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The operation, safety and security of nuclear and radiation facilities and activities during the COVID-19 Pandemic

Report by the Director General

Summary

The document summarises Agency's actions undertaken to facilitate information exchange among stakeholders, collect feedback, and gather support for requesting Member States in mitigating the impact of COVID-19 on the operation, safety and security of nuclear and radiation facilities and activities. It provides summary information on actions taken by operators and regulators during this period. The document also identifies elements of the pandemic's impact, as well as, on the Agency's support to Member States on the operation, safety and security of nuclear and radiation facilities and activities.

The operation, safety and security of nuclear and radiation facilities and activities during the COVID-19 Pandemic

Report by the Director General

A. Introduction

1. The impact of the COVID-19 pandemic has been far reaching. Governments around the world have adopted and implemented strict health and safety related measures, such as physical distancing, restricting inbound and outbound travel, free movement and closing borders.

2. National policy decisions made by governments have direct and indirect repercussions to organizations in the nuclear and radiological field, for example in the area of human resources. Decisions in one country could have affected facilities in other countries, for example through introducing supply chain difficulties in large scale projects such as outage management, major refurbishment or new plant construction. Any impact causing delay of services could have also affected the transport of time sensitive products such as medical isotopes. The stretching of government infrastructure capacity could also potentially have an impact on the emergency preparedness of nuclear and radiation facilities.

3. The nuclear industry has always learned from experience and sought to improve already high levels of safety and security while improving operational performance, including following the accidents at Three Mile Island, Chornobyl and Fukushima Daiichi. Institutional and technical measures were enhanced to improve resilience, and international legal instruments, IAEA safety standards and national regulations were strengthened. Member States have recognized the COVID-19 pandemic as an external event and the nuclear industry was prepared to take special measures to cope with its impact. Nevertheless, COVID-19 is the first pandemic of this scale in the history of the nuclear industry.

4. In Member States, organizations implemented predetermined actions from already prepared pandemic plans designed to ensure safety, security and continuity of business, and adapted them as the pandemic progressed. The Agency significantly adjusted its ways of working to maintain and enhance its support to Member States. In particular, the Agency's efforts to facilitate information exchange were enhanced in order to gather and share experiences, including good practices, of Member States as the pandemic spread. This rapid mobilization enabled the Agency to understand the specific challenges faced by Member States and to respond via appropriate support.

B. Actions undertaken by the Agency to support Member States in mitigating the impact of the COVID-19 pandemic

I – Facilitating information exchange with Member States

5. The International Reporting System for Operating Experience (IRS) for nuclear power plants (NPPs), the Incident Reporting System for Research Reactors (IRSRR) and the Fuel Incident Notification and Analysis System (FINAS) for nuclear fuel cycle facilities remain fully operational and reports relating to plans and actions taken to mitigate the impact of the COVID-19 pandemic have been received from Member States through these systems.

6. The Incident and Trafficking Database (ITDB) remains fully functional.

7. The Agency's Incident and Emergency Centre (IEC) continued to ensure that the communication channels for notification and information exchange on nuclear and radiological emergencies remain fully operational on a 24/7 basis.

8. Member States have provided details on the pandemic's impact on NPP performance, including details on outage scope, schedules and timing, through the Power Reactor Information System (PRIS). The Country Nuclear Power Profiles resources were applied to gather, collate and summarise open source information related to the pandemic's impact on operating NPPs as well as advanced new build projects.

9. The Agency rapidly developed and piloted an international peer-to-peer network, the NPP COVID-19 Operating Experience Network (COVID-19 OPEX Network), through the Technical Working Group (TWG) on NPP Operation. The Network was established for information and experience sharing between operating organisations, technical support organisations, relevant international organisations and other stakeholders, and has proven to be very valuable with 26 reports from 9 Member States and 4 international organizations. From the beginning of April, the Agency developed weekly summary reports to share information via the COVID-19 OPEX Network on mitigating actions implemented at NPPs to limit the impact. The focus was on operating plant performance, but information on energy markets and new construction projects was also included.

10. Information on the pandemic's impact on training activities and human resources policies, gathered through the TWG on Managing Human Resources in the Field of Nuclear Energy, was shared in the Nuclear Energy Capacity Building Hub, hosted on the NUCLEUS platform and will be discussed and validated in a special session of the TWG meeting in October 2020.

