



Wilton Park



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Report

In support of Africa's Agenda 2063: pathways forward for expanding peaceful uses of nuclear energy and nuclear technology in Africa

Monday 24 – Friday 28 February 2020 | WP1763

Held in South Africa



Canada 



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In association with the Government of Canada and The African Commission on Nuclear Energy (AFCONE)

Actionable executive summary

On 24-28 February 2020, Wilton Park, in association with the African Commission for Nuclear Energy (AFCONE) and the Government of Canada, convened a conference between senior African policy and technical experts from governments, regulators, academia, industry and their regional and international partners. The participants considered the successes and challenges related to the peaceful applications of nuclear energy and nuclear technologies in Africa, and identified pathways for expanding and strengthening the contribution of these peaceful applications to support Africa's development goals (Agenda 2063, the UN Sustainable Development Goals (SDGs) and the Common African Position (CAP). In addition, the conference participants worked to develop a common understanding of regional positions on peaceful uses to inform the Presidency of the 2020 Review Conference to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT).

Participants considered the contribution of power and non-power applications to sustainable development on the African continent in the fields of agriculture, food and water security, climate change mitigation, human health and electricity generation. Building on past successes in these fields, participants identified challenges and obstacles to expanding peaceful uses. They discussed ways in which national, regional and international partnerships could be leveraged to increase sustainability, coordination and capacity building efforts to maximize the contribution of nuclear energy and technology to the African development agenda.

Participants recognised the essential role of the International Atomic Energy Agency (IAEA) in the development and transfer of these technologies and the support it provides to African countries in this regard. They also considered ways in which countries could make better use of this support.

An important component of this work was to consider ways in which the 50th Anniversary of the NPT's entry into force could be leveraged to this end. Participants recognised that the Treaty has facilitated the application of peaceful uses in Africa over the last 50 years but that more can be done in this regard.

Overarching themes were identified as:

- **Communication.** The importance of communicating the role of peaceful uses in achieving sustainable development, in particular to the leadership on the African continent, development partners and society in general. Promoting the benefits of peaceful uses at home and abroad;

- **Partnerships.** Leveraging regional and international cooperation through enhanced use of AFCONE, the African Regional Cooperative Agreement for Research (AFRA) and the Forum of Nuclear Regulatory Bodies in Africa (FNRBA). Together they can be the strong voices on the continent. Using regional and international networks to connect policymakers, regulators, academia, researchers, youth, women and others to create an enabling environment for peaceful uses. Making use of the 50th Anniversary of the NPT to increase the focus on peaceful uses and its contribution to the UN Sustainable Development Goals (SDGs), COP 21, Agenda 2063 and the Common African Position (CAP);
- **Sustainability.** High-level political commitment to ensure adequate financial resources, robust policy and regulatory frameworks and long-term planning. Developing and retaining home-grown capacity through education and training to implement nuclear technologies safely and securely across the continent.

Participants identified challenges to expanding the applications of nuclear energy and nuclear technology in Africa and made recommendations to address these challenges.

Challenges included:

- Lack of sufficient awareness among senior policymakers and international development partners as to the benefits of peaceful uses of nuclear energy and nuclear technology for development in the areas of agriculture, food security, water resource management, environmental sustainability and human health;
- Lack of sufficient government commitment (political, financial, institutional) to peaceful uses as a tool for development, resulting in the absence of a national policy framework for integrating nuclear technology into relevant sectors mentioned above;
- Lack of sufficient electricity Africa;
- Lack in some countries of sufficient seniority and competence of IAEA National Liaison Officer (NLOs) and other designated counterparts (AFRA National Coordinators) to engage with the IAEA and other partners on different aspects of nuclear science and technology, including articulating country needs and requirement according to the national development plans;
- Lack of proper assessment and/or technical complacency at the IAEA Secretariat (project teams), allowing implementation of non-qualitative and non-sustainable TC projects at the national and regional levels;
- Lack of sufficient data volume and consistent data collection to enable informed needs assessments and gap analyses on a national and regional level to identify how Africa can best utilize nuclear applications to contribute to the SDGs, COP 21, Agenda 2063 and CAP;
- Inadequate long-term planning and coordinated efforts at the national and regional levels, which hinder sustainable capacity building, skills retention and the purchase and maintenance of necessary equipment for laboratories, national nuclear institutions (NNIs) and universities;
- Lack of trust, coordination and transparency between government agencies and national institutions, including regulators, universities, NNIs, research institutes, laboratories, etc.;
- Lack of sufficient infrastructure at universities to conduct research and train students which in turn limits the national capacity in the research, development and application of essential nuclear techniques;
- Lack of sufficient coordination between international partners, in particular under the United Nations Development Assistance Framework (UNDAF) at the country level.
- Lack of critical mass of qualified staff in nuclear application for sustainability

Recommendations include:

- Leverage the 50th Anniversary of the NPT and the Review Conference to create awareness about the contribution peaceful uses of nuclear energy and nuclear technology can make to achieve the SDGs and CAP.
- Establish at the NPT Review Conference a mechanism to fund non-power applications of nuclear science and technology in support of regional needs and priorities, which could include a panel of experts to identify gaps and recommend potential solutions. A recommendation prior to the conference could be made for Subsidiary Body 3 to take up the issues related to the establishment of such a mechanism.
- At the NPT Review Conference, raise the profile of the need for a mechanism to fund, manage and oversee the implementation of cancer control plans in Africa. Such a mechanism would act as a clearinghouse for cancer control in Africa, matching needs with requisite funding, allow for accountability, transparency and coordination. It would also support education and training, equipment provision, maintenance and infrastructure needs.
- Regular ministerial-level meetings to be conducted at the IAEA and the AU on the contribution of Nuclear Science and Technology and the IAEA Technical Cooperation programme to addressing development challenges.
- The IAEA to support the process of establishing and operationalising a mechanism to formalise the coordination between AFRA and the FNRBA with AFCONE to: i) clarify and define the role, duties/mandate and scope of each organisation, ii) define the interfacing areas in terms of technical, financial and managerial aspects, iii) harmonise the vision, mission and strategic objectives of the three organisations so as to align them with the African Union Commission development agenda and strategic plan; and iv) define guides and operational modalities for cross-cutting activities such as partnership building, resource mobilisation, communication and public relations.
- The IAEA to review and update the 2008 NLO guidelines, bring these guidelines to the attention of Member States and encourage Member States to review their selection & nomination criteria in line with the guidelines.
- The IAEA Technical Cooperation Division to develop a tool, similar to the Integrated Nuclear Security Support Plan (INSSP), to better assist countries to develop a comprehensive workplan with milestones per area.
- International partners to continue creating opportunities for cross-sectoral engagement between policymakers, regulators, operators, academia and practitioners to promote better understanding and creative ways to expand peaceful uses.
- Disseminate success stories from Africa and other developing regions, nationally, regionally and internationally to illustrate the clear and measurable impact of nuclear applications on increasing agriculture production and food security, including return on investment;
- Senior policy makers, especially in Africa, are needed to champion the benefits of peaceful uses of technology for development in the areas of agriculture, food security, water resource management, environmental sustainability and human health;
- Encourage technology holders to design and develop equipment, like linear accelerators for radiotherapy, to be more durable, easier to operate and more energy efficient to the needs of the African market.
- For the purpose of expanding nuclear power applications, AFCONE/AFRA/FNRBA to explore the feasibility & cost-effectiveness of creating an arrangement modelled

on EURATOM for cooperation, regulation and control in Africa.

- The African Union (AU) to encourage the accession of all its members to the three organisations (ratification of the Pelindaba Treaty, accession to the AFRA Agreement and the accession to the NRB Forum in Africa).
- The AU to urge the countries party to the protocols to contribute financial resources in a timely and sustainable manner to enable AFCONE, AFRA and the FNRBA to deliver consistently on their respective mandates.
- The AU to develop with AFCONE a regional nuclear energy strategy with time-bound benchmarks to increase the contribution of nuclear power to electricity production and to decrease the use of fossil fuels. This should be done with the support of the IAEA and relevant regional organisations.
- Promote education at secondary and tertiary levels, especially of women, on nuclear technology both nationally and regionally.
- Develop national regulatory infrastructure and competencies required to apply safe, secure and safeguarded nuclear technologies.
- African countries to champion the important role of peaceful uses in achieving Africa's development agenda and the SDGs through national statements and through African Group statements at the NPT Review Conference.
- AFCONE to submit working papers on issues relating to the peaceful uses of nuclear energy and nuclear technology to the NPT Review Conference, in consultation with other regional organisations.
- Review, on the national level, the selection criteria for designating national counterparts (including but not limited to NLOs and AFRA NCs) to engage with the IAEA, to ensure that these representatives are senior policy and scientific experts who are able to liaise effectively between national and international partners and to articulate country needs and requirements.
- Establish and implement a robust national policy and planning framework for integrating nuclear technology into the national agenda, which can be developed through a panel of experts representing the relevant sectors.
- Develop and implement a national cancer control plan, including raising awareness on WHO, IAEA, AFCONE and AORTIC cooperation support.
- Governments to coordinate their budgets and long-term priorities with capacity building and training activities to ensure that qualified professionals and experts can find placement and be retained in the national job market, and that laboratories and universities have the required funds to purchase and maintain equipment.

Introduction

1. According to the Food and Agriculture Organisation (FAO) 2019 report on the "State of Food Security in the World," hunger is on the rise in almost all African subregions, making Africa the region with the highest prevalence of undernourishment, at almost 20 percent. According to the International Atomic Energy Agency (IAEA), the number of people suffering from cancer will double by 2035. With the support of the IAEA the peaceful application of nuclear technologies has contributed significantly over the last 50 years to socio-economic growth, human health and food security in Africa. Approximately 57% of the population of sub-Saharan Africa does not have access to electricity. Africa is hungry for energy, and nuclear power could be part of the answer for an increasing number of countries.
2. There have been successes, but given the prevailing situation, more can and must be done to increase the contribution of nuclear energy and nuclear technology to achieving sustainable development in Africa to fight hunger, facilitate industrial development, improve human and animal health, to ensure access to cancer care,

combat climate change and to power the African continent.

