8 October 2021

IAEA Safeguards, the Naval "Loophole" and the AUKUS Proposal

John Carlson

Non-Resident Senior Fellow, VCDNP

The announcement on 15 September 2021[1] of a proposal for the United States and the United Kingdom to supply Australia with nuclear-powered submarines has sparked a flurry of commentary on the so-called "loophole" for naval fuel in the Nuclear Non-Proliferation Treaty (NPT) and International Atomic Energy Agency (IAEA) safeguards agreements, and the potential consequences for the non-proliferation regime. Claims that the proposal will open a "Pandora's box of proliferation" are overstated. Very few states are likely to pursue nuclear-powered submarines, they are too complex and too expensive. Further, as will be discussed, the safeguards "loophole" is not as open as some think. Nonetheless, the need for appropriate arrangements to assure naval fuel is not diverted to nuclear weapons has been recognised for many years; the Australian proposal presents the opportunity to develop detailed approaches on this issue.

The AUKUS proposal

The Australian, UK and US governments have announced the creation of an "enhanced trilateral security partnership", with the acronym AUKUS, which will include, *inter alia*, provision to Australia of at least eight conventionally-armed, nuclear-powered submarines. All three governments have emphasised that Australia has no plans to acquire nuclear weapons and that the proposal will be fully consistent with Australia's longstanding commitment to nuclear non-proliferation.

The three governments have undertaken to pursue this proposal in a way that reflects vigorous verification standards, in partnership with the IAEA, and engagement with the IAEA has commenced. There will be an 18-month consultation process to determine the various elements of the proposal, especially safeguards and non-proliferation measures and how to ensure full compliance with each party's NPT commitments.

At this stage it has not been decided whether the submarines will be US or UK models (Virginia-class or Astute-class respectively). In either case the submarine reactors would be supplied with lifetime cores, meaning that Australia will not produce the fuel and will not be refuelling the reactors. At the end of each submarine's operating life, expected to be around 30 years, the submarine with its reactor and fuel will be returned to the supplier.

One aspect of these submarines, contentious for many commentators, is that, in line with current US and UK practice, the fuel will be highly-enriched uranium (HEU), at weapon-grade enrichment (around 93% U-235). Here, an important feature of these submarines is that, because the reactor does not require refuelling, the reactor is built into the hull without provision of refuelling hatches. The fuel is inaccessible without cutting into the hull, requiring substantial rebuilding before the submarine can return to service. The significance of this is discussed later in this paper.

NPT and safeguards agreement provisions on naval fuel

Neither the NPT nor safeguards agreements concluded pursuant to the NPT specifically refer to naval fuel. However both the NPT and comprehensive safeguards agreements (CSAs)

---

1. See INFCIRC/963 of 21 September 2021, https://www.iaea.org/sites/default/files/publications/documents/infcircs/2021/infcirc963.pdf.

concluded by non-nuclear-weapon states (NNWS) parties to the NPT provide for non-proscribed (that is, non-explosive) military uses of nuclear material.

The NPT Under the NPT, NNWSs are absolutely prohibited from acquiring nuclear weapons or other nuclear explosive devices (Article II), and are required to accept IAEA safeguards on all their nuclear material in peaceful nuclear activities (Article III.1). All NPT parties are obliged not to supply nuclear material to any NNWS for peaceful purposes except under IAEA safeguards (Article III.2). This reference to peaceful purposes implies the possibility of NNWSs having nuclear material in non-peaceful use (that is, military use), provided this is not for nuclear explosives. This language was included in the NPT at the request of some NNWSs that wanted to leave open the possibility of having nuclear-powered submarines.

With the benefit of hindsight, these parts of the NPT could have been better drafted. On a literal interpretation, the NPT could be read as allowing supply of nuclear material to NNWSs for non-peaceful non-explosive purposes outside safeguards. Clearly this would create opportunities for diversion of nuclear material to nuclear weapons. Such an interpretation would defeat the object and purpose of the treaty, so we must assume was not intended by the parties. Rather, the exclusion of safeguards on nuclear material in non-proscribed military use reflects concerns to protect sensitive information, such as the design of naval reactors and their fuel, details of core loadings and range between refuelling, and details of submarine deployments. Because these issues weren’t thought through at the time, this part of the NPT was written in general terms, and it is really only now, more than 50 years after, that the issue is receiving detailed attention.