11. The Agency set up a network for research reactors, similar to that for NPPs. This network used a dedicated webspace for operators of research reactors to share information on their status and the remedial measures being implemented.

12. The Agency keeps an open communication with national regulatory bodies for nuclear and radiation safety. In addition, the Agency has conducted a survey with radiation safety regulators with the objective to have a first overview of the impact of the COVID 19 pandemic on the safety of radiation sources and their regulatory oversight. The survey was launched on April and by May more than 70 regulators had replied.

II – Safety standards and nuclear security guidance

13. The process for developing and revising safety standards and nuclear security guidance has continued. Instead of the regular Headquarters meetings set for the first half of 2020 for the Commission on Safety Standards (CSS), the Safety Standards Committees (SSCs) and the Nuclear Security Guidance Committee (NSGC), procedures for online review and approval of documents, using video-conference meetings of members were adopted.

14. The Secretariat initially undertook a preliminary analysis of safety standards and guidance to identify whether pandemic situations are currently addressed, and whether the guidance in this field should be strengthened. On the basis of this initial work, the Secretariat has mapped its preliminary analysis of safety standards and guidance against drafts currently under revision and has already included enhanced guidance addressing pandemic situations in several draft Safety Guides that will be presented to the CSS, the SSCs and the NSGC for final approval in 2020.

15. As a second step, a deeper analysis of the standards and guidance was also initiated, with the involvement of the CSS, SSCs and NSGC, as well as the international organizations involved in their development.

16. The Secretariat has also begun the development of a Safety Report synthesising the actions taken by Member States and lessons learned, including through the survey to regulatory bodies of radiation safety. This planned publication will help to identify good practices and form the basis for any later additional consensus guidance on pandemic situations.

17. In addition, the International Nuclear Safety Group, (INSAG) had a virtual meeting in May with wide attendance that was predominantly focused on the implications of the COVID-19 pandemic on nuclear safety. There was discussion of the uncertainty surrounding the future trajectory of the pandemic and of the long-term implications of measures to deal with COVID-19 for the operation of nuclear facilities and the assurance of safety. As a result, INSAG will continue to pursue the subject. As a first step, reflections on the implications of the response to COVID-19 for nuclear safety will be the focus of the annual letter prepared by the Chairman to the Director General. The letter will be submitted in July and customarily is then circulated to Member States. It was also agreed that the implications of the pandemic should be the focus of the upcoming INSAG Forum, which occurs on the margins of the General Conference.

III - Emergency preparedness and response

18. The Agency's Incident and Emergency System continued to be operational and a programme of emergency exercises continued to be carried out. The IEC continued conducting and planning for Conv-Ex (Convention Exercises) in accordance with existing plans.

19. Of particular note was the ConvEx-2b exercise conducted on 24 - 26 March 2020 in order to test the arrangements for a request for assistance and the provision of assistance. 35 Member States and two Regional Specialized Meteorological Centres (RSMCs) of the World Meteorological Organization (WMO) participated in the exercise. This timely and successful three-day exercise was conducted while the responders in many Member States and in the Secretariat worked remotely and operated in an even more challenging environment. For instance, Requesting States' plans provided for additional precautions to protect the Field Assistance Teams deployed by the Assisting Member States.

20. A ConvEx-2a exercise was conducted on 12 May 2020 to test the availability of contact points to complete the appropriate reporting forms and to upload monitoring data on IAEA's International Radiation Monitoring Information System (IRMIS). 58 Member States participated in the exercise.

IV – Meetings of Conventions and other legal instruments

21. The Eighth Review Meeting of the Convention on Nuclear Safety (CNS) was postponed. In this regard, communication has been maintained with the Presidency of CNS on the rescheduling options, to hold the meeting from 15 to 26 March 2021. The proposed dates will be decided by a consensual decision of the Contracting Parties to the CNS.

22. COVID-19 pandemic had also direct impact on the 7th Review Cycle of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (The Joint Convention). The Third Meeting of the Joint Convention Working Group to Prepare the Fourth

Extraordinary Meeting of the Contracting Parties, scheduled for 17-18 March 2020, the Fourth Extraordinary Meeting and the Seventh Organizational Meeting of the Joint Convention Contracting Parties, scheduled for 25-29 May 2020, have been postponed to later dates that are yet to be determined. Contact and exchanges continue to be maintained with the Joint Convention Contracting Parties to discuss the rescheduling of these meetings when normal working conditions come into effect.

