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**THE MINING, GEOLOGICAL AND
METALLURGICAL INSTITUTE OF INDIA**

BIENNIAL EVENT OF MGMI

10TH ASIAN MINING CONGRESS & EXHIBITION 2023

The Asian Mining Congress (AMC) and International Mining Exhibition is a biennial flagship event organized by the Mining, Geological and Metallurgical Institute of India (MGMI). The 1st AMC and Exhibition were held in January 2006 to commemorate the Centenary of MGMI, followed by the 2nd in January 2008, the 3rd in January 2010, the 4th in January 2012, the 5th in February 2014, the 6th in February 2016, the 7th in November 2017, the 8th in November 2019 and the 9th AMC in April 2022. These events were highly successful with participation of around 20 countries spread over different parts of the globe along with large participation of various mining organizations in India. **The 10th Asian Mining**

Congress and Exhibition in this sequel will be held from **November 06-08, 2023 at Kolkata.**

The theme of 10 AMC is **'Roadmap for Best Mining Practices vis-à-vis Global Transformation'**. Technical Sessions of the Congress will be held at Taal Kutir Convention Centre, Rajarhat, Kolkata. The 10th International Mining Exhibition (IME 2023) will be held at Eco Park, Rajarhat, Kolkata.

The Congress will provide a forum for promotion and support of techno-scientific cooperation towards national and international progress in the areas of mineral production, in addition to the development of new opportunities of sustainable business that will benefit both Asian and the World Communities.

Principal Coordinators

Dr. B Veera Reddy : President, MGMI & Director (Technical), CIL

Shri Ranajit Talapatra : Honorary Secretary, MGMI & GM, CIL

ORGANISERS

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Chairman, Technical Committee	Dr. Amalendu Sinha , Former Director, CSIR – CIMFR	Convener, Exhibition	Dr. C S Singh , GM, CIL
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Convener, Conference	Shri Prasanta Roy , HOD (Geology), CIL	Chairman, Buyer Seller Meet	Shri V K Arora , Chief Mentor, KCT Bros. Ltd.

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THEME **"Safety and Labour Considerations in the Mining Industry"**



The Mining, Geological and Metallurgical Institute of India

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The Advertisement Tariff for Insertion in MGMI News Journal

Mechanical Data	Advertisement tariff per issue	
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THE HUMAN ELEMENT OF THE ENERGY TRANSITION



At the outset, let me congratulate our Immediate Past President, Shri P M Prasad, on his taking charge as the Chairman of Coal India Limited. His guidance and counsel will further enhance the scope and quality of MGMI's activities.

The *MGMI News Journal* has brought out several thematic issues over the past couple of years highlighting the technological challenges and innovations in the decarbonization space. It is notable that areas ranging from CO₂ sequestration, methane emissions mitigation and energy efficiency have been covered. When we look at the United Nations Sustainable Development Goals, it is true that many targets are focused on technology, infrastructure and conservation. That said, SDGs 1-6 are focused on societal priorities, or what we may call the human element of energy transitions. These include poverty alleviation, employment opportunities, clean water, sanitation and health targets. One could argue that India's primary thrust is on including these goals. As such, I compliment the Editorial Board for choosing a timely theme for this special issue.

If we look at the budgetary investments required to achieve SDGs 1-6, they can be achieved at modest costs with high returns. A paper in *Nature Sustainability* by David McCollum and his colleagues indicates that global food security can be achieved with an investment of \$40B/year, while education until the age of 14 can be facilitated with investment of \$180B/year.

The magnitude of these investments is certainly realizable with global cooperation. Currently, India's human development index is close to 0.65, which places it on a moderate level of development. Investments in education and health can help push this to the very-high target of 0.8. This will dramatically improve the quality of lives in the country, while creating a healthy and skilled workforce which will be poised to more effectively deliver a clean energy transition. Thus, the goals of safety and labour considerations should be viewed in tandem – and not in isolation – with technological targets to achieve net-zero emissions by 2070.

If we take a closer look at safety conditions of Indian mines, we can certainly say that India has one of the strongest regulatory regimes. This has paid dividends as fatalities have fallen continuously. The fiscal year 2022-23 saw the fatality rate fall down to 0.028/Mt-coal, which was 40% lower than that in 2021-22. While this is encouraging, we do believe that even a single fatality impacts the lives of families and the morale of the coal mining community. As such, we are targeting even improved safety mechanisms. Earlier this year, the Hon'ble Minister of Coal, Government of India launched the UG Vision Plan of Coal India to increase annual production to 1000 Mt by 2027-28. This will be accompanied by a strong digital footprint of mines using the newly-inaugurated 'DigiCoal' framework to optimize safety, efficiency and productivity in mines. New measures are also being routinely implemented in all aspects of mine safety, ranging from strata monitoring to methane measurements. In this vein, I am grateful to the Director General of Mines Safety and his colleagues for sparing their valuable time on the interview in this special issue. Methane drainage from coal mines, particularly, can offer a simultaneous solution to reduction in the carbon intensity, improved energy security and mine safety – all of which are important priorities for both public and private practitioners in the mining community. Taking a look at our Honorary Editor's book on Coalbed Methane in India, we can see that a substantial potential for coal mine methane exists in operational mines and coal blocks awarded to Coal India.

While safety is the highest priority in labour issues, it is not the only one. The Indian coal supply chain employs close to two million individuals. Our beloved Secretary (Coal), Shri Amrit Lal Meena clearly stated in the 62nd Holland Memorial Lecture that an increase in coal production is imminent even as renewables also grow. Thus, the nature of the 'just transitions' in India is separate from many other economies as we are not targeting a coal phase-out. That said, the nature of coal utilization may change. As renewables grow at an exponential rate – including with support from Coal India – the share of coal in the electricity mix may go down with diversification of the coal economy. For instance, coal may be converted to other energy carriers such as hydrogen, methanol or specialty chemicals. MGMI is particularly looking at these pathways very closely and will be organizing a half-day seminar on "Green Mining and Net-Zero" in September 2023, which will nominally have inputs from experts in the fossil, nuclear and renewable domain. I urge all our learned members to participate in this event and provide your insights on this important topic.

