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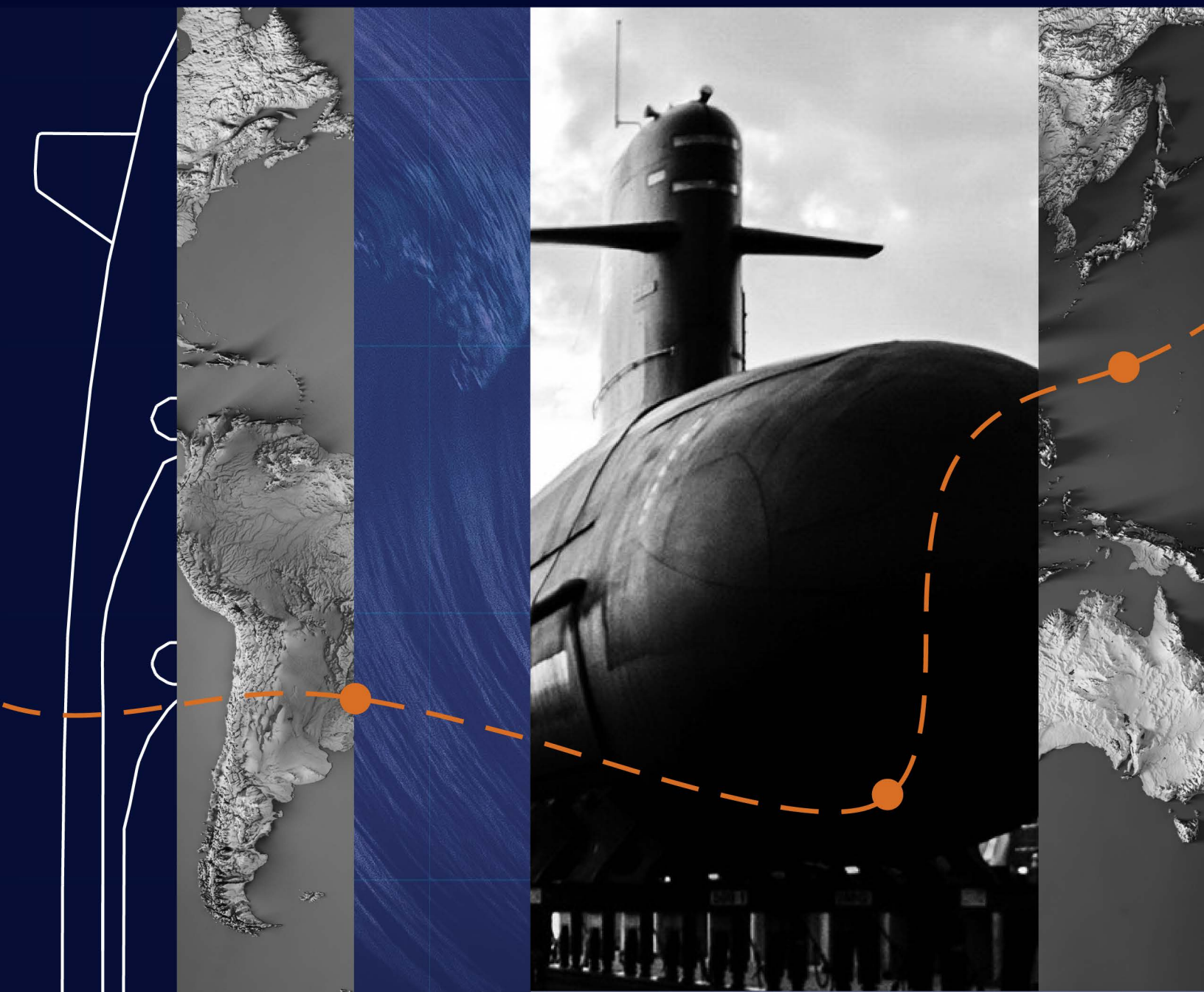
A New Era of Nuclear-Powered Submarines Is Making Waves in Nuclear-Weapon-Free Zones

Jamie Kwong, Toby Dalton, Celia McDowall, editors



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Alain Ponce Blancas | Monique Cormier | Corey Hinderstein | Ryan A. Musto
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Preface

Corey Hinderstein

For the first time, states without nuclear weapons are acquiring naval nuclear propulsion (NNP) capabilities for use in conventionally armed, nuclear-powered attack submarines (SSNs). The geostrategic and technological shifts resulting in and from this development create challenges to the nuclear nonproliferation regime and raise questions about how it must adapt. Australia and Brazil, the states currently pursuing this technology, each cite their membership in a nuclear-weapon-free zone (NWFZ) treaty—the Treaty of Rarotonga and the Treaty of Tlatelolco respectively—as evidence of their continued commitment to nonproliferation and trustworthiness to responsibly pursue NNP.

Although they are often overlooked in nuclear policy discourse, NWFZs are viewed by adherent states as important tools for regional management of the risks posed by nuclear weapons and related technologies. They are regionally-driven tools designed to protect zone members from the dangerous spillover effects of competition among states with nuclear weapons and to advance global disarmament. In a demonstration of the contemporary relevance of NWFZs, the UN General Assembly voted in 2024 to task the UN Office for Disarmament Affairs with convening a group of qualified experts to examine NWFZs, the first study of its kind since 1975. The implications of the development of NNP by zone members are important for this group to address as it considers how to strengthen the role of the zones in future matters of international peace and security.

This volume explores issues raised by the introduction of nuclear-powered submarines, even though they are not armed with nuclear weapons, into regions that have explicitly chosen to restrict nuclear weapons and their associated risks. The chapter authors consider various normative, legal, technological, and institutional angles to these issues; highlight challenges; and suggest approaches for preserving and enhancing the value of the zones in a time of rapid change. The compilation offers perspectives from a range of regions and areas of expertise and provides insights relevant to the governance of other prospective advanced nuclear technologies, demonstrating how NWFZs can remain dynamic, credible, and internationally relevant. We hope it provides holistic and incisive food for thought in evaluating the role and adaptability of NWFZs to novel and evolving uses of nuclear technology.

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Credential or Conundrum? Naval Nuclear Propulsion and Nuclear-Weapon-Free Zones

Toby Dalton and Jamie Kwong

Challenges from Within

Australia and Brazil are navigating uncharted waters. As the first non–nuclear weapon states (NNWS) set to operate SSNs,[1] they are forging a path through a long-standing gray area of the nuclear nonproliferation regime: the matter of "non-proscribed" nuclear applications that could potentially blur the boundaries between legitimate military uses of nuclear technology and illicit weapons purposes.

Proliferation concerns are chief among the issues raised by NNWS' pursuit of this military use of nuclear technology. Specifically, a state could attempt to use an SSN program, through which it would be permitted to legally remove nuclear material from international monitoring, as cover for nuclear weapons activities. These concerns are likely to increase as SSNs and the perceived military advantages they offer continue to grow in relevance in contemporary geopolitics and as other NNWS seek this capability. This first non-proscribed military use of nuclear technology could also bear on governance of other future non-proscribed or non-traditional uses, only increasing the stakes involved.

Consequently, international attention has focused primarily on how Australia and Brazil will establish special safeguards procedures with the International Atomic Energy Agency (IAEA) to provide assurance that the nuclear material used to fuel the submarines' power reactors will not be diverted for weapons purposes. Although there is little apparent proliferation risk posed by either country—historically, both explored nuclear weapons options but later renounced these pursuits and have since been in good standing with international nonproliferation obligations—this is the first time the IAEA has been asked to negotiate such special arrangements. Given the consequential and potentially precedential nature of these negotiations, many concerned countries are actively observing the process. In a companion volume, Australian, Brazilian, and other international experts consider this issue, as well as other actions and measures the two countries are or could be taking to establish their credentials as responsible stewards of naval nuclear propulsion.

Aside from the narrow focus on IAEA safeguards, however, there has been comparatively little attention paid to how these programs may challenge the adaptability of the nonproliferation regime to evolving uses of nuclear technology. Until now, SSNs have been utilized solely by nuclear-armed states and, as a result, have not been subject to international nuclear governance. The Australian and Brazilian programs therefore raise new questions on what this technology signifies about normative gaps in the nuclear order and whether and what instruments can be brought to bear to provide effective governance.

