PRELIMINARY FINDINGS FROM A SURVEY OF REGULATORY REQUIREMENTS OF EURATOM MEMBER STATES ON NUCLEAR MATERIAL ACCOUNTING AND CONTROL MEASURES FOR NUCLEAR SECURITY

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I. ABSTRACT

Continuous regulatory control of nuclear material in a State is key in meeting the obligations under the Amendment to the Convention on Physical Protection of Nuclear Material (A/CPPNM) and the United Nations Security Council Resolution on Non-proliferation of Weapons of Mass Destruction (UNSCR 1540 or Resolution). The International Atomic Energy Agency (IAEA) Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (NSS 13), also known as INFCIRC/225/Revision 5, provides that the operator should ensure control of and be able to account for all nuclear material at a nuclear facility at all times and report any confirmed accounting discrepancy in a timely manner as stipulated by the competent authority. Recent analysis from the Pacific Northwest National Laboratory (PNNL) reviewed how adoption of national laws and regulations specifically governing the use of nuclear material accounting and control (NMAC) for security can promote effective implementation of this principle and of corresponding international requirements. Continuing this work, PNNL undertook a preliminary review of laws and regulations governing NMAC in the European Union (EU) region to assess practices among a set of developed countries with nuclear fuel cycle infrastructure as a starting point for a broader global survey to identify regulatory good practices on NMAC for security. Preliminary findings suggest that EU non-nuclear weapon States (NNWS) under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) typically lack dedicated regulations on this topic, tending instead to rely on the regional authority for international nuclear safeguards, the European Atomic Energy Community (Euratom), to carry out oversight of nuclear material accounting. A somewhat deeper review of the EU and Euratom framework sparks important questions about whether a regional authority may or should conduct material accountancy oversight activities for security when security is generally recognized as a national responsibility, and whether an additional layer of accountancy oversight at the national level may be called for. This paper offers initial results from this review as an invitation to validate its findings and a basis for further discussions on the topic.

II. INTRODUCTION

Continuous regulatory control of nuclear material in a State is key in meeting the obligations under the Amendment to the Convention on Physical Protection of Nuclear Material (A/CPPNM) and the

United Nations Security Council Resolution on Non-proliferation of Weapons of Mass Destruction (UNSCR 1540 or Resolution).[1] The International Atomic Energy Agency (IAEA) Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (NSS 13), also known as INFCIRC/225/Revision 5, provides that the operator should ensure control of and be able to account for all nuclear material at a nuclear facility at all times and report any confirmed accounting discrepancy in a timely manner as stipulated by the competent authority.[2] Recent analysis from the Pacific Northwest National Laboratory (PNNL) reviewed how adoption of national laws and regulations specifically governing the use of nuclear material accounting and control (NMAC) for security can promote effective implementation of this principle and of corresponding international requirements and guidance.[3] Continuing this work, PNNL recently undertook a preliminary review of laws and regulations governing NMAC in the European Union (EU) region to assess practices among a set of developed countries with nuclear fuel cycle infrastructure as a starting point for a broader global survey to identify regulatory good practices on NMAC for security. Preliminary findings suggest that EU non-nuclear weapon States (NNWS) under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) typically lack dedicated regulations on this topic, tending instead to rely on the regional authority for international nuclear safeguards, the European Atomic Energy Community (Euratom), to carry out oversight of nuclear material accounting. A somewhat deeper review of the EU and Euratom framework sparks important questions about whether a regional authority may or should conduct material accountancy oversight activities for security, when security is generally recognized as a national responsibility, and whether an additional layer of accountancy oversight at the national level might be appropriate. This paper offers initial results from this review as an invitation to validate its findings and as a basis for further discussions on the topic.