On the same note, I must emphasize that India views just transitions as the highest priority. The Ministry of Coal and the World Bank have published a roadmap on the global experiences in this space, which has been aptly summarized by the CMD, CMPDI and his team

in this special issue. Another effort was carried out in a joint Indo-US partnership led by the NITI Aayog to suggest a policy framework incorporating employment, training and health for the mining community. Overall, when we look at the issue of just transitions, we have to be mindful that funding from developed economies is primarily in the form of grants and technology transfer, and not loans. This has been an important issue that various experts have raised in the G20 events and the Clean Energy Ministerial recently concluded in Goa.

My hope is that this special issue will inspire our readers to emphasize this human element in their work – whether in the laboratory, mines, industries or power plants. We should begin to internalize these effects in our work. An excellent example can be found in a recent op-ed in the PSU Watch outlet where Singh and Vishal have showcased how CO₂ sequestration and utilization approaches can deliver several co-benefits in terms of employment, potable water, air quality and energy affordability. The next issue will delve into the aspects of "Unearthing the Depths: A Journey into the World of Underground Coal Mining" which will present a comprehensive and nuanced view of underground coal mining, giving readers a better understanding of its importance, challenges, and potential for sustainable development in an ever-changing global energy landscape.



Dr B Veera Reddy

President, MGMI and
Director (Technical) CIL & CMD, CCL

ENSURING SAFETY IN MINING OPERATIONS



Safety is the tangible outcome of prudently anticipated conditions attained through the methodical implementation of technological and managerial strategies. Risks of accidents and hazards are prevalent in various domains, including road transport, railways, aviation, maritime transport, and industries. Numerous internal and external events and circumstances have the potential to undermine the intended services and results.

According to estimates by the International Labour Organisation (ILO), more than 2.3 million individuals, both women and men, lose their lives annually as a result of work-related injuries or diseases. Among these, approximately 0.35 million are attributed to fatal accidents, while nearly 2 million are caused by fatal work-related illnesses. The ILO also provides estimates indicating that approximately 160 million cases of non-fatal work-related diseases occur annually, while more than 313 million workers experience non-fatal occupational accidents, leading to severe injuries and absences from work. The implications indicate that on a daily basis, around 6,400 individuals on an average lose their lives due to occupational accidents or diseases, with an additional 0.86 million people sustaining injuries while on the job. Notably, work-related diseases emerge as the primary cause of fatalities in the workplace, claiming the lives of nearly six times as many workers compared to occupational accidents.

Mining operations involving the extraction of coal, iron ore, crude oil, stone, and other minerals of commercial value are inherently challenging, given their adverse impact on the natural environment. To ensure successful and sustainable mining ventures, meticulous planning and prudent resource management, especially with regards to human resources and energy, become paramount.

The criticality of prioritizing safety cannot be overstated, as mining activities carry inherent risks to both workers and the surrounding ecosystem. Accidents and hazardous events pose significant threats to personnel and can cause irreparable damage to the environment, disrupting ecological balance for years to come.

In light of recent mining accidents, it is evident that the key to preventing such tragedies lies in implementing rigorous safety protocols. Comprehensive risk assessments, regular safety drills, and the integration of state-of-the-art technology into mining operations are essential steps toward reducing potential hazards. Furthermore, fostering a safety-oriented culture within the mining industry is of utmost importance. Employers must invest in continuous training and provide workers with the necessary knowledge and tools to respond effectively to emergencies. Creating an environment where workers feel comfortable reporting safety concerns without fear of retribution is also vital in mitigating potential risks. In this edition of MGMI News Journal, we present an exclusive interview with Shri Prabhat Kumar, Director General of Mines Safety, shedding light on various critical aspects concerning mines safety in India.

Collaboration between government authorities, industry stakeholders, research institutions and environmental experts is critical in setting and enforcing safety standards. Regular inspections and adherence to best practices will foster a culture of compliance, resulting in safer mining practices and more secure working conditions.

The recent tragedies serve as reminders of the responsibility we must bear to safeguard human lives, natural resources, and the environment. For instance, there was a leak of poisonous gas near Boksburg in South

Africa, which led to the loss of 17 lives. In a remote region of southern Peru, 27 workers tragically lost their lives in a gold mine fire. In northwestern Pakistan's Orakzai district, a coal mine collapse resulted in a deadly mine mishap. An illegal mining site at Kaparsa Colliery of Eastern Coalfields Limited (ECL), Nirsra Block, Dhanbad, saw a fatal accident. In Afghanistan, the Kohistan mine collapse claimed the lives of 30 gold miners, while in Myanmar, the Hpakant jade mine disaster resulted in the tragic loss of 174 lives due to a landslide. These incidents underscore the importance of ensuring safety measures in mining operations and preserving both human lives and the environment. In this issue, we are privileged to feature a technical article on safety management strategies in the mining industry authored by the CMD, CMPDI, and his team. This insightful article delves into the safety challenges faced by the mining sector, offering valuable insights and knowledge for the benefit of our readers.

In India, a mine disaster is defined as an accident in which ten or more casualties occur. Between 1908 and 2016, fifty-eight such disasters have occurred in coal mines across the country. Notable among these were the mine disasters at Amalbad, Bhatdee, Chasnala, Chinakuri, Dhori, Gaslitand, New Kenda, Newton Chikli, and Poidih. Among the coal mine disasters, explosions were responsible for a significant portion, approximately 53% of the fatalities. However, the most severe catastrophe was triggered by a water inrush or inundation at the Chasnala underground coal mine in December 1975, which claimed the lives of 375 mine workers. These unfortunate tragedies led to significant upheaval within the coal mining industry, prompting a reevaluation of regulations and the formulation of new guidelines.

Metalliferous mines have registered significantly fewer accidents that qualify as mine disasters when compared to coal mining. However, there have been two notable incidents at the Rajpura Dariba mine, owned by Hindustan Zinc Limited. In one of these accidents, a major fire broke out in a diesel storage tank on the surface, claiming the lives of six individuals. The second incident occurred during shaft deepening operations and tragically resulted in the loss of thirteen lives.