3. The conference participants considered the key elements that contributed to the successful application of nuclear energy and nuclear technologies in Africa and identified challenges and obstacles to expanding the use of nuclear technologies for power and non-power applications. Sustainability of these applications was a key consideration throughout the discussions. Participants identified sustainability as having four competent parts:
 - I. Economic sustainability, including long-term financing;
 - II. Political sustainability in terms of high-level political commitment at national, regional and international levels to maximising the benefit of peaceful uses for development, including the integration of peaceful uses into policy frameworks and strategic planning at a national level;
 - III. Institutional sustainability, with particular regard to regulatory infrastructure, institutions to develop and advance expertise, procurement and maintenance of equipment and robust safety and security cultures;
 - IV. Social sustainability in terms of society's understanding and acceptance of the benefits of nuclear technology for development.
4. Many countries in Africa require improved regulatory competencies and some have no regulatory infrastructure to implement safe, secure and safeguarded nuclear technologies. The conference participants agreed that most countries have acknowledged the importance of nuclear safety and security and want to develop the required infrastructure and competencies. The IAEA is responding to countries needs by developing the tools and support requested by countries; Canada, the United States and France recently contributed new funding for the development of regulatory infrastructure in 37 African countries through the IAEA.
5. Another thread woven throughout the conference was the critical role of regional cooperation. The importance of sharing expertise and technology between countries in the region was emphasised as a sustainable pathway to developing capacity and finding solutions, especially given the diverse levels of technological capabilities and development between countries.

The Sustainable Use of Nuclear Technologies in Non-Power Applications for Food and Water Security, Climate Change Mitigation and Human Health

Nuclear technologies are applied across a broad range of sectors to increase agriculture production and food security, contribute to water and environmental management and improve human and animal health. These techniques are becoming increasingly relevant as tools for managing the impact of climate change, whether through the development of drought resistant crops, better utilisation of soil and water resources or combatting disease.

Agriculture and Food Security

6. The IAEA contributes to improving agriculture production and food security in 45 African countries through the Technical Cooperation (TC) Programme. The application of nuclear technology in Botswana and Namibia was highlighted where nuclear applications have been utilised to increase agriculture production through crop improvement and by preventing the spread of livestock diseases through early diagnoses and surveillance.
7. The IAEA supported the capacity of the Botswana National Veterinarian Laboratory (BNVL) through staff training (over 30 professionals have been trained through IAEA TC Projects), transfer of nuclear and nuclear derived techniques, procurement of equipment, reagents and consumables as well as through expert missions. In the past the laboratory had limited capacity to deal with transboundary animal diseases. Samples taken from sick animals had to be sent abroad often taking weeks to test.

Now the laboratory uses nuclear techniques to make rapid and accurate in-field diagnoses, allowing the government to take immediate action to stop the spread of livestock diseases that can devastate the livestock industry and destroy the livelihoods of small farmers.

8. As a result of this support and the close collaboration between the laboratory and the Government of Botswana, Botswana is free of a number of diseases including Foot and Mouth Disease and Contagious Bovine Pleuropneumonia (CBPP) (an infectious and highly contagious disease of cattle and water buffalo). In just a few years, BNVL went from zero capacity to one of four reference laboratories globally for CBPP. Botswana is also better prepared to deal with existing threats from diseases which are present in neighbouring countries and with diseases of public health concern such as Brucellosis, Rabies and Tuberculosis.
9. The laboratory has developed a five-year strategic plan to maintain current capacity and to increase the diagnostic capacity of the laboratory. This strategy has been broken down into five annual performance plans which capture how the gaps associated with diagnostic capacity, staff competence and retention, availability of diagnostic reagents, equipment and technical expertise will be closed.
10. Nuclear technology is also used to increase crop yields through plant mutation breeding. Mutation breeding does not involve gene transformation, but rather uses a plant's own genetic components and mimics the natural process of spontaneous mutation, the motor of evolution. By using radiation, scientists can significantly shorten the time it takes to breed new and improved plant varieties that include resistance to drought and disease. More countries are experiencing longer periods of draught which has resulted in crop failures and increased food insecurity. More than 40% of food harvest is lost in Africa and nuclear technology can stem these losses. As a result of using disease-resistant varieties of cassava crop yields a farmer in Burundi was able to increase his Cassava yield from 10 tons per hectare to 30 tons per hectare.
11. In Namibia the IAEA is supporting a plant breeding programme that produces sorghum and cowpea seed varieties that are draught resistant. The new varieties are expected to benefit over 8,000 farmers. However, there is not yet legislation in place that allows for the seeds to be distributed to the farmers. Another complicating factor to the country-wide application of this technology is the perception that plant mutation breeding and GMOs are synonymous.
12. The lack of an adequate policy framework to support the development and use of nuclear technology has had an impact on training, as experts trained in the application of these technologies are not able to find work in the agriculture sector. The Namibian Government has established an intergovernmental panel to make recommendations on the inclusion of nuclear technology into national policies and strategies.
13. Conference participants agreed that policy and strategy frameworks that support the development and application of nuclear science and technologies are essential to the sustainable use of nuclear technologies. The lack of understanding among policy makers about the broader benefits of nuclear applications was identified as common problem in Africa. They also noted that senior leadership, including at the political level, were sometimes the barrier to the use of nuclear energy and nuclear technology. Participants agreed that champions for peaceful uses among senior policy makers were required at international, regional and national level to expand access to peaceful uses in Africa.
14. They also emphasised the importance of better communication in countries with the public and between government departments, laboratories and universities, between the IAEA and African governments and between these governments and regional organisations.
15. Conference participants also agreed that success stories in Africa and other developing regions should be widely shared to illustrate to all stakeholders, including the public,

the clear and measurable impact of nuclear applications on increasing agriculture production and food security as well as the high return on investment.