> **Military activities by a state from within a NWFZ that rely on nuclear technology could create a conundrum both for the zone's other members and for the relevance of the zone itself.**

In this regard, both Australia and Brazil are members of NWFZ treaties, the Treaties of Rarotonga and Tlatelolco respectively. Officials from both countries regularly tout their membership in these zones as part of their nonproliferation "credentials"—that is, as an additional form of international reassurance that their SSN programs will not pose proliferation risks. Yet, although the zones affirm their members' renouncement of nuclear weapons, they also were established with an aim to circumscribe the military activities of nuclear-armed states from outside these regions. Thus, military activities by a state from within a NWFZ that rely on nuclear technology could create a conundrum both for the zone's other members and for the relevance of the zone itself.

SSNs and the Zones

Whether or not NWFZs can remain relevant in light of changing geopolitics and technology, in this case the adoption of SSNs by zone member states, turns on several normative, legal, procedural, and technical questions. Namely, what do NWFZ treaties say about naval nuclear propulsion? If there were any concern about a breach of NWFZ treaty obligations, how would that dispute be handled? Would that differ in principle versus in practice, not only because such disputes are unprecedented but also because NWFZ treaty regimes face significant capacity and resource constraints? And who would handle that dispute? Do treaty mechanisms allow for voluntary measures to demonstrate compliance?

No member state of either Rarotonga or Tlatelolco has formally raised an issue about the Australian or Brazilian SSN programs through the treaties' dispute mechanisms to date. Given the SSN programs serve military purposes, however, both Australia and Brazil could plausibly at some point in the future be challenged by other states to demonstrate that they remain in compliance with their NWFZ commitments, including not carrying nuclear weapons on their SSNs.

> **While NWFZ issues tend to be consigned to peripheral roles in nuclear debates among major powers, for their member states, free zones form a central part of their regional identities and self-determined decisions to insulate themselves from extra-regional nuclear weapons dynamics.**

But how should they approach demonstrating compliance, both in the narrow sense of adhering to the letter of these treaties and in the broader sense of upholding the normative foundations at the heart of the treaties? After all, while NWFZ issues tend to be consigned to peripheral roles in nuclear debates among major powers, for their member states, free zones form a central part of their regional identities and self-determined decisions to insulate themselves from extra-regional nuclear weapons dynamics.

If a compliance dispute escalated, how would a responsible entity carry out an inspection to verify there had been no breach of the treaty? If that inspection required verifying SSNs were not carrying nuclear weapons, how might the parties reconcile any perceived gaps between this no-weapons assurance and the IAEA's verification mandate to ensure the non-diversion of fissile material from peaceful activities to nuclear weapons under relevant safeguards agreements?

Even if there is no concern about a material breach of the letter of a NWFZ treaty, how can member states reconcile the military use of nuclear technology with the spirit of that treaty? In this regard, how can member states ensure that NWFZs evolve to be more relevant in a changing nuclear landscape?

The Compilation

The following chapters help shed light on these questions. Given Australia's and Brazil's pursuit of SSNs, the chapters focus primarily on the Treaty of Rarotonga, which established the South Pacific Nuclear-Free Zone (SPNFZ), and the Treaty of Tlatelolco, which established the NWFZ for Latin America and the Caribbean. But they also consider other free zones, especially the Southeast Asia zone (SEANWFZ), given its proximity to the South Pacific zone and the potential for Australian SSNs to operate within that zone. As the chapters demonstrate, it is important to recognize the variation in the historical, institutional, and geopolitical context of each zone, which informs how the zones might address different technical challenges and evolving circumstances, including around SSNs.

Ryan A. Musto begins by explaining that it is not a question of whether SSNs are legally permissible in NWFZs, but rather whether operation of SSNs by member states will drive fragmentation within the free zone regimes. He examines a critical issue at the heart of this intersection of SSNs and free zones: how to align the letter and spirit of NWFZ treaties when it comes to activities that potentially blur the boundaries of acceptable uses of nuclear technology.

For free zones to remain salient in their regional security contexts, Alain Ponce Blancas argues they must adapt to evolving technical and political challenges. He examines how the Tlatelolco treaty, with its institutionalized yet flexible control system implemented by the Agency for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (OPANAL) in conjunction with the IAEA, could serve as a potential exemplar for addressing regional challenges raised by SSNs.

Monique Cormier then explains how, though never invoked, free zone treaty texts prescribe dispute and special inspection mechanisms. She concludes not only that these mechanisms could address proliferation concerns that fall outside of the IAEA's traditional verification mandate, but that Australia and Brazil could draw on them as a voluntary confidence-building measure for reaffirming their nonproliferation credentials.

Sébastien Philippe addresses pragmatic technical questions about how a special inspection could be carried out to verify the absence of nuclear weapons on board an SSN without compromising sensitive military information. He argues that with a cooperative operator, such an inspection is technically feasible and could serve as a valuable assurance mechanism that could help strengthen the credibility of NWFZ regimes.

Karla Mae G. Pabeliña concludes by addressing the broader credential versus conundrum debate created by SSNs, arguing that while free zones are a collective protest against perceived external nuclear dangers, they will face new challenges as their own members increasingly turn to nuclear technology for non-weapons purposes. How can member states ensure that SSNs and other new nuclear developments do not undermine the objectives of nuclear free zones?

02

How SSNs Challenge the Letter and the Spirit of NWFZ Treaties

Ryan A. Musto

Naval nuclear propulsion has proven a thorny issue in NWFZ treaties. Historically, debates about nuclear-powered submarines largely rested on concerns that nuclear-armed states outside the zones could use these vessels to transit nuclear weapons through the zones. After all, at the time the treaties were negotiated, nuclear-armed states were the only operators of nuclear-powered submarines. Now, Brazil's and Australia's respective SSN programs raise new questions about what it means for a zone's member states to undertake naval nuclear activities. Are SSNs viewed by zone members as consistent with both the letter and the spirit of NWFZ treaties? If not, how might perceived inconsistencies be reconciled?

Latin America Leads the Way

By the letter of the law, naval nuclear propulsion is allowed under all NWFZs.[2]

The 1967 Treaty of Tlatelolco for Latin America's NWFZ, the first in an inhabited region, set an enduring precedent for grappling with the challenges posed by naval nuclear propulsion in how it defines a nuclear weapon. The framers of Tlatelolco followed the definition from a 1954 agreement that prohibited West Germany from developing devices that release nuclear energy in an "uncontrolled" manner.[3] This definition implicitly permits activities in which nuclear energy is released in a controlled manner, such as naval propulsion. Further, amid parallel intense debates about the issue of peaceful nuclear explosions, states agreed in Tlatelolco to specifically ban devices "with a group of characteristics that are appropriate for use for warlike purposes." Mindful that naval nuclear propulsion could be interpreted as a "warlike purpose," the drafters affixed a clause that permitted propulsion and launching devices if naturally separate from the explosive device—thus allowing for SSNs.

Because some SSNs (as well as other types of nuclear-powered submarines) can be equipped to carry and launch nuclear weapons, however, the right to transit such explosive devices was important in the debate over whether to permit these vessels in the zone. While nuclear

powers like Great Britain and the United States pushed strongly for that right, Latin American states were divided over the issue. Eager for a treaty, they ultimately agreed to permit nuclear transit and address the issue more fully in other international forums.

The opinions of the nuclear weapons states (NWS) mattered in these debates: Without formal commitments by the NWS to respect the zone through legally binding protocols, the pact would not be as effective. That dynamic rang especially true with regard to nuclear-powered submarines and nuclear weapon transit, since, at the time of the treaty's negotiation, this capability was exclusive to NWS. But not all liked the outcome. In 1978, the Soviet Union ratified Tlatelolco with the interpretation that nuclear transit was "incompatible" with and "contrary to the purposes of the Treaty." Moscow surely disliked the perceived benefit nuclear transit could provide to Western nuclear forces. This statement thus left the Soviet Union a loophole to reconsider its obligations under Tlatelolco. A decade later, Moscow similarly clarified its intent to abide by a NWFZ when faced with a similar outcome on the transit question in the South Pacific.

From Pattern to Problem

The issue of SSNs and NWFZs proved more fraught in the South Pacific. In the early 1970s, New Zealand placed restrictions on port visits by nuclear-powered vessels, citing the public's "nuclear allergy" to widespread French nuclear testing in the region. The public feared SSNs could cause a nuclear accident and lead to the dumping of radioactive waste in New Zealand's waters. Citizens also feared the armaments on board SSNs; the refusal by London and Washington to confirm or deny the presence of nuclear weapons onboard their vessels only exacerbated these concerns. When a new government in New Zealand eased its policy later that decade, citizen "peace squadrons" tried to block port entry by SSNs with hundreds of protest boats, to no avail. Elsewhere, Pacific island nations like Fiji, Papua New Guinea, and Vanuatu enacted total bans on SSN port entry. These national approaches coalesced around a broader regional push to make the South Pacific nuclear-free.