Most of the disasters occurring in oil and gas fields are closely linked to drilling operations, specifically caused by unbalanced pressure problems when the drilling bit

cuts through a permeable formation. This results in the formation of fluid pressure exceeding the hydrostatic pressure, leading to the leakage of formation fluid into the bore well. Another major contributing factor to these disasters is the sudden release of gas. Mishandling of gas during processing or flowing under constraints has been identified as another significant cause. One notable incident occurred in 1988 on the Piper Alpha oil platform in the British North Sea, claiming the lives of 167 individuals. In India, a tragic event took place in the history of the Oil and Natural Gas Corporation (ONGC), involving the Bombay High North (BHN) platform situated in the offshore Mumbai High field. On 27th July 2005, a devastating fire engulfed the massive platform, which had been actively separating oil from gas for 24 years. In just two hours, the BHN platform was reduced to molten metal, resulting in the loss of eleven lives, with eleven others reported missing. The intensity and suddenness of the fire left little time for the occupants to utilize lifeboats. We present in this issue, a compelling technical article that explores the safety concerns pertaining to oil and gas fields, along with effective measures for their mitigation.

Disasters like these serve as valuable lessons, underscoring the importance of adhering to established standards and remaining vigilant about alarming indications. Such incidents are often caused by faulty equipment or human error, with root causes including lack of knowledge, practice and experience among well operators. By learning from these unfortunate events, the industry can strive to prevent similar disasters in the future and ensure the safety of its workers and the environment.

Emphasizing a safety-centric approach and fostering harmonious collaboration, we can achieve significant progress in the mining industry, ensuring both economic prosperity and environmental sustainability. Our collective commitment to safety and responsible resource management will pave the way for a thriving and respectful mining sector that honours our surroundings and benefits all stakeholders involved.

Mining in India is predominantly labour-intensive, offering a diverse range of job opportunities from skilled underground miners to manual extraction labourers. However, persistent concerns about worker welfare have spurred ongoing efforts to enhance labour conditions and enforce stricter regulations. To address these issues, good policies for the mining industry's work-

force should prioritize providing workers with adequate training, protective gear, and regular health check-ups to safeguard their well-being. The Indian coal sector involves reasonably good compensation to the workers, alongside other perks such as tuition fees for their children admitted to engineering or medical colleges. The improvement of employees' performance relies on three interdependent factors : motivation, ability, and opportunity. While highly motivated workers are essential, being motivated alone does not guarantee optimal performance if ability or opportunity is lacking. Hence, it is crucial to exercise caution and ensure that all three factors are adequately addressed to motivate the workforce effectively.

The global energy markets are undergoing a transition with increase in clean energy, driven by international agreements, climate policies, growing regulatory and political restrictions on their usage, and the competitive pricing of alternative fuels. A just transition in the Indian context is necessary to ensure that the shift towards renewable and sustainable energy sources does not disproportionately impact vulnerable communities and workers dependent on traditional fossil fuel industries. By implementing policies that prioritize social equity, job retraining, and fair compensation for affected workers, India can successfully navigate the energy transition while promoting inclusive growth and minimizing social and economic disruptions. Two groundbreaking reports, one led by NITI Aayog and the other by CMPDI with World Bank contributions, propose a just transition framework for India, ensuring a fair shift from coal to sustainable energy sources. Emphasizing inclusivity, these reports inspire a greener and socially responsible future for the nation. In the current issue, a pioneering technical paper on sustainable development and just transition authored by the CMD of CMPDI and his

team unfolds essential recommendations for a smooth transition in India's coal/lignite sector. This insightful piece aims to empower readers with valuable insights and strategies towards fostering a fair and sustainable future.

I take this opportunity to extend my heartfelt congratulations to our esteemed Immediate Past President, Shri P M Prasad, on assuming the distinguished role of Chairman, Coal India Limited, and to our President Dr B Veera Reddy, as he takes additional charge as CMD, CCL. Their unwavering inspiration has fuelled our efforts to elevate the standards of our publications. The invaluable contributions of authors have emboldened us to present this issue, fostering new strategies for our readers' benefit. My sincere gratitude goes to the reviewers and Editorial Board members for their unwavering support. Special gratitude is extended to several esteemed individuals who have played instrumental roles in making the 62nd Holland Memorial Lecture and the National Seminar on "Meeting the Challenges - Blue Hydrogen" a resounding success and for their valuable contributions to this edition. We express our heartfelt thanks to Shri U Kumar, Past President of MGMI and Former CMD, SECL & NCL, Shri N. N. Gautam, Council Member of MGMI and Special Secretary - Events of MGMI - Delhi Chapter, and Former Advisor to the Ministry of Coal & UNDP, for their insightful inputs and expertise, which greatly enriched the content of the report on this event. Our sincere appreciation goes to Shri P S Upadhaya, Chairman of MGMI Delhi Chapter, and Shri Peeyush Kumar, OSD at the Ministry of Coal and Council Member of MGMI, for their indispensable efforts in shaping the comprehensive report that appears in this publication.

Ajay K. Singh

MINUTES OF THE 897TH MEETING OF THE COUNCIL

(Held through Hybrid Mode in Physical and Virtual Platform through Zoom)

The 897th Council Meeting (2nd Meeting of the 117th Session) was held at WCL Office, Nagpur on Saturday, 11th March 2023 at 7.00 p.m. (dully approved in the 898th Council Meeting held on 27th May, 2023).

PRESENT : Dr. Reddy B Veera, President in the Chair. The meeting was attended by Prof Banerjee Sakti Pada (Virtual), Prof B B Dhar (Virtual), Dr N K Nanda (Virtual), S / Shri Jha N C (Virtual), Ritolia R P (Virtual), Saha R K (Virtual), Thomas Cherian (Virtual), Lochan Rajiw (Virtual), Roy Prasanta, Singh Dr Chandra Shekhar (Virtual), Dr Mandal Prabhat Kumar (Virtual), Dr Singh Ajay Kumar (Virtual), Arora V K (Virtual), Sarkar Prof Bhabesh Chandra (Virtual), Chakraborti Bhaskar (Virtual), Pandey Awadh Kishore, Kumar Peeyush (Virtual), Nag T K (Virtual), Dattatreylu J V (Virtual), Sinha Dr Amalendu (Virtual), Karmakar Prof (Dr) G P (Virtual), Dey-Prof N C (Virtual), BarnwalDr J P, Singh Anil Kr, Wadhwa I P (Virtual) and Talapatra Ranajit.

ITEM No. 0 Opening of the Meeting

0.1 Honorary Secretary informed the Council of the passing away of Shri Lab Kumar Bose, former Honorary Secretary, MGMI (1995 - 1999) on 9th March at his residence at Kolkata after almost a year of age-related illness. He was 84 and left behind his wife, two daughters and a grandson.

