retrievability (R&R) for the Deep Disposal of High-Level Radioactive Waste and Spent Fuel: final Report of the NEA R&R Project (2007-2011)* (2011) 5-6 ('Disposal of High-Level Radioactive Waste').

There is currently only one operating deep geological repository for intermediate-level radioactive waste: the Waste Isolation Pilot Plant in New Mexico, USA, which opened in 1999 and stores intermediate level waste. The Onkalo repository in Finland, expected to open this year, will be the world's first deep geological repository for high-level waste.[94] There are also deep geological repositories planned for Sweden, France, Canada, Switzerland, and the USA.[95]

In Australia, the privately operated Sandy Ridge facility in Western Australia permanently stores low-level radioactive waste in a geological repository.[96]

VI. Optimal Contractual Strategies

A detailed examination of all contractual potentialities is beyond the scope of this paper. The below sections highlight major areas of risk that parties should consider at the time of contractual negotiations.

(a) Front-end risk allocation

Given the complexity, cost, and long-term nature of nuclear projects, a clearly defined scope is even more important than in other infrastructure contexts. The contracts should, as clearly as possible, specify what each party is responsible for building, to what specification and under what regulatory standard. Changes mid-construction may trigger regulatory re-approval, with cascading schedule and cost consequences. A target cost or cost-reimbursable model may be useful to allocate cost overrun risk and protect against dangerous corner-cutting pressures that might otherwise arise. The licensing regimes set out above will govern matters such as radiological incidents, consequences of regulatory non-compliance, and decommissioning (including costs),[97] but licensees will want to consider how to ensure compliance with the conditions of their licence and downstream contractors should be aware of the licensee trying to pass nuclear risk down the chain. Contracts should expressly address schedule risk allocation, including through escrow accounts and financing arrangements that quarantine funds for later stages of the project from the outset.

(b) Dispute resolution

Expert determination may be appropriate for narrow, technical disputes between engineers, but the broader commercial disputes likely to arise on nuclear projects may require more structured processes. Arbitrability is a live question, as the significant public interest dimension of nuclear construction suggests that some disputes may not be suitable for private arbitration, pointing instead towards a specialist tribunal or standing dispute board with appropriate technical expertise. Choice of law is also an open question in the AUKUS context, where UK and US parties may claim an interest in any dispute that arises. AUKUS submarine projects fall within the jurisdiction of ANNPSR, which has the power to bring civil penalty proceedings or refer matters for criminal prosecution. This cannot be contracted around and should be factored into the dispute resolution regime from the outset.

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94 World Nuclear Association, 'Nuclear Power in Finland' (Web Page, updated 5 January 2026) <https://world-nuclear.org/information-library/country-profiles/countries-a-f/finland>.; Alex Hunt, 'How Are Geological Repository Projects Progressing?' (Web Page, *World Nuclear News*, 28 December 2025) <https://www.world-nuclear-news.org/articles/how-are-geological-repository-projects-progressing>.

95 Alex Hunt, 'How are geological repository projects progressing?' (Web Page, 28 December 2025) < https://www.world-nuclear-news.org/articles/how-are-geological-repository-projects-progressing>.

96 'Sandy Ridge – Tellus' <https://tellus.com.au/project/sandy-ridge-facility/>

97 See, eg, ARPANS Act s 35; ARPNS Regs 57A, 58 and 60; ANNPSA ss 20-21; and ANNPS Regs 18 and 60.

(c) Indemnities and sovereign immunity considerations

Where the Commonwealth is the operator, sovereign immunity may not always serve the public interest. In particular, a structured compensation regime modelled on the frameworks in place in other jurisdictions[98] is likely to be implemented in Australia and would provide a more certain and transparent mechanism for funding liability arising from catastrophic events. It is likely that operators (potentially private entities in the civilian context) and downstream contractors will need to have regard to that framework when negotiating contractual provisions relating to indemnities. This will ensure there is no conflict with legislated regimes and to consider addressing any residual exposure they may have depending on their specific role.

On the contractor side, decommissioning obligations present a distinct long-tail risk. For defence nuclear projects operated by the Commonwealth, this concern is largely mitigated: the Commonwealth, as operator, will not become insolvent. As referenced above, decommissioning obligations will be addressed in licensing conditions (in both the defence and civilian contexts). Nevertheless, contracts should not rely solely on regulatory compliance as a substitute for robust contractual protections and should still include provisions requiring maintenance of adequate decommissioning funding throughout the project lifecycle.

(d) Warranties

Managing warranties on materials, fixtures and equipment is difficult in the nuclear context, particularly where those items may sit idle for years or decades before ultimately being used. While typical procurement practice might be to delay receiving items until as late as possible, equally parties should be mindful of procurement delays caused by export control and long lead times on bespoke and technical equipment.

(e) Regulatory change clauses

Standard regulatory change clauses under which variations required by changes in law are typically absorbed by the contractor are poorly suited to nuclear projects, where best practice may evolve significantly over a decade-long construction programme. Contracts should distinguish between regulatory changes the contractor should reasonably have anticipated and those arising from genuinely unforeseeable shifts in statutory requirements, with the latter giving rise to a compensation event.

(f) Long-term obligation frameworks

In addition to decommissioning, waste storage obligations present a unique challenge in the nuclear context as they need to consider a centuries-long timescale which might outlast not just the original contracting parties but potentially even the legal and governmental structures within which those parties operated. There will necessarily be an institutional framework developed to address this[99] and future contracts will need to take those frameworks into consideration in clauses related to long-term obligations such as decommissioning, waste storage, records retention, contamination surveys and the like.

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98 See World Nuclear Association, 'Liability for Nuclear Damage' (Web Page, 15 March 2021) <https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/liability-for-nuclear-damage>.

99 World Nuclear Association, 'Liability for Nuclear Damage' (Web Page, updated 15 March 2021) <https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-waste/radioactive-waste-management>.

VII. Conclusion

The time to start planning for the storage of spent nuclear fuel is now. On the optimistic assumptions that the AUKUS agreement remains on foot and that AUKUS deadlines are met, Australia will receive nuclear powered submarines in the early 2030s and will be producing its own nuclear-powered submarines by the early 2040s. The uranium fuel used to power nuclear submarines may last 30-odd years.[100] Having regard to the exceptionally long lead-times on all aspects of nuclear projects, those are not comfortably far-off points in time. Any planning must result in contracts that address the unique combination of extreme risks present on nuclear projects, and do so in a sufficiently flexible way to survive the years or decades that the contracts will remain on foot.

[100] Australian National University, 'How Do Nuclear-Powered Submarines Work? A Nuclear Scientist Explains' (Web Page, 16 September 2021) <https://science.anu.edu.au/news-events/news/how-do-nuclear-powered-submarines-work-nuclear-scientist-explains>.