IAEA Director General Rafael Mariano Grossi views construction on unit 5 at Chashma Nuclear Power Plant in Pakistan. (Photo: IAEA)

PAEC's Collaboration With The IAEA – OpEd

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By Hafsa Azam

Pakistan has a long tradition of engagement with nuclear science, exemplifying resilience, innovation and a steadfast commitment to the peaceful application of nuclear technology. Pakistan today has a well-established civilian nuclear energy programme. Crucial to this achievement has been the enduring partnership between the Pakistan Atomic Energy Commission (PAEC) and the International Atomic Energy Agency (IAEA), of which Pakistan was a founding member. Over the years, this partnership has evolved into a strong, mutually beneficial collaboration, meaningfully contributing to the IAEA's long-running international "Atoms for Peace and Development" initiative. In an era defined by the crises of energy insecurity and climate change, the collaboration between the PAEC and the IAEA stands as a compelling example of how nuclear technology can be used effectively as a low-carbon energy source, a means to bolster food security, and advance health sciences, among other benefits.

A robust institutional setup underpins the effectiveness of Pakistan's nuclear programme. Rather than operating as a monolithic organisation, the PAEC oversees an extensive network of research institutes, laboratories and hospitals, all of which are further integrated into the IAEA's global technical cooperation framework. This integration is formalised through the designation of several Pakistani institutes as IAEA Collaborating Centres, a status reserved for institutions that demonstrate clinical excellence, advanced research capacity and a commitment to international knowledge sharing. These centres act as regional hubs, bridging the gap between advanced nuclear research and practical application in the Global South.

Pakistan Institute of Engineering and Applied Sciences (PIEAS) stands at the forefront of this institutional network. In the 2026 Quacquarelli Symonds (QS) World University Rankings, PIEAS secured a global position in the 721-730 range out of over 15,000 universities, reflecting its continued focus on research intensity and faculty quality. Its role as an IAEA Collaborating Centre for nuclear education facilitates the exchange of students and researchers, ensuring that Pakistan's expertise is disseminated across the Asia-Pacific region and beyond.

The sustainability of a nuclear programme depends on a consistent supply of highly skilled professionals. Recognising this, Pakistan has prioritised nuclear education as a strategic imperative. Through PIEAS, Pakistan provides undergraduate, graduate, and postgraduate education in nuclear engineering as well as medical science subjects such as medical physics and radiation oncology. The integration of the IAEA's Marie Sklodowska-Curie Fellowship Programme (MSCFP) into the PIEAS curriculum has been particularly successful in promoting gender inclusivity. For the 2025-26 academic year, PIEAS awarded 20 fully funded international scholarships and five dedicated Marie Curie Fellowships. These scholarship programmes support students from other developing nations. On 17 September 2025, Pakistan and the IAEA also signed the fifth Country Programme Framework (CPF) for the period 2026-2031.

Other PAEC-supervised institutes like the National Institute of Safety and Security (NISAS) and the Pakistan Centre of Excellence for Nuclear Security (PCENS) have also established Practical Arrangements (PAs) with the IAEA, focusing on the critical dimensions of radiation safety and the security of radioactive materials.

For Pakistan, nuclear energy is a strategic necessity. As a country facing chronic energy shortage and the existential threat of climate change, Pakistan has prioritised the expansion of its nuclear power as a reliable source of energy. Currently, the PAEC operates six nuclear power plants (NPPs) with a combined net capacity of 3,530 MWe. According to the PAEC, as of 2024-2025, these plants contributed significantly to the national energy mix, providing approximately 18.3% of the country's total electricity and 34% of its low-carbon power generation. According to the 2025 World Nuclear Industry Status Report (WNISR), in 2024, net nuclear energy generation in Pakistan reached an all-time high of 21.7 TWh, an increase from 21.3 TWh in 2023.

The commissioning of the Karachi Nuclear Power Plant (KANUPP) K-2 and K-3 units, both Generation III reactors with a capacity of 1,100 MWe each, has transformed the energy landscape of Pakistan's largest industrial hub. The ongoing construction of Chashma-5 (C-5), a 1,200 MWe Hualong One (HPR1000) reactor, represents the next milestone in Pakistan's energy trajectory. With a total estimated cost of approximately USD 3.7 billion, C-5 is a central component of Pakistan's plan to increase its nuclear capacity to meet the growing demands of its energy needs. In March 2026, the IAEA Board of Governors also approved safeguards arrangements for C-5 and expected to become operational by 2030. The IAEA has been a vital partner in this journey, providing peer reviews and advisory missions that ensure the expansion remains aligned with the highest international safety benchmarks.