A solemn one - minute silence was observed in respect to the departed soul and thereafter, the Council Members were requested to speak about their interactions and memories of Late L K Bose.

Several members paid glowing tributes to Late Bose, one of the very active and contributing members of MGMI. It was informed that it was during his tenure as Honorary Secretary, that the present MGMI

Building at Sector V was built. Prof S P Banerjee informed that it was Late Bose who prepared the masterplan of creation of Eastern Coalfields Limited when he was working in Coal India Limited.

Shri V K Arora recommended that Late L K Bose's contribution to MGMI be recorded and a resolution passed to send across to his grieving family expressing sincere condolences. The resolution was passed with several members supporting the recommendation.

President promised that whatever help is required by the family at this juncture, MGMI members will help.

0.2

The President welcomed the Past Presidents, Past Honorary Secretaries, Present Honorary Secretary, Chapter Chair Persons and existing Council Members who were present physically as well as virtually in the meeting.

He informed all members about the good work started by the local chapters, like Hyderabad, Odisha, Delhi and Nagpur. The Nagpur Chapter organised a seminar on 12th March, 2023.

He talked at length about his vision for MGMI and the targets including making MGMI more meaningful all over the country. He introduced the Chairman, Nagpur Chapter, Shri Anil Kr Singh, Director (Technical), Project & Planning, WCL as the main man behind the seminar being organised by MGMI Nagpur Chapter the next day on 12th March, 2023 and reminded that senior members like him are coming back to MGMI Council and enriching it. It was informed that in the past, Sri Singh was the Honorary Secretary of Odisha Chapter and a Council member too.

0.3 Leave of absence was granted to those who could not attend the meeting.

897.1.0 To confirm the Minutes of the 896th meeting of the Council held in Hybrid platform at MGMI Hqs, Kolkata on 3rd December, 2022.

The 896th Council Minutes were circulated to all the Council Members. As no comment was received, the Council resolved that :

Resolution : The Minutes of the 896th (2nd meeting of the 117th Session) Meeting of the Council held on 3rd December, 2022 at 11.30 AM on Hybrid platform, be confirmed.

897.1.1 To consider matters arising out of the Minutes.

The Council considered the Action Taken Report in respect of the Minutes of 896th Council Meeting held on 3rd December, 2022 on virtual platform and concurred.

897.2.0 To discuss about the 10th Asian Mining Congress and Exhibition.

Shri Prasanta Roy – Convenor of the Conference highlighted the points as below :

In the last Council Meeting, the Organizing Committee & Exhibition Committee were finalized and subsequently an Organizing Committee Meeting was held in which a Technical Committee was constituted.

A Technical Committee meeting was held subsequently and a draft brochure has been prepared.

Important dates related to “**Call for papers**” were proposed–

Abstract submission - by 31st May 2023

Abstract acceptance notification – by 15th July 2023

Full paper submission – by 1st September 2023

Full paper acceptance notification – by 13th October 2023

He informed that letters have been sent for logo support to different Ministries and Secretaries of Heavy Industries, Power, Steel,

etc., but till date, responses are awaited other than The Ministry of Coal, who has consented for logo support and Secretary (Coal) as Patron. It was proposed to wait for few more days to see if any other Ministry provides Logo Support, before sending the Brochure for printing.

He requested Shri Peeyush Kumar to follow up with other Ministries, who agreed to do the same.

Convenor, Conference read out the sponsorship rates of the 9th Asian Mining Congress and informed that the rates have been kept the same for 10th Asian Mining Congress.

Taj Taal Kutir Convention Centre, adjacent to the Exhibition venue, has been blocked for 3 days from 6th to 8th November for 3 days Conference. Based on discussions with Taj, it is assumed that the 3 days Conference budget will increase substantially, in comparison with the expenditure for 9th AMC, which was held over 2 days only.

Dr Chandra Shekhar Singh, Convenor of 10th IME, briefed the Council about the exhibition.

He informed that for 9th IME, the minimum guaranteed amount from M/s TAFCON was Rs.35 Lakhs, which was reduced from the normative 45 lakhs as a one-time exception, considering the Pandemic. However, due to very good participation, Rs.45 Lakhs was paid by M/s TAFCON as per MOU terms. The minimum guarantee this time has been thus raised to Rs.55 Lakhs. The Council agreed and advised the Honorary Secretary to sign the MOU with M/s TAFCON.

897.3.0 To discuss about Holland Memorial Lecture.

President informed that he has talked with the Secretary, Ministry of Coal for delivering the 62nd Holland Memorial Lecture and he has agreed.

President requested Shri Peeyush Kumar to organise a 1-day event with Holland Memorial Lecture. Sri Kumar agreed and requested for a finalised date so he can book the venue.

President assured that he would talk to the Secretary, Ministry of Coal for a choice of dates (preferably Saturday). 29th April, 2023 Saturday was tentatively proposed by Honorary Secretary.

897.4.0 To discuss about the MGMI Membership Drive.

Considering the number of applications received, it was commended by all and the President was congratulated for the success of the drive.

Chairman, Nagpur Chapter informed that about 30 applications have been handed over on 11th morning to Honorary Secretary with payment and on 12th, before the Seminar on "Best practices in Mineral Industry" organised by MGMI, Nagpur Chapter, further 70 applications will be handed over, making it 100 applications from Nagpur Chapter for now.

The Council unanimously congratulated the President along with the Chairman, Nagpur Chapter for such wonderful achievement. Shri Singh promised there will be more membership in time, considering so many Mining related companies, colleges and organisations, like MECL, MOIL, IBM, VNIT are located in Nagpur.

President prodded every Council member to take an active part in membership drive setting a target of 3000 members, an increase of 1000 members from present strength of 2000 members.

897.5.0 To discuss about the revival of Chapters of MGMI.

President and all others praised the performance of Nagpur, Odisha, Delhi and Hyderabad chapters. It was informed by Dr A Sinha and Dr P K Mondal, Honorary Treasurer, MGMI, that Dhanbad Chapter had a meeting to choose Office bearers (Chairman, Secretary, etc.) and is gearing up for an event along with membership drive.

897.6.0 To consider applications for membership and the membership position of the Institute.

There were 86 new and complete applications since the last Council, out of which the Council members unanimously agreed for 85 candidates.