> **Without formal commitments by the NWS to respect the zone through legally binding protocols, the pact would not be as effective.**

The issue came to a head in the mid-1980s. Though backed by strong anti-nuclear sentiments from the public, ruling Labour Party governments across the region chose a path of moderation. Australia's then prime minister Bob Hawke did not want to jeopardize U.S. protection under the ANZUS collective security pact, while New Zealand's then prime minister David Lange understood that no NWFZ treaty could realistically exist without American and British buy-in. They agreed to a prohibition in the 1985 Treaty of Rarotonga specifically on nuclear explosive devices and referenced Tlatelolco's model in allowing for SSN port entry and nuclear transit. Like Tlatelolco, this South Pacific NWFZ would allow individual member states to determine their own policies for SSNs in their waters and ports.

Rarotonga's arrangement informed Africa's NWFZ under the 1996 Treaty of Pelindaba. Initially, Ethiopia pushed to restrict nuclear transit to the shortest possible distance and duration within the zone. Other states pushed back against visits by nuclear-armed ships, arguing that South Pacific states had to permit such behavior given alliance commitments that did not exist for Africa. However, faced with U.S. pushback, African states followed the Rarotonga model to ban nuclear explosive devices and accept port entry and nuclear transit at the discretion of individual member states. They did so with the compromise that nuclear transit must occur "without prejudice to the purposes and objectives of the treaty." How this point should be addressed in practice, though, was not fleshed out.

A greater challenge currently exists for Southeast Asia. The 1995 Treaty of Bangkok for Southeast Asia's NWFZ allows for SSNs, but its jurisdictional extension over the waters above the continental shelf and exclusive economic zones (EEZs) of member states, some 200 miles out to sea, raises questions about the right of innocent passage. The Bangkok treaty explicitly endorses this right, which allows foreign vessels to navigate through a state's territorial waters without prior authorization so long as their activities are deemed peaceful and outside the scope of other prohibitions, such as spying and fishing. And yet, NWS remain wary of long-standing differences over its meaning and application. Their concern is not unique to Southeast Asia's NWFZ; for example, the United States has expressed unease that Rarotonga extends to cover large portions of EEZs and the high seas and contains a similar endorsement of the right to innocent passage. But the Bangkok treaty appears more troublesome because it covers more maritime territory across a critical expanse of the Indo-Pacific. As the top U.S. diplomat to the Bangkok negotiations articulated, the issue is whether nuclear states could move their nuclear submarines through this region as there "would be no one within a 150-mile radius to determine whether a certain passage is innocent." In part for this reason, no NWS has yet signed on to the Bangkok treaty.

As these interpretive debates reveal and as seen across oceans today, however, the strict letter of the law is not all that matters when deciding whether SSNs are permitted under NWFZs.

Do NWFZs Have a Different Spirit?

During the 1982 Falklands/Malvinas War and in its aftermath, Argentina accused Great Britain of violating the Treaty of Tlatelolco. Buenos Aires charged that not only did London bring nuclear weapons into the theater of conflict with the intent to use them, but it deployed SSNs to the NWFZ for warlike purposes. The results proved devastating. One month into the conflict, a British SSN used conventionally armed torpedoes to sink an Argentine cruiser, killing over 300 sailors. It remains the only publicly known attack by an SSN on another ship to date.

Did Great Britain's actions violate Tlatelolco? The issue split the members of Tlatelolco's oversight body, OPANAL. OPANAL's secretary general declared that British actions did not breach the treaty, in part because SSNs themselves do not constitute nuclear weapons. Some

regional states concurred. But others decried British actions in the South Atlantic as a clear violation of the "spirit of Tlatelolco." Héctor Gros Espiell, an influential adviser and former head of OPANAL, found London's use of SSNs to transgress "the general obligation" under Tlatelolco to use nuclear energy for peaceful purposes. In 1983, OPANAL passed a resolution that expressed "concern" over British actions. While the resolution had no practical consequences, Chile, which had secretly supported Great Britain during the war, labeled the symbolic gesture "a success" for Argentina. It seemed to many that Tlatelolco's intent had been broken.

> **Zone treaties are assertions of sovereignty intended to free regions from the perceived terror of a destructive force wielded by a few.**

This episode is a useful reminder that NWFZs possess an underlying ethos. Tailored to regional histories and realities, NWFZs help member states secure the non-nuclear-weapons future they wish to see and that they deem most appropriate for their part of the world. Zone treaties are assertions of sovereignty intended to free regions from the perceived terror of a destructive force wielded by a few. In Latin America, for example, negotiators of Tlatelolco professed to operate with the "same emancipatory zeal" as the revolutionaries that fought for freedom in the region's nineteenth-century wars of liberation.

Indigenous SSNs and the Spirits of the Zones

The need to account for the spirit—or what legal scholars might call the "object and purpose"—of Tlatelolco looms over Brazil, which plans to develop and deploy an SSN program over the next decade. Brazil seeks to defend its extensive coastline and natural resources in offshore waters, an expanse that Brazilian officials have labeled the "Blue Amazon," to align with the traditional defense of Brazil's vast interior. Many advocates of the program have taken inspiration from the 1982 Falklands/Malvinas War, based on the notion that one British SSN determined the entire conflict. "The Malvinas War forever marked Brazil," notes one Brazilian nuclear engineer in reference to his country's quest for an SSN.

Unlike those of NWS, however, Brazil's SSNs will not simply pass through Latin America but rather will be permanently based within it, anchoring nuclear propulsion to the area in a way heretofore unseen. Brazil's focus on deterrence and defense—factors arguably mirrored in Great Britain's 1982 actions to thwart Argentina's territorial gambit for the Falklands/Malvinas Islands—sparks anew questions about the role of nuclear energy in the defense of the region. For the first time, Brazil's SSN program will open the possibility that nuclear energy is employed by a regional member of Tlatelolco for warlike purposes. In this regard, Brazil's indigenous SSN, though legally permissible, could pull at the seams of Tlatelolco's intent.

The need to account for the spirit of NWFZ treaties with respect to SSNs also resonates today in the South Pacific NWFZ, as Australia seeks to acquire a fleet of SSNs as part of the Western security partnership dubbed AUKUS. The security pact is designed to deter and defend against China's military buildup in the Indo-Pacific. Beijing staunchly opposes it on this basis and has employed numerous strategies to try to stoke further opposition, including trying to sow doubts about its compatibility with regional NWFZs. Chinese Foreign Minister Wang Yi declared that AUKUS would make Rarotonga a "dead letter," while a Chinese foreign ministry spokesman questioned whether Australia was "serious" about its commitments under the treaty.

Unlike Tlatelolco, Rarotonga does not require that all nuclear materials be used for peaceful purposes. And yet, Rarotonga emerged from a stronger antinuclear tradition. As host of the annual Pacific Islands Forum that oversees Rarotonga, the prime minister of the Cook Islands argued in 2023 that the region "should rediscover and revisit our Rarotonga treaty to ensure that it reflects the concerns of Pacific countries today, and not just what occurred back in 1985." These concerns include the storage of nuclear waste, release of radioactive materials, complicated legacies surrounding nuclear testing, and more general threats that could be exacerbated or posed by the presence of SSNs. The Pacific Elders' Voice, a prominent group of former regional leaders, expressed concern that AUKUS "is escalating geopolitical tensions in our region and undermining Pacific-led nuclear-free regionalism." Not all in the Pacific, however, have expressed this sentiment. Australia's Prime Minister Anthony Albanese insists the Treaty of Rarotonga remains a "good document" and that AUKUS is "consistent with" it. Similarly, the prime minister of Fiji has stated that he is "sure . . . the building of the submarine does not break" the Rarotonga treaty or the Nuclear Non-proliferation Treaty (NPT).

As part of its political opposition campaign, China has also pitted AUKUS against the spirit of the Bangkok Treaty in southeast Asia, a region adjacent to Australia's maritime border where future Australian SSNs will presumably patrol. In talks with counterparts from Malaysia and Brunei in September 2021 (the same month AUKUS was announced), Wang rebuked AUKUS as anathema to the Bangkok Treaty. Likewise, leaders from Indonesia and Malaysia have expressed concern that AUKUS might spark a regional arms race and set a "dangerous precedent" for nonproliferation norms in their region.

