Foreword

Harold S. Green, a former CEO of International Telephone & Telegraph (ITT), put it well when he said "We must not be hampered by yesterday's myths in concentrating (on) today's needs." In this book, benefiting from his decades-long research and analysis of publicly available, non-classified information, Jones seeks to debunk a long-standing myth that reactor-grade plutonium cannot be used—with certain limitations—for nuclear weapons.

This report provides a timely re-think for a number of reasons. Should nuclear developments in Northeast Asia or in the Middle East go in a wrong direction, we may come to witness a new type of nuclear race, based on existing large stocks of spent fuel containing plutonium which can be used in a fairly short time for nuclear weapons, if national security circumstances so warrant. Current states with nuclear weapons have traditionally produced their stocks using dedicated plutonium production reactors and used plutonium with more than 93% isotope plutonium-239, weapon-grade plutonium. Plutonium, that has more than 7% isotope plutonium-240, or reactor-grade plutonium, is not deemed suitable for nuclear weapons due to heating or nuclear pre-detonation possibilities caused by the plutonium-240.

Jones persuasively argues that today's weapon material potential can no longer be viewed as a stark distinction between having usable weapon-grade plutonium or un-usable reactor-grade plutonium. Rather, faced with a lack of weapons grade material, states bent on seeking nuclear weapons that already possess reactor-grade plutonium may view its choices differently.

According to the latest IAEA Nuclear Technology Review, there are 447 operational nuclear power reactors in 30 countries, and another 60 reactors are in construction—many of them in regions with political turmoil and long-term instability. The World Nuclear Association estimated that at the end of 2014 the global stock of spent fuel was 371,000 tonnes of heavy metal (t HM). This spent fuel contains the order of 400 tons of plutonium. The stocks of spent fuel have been estimated to increase about 12,000 tHM annually. In addition, there is highly enriched uranium and already separated plutonium in military and civilian fissile material stocks. The International Panel on Fissile Material estimated in January 2017 that the global stocks were 1,340 tons of highly enriched uranium, 230 tons of military plutonium, and 290 tons of separated plutonium in civilian custody.[1] It can be assumed that most of the latter is reactor-grade plutonium. This stock is sufficient, using the IAEA definition for a significant quantity, for the manufacture of 36,000 nuclear weapons. In addition, plutonium accumulated currently as spent fuel has a calculated potential for at least another 55,000 nuclear devices.

Jones points to the disquieting fact that there is a way to design a reactor-grade plutonium nuclear device that would have a yield of 5 kilotons that could technically mitigate the physical constraints otherwise caused by some of the plutonium isotopes. Such a device may not cause a Hiroshima like devastation to an adversary, but is certainly sufficient to cause tremendous damage—and for that reason—also has a lower threshold in use.

If such a hedging option is selected by a state that has spent fuel or separated plutonium under safeguards, is the IAEA equipped to monitor spent fuel and provide timely warning to states with the current safeguards agreement in force?

---

1. International Panel on Fissile Material, "Fissile Material Stocks," accessed on February 13, 2018, available from http://fissilematerials.org/.

On the first question, the good news is that IAEA safeguards do not differentiate plutonium based on its isotopic composition. Since the dawn of IAEA safeguards, the IAEA Board of Governors has used as a definition for nuclear material as any source and/or special fissionable material as defined in Article XX of the Statute. Accordingly, any plutonium that has plutonium-239 is subject to safeguards.

At the same time, the IAEA reviews at regular intervals its inspection parameters including definitions. There have been suggestions in the past to split plutonium to weapon grade and reactor-grade plutonium. Advocates for such the split have argued that reactor-grade plutonium is not suitable for nuclear weapons, and that the IAEA spends unnecessary resources to safeguard plutonium that is not a proliferation risk. However, based on consultations with nuclear weapons states, the IAEA Secretariat has not seen it prudent to do so. In other words, the IAEA and its Board of Governors have tacitly acknowledged that reactor grade plutonium can be used to manufacture a nuclear weapon.

But there are also civilian plutonium and spent fuel stocks in states with nuclear weapons that are not monitored by the IAEA. The amount of spent fuel in storage subject to the IAEA safeguards was estimated to have reached 273,000 t HM by the end of 2016 and it is increasing at a rate of 7,000 tons/year. In other words, every year, an additional 70 tons of plutonium is accumulated in newly produced spent fuel. This means that two-thirds of the global spent fuel stocks are covered by the IAEA verification system. Out of 270 tons of civilian plutonium in 2015, only 98.6 tons of plutonium were subject to the IAEA verification.

Most of the plutonium exists today in states that have nuclear weapons, which—at this stage—have sufficient amounts of weapon grade material stocked for their arsenals. If and when nuclear disarmament proceeds, tapping reactor grade plutonium may become attractive. Thus it is important in future disarmament agreements, such as the Fissile Material Cut-off Treaty (FMCT), to include all plutonium regardless of its origin subject to the treaties to be negotiated.

As to the second question of whether the IAEA verification regime is fit to provide sufficient early warning should a state decide to divert plutonium from existing stock for nuclear weapons, there are two basic scenarios. One is for a state to have a declared program to extract plutonium for future use in a nuclear program to recycle it as fuel. With the current verification regime, reasonable assurances can be provided by the IAEA. The loophole here is that under the Non-Proliferation Treaty (NPT), a state can withdraw from the NPT using the supreme interest provision and use existing materials to produce nuclear weapons. This is what North Korea has done, and Jones proposes that the NPT Parties close this loophole.

Can a state produce nuclear weapons without the IAEA detecting it? Since the verification of spent fuel is a relatively straight forward process, such a development is not likely to go without detection. However, a state's breakout time can be reduced by conducting preliminary studies on plutonium metallurgy with small quantities of plutonium, as North Korea has likely done. North Korea has been able to go from its withdrawal from the NPT to conducting its first nuclear test in three years. Jones further correctly points out that plutonium extraction for the first few nuclear weapons can be carried out under less sophisticated reprocessing installations, which would, in turn, reduce break-out time and possibilities of detection, particularly in an isolated country. While the IAEA can detect with a high probability abrupt diversion of a significant amount of spent fuel from the stocks subject to safeguards, the Achilles heel is still in discovering a clandestine nuclear installation. As in the cases of the Al Kibar reactor in Syria or the Fordow enrichment plant in Iran, the international community had to rely to a great extent on intelligence information from member states, which have their own limitations.

In sum, reactor-grade plutonium poses a proliferation risk, and stocks of civilian separated plutonium and plutonium in spent fuel should all be subject to international monitoring. It is also essential that the future arms control treaties like the FMCT subject all plutonium regardless of its isotopic composition to Treaty provisions. This book provides the necessary technical justification and considerations to make the case.

Olli Heinonen