Water Management

16. Groundwater is the largest source of freshwater for mankind. Isotope techniques are used to determine the origin and replenishment rates of groundwater. A common isotope used for this purpose is radon, which has a short half-life that provides an analysis window of only nine hours. This means that the correct equipment and expertise must be available on the ground in order to gather sufficient data to inform and drive policy.
17. Much of the work in water resource management in Africa is conducted through universities and this work is often viewed as not having a real-world application. While the Cape Town water crisis provided a vivid visual impact of the finite nature of water and the importance of water resource management, some universities still struggle to obtain the necessary funding, equipment and on-going big data for water analysis. For example, Stellenbosch University has only one RAD7 Radon detector (which costs less than € 20,000) that has to be shared between departments. As a result, research and training is compromised.
18. Conference participants agreed that a common problem in Africa is the disconnect between universities and governments, as is the lack of funding, sufficient and consistent data and infrastructure. Limited access to the necessary equipment is detrimental to students' ability to further their practical application of the technology and can result in limited national capacity in the research, development and application of essential nuclear techniques. Lack of resources is a major obstacle to the retention and advancement of students.
19. The participants recognised the important role of the IAEA in providing support through its TC programme, but some participants pointed out that they were never able to apply for TC projects or participation in Coordinated Research Projects (CRPs) as their applications always seemed to fall outside the funding timeframes of the IAEA. In this regard the conference agreed that it was the role of the National Liaison Officers (NLOs), appointed by countries, to coordinate between national institutions and the IAEA on the needs and requirements of the country. Participants further agreed that a common challenge in Africa in several countries, is the lack of sufficiently senior and competent NLOs, AFRA National Coordinators and other designated counterparts in countries to engage with the IAEA on different aspects of nuclear science and technology, including articulating country needs and requirements.

In order to improve the application of nuclear science and technologies to agriculture, food and water security in Africa, participants made the following recommendations:

National

- Establish policy and strategy frameworks that support the development and application of nuclear science and technologies as a tool for development;
- Ensure synergy of policy with training and infrastructure for application of nuclear technologies;
- Coordinate national legislation with national peaceful uses programmes in order to maximise the benefits from nuclear technologies;
- Prioritise nuclear technologies as a key component of sustainable development and develop national policies to reflect this;

- Senior policy makers at national regional and international levels are needed to champion the benefits of peaceful uses of technology for development in the areas of agriculture, food security, water resource management, environmental sustainability and human health;
- Promote coordination and communication between governments and their laboratories, research institutions and universities as keys to ensuring the development and retention of experts to apply nuclear techniques that will increase agriculture production, contribute to food and water security, as well as mitigate the impact of climate change;
- Ensure that NLOs are communicating effectively among stakeholders when articulating country needs and requirements to the IAEA;
- Embed the Country Programme Frameworks, which are prepared by a Member State in collaboration with the IAEA Secretariat, in national policy frameworks;
- Teach experts to present the benefits of what they do to policymakers and investors.

Regional

- Regional organisations, in particular AFCONE as the African Union Treaty Body and Specialised Agency, to promote the benefits of peaceful uses in achieving Agenda 2063, CAP and the SDGs;
- Encourage governments to develop the relevant policy frameworks and strategies and to ensure synergy of policies with training and procurement for peaceful uses;
- Identify regional networks and organisations that could assist in capacity building efforts;
- Twin better-resourced countries with poorly resourced countries was recommended as pathway to overcoming some of these obstacles. Such programmes can contribute to developing capacity, maximising the use of resources and fostering regional solutions, including for the development of regulatory infrastructure and competencies.

International

- The IAEA to continue to champion the important role of nuclear science and technology in achieving the SDGs.
- The IAEA to encourage governments to develop policy frameworks and strategies to support the application of nuclear technologies and to increase the impact of TC projects.
- The IAEA, NGOs and other development partners to identify creative ways to demonstrate how nuclear technologies address and ameliorate real-life problems;
- The IAEA to support twinning programmes.
- Successful projects should be upscaled and should include, where relevant the support and participation of other organisations, such as the WHO.

Human Health

20. Africa's Agenda 2063 identifies human health as a priority area for a prosperous Africa. Cancer is a growing problem in Africa. In 2012 there were 847,000 new cancer cases on the continent. By 2030 this figure is expected to reach 1.4 million. Twenty-eight

African countries do not have a single radiotherapy machine for treating cancer. Participants however agreed that combating cancer in Africa requires more than radiotherapy machines.