III. BACKGROUND ON NMAC FOR SECURITY AND NMAC IN THE EU

NMAC systems are crucial for effective nuclear security through providing continuous information to operators and to States on their nuclear material inventories, ensuring that those inventories remain under operational and regulatory control, and deterring and detecting the unauthorized removal of nuclear material and other unauthorized acts.[4]

NMAC is commonly subdivided into "item" and "bulk" accounting of nuclear material. Item accounting involves tracking discreet items or packages that are left intact for the period of their accountancy, whereas bulk accounting addresses accountancy of loose quantities of nuclear materials that are in an industrial or other process or otherwise cannot be packaged. Item accounting is comparatively simpler – cataloguing items, tracking their movement or transfer, and periodically confirming their presence and integrity – whereas bulk accounting involves technically sophisticated metrology to calculate or account for material produced, present, "held up" (left as residue) in processing equipment,

[1] Convention on the Physical Protection of Nuclear Material, as amended, INFCIRC/274/Rev.1/Mod. 1, IAEA, Vienna (2016); UN Security Council, Security Council resolution 1540 (2004) Concerning Weapons of Mass Destruction, 28 April 2004, S/RES/1540 (2004).
[2] International Atomic Energy Agency, Nuclear Security Series No. 13, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), IAEA, Vienna (2011).
[3] Man, M, McGinnis, B., and Morris F., Nuclear Material Accounting and Control for Nuclear Security in The International Legal Framework for Nuclear Energy and In International Nuclear Security Guidance: Gaps and Opportunities (2022).
[4] At the nuclear facility level, an NMAC system serves to "deter and detect the unauthorized removal of nuclear material by maintaining an inventory of all nuclear material, including information related to its location." International Atomic Energy Agency, Nuclear Security Series No. 25-G, Implementing Guide, Use of Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities, IAEA, Vienna (2015).

and more. A particular security concern with bulk facilities or activities is the prospect of "protracted theft," where small quantities of bulk material, particularly under detection or reporting thresholds, might be diverted and stolen over time in order to accumulate a larger quantity of nuclear material that is outside both national regulatory control and international accountancy. In this connection, NMAC generally presents a greater challenge and concern for bulk facilities and States that possess these.

NMAC has always been a standard practice for bulk processing facility operations, but the importance of its use for security has become more generally recognized since the terrorist attacks of Sept. 11, 2001, and the adoption of UNSCR 1540, which requires UN member states to adopt effective measures to account for and secure, *inter alia*, nuclear materials (see Sec. IV.a. below).[5]

a. NMAC FOR SAFEGUARDS VS. SECURITY

There are important distinctions between accounting goals and approaches for international nuclear safeguards and for security, respectively. The former is performed by international bodies and seeks to verify that a *State* is not diverting nuclear material for undeclared non-peaceful purposes, assessed in the aggregate for all nuclear activities in the State and at the scale where there is a risk that the State may be pursuing a clandestine nuclear weapons program. The latter is done by facilities and by national regulatory bodies, and seeks to deter and detect unauthorized acquisition of nuclear material by *any person*, with commensurately more specific detection thresholds.

Implementation of international nuclear material accounting for safeguards in Europe has been exemplary – Euratom safeguards predate the NPT, and the robustness of Euratom safeguards allowed for a somewhat exceptional arrangement where Euratom serves as a regional reporting authority to the IAEA for NPT safeguards (where nearly all other NNWS report accounting data to IAEA on a national basis).[6]

b. OVERVIEW OF SCOPE, FINDINGS OF SURVEY OF EU NNWS LAWS AND REGULATIONS FOR NMAC

To narrow the scope of this survey to a more manageable dataset of countries and activities, we chose to review the legislative and regulatory frameworks of EU NNWS with bulk processing facilities, which were seen as more likely cases where NMAC for security regulations might be present, or, if they were absent, this might present a topic that would be illuminating as to the state of the international nuclear security framework and State implementation. The authors identified Germany, Netherlands, Romania, Spain, and Sweden as NNWS with bulk processing facilities (uranium enrichment and fuel fabrication plants).[7]

Our preliminary review of the legislative and regulatory frameworks of these countries did not identify national regulatory requirements governing or directing the use of NMAC at all, or for security specifically – rather, the countries appeared to rely exclusively on the Euratom-level requirements for

[5] UNSCR 1540, para. 3(a).
[6] Piotr Szymanski, "The EURATOM regional safeguards system," Statement by Euratom at the Forum on Experience of Possible Relevance to Creation of a Nuclear-Weapon-Free-Zone (NWFZ) in Middle East, 21-22 November 2011, https://www.iaea.org/sites/default/files/euratom211111.pdf. The only other two NNWS in a multi-State accounting arrangement for NPT safeguards are Brazil and Argentina, which collect and report safeguards nuclear material accountancy information through the Brazil-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) [https://www.abacc.org.br/en/the-abacc/about].
[7] NuclearEurope, Interactive Map of Nuclear Facilities (2023), https://www.nuclearеurope.eu/facts-figures/nuclear_facilities/.