Safeguards agreements CSA provisions on non-proscribed military use of nuclear material are based on paragraph 14 of INFCIRC/153. For convenience these are referred to as “paragraph 14” provisions, though in a particular CSA the corresponding article may be numbered differently.

Paragraph 14 provides for the “non-application” of safeguards set out the agreement, but only while the nuclear material is in the non-proscribed military use. Safeguards are to apply again as soon as the material is re-introduced into a peaceful nuclear activity. If the state wishes to make use of paragraph 14 it must inform the IAEA, making it clear the material will not be used for production of nuclear weapons. The state is required to conclude an arrangement with the Agency, identifying the period or circumstances during which safeguards will not be applied, and keeping the Agency informed of the total quantity and composition of such unsafeguarded nuclear material. The arrangement should relate only to temporal and procedural provisions, reporting arrangements, etc., but should not require any classified knowledge of the military activity.[2]

Paragraph 14 does not specify that an arrangement requires the approval of the Board of Governors, but in 1978 the Board received advice from the Director General that any such arrangement would be submitted to the Board to decide on the appropriate action. Interestingly in light of current developments, the Director General’s advice was prompted by a request by Australia, which at that time was looking at the issue from the perspective of a uranium supplier.[3]

To date the paragraph 14 provisions have not been used, as no NNWS has introduced nuclear naval propulsion. Canada considered nuclear-powered submarines in the 1980s but did not proceed. Brazil is planning to develop a nuclear-powered submarine, and currently is

---

2. For a detailed discussion of safeguards aspects see T. Shea, *The Nonproliferation and Disarmament Challenges of Naval Nuclear Propulsion*, Federation of American Scientists (FAS), 2017, https://fas.org/wp-content/uploads/media/The-Nonproliferation-and-Disarmament-Challenges-of-Naval-Nuclear-Propulsion.pdf, and L. Rockwood, *Naval Propulsion and IAEA Safeguards*, FAS, 2017, http://vcdnp.org/wp-content/uploads/2017/08/Naval-Nuclear-Propulsion-and-IAEA-Safeguards.pdf.
3. GOV/INF/347 of 3 July 1978.

conducting trials of a land-based prototype naval reactor. It is not known when the first submarine will be built and ready for operation, this might not be until the 2030s.

Military transfers outside safeguards agreements

When Canada was considering nuclear-powered submarines in the 1980s, it was proposed that the US would supply Canada with fuel produced from Canadian uranium. It was suggested one way of dealing with this would be for the transfer of uranium to the US and its return to Canada as fuel to be treated as a "military-to-military" arrangement, entirely outside IAEA purview, thereby avoiding the complications of a paragraph 14 arrangement. Fortunately this idea did not proceed.

Clearly any such arrangement would be totally contrary to the intent of the NPT, which is to ensure that all nuclear material in a NNWS is under IAEA oversight – either the Agency's safeguards system or appropriate arrangements pursuant to paragraph 14. Without this the IAEA cannot provide any assurance that the state is observing the prohibition on nuclear weapons, a situation that would be contrary to the fundamental object and purpose of the NPT. Any proposal along these lines should be rejected by the IAEA and all NPT parties.

Scope of safeguards "suspension"

While the concern of states to protect national security aspects of any nuclear material in non-proscribed military use is understandable, obviously it is essential to develop appropriate verification arrangements so naval programs do not present an opportunity for diversion. The INFCIRC/153 negotiating record shows that both the negotiators and the IAEA Secretariat were anxious "... to avoid a situation where withdrawals of nuclear material from safeguards for non-proscribed military use could become a loophole allowing use for nuclear explosive purposes, beyond the reach of Agency verification activities".[4]

The safeguards suspension provisions of paragraph 14 raise a number of questions, particularly the beginning and end points of the suspension, and the kind of activities the IAEA might undertake to ensure it has sufficient knowledge of the nuclear material involved, with respect to its return to safeguards and to its non-diversion to nuclear weapons. Although routine safeguards are suspended, the prohibition against nuclear weapons continues to apply; assurance is needed that this prohibition is being met.