How to Reconcile Letter and Spirit?

How might governing bodies and treaty members reconcile disparities between the letter and spirit of their NWFZs when faced with the acquisition of SSNs by zone members? There is no easy answer, not least because the contours of and motivations behind each NWFZ vary. As such, gaps between the letter and spirit of NWFZ treaties will need to be defined and measured in different ways within and across regions. States may need to revisit their

understandings of what constitutes peaceful use of nuclear energy and what the best approaches are for guarding against risks that range across environmental degradation, nuclear transit, and the improper diversion of nuclear materials. At stake are not just questions of legality but also questions about how SSNs could challenge the normative foundations of NWFZs and cause fragmentation in these nonproliferation regimes. Increasingly, states will need to approach the intersection of SSNs and NWFZs in novel ways.

At stake are not just questions of legality but also questions about how SSNs could challenge the normative foundations of NWFZs and cause fragmentation in these nonproliferation regimes.

Bilateral approaches will be important. In Latin America, Brazil will need to reassure its traditional rival Argentina that its SSN program aligns with Tlatelolco's peaceful letter and intent, possibly by working through their bilateral inspections agency that operates in partnership with OPANAL and the IAEA. In the South Pacific, AUKUS members will need to provide ongoing reassurances and updates to regional leaders on the issues that first inspired Rarotonga, such as the disposal of radioactive waste and unchecked militarization.

Regional approaches will also matter. The oversight bodies of NWFZs will find themselves in unfamiliar territory. At the time of the Falklands/Malvinas War, Argentina had not yet ratified Tlatelolco and therefore could not call a special session of OPANAL to deal with British actions in real time. Nor has any NWFZ dealt with SSN capabilities from within. Regional leaders, including future SSN operators, must test the entities that regulate NWFZs early on to make sure they are fit for purpose. Measures taken might include special dialogue sessions, the formation of new committees, and commitments to greater technical transparency.

Yet there is something more fundamental that can happen first: formal recognition by the international community—and foremost the future operators of SSNs—that the spirits of NWFZs exist and matter. This approach can help ensure that the acquisition of SSNs properly aligns with the purpose of these regional nonproliferation pacts and does not further inflame geopolitical tensions. A unique window for collective action may be open. In December 2024, the UN called for the second-ever comprehensive study of NWFZs and the first in fifty years. The original report made no mention of the spirits behind NWFZs, but the new one will offer a chance to spotlight their existence. Even that small gesture may prove important as SSNs bring NWFZs into uncharted waters.

03

Adapting Free Zones for Evolving Nuclear Applications: A Model from Latin America and the Caribbean

Alain Ponce Blancas

The Treaty of Tlatelolco, which established the first NWFZ in a densely populated region, offers a particularly pertinent case study in how regional approaches and international regimes can adapt to remain relevant amid evolving global security challenges. The enduring significance of the treaty is due to the combination of an engrained legal framework endowed with an adaptable institutional structure; the vital role of OPANAL; and a conscious consideration of the spirit of the treaty, as the regional issues that spurred the creation of the Latin American zone have evolved.

> **The Latin American and Caribbean NWFZ is not insulated from the contemporary struggles NWFZs face in today's security environment, even though it has the most institutionalized architecture among the existing zones.**

The Latin American and Caribbean NWFZ is not insulated from the contemporary struggles NWFZs face in today's security environment, even though it has the most institutionalized architecture among the existing zones. As debates intensify over naval nuclear propulsion and its implications for nonproliferation regimes, the combination of legal clarity and institutional flexibility provided by OPANAL could serve the region well—especially if Brazil is at some point in the future challenged to demonstrate that its naval nuclear program complies with its commitments under the treaty. While practical questions remain and emergent challenges might stress the treaty's existing procedures, Tlatelolco offers an example that other states might look to of how regional leadership, institutional integration, and multinational backing can coalesce to address evolving technical and political challenges.

Main Provisions and Institutional Architecture

Opened for signature on February 14, 1967, the Tlatelolco treaty has served as a model and inspiration for similar initiatives, demonstrating the value of regional approaches to disarmament and nonproliferation. Notably, the Treaty of Tlatelolco predates the NPT and helped shape some of its foundational elements, underscoring Latin America's early leadership in advancing global nuclear norms.

Article 1 of the Treaty of Tlatelolco outlines two central obligations:

1. A commitment to use nuclear materials and facilities exclusively for peaceful purposes

2. A comprehensive prohibition of nuclear weapons, whether produced, acquired, possessed, or used by or on behalf of anyone, by any means whatsoever

To verify compliance with these obligations, the treaty established a control system under Article 12, jointly implemented by the member states, OPANAL, and the IAEA.

OPANAL, as the regional monitoring body created by the treaty, plays a central role in coordinating and overseeing this control system. Pursuant to Article 14, OPANAL receives and organizes the semi-annual compliance reports submitted by member states, in which they affirm that no prohibited activities have taken place within their territories. Through its three principal organs—the General Conference, the Council, and the Secretariat—OPANAL also serves as a political forum for member states. It facilitates both regular and extraordinary consultations on the implementation, interpretation, and advancement of the treaty's provisions, thereby providing a platform for dialogue, consensus-building, and reaffirmation of treaty obligations, including in relation to emerging challenges. In this sense, OPANAL sustains the treaty as a "living" institution, one that evolves in step with a changing environment.

The IAEA, meanwhile, plays a technical role. It verifies compliance through safeguards agreements concluded under Article 13 of the Tlatelolco treaty, which establishes the obligation for member states to conclude bilateral or multilateral agreements with the IAEA to apply safeguards to their nuclear activities.[4] These agreements form the basis for ensuring the peaceful use of nuclear materials across the thirty-three Latin American and the Caribbean member states, enhancing transparency and reinforcing the region's commitment to nonproliferation.

Although not explicitly referenced in the original text of the treaty, the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) also plays an essential role within the regional control architecture and maintains formal cooperation agreements with both OPANAL and the IAEA. ABACC was formed in 1991 following the Guadalajara Agreement between Argentina and Brazil, in which they committed to deepen bilateral

nuclear cooperation and establish a common system of accounting and control of nuclear materials. Under the Quadripartite Safeguards Agreement between ABACC, the IAEA, Brazil, and Argentina, ABACC implements a coordinated system of safeguards that reinforces the transparency, credibility, and technical rigor of nuclear oversight in the region. This four-party arrangement not only complements the IAEA's global mandate but also introduces a regional verification mechanism that enhances mutual confidence between Brazil and Argentina. As such, ABACC is an integral element of the broader verification architecture envisioned by the Treaty of Tlatelolco.

The institutional interplay between OPANAL, the IAEA, and ABACC has yielded a verification regime that is both technically credible and politically effective. It demonstrates how regional and global mechanisms can reinforce each other in pursuit of shared nonproliferation objectives.

Special Inspections: Ensuring Accountability

Nuclear propulsion is neither a novel technology nor an unfamiliar concept in the Latin American and Caribbean context. However, its practical application has historically remained confined to NWS. Against this backdrop, Brazil's naval nuclear propulsion program constitutes a significant development among NNWS in the advancement of nuclear technology. This evolution, while technologically notable, inevitably prompts critical questions regarding how such activities are situated in the normative framework of the region's NWFZ.

Nuclear propulsion is neither a novel technology nor an unfamiliar concept in the Latin American and Caribbean context. However, its practical application has historically remained confined to NWS.

Both the Guadalajara Agreement and the Quadripartite Safeguards Agreement contain provisions recognizing the right of member states to utilize nuclear energy for "the propulsion or operation of any vehicle, including submarines and prototypes, or in such other non-proscribed nuclear activity." These agreements also establish special procedures for such activities, spearheaded by ABACC and the IAEA, to ensure that even sensitive uses of nuclear technology remain subject to appropriate control and verification. This reflects a pragmatic approach to balancing sovereign technological ambitions with the overarching commitment to nonproliferation in Latin America and the Caribbean.

Nevertheless, it is conceivable that some member states may have questions about Brazil's nuclear-powered submarine program that are not otherwise addressed by the envisioned special procedures. If that occurs, one of the key mechanisms available to member states and OPANAL is so-called special inspections. Special inspections under the treaty are governed by a structured, multilateral process designed to uphold transparency and reinforce

compliance. In accordance with Article 15, any member state may request supplementary information from another member if "any event or circumstance" raises concerns about compliance with the treaty. With authorization from the Council, the secretary general may then be mandated to request a special report. If the report raises further concerns, Article 16 provides a pathway for further investigation and resolution: The Council, following the procedures set forth in Article 15, may request the IAEA to initiate a special inspection under the IAEA's safeguards authority.