Pakistan's nuclear programme plays a constructive role in reducing environmental impacts. By operating its current fleet of reactors, Pakistan avoids nearly 15 million tonnes of CO2 emissions annually. This contribution is particularly significant given Pakistan's high vulnerability to climate change, characterised by erratic monsoons, glacial melt, and heatwaves, despite contributing less than 1% to global greenhouse gas emissions. The PAEC's commitment to the IAEA's "Atoms4NetZero" initiative reflects a strategic alignment with the global effort to decarbonise energy systems.

In a country where agriculture is the backbone of the economy and the primary source of livelihood for millions, the application of nuclear science for food security is a transformative endeavour. The "Atoms4Food" initiative, launched by the IAEA and the Food and Agriculture Organisation (FAO), has found a dedicated partner in the PAEC with its decades of experience in using radiation and isotopic techniques to improve crop yields and soil health.

The August 2025 Atoms4Food assessment mission to Pakistan, organized by IAEA and FAO, the first of its kind in Asia and the Pacific, provided a comprehensive evaluation of the country's agricultural needs and capabilities. The mission highlighted the success of mutation breeding by the PAEC, which has led to the development of over 150 high-yield, disease-resistant and climate-resilient crop varieties. Cotton varieties developed through the FAO/IAEA-PAEC collaboration now account for approximately 30% of all cotton cultivated in Pakistan. As of early 2018, the estimated cumulative economic impact of the 43 mutant varieties developed by the Nuclear Institute for Agriculture and Biology (NIAB) amounted to USD 6 billion.

Beyond crop improvement, the PAEC's work in soil and water management is critical for a country facing land degradation and water scarcity. Isotope hydrology techniques allow scientists to track the movement of water and fertilisers, enabling farmers to optimise resource use and reclaim saline or barren lands. The NIAB has been instrumental in transforming salt-affected soils into productive farmland, a technique that has been shared with other countries through the IAEA's regional cooperation agreements.

The PAEC's contribution to public health is potentially the most visible and humanised effort. According to the Director of Nuclear Medicine, Oncology, and Radiotherapy Institute (NORI), through a network of 21 Atomic Energy Cancer Hospitals (AECHs), the PAEC provides essential oncology services to over 46,000 new patients annually. This robust nuclear medicine infrastructure facilitates approximately one million diagnostic and therapeutic procedures each year.

During his visit to Pakistan in February 2025, DG IAEA Rafael Mariano Grossi inaugurated Pakistan's first public-sector CyberKnife facility, describing it as a major step forward in expanding access to advanced, non-invasive cancer treatment nationwide. He also recognised the designation of the NORI as an "IAEA Rays of Hope Anchor Centre," highlighting its role as a regional hub for capacity building, training and knowledge sharing. Grossi emphasised that "technology only becomes a lifesaver in the hands of well-trained experts." He acknowledged and appreciated Pakistan's commitment to strengthening its partnership with the IAEA, while highlighting efforts to upgrade facilities. He also emphasised expanding access to essential radiotherapy and diagnostic imaging services under the Rays of Hope initiative.

Pakistan is a party to numerous international conventions that govern the peaceful use of nuclear technology. Its participation in the Convention on Nuclear Safety (CNS) and the Convention on the Physical Protection of Nuclear Material (CPPNM) underscores its role as a responsible nuclear state. In a significant move toward transparency, Pakistan has announced that it will host the IAEA International Physical Protection Advisory Service (IPPAS) mission and the Nuclear Security Support Centre (NSSC) meeting in 2026. The nuclear collaboration between the PAEC and the IAEA remains a powerful tool for progress, proving that nuclear technology, when harnessed for peaceful purposes, provides transformative solutions for global well-being and prosperity.

About Hafsa Azam

Hafsa Azam is a Research Officer at the Center for International Strategic Studies Sindh. She holds a Bachelor's degree in Environmental Sciences from Bahria University, Karachi. Her areas of interest include climate change, climate mitigation and adaptation, environmental impact assessment, environmental policies and laws, environmental hazards and management, occupational health and safety, Sustainable Development Goals, energy and artificial intelligence.

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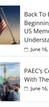

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