Discussions arose regarding membership of a candidate, namely, Ms. Nandini Chakraborty who is associated with a company supplying FLP equipment to mines since several years and have been doing Research and Development on Flameproof electricals for usage in UG Mines. She has been an associate member since a long time and has now put in an application for upgrading herself to Life Member. She is now an MD with vast experience of 40 years in related industry. However, as per AOA of MGMI, she does not fulfil the eligibility criteria of educational qualification.

The Qualification of Members as given in Articles of Association in Page no. 7 was spelt out. It was explained that AOA needs to be modified suitably to consider her Life membership.

It was decided that a committee will be constituted in the next Council Meeting for review of the AoA in view of the above discussions.

**Membership Position
(As on 11.03.2023)**

	03.12.2022	Add	Trans	Loss	11.03.2023
Member	42	01	-	-	43
Life Member	1946	84	-	01	2029
Associate	18	-	-	-	18
Student					
Associate	06	-	-	-	06
Life Subscriber	27	-	-	-	27
Subscriber	01	-	-	-	01
Life Donor	01	-	-	-	01
Donor	01	-	-	-	01
Patron	05	-	-	-	05
Corporate	08	-	-	01	07
Life Corporate	02	-	-	-	02
	2057	85		02	2140

897.7.0 Any other matter with the permission of the Chair.

A. Prof B B Dhar proposed to have a good website with all information about activities and presence in all social platforms like Facebook, Twitter, etc.

Honorary Secretary informed that the website www.mgmiindia.in now has far improved look with several dynamic features, with comprehensive online membership application form and UPI payment facility. He requested Prof Dhar to kindly suggest specific issues needing improvement or advice on new items to be possibly added. There needs to be a dedicated person who will update or handle the social media accounts, including a Twitter handle.

President suggested appointing a paid PR agency to handle such social media professionally and requested Honorary Jt Secretary to facilitate opening of a Twitter account for MGMI.

Honorary Secretary also informed the Council that initially for online payment for membership, Razorpay was selected by the Website handlers and the process was taken to an advanced stage, when RBI stopped a few payment gateway service providers from

on-boarding new clients till security audit of the companies were completed and compliance established. Also, there were some negative issues with RazorPay that came out in the papers and it was decided to talk to some other reputed companies like PayTM, CcAvenue, Easypay, RUpay etc. Accordingly, they had talked, with CCAvenue and is going ahead with the payment gateway company (Registered Company is known as Infibeam Avenues Limited).

The Council agreed to the proposal with a rider that account security should be primarily kept in mind.

B. Honorary Secretary informed the Council that based on recommendation of a Finance Committee, an advertisement was placed in 2 papers for the post of Executive Secretary. There were 179 applications, out of which 11 were shortlisted and called for interview.

6 candidates turned up and Sri Prasun Nag was selected on the basis of interview judged on pre-determined criteria parameters. The new incumbent will be on contract basis for the first year and the salary will be Rs.40,000/- per month.

The meeting ended with Vote of Thanks to the Chair and others present both physically and virtually by Honorary Secretary.

MINUTES OF THE 898TH MEETING OF THE COUNCIL

(Held through Hybrid Mode in Physical and Virtual Platform through Zoom)

The 898th Council Meeting (3rd Meeting of the 117th Session) was held at MGMI Bldg, GN-38/4, Sector-V, Salt Lake, Kolkata- 700 091 on Saturday, 27th May 2023 at 2.30 p.m. (dully approved in the 899th Council Meeting held on 27th July, 2023).

PRESENT : Dr Reddy B Veera, President in the Chair. The meeting was attended by Prof Banerjee Sakti Pada (Virtual), Prof Dhar B B (Virtual), S / Shri Jha N C (Virtual), Ritolia R P (Virtual), Saha R K (Virtual), Goenka J P, Lochan Rajiw (Virtual), Roy Prasanta, Singh Dr Chandra Shekhar, Mandal Dr Prabhat Kumar, Singh Dr Ajay Kumar, Arora V K, Sarkar Prof Bhabesh Chandra (Virtual), Pandey Awadh Kishore, Kumar Dr Peeyush (Virtual), Nag T K, Dattatreylu J V (Virtual), Sinha Dr Amalendu (Virtual), Karmakar Prof (Dr) G P (Virtual), Gautam N N, Sen Dr Kalyan, Dey Prof N C (Virtual), Barnwal Dr J P (Virtual), Bhattacharjee Prof. Ashis, Kumar Manoj, Upadhyay P S, Wadhwa I P, Sundara Ramam D B and Talapatra Ranajit.

ITEM No. 0 Opening of the Meeting

0.1 Honorary Secretary welcomed all members present physically as well as virtually and requested the President to call the 'meeting to order' and address the council members.

0.2 The President welcomed all those present physically and virtually in the meeting.

He informed all members about the 62nd Holland Memorial Lecture in New Delhi on 29.04.2023 delivered by Sri Amrit Lal Meena, Secretary (Coal) and thanked the Delhi Chapter for organising it very successfully. The Lecture was followed by National Seminar on "Meeting the Challenge- Blue Hydrogen". Sri Pramod Agrawal, Chairman, Coal India Ltd was the Guest of Honour.

He mentioned that the membership drive is yielding good result, with some of the chapters doing commendable work.

President reiterated that there is a need to increase membership every month. There is also a need to organize Technical Seminars, talks, etc. regularly. He then requested Honorary Secretary to take up the agenda points one by one and discuss the same.

Honorary Secretary introduced Sri Prasun Nag, the New Executive Secretary appointed, to all council members physically present. The council members wished him all the best in his new job here and hoped that he would be up to the mark.

898.1.0 To confirm the Minutes of the 897th meeting of the Council held in Hybrid platform at WCL Office, Nagpur on 11th March 2023.

The 897th Council Minutes were circulated to all the Council Members. As no comment was received, the Council resolved that:

Resolution : The Minutes of the 897th (2nd meeting of the 117th Session) Meeting of the Council held on 11th March, 2023 at 07:00 PM on Hybrid platform, be confirmed.

898.1.1 To consider matters arising out of the Minutes.

Honorary Secretary read out the ATR (Action Taken Report) in respect of the Minutes of 897th Council meeting.

The Council considered the Action Taken Report in respect of the Minutes of 897th Council Meeting held on 11th March, 2023 held in Hybrid platform and concurred.