Upon receiving a request for a special inspection, the IAEA would be responsible for carrying out the necessary verification activities in accordance with its mandate. Such inspections require prior authorization by the IAEA Board of Governors, which is the only oversight body empowered to approve and mandate these procedures. Once the board grants authorization and the Secretariat completes the inspection, the IAEA director general would transmit the relevant information to the secretary general of OPANAL, who would in turn inform the Council and share the findings with all member states. This process ensures transparency and collective access to the results of any inspection.

These provisions have never been utilized and no special inspections have been conducted to date. Several technical legal questions remain unanswered, but the existence of this mechanism remains a critical element of the Treaty of Tlatelolco. It provides a credible means of responsive verification; reinforces collective accountability; and serves to prevent or, if needed, to address any potential noncompliance or violation through a structured process.

Measures in the Event of a Suspected Violation of the Treaty

In addition to establishing procedures for resolving questions about the nature of an activity, the Tlatelolco treaty also has provisions that could be utilized in the event of allegations of noncompliance (which might result from a special inspection). In that situation, the Council or any member state may request the General Conference convene a special session. During such sessions, the General Conference may examine the facts available; consider all relevant information, including reports from the IAEA or the Secretariat; and adopt recommendations or decisions accordingly, which would be taken according to a two-thirds majority. These may include demarches, requests for clarification, or further engagement with relevant international bodies. Moreover, the General Conference may delegate specific mandates to the Council to follow up on its decisions, ensuring continuity and oversight in the implementation of any measures taken.

If, following this process, a member state is found in noncompliance, the authority to address it resides with the General Conference, per Article 21 of the treaty. The conference is mandated to formally notify the concerned member and may issue appropriate recommendations for corrective action. Should the General Conference determine that the noncompliance constitutes a violation that could threaten regional or international peace and security, the conference must report its finding through the UN secretary general to both the UN

Security Council and the UN General Assembly; to the Organization of American States; and to the IAEA in cases where the violation is relevant to the agency's statute. This procedure exemplifies how the treaty was intentionally designed to operate within a multilateral framework and remain anchored in the international peace and security architecture of the UN system.

While the Treaty of Tlatelolco does not establish predefined enforcement mechanisms, it does provide the General Conference with a framework to respond to non-compliance that is structured yet situationally flexible. This flexibility is intentional, allowing OPANAL to tailor its response to the specific circumstances of each case. In practice, this means that the General Conference retains the authority to assess whether the situation constitutes a case of noncompliance or a broader issue of concern regarding treaty violation and adopt measures on a case-by-case basis accordingly. So even though it lacks a rigid enforcement toolkit, this combination of legal flexibility, institutional procedures, and political mechanisms allows OPANAL to respond, at least in principle, effectively and credibly to noncompliance within the bounds of consensus and international law.

Evolving NWFZs with Changing Nuclear Uses

The Treaty of Tlatelolco is a landmark achievement in the global nuclear disarmament and nonproliferation architecture. OPANAL is not only the oldest regional nonproliferation mechanism of its kind but also the only one to maintain ongoing institutional relationships with other key international organizations such as the IAEA and the UN. Together with ABACC, OPANAL and its control system contribute to a robust and multilayered verification regime grounded in regional ownership and cooperation.

However, while the Treaty of Tlatelolco and OPANAL compose one of the more institutionalized regional frameworks for nuclear disarmament and nonproliferation structures, their relevance and operational success should not be taken for granted, not only in the realm of multilateral diplomacy but also in light of the evolution in how nuclear technologies may be employed in the region, including in nuclear-powered submarines.

To sustain and enhance the legacy of Tlatelolco as well as other NWFZs, member states must ensure that the legal and institutional structures underpinning the treaties remain dynamic. This will require regular, region-driven assessments of evolving challenges, administrative gaps, and novel threats and expectations. When these assessments are paired with tailored technical assistance, they can significantly reduce burdens and improve transparency by strengthening reporting practices, enabling institutional modernization, and facilitating deeper integration with international verification systems. The ability of any control system or verification mechanism to remain credible will depend on sustained political will and the commitment to modernize governance structures, streamline procedures, and clarify obligations.

Central to this effort will be ensuring that implementation bodies—whether permanent secretariats or rotating coordination mechanisms—have the authority, resources, and technical capacity to carry out their mandates. Adequate budgetary support and investment in training are essential to maintain operational readiness and enable innovative verification practices that may be required as new applications of nuclear technology present new challenges to NWFZ frameworks. A robust monitoring and support function is central to safeguarding the integrity of any multilateral treaty; it cannot be regarded as a luxury.

Beyond procedural upgrades, the continued relevance of NWFZs depends on a collective willingness to reimagine the role of implementation bodies. Rather than being passive repositories of obligations, these institutions should evolve into proactive actors capable of fostering dialogue, facilitating regional consensus, and amplifying the normative weight of the zones. They should be seen as living institutions sustaining their respective treaties, capable of adapting to changes in the international environment. Their work must be visible, strategic, and both outward- and inward-facing. In other words, member states need to center NWFZs as a relevant and important tool as they grapple with new nuclear technologies and uncertain global politics.

> **Rather than being passive repositories of obligations, [implementation bodies] should evolve into proactive actors capable of fostering dialogue, facilitating regional consensus, and amplifying the normative weight of the zones.**

Any effort to enhance implementation mechanisms must emerge from within the region itself; no external formula can substitute for the legitimacy that comes from regional ownership. As the Tlatelolco experience demonstrates, sustainability depends on the active engagement of member states and their shared understanding that NWFZs are indispensable tools for confidence-building, transparency, and long-term security.

NWFZs are living entities and remain deeply relevant in today's complex security environment. As enduring testaments to regional ownership, legal innovation, and the collective pursuit of a world free of nuclear weapons, their adaptability and institutional robustness demand continued nurturing.

04

The Applicability of NWFZ Special Inspection and Dispute Clauses

Monique Cormier

Though special inspection provisions exist in most NWFZ treaty texts, they have never been invoked, leaving their practical application uncertain. Nevertheless, these mechanisms may offer an alternative avenue for addressing proliferation concerns that fall outside the IAEA's traditional role of verifying the non-diversion of nuclear material from declared uses.

The language of the NWFZ treaties' complaints procedures indicates that special inspections may be invoked for reasons beyond diversion concerns. The Treaty of Tlatelolco, for example, allows for any member state to request a special inspection to verify that no treaty-prohibited activity is undertaken by another member. Similarly, the Treaty of Rarotonga provides for special inspections where there are grounds for a complaint that a party is in breach of any of its treaty obligations. In both cases, special inspections appear to offer broader verification tools than those available under standard IAEA safeguards.

Rarotonga's Complaints Procedure

The Treaty of Rarotonga prohibits parties from acquiring, possessing, or controlling any nuclear explosive device, and from stationing nuclear weapons in their territory, which includes installation or deployment. Under the treaty's complaints procedure, set out in Annex 4, a member state could initiate the treaty's multi-step complaints process if it "considers that there are grounds" to suspect that another member is engaging in or pursuing a prohibited activity—including, for example, if Australia was suspected of carrying nuclear weapons on board its SSNs. First, the complainant would alert the accused party of the alleged breach and give it the opportunity to respond. If the matter remains unresolved, the complainant may then bring the allegation to the secretary general of the Pacific Islands Forum. The secretary general would then be tasked with convening a consultative committee, an ad hoc body to which each Rarotonga member can appoint one representative. Upon considering

the complaint, the committee may decide by consensus, or (failing that) a two-thirds majority, to appoint a team of "three suitably qualified special inspectors" to investigate the alleged breach.

Importantly, Rarotonga's complaints procedure specifies that the special inspectors "shall not duplicate safeguards procedures to be undertaken by the IAEA," indicating that the special inspection mechanism is designed to cover activities beyond the IAEA's diversion mandate. In principle, this could include verifying the non-deployment of nuclear weapons aboard SSNs.

Once the investigation is complete, the special inspectors must provide a written report to the consultative committee with evidence and documentation to support their findings. The committee must then provide a full report to the members of the Pacific Islands Forum and make a determination as to whether there has been a breach of the treaty obligations.