21. Notwithstanding the lack of even the most basic cancer management infrastructure in many countries, experts made the case for developing and adopting advanced techniques as part of the approach to cancer management strategies on the continent. The point was made that nuclear medicine is revolutionising cancer management. There was agreement that Africa needs the innovation and research opportunities that nuclear medicine provides. To this end it was emphasised that countries need access to radiopharmaceuticals, a research agenda that is shaped accordingly, excellence in training, strong leadership and financially sound institutions.
22. In South Africa, cutting edge research is being conducted on the use of radiopharmaceuticals in the diagnoses and treatment of cancer to ensure early and accurate diagnoses and effective treatment of the disease. In Africa, diseases such as HIV and tuberculosis complicate cancer diagnosis and care. A cancer expert made the case that to effectively diagnose and treat these patients, theragnostics, which provide personalised approaches, should be implemented in Africa.
23. This is an approach that integrates imaging and therapy in a single system, allowing simultaneous therapy and follow-up of the treatment. The expert also argued that the approach to cancer management in Africa should be multi-disciplinary and multi-sectoral including health, education, energy and science as well as public/private partnerships. Furthermore, to combat cancer we have to include the IAEA and the WHO.
24. Participants agreed that political will at the highest level is essential to develop the facilities and the human resources required to ensure the financial and political commitment to cancer control. Zambia is an example of how political will changed the fate of many cancer sufferers in that country. The President of Zambia made the fight against cancer a national priority resulting in the establishment of a cancer treatment centre that has diagnosed and treated close to 20,000 people since 2007. The IAEA, through its TC Programme, has supported the hospital since planning began in 2002.
25. Another essential element for sustainable cancer control identified by the participants is a cancer control plan. Each government must develop a comprehensive cancer control plan, based on which it can engage with the IAEA and other partners to identify additional resources required to implement the plan.
26. Participants also emphasised the value of regional collaboration in this regard and proposed the strengthening of Technical Cooperation Among Developing Countries (TCDC Modalities), sharing of competencies and facilities as a way to address the lack of expertise and infrastructure. The establishment of a regional mechanism to fund, manage and oversee the implementation of cancer control plans in Africa was suggested. Such a mechanism would act as a clearinghouse for cancer control in Africa, matching needs with requisite funding, allow for accountability, transparency and coordination.
27. Other challenges were identified as a lack of data about cancer statistics in most countries, the cost of servicing equipment and unstable power sources. In southern Africa many countries depend on hydroelectricity. With the changing climate, water is drying up and with it the reliable electricity sources required to power equipment for cancer treatment such as linear accelerators.
28. The challenges related to the delay and denial of shipments of radioactive sources and medical isotopes was also touched upon within the context of access to radiopharmaceuticals and equipment for cancer treatment. Regional collaboration and twinning of better-resourced countries with poorly resourced countries was recommended as pathway to overcoming some of these obstacles.

In order to improve the sustainable application of nuclear technologies to combat cancer in Africa, participants made the following recommendations:

National

- Governments to develop and implement national cancer control plans.
- Collect data to better inform budgets and planning;
- Seek solutions for affordable cancer treatment;
- Regulatory authorities to strengthen their engagement with users of nuclear technology to ensure that regulations respond adequately to the resources required to apply nuclear applications.

Regional

- AFCONE, AFRA and the AU to promote the role of nuclear technology in expanding the quality of health care as providing the research and innovation that Africa needs to effectively combat cancer;
- AFCONE, AFRA and FNRBA should explore pathways to addressing issues related to the access of medical isotopes and radioactive sources for cancer diagnosis and treatment;
- AFCONE, the FNRBA and the AU to promote safe and secure power alternatives in the face of unstable and often interrupted power supply;
- Seek regional solutions for training of medical professionals and sharing of equipment.
- AFCONE, AFRA and the FNRBA to strengthen the TCDC modalities and twinning between more advanced and less advanced countries to build capacity;
- Develop a cancer fund for Africa to support countries that have national cancer control plans in place.

International

- IAEA to continue to encourage countries to develop national cancer control plans and to support the implementation of these plans in countries;
- WHO and IAEA raise awareness of the cancer crisis and support African solutions to combat cancer;
- IAEA should expand the applications of nuclear energy and nuclear technology on the continent that include steps to address denials and delays of shipment of medical isotopes and radioactive sources;
- African end-users and development partners to encourage the design of linear accelerators to be more durable, easier to operate and lighter on electricity, to respond to the needs of the African market.

Facilitating Nuclear Power Expansion on the African Continent

29. According to the IAEA approximately 640 million people in Africa live without access to electricity. In many cases, even when people have access to electricity, the supply is unreliable, leading to power outages that are disruptive and difficult to predict. Nuclear power provides approximately one third of low-carbon energy in the world and is a part of future solutions to the energy crisis.

30. As reliable access to electricity is a precondition to sustainable development, the conference dedicated time to discussing ways to facilitate the expansion of nuclear power for electricity production in Africa, focusing on small modular reactors (SMRs) as

an alternative to traditional large nuclear power plants (NPPs).

31. Obstacles to the expansion of nuclear power in Africa were identified as a lack of capacity in the electrical grids of countries to support a traditional 1000 MW(e) reactor; often lower electricity requirements, which do not justify building a traditional NPP; lack of qualified workforce to build and run a traditional NPP; overall cost of a large-scale NPP; the significant lead time associated with new nuclear power programs, often 30 years for newcomer countries; public mistrust in and fear of nuclear power; and lack of adequate regulatory infrastructure.
32. The participants agreed that SMRs can be a viable alternative to traditional NPPs. If SMRs live up to their promise, they would require less financing, less staff and maintenance, less waste management than a large-scale NPP, and would more likely be compatible with existing grids.
33. SMRs also offer the potential of addressing fuel cycle and proliferation concerns, offer inherent passive safety features and provide lower-cost production and operational flexibility. From a security point of view, SMRs limit the risk of facility sabotage or attack and resulting radiation release concerns, as they are designed with characteristics that reduce the risk of dispersal of radioactivity.
34. In terms of safeguards, the question is how can reactors be safeguarded and at what cost? The current international safeguards system has been implemented for light water reactors and the IAEA will need to consider how best to accommodate the unique characteristics of advanced reactor designs.
35. The IAEA's Safety Standards, according to one expert, would also have to be adapted. The IAEA standards for regulatory systems are not technology-neutral as safety standards and systems are shaped for traditional reactor designs.
36. An expert from the IAEA emphasised that, whether a country plans to produce electricity through a traditional NPP or an SMR, it would still need a nuclear power programme that must comply with the international legal regime and follow many of the milestones as enumerated in the IAEA's Milestones Approach.
37. The IAEA is hoping that that SMRs will offer easier construction than traditional NPPs and that large-scale manufacturing will make the technology more affordable than current NPP technology. However, the unproven nature of SMR technology may make it a risky financial and operational choice for newcomer countries.
38. Another expert countered this and noted that we need to stop referring to the ideal situation in which countries build up experience over a long period of time. In fact, one benefit of SMR deployment is that they can potentially be deployed faster than traditional NPP designs.
39. We should find solutions that move toward common approaches to safety and security. Another solution to the lack of experience with SMRs would be for the SMR developers to run their designs as demonstration models.
40. A Canadian expert explained how Canada is preparing for its SMR and how it will engage as a vendor with potential end-users of the technology. To prevent trade barriers, Canada will work with the potential end-user beforehand to determine requirements.
41. The expert noted that countries interested in purchasing SMRs should be ready for the challenges related to licensing innovative reactors with different fuel and different technologies. She recommended that end-users have a good dialogue with vendors, use their current non-proliferation technology and export controls and that the regulators should be ready to innovate in terms of its regulations. Canada is planning to run a demonstration reactor for potential end-users in the near future.
42. Finally, participants noted that public perception will need to improve vis-à-vis nuclear in order for nuclear power to be sustainable. Many in society associate nuclear power