The first issue considered by the INFCIRC/153 negotiators was whether, in view of the provision of the Agency Statute against furthering any military purpose (Article III.A.5), it was even permissible for the IAEA to apply safeguards to nuclear material which might be withdrawn for military use. The Director General advised that:

> "... the Statute ... does provide the legal authority to apply safeguards to achieve the objective foreseen in ... NPT, namely, to verify that there is no diversion ... to nuclear weapons or other explosive devices, and to conclude ... agreements to that effect."

Having clarified this legal issue, the intention of the negotiators with paragraph 14 was to narrow the suspension or "non-application" of safeguards on material in non-proscribed military use as far as possible; to require the provision of as much information concerning the withdrawal as possible without compromising classified information; and to require specific arrangements between the state and the Agency defining and circumscribing the arrangement as carefully as possible.

Of particular importance was the understanding that facilities which merely produce or process nuclear material for use in non-proscribed military uses are not themselves exempt from safeguards. Thus the suspension of routine safeguards on nuclear material in non-proscribed military use is limited to the period the material is actually in that use. All

4. *Review of the Negotiating History of IAEA Safeguards Document INFCIRC/153*, ACDA, 30 July 1984, pp. 132-4, https://nationalsecuritytraining.pnnl.gov/fois/doclib/IAEA_153_Negotiating_History.pdf.

processes before this use, such as enrichment and fabrication, and all processes after, such as storage, transportation, reprocessing if any, and disposal must be under full safeguards.

What measures could apply to nuclear material covered by paragraph 14?

The primary consideration is that the state and the Agency must be able demonstrate that the prohibition on diversion of nuclear material to nuclear weapons is being met. Obviously this could be achieved by the normal application of safeguards, a point to which Argentina and Brazil seemed to allude in their 1991 Agreement on the Exclusively Peaceful Utilization of Nuclear Energy when they described propulsion as a peaceful application of nuclear energy. Unfortunately, this positive approach was not followed through in the subsequent safeguards agreement, which has a provision similar to paragraph 14 but couched in terms of "special procedures".[5]

The main obstacle to applying routine safeguards to nuclear material in use as naval fuel is the need to protect sensitive or classified information. Here, it is important for states to be realistic about what information genuinely requires protection; information cannot be declared secret simply because it pertains to military matters. Provided genuine secrecy concerns are met, there is no reason why a state could not conclude an arrangement with the IAEA under which, as far as possible, normal safeguards would apply to nuclear material in use as naval fuel.

Examples of verification activities that should be acceptable include the following:

- Where nuclear materials accountancy information does not compromise military secrets, there should be no objection to providing it to the IAEA.
- If the specific design of fuel assemblies is sensitive, it may be possible to shroud the fuel from inspectors while still enabling verification of mass and nuclear content.
- Inspectors could observe fuel loading and unloading, and attach seals to fuel access points, with shrouding being applied to any sensitive equipment they otherwise might see.
- Inspectors should be able to use neutron detectors to verify the presence of core fuel in the reactor. It should be examined whether flux tabs could be installed at suitable locations near the reactor, so inspectors can confirm periodically that the reactor has been operating as expected. Antineutrino monitoring is another technique that could be developed for this application.

One difference to routine safeguards relates to inspection timeliness requirements. Obviously inspections aren't possible when a submarine is at sea, and it is likely the submarine's operating schedule would not coincide with the relevant safeguards timeliness period.[6] Therefore a rigorous application of timeliness may not be possible. However, it should be possible to arrange inspector access when the submarine is in port. Generally a submarine's presence in port is public knowledge, so there seems no reason why the IAEA cannot be notified of this.