This process provides basic procedural assurances against complaints that are vexatious or overtly politically motivated. In bringing a complaint to the committee, the complainant must provide "an account of evidence" to support its allegations. Before proceeding, the committee is required to give the accused state an opportunity to respond and can only appoint a special inspections team if it considers there to be "sufficient substance" to the complaint. Whether there is enough substance to a breach allegation is ultimately up to the discretion of the committee. Notably, though, Article 9 of Annex 4 provides that "at any time at the request of either the complainant or complained of Party," member states can meet at the Pacific Islands Forum. This would presumably allow either party to avoid the possibility of special inspections and leave it up to the forum members to decide on a course of action.

Tlatelolco's Special Inspection Mechanism

The Treaty of Tlatelolco contains similar prohibitions on the "receipt, storage, installation, deployment and any form of possession of any nuclear weapons." If Brazil were suspected of deploying nuclear weapons on its SSNs, any party could ask the treaty's Council to request a special inspection by the IAEA to verify Brazil's compliance with the treaty.[5] Originally, the Council was permitted to make its own arrangements for special inspections, but this power was removed in a 1992 amendment as an efficiency measure to avoid duplication of work already being done by the IAEA. Limiting the power of special inspections to the IAEA, an entirely independent technical body, may have the additional benefit of helping to safeguard against politically motivated complaints.

However, it does raise a potential legal question: Is authorizing the IAEA to investigate broader breaches of Tlatelolco a permissible extension of the IAEA's traditional verification mandate? As Dan Joyner has noted, the IAEA is "not some general FBI-like investigator of all alleged breaches of international nuclear energy law." Yet while the IAEA's functions

do not extend to verifying whether a state has received or otherwise possesses nuclear weapons, the Additional Protocol grants the IAEA expanded powers of inspection that could allow it to detect unlawful nuclear activity beyond diversion. States that have ratified an Additional Protocol agree to allow the IAEA to carry out special inspections on their territories to investigate the existence of undeclared nuclear material or activities. The Additional Protocol thus affords the IAEA much broader powers of access and inquiry, which would at least theoretically allow it to detect the existence of nuclear weapons.

Brazil, however, has not signed an Additional Protocol, claiming that the 1991 Quadripartite Safeguards Agreement between Brazil, Argentina, the IAEA, and ABACC provides a higher level of assurance through joint IAEA-ABACC inspections and mutual verification with Argentina. Yet the Quadripartite Safeguards Agreement does not allow the IAEA to undertake special inspections of undeclared nuclear material or activity. Nevertheless, if a special inspection request were raised under the Treaty of Tlatelolco alleging Brazil's noncompliance, any argument that the IAEA was acting ultra vires would likely fail, given that Tlatelolco parties have explicitly empowered the IAEA to conduct such inspections. Moreover, if the IAEA Board of Governors takes action to accept responsibility for investigation beyond its traditional mandate, the extension may be more easily justified and accepted. Nevertheless, there would still be important practical implications to resolve to enable a special inspection, including which state or states would pay for it and how to include inspectors with relevant nuclear weapons knowledge.

A Complicating Factor

One uncertainty is whether the NWFZ treaties' special inspection mechanisms could be invoked to investigate suspected diversion of nuclear material that had been removed from the IAEA nuclear safeguards system under pending arrangements. Both Australia and Brazil are negotiating agreements—under Article 14 of the Comprehensive Safeguards Agreement (for Australia) and Article 13 of the Quadripartite Safeguards Agreement (for Brazil)—that would allow for nuclear material used for naval propulsion to be removed from safeguards.

In Australia's case, if such material were suspected of being diverted for weapons purposes, the Rarotonga Treaty does not appear to prevent its consultative committee from appointing a special inspection team, even where the IAEA's mandate is constrained. However, inspections involving highly classified shared AUKUS technologies would face steep practical and political hurdles. Cooperation from the United Kingdom and United States would likely be essential.

Brazil's negotiation of a special procedures arrangement under Article 13 of the Quadripartite Safeguards Agreement would also limit IAEA oversight of nuclear material used for submarine propulsion. In theory, if the Tlatelolco treaty's Council requested a special inspection to verify that Brazil was not diverting nuclear material designated for propulsion to weapons, this would be within the scope of the treaty's special inspection

procedures. However, because the Tlatelolco treaty limits the power of special inspections to the IAEA, the agency's agreement to conduct a special inspection would be in clear conflict with its bilateral Article 13 arrangement with Brazil. How such a conflict would be resolved remains uncertain.

Inspections as a Confidence-Building Measure?

Special inspections under NWFZ treaties can therefore go beyond traditional IAEA diversion safeguards and could play a valuable role in verifying compliance with broader treaty obligations. Their potential should not be overlooked as naval nuclear propulsion by NNWS challenges the boundaries of the current verification regime.

While these special inspections were presumably envisioned to be invoked by other member states,[6] Australia or Brazil could also voluntarily invoke inspections of their own SSN programs. Such voluntary inspections could serve as a novel confidence-building measure, signaling a country's commitment to nonproliferation even as it pursues naval nuclear propulsion.

The Treaty of Tlatelolco allows any state party to make a request for a special inspection, with no suggestion that the request cannot be self-directed. This opens the door for Brazil to use the mechanism proactively. By contrast, the Rarotonga Treaty embeds special inspections in its complaints procedure as a dispute resolution option, which requires a complaint from one state against another. It is therefore unclear whether Australia could initiate a voluntary inspection of its own territory, though the Rarotonga parties may be receptive to a broader interpretation of the procedure given the South Pacific region's strong anti-nuclear sentiment. Alternatively, Australia could ensure that the IAEA continues to conduct additional verification activities on its territory in accordance with the broader remit of the Additional Protocol.

> **Voluntary inspections could serve as a novel confidence-building measure, signaling a country's commitment to nonproliferation even as it pursues naval nuclear propulsion.**

Strategically, voluntary inspections could help both states demonstrate that their nuclear submarine programs are not associated with nuclear weapons. Such transparency could reassure neighbors and partners without compromising classified, propulsion-related information. And if Australia and/or Brazil voluntarily invites special inspections, that could establish a best practice precedent for any future NNWS pursuing naval nuclear propulsion.

Voluntary special inspections could also serve to stress-test the relevant NWFZ inspection provisions by operating as a low-risk, cooperative test case to reveal both the strengths and limitations of existing mechanisms. Because the verification procedures in these treaties have never been invoked, there is significant uncertainty around how they would function in practice. A voluntarily-initiated inspection could parse out the largely unexamined procedural ambiguities, political dynamics, and institutional capacities before any contentious dispute arises.

But practical and political barriers loom large. Any voluntary inspections would require carefully negotiated inspection parameters that provide meaningful transparency without compromising legitimate military secrets. For Brazil, which has invested decades in developing indigenous nuclear technology with strategic autonomy as a core principle, any verification regime would need to respect sovereignty concerns that have historically complicated its relationship with international inspectors. Australia faces different but equally complex dynamics: balancing AUKUS partner expectations about technology protection while addressing regional proliferation anxieties.

An initial voluntary agreement to allow special inspections might also create expectations for ongoing inspections under the NWFZ treaties that could become difficult to satisfy as programs mature. Both states would need to manage these expectations carefully, balancing transparency with strategic and security interests.

Despite these challenges, voluntary special inspections offer an innovative legal and diplomatic tool to address proliferation concerns that have arisen with NNWS' pursuit of naval nuclear propulsion. By proactively addressing compliance concerns rather than waiting for complaints from other states, Australia and Brazil could strengthen regional nonproliferation frameworks while advancing their strategic interests in nuclear submarine development.

05

Verifying the Absence of Nuclear Weapons Aboard Attack Submarines

Sébastien Philippe

For the first time, two NNWS—Brazil and Australia—are preparing to operate SSNs. Public and diplomatic focus thus far has questioned how Brazil and Australia will work with the IAEA to ensure the non-diversion of enriched uranium fuel from their naval propulsion reactors. Far less attention has been given to how these programs could demonstrate continued compliance with their NWFZ treaty obligations, particularly in credibly demonstrating that these vessels do not carry nuclear weapons.

Regional NWFZ treaties prohibit the receipt, storage, installation, deployment, or stationing of nuclear weapons anywhere within national territory, including territorial seas and airspace. While neither Brazil nor Australia intends to deploy such weapons, SSNs in nuclear-armed states have historically carried nuclear torpedoes, mines, and sea-launched cruise missiles (SLCMs). This precedent, combined with renewed deployment of nuclear weapons on SSNs in nuclear weapons states, could heighten regional concerns and prompt calls for assurances that Australian and Brazilian submarines remain non-nuclear-armed.