with nuclear accidents and are thus reluctant to rely on it. However, one participant expressed the view that problems with public perception are not insurmountable.

43. Participants also discussed the responsibilities and challenges related to being a nuclear operating country in a national, regional and global context. In terms of defining what a nuclear operating country is, the point was made that not only countries with nuclear power plants should be considered to be nuclear operating countries, as many countries without nuclear power and not considering nuclear power are applying nuclear technologies.
44. It was agreed that there should be a culture of nuclear safety and security as well as non-proliferation from the outset in countries. Cooperation and solidarity should be the clarion call for the development of the infrastructure and expertise to apply nuclear energy and nuclear technology for peaceful purposes.
45. South Africa shared its experience with safeguards implementation. The expert noted that it should be acknowledge that safeguards obligations are more demanding for developing countries. The main challenge is a lack of regulatory framework, technical capabilities and infrastructure in developing countries. She noted that IAEA provided support in this regard.
46. Argentinian experts agreed that embarking on traditional nuclear builds required a large industrial network behind the programme and a robust regulatory body. Given the need for electricity in developing countries the ideal situation would be to build nuclear power plants in shorter times with less capital.
47. Participants discussed the potential of regional collaboration as a way to address the obstacles to expanding nuclear power in Africa. Argentina and Brazil collaborate on accountancy and control of nuclear material through the Brazilian-Argentine Agency for Accounting and Control of Nuclear Material (ABACC), which acts a regional authority and liaises with the IAEA on safeguards matters.
48. Experts however agreed that the EURATOM model was better suited for Africa's purposes. EURATOM's original purpose was to create a specialist market for nuclear power in Europe, by developing nuclear energy and distributing it to its Member States while selling the surplus to other states. However, over the years its scope has been considerably increased to include safeguarding of nuclear materials, radiation protection and infrastructure development.

In order to facilitate the expansion of nuclear power on the African continent, participants made the following recommendations:

National

- Engage with potential SMR vendors at an early stage to determine regulatory requirements;
- Consider proven designs, rather than first-of-a-kind;
- Incorporate safety, security and safeguards into national legislation;
- Take advantage of IAEA resources, including the Milestones Approach, Nuclear Security Series, Safety Standards and expert missions such as INIR and ISSAS;
- Develop a public outreach and engagement strategy to build trust and allay fears on the use of nuclear energy;
- Consider private sector engagement to help with funding;
- Identify barriers early to licensing.

Regional

- For the purpose of expanding power applications, AFCONE/AFRA/FNRBA to explore feasibility & cost effectiveness of creating an arrangement modelled on EURATOM for cooperation, regulation and control in Africa.
- Support already existing regional centres of excellence to develop regional capacity for energy planning, safety, security and safeguards. Also invest in developing other capacities related to managing an SMR.
- Work with neighbours to develop common understandings and practices of nuclear safety and security.
- Encourage twinning to develop especially regulatory capacities.

International

- IAEA to continue to support the African Member States through INPRO Programme, Regional & Interregional Programmes and CRPs, integrating efforts on SMRs Concepts, Safety and Security,
- SMR designers should include security and safeguards by design concepts, in addition to passive safety features.
- International partners, including NGOs, should conduct more research into identifying the challenges related to safeguards, security and export controls in terms of SMRs.

Leveraging Regional and International Partnerships to Expand Peaceful Uses in Africa

In addition to specific non-power and power applications of nuclear technologies and their contribution to development conference, participants discussed the ways to best use regional and international partnerships. Among the themes identified in this regard were: engagement and outreach; national, regional and international coordination; and strengthening capacity.

Strengthening Capacity through Communication, Engagement and Outreach

49. Conference participants noted a number of obstacles and opportunities related to communication, engagement and outreach. Chief among these was the need to reframe the conversation around nuclear technologies as a tool for development. Nuclear applications are not an end to themselves, but rather a tool to aid the development process.
50. To this end, several participants suggested that nuclear technologies for development be thought of as an “Atoms for Life” initiative. This entails a close association with the SDGs, all of which are aided by the peaceful use of nuclear technologies, as well as putting human faces to nuclear applications. Conference participants gave examples of existing initiatives to this end.
51. For example, one participant, an eminent female nuclear scientist from Ghana, started visiting local schools to educate young people, and in particular, to encourage young women, to pursue careers in nuclear science. She stressed that building the confidence of women is key and we cannot underestimate the role of men in advocating for women. The world needs nuclear and nuclear needs women. Supporting women in Science, Technology, Engineering and Mathematics (STEM) is central to young students identifying nuclear as a viable career choice early on.
52. The conference agreed that more educational initiatives like this one were needed in Africa, conducted by champions of nuclear technologies for development. Such engagement increases the capacity of the population and creates an environment where nuclear technologies can be more easily used. This is especially important as it

was stressed that many experts are 'aging out' and there could potentially be a real lack of expertise on the continent.

