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Pulsed Power and Beam Technology for Visit Bharat: Science, Strategy, and Societal Impact

India's march toward becoming a developed and self-reliant nation will be powered by indigenous, cutting-edge technologies capable of transforming society at scale. Among these, pulsed power, plasma, and beam technologies stand out as true game-changers. Pulsed power systems, capable of delivering multi-gigawatt bursts within micro- to nanosecond timescales, hold immense strategic importance across industrial domains —from advanced welding to rock fracturing—and have been nurtured in national R&D laboratories for decades. Plasma devices, both pulsed and DC, are being engineered for societal applications, particularly in healthcare and sterilization industries. Globally, plasma systems that mimic the Sun's fusion processes are under development to unlock clean and limitless energy. Similarly, electron beam accelerators have matured into versatile tools for industrial applications spanning food preservation, environmental remediation, border security, and non-destructive testing. These technologies are not futuristic aspirations; they are practical enablers that can strengthen security infrastructure, propel spacecraft deeper into the cosmos, and support India's quest for sustainable energy solutions. In defense, pulsed power enables electromagnetic launchers and directed energy systems, redefining readiness. In space, plasma propulsion enhances satellite agility and makes interplanetary missions more feasible. Current plasma research is advancing toward fusion energy, novel materials, and radiation-hardened technologies that secure our energy future while minimizing climate impact. Industrial accelerators are poised to replace radioisotope-based irradiators, offering safer and more sustainable solutions for neutron radiography, food processing, and medical sterilization.

The true opportunity lies in translational research and innovation through collaboration. Universities can push the boundaries of fundamental science and technology demonstration, while industries can engineer prototypes and scale them for national missions. Together, academia and industry can establish innovation hubs, shared test facilities, and joint research programs that serve strategic sectors while delivering societal benefits—ranging from plasma-based healthcare solutions to clean energy and industrial modernization. By integrating science with strategy, pulsed power and beam technologies can become a cornerstone of India's technological sovereignty. They will ensure that Viksit Bharat is not merely a vision, but a reality built on indigenous innovation, global leadership, and societal impact.

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