One likely case is Australia's planned acquisition of U.S. Virginia-class SSNs under AUKUS. If the United States deploys the SLCM-N on its own Virginia-class submarines, Australia may face pressure to prove that the boats it receives are not similarly armed. Because visual inspection cannot confirm payload type, technical verification using radiation measurements would be necessary.[7] This chapter explains how such inspections could be feasible and could provide valuable opportunities to reinforce treaty compliance and regional confidence.

Designing SSN Inspections

The prospect of conducting a special inspection of an SSN suspected of carrying nuclear weapons may appear technically and administratively challenging. However, these difficulties could be overcome by establishing a cooperative verification approach specifically designed to confirm the *absence* of nuclear weapons. Put simply, no nuclear weapons, which emit radiation signatures, should be aboard vessels operated by NNWS. Thus, there should be no technical obstacle to conducting radiation-based measurements on conventional weapon systems that do not emit such signatures.

All nuclear weapons contain fissile materials, typically weapons-grade plutonium or highly enriched uranium, which emit both neutrons and gamma rays continuously. These emissions are distinctive, persistent, and detectable—akin to a radiation fingerprint. They can be compared to a baseline measurement using the right instrumentation. For example, high-purity germanium gamma spectrometers can resolve characteristic energy lines associated with plutonium-239, uranium-235, and their decay products, as well as secondary emissions from conventional explosives surrounding the fissile core. The positive detection of these signatures would indicate the presence of nuclear weapons.

Such a positive detection aboard a submarine has happened at least once before. In November 1981, the Soviet submarine U137 ran aground in the Gåsefjärden archipelago of Sweden. Unable to access the vessel's interior, Swedish authorities conducted passive gamma spectroscopy from an adjacent boat. The measurements revealed the presence of uranium-238 and a strong proxy signature consistent with neutron emissions from weapons-grade plutonium. Although no plutonium-specific gamma lines were observed, the measurements were sufficient for the Swedish Defence Research Agency to conclude that a nuclear warhead was likely stored in a forward torpedo tube. The Soviet Union did not deny this possibility.

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The U137 case remains the only publicly known instance of a de facto nuclear weapons inspection conducted entirely from outside a submarine's hull. It demonstrated that meaningful radiation measurements can be achieved without access to a vessel's interior—the challenge likely to arise in most SSN verification cases, given concerns about protecting sensitive military information.

Managed Access, Cooperation, and Treaty Opportunities

Absence inspections could be triggered when evidence suggests that a NNWS SSN operator may not be in compliance with its NWFZ obligations. Properly designed, these inspections could be implemented without compromising operational security; revealing sensitive military information, including about the SSN reactor; or endangering sensitive nuclear weapon information, unless a violation has occurred.

Verification methods could be adapted to different levels of negotiated access and could draw on IAEA safeguards experience and the special inspection provisions of Brazil's and Australia's—or some future operator's—respective NWFZ treaties. External neutron and gamma measurements could be conducted in port or drydock, ideally above open vertical launch hatches or along the hull near torpedo rooms.[8] Where higher confidence is required, managed access to internal weapon compartments may be arranged. The SSN operator could curtain off sensitive equipment and inspectors could use detectors approved by the operators. Such procedures could be rehearsed on mock-ups to demonstrate they would not compromise sensitive information about the submarine. Measurements compared against expected background levels could quickly demonstrate that no threshold quantity of plutonium or uranium is present within the front section of a cruise missile or torpedo. In many cases, this could be accomplished within minutes.

The SSN operator should conduct measurement campaigns in advance of an inspection to characterize background radiation. Care should be taken to ensure that radiation emitted from the reactor compartment neither reveals sensitive design information nor would be so high as to mask the expected signatures of nuclear warheads. In port, radiation from the reactor is dominated by gamma emissions from fission products in the fuel and activation products in structural materials. However, because the reactor is heavily shielded to protect both the crew during operation and shipyard workers during maintenance, emissions outside the hull should remain below natural background levels.

Reactors on SSNs are also physically separated from weapons stowage areas and their radiation spectra, whether fueled with low- or highly-enriched uranium, differ from those of warheads. As a result, reactor emissions would be unlikely to interfere with absence measurements. If there is concern that detectable background emissions might reveal sensitive information about the reactor, the inspected items could simply be removed from the submarine for measurement, as is practiced in New START treaty inspections that use neutron detectors to confirm that some objects are non-nuclear.

Alternatively, radiation measurement devices could be constrained to specific energy regions to minimize background effects and focus on specific signatures related to the presence of plutonium, highly enriched uranium, and high explosives. While a warhead could

theoretically be separated from its delivery system and placed near or inside the reactor compartment, such a configuration would be impractical, unlikely to mask all detectable signatures, and, above all, operationally hazardous for the ship and its crew.

These absence inspections could therefore serve as visible demonstrations of treaty compliance. And because they would rely on a cooperative operator, refusing reasonable inspection requests could instead raise compliance concerns. Considering their international standing, NWFZ obligations, and the political benefits of transparency, it is reasonable to assume Brazil and Australia would be cooperative if challenged to verify their treaty compliance. Moreover, although Tlatelolco's and Rarotonga's special inspections provisions have never been invoked, let alone applied to naval vessels, these mechanisms could be adapted for voluntary inspections of SSNs during port calls, maintenance periods, or joint exercises. Brazil and Australia have an opportunity to pioneer such measures—reassuring their treaty partners, strengthening the credibility of their NWFZ regimes, and contributing to the broader disarmament verification agenda in the process.

06

Nuclear-Weapon-Free Zones: Why, Wherefore, What Next?

Karla Mae G. Pabeliña

The views expressed in this publication are those of the author alone and do not reflect the official position of any organization she is affiliated with.

NWFZs have long been regarded as instruments for safeguarding regional peace and security, preventing the proliferation of nuclear weapons, and contributing to nuclear disarmament goals. With stringent obligations concerning nuclear activities within their zonal areas of coverage, NWFZs serve as important confidence-building measures and tools for regional stability. However, the spread of non-proscribed and novel nuclear technology applications, including NNP, has brought forward concerns and questions about how these applications could affect the vitality of the zones. Focusing on AUKUS and Australia's future NNP program, this chapter considers how new nuclear developments challenge NWFZs. It concludes by arguing that NWFZs have a central role to play today and in the future as regional instruments to ensure that such developments do not undermine the non-nuclear norms at the heart of the zones.

Expression of Non-Nuclear Norms

NWFZs remain the most concrete expressions of NNWS' collective will to live in a world without nuclear weapons. They are aimed not only at prohibiting the development of nuclear weapons in a given region and limiting their impacts on regional dynamics and stability, but also at insulating the region from external nuclear dangers. As sovereign initiatives established by regional groups of states, NWFZs reflect their historical experiences, hopes, expectations, and fears.

> **NWFZs remain the most concrete expressions of NNWS' collective will to live in a world without nuclear weapons.**

For example, the establishment of the Latin America and Caribbean NWFZ came in response to the Cuban Missile Crisis, which brought the world to the edge of nuclear Armageddon over the deployment of Soviet nuclear weapons in Cuba. The South Pacific Nuclear Free Zone (SPNFZ) was born out of the actions of Pacific peoples and their governments against the more than 300 nuclear tests carried out in the Pacific and Oceania by the United States, the United Kingdom, and France, and subsequent concerns about radioactive dumping.

The Southeast Asia NWFZ (SEANWFZ), meanwhile, was established to insulate the region from the humanitarian consequences of a potential nuclear conflict, particularly at the height of the Cold War, when the region was a front line in the East-West rivalry. Today, the region is again a theater of great power competition. Member states hope that the SEANWFZ will provide a normative framework to insulate the region from a nuclear war and thus view it as a crucial pillar of the Zone of Peace, Freedom, and Neutrality (ZOPFAN) concept of the Association of Southeast Asian Nations (ASEAN). Further, the basic premise of the SEANWFZ reflects a key underpinning belief of the Latin American and Caribbean NWFZ: that the existence of nuclear weapons in the territory of any regional state will make it a target for possible nuclear attacks, set off a disastrous arms race, and lead to the diversion of resources required for economic and social development.

The NNP Challenge and Regional Reactions

Although traditionally focused on preventing the regional presence of nuclear weapons and their use by nuclear-armed states, NWFZs and the non-nuclear norms they embody now face a new challenge: NNP by non-nuclear neighbors. In the South Pacific, the AUKUS nuclear submarine initiative has triggered vigorous debate on the impacts of NNP on NWFZs, in part due to Australia's membership in the SPNFZ and its proximity to the SEANWFZ.