53. Regional and international networks, such as those discussed in the next session, could be a vehicle through which more such capacity building activities could be achieved.

National, Regional and International Coordination

54. Conference participants found the roles of regional and international organisations to be especially important in the context of the existing regional organisations within Africa. AFCONE explained these organisations as follows:
- The African Union (AU): a continental body consisting of the 55 member states that make up the countries of the African Continent. The AU is guided by the vision of an "Integrated, Prosperous and Peaceful Africa, driven by its own citizens and representing a dynamic force in the global arena."
 - African Commission on Nuclear Energy (AFCONE): Established by the Treaty of Pelindaba is recognised by the African Union Commission as the African Specialised Agency for Nuclear Activities in the Continent (AU Handbook 2019). AFCONE plays a key role in advancing the peaceful application of nuclear science and technology in Africa and in bringing much-needed support to States Parties to fully benefit from nuclear sciences and technology applications in the areas of health, agriculture and energy. Participants also discussed the benefits of Nuclear Weapons Free Zone Treaties, like the Pelindaba Treaty. Not only do these zones provide tangible security benefits, like the NPT, the treaties recognise the rights of all States in their respective regions to make full use of nuclear technologies to enhance economic and social development.
 - African Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology (AFRA): an intergovernmental Agreement established by African Member States to strengthen and enlarge the contribution of nuclear science and technology to socioeconomic development on the African continent. It was noted during the conference that AFCONE considers AFRA its technical implementation arm.
 - Forum of Nuclear Regulatory Bodies in Africa (FNRBA): a coordination mechanism meant for the enhancement, strengthening and harmonization of the radiation protection, nuclear safety and security regulatory infrastructure and framework among its members.
55. Participants agreed that in order to best utilise nuclear technologies for sustainable development in Africa, countries will need to leverage the AU, AFCONE, AFRA and the FNRBA, the relationships between them and their relationships with other international partners, such as the IAEA.
56. As detailed in the previous section, there is great opportunity for education and training opportunities to be supported through regional organisations. For example, AFRA established the African Network for Education in Nuclear Science and Technology (AFRA-NEST), to facilitate the implementation of its strategy on human resource development and nuclear knowledge management.
57. Whilst AFRA-NEST is currently operationalised under an AFRA regional project the question of sustainability of regional networks is under discussion. If AFRA-NEST is to be empowered, particularly through financial contributions by international partners and private donors, many challenges related to the lack of human resources capacity and poor public perceptions about nuclear could be better addressed.
58. Another regional network discussed by the conference was the Veterinary Diagnostic Laboratory Network (VETLAB) initiative developed by the FAO/IAEA joint division and supported by South Africa, the United States and Japan.

59. Through this project 40 laboratories, of which the Botswana National Veterinary Laboratory is one (as discussed earlier in the report), are able to use efficient nuclear-related technology to facilitate surveillance and diagnosis in the field. As a result, countries can immediately respond to an outbreak to prevent the disease from spreading. The eradication of Rinderpest, a disease that had plagued the livestock sector for millennia, owed much of its success to this network of laboratories.
60. Common to both AFRA-NEST and VETLAB are that they are solutions to African problems driven by Africans, which conference participants highlighted as an essential part of sustainable development and accountability.
61. However, participants also noted that without investment by governments, housing these laboratories the sustainability and the quality of the network would be compromised. This “capacity to develop capacity” was identified as a challenge by conference participants.
62. Another obstacle identified was duplication and overlap of efforts and poor coordination between regional organisations and between national stakeholders and governments. One participant noted the difficulty she had experienced in arguing the need for a medical physicist in her laboratory when existing regulations did not require it.

In order to improve strategic communication, engagement and outreach for the purposes of capacity building, and to improve the impact of existing initiatives, facilitate and environment for new ones and enhance coordination on nuclear issues on the African continent overall, the participants made the following recommendations:

National

- Establish national policies to match national efforts and needs;
- Replicate the VETLAB model, noting the contribution that strong and sustainable networks can make to strengthening national capacity to address threats and mobilise regional response;
- Increase awareness among high-level decision makers of the need to champion nuclear technologies for development;
- Consider “train the trainers” initiatives to avoid high staff turnover;
- Coordinate their budgets and long-term priorities with capacity building and training activities to ensure that qualified professionals and experts can find placement and be retained in the national job market, and that laboratories and universities have the required funds to buy and maintain equipment.

Regional

- AFCONE to promote research and development as well as education and training in nuclear science and Technology, including the support of the AFRA.
- Establish a long-term, international or regional planning mechanism with short-term benchmarks to facilitate the activities of national research bodies;
- Promote, as a common agenda, the national coordination of capacity building and training priorities with budgets;
- Support already existing regional centres of excellence to develop capacity;
- Support the youth and women in Africa to create and strengthen official and sustainable national chapters and/or regional organisations.

International

- The IAEA and other international partners to coordinate support provided to countries in training and capacity building with both the needs and the opportunities available on the national level.
- International financial institutions to contribute to the use of nuclear technology in Africa for development.