23. The Tenth Meeting of the Representatives of Competent Authorities identified under the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the case of a Nuclear Accident or Radiological Emergency will take place as a virtual meeting from 15-19 June 2020.

24. The open-ended Meeting of Legal and Technical Experts on the Implementation of the Guidance on the Management of Disused Radioactive Sources, Supplementary to the Code of Conduct on the Safety and Security of Radioactive Sources, which was scheduled take place from 8 to 10 June 2020, has been postponed to 16 to 18 February 2021.

25. In support of the Meeting of the Preparatory Committee for the 2021 Conference of the Parties to the Amendment to the Convention on the Physical Protection of Nuclear Material (A/CPPNM), the designated Co-Chairs of the Preparatory Committee have prepared a draft agenda and programme for the 2021 Conference, as well as draft Rules of Procedure to be discussed during the Preparatory Committee Meeting. Although the Agency has had to postpone some promotional events as well as the Preparatory Committee Meeting itself, it has taken steps to ensure that this does not impact the robustness of the preparations for the 2021 Conference.

V - Collaboration with other United Nations organizations and other international bodies

26. Regular interaction between the IAEA and the World Organisation of Nuclear Operators (WANO), the OECD Nuclear Energy Agency and others permitted an effective exchange of information as well as independent validation of relevant information. These discussions are intended to support the resumption of assistance and advisory missions offered by the Agency together with other international organizations while minimising risk to both mission participants and host organizations.

27. There has been significant disruption in the distribution of medical isotopes and radioisotopes. The Agency has contacted stakeholders to ascertain means to support mitigation of these disruptions including the International Civil Aviation Organisation (ICAO), the International Air Transport Association (IATA) and the International Federation of Air Line Pilots' Associations (IFLAPA). The Secretariat is developing a strategy on how the Agency can work together with relevant international organisations, including WHO and ICAO to address this critical challenge.

VI – Other support to Member States

28. In order to support safeguards inspection programme, the Agency's Radiation Safety Technical Services have continued providing the essential services and radiation monitoring and workplace monitoring and emergency response services to ensure the safety of the Agency's laboratories is maintained throughout the shutdown period.

29. The Agency continued supporting Member States on projects related to remote monitoring and verification of physical protection systems at nuclear facilities. Procurements and development of work related to planned nuclear security projects continued during this period.

30. E-learning courses on nuclear security, emergency preparedness and response and radiation protection are available to Member States. The Secretariat has noted an increase in enrolments on and completion of its e-learning courses in in this regard. In addition, the Agency successfully tested and deployed several upgraded e-learning modules as planned. The Agency also provided Member State organizations with training course material in order to conduct training themselves and provided human

resource development (HRD) planning and training support and reviewed Member States' HRD documentation.

C. Actions undertaken in Member States to mitigate the impact of the COVID-19 pandemic

I – Nuclear Power Plants

31. Member State actions focussed on ensuring the safety and wellbeing of staff through prompt action to minimise the risk of the pandemic's spread, while maintaining business continuity and adequate levels of safety and security of NPPs. No Member State reported the enforced shutdown of any nuclear power reactors resulting from the effects of COVID-19 on their workforce or essential services such as supply chains. Regulatory bodies have generally applied graded approach during the pandemic and adjusted the scope of regulatory inspections based on their safety significance.

32. Member States indicated different levels of impact on planned outages, scheduled maintenance plans or programmes due to limited availability of manpower caused by travel restrictions as well as for the protection of health of their employees, while ensuring adequate levels of safety and security at the NPPs. In some cases, the operators have proposed to the Regulatory bodies the deferment of the planned outages to the next year, which could eventually show higher than average yearly contributions to electricity production from the nuclear power in the country in 2020. In some cases, economic slowdowns led to decreased energy demand leading to the operators to reduce power or even shutdown. Some of the actions in relation to the above are brought out in the next paragraphs.