Various experts have warned of the risks posed by the proliferation of nuclear-powered submarines and SLCMs. For example, noted nuclear experts Tanya Ogilvie-White and John Gower identify several dangers related to the AUKUS submarine initiative. They argue it risks eroding the global nonproliferation regime, inducing arms racing and submarine proliferation, broadening the risks of dual capable missiles, and accelerating the trend toward unvarnished power politics in the Asia-Pacific. Prominent Fijian professor Vijay Naidu argues that "AUKUS has increased insecurity in the region, instead of enhancing it" by exacerbating "the threat of increased militarisation and the use of nuclear arms linked to American bases in the northern Pacific and in Darwin, Australia."

Singaporean maritime expert Collin Koh acknowledges that while AUKUS may not necessarily cause submarine proliferation, it could be "a contributing influence" in some states' decisions to expand their submarine fleets or justify establishing submarine programs, particularly in the cases of Iran, India, China, Japan, and South Korea. Indonesian maritime expert Ristian Atriandi Supriyanto highlights the evolving risks and dangers that may arise

from incidents and accidents involving underwater warfare systems—especially those that are nuclear-powered—such as when the USS Connecticut (SSN-22) hit an "uncharted" seamount in the South China Sea in October 2021.

Meanwhile, official reactions to the AUKUS submarine initiative in Southeast Asia have varied. Some members of the SEANWFZ, especially those geographically adjacent to Australia, have raised even more specific concerns about Canberra's future SSNs that relate to the norms the zone aims to uphold. Indonesia has been particularly critical of AUKUS in this regard and stated that the transfer of nuclear materials from nuclear states to non-nuclear states for military purposes increases the "associated risks and the catastrophic humanitarian and environmental consequences, as well as navigation risks posed by potential proliferation and conversion of nuclear material to nuclear weapons, particularly highly enriched uranium." Some members of the Indonesian Parliament have gone so far as to threaten denial of passage rights to Australian SSNs if and when they exist.

Similarly, Malaysia has highlighted the need for the AUKUS states to "fully respect and comply with its existing national regime in relation to the operation of nuclear-powered submarines in its waters," including those under the 1982 UN Convention on the Law of the Sea, the SEANWFZ, and ZOPFAN. It has also stressed the importance of promoting transparency and confidence-building, and of states refraining from any provocation that could trigger an arms race in the region. Although neither Indonesia nor Malaysia has directly argued that the AUKUS arrangement violates the SEANWFZ treaty, there are clearly concerns that the introduction of SSNs could result in actions that undermine the zone's objectives.

In contrast to Indonesia and Malaysia, Singapore is generally receptive to the AUKUS initiative, as former prime minister Lee Hsien Loong welcomed Australia's assurances that AUKUS will "support ASEAN centrality, deepen economic integration, and promote a stable and secure Asia-Pacific region and a rules-based order." Meanwhile, former Philippines foreign secretary Teodoro Locsin highlighted how AUKUS would address the "geographic imbalance" through the "additional time it affords all protagonists for reflection before reacting"—alluding to the potential role of the AUKUS submarines as a counterweight against China in the event of conflict in the South China Sea.

The intense debate reflects the state of discourse and competing interpretations of what exactly constitutes the spirit of NWFZs. For Australia and its AUKUS partners, there are expectations that their actions comply not just with the letter of the SPNFZ treaty that prohibits the stationing, storage, or use of any nuclear weapon or other nuclear explosive device in the zone, but also the normative spirit of the SPNFZ that embodies the region's strong anti-nuclear values. Evidently, there is also an expectation that the AUKUS initiative conforms to the neighboring SEANWFZ, though the fact that neither the United Kingdom nor the United States has ratified the protocols to the treaty may pose difficulties in this regard.

Southeast Asian states are for their part adopting a "wait and see" approach, particularly as the consultation on the technical aspect, structure, and content of the Article 14 arrangement between the IAEA and Australia are still ongoing. The AUKUS submarine initiative will likely receive renewed attention as soon as the arrangement is finalized and transmitted to the IAEA Board of Governors for appropriate action. The fate of AUKUS will have significant implications, in regards not only to Australia's obligations to the SPNFZ and its relations with the members of the SEANWFZ, but also to potential future transfers of nuclear technology by nuclear weapon states to NNWS.

Shoring Up NWFZs in a Changing Nuclear Landscape

The increasingly volatile security environment, characterized by deteriorating relations among the nuclear-armed states and their allies, has prompted NNWS to further strengthen existing nuclear disarmament and nonproliferation initiatives, including NWFZs. In December 2024, the UN General Assembly adopted a resolution requesting the UN secretary general to convene a group of experts to prepare a new comprehensive study on NWFZs, examine options and recommendations toward the strengthening of existing zones, and consider the possible establishment of new zones.

The Republic of Kazakhstan has also convened a consultation workshop aimed at fostering cooperation between the existing NWFZs to facilitate the full implementation of the treaties' objectives and principles. The representatives of the zones agreed to implement joint diplomatic efforts; raise public awareness of the importance of establishing new NWFZs; and coordinate outreach to strengthen the norm against nuclear weapons, including by working with members of the Treaty on the Prohibition of Nuclear Weapons.

> **There is space for the NWFZs to be even more adaptive to the changing nuclear landscape.**

There is space for the NWFZs to be even more adaptive to the changing nuclear landscape. This landscape is characterized not only by the onset of NNP by NNWS within and adjacent to the zones, but also by growing interest among regional states in deploying small modular reactors in applications such as floating nuclear power plants, and even more advanced nuclear reactions such as nuclear fusion.

For example, to properly regulate these technologies, the NWFZs could develop robust regional nuclear safety regimes. ASEAN has already made progress in this regard by adopting three Plans of Action to Strengthen the Implementation of the Treaty of the SEANWFZ. These plans provide actionable measures to ensure compliance with the undertaking of the SEANWFZ treaty, including to "strengthen relevant existing mechanisms within ASEAN such as the Nuclear Energy Cooperation Sub-Sector Network . . . and the ASEAN Network of Regulatory Bodies on Atomic Energy . . . to contribute to the eventual development of a regional nuclear safety regime." Partnerships with the IAEA and others are also encouraged by ASEAN member states to support the implementation of the SEANWFZ, including through the development of regional legal frameworks and a regional early warning radiation monitoring network.

Conclusion

The spread of nuclear technologies to NNWS, as exemplified by the Australian NNP program, should be seen as an opportunity for NWFZ members to take further steps that would both strengthen the resilience and integrity of their zones and establish a normative foundation that can address new nuclear applications. It is imperative that even as states inevitably build their capacities, they remain bound to respect the norms of nonproliferation and disarmament that have been a cornerstone of regional peace for decades.

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Notes

1 SSNs are distinct from nuclear-powered submarines equipped with nuclear weapons (SSBNs). NNWS are not prohibited from developing SSNs but, by definition, are prohibited from developing SSBNs.

2 The 2006 Treaty of Semipalatinsk for Central Asia's NWFZ does not explicitly endorse nuclear propulsion for the landlocked region, but nor does the pact prohibit it. Transit rights are left to the discretion of individual countries in the NWFZ.

3 John R. Redick, The Politics of Denuclearization: A Study of the Treaty for the Prohibition of Nuclear Weapons in Latin America (University of Virginia Press, 1970).

4 Tlatelolco was the first multilateral treaty to incorporate IAEA nuclear safeguards, setting an important precedent. The Article 13 safeguards provisions were later mirrored in Article III of the NPT.

5 For more details on Tlatelolco's control system, see Alain Ponce Blancas's chapter in this compilation, "Adapting Free Zones for Evolving Nuclear Applications: A Model from Latin America."

6 Under international law, treaties generally do not create rights or obligations for third states. Accordingly, only state parties to NWFZ treaties can trigger their special inspection provisions. Nonetheless, non-member states suspicious of a treaty breach are not completely without options. They can share intelligence with treaty members, lobby for inspections through diplomatic channels, or raise concerns in forums such as the UN General Assembly or Security Council. While indirect, these avenues respect the integrity of treaties as sovereign agreements among consenting states.

7 Nuclear and conventional versions of SLCM systems are often externally indistinguishable. For example, the U.S. Tomahawk SLCM has been deployed in both nuclear and non-nuclear variants using identical airframes.

8 Nuclear-armed SLCMs can be launched from vertical launch systems or torpedo tubes.

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