Because of the sensitivities, some aspects of verification for naval programs may require novel approaches. However, the problems are not insurmountable: the Trilateral Initiative[7] between the US, Russia and the IAEA demonstrated the practicability of innovative approaches to verifying fissile material of sensitive composition, shape and mass. Formal

5. Article III, https://www.iaea.org/sites/default/files/infcirc395.pdf. The Quadripartite Agreement between Argentina, Brazil, the IAEA and ABACC does not expressly suspend safeguards on naval fuel, but the "special procedures" that would apply appear more restrictive than paragraph 14 – see L. Rockwood, *op.cit*.
6. Typical patrol times for a nuclear-powered submarine are 70-90 days. Safeguards timeliness periods are one month for unirradiated HEU, 3 months for irradiated HEU, and one year for LEU.
7. See e.g. T. Shea, *The Trilateral Initiative: A Model for the Future?*, Arms Control Today, May 2008, https://www.armscontrol.org/act/2008-06/features/trilateral-initiative-model-future.

verification may be complemented by transparency arrangements: for example, it is easy to check that a vessel is at sea (and therefore *prima facie* the reactor is operating).

Diversion scenarios

In considering the proliferation risks presented by naval fuel programs, and the ways of minimising these risks, it is helpful to examine the potential diversion scenarios involving such programs.

Here, it is important to distinguish between the submarines themselves and the associated nuclear fuel cycle activities. Although in a NNWS NPT party the fuel cycle activities (enrichment, fabrication, possibly reprocessing) will be under safeguards, a state having these capabilities has a number of diversion options, each of which is challenging to safeguards, especially in terms of timely detection (that is, detection in time to enable international intervention). For example:

- Diversion of enrichment plant output
  - with a large enrichment plant, and preparations in advance, the plant could be reconfigured for HEU, and significant quantities of HEU could be produced and removed in a matter of days
  - alternatively, LEU product could be removed very quickly for further enrichment at an undeclared plant
  - if the declared plant is producing HEU routinely, product could be removed very quickly.
- Diversion of enriched product stockpiled for fabrication
  - in the case of LEU, this would involve further enrichment at an undeclared plant.
- Diversion from fabrication throughput
  - depending on the form of the material (UF_6, fuel pellets), this would require conversion to a form suitable for further processing.
- Establishment of an undeclared enrichment plant
  - for a state manufacturing enrichment equipment, it could be relatively easy to produce additional equipment for an undeclared plant
  - the undeclared plant, especially if enriching LEU rather than natural uranium feedstock, could be much smaller than the declared plant, making it harder to detect.
- Diversion of spent fuel from storage, followed by reprocessing
  - in the case of LEU fuel, the object would be recovery of plutonium
  - in the case of HEU fuel, the plutonium content would be negligible – the object of reprocessing would be recovery of HEU. This may require further enrichment to an optimum level for nuclear weapons, in which case the state will require enrichment as well as reprocessing capabilities.

Acquiring nuclear-powered submarines in order to divert the fuel is complicated and expensive, though of course appropriate measures are required to counter this possibility. It is likely a more attractive option for the state is to use nuclear-powered submarines as a justification for establishing enrichment operations – in this case the proliferation risk lies more with enrichment and associated activities than with the submarines themselves.

A brief outline of diversion scenarios involving naval fuel while in the period of use (that is, outside routine safeguards) is as follows.

1.A HEU fuel – produced by the state

As discussed, the principal diversion risk will be with fuel cycle activities either side of naval use, particularly enrichment.

For diversion from a submarine, factors to consider include:

- How accessible is the fuel – how easy is it to remove without detection?
  - monitoring should include surveillance of docking facilities suitable for this.
- How will defuelling be hidden – could the fuel be replaced by LEU? (Operating the reactor with LEU fuel may not be feasible, and producing LEU submarine fuel will require substantial capabilities in fuel design and fabrication.)
  - could the submarine be operated on auxiliary diesel to conceal from observers that the reactor has been defuelled?
- To counter substitution of vessels, inspectors will need to look at unique identification of each submarine (painted identification marks are not enough).
- Recovery of HEU from fuel elements will require appropriate facilities – after the initial years, with increasing irradiation, this would include reprocessing.
- If the enrichment level is significantly below weapon-grade (either initially or because of burnup) the HEU will require further enrichment.

1.B HEU fuel – imported

Factors to consider are similar to case 1.A, except that, unless the state has enrichment facilities, scenarios requiring further enrichment of HEU and substitution by LEU fuel are not available.

1.C HEU fuel – reactor with lifetime core, not readily accessible

This is the situation with the AUKUS proposal. Each reactor will be supplied with the fuel loaded, providing an operational life of around 30 years without refuelling. Because the reactor will not be refuelled, when the reactor is installed in the submarine the hull will be built over it, with no hatches enabling access to the fuel. At the end of its operating life the submarine with its reactor and fuel would be returned to the supplier.