898.2.0 To discuss about the 10th Asian Mining Congress and Exhibition.

Honorary Secretary took President's permission to take up the progress of 10th IME to let Sri Wadhwa of TAFCON elucidate about the status of exhibition and then leave the meeting.

Mr Wadhwa highlighted that the response has been good and countries like Australia, Germany have expressed willingness to

participate in the event. Regarding China as there has been a visa related issue with the Ministry of External Affairs, Govt. of India, he requested MGMI to take up the issue with MEA.

Countries like Poland, Czech Republic, Russia have shown interest and at least 30 countries are expected to participate. To showcase the Exhibition and Conference, especially among the diplomatic community for better representation from their respective countries, he requested MGMI President to consider holding Press meeting in New Delhi for wider publicity like 2014, when Sri R K Saha was the President. As there was no more question on IME, Mr Wadhwa left the meeting with permission of the Chair.

Dr C S Singh, Convener, IME informed that MOU has been signed with M/s TAFCON for organizing the 10th IME with similar terms but enhanced rate of stalls/per square foot for both inner and outer areas as well as a minimum guarantee of Rs.55 Lakhs.

Convenor of the 10th AMC highlighted that there will be a 3 days event (6th – 8th) Nov 23 at Taaj Taal Kutir Convention Centre, adjacent to Eco Park Exhibition venue. Brochures were circulated to members, different institutes all over India and also to different Embassies and High Commission offices located in India. Ministry of Steel, Ministry of Coal and Department of Defence Research & Development have confirmed logo support. He informed that final Submission date of abstracts of Technical papers that was earlier fixed as 31st May 2023 was extended to 15th June 2023.

Prof Amalendu Sinha, Chairman, Technical Committee, 10th AMC felt that more keynote addresses will give a buffer to uncertainties of the speakers on that day at Kolkata. Steps should be taken to see that parts of Mining & exploration areas other than Coal are also covered. He said that about 60 papers must be available by the final date to choose from.

To improve the quality of papers, Scopus indexing of the Proceedings was suggested.

Convener, Conference and Chairman, Technical Committee said that they will look into the matter, though they said that time may not be enough for the registration before publication, but earnest efforts will be made.

898.3.0 Election of Council Member for Session 2023-26.

Honorary Secretary said that in 2020 due to pandemic, no election was held and the then Honorary Secretary took permission from MCA (Ministry of Corporate Affairs) to extend the Tenure of the council for 1 year under exceptional Force Majeure Clause. Hence in 2021, election was held for all those who completed 4 years as well as 3 years in 2021. Accordingly, no one in the present council is due to retire in 2023. There is no vacancy except 1 seat for Metallurgy. Suggestions were received and it was decided that the election for this 1 seat for Metallurgists would be held through e-voting mode, if there are more than one candidate. A committee with Mr V K Arora, Mr J P Goenka, Mr Prasanta Roy and Prof Amalendu Sinha was constituted for the process.

898.4.0 Half day Seminar, 63rd Holland Memorial Lecture for 2023 & AGM.

As per MCA rules, the AGM will have to be held within 1 year of 25th September 2022, the date the last AGM was held. It was suggested that since the 62nd Holland memorial Lecture was held recently, though after a period of 3 years, it will be better if the 63rd lecture is held in 2024. As per precedents, the AGM will follow a half day seminar. The date decided was 23rd September, 2023, a Saturday two days before Deadline.

For organizing the Half Day Seminar successfully, Shri R K Saha was proposed as Chairman and Shri Rajiw Lochan as Convener, which were approved.

898.5.0 To consider and appoint a judging committee for MGMI Awards of Excellence.

Honorary Secretary read out the different award category and suggested names

for the judging committees which were approved.

- A. Judging Committee for MGMI Award of Excellence for Coal Mining for outstanding contribution in Coal Mining Industry comprising Prof S P Banerjee (Chairman), Sri N C Jha, Shri Thomas Cherian and Dr T K Nag.
- B. Judging Committee for MGMI Award of Excellence for Non-Coal Mining for outstanding contribution in Non-Coal Mining Industry comprising Dr N K Nanda (Chairman), Prof Amalendu Sinha, Sri D B Sundara Ramam and Sri Prasanta Roy.
- C. Judging Committee for MGMI Award of Excellence for Earth Science / Mineral Engineering for outstanding contribution in any Branch of Earth Science or Mineral Engineering comprising Dr. Anupendu Gupta as Chairman, Dr Kalyan Sen, Shri Rajiw

Lochan & Dr Rajib Dey.

- D. A committee was also suggested for Judging award for best technical paper in MGMI Transaction Volume. This committee will also work to find out people & resources who can provide world class papers suitable for publishing in MGMI transactions. Committee will comprise Prof B C Sarkar, Dr Ajay Kr Singh, Dr P K Mondal and Sri R P Ritolia.

898.6.0 To consider applications for membership and the membership position of the Institute.

Honorary Secretary informed that between the last council meeting and this council meeting, the institute have received 22 membership applications and all of them are eligible. The council accepted membership of all the 22 members.

**Membership Position
(As on 27.05.2023)**

	11.03.2023	Add	Trans	Loss	27.05.2023
Member	43	-	-	-	43
Life Member	2029	22	-	-	2051
Associate	18	22	-	-	18
Student Associate	06	-	-	-	06
Life Subscriber	27	-	-	-	27
Subscriber	01	-	-	-	01
Life Donor	01	-	-	-	01
Donor	01	-	-	-	01
Patron	05	-	-	-	05
Corporate	07	-	-	-	07
Life Corporate	02	-	-	-	02
	2140	22			2162

898.7.0 Any other matter with the permission of the chair.

1. Honorary Secretary said that it is felt that the Transit house should be fully revived and run like earlier. However, due to more than 2 years of disuse, a lot of refurbishment / renovation is required. The council approved the repair and operation of the Transit house and gave permission for requisite work and related expenditures.
2. Honorary Secretary brought out the fact that a long time back in the 80s and 90s some money was deposited in UTI Master Share scheme and now they are wanting KYC to keep them activated as per statutory norms. One requirement of the KYC is a board resolution- approving the investment in UTI shares by the Board (Council). The council members approved the investment in UTI shares and submission of KYC to re-activate, and advised Secretary to conduct due diligence and re-invest the same after some time in better schemes if possible.
3. Honorary Secretary informed that as MGMI is registered under the Company's Act there is a need to have proper compliance else

Council (which is the Board in Company Act parlance) will be liable for non-compliance & may be prosecuted as per the Act. Accordingly to effect and monitor compliances and flag non-compliance, there is a need to appoint a Company Secretary on monthly retainer ship. Shri Rajiw Lochan, immediate past Secretary aired his views that now, everything has been made transparent through MCA portal and lot of laws/by-laws and rules need to be complied under strict surveillance of the Ministry of Company Affairs, Hence, it is imperative that a Company Secretary is appointed on retainership basis. The Council agreed to the suggestions of Sri Lochan that the CS working on job to job basis for MGMI presently, be appointed on monthly retainer-ship fees and gave the Honorary Secretary to finalise the CA and his remuneration at a reasonable level.