Leveraging the Treaty on the Non-Proliferation of Nuclear Weapons

63. Participants also discussed how African countries might leverage the occasion of the 50th Anniversary of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) to expand the application of peaceful nuclear technologies for development.
64. Participants observed that there has been a lack of balance in the NPT context between its three pillars of non-proliferation, disarmament and peaceful uses of nuclear energy respectively, and agreed that this would be an opportunity to elevate the discussion around peaceful uses.
65. Participants also discussed how African countries might leverage the occasion of the 50th Anniversary of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) to expand the application of peaceful nuclear technologies for development. Participants observed that there has been a lack of balance in the NPT context between its three pillars of non-proliferation, disarmament and peaceful uses of nuclear energy respectively, and agreed that this would be an opportunity to elevate the discussion around peaceful uses.
66. The 2020 Review Conference provides an opportunity for the international community to increase focus on the peaceful uses pillar, which will allow Africa in particular to derive more benefits from the NPT review process. Ambition in one pillar does not preclude ambition in another.
67. It was agreed that more can be done to expand the contribution of peaceful uses of nuclear energy and nuclear technology in Africa to achieve the SDGs. It was also agreed that a strong, collective African voice with clearly identified priorities would help to advance Africa's development agenda in the context of the NPT.

To this end, conference participants considered four concrete pathways to:

- Expand nuclear non-power applications to support health outcomes within the framework of the NPT;
- Expand nuclear non-power applications to enhance environmental outcomes within the framework of the NPT;
- Use the NPT to leverage nuclear power as a safe, secure and affordable source of electricity for all
- Use the NPT to strengthen and leverage regional partnerships and networks;

The conference identified challenges and recommendations associated with each of these four pathways.

Challenges identified included:

- Lack in some countries of sufficient government commitment (political, financial, institutional) to peaceful uses as a tool for development, resulting in a lack of a national policy framework for integrating nuclear technology into relevant sectors, including those identified above;
- Lack of awareness among senior policymakers as to the benefits of peaceful uses for development in the areas of agriculture, food security, water resource management, environmental sustainability, human health and electricity

generation;

- Lack in some countries of sufficient seniority and competence of designated counterparts to engage with the IAEA and other partners on different aspects of nuclear science and technology, including articulating country needs and requirements according to the national plans of development;
- Lack of sufficient data and consistent data collection to enable informed needs assessment and gap analysis on a national and regional level to identify how Africa can best utilize nuclear applications to contribute to Agenda 2063 and CAP, UN Sustainable Development Goals and COP 21.
- Lack of long-term planning and coordinated efforts at the national and regional levels, which hinder sustainable capacity building, skills retention and the purchase and maintenance of necessary equipment for laboratories and universities;
- Lack of trust, coordination and transparency between government agencies and institutions, including regulators, universities, research institutes and government departments, etc.;
- Lack of sufficient coordination and solidarity between international partners, in particular under the UNDAF, at the country level;
- Lack of a mechanism to track funding pledges/uses (transparency and accountability) and move towards sustainability.

Recommendations included:

- Leverage the 50th Anniversary of the NPT and the Review Conference to highlight the link between peaceful uses of nuclear energy, nuclear technology and the UNSDGs, Agenda 2063 and CAP;
- Establish a mechanism to fund non-power applications of nuclear science and technology in support of regional needs and priorities at the NPT Review Conference, which could include a panel of experts to identify gaps and recommend potential solutions. A recommendation prior to the conference could be made for Subsidiary Body 3 to take up the issues related to the establishment of such a mechanism.
- At the NPT Review Conference, raise the profile of the need for a mechanism to fund, manage and oversee the implementation of cancer control plans in Africa. Such a mechanism would act as a clearinghouse for cancer control in Africa, matching needs with requisite funding, allow for accountability, transparency and coordination. It would also support education and training, equipment provision, maintenance and infrastructure needs.
- At the national level, each country should develop and implement a national cancer control plan, including awareness raising on IAEA cooperation and support.
- Regular ministerial-level meetings to be conducted at the IAEA and the AU on the contribution of Nuclear Science and Technology and the IAEA Technical Cooperation programme to addressing development challenges.
- Regional organisations, AFCONE in particular, and their partners to conduct regular regional consultations on pillar three of the NPT to advance and amplify the benefits of peaceful uses to sustainable development.
- Champion peaceful uses (“Atoms for Life”) in support of the SDGs and CAP and to reflect the evolving priorities of Member States.
- The IAEA should review and update the 2008 NLO guidelines, bring these guidelines to the attention of Member States and encourage Member States to review their selection and nomination criteria in line with the guidelines.

- Governments should review the selection criteria for designating national counterparts (including but not limited to NLOs and AFRA National Coordinators) to engage with the IAEA, to ensure that these representatives are senior policy and scientific experts who are able to liaise effectively between national and international partners and to articulate country needs and requirements.
- Establish and implement a robust national policy and planning framework for integrating nuclear technology into the national agenda, which can be developed through a panel of experts representing the relevant sectors.
- Governments to coordinate their budgets and long-term priorities with capacity building and training activities to ensure that qualified professionals and experts can find placement and be retained in the national job market, and that laboratories and universities have the required funds to buy and maintain equipment.
- Promote education at secondary and tertiary levels, especially of women, on nuclear technology both nationally and regionally.
- For the purpose of expanding power applications, AFCONE/AFRA/FNRBA to explore the feasibility and cost effectiveness of creating an arrangement modelled on EURATOM for cooperation, regulation and control in Africa.

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