The only way for the state to access the fuel is to cut into the hull, thereby requiring substantial rebuilding for the submarine to return to service. Such a situation – a submarine undergoing major rebuilding over a period of several months – should be readily apparent. These circumstances should make diversion a low risk, though it cannot be totally excluded and a diversion analysis should be undertaken to establish an effective verification plan. This would take into account whether it is practical for the state to access the fuel, undertake some form of reprocessing and weaponise fast enough to escape detection and intervention. It should be relatively easy to establish that the fuel has not been diverted through periodic observation of the submarine, including measures to confirm the submarine's identity and that the reactor is operating as expected.

2.A LEU fuel – produced by the state

As in case 1.A, the principal diversion risk is with enrichment.

For diversion from a submarine, the factors to consider are similar to those in case 1.A, except:

- the fuel, being LEU, would require further enrichment to obtain HEU
- diversion from a submarine, and fuel substitution to hide this fact, would not make sense unless the objective is to recover plutonium – but if the state can produce LEU it is easier for it to produce HEU than to reprocess spent fuel for the plutonium content.

2.B LEU fuel – imported

The diversion potential associated with importing LEU depends on whether the state is stockpiling LEU:

- if this is bulk LEU for a state fabricating its own naval fuel, the LEU could be suitable for re-enriching to HEU. Of course, this requires the state to have an enrichment plant
- if the LEU is imported as fuel elements, additional time would be required for conversion of the LEU to UF_6 for further enrichment.

If the state does not have enrichment, the only reason to divert LEU would be to reprocess irradiated fuel for plutonium. The obvious problem is, how can the state hide the fact the submarine has been defuelled? This would be possible if the state has imported stocks of fuel elements it can draw on to refuel the submarine, but as this fuel will be under safeguards its removal would be readily detected.

Additional verification measures that might be considered

The safeguards measures outlined above could be supplemented by further safeguards and transparency measures, such as:

- monitoring dockyards where fuel might be unloaded
- monitoring dockyards where cutting into a submarine hull, removing radioactive fuel, and substantial rebuilding work might be possible
- checking whether the state has shielded containers and large hot cells suitable for handling radioactive naval fuel, and monitoring these – these items are covered by the IAEA safeguards Additional Protocol.

Use of HEU naval fuel

One aspect of the AUKUS proposal that has attracted critical comment is the use of HEU fuel. Today only the US and the UK use weapon-grade HEU for naval fuel. Russia uses HEU well below weapon-grade. India is leasing a Russian submarine, also fuelled by HEU below weapon-grade, and is developing its own design, believed to be similar to the submarine leased from Russia. The other states with nuclear-powered submarines, France and China, use LEU fuel. There are long-running efforts in the US to persuade the US Navy to move to LEU-fuelled reactors, but to date the Navy has refused to change and is considering a new enrichment program to produce more HEU for when current stocks run out, expected to be around 2060.

Critics are concerned about potential nuclear material security risks associated with the processing and handling of HEU for fuel in the US. They also strongly oppose, on non-proliferation grounds, supply of HEU to any NNWS. Regarding the security risks associated with HEU, the US has huge stocks of HEU which must be eliminated somehow. Fabrication and handling of naval fuel presents some risk, but the security record with naval fuel is good. Such risks apply however HEU is disposed of. An alternative method of eliminating HEU, dilution to LEU, could also present security risks, but the Megatons to Megawatts program shows these risks can be managed.

It is one thing to manage risks while eliminating existing stocks of HEU, it is quite another matter to add to these risks by producing more HEU. It makes more sense for the US to develop LEU-fuelled reactors for future deployment.

Paradoxically, use of HEU fuel is a positive aspect of the AUKUS proposal because the HEU will be practicably inaccessible to Australia, meaning that the proposal has minimal proliferation risk. The AUKUS proposal should not be criticised for use of HEU, both because of this inaccessibility factor and because the proposal is marginal in the overall context of US, and UK, use of HEU. However, HEU should not be supplied to a NNWS if the fuel will be accessible by the state concerned. And under no circumstances should production of HEU by a NNWS be accepted – there needs to be international action to rule out this possibility.