33. In Argentina the nuclear power operators are seeking regulatory approval to reschedule all planned outages. In Canada a major refurbishment outage was deferred to 2021. In Hungary, the scope of planned 2020 outage activities have been reduced mainly due to travel restrictions of foreign vendor companies. In the Republic of Korea, the schedule and duration of an NPP outage was adjusted to ensure worker safety. Trillo-1 NPP in Spain was taken offline for a refuelling outage while the operator limited the number of workers onsite, resulting in an outage extension to 35 days.

34. In Armenia, the shutdown dates for preventive maintenance were postponed for 45 days due to the consequences of the COVID-19 pandemic. France made fleetwide adjustments to maintenance plans that adapted to the pandemic's impact on electricity demand. In Mexico, level of maintenance staff on shift was optimised to the level necessary to complete the minimum preventive and corrective maintenance activities. In the USA, Tennessee Valley Authority (TVA) is scaling back some of its planned maintenance work to limit the number of individuals on site and is performing health screenings of all TVA employees and contractors coming to the plants.

35. Economic slowdowns led to decreased energy demand in France, resulting in requests for NPPs to reduce power or even shutdown. To help provide a continuous supply of power throughout the winter of 2020-2021, a number of nuclear reactors may have to be taken offline this summer and autumn in order to save fuel on these power plants.

36. Changes in demand are major sources of disruption for NPP operation and maintenance in a number of Member States. NPPs in Belgium, Canada, China, France, South Africa and Ukraine are estimated to produce less electricity during 2020 as a result of the pandemic. In a few countries, electricity demand fell dramatically by more than 10% between 9 and 15 March and the week after.

Generation from variable renewables (VRE) benefitting from Feed-in-Tariffs, however, is likely to be unaffected by the drop-in electricity demand and subsequent decrease in wholesale prices.

37. For NPPs in Brazil, Finland, the Islamic Republic of Iran, the Netherlands and Switzerland, generation is expected to exceed original 2020 estimates because outages were either shortened or deferred to 2021.

38. In addition to following national government recommendations on hygiene and physical distancing, operating organizations of NPPs reported that they are implementing a number of special measures. For example, at the Russian nuclear power plants operational personnel working at nuclear facilities have special living conditions. This includes, separate accommodation, meals, leisure and constant medical control.

39. Other steps taken include regular medical screenings of staff, body temperature checks of staff, travel restrictions, self-isolation and physical meeting restrictions. Where COVID-19 cases were confirmed among staff, entire shifts have been quarantined and the conditions for reactor shutdown have been reviewed. It is also important to note that there is potential for common cause failure, as operators reside together in communities.

40. Pandemic mitigation plans at some facilities result in a need for more authorized or licensed personnel. This need is being satisfied by newly trained as well as previously qualified staff, including recent retirees and instructors. However, this approach in itself is facing challenges in maintaining the required quality and quantity of training in the context of other restrictions limiting the ability to assemble employees.

41. Some Member States reported that work management practices were adapted by reviewing maintenance and surveillance tests to identify which activities could be postponed without any impact on regulatory requirements, safety or reliability. This assessment involved reviewing required materials and spare parts to ensure critical item availability and evaluating upcoming outage plans to minimise access of external contractors. Support staff adapted to remote working through maximised use of IT platforms and distance collaboration tools. Some facilities have decided to reduce, postpone or cancel work of contractors on the site during the COVID-19 pandemic.

42. Ongoing and future challenges include the implementation of planned maintenance activities to ensure interim- to long-term reliability. Current mitigation actions minimise the site presence of external staff by deferring online and outage work that is not necessary to ensure safety. This work is being rescheduled, but uncertainties regarding how the pandemic might progress are posing a challenge for many Member States.

43. The pandemic also impacted resources being applied to construct new plants in Belarus, United Arab Emirates, Turkey and Bangladesh, but did not stop the construction activities. The impact on schedules continues to be assessed.

II – Research reactors and the production of radioisotopes

44. Most research institutions and universities, which operate many research reactors for education, training, and research, decided to temporarily shut down the facilities. They have also implemented measures to maintain safety of the reactors during the extended shutdown state, for example by partial unloading fuel from reactor cores and monitoring safety in accordance with existing procedures for long-shutdown periods.

45. Most Member States decided to postpone (or reduce the scope of) regulatory inspections during the pandemic period. Along with the universities and research institutions in which they operate, many research reactors that focus on training and research are in temporary shutdown – a state in which a reactor's operations are on hold until circumstances change.