At the end, President thanked all Council Members and invited all to attend a roadmap on underground mining being organised by CIL at Delhi on 6th and 7th June, 2023.

The meeting ended with Vote of Thanks to the Chair and others present both physically and virtually by Honorary Secretary.

**Theme of the Next Issue of
MGMI News Journal, Vol. 49, No. 2**

**"Unearthing the Depths :
A Journey into Underground
Coal Mining."**

NEW MEMBERS

As Life Member

10992 - LM, Shri Sanjiv Kumar Singh, B. Tech (OC Mine), M. Tech (OC Mine), MBA (Finance), Director (Mining), Ministry of Mines, Tamra Bhavan, 1, Ashutosh Chhowdhury Avenue, Kolkata 700019, Ph: 033 22837138, 03335609310, (M) 9650991396, Email : sanjivkumarsingh@hindustancopper.com

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10994 - LM, Shri Manoj Kumar Jha, BE (Mining), Chief Manager Mining, Coal India Limited, T2/B-1/7/8, Millennium Tower, New Town, Kolkata 700156, (M) 9477170337, Email : manoj.j7926@coalindia.in

10995 - LM, Shri Anjani Kumar, B.Tech (Mining), General Manager (New Initiative), Coal India Ltd., Flat – 1N, Tower - 2, Alcove Gloria, 403/1, Dakshindari Road, on VIP Road, Kolkata 700048, Ph : 033 23246626, (M) 9831104134, Email : gmni.cil@coalindia.in

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11007 - LM, Shri C Jayadev, BE (Mining), M.Tech. Environment Science & Engineering, General Manager (Environment), CIL, Coal Bhawan, Premises No.04 MAR, Plot No AF –III, Action Area 1A, New Town, Rajarhat, Kolkata 700156, (M) 09937242304,
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INSIGHTS FROM THE 62ND HOLLAND MEMORIAL LECTURE AND NATIONAL SEMINAR ON 'MEETING THE CHALLENGES – BLUE HYDROGEN'

One of the marquee Annual Events of MGMI – Sir Holland Memorial Lecture was organized at Hotel The Grand, New Delhi on the 29th April 2023. This Lecture is organized annually barring exceptions for unforeseen difficulties in the memory of Sir Thomas Holland, the Founder and first President of MGMI.

Shri Amrit Lal Meena, IAS, Secretary, Ministry of Coal, Government of India, having agreed to deliver the lecture kept his word, despite the dislocation caused because of an unscheduled program necessitating his travel away from Delhi, by delivering the lecture virtually.

An added attractive feature this year was the National Seminar on the theme “**Meeting the Challenges – Blue Hydrogen**” which was held immediately after conclusion of the Lecture. **Shri U Kumar, Past President, MGMI and Former CMD, SECL & NCL** welcomed the Guests and participants, especially Shri Meena, Shri Pramod Agrawal, Chairman, Coal India Limited and Dr B Veera Reddy, Director (Technical) Coal India Limited and President MGMI. In the welcome address he dwelt on the role of fossil fuels like Coal, Oil and Natural Gas as the major energy source globally and stated that in India’s energy scenario, coal played the dominant role by providing more than 50% of commercial energy and close to 75% of power generation is dependent on Coal.

But now that coal has been established as the major contributor to global warming and climate change, it has become necessary to take a fresh look at our energy basket.

As a responsible global society, we have chosen the path of reducing the role of coal in our power generation system and have already launched an exceptionally ambitious programme to establish a renewable energy generation capacity of 500 GW by 2030. However, we must consider that power generation facilities from renewables require significant investments, land and entail a lengthy setup process.

Regrettably our escalating power demands are pressing and we currently lack the financial means and time necessary to solely rely on renewables to fulfill our entire energy needs. Given this challenge, it has become imperative to realign our power policy, seeking a balanced approach that meets our requirements while effectively curbing greenhouse gas emissions.



Shri U Kumar initiating and extending a welcome to the Guests

As part of our action-plan to achieve these objectives, India has recognized Hydrogen as a crucial solution to address the trilemma : generating sufficient power to meet our needs, ensuring affordability, and managing GHG emissions. Hydrogen stands out as a remarkably clean and versatile energy source, and India has already embarked on an ambitious Hydrogen Mission since 2021. While the world focuses on producing and using green hydrogen, which can be costly, we propose a slight adjustment in our hydrogen program by initially producing blue hydrogen. This approach is not only more cost-effective but also better aligned with India's abundant natural resources. By adopting blue hydrogen, we aim to strike a balance between our energy goals and sustainability targets. In this context, he emphasized that the theme of the seminar, "Meeting the Challenges - Blue Hydrogen," had been selected.

Dr B Veera Reddy, Director (Technical), CIL and President, MGMI presented the historical background of Holland Memorial Lecture. Dr Reddy began by providing an overview of Sir Thomas Henry Holland's career growth and development, emphasizing that he was the Founder President of MGMI, which was established in 1906. Sir Holland was born on 22nd November 1868 in Helston and became the Director of Geological Survey of India (GSI) in 1903. In tribute to Sir Holland's lifetime contributions, MGMI made the decision to honour his memory by initiating the Memorial lecture dedicated to him. Barring very strong insurmountable reasons, this lecture has been organized regularly and has been delivered by very eminent personalities in their respective fields primarily at MGMI Head Office, Kolkata but also at Chapter Headquarters like Hyderabad, Bhubaneswar, Nagpur and New Delhi. In fact, the last three years, 2020, 2021 and 2022 marked perhaps the longest period during which this lecture could not be organized, primarily due to the global pandemic.