nuclear material accountancy, which implements the countries' international nuclear safeguards obligations.[8]

This configuration of requirements, if accurately characterized, could present questions potentially worth closer examination and discussion in light of other important principles of international nuclear law and EU law. The establishment and maintenance of a nuclear security regime is generally recognized as a national responsibility, one that cannot be derogated or transferred to other States or international bodies.[9] Similarly, in the EU framework, while EU Member States are to strive to develop a Common Foreign and Security Policy and a Common Security and Defense Policy, these are common and externally-facing (i.e., these deal with EU relations with States or entities external to the EU). The Lisbon Treaty reserves safeguarding national security as the sole responsibility of each Member State.[10] The EU typically does not legislate for its Member States what their respective national security requirements are to be, nor does it typically promulgate or oversee regulatory requirements for managing security threats. The EU does not direct the establishment of specific security requirements for nuclear facilities or associated activities, for example. The EU typically takes the approach of coordinating and facilitating Member State activities for the protection of their citizens and critical infrastructure through development of non-binding action plans and promulgation of non-binding guidance.[11] Nevertheless, there are some examples of the EU exercising binding legislative powers to address non-State threats, such as the Commission's binding Regulation 2019/1148 (and its predecessor, Regulation 98/2013) on the marketing and use of explosives precursors, which imposed requirements on Member States to restrict and control such substances.[12]

IV. RELEVANT INTERNATIONAL LEGAL OBLIGATIONS AND GUIDANCE

International instruments such as the United Nations Security Council Resolution (UNSCR) 1540, CPPNM, A/CPPNM, and IAEA guidance documents, including the Handbook on Nuclear Law, set forth a number of nuclear security principles to which NMAC for security is arguably integral. These instruments could help to strengthen the current regulatory practices of States for NMAC in line with evolving guidance. As PNNL noted in its earlier work on regulatory good practices for NMAC for security, international guidance could benefit from more specifically identifying regulations on NMAC for security as a distinct nuclear security topic.

a. UNSCR 1540

UNSCR 1540 is the only international instrument on nuclear security that establishes a clear, though general, obligation related to nuclear materials accountancy. Adopted in April 2004 through the Security Council's Chapter VII authority under UN Charter, it obligates UN Member States to, *inter alia*, "[d]evelop and maintain appropriate effective measures to account for and secure [nuclear material] in

[8] IAEA Safeguards Glossary, International Nuclear Verification Series No. 3, IAEA, Vienna (2001).
[9] CPPNM/A, Fundamental Principle A; IAEA, Objective and Essential Elements of a State's Nuclear Security Regime, Nuclear Security Series No. 20 (NSS 20) (2013), Essential Element 1; IAEA, Handbook on Nuclear Law (2003), 1.4.2. Security Principle, 1.4.3. Responsibility Principle.
[10] Treaty of Lisbon amending the Treaty on European Union and the Treaty establishing the European Community, signed at Lisbon, 13 December 2007, OJ C 306, 17.12.2007 (Lisbon Treaty), Art. 3a(2), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A12007L%2FTXT.
[11] European Commission, Migration and Home Affairs: Protection (2023), https://home-affairs.ec.europa.eu/policies/internal-security/counter-terrorism-and-radicalisation/protection_en.
[12] Regulation (EU) 2019/1148 of the European Parliament and of the Council of 20 June 2019 on the marketing and use of explosives precursors, amending Regulation (EC) No 1907/2006 and repealing Regulation (EU) No 98/2013, PE/46/2019/REV/1.

production, use, storage or transport; and […] [d]evelop and maintain appropriate effective physical protection measures."[13] Thus, UNSCR 1540 provides an overarching directive to all UN Member States to comprehensively account for nuclear materials throughout their life cycle. The Resolution does not stipulate whether regional, versus national, accounting arrangements might satisfy this obligation, nor does it provide mechanisms for an enforcement or for the development of guidance additional to that available under existing international regimes for the control of weapons of mass destruction. Nevertheless, UNSCR 1540 is often cited as a foundation for international security and nonproliferation efforts, and for national obligations to implement security for dual-use materials of concern.