46. Most research reactors in operation remain operable, with specific measures implemented to address the pandemic.

47. Six of the major producers of radioisotopes surveyed continue to operate and have developed business continuity plans with defined proactive measures to ensure safety of the facility and personnel during the pandemic, while continuing production. These include revised staffing arrangements (minimum staffing during operation shifts, on-call duties and non-essential staff work from home), and implementation of the national health requirements on the spread of the COVID-19 virus (physical distancing, hygienic procedures, similar to the actions taken in NPPs).

48. Production of medical radioisotopes and radiopharmaceuticals has been recognized as "essential services" in most countries. The production has currently remained sufficient to meet the demand. However, the COVID-19 crisis resulted in a re-prioritization of hospital medical procedures, and a drop of around 20% of the global demand of Mo-99.

49. A reduction in nuclear medicine procedures worldwide has been reported, reaching up to 45% to 80% depending on the procedure and the country. This is due to postponement of non-urgent procedures and the disruption in the supply chain. The regions most affected are Africa, Latin America, Middle East and South East Asia, with some cases of suspension of services. Plans have been made to restore the deferred services.

III - Nuclear Fuel Cycle Facilities

50. Most nuclear fuel cycle facilities continue operation, except some radioactive waste management facilities and some mining and processing facilities, which have been temporarily shut down.

51. Operating organizations of nuclear fuel cycle facilities have adopted measures aimed to ensure business continuity, nuclear safety and security, and the security of supply of nuclear fuel required for the operation of NPPs and research reactors. Typical measures include prioritization of strategic activities such as the manufacture and transport of nuclear fuel and the elimination of non-essential activities. Similar to NPPs, measures also focus on minimizing the potential transmission of the virus among personnel by physical distancing, enhanced personal hygiene protocols, revised staff arrangements especially for operating personnel, non-essential staff working from home, and reduced contractor presence on site.

52. In addition, many facilities have provided support to pandemic mitigation measures. Examples include 3D manufacturing of ventilators or donation of masks and other personal protective equipment.

IV - Facilities using radiation sources

53. The survey on the impact of the COVID 19 pandemic on the regulatory activities for the safety of radiation sources has identified a number of issues that may be of interest for the regulatory oversight in the current circumstances. The survey indicates that users may be constrained due to economic challenges to continue business thus may fail to ensure safety of sources including disused sealed sources. Some of the facilities, for example, may not be able to meet necessary staffing needs thus could jeopardise the safety of radiation sources, occupational workers, patients or the facilities itself.

54. Almost all the regulatory bodies are following a graded approach and adjusting their inspection programme to deal with the challenges presented by the pandemic.

55. Medical physicists in a diagnostic radiological setting queried the potential impact on medical and occupational radiation protection from COVID-19 pneumonia imaging activities. With chest CT being used in the management of patients with known or suspected COVID-19 infection, sometimes repeatedly, and with the imaging sometimes being performed in locations outside the traditional radiological imaging departments, a continued focus on radiation protection of patients and workers is

strongly recommended. The prevention of COVID-19 infections of patients and medical staff also needs to be considered in these imaging activities.

D. Final Remarks and future work

56. The COVID-19 pandemic is a common concern. Response actions have been implemented by operating organizations and regulatory bodies in Member States to ensure safety, security and reliable generation of electricity, production of isotopes or supply of other relevant products and services to the extent possible. Supply chains, however, must continue to be monitored to ensure that latent risks from broader industrial shutdowns are properly managed to ensure future nuclear installations safety, security and reliability.

57. While the pandemic is disrupting operation and maintenance activities as well as outage scope, timing or duration at many NPPs to accommodate local pandemic mitigating actions, the Agency estimates, on the basis of the information received, that the actions taken by operators and regulators are focused to maintain adequate levels of safety and security at all 442 of the world's nuclear power reactors. The Agency will continue to monitor the impact of the pandemic through the NPP COVID-19 Operating Experience Network.

58. Some significant Agency meetings were either cancelled, postponed or reformatted to accommodate virtual meetings. These included meetings related to several Conventions, Codes of Conduct and preparations for international conferences. Furthermore, some Agency peer review and advisory services were also deferred during this period. Nevertheless, the long-term impact of these cancellations and postponements is expected to be minimal.

59. Reports of events continued to be received by the Agency through existing mechanisms, as did the notification and information exchange in nuclear and radiological emergencies. The development of Agency standards and guidance also continued throughout the period.

60. Member State reports support flexibility and resilience of NPPs under the impact of the pandemic. No Member State reported the enforced shut down of any nuclear power reactors resulting from the effects of COVID-19 on their workforce or essential services such as supply chains. The Agency has received reports of impact on plant operation from fourteen Member States and examples of the impact included modifications to shift arrangements, training and access restrictions. Seventeen Member States indicated some impact on in-progress or planned outages.

61. The pandemic's broad impact on the global economy and industrial activity will continue to challenge the global supply chain for months or years to come. That impact could threaten NPP performance over the interim- to long-term, for example, delaying long lead time items for new build or major refurbishment projects.

62. The IAEA received reports of outage impacts at NPPs in 26 of the 30 Member States with operating NPPs. In some cases, outage scopes were reduced by eliminating non-critical work to minimise external staff brought on-site. In other cases, outages were extended to allow work to proceed at a slow pace that accommodated physical distancing constraints. In still other cases entire outages were deferred to next year. The full impact will play out over at least the next year as future outage plans are revised to complete deferred work.

63. To collect information and make an assessment, the Agency initiated a survey at the end of April of radiation safety regulatory bodies in order to identify any impact of the COVID-19 pandemic on the safety of facilities using radiation sources and on their regulatory oversight. One of the anticipated

challenges for Member States is that some companies may close as a result of the economic impact of the pandemic and there could be an increased risk of radioactive sources to become orphan. Reporting about the COVID situation at nuclear installations was enhanced through new and existing ad-hoc mechanisms.

64. The Agency will continue to support Member States mitigate and manage the impact of COVID-19 as it continues to evolve. The Agency, at an appropriate time and in collaboration with peer and partner organisations, will reflect on and share lessons learned from the pandemic and the relevant global response to it. Joint reports are foreseen, including possible standards or guidance on pandemic response.

65. The Secretariat continues to review and strengthen its standards and guidance. A deeper analysis of standards and guidance has been initiated including the guidance on emergency preparedness and response. The Secretariat began the development of a publication synthesising the actions taken by Member States and lessons learned. This planned publication, together with the deeper analysis of standards and guidance, will help to identify good and best practices and form the basis for any later additional consensus guidance in new or revised standards and guidance.

66. To discuss the impact of the pandemic situation regarding the safety of nuclear facilities and activities, the Secretariat will conduct meetings with the Commission of Safety Standards, the International Nuclear Safety Group, (INSAG), the Advisory Group on Nuclear Security and a sub-group of the Nuclear Security Guidance Committee. The Standing Advisory Group on Nuclear Energy (SAGNE) will convene similar discussions about the impact of the pandemic on NPP performance, including outage planning and implementation.

67. The analysis of the data collected through the survey on the impact of the COVID-19 pandemic on the safety of facilities using radiation sources and on their regulatory oversight will continue, as more responses are being collected. The conclusions of the survey will be shared appropriately with MS.

68. Member State experience related to supply chain disruptions will be gathered to share lessons learned. Collaboration with peer, international organizations will continue to share available information on impact and to resume assistance and advisory missions through the systematic and effective management of pandemic related risks.

69. As for the long-term impact of the pandemic on major nuclear power projects, delays in the tendering processes as well as uncertainty on the level of available financing for new build projects will need to be assessed to determine how they will affect the contribution of nuclear power to Climate Change mitigation.

70. Most research reactors whose production of isotopes used in medicine is vital for health care continue to operate at reduced staffing levels. The Agency is currently reaching out to operators who are members of its TWG on research reactors to gather information on the status of those research reactors that produce medical isotopes during the COVID-19 crisis as well as issues related to worldwide supply.

71. The IAEA recognises the need to encourage the governments of the producers and users of medical radioisotopes, the operators of research reactors, and the relevant Member States involved in production and transport of radioisotopes to continue to take steps to strengthen arrangements for deliveries. This action will allow mitigation of potential supply risks as the pandemic continues at different rates in Member States.

72. The Secretariat will provide an update to this report in time for this year's General Conference.