Speaking on geographical spread of MGMI, Dr Reddy added that there are as many as 18 Chapters of MGMI in India today. These Chapters together with the MGMI Headquarters at Kolkata are working in close cooperation and for healthy growth of mineral industry in India. MGMI is also represented on some important Government Bodies and it is making significant contribution to the policy formulation in respect of mineral industry by the Government of India.

Heartfelt gratitude was expressed to Shri Amirt Lal Meena ji, Secretary Coal, who served as the Chief Guest of the event and graciously accepted the opportunity to deliver the esteemed Holland Memorial Lecture. He extended his thanks to Shri Pramod Agrawal ji, Chairman, Coal India Limited, for accepting the invitation to grace the event as the Guest of Honour and for agreeing to address the esteemed gathering present on this occasion.



Dr B Veera Reddy providing the context and extending a warm welcome to the Guests

Profound thanks were conveyed to Shri U Kumar, Shri N N Gautam, Shri P S Upadhaya, and other officials of MGMI Delhi Chapter for their exceptional efforts in successfully organizing the Holland Memorial Lecture and the technical session on "Meeting the Challenges - Blue Hydrogen" at short notice. Their dedication and efficiency were truly commendable.

He expressed whole hearted appreciation to everyone in attendance, including all former Presidents of MGMI, for graciously sparing their valuable time to participate in this significant MGMI event.

Shri Ranajit Talapatra, Honorary Secretary, MGMI emphasized that the Holland Memorial Lecture holds a prominent place in the Institute's calendar. He expressed deep regret that the lecture could not be held for three consecutive years, namely 2020, 2021 and 2022 due to the ongoing pandemic.

The last 61st Holland Memorial lecture was delivered by Shri Amitabh Kant, CEO, NITI Aayog in the year 2019 in New Delhi. The event was also organized by MGMI, Delhi Chapter.

He thanked Shri Amrit Lal Meena, Secretary Coal and the Chief Guest of the function for having taken the trouble of delivering the Memorial Lecture despite being away from New Delhi on a Government assignment. He also thanked Shri Pramod Agrawal, Chairman Coal India for having taken the trouble of coming to New Delhi all the way from Kolkata to be with us.

He informed that like in the previous years, MGMI is organizing 10th Asian Mining Congress along with International Mining Exhibition at Taal Kutir Convention Centre and Eco Park, New Town Kolkata respectively from 6th to 9th November 2023. He requested all to block these dates and join the Asian Mining Congress & IME.

While introducing Shri Pramod Agrawal, Chairman, Coal India Ltd as the Guest of Honour, he stated that he was privileged to have been given the opportunity of introducing Shri Agrawal. He stated that Shri Agrawal did not need any introduction but for the sake of formality he referred to his IAS background and his past achievements in the Government of Madhya Pradesh. Shri Agrawal joined as Chairman, Coal India Limited in 2020 and the company has made tremendous strides in all parameters of performance because of his matured leadership and qualities of head and heart. He stated that Coal India Limited had achieved a record growth rate of 13% in production and hoped that it would build on this success to ensure that the country becomes self-sufficient at least in respect of Power grade Coal.



Shri Ranajit Talapatra introducing the Guest of Honour

Shri Pramod Agrawal, IAS, Chairman, Coal India Limited and Guest of Honor welcomed all the Guests, particularly the Secretary (Coal), Shri Meena, who was attending the Seminar online. He expressed the views that the Seminar like the one on Blue Hydrogen serves great purpose where one gets to listen and interact

with experts and stalwarts who have made tremendous contribution to the sector under discussion.

Referring to Blue Hydrogen, he stated that energy security is very important for every country especially for India, where apart from coal we don't have sustainable reserves of oil and gas. But then problem with coal is its adverse impact on environment and the need of the day is to establish an alternative source of sustainable energy. He expressed the view that Hydrogen has a great role to play in India's quest of sustainable energy. Understandably, the world is preferring Green Hydrogen for the simple reason that Carbon does not play any role in its generation but then it has to be appreciated that Green Hydrogen is very expensive and no doubt, moving forward research work on Green Hydrogen is certainly going to make it cheaper and affordable. But in the present scenario, India cannot afford the investment and the time required for Green Hydrogen becoming affordable. On the other hand, it has huge reserves of coal and Blue Hydrogen in the production of which coal has an important role to play, should be preferable choice in India.



Shri Pramod Agrawal addressing the audience

He assured that Coal India Limited would support any R & D activity, which will make the entire value chain related to blue hydrogen more affordable.

The speech of Shri Agarwal was followed by **Shri P S Upadhyaya, Chairman, MGMI Delhi Chapter** who had been called upon to introduce Shri Amrit Lal Meena, the Chief Guest of the Event. He traced the career of Shri Meena as Electrical Engineer by education and holder of Post Graduate Degree in Public Policy from IIM Bangalore as his Professional Qualification. He belongs to Bihar Cadre of IAS - 1989 Batch. He has handled very important and complex assignments in Bihar and he holds the unique distinction of being the Collector of as many as 5 districts.

Shri Meena has held many important positions at the Central Government also before taking up the challenging assignment of Secretary, Ministry of Coal in November 2022. Like his excellent record in Bihar, he has confronted the challenges in the coal sector and within a very short time he has achieved record rate of growth in coal production and dispatches. In fact, he has given the Indian coal industry the confidence that it would be able to meet any challenge in future and the day may come, when India would become a net exporter of coal from the net importer status where it stands today.

Holland Memorial Lecture by Shri Amrit Lal Meena, IAS, Secretary, Ministry of Coal (virtual)

Shri Meena was travelling for an official engagement but despite the inconvenience he was kind enough to keep his commitment of delivering the Holland memorial Lecture. At the outset he thanked all the guests and participants present and MGMI for giving him the opportunity of delivering this prestigious lecture. He stated that he was very keen to deliver the lecture physically but on account of a very urgent official work he had to move out of the city and it was for this reason that he was delivering the lecture in virtual mode. He referred to the National Seminar being held together with the Holland Memorial Lecture and stated that the theme “**Meeting the Challenges – Blue Hydrogen**” was very topical and in a way it is a subject on which National focus has to be directed immediately.

He hoped that the forthcoming speakers, who are experts in the field, would deliver presentations on this topic. These presentations would facilitate the creation of a feasