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Renovation of the IAEA's Nuclear Sciences and Applications Laboratories in Seibersdorf

Report by the Director General

Summary

The laboratories of the Agency's Department of Nuclear Sciences and Applications (NA laboratories) in Seibersdorf represent a key vehicle for the delivery of Major Programme 2 and part of Major Programme 1. They also significantly support the Agency's technical cooperation programme. The laboratories respond directly to the scientific and technical needs of Member States in nuclear sciences and applications in the areas of food and agriculture, human health, the environment and instrumentation.

In the 51 years since the NA laboratories in Seibersdorf were established in 1962, there has been no comprehensive renovation or a thorough upgrading of equipment to ensure the continuing ability of the laboratories to respond to Member States' evolving needs. In his opening remarks at the fifty-sixth regular session of the General Conference in 2012, the Director General expressed his intention to launch an initiative to renovate and modernize the NA laboratories in Seibersdorf. The modernization of the laboratories was called for by the 2012 General Conference through resolution GC(56)/RES/12.5.

Consequently, a new capital project to support the renovation and modernization of the NA laboratories in Seibersdorf, to be named as the "ReNuAL" (Renovation of the IAEA Nuclear Applications Laboratories) project, was included in the Major Capital Investment Plan of the 2014-2015 Programme and Budget (GC(57)/2). Significant extrabudgetary resources will also be required for the completion of this project.

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A. Background

1. The 56th regular session of the General Conference responded positively to the Director General's call for the modernization of the laboratories of the Agency's Department of Nuclear Sciences and Applications (NA laboratories) in Seibersdorf in resolution GC(56)/RES/12.5. In this resolution, Member States fully supported the continuation of the mandate and the role of the NA laboratories in Seibersdorf under the strategic direction of the Department of Nuclear Sciences and Applications, and recognized the urgent need for modernization given the evolving range and complexity of Member States' growing demands for increasing technological development. Strengthening the laboratories is also a key aspect of the Agency's Medium Term Strategy for 2012-2017.

2. In resolution GC(56)/RES/12, the General Conference also requested the Secretariat to develop a strategic plan for the modernization of the NA laboratories based on a vision of the role of the laboratories in meeting the current and future needs of Member States. The Secretariat took the first steps in responding to this request during the Financial and Administrative Workshops held in April and May 2013, at which briefings were provided to Member States to present initial elements of the modernization initiative.

3. A tentative, preliminary budget of €31 million has been estimated for the initiative. Thus, a new capital project of €2.6 million for each of 2014 and 2015 from the capital regular budget to support this initiative was included in the Major Capital Investment Plan (MCIP) in the 2014-2015 Programme and Budget (GC(57)/2). An additional €5.4 million for each of 2014 and 2015 in extrabudgetary resource requirements is also anticipated. This project, to be named as "ReNuAL" (Renovation of the IAEA Nuclear Applications Laboratories) is scheduled to begin on 1 January 2014. Initial planning for the initiative has begun in 2013 and will be ongoing until the formal start of the project.

4. The General Conference requested the Director General to report on progress made in implementing resolution GC (56)/RES/12 to the September 2013 Board of Governors and to the GC at its fifty-seventh session. A progress report on the implementation of that resolution is provided in document GOV/2013/32-GC(57)/9, *Strengthening the Agency's Activities related to Nuclear Science, Technology and Applications*. The present document provides more detailed information regarding actions in progress and future steps in the development of the strategic plan for the renovation of the NA laboratories.

A.1. Current Situation

5. The NA laboratories in Seibersdorf comprise eight laboratory groups supporting three Major Programme 2 thematic programmes in the areas of food and agriculture, human health and the environment, as well as one in nuclear sciences which is funded by Major Programme 1. The laboratories support the delivery of nuclear sciences and applications through the IAEA's Technical Cooperation Programme, through regular budget-supported activities, e.g. coordinated research projects (CRPs), and by extrabudgetary mechanisms. Currently there are 87 NA staff members working in Seibersdorf supported by cost-free experts, visiting scientists and interns representing about 30% of the Department staff. The laboratories maintain a balance among applied/adaptive research and development, education and training, scientific and technical services.

6. Key activities in the laboratories may be summarized as follows:

- **Applied/Adaptive Research and Development***:* All of the laboratories are instrumental in developing and adapting proven methodologies and technologies for transfer to Member States. Research is demand driven and leads to new possibilities in the provision of services that in turn support research in Member State laboratories. Currently, over 50 CRPs are directly supported by the NA laboratories in Seibersdorf.

- **Education and Training***:* The NA laboratories provide trainees and fellows from Member States with hands-on training in nuclear techniques through the TC programme and via extrabudgetary funding. The number of fellows, scientific visitors, training course and workshop participants is currently reaching 350 Member State experts per year. Most training courses are oversubscribed and there is currently little capacity to receive more.

- **Scientific and Technical Services**: The laboratories provide quality assured technical services, such as calibration and dosimetry audits, reference materials, proficiency testing and other analytical support services. The laboratories' services include supporting the research of Member States' scientific institutions by establishing and sharing best practices worldwide and building collaborative global scientific networks. Demand for laboratory services continues to grow. For example, the number of reference materials supplied by the Terrestrial Environment Laboratory in the last 10 years has doubled. The number of beam lines checked by the Dosimetry laboratory over the last 20 years has increased by 600%, from approximately 90 in 1990 to almost 700 in 2012.

- **Support for the Delivery of Technical Cooperation Projects***:* The NA laboratories currently provide support to almost 300 TC projects through education and training activities, scientific and technical services and technical advice.

B. Need for the Renovation of the NA Laboratories at Seibersdorf

7. There has been no comprehensive renovation of the Seibersdorf laboratories in the last 51 years, nor has there been any thorough upgrading of equipment to ensure the continuing ability of the laboratories to respond to Member States' needs. At the same time, demands on the NA laboratories have increased as the number of Agency Member States has grown (from 79 in 1962 to 159 in 2013), and as more have recognized the laboratories' value and sought their support. These demands are expected to increase further in the future while the issues that the laboratories are expected to address

continue to evolve. New investment in space and equipment is now essential to secure the future of the laboratories for the benefit of Member States and to ensure that all laboratories and support operations are fully compliant with the latest safety and security standards for nuclear research facilities.

8. The Agency's Standing Advisory Group on Nuclear Applications (SAGNA) considered a draft NA laboratory renovation concept at its meeting in June 2013. One of the key recommendations from SAGNA was that priority should be given to the redesign and expansion of infrastructure, including buildings, safety, security and administration. The Group further recommended that construction under the ReNuAL project should begin no later than the end of 2014 so as to take advantage of the lessons learned from the Enhancing Capabilities in Analytical Services for Safeguards (ECAS) project and its project management structure that is currently in place. SAGNA supported the strategic positioning of the laboratories.

9. The NA laboratories in Seibersdorf should, after renovation, be fit-for-purpose and appropriately positioned to meet the evolving needs of Member States with a satisfactory infrastructure in place for the next 20–25 years. The goals of the ReNuAL project are to:

- Redesign and expand the current infrastructure to improve the efficiency and effectiveness of laboratory operations and services in order to better meet the current and future requirements of Member States;
- Ensure that the NA laboratories in Seibersdorf are a vibrant research and training institution in the future; and
- Continue to attract highly qualified scientists and other staff committed to advancing applied nuclear sciences to serve the needs and interests of Member States.

10. In particular, the laboratories will seek to:

- Serve as a hub for growing networks of Member State laboratories in the respective thematic areas as a means to enhance their sustainability;
- Address emerging issues, for example, the impact of and adaption to climate change, new transboundary animal diseases, rapidly growing issues in the field of cancer;
- Foster the development of new nuclear applications, products and services;
- Increase capacity-building activities by providing hands-on training in new areas, for example, in accelerator applications;
- Institutionalize a more systematic approach to quality assurance through modern laboratories capable of accreditation to international standards, where relevant, and contribute to improving the quality of Member States' laboratories within the framework of respective environmental, health and safety standards.

11. Summaries of the positioning of the eight NA laboratories located at Seibersdorf are provided in the Annex.

C. The Major Elements of the Project

12. The ReNuAL project should result in adequate infrastructure and equipment and a forward-looking approach for the NA laboratories to carry out their mandate proficiently. Acquiring a balanced mix of the necessary laboratory, office and training space, along with the highest priority equipment, will be key to the success of this project.

C.1. Existing Infrastructure

13. The NA laboratories in Seibersdorf were opened in 1962. There have been some individual upgrades and extensions since then as follows: the Agriculture barracks (1964), the Entomology building (1968), the Hot-lab extension (1970), the Dosimetry and Medicine lab extension (1978), the Fruit Fly Mass Rearing Facility (1984), the Agriculture Wing (1985), the Training Centre (1990), the Clean Laboratory (1996), the Service building (1997), the Training and Reference Centre for Food and Pesticide Control (1998), and the Dosimetry Bunker Extension (2006). However, they were implemented one by one in response to individual needs without an overall and comprehensive plan.

14. The NA laboratories in Seibersdorf need both a quantitative and a qualitative enhancement of space. Based on preliminary internal planning, space norms and specific laboratory needs, it is estimated that compared to the current situation, an additional 60% of space, including office, laboratory, training and storage space, is needed.

15. The technologies and techniques used in the laboratories have changed over time, but the facilities have not evolved to match the requirements for operations, training and compliance with current safety and security regulations and the relevant quality management requirements. For example, with an increased need to address transboundary animal diseases, including those that pose dangers to humans, there is a proposal to equip the Animal Production and Health Laboratory to house existing and emerging animal pathogens, which requires this laboratory to meet Biosafety Level 3 standards, which it currently does not meet. The Dosimetry Laboratory provides another example, as it is currently set-up to provide services solely for cobalt-60, although the current technology for cancer treatment is increasingly based on the use of linear accelerators.

16. The current planning approach under consideration calls for upgrading the existing infrastructure to meet basic requirements and comply with statutory guidelines, and to only add new space where needed. However, it should be noted, that work is presently being undertaken by external experts to assess the condition of the site's buildings, their suitability for use as well as their compliance with relevant norms, for example with fire, health and safety, and environmental standards. Further detailed technical assessments will be conducted in the coming months. Based on these detailed reviews, a cost/benefit assessment will be undertaken to ascertain the optimal mix of renovations versus new construction, given that maintaining old and failing infrastructure can often be costly in the medium term and energy inefficient.

17. From these assessments actions will be identified to address both existing safety risks (such as the lack of adequate ventilation systems) and potential safety risks. Some of these are currently being addressed with short-term stopgap measures, which prevent the establishment and/or accreditation of quality management systems.

C.2. Additional Laboratory, Office and Training Space

18. There are severe space constraints in the NA laboratories at Seibersdorf as stated above. For example, in some areas space is being shared for the implementation of different analytical activities and as a result only one type of analysis can take place at any given time. This is time-consuming,

inefficient and contrary to appropriate quality management systems and can only be addressed through new construction. Additionally, because of constraints, some laboratory space is currently being used for office space, which is not in line with good laboratory practices and safety protocols.

19. Additional space for fellows/trainees, cost-free experts and scientific visitors is required. It is estimated that the number received by most of the laboratories could be increased significantly should adequate space and capacity become available.

20. Additional space will be required to accommodate essential new equipment which could not be accommodated in existing space due to equipment specific requirements.

C.3. New Equipment

21. The NA laboratories need new equipment either to replace aging or obsolete hardware or to be able to respond to newly emerging issues and/or changes in technology. Of the 94 pieces of major equipment at Seibersdorf (those with a procurement value above €50 000), 70 are beyond the lifespan recommended by the manufacturers. The age of equipment is a serious risk factor for the future effectiveness and quality performance of the laboratories.

22. Equipment needs have been grouped by priorities with "need now" as priority 1. This could include, for example:

- High dose rate brachytherapy systems to improve dosimetry services for certain types of cancer;
- A gas chromatograph–isotope ratio mass spectrometer to enhance food traceability, authenticity and fingerprinting techniques, as well as to support efforts to address the impacts of climate change in agriculture;
- Novel e-beam and X-ray machines as alternatives to gamma sources;
- Ultraviolet blood irradiators and a climate-controlled greenhouse for assessment of novel insect mass rearing and pest control technologies; and
- Ion-beam accelerator for developing accelerator application techniques and for training Member States' experts in the use of these techniques.

D. Budgetary Targets

23. The cost of the ReNuAL project was initially and preliminarily estimated at approximately €31 million. However, this is a tentative figure and subject to further expert and technical review as described below. The project should be funded through a mix of regular budget funds and extrabudgetary funding. A capital project has with capital regular budget funding set at €2.6 million for each of 2014 and 2015 has been included in the 2014-2015 Programme and Budget. In addition, an initial extrabudgetary target of €5.4 million for both 2014 and 2015 has been set. Prioritization efforts are being made to assure the continuity of the "core functions" of the laboratories.

24. The above-mentioned preliminary cost estimates have been based on an internally conducted needs assessment and attempt to balance the needs for new space and for renovations of existing space, as well as the acquisition of essential new equipment.

25. More detailed information is now needed concerning the cost/benefits of further utilizing existing buildings. The outcomes of such detailed technical studies will determine an appropriate mix of buildings to be refurbished and newly constructed, as well as new equipment to be acquired.

26. Equipment needs beyond the project horizon have also been identified and would have to be addressed as funding becomes available and/or potentially after the proposed project time frame.

27. Detailed plans, proposed schedules and more accurate cost estimates will be developed over the next year to quantify the requirements for laboratory space and supporting infrastructure renovation and/or new construction, as well as equipment needs to fully support laboratory operations.

E. Securing Adequate Resources

28. It is envisaged that the project needs to be financed through a combination of regular budget and extrabudgetary funding. Member States will be encouraged to make extrabudgetary resources available. Core partners, such as the Food and Agriculture Organization of the United Nations, or others with a prime interest in the Agency's work will be engaged. Non-traditional partners, funds and other potential donors will be approached.

29. Efforts will also be made to attract private sector support. An internal analysis is under way to assess the possibility of either receiving in-kind donations of equipment or for arranging low cost leasing arrangements in line with the Agency's administrative and financial rules. This would represent a new type of partnership for the Agency.

30. One of the lessons learned from ECAS is the importance of a focused resource mobilization approach. An immediate next step would be to develop a concrete strategy to address the resource requirements in the necessary time frame.

31. Member States that have made or are interested in making financial commitments to the Agency's Peaceful Uses Initiative or other extrabudgetary initiatives will also be approached.

F. Next Steps and Approach

32. During the next six months, the analysis of the current status/conditions of the existing buildings will be completed, including a cost-benefit analysis of renovation, new construction or a combination of both. With this analysis the requirements for laboratory operations will be reviewed in order to more precisely establish future space and operational requirements. This will allow for an appropriate scoping of the project and the development of a detailed road map for the remainder of the project. Based on the assessment of these requirements, a detailed design phase will begin early in 2014. Appropriate consideration will be given to ensuring the provision of services during the course of the project.

33. A "ReNuAL" Project Board will be established in the fourth quarter of 2013 chaired by the Deputy Director General of the Department of Nuclear Sciences and Applications and involving all major internal stakeholders. In addition, it is foreseen that a Project Management Group (PMG) will be established to ensure effective project implementation, as has been the successful practice in the

ECAS project. The PMG will consist of relevant project engineering and construction staff and other project-based professionals.

34. An important planning measure will be to determine what resources will be needed at which phase of the project. Detailed project planning will be carried out through 2014 to provide a firm cost basis and scope for the project decisions in the light of the available capital regular budget funding and the need to mobilize other resources during the project's planned time period.

35. The Director General will provide further updates as the project progresses.

Overview of the eight NA laboratories in Seibersdorf

The ReNuAL project will address current constraints within the eight NA laboratories as well as put in place the infrastructure and equipment needed for the future thematic direction of the respective laboratories. Currently there is a lack of space for the number of people (Agency staff, MS visitors e.g. fellows, scientific visitors, trainees etc.) on site and for the laboratory services to be provided. In some cases the space is not suitable for the type of laboratory work required. This leads to limitations in service capacity, constraints on quality assurance and potential safety issues. Below are brief descriptions of the strategic direction and plans for each of the NA Laboratories. Along with addressing current constraints, the ReNuAL project should also ensure that the appropriate types of space and equipment will be in place to meet the evolving needs of Member States and to provide the requested services in the future.

Food and Agriculture

The FAO/IAEA agricultural and biotechnology laboratories addressing issues related to food security account for five of the laboratories.

The **Animal Production and Health Laboratory (APHL)** supports Member States in the use of radioisotopes and related technologies for increased animal productivity and the improvement of animal health. The rationale for modernizing this laboratory is to support an increasing focus on alleviating the growing impact of major transboundary and zoonotic animal diseases (those that can be transmitted from animals to humans) and climate change on livestock productivity in Member States. This laboratory is already receiving hundreds of pathological samples from Member States for animal disease diagnosis each year. However, without a dedicated facility meeting the Biosafety Level-III standard to handle such samples (which is proposed in the modernization), the demand cannot be met. Thus necessary infrastructure and equipment is required.

The future focus of the **Food and Environmental Protection Laboratory (FEPL)** will be to carry out applied research, method development and training in food traceability and authenticity techniques, chemical food contaminant detection and control, and the capability to respond to emerging and emergency problems affecting food and agriculture. . Appropriate space and equipment is required to fully provide the services in this direction. Member States will increasingly be challenged to expand food production and availability to meet the demands of a growing global population. Part of the demand will be met by a rise in the trade of agricultural products amongst countries, and food authenticity, safety and quality will be of the utmost concern.

The **Insect Pest Control Laboratory (IPCL)** is concerned with the use of the sterile insect technique (SIT) integrated with biological methodologies for the environmentally friendly control of insect pests such as fruit flies, tsetse flies, moths and disease transmitting mosquitoes. This laboratory currently has insufficient and substandard space for the tasks that it carries out. Modernizing this laboratory is necessary to ensure that the IPCL remains the leader in this technological area to be able to develop SIT and low-pest prevalence strategies for the increasing number of emerging insect pests and disease vectors that are appearing, in part, due to climate change and the growing international movement of goods and people. It will also enable this laboratory to serve as a reference facility in terms of strains and other biological materials, as well as the planning, development and establishment of sterile insect production and release facilities. Modernization will represent an important step in ensuring the sustainability and quality of activities.

The future work of the **Plant Breeding and Genetics Laboratory (PBGL)** will be increasingly directed towards assisting Member States to respond to pressures that are being placed on farming systems to reduce greenhouse gas emissions as well as to adapt to the impacts of climate change. This can be achieved through the increased production of mutant varieties that are resistant to disease and/or tolerant to environmental stresses, such as drought, salinity and high temperatures. In terms of technology, the gamma-ray irradiators currently used are now subject to strict regulations aimed at restricting the use of radioactive gamma emitters. A future focus will be to develop an alternative using more accessible and less restrictive X-ray machines. . The "fit for purpose" space and equipment is required in order to move in this direction.

The **Soil and Water Management and Crop Nutrition Laboratory (SWMCNL)** uses isotopic and radiation methods to measure and monitor soil, water and nutrients in cropping systems as a basis for more efficient use of increasingly scarce resources and reduced environment impact. This laboratory will increasingly focus on addressing the improvement of soil and water management at an area-wide level in order to foster climate change resilience and adaptation These efforts will be supported by a new generation of robust and affordable isotope and nuclear techniques (such as COSMOS soil moisture probes, infrared laser isotope spectrometers and in-situ gamma spectrometers) that can be used in-situ at the plot (on-farm) and area-wide level. This can only be achieved with the acquisition of the necessary equipment that can be then adapted for the further use by Member States.

Human Health

The demand for Agency services increases as efforts to address cancer in Member States continue to grow. The **Dosimetry Laboratory** (DOL) establishes and disseminates best practices in the safe and effective use of radiation for the treatment of cancer through its quality assurance activities related to medical physics and dosimetry. The Laboratory needs to evolve to meet changing trends in technology that are currently influencing this field.

For brachytherapy calibrations, the Agency provides only low dose rate brachytherapy based on caesium-137. The use of caesium-137 low dose rate brachytherapy is being reduced and gradually replaced by high dose rate brachytherapy based on iridium-192 or cobalt-60. The DOL needs to acquire the appropriate equipment to respond to this technology change and continue to fulfil its role as a provider of best practices. For external beam radiotherapy, the Agency's calibration services are based on a cobalt-60 beam. However, the worldwide trend now is to provide calibrations in high-energy photon and electron beams generated by a linear accelerator. For dosimetry audits, the DOL checks the calibration of about half the radiotherapy photon beams in hospitals in developing Member States. Currently, the DOL does not audit electron beams, and requires additional resources to carry out such audits to ensure their safe use.

Terrestrial Environment

The **Terrestrial Environment Laboratory** (TEL) focuses on helping Member State laboratories to improve the quality of their own laboratory services to strengthen their environmental monitoring activities as a necessary element of public health and safety. Whereas in the past, the Agency focused on helping Member States to establish laboratories, in the future it will increasingly assist Member States in improving the quality of their laboratory services. A key element of TEL's activities, therefore, will be the provision of reference materials (RMs) for environment and trade. These materials are necessary to ensure the accuracy of Member State laboratory measurements, with a particular emphasis on environmental radioactivity and radiation protection, and the detection of organic contaminants in traded agricultural products. The IAEA is already the largest supplier worldwide of stable isotopes and environmental radionuclide RMs. Requests for this service, along with other quality assurance activities, such as proficiency testing for Member States' laboratories, has

been steadily increasing. Annual supply of RMs have risen for example, from 1100 units in 2000 to 2400 in 2012 because of the international trend for laboratories to seek accreditation requiring the use RMs and to participate in and pass proficiency tests. A further increase in proficiency testing beyond the current level of 400 participating laboratories per year is currently not possible due to space and capacity constraints.

Nuclear Sciences

The **Nuclear Science and Instrumentation Laboratory** (NSIL) is engaged in the development and deployment of nuclear techniques with a broad range of applications over a wide scope of technological and industrial areas. Key technologies that are currently employed include ion beam analysis, as well as X-ray and gamma spectrometry. As an example, both ion beam analysis and X-ray fluorescence spectrometry are used to test materials related to micro-electronics, bio-medicine, pharmaceutics, agriculture, fusion power plants and cultural heritage objects. Training in these and other kinds of nuclear techniques is an important part of nuclear technology capacity building.

The centrepiece would be a 3 MeV ion beam accelerator, in combination with a modern training and research infrastructure to support technological and economic development for Member States. The laboratory would provide unique opportunities for practical training in ion beam accelerator techniques, X-ray and gamma spectrometry and nuclear instrumentation, overcoming the restricted opportunities provided elsewhere. The facility will support scientific activities across NA, including environmental studies, plant breeding, soil management and food traceability. The infrastructure of the laboratory could also support activities related to the applications of radiation technology employing e-beam accelerators and the use of radiotracers in industrial applications.