



**NE&CM-2026 CONFERENCE ON  
NUCLEAR ENERGY AND CRITICAL MINERALS:  
EXPLORATION, MYTHS, AND SOCIETAL IMPACT**

**24<sup>TH</sup>-25<sup>TH</sup> FEBRUARY, 2026**

**CONFERENCE REPORT**



**Anusandhan  
National  
Research  
Foundation**



**CENTRAL UNIVERSITY OF PUNJAB  
INDIAN NUCLEAR SOCIETY (INS), MUMBAI  
ATOMIC MINERALS DIRECTORATE FOR EXPLORATION AND RESEARCH, HYDERABAD**

# NE&CM-2026 Conference on NUCLEAR ENERGY AND CRITICAL MINERALS: EXPLORATION, MYTHS, AND SOCIETAL IMPACT

## Executive Summary

The national conference entitled "Nuclear Energy and Critical Minerals: Exploration, Myths, and Societal Impact" (NE&CM-2026) was convened on February 24 and 25, 2026, at the Central University of Punjab (CUP), Bathinda. Organized through a highly strategic institutional collaboration involving the Indian Nuclear Society (INS), Mumbai, the Atomic Minerals Directorate for Exploration and Research (AMD), Hyderabad, and the Anusandhan National Research Foundation (ANRF), the event represented a critical intersection of high-level scientific research, legislative policymaking, and regional civil administration. This comprehensive report provides an exhaustive analysis of the two-day proceedings, which included structured technical sessions, extensive doubt clarification dialogues, interactive student placard competitions, and a massive public walkathon.

The overarching strategic context of NE&CM-2026 is rooted in the unprecedented expansion of India's energy sector. The nation is currently navigating a complex, dual-mandate mission: sustaining a hyper-accelerated trajectory of industrial and economic growth while simultaneously honouring binding international commitments to achieve "Net Zero" carbon emissions by the year 2070. The foundational premise establishing the conference's relevance is the inherent intermittency of renewable energy sources such as solar and wind power. While crucial to the ecological transition, these sources lack the capacity to provide the continuous, uninterrupted baseload power required to drive a massive, rapidly industrializing economy. Consequently, advanced nuclear energy technologies, coupled with the secure, sovereign acquisition of critical minerals, the essential building blocks for modern clean energy infrastructure have been elevated to the status of supreme national security priorities.

The conference, attended by an estimated 200 delegates, featured an assemblage of distinguished scientists from the:

- Indian Nuclear Society, Mumbai
- Central University of Punjab, Bathinda
- Bhabha Atomic Research Centre (BARC), Mumbai
- Post Graduate Institute of Medical Education & Research (PGIMER), Chandigarh
- Atomic Minerals Directorate for Exploration and Research (AMD)
- Gujarat Mineral Development Corporation (GMDC),
- Central University of Jammu,
- Guru Kashi University,
- Lovely Professional University

Leading academicians, domain experts, and local administrators participated in this event. Beyond the highly technical deliberations regarding basic Nuclear Chemistry, reactor physics, geological exploration, and mineral beneficiation, a core mandate of NE&CM-2026 was the sociological imperative to bridge the chasm between high-level scientific research and public understanding. The event sought to actively dismantle entrenched, historically pervasive myths surrounding radiation, illuminating the profound societal applications of nuclear technology in non-power sectors such as agriculture, oncology, and hydrology.

### **The Inaugural Programme**

The inaugural session, held in the morning on February 24, 2026, established the formal thematic and policy parameters for the ensuing deliberations. The proceedings commenced with the traditional recitation of the University Anthem and the ceremonial watering of plants, a symbolic gesture highlighting the conference's ultimate focus on environmental stewardship and ecological preservation.

### **The Welcome Address**

Prof. Anjana Munshi, Director of Research and Development at the Central University of Punjab, formally welcomed the distinguished assembly to the university's sprawling, 500-acre eco-friendly campus situated in Ghudda. Her address meticulously outlined the core thematic framework of NE&CM-2026, explicitly noting that India's nuclear sector is transitioning into a highly aggressive "mission mode". Prof. Munshi articulated the indispensable nature of securing supply chains for critical minerals, specifically identifying Lithium, Niobium, Tantalum, and Rare Earth Elements (REEs) as non-negotiable prerequisites for driving the national clean energy revolution, accelerating electric vehicle (EV) adoption, and ensuring long-term national security.