b. CPPNM AND A/CPPNM

The CPPNM and its 2005 Amendment establish obligations for the physical protection of nuclear material and require various measures related to the prevention, detection, and punishment of criminal acts related to nuclear material. Whereas the CPPNM addresses strictly international transport and transfers of nuclear material, A/CPPNM also addresses the security of nuclear material in domestic use, storage, and transport. For a national nuclear security regime, the A/CPPNM requires the implementation of twelve key physical protection principles.[14] Neither CPPNM nor A/CPPNM specifically requires nor invokes NMAC for security, however certain of the key principles in A/CPPNM relate closely to NMAC. These include the "graded approach" (based in significant part on nuclear material categorization, which CPPNM and A/CPPNM do require, and which assumes some kind of nuclear material inventory and accounting to implement), "defense in depth" (typically involving multiple, redundant layers of detection measures, and NMAC is generally recognized as a core class of detection activity), and "quality assurance" (which involves mitigating operational unreliability and uncertainty with validated methods, and in bulk processing activities means application of rigorous NMAC). Additionally, A/CPPNM requires States to develop a legislative and regulatory framework managed by a competent authority that is responsible for establishing, implementing and maintaining a physical protection regime for nuclear material and nuclear facilities.[15] While CPPNM and its Amendment do not specifically address NMAC, NMAC is nonetheless integral to their implementation through creating mechanisms to detect the loss of stolen nuclear material and to initiate the security and prosecutorial responses that CPPNM and the Amendment envision.

c. IAEA GUIDANCE ON NMAC

There are two primary publications within the IAEA's Nuclear Security Series (NSS) that are relevant, for the purposes of this paper, to NMAC and the legislative and regulatory framework: the Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (NSS 13 or INFCIRC/225/Revision 5) and the Implementing Guide on the Use of Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities (NSS 25-G). The supplementary publication on implementing legislation for IAEA's Handbook on Nuclear Law also mentions NMAC.

NSS 13 enjoys a unique status somewhat apart from normal non-binding international guidance given the close mutual influence and evolution between the subsequent versions of INFCIRC/225, on the one hand, and the CPPNM and A/CPPNM, which are legally binding, on the other, as well as the direct incorporation of INFCIRC/225 into certain binding international nuclear cooperation arrangements as a

[13] UNSCR 1540 para. 3(a),(b).
[14] Convention on the Physical Protection of Nuclear Material, as amended, INFCIRC/274/Rev.1/Mod. 1, IAEA, Vienna (2016), Art. 2A(3).
[15] *Ibid,* Art. 2A(2).

common security standard for the parties to observe.[16] NSS 13 repeatedly recognizes the importance of NMAC as integral to various of the "Fundamental Principles" for nuclear security that it identifies, including Competent Authority, Responsibility of the License Holders, Threat, and Defense in Depth.[17] NSS 13 additionally identifies nuclear material accountancy and control among the measures it recommends requiring for physical protection of nuclear material in use and storage, for location and recovery of missing or stolen nuclear material, and the process for design of a physical protection system against sabotage.[18]

NSS 25-G directly addresses the implementation of a State's NMAC system to achieve nuclear security objectives by, *inter alia*, developing regulations and regulatory oversight of nuclear facilities by a State's competent authority. [19] Nevertheless, NSS 25-G does not elaborate on the elements that should be addressed in a State's legislative and regulatory framework to achieve nuclear security objectives through NMAC.

Lastly, the IAEA's *Handbook on Nuclear Law: Implementing Legislation* additionally highlights that "accounting and control measures for nuclear material" should be included in legislative provisions on the physical protection of nuclear material and nuclear facilities.[20]

V. STRUCTURE OF EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM) SAFEGUARDS FRAMEWORK AND SURVEY OF RELEVANT EURATOM NNWS FRAMEWORKS

Established by the 1957 Treaty Establishing the European Atomic Energy Community, Euratom is an international organization focused on developing nuclear energy, facilitating research, and developing technical information for its Member States.[21] Euratom implemented a regional nuclear safeguards arrangement in 1960 under a similar paradigm to the integrated governance frameworks under the European Coal and Steel and European Economic Communities, which sought to prevent conflict on the European continent through mutual governance and oversight arrangements. As noted in Sec. II.b. above, this regional arrangement went on to become the basis for application of IAEA comprehensive safeguards under NPT for the Member States of the European Community. Euratom's Commission merged with those of the European Coal and Steel Community and European Economic Communities in the 1965 Merger Treaty, which was reaffirmed and manifested in the European Commission in the 2007 Lisbon Treaty.[22] Euratom continues to operate under the original 1957 treaty, so it enjoys a distinct legal personality, but is also an integral part of the European Union architecture.

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[16] See, e.g., Everton, Bayer, and Carlson, *Developments in the IAEA's Nuclear Security Series and Physical Protection Guidance Document INFCIRC/225* (2010), https://www.dfat.gov.au/sites/default/files/developments-in-the-iaea-INFCIRC225.pdf.

[17] International Atomic Energy Agency, Nuclear Security Series No. 13, Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities (INFCIRC/225/Revision 5), IAEA, Vienna (2011), 3.19, 3.26, 3.28, 3.36, 3.47.

[18] *Ibid* at 4.10, 4.11, 4.57, 4.58, 5.19.

[19] International Atomic Energy Agency, Nuclear Security Series No. 25-G, Implementing Guide, Use of Nuclear Material Accounting and Control for Nuclear Security Purposes at Facilities, IAEA, Vienna (2015).

[20] International Atomic Energy Agency, Handbook on Nuclear Law: Implementing Legislation, Vienna (2010), 14.2.1.

[21] Treaty Establishing the European Atomic Energy Community (1957), 298 UNTS 167, entered into force 1 January 1958 (Euratom Treaty), https://www.europarl.europa.eu/about-parliament/en/in-the-past/the-parliament-and-the-treaties/euratom-treaty.

[22] Treaty establishing a single Council and a single Commission of the European Communities (Treaty of Brussels, Merger Treaty) (signed 8 April 1965, entered into force 1 July 1967); Lisbon Treaty (2007).

While Article 2 of the Euratom Treaty requires that Euratom Member States collectively "make certain, by appropriate supervision, that nuclear materials are not diverted to purposes other than those for which they are intended" and Chapter VII (Arts. 77-85) sets forth more detailed safeguards accountancy stipulations, there is no explicit mandate for nuclear materials security or physical protection in the Euratom Treaty (perhaps unsurprising, given its adoption before international terrorism came to the fore). Commission Regulation (Euratom) No. 302/2005 of 8 February 2005 on the application of Euratom safeguards (Euratom Safeguards Regulation) and Commission Recommendation of 11 February 2009 on the implementation of a nuclear material accountancy and control system by operators of nuclear installations (notified under document number C(2009)785) establish binding requirements and non-binding guidance, respectively, for nuclear facilities on implementation of NMAC for safeguards channeled through Euratom.[23]

Though the Euratom Treaty does not explicitly contemplate physical protection, the European Court of Justice (ECJ), in a 1978 opinion on whether Euratom Member States could join the CPPNM, noted that the Euratom safeguards concept was sufficiently broad to encompass physical protection, and asserted that, due to concerns over the potential that piecemeal accession to CPPNM by Euratom Member States could affect the single European market, the Member States could join CPPNM only in close coordination with the Euratom community and only if the Euratom community also became party to the Convention.[24] And indeed, for both CPPNM and A/CPPNM, Euratom and each of its individual Member States joined together.[25]

This obscures somewhat the legal significance of Euratom's status as a party to A/CPPNM. As all Euratom Member States are already States Parties, does Euratom's membership create any meaningful additional obligations, and if so, on whom? It likely makes adoption of and adherence to CPPNM and A/CPPNM part of the *acquis communautaire*, so, obligatory for new EU and Euratom Member States. But A/CPPNM explicitly imposes obligations on participating States to implement the fundamental nuclear security principles – does Euratom's participation create analogous obligations, or vest Euratom with authority, to undertake those same activities at the community level? Some experts have argued that it does, that it provides a basis and an obligation for Euratom to issue regulations for nuclear security.[26] Particularly in light of the ECJ's analysis that individual Member State actions to implement CPPNM might interfere with the common market, there may be a compelling reason for action on regulations for NMAC for security might have to happen in coordination at the Euratom level.

In any case, whether because of possible preemption by Euratom or not, our preliminary survey of the regulatory frameworks of EU NNWS with bulk facilities appears to indicate that Euratom Member States have yet to take national-level regulatory action on NMAC for security.

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[23] Commission Regulation (Euratom) No 302/2005 of 8 February 2005 on the application of Euratom safeguards, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32005R0302; Commission Recommendation of 11 February 2009 on the implementation of a nuclear material accountancy and control system by operators of nuclear installations (notified under document number C(2009) 785), https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A32009H0120.

[24] Ruling of the Court of 14 November 1978, Ruling delivered pursuant to the third paragraph of Article 103 of the EAEC Treaty - Draft Convention of the International Atomic Energy Agency on the Physical Protection of Nuclear Materials, Facilities and Transports, European Court Reports 1978 -02151, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:61978CX0001.

[25] IAEA, Convention on the Physical Protection of Nuclear Material: Agreement Status (2023), https://www.iaea.org/sites/default/files/22/06/cppnm_status.pdf; IAEA, Amendment to the Convention on the Physical Protection of Nuclear Material: Agreement Status (2023): https://www.iaea.org/sites/default/files/22/06/cppnm_status.pdf.

[26] Athanase Popov, "Euratom competence in the areas of nuclear security and nuclear safety: An impossible parallel?" Nuclear Law Bulletin No. 101 (2018), https://inis.iaea.org/collection/NCLCollectionStore/_Public/50/020/50020742.pdf.

a. SURVEY OF RELEVANT EURATOM NNWS FRAMEWORKS

The authors surveyed the frameworks of European NNWS with bulk processing facilities – specifically Germany, Netherlands, Romania, Spain, and Sweden – for NMAC topical coverage using the following approach. Research began with a review of the 1540 Matrix for each country, which provides information on State implementation of UNSCR 1540, including legislation and treaty ratifications. Reviewers located the foreign language originals of the documents cited in the 1540 matrices and reviewed these using machine translation. Using a list of NMAC-relevant search terms (e.g. "nuclear material accounting and control," "bulk facilities") translated into the official language of each country, we reviewed available databases of laws and regulations as well as the websites of the regulatory authorities for nuclear and radiation safety and security for each State. Beyond the Euratom safeguards regulation as well as other regulations from this organization however, the laws and regulations generated from these searches included mostly nuclear security and safety legislation with no direct reference to NMAC for security.

i. GERMANY

An in-depth review of Germany's nuclear-related legislation and regulations, including "Law on the Peaceful Use of Nuclear Energy and the Protection Against their Dangers (Atomic Act)", "Law to protect against the harmful effects of ionizing Radiation (Radiation Protection Act - StrlSchG)," and a host of other sources, did not identify national-level requirements for NMAC beyond those set forth in the relevant European Commission regulations. Germany's "Requirements relating to the physical protection service and physical protection officers at nuclear facilities and installations (BASE Reactor Safety and Radiation Protection Handbook [RS-Handbuch], 3-57.1, English version)" does state that Germany's physical protection regulations are based on the recommendations in NSS 13.

ii. NETHERLANDS

Similar to Germany, the authors did not identify operational legislative or regulatory provisions on NMAC for the Netherlands. It was not readily apparent that the Netherlands Authority for Nuclear Safety and Radiation Protection engages in regulatory oversight with respect to NMAC.

iii. ROMANIA

Romania's framework for NMAC is fairly developed. In addition to the European Commission regulations, the Romanian National Commission for Nuclear Activities Control (CNCAN) has also enacted several regulations promoting the implementation of NMAC at its nuclear installations. CNCAN is responsible for establishing and coordinating the national system for accounting and control of nuclear material in-country. CNCAN requires that the operator ensure the accountancy of all nuclear material.[27] CNCAN regulations also require operators to ensure physical protection of nuclear facilities and materials in all lifecycle activities (storage, use, measurements, transfer), to address the interfaces of nuclear safety, safeguards, and physical protection.[28] Nevertheless, research did not identify detailed provisions specifically on NMAC for security.

[27] Norms on the Control of Nuclear Safeguards, approved by Order No. 363/2001 of CNCAN President (NGN-01), Art. 25.

[28] CNCAN, Norms on physical protection in the nuclear field, approved by Order of the CNCAN president no. 173 of October 26, 2021 and published in the Official Gazette of Romania no. 1130 bis of November 26, 2021, http://www.cncan.ro/assets/NPF/Monitorul-Oficial-Partea-I-nr.-1130Bis.pdf.

iv. SPAIN

Spain also has requirements for facility-level NMAC systems. Per Royal Decree 1308-2011 on physical protection (as amended by Royal Decree 1086-2015), NMAC systems are required to be in operation at all times and accurately recorded.[29] Article 33 of the amended Decree 1308-2011 requires nuclear facilities to implement NMAC systems and periodic physical inventories. It also grants the Ministry of Industry, Tourism and Commerce, the authority to request an immediate physical inventory, and requires nuclear facilities to make the Ministry aware of any accounting anomalies.[30] However, there do not appear to be provisions that directly address NMAC for security.

v. SWEDEN

The authors did not identify national-level legislative or regulatory provisions on NMAC for security for Sweden beyond the applicable European Commission requirements.

VI. IMPLICATIONS AND RECOMMENDATIONS

Our preliminary open-source survey of legislative and regulatory frameworks of Euratom NNWS with bulk facilities suggests that these States sometimes lack national requirements for NMAC altogether, and that none have specific requirements regarding use of NMAC for security. In addition, there appears to be some ambiguity as to whether EU Member States may even act on this topic, given past policy stances by EU-level institutions that national initiatives to implement CPPNM pose a concern to the single market. At the same time, standing EU policy and requirements that reserve national security as the exclusive legislative province of its Member States may, in turn, present an obstacle to EU- or Euratom-level action. In spite of this, there are examples of EU-level legislative action on similar topics for security and terrorism prevention, such as the Commission regulations on sales of explosives precursors.

Given limitations of our research methodology, which relied on open sources, machine translation, and interpretation of legal provisions and systems on which we are not experts, we welcome feedback on whether our findings regarding the substance of these countries' frameworks are indeed accurate.

Assuming our findings are correct at least in the fundamentals (that requirements on NMAC for security are lacking), European regulators might review and consider whether development of regulatory requirements on NMAC for security represents a valid and worthwhile area to strengthen their nuclear security frameworks. Natural forums for such discussions could include the European Nuclear Energy Forum (ENEF) and the European Nuclear Security Regulators Association (ENSRA), or Euratom itself.

If European regulators were to agree that regulations on NMAC for security might be worthwhile, there appear to be challenging questions to resolve on how they might proceed. Our preliminary survey of the history and substance of relevant EU and Euratom law suggests multiple potential paths to address this topic. Different aspects of EU law and precedent suggest that States might lead the process, under the view that security is an area of their exclusive competence, or that Community-led action might be

[29] Royal Decree 1308-2011 on physical protection, as amended by Royal Decree 1086-2015; Art. 33(1)(a) states "All movements of nuclear materials and radioactive sources within the facility are accurately recorded, as well as their entrances and exits from the facility, and their location, use, movement and transformation must be documented at all times, as well as such as the date and the origin and destination of those who enter and leave the facility."

[30] Royal Decree 1308-2011 on physical protection, as amended by Royal Decree 1086-2015.

required, given that isolated Member State regulatory actions might be deemed impermissible for the single market. A third way might be for the Member States and the Commission to coordinate and act in concert, similar to their simultaneous adoptions of CPPNM and CPPNM/A.

VII. CONCLUSION

Continuing prior PNNL work that recommended development of guidance on regulatory provisions on NMAC for security, we undertook a survey of the regulatory frameworks of EU NNWS with bulk nuclear material processing facilities to identify regulatory good practices on NMAC for security. This yielded the preliminary finding that none of these countries appeared to have adopted national regulations on NMAC for security, which prompted a deeper inquiry into the EU and Euratom frameworks for nuclear materials accountancy and security. While covering international nuclear safeguards, the EU and Euratom frameworks also do not appear at present to directly require security measures. We identified two threads of EU-level policy that may be in tension and may need to be resolved to proceed with regulations on this topic in the EU, namely that binding regulations on national security are the exclusive province of EU Member States, but also that isolated implementation by Member States of the CPPNM framework might be impermissible under the European single market. The authors hope this paper can serve as a starting point for further discussions among regulatory practitioners in Europe on whether and how to address NMAC for security in their regional and national regulatory frameworks.