Considering the AUKUS proposal

The Joint Leaders Statement on AUKUS[8] says "Australia is committed to adhering to the highest standards for safeguards, transparency, verification, and accountancy measures." This suggests paragraph 14 arrangements can be concluded which will meet the IAEA's requirements for verifying that submarine fuel is not diverted to nuclear weapons. Some of the measures that could be included in these arrangements have been outlined in this paper.

Of course, the detailed procedures and measures are not entirely up to Australia, as the technology and the fuel will be provided by the US, or possibly the UK, and they will determine which aspects are classified and require protection – though the US and UK leaders have subscribed to this Joint Statement. A specific point some commentators have raised is whether nuclear material accountancy and verification will apply to the fuel. This is one of the matters to be decided in the elaboration of the project; at this stage it is not known if the US would have concerns about this on classification grounds.

If, as expected, the fuel is loaded in the reactor by the US and will remain inaccessible to Australia, and is also inaccessible to IAEA inspectors, then it can be argued that determining the fuel is not diverted by Australia does not depend on the normal material accountancy and verification measures. If Australia cannot access the fuel, and the fuel will be returned to the US at the end of the submarine's service life, all the IAEA needs to be assured of is that Australia never removes any of the fuel. The precise quantity isn't important unless there were indications that Australia may have removed some fuel, which is most unlikely, given this would require cutting into the hull. This paper has touched on some of the measures that could be applied to determine no fuel has been removed. If necessary for IAEA accountancy purposes, the US could declare nominal figures for the quantity of HEU transferred and its U-235 content, but these figures would not have to be verified.

The precedent established by AUKUS would actually be a positive one – in effect Australia would be acquiring submarines with a nuclear "battery"; under no circumstances would Australia have access to the fuel and the "battery" would be returned at the end of its life. This is in marked contrast to situations where a state may be handling naval fuel, and the contrast is even greater if a state is operating a fuel cycle for naval fuel.

Other NNWS proposals for naval reactors

Currently only one NNWS, Brazil, is developing a nuclear-powered submarine. This has not yet progressed to the stage where it has been necessary to consider safeguards measures for the fuel, and it is not known what Brazil may propose. An obvious issue with Brazil is that it is currently operating an enrichment program and intends to produce its own naval fuel. This raises the various proliferation concerns outlined above, and highlights that Brazil has not concluded an Additional Protocol. The IAEA has emphasized on many occasions that for a state without an Additional Protocol in force it is unable to conclude that all nuclear material in that state has remained in peaceful (non-proscribed) activities. This will become even more of a problem as Brazil proceeds with a naval fuel cycle. There are strong reasons why Brazil should reconsider its position on the Additional Protocol[9], and even stronger reasons for the IAEA to insist that the Additional Protocol is an essential part of the safeguards framework for a state proposing to use naval reactors.

Iran has said it is considering the development of nuclear-powered submarines, and has started producing HEU at 60% enrichment. Production of HEU is a provocative step, widely seen as a pressure tactic in negotiations to restore or replace the JCPOA.[10] Iran may claim it needs to enrich at HEU levels for the future naval program. Considering that Iran is many

8. Attached to INFCIRC/963 (footnote 1 refers).
9. See E.P.L. Diniz Costa, *Brazil's Nuclear Submarine: A Broader Approach to the Safeguards Issue*, Revista Brasileira de Política Internacional, 2017, https://doi.org/10.1590/0034-7329201700205.
10. 2015 Joint Comprehensive Plan of Action, abrogated by the Trump administration in 2018.

years away, if ever, from acquiring nuclear-powered submarines, this would be seen for what it is, a pretext to justify enrichment. This situation highlights two major issues:

- Production of HEU by any NNWS threatens the non-proliferation regime and the international community should work against this.
- The spread of uranium enrichment capabilities generally is problematic for non-proliferation, it is time to seriously consider proposals for multination control of proliferation-sensitive stages of the nuclear fuel cycle.