Crucially, Prof. Munshi emphasized the sociological dimension of technological deployment, asserting that scientific advancement remains fundamentally incomplete without the prerequisite of public trust. This assertion anchored the conference's secondary, yet equally vital, objective: to demystify the physical phenomena of radiation, dispel common but scientifically inaccurate myths surrounding nuclear technology, and highlight its vast, life-saving societal benefits beyond electricity generation, particularly in the fields of nuclear agriculture, molecular medicine, and clean water technologies. She proceeded to formally introduce the diverse array of domain experts present, welcoming scientists from NPCIL, AMD, BARC, and PGIMER, thereby setting the collaborative tone for the event.

### **The Convener's Strategic Geopolitical Overview**

Prof. Smeer Durani, as the Convener of the Conference, delivered a sweeping, highly analytical address dissecting India's energy future and its intersection with global geopolitical dynamics. Prof. Durani characterized the current national challenge as a "tricky double-mission," emphasizing that the integration of heavy-duty, 24/7 baseload power is an absolute necessity to reconcile the demands of rapid economic expansion with the 2070 Net Zero climate commitments. To achieve this, he noted, India holds the immensely ambitious policy goal of escalating its installed nuclear capacity from a modest baseline of

8.8GW to an unprecedented 100 GW by 2047, the centenary of Indian independence.

A critical focal point of Prof. Durani's address was the analysis of recent legislative paradigm shifts, specifically the enactment of the SHANTI Act in December 2025. For over six decades, the Indian nuclear sector functioned as a highly exclusive, heavily guarded governmental monopoly. The SHANTI Act structurally dismantled these legacy barriers, introducing a legal framework that permits the licensing of private corporations to finance, construct, and operate nuclear power facilities. Furthermore, Prof. Durani explained that the legislation comprehensively addressed and resolved complex civil liability issues that had historically deterred foreign reactor vendors, successfully aligning domestic policy with global nuclear commerce regulations. Simultaneously, the Act empowered the national atomic safety regulator with absolute legal independence, ensuring that the accelerated deployment of nuclear assets does not compromise stringent environmental and operational safety standards.

He also introduced the technological pivot toward Small Modular Reactors (SMRs). Utilizing an accessible "IKEA furniture" analogy, he described SMRs as modular systems whose components are fabricated sequentially in centralized manufacturing facilities and subsequently transported to the deployment site for rapid assembly. This methodology fundamentally circumvents the massive capital expenditures and protracted construction timelines associated with traditional, multi-gigawatt stick-built nuclear plants. Regarding fuel security, he highlighted the strategic imperative of mastering the complex chemistry of the Thorium fuel cycle. Because India possesses limited reserves of high-grade Uranium but holds some of the world's most extensive coastal deposits of monazite sand a primary source of Thorium mastering Thorium-based reactor technologies ensures virtually endless energy independence.

The Convener's address concluded with a stark assessment of the critical minerals supply chain. Prof. Durani talked about the severe geopolitical vulnerability stemming from the fact that China currently controls approximately 85% of the global processing capacity for rare earth elements and 60% of lithium processing. To counteract this monopolistic dominance, India is executing a dual-pronged strategy: engaging in aggressive diplomatic negotiations in South America's "Lithium Triangle" to secure foreign mineral rights, while simultaneously intensifying domestic exploration and beneficiation efforts. He highlighted recent milestones, such as the direct handover of major REE geological blocks in Gujarat from the AMD to the Gujarat Mineral Development Company (GMDC), a critical step toward establishing sovereign processing infrastructure.

### **Presidential Remarks**

The Hon'ble Vice-Chancellor, Central University of Punjab, Prof. Raghavendra P. Tiwari, delivered the Presidential Remarks, elevating the discourse from national macroeconomic policy to immediate, localized societal intervention. Prof. Tiwari reinforced the critical nature of the SHANTI Act of 2025 and the 100GW nuclear capacity target, recognizing these as the bedrock of India's clean energy revolution and strategic autonomy.

However, Prof. Tiwari critically directed the assembly's attention to the acute, localized ecological and public health challenges manifesting within the host region: The Malwa belt of Punjab. The region faces severe water quality issues, specifically concerning geogenic (naturally occurring) uranium contamination in the groundwater reservoirs. He noted that while the uranium originates from local geological formations, its mobilization has been inadvertently accelerated by intensive agricultural practices, including the heavy application of chemical fertilizers and the unsustainable over-pumping of aquifers, which alters the subsurface hydrochemistry.

### **Guest of Honour's Address**

Prof. Manchanda outlined India's three-stage nuclear program to overcome uranium shortages by transitioning to an abundant thorium cycle. He highlighted current goals, including the 100GW capacity target by 2047, Small Modular Reactors, and atomic energy's broader societal applications. His technical exposition detailed the nuclear fuel cycle

### **Chief Guest's Address**

The explicit inclusion of the Chief Guest, Shri Rajesh Dhiman, Indian Administrative Service (IAS), Deputy Commissioner of Bathinda, was highlighted by Prof. Tiwari as a deliberate structural feature of the conference. This inclusion strengthened the university's commitment to translating highly complex hydrochemical research directly into actionable civil administration protocols, ensuring that scientific data informs localized public health interventions and community awareness campaigns. The Chief Guest, Shri Rajesh Dhiman along with other dignitaries formally released the Abstract Book—a dense compendium of the rigorous scientific efforts to be deliberated over the ensuing days—and welcomed the delegates to the intellectual gathering.

### **Vote of Thanks**

The Inaugural Programme culminated with a comprehensive Vote of Thanks delivered by the Registrar, Central University of Punjab. He expressed profound gratitude to the Chief Guest, Shri Rajesh Dhiman, for bridging the critical gap between empirical scientific research and practical civil administration. Deep appreciation was extended to the Guest of Honour, Prof. V.K. Manchanda, President, Indian Nuclear Society, for setting the intellectual tone, and to the institutional co-organizers from the AMD and the Anusandhan National Research Foundation. Special commendations were directed toward the organizing committee, spearheaded by Convener Prof. Smeer Durani and Co-Convener Prof. K.N. Yogalakshmi, and the key academic pillars of the university including Deans Prof. Ramakrishna Wusirika and Prof. Sanjeev Kumar, Head of Department Prof. V.K. Garg, IQAC Director Prof. Monisha Dhiman, and Prof. Raj Kumar, whose meticulous planning facilitated the successful commencement of the event.

## **Comprehensive Analysis of Technical Deliberations**

The academic and technical architecture of NE&CM-2026 was systematically structured into six distinct sessions across two days, designed to progress sequentially from high-level strategic frontiers to granular material science, and finally to the societal implications of nuclear technology.

### **Session I: Strategic Frontiers and the National Nuclear Mission**

Chaired by **Prof. Ramakrishna Wusirika**, Professor in the Department of Biochemistry and Dean In-charge Academics at CUP, the opening session focused on the historical evolution and the aggressive forward trajectory of India's atomic capabilities.

**Invited Talk 1: Prof. V.K. Manchanda** (President, INS) delivered the keynote lecture, entitled “Journey of Indian Atomic Energy Program of Seven Decades and the Role of INS”. His presentation provided a rigorous historical analysis, tracing the origins of the national nuclear enterprise to the visionary leadership of Jawaharlal Nehru and the foundational scientific architecture designed by Dr. Homi Jehangir Bhabha.

Prof. Manchanda detailed the rationale behind the establishment of the Department of Atomic Energy (DAE) and the formulation of India's unique three-stage nuclear power programme. This sequential strategy was explicitly designed to bypass the nation's geological deficiency in natural uranium by first utilizing pressurized heavy water reactors (PHWRs), subsequently deploying fast breeder reactors (FBRs) to multiply fissile material, and ultimately transitioning to advanced reactors operating on the highly abundant thorium-uranium-233 cycle. The lecture emphasized the current phase of unprecedented nuclear resurgence, contextualizing the 100GW target by 2047 and the critical developmental pivot toward Small Modular Reactors under the National Nuclear Mission. Furthermore, Prof. Manchanda elucidated the broader societal applications of atomic energy pioneered by the DAE in healthcare, agriculture, and industrial preservation, underscoring the vital professional outreach initiatives spearheaded by the Indian Nuclear Society.

**Invited talk 2: Dr. Debabrata Datta, Associate Director (Rtd.), NPCIL**, expanded upon the technological mechanics of this expansion in his lecture, “National Nuclear Mission and Relevance of SMRs”. Dr. Datta provided a detailed comparative analysis of fundamental reactor technologies, delineating the operational distinctions between indigenous systems (PHWR, FBR) and imported light-water systems (PWR, BWR). He analyzed the National Nuclear Energy Mission (2025), which aims to achieve 100GW capacity, highlighting a massive sovereign investment of ₹20,000 crore specifically allocated for the indigenous research, development, and deployment of SMRs. The strategic importance of SMRs was emphasized not only for their role in the clean energy transition but also for their operational flexibility, allowing for decentralized deployment in remote geographical areas, integration with variable renewable grids, and direct utilization in industrial applications requiring high-temperature process heat.

**Invited Talk 3: A talk by Shri M.K. Mathur, Former Associate Director** and Head of the Nuclear & Mechanical Group at NPCIL, titled “Safety of Nuclear Power Plants and Impact of SHANTI Act 2025 on Indian Nuclear Program”. Shri Mathur directly confronted the persistent public anxieties regarding nuclear safety by presenting a stark, data-driven comparison between nuclear fission and traditional coal power

generation. The analysis emphasized the vastly superior energy density of nuclear fuel and its negligible carbon footprint, essential attributes for mitigating anthropogenic climate change. The core of his presentation detailed the "Defence-in-Depth" safety philosophy, a universally adopted nuclear engineering paradigm that employs multiple, redundant, and independent physical barriers (fuel matrix, cladding, pressure vessel, containment building) and active/passive safety systems to ensure the fundamental objective of protecting the public and the biosphere from radiological exposure. Additionally, Shri Mathur deliberated on the economic and regulatory implications of the SHANTI Act 2025, explaining how the legislation establishes clear environmental safeguards and transparent liability frameworks, thereby catalyzing massive capital investment and active participation from the domestic Indian industrial manufacturing sector.

## **Session II: Critical & Strategic Minerals: Exploration and Self-Reliance**

Chaired by **Prof. Raj Kumar**, this session shifted the analytical focus from the physics of energy generation to the terrestrial exploration and extraction of the strategic minerals requisite for sustaining the clean energy infrastructure.

**Invited talk 4: Shri Shaker Gupta, Scientist-G** at the AMD, Jaipur, delivered an exhaustive lecture entitled "Augmentation and Development of Atomic and associated Critical Mineral Resource: A pathway to empower India's Energy Future and Net Zero Goals". The core thesis of his presentation asserted that the transition to a decarbonized global economy is fundamentally reliant upon the massive extraction of specific geological resources. Achieving Net Zero targets is physically impossible without exponentially increasing the domestic supply of critical minerals required for nuclear fuel fabrication, high-capacity energy storage systems, and advanced grid infrastructure. Shri Gupta detailed the AMD's strategic initiatives to aggressively augment these resources through the deployment of advanced, multi-disciplinary exploration methodologies, ensuring that India's energy transition is not delayed by raw material bottlenecks.

**Invited talk 5: Shri K.L. Mundra, DAE-Homi Sethna Chair and Additional Director (Rtd.)** at AMD Hyderabad, presented "Self-Reliance in REEs for Atmanirbhar Bharat: My Perspective" addressed the severe geopolitical vulnerabilities discussed during the inaugural session. Dr. Mundra categorized the strategic importance of Rare Earth Elements (REEs), classifying them into light and heavy subgroups, and emphasizing their non-negotiable role in manufacturing permanent magnets for electric vehicles and wind turbines, advanced electronics, and defence technologies. He provided a detailed geological map of India's REE resources, identifying massive potential within monazite-bearing beach placers along the coastal regions, as well as complex inland carbonatite deposits that show high prospectivity for Heavy Rare Earth Elements (HREEs). Dr. Mundra elucidated the modern technological arsenal deployed by the AMD for mineral discovery, including high-resolution multi-spectral remote sensing, deep-penetration geophysical surveys, and precision diamond core drilling. The ultimate strategic objective detailed in his address was the establishment of a fully indigenous, sovereign REE value chain, spanning from upstream mining to midstream metallurgical processing and downstream component manufacturing thereby realizing the vision of an "Atmanirbhar Bharat" (Self-Reliant India) and neutralizing external supply chain coercion.

### **Session III: Sustainable Nuclear Energy: Waste Management and Net Zero Goals**

Chaired by **Prof. Sanjeev K. Thakur** from the Department of Botany, this session addressed the secondary environmental impacts of nuclear power—specifically the management of radioactive by-products and analyzed the macroeconomic data linking energy consumption to human development.

**Invited talk 6: Dr. Hrishikesh Mishra, Distinguished Scientist and Controller (Rtd.) at BARC**, fundamentally reframed the scientific narrative surrounding radioactive byproducts in his lecture, “Nuclear Waste to Wealth: Strategic Management and Career Pathways in DAE”. Dr. Mishra explained that the DAE operates upon rigorous waste management principles: "delay and decay" for short-lived isotopes, "concentrate and contain" for medium-level waste, and crucially, "recycle and reuse" for spent nuclear fuel. The presentation delved deeply into the mechanics of the closed nuclear fuel cycle, a cornerstone of India's three-stage program. Through advanced radiochemical reprocessing and actinide partitioning, highly radioactive and long-lived transuranic elements are separated from the bulk waste stream. This highly sophisticated process not only drastically reduces the volume and radiotoxicity of high-level waste destined for geological disposal but also facilitates the recovery of valuable radioisotopes. These recovered isotopes are subsequently repurposed as "wealth" for vital societal applications in industrial radiography, food preservation, and targeted medical therapies. Furthermore, Dr. Mishra utilized the platform to outline the dynamic and highly specialized career opportunities available within the DAE and BARC for emerging scientists and engineers.

**Invited talk 7: Dr. S. Gangotra from BARC** expanded the analytical scope to global climate mechanics in his presentation, “Nuclear Energy and Net Zero Carbon Emission”. Dr. Gangotra addressed the urgent, existential challenge of anthropogenic climate change, driven by steadily rising atmospheric carbon dioxide levels. A critical theoretical component of his lecture was the exploration of the "development-energy nexus." He presented compelling macroeconomic data demonstrating the direct, unbreakable correlation between a nation's Human Development Index (HDI) and its per capita electricity consumption. Dr. Gangotra argued mathematically that in order to lift hundreds of millions of citizens into higher tiers of development, India must radically scale its energy output. He detailed the inherent physical limitations of relying solely on renewable energy pathways, noting their low energy density, vast land requirements, and grid instability due to intermittency. Therefore, nuclear energy functions not merely as an alternative, but as the primary, indispensable clean baseload necessity required to honor India's international "Panchamrit" climate commitments. Additionally, he highlighted the emerging role of high-temperature advanced reactors in generating massive quantities of green hydrogen, a critical mechanism for the deep decarbonization of hard-to-abate industrial sectors such as steel and cement manufacturing.

### **Session IV: Advanced Nuclear Technologies: Fuel Cycles and Medical Innovations**

Commencing the second day of the conference under the chairmanship of **Prof. Monisha Dhiman**, Director of the Internal Quality Assurance Cell (IQAC), Session IV explored specialized technological and biological frontiers.

**Invited Talk 8: Prof. V.K. Manchanda** returned to deliver a highly technical exposition entitled “The Nuclear Fuel Cycle and Thorium as an Abundant Source of Nuclear Energy”. The presentation focused on the fundamental physics and metallurgy of the nuclear fuel cycle. Prof. Manchanda explained the critical distinction between fissile materials (which undergo fission upon absorbing a neutron) and fertile materials (which absorb a neutron to transmute into a fissile isotope). Because the reactor core contains both, additional fissile material is invariably synthesized during standard power generation, a principle maximizing resource efficiency. A significant portion of the lecture was dedicated to the highly complex chemical engineering involved in uranium processing, specifically detailing the transition from Uranium Dioxide  $UO_2$  powder to precisely engineered, sintered  $UO_2$  ceramic pellets that constitute the reactor core. Prof. Manchanda emphasized the rigorous parameters required for nuclear fuel characterization to ensure absolute operational safety and thermal efficiency. These parameters include strict limits on impurity levels (specifically monitoring neutron-absorbing elements like Boron, Cadmium, and Gadolinium), exacting physical properties (maximizing density and surface area while maintaining precise oxygen-to-metal ratios), and highly controlled microstructural features (optimizing grain size and pore size distribution to contain fission gases).

**Invited Talk 9: Dr. Ankit Watts, a Nuclear Medicine Physicist from the Department of Nuclear Medicine at PGIMER, Chandigarh**, radically shifted the analytical focus from industrial physics to human molecular biology in his lecture, “Nuclear Medicine: Redefining Diagnosis and Therapy”. Dr. Watts provided a comprehensive overview of nuclear medicine, defining it as a highly specialized branch of molecular imaging. He explained that unlike traditional morphological imaging modalities (such as standard X-rays or CT scans) which merely reveal structural anatomy, nuclear medicine utilizes tracer amounts of radiopharmaceuticals to evaluate real-time physiological, metabolic, and biochemical functions at the cellular level. Dr. Watts delineated the field into two primary clinical pathways. The first is *Imaging & Diagnosis*, which relies on tracking the biological pathway of radioactive agents to identify functional anomalies in specific organ systems, including the brain, pulmonary networks, renal systems, and the skeletal matrix. The second pathway is *Therapy*, often referred to in the medical physics community as radiotheranostics. This involves deploying precisely calculated, higher doses of targeted radiation to selectively seek out and eradicate pathological tissues. Drawing upon the "smart bombs" analogy mentioned in the inaugural address, Dr. Watts detailed how therapeutic isotopes are engineered to destroy aggressive malignancies, metastasized cancer cells, and severe thyroid disorders from within the cellular structure, thereby drastically minimizing collateral damage to surrounding healthy tissue.

## **Session V: Societal Benefits and Demystifying Radiation in Daily Life**

Chaired by **Prof. Anjana Munshi, Director (R&D)**, this session represented the zenith of the conference's sociological mandate, focusing explicitly on bridging the "Science-to-Society" gap by elucidating the profound, non-electric benefits of radiation.

**Invited talk 10: Dr. Shraddha Singh, Scientific Officer 'G'** in the Nuclear Agriculture & Biotechnology Division at BARC, delivered a compelling presentation on “Nuclear Agriculture”. Dr. Singh addressed the

deployment of radiation technologies to fortify national food security. The central strategic objective articulated was bridging the "Lab-to-Land" gap, the systemic challenge of translating highly complex, controlled botanical research into practical, robust, and easy-to-adopt agricultural techniques for rural farming communities. The analysis detailed how BARC scientists have utilized controlled radiation-induced mutation breeding to successfully develop over 41 superior, super-strong crop varieties characterized by higher yields, enhanced nutritional profiles, and greater resistance to abiotic stress and disease. However, Dr. Singh stressed that mere technological provision is insufficient. Sustained agricultural success depends fundamentally upon rigorous localized capacity building—training farmers in modern water-efficient irrigation, soil health maintenance, and integrated pest management. Furthermore, she highlighted the critical integration of Information and Communication Technology (ICT), such as mobile applications providing real-time weather alerts and market pricing, as essential tools for scaling outreach. She also advocated for sustainability and risk mitigation by encouraging agrarian populations to pivot from vulnerable monoculture practices toward diversified operations including dairy, poultry, and organic farming.

**Invited Talk 11: Shri R.K. Singh, Former Head of the Media Relations & Public Awareness Section at BARC,** delivered a highly persuasive narrative entitled "Nuclear Energy in Daily Life". His presentation fundamentally challenged the narrow, ubiquitous public perception that atomic energy is confined exclusively to the hazardous generation of electricity. Instead, Shri Singh framed nuclear science as the "best scientific gift of the 20th century," arguing that it has become an invisible yet integral pillar of modern existence, offering critical, unparalleled solutions across a multitude of non-electric sectors. He systematically detailed the following societal impacts:

- **Food & Water Security:** Utilizing advanced environmental isotope hydrology to map deep underground aquifers, track groundwater recharge rates, and ensure sustainable "drinking water for all," alongside deploying thermal desalination technologies at coastal nuclear facilities to convert seawater into potable supplies. Furthermore, the use of gamma irradiation facilities significantly extends the shelf life of agricultural produce, mitigating massive post-harvest losses.
- **Energy Independence & Economic Growth:** Fostering highly competitive industrial production through the use of non-destructive radioisotope testing, ensuring the structural integrity of critical infrastructure, pipelines, and aerospace components.
- **Public Health:** Enhancing the fundamental well-being of the population through the mass production of medical isotopes vital for the sterilization of medical equipment and the diagnostic and therapeutic protocols detailed in the preceding session.

## **Session VI: Mineral Processing Technologies and Resource Development**

The final technical session, chaired by Professor Surinder Kumar Sharma of the Department of Physics, addressed the highly complex downstream realities of the critical mineral supply chain.

**Invited talk 12: Shri Devendra Verma, Gujarat Mineral Development Corporation (GMDC), Ahmedabad,** presented an exhaustive technical analysis titled "Strategic Development of Rare Earth and Critical Mineral Deposits in India: Geological Potential, Processing Constraints, and Pathways to Net Zero

Resource Security". Expanding upon the geopolitical imperatives introduced earlier, Shri Verma detailed the immense systemic and metallurgical challenges inherent in mineral beneficiation. Rare earth elements are notoriously difficult to separate from composite ores due to their highly similar chemical properties. The analysis highlighted the severe processing constraints that have historically forced nations to export raw ore and re-import refined materials, thereby perpetuating economic dependency. Shri Verma detailed the proactive, sovereign countermeasures recently enacted by the Cabinet Committee on Critical Minerals, specifically focusing on the operational handover of major REE geological blocks in Gujarat from the AMD to the GMDC. This institutional handoff represents a monumental execution of national policy, translating raw geological exploration data into active, sovereign industrial processing capabilities. By establishing domestic beneficiation infrastructure, India aims to permanently secure the upstream supply chains essential for manufacturing the advanced technologies required for Net Zero resource security.

### **Interactive Session: The Imperative of Doubts Clarification**

A defining and highly functional hallmark of NE&CM-2026 was its structural commitment to participatory dialogue. Moving beyond the unidirectional dissemination of scientific data, the conference schedule explicitly incorporated dedicated intervals for rigorous "doubts clarification" from the diverse assembly of participants. These interactive sessions served as the vital crucible where academic theory, regional anxiety, and public scepticism intersected.

The overarching theme of the clarification sessions centered intensely on demystifying radiation and addressing localized environmental concerns. Given the acute context highlighted during the Presidential Remarks, substantial interactive focus was directed toward the Malwa belt's groundwater crisis. Participants, including local students and regional administrators, engaged the domain experts from BARC and AMD regarding the severe hydrochemical dynamics of geogenic uranium contamination in the region.

The scientific consensus communicated and clarified during these intensive Q&A dialogues was critical for public understanding: the experts systematically explained that the presence of uranium in the Punjab aquifers is a natural geological reality derived from ancient rock formations. However, its rapid mobilization into the water table is a severe anthropogenic crisis, exacerbated dramatically by the excessive, unregulated application of bicarbonate-heavy agricultural fertilizers and the unsustainable over-pumping of groundwater, which alters the subsurface oxidation-reduction potential. This vital clarification fundamentally shifted the perspective of civil administrators in attendance, redirecting their focus away from technologically unfeasible subsurface radiological remediation and toward actionable, urgent agricultural reforms, sustainable water management, and the restriction of specific chemical fertilizers.

Furthermore, extensive clarifications were sought regarding the economic viability and operational safety of the newly proposed Small Modular Reactors. Given the massive legislative pivot induced by the SHANTI Act of 2025, participants actively interrogated the parameters of private sector involvement in nuclear generation. Concerns were raised regarding whether the profit motives of private corporations might compromise stringent safety protocols. The assembled experts systematically dismantled these concerns by thoroughly explaining the absolute legal independence of the atomic safety regulator granted by the

new legislation. They reiterated the immutable nature of the multi-layered Defence-in-Depth engineering philosophy, ensuring participants that private sector agility in construction and operation does not, and legally cannot, dilute sovereign nuclear safety standards.

Additional interactive dialogues served to demystify the everyday safety of consuming irradiated agricultural products, with scientists explaining the fundamental physical difference between irradiation (which kills pathogens without leaving residual radiation) and radioactive contamination. By directly, respectfully, and scientifically addressing these deep-seated public anxieties, the clarification sessions fulfilled the conference's foundational sociological objective: cultivating the informed public trust that is an absolute prerequisite for executing massive national infrastructural transitions.

### **Public Outreach and Societal Integration: Placard Competition and the Walkathon**

Recognizing that scientific literacy and policy acceptance must extend far beyond the confined acoustics of an academic auditorium, the organizers of NE&CM-2026 integrated highly dynamic, visible public outreach initiatives into the core structure of the event. These activities were meticulously designed to foster immediate, visceral engagement with the student demographic and the broader regional community.

### **The Valedictory Function and Conclusive**

Following the energetic public engagement of the walkathon, the intellectual proceedings of NE&CM-2026 culminated in a formal Valedictory Function, scheduled from 16:00 to 16:30 on the final day, immediately succeeding the screening of an extensive educational documentary detailing the historical trajectory of India's atomic journey. The concluding valedictory ceremony served as the critical nexus to synthesize the vast expanse of empirical data, legislative policy directives, and sociological insights generated by the expert panels over the preceding 48 hours.

The addresses delivered during the valedictory function rigorously reiterated that the NE&CM-2026 conference was not merely an isolated academic exercise in theoretical physics or geology. Rather, it represented the active drafting of a strategic blueprint for a massive, unavoidable national economic and infrastructural transition. The scientific and policy consensus derived from the six exhaustive sessions was stated unequivocally: the international timeline obligating India to achieve Net Zero carbon emissions by 2070 is rigid and non-negotiable. Concurrently, the mathematical and physical realities dictate that a traditional reliance on intermittent renewable energy sources is fundamentally insufficient to support the massive industrial baseload required to sustain India's ascending trajectory toward becoming a developed global economic superpower.

The valedictory synthesis firmly established that the immediate, strategic integration of advanced nuclear capacity is the only viable pathway forward. This capacity must be scaled rapidly through the mass deployment of factory-fabricated Small Modular Reactors, a deployment uniquely facilitated by the recent regulatory and liability liberations achieved through the SHANTI Act 2025. At the same time the

uninterrupted, sovereign supply of Critical Minerals and Rare Earth Elements must be aggressively secured. The assembly concluded that the nation can no longer tolerate monopolistic external dependencies; upstream exploration must be intensified by the AMD, and sovereign downstream processing capabilities must be rapidly scaled by entities such as the GMDC.

Crucially, the Valedictory Function celebrated the profound success of the conference in bridging the critical "Lab-to-Land" and "Science-to-Society" gaps. Through rigorous, peer-reviewed technical exposition, direct localized administrative engagement regarding the Malwa belt uranium crisis, exhaustive doubt clarification sessions, and highly expansive public outreach via the student placard competitions and the 300-person awareness walkathon, the Central University of Punjab demonstrated a vital governing principle. The fundamental conclusion of NE&CM-2026 is that profound technological and ecological evolution cannot be achieved in a vacuum of public ignorance or fear. It requires the deeply informed, enthusiastic, and scientifically literate consent of the public.

Ultimately, the proceedings of NE&CM-2026 succeeded in repositioning nuclear science in the public consciousness not as an isolated, hazardous industrial sector, but as the foundational, indispensable bedrock of 21st-century national security, environmental preservation, and comprehensive societal well-being. By successfully demystifying the atom and outlining the strategies to secure the critical minerals of tomorrow, the expert deliberations mapped a highly clear, actionable, and scientifically sound trajectory for an Atmanirbhar (Self-Reliant), fully electrified, and ecologically sustainable Indian future.

### **Pedagogical Impact of the Student Placard Competitions**

In a targeted effort to cultivate early-stage scientific communication skills, the conference hosted specialized "ply card" (placard) competitions specifically for the university and visiting student body. This pedagogical initiative was far more than a supplementary activity; it served as a critical exercise in scientific distillation.

Students were challenged to take the highly complex, abstract themes discussed during the technical sessions, such as the complex mechanics of the Thorium fuel cycle, the macroeconomic necessity of Net Zero carbon targets, the intricacies of closed-cycle waste management, and the biological precision of molecular nuclear medicine—and translate them into visually compelling, highly accessible public messaging on physical placards. By actively forcing this demographic to synthesize and graphically represent empirical data, the conference effectively assessed the comprehension levels of the incoming generation of scientists and potential policymakers. More importantly, the placard competition transformed these students into active, informed ambassadors for scientific truth, equipping them with the communicative tools necessary to counter entrenched, historically pervasive myths regarding nuclear technology within their own communities and peer networks.

### **The Awareness Walkathon: A Physical Manifestation of Public Trust**

The zenith of the conference's public outreach and community integration occurred on the late afternoon of Day 2 (Wednesday, February 25, 2026). Centred at the Activity Hall of the Central University of Punjab, the walkathon was executed in direct organizational association with the Indian Nuclear Society (INS),

Mumbai. The event operated under a highly optimistic and scientifically grounded thematic banner: "Nuclear Energy and Nuclear Radiation 'A Boon for a Bright Future' *परमाणु ऊर्जा और परमाणु विकिरण, उज्वल भविष्य के लिए एक वरदान*. The logistical execution of the walkathon was highly efficient, utilizing streamlined QR code registrations that successfully registered and mobilized exactly 300 enthusiastic participants.

The demographic composition of the walkers was deliberately broad, encompassing senior scientists from BARC and AMD, university faculty, and the student body who carried the visual messaging developed during the placard competitions. The walkathon started (17.30 Hrs) from the Activity Hall to Main gate and back served a profound dual purpose. Physically, it represented a communal taking of space a highly visible, public affirmation of trust in nuclear science and radiation technologies. Metaphorically, the synchronized movement of 300 individuals symbolized the massive, collective journey the Indian nation must urgently undertake: a united, scientifically informed march toward sovereign energy independence, ecological preservation, and sustainable industrial growth. By concluding the rigorous, highly technical academic deliberations with an expansive, inclusive physical event, NE&CM-2026 successfully transcended traditional academic boundaries, achieving true, measurable societal integration.







# NE&CM 2026 CONFERENCE ON



## Organised by

Central University of Punjab  
Indian Nuclear Society (INS), Mumbai  
Atomic Minerals Directorate for Exploration and Research, Hyderabad

## Co-Organised by

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