South Korea has expressed interest in purchasing or developing nuclear-powered submarines, and in September 2020 asked the Trump administration if the US would supply LEU for naval fuel. Reportedly the US declined on non-proliferation grounds. Apart from general non-proliferation concerns, nuclear-powered submarines, and potentially a supporting enrichment program, would be seen as major complications for efforts to achieve a denuclearised Korean peninsula.

There have been suggestions in Japan for pursuing nuclear-powered submarines, but there does not appear to be serious interest by the Japanese government.

Implications for nuclear-armed states

While currently verification of naval nuclear propulsion is discussed only in the context of non-proliferation, this is also very relevant to future nuclear disarmament efforts. Because no NNWS has yet proceeded with nuclear submarines, the IAEA has not had to develop appropriate arrangements to counter diversion risk from naval programs. However, this is on the horizon as a key issue for nuclear disarmament – if, as we all hope, the NPT nuclear-weapon states and the other nuclear-armed states proceed with substantial nuclear arms reductions, leading to elimination of nuclear weapons, the challenge of assuring non-diversion from naval programs will have to be addressed. The difficulties now being considered with respect to possible NNWS naval programs will be straightforward relative to the scale of the US and Russian naval programs.

Conclusions

It is essential that paragraph 14 is not allowed to become a loophole, by which naval propulsion programs are used to evade safeguards and divert nuclear material to nuclear weapons. The negotiators of INFCIRC/153 recognised this risk, and emphasised the need to narrow the "non-application" of safeguards as far as possible. The point of paragraph 14 is to enable the protection of genuinely sensitive information – it is entirely possible to apply effective verification measures consistent with the protection of such information. The state concerned must cooperate with the IAEA to demonstrate that the fundamental NPT obligation not to divert nuclear material to nuclear weapons is being met.

Because to date no NNWS has reached the point where paragraph 14 arrangements are necessary, the IAEA has not yet indicated how it would approach arrangements for dealing with a naval propulsion program. The AUKUS proposal creates an opportunity to develop some constructive thinking on verification and monitoring arrangements to apply to naval propulsion programs. This can set a precedent for verification approaches for other NNWS naval programs. It is also relevant to nuclear disarmament, nuclear material in naval fuel will have to be addressed as part of future disarmament efforts.

In considering paragraph 14 arrangements, the IAEA and the international community should look at the overall non-proliferation credentials of the state concerned. The range of fuel cycle activities and their history needs to be taken into account. The Additional Protocol is an essential part of this: the IAEA should not consider 14 arrangements unless the state is implementing an Additional Protocol.

Despite the concerns of some commentators, the AUKUS proposal does not jeopardise non-proliferation and safeguards objectives. Notwithstanding the use of HEU fuel, the AUKUS proposal has a positive aspect, that the fuel is not practicably accessible to Australia, making non-diversion relatively straightforward to verify. AUKUS sets the precedent that a state does not need to undertake enrichment in order to operate nuclear-powered submarines. This is a very different situation to that of a state enriching and producing its own fuel. In such a case the proliferation risk is more likely to be with the enrichment program rather than the use of naval fuel. This highlights the need to revisit proposals for multination approaches to proliferation-sensitive stages of the nuclear fuel cycle.

This paper outlines verification and monitoring measures that could apply under paragraph 14 arrangements. These could involve significant effort and costs for the IAEA. The state concerned should be prepared to cover these costs, they are miniscule compared with the defence expenditures involved.

The use of HEU fuel in naval programs is an issue of major importance for non-proliferation. The international community should move to proscribe HEU production by any NNWS. This would be a natural extension of the international program to eliminate HEU from civilian use. The IAEA should not agree to paragraph 14 arrangements that involve the production of HEU by a NNWS.

The issue of HEU use has implications for the NPT nuclear-weapon states and the other nuclear-armed states. Where HEU is being used as naval fuel, this has the merit of eliminating HEU stocks, but there is no good reason to produce further HEU. States currently using HEU fuel should transition to LEU. It is time to take a Fissile Material Cut-off Treaty seriously, and to consider how an FMCT could be used to advance non-proliferation, disarmament and nuclear security objectives.

From this discussion, it can be seen that naval nuclear propulsion involves much wider issues than just paragraph 14 arrangements. International collaboration to address these issues could help build the confidence and trust needed for real progress towards the elimination of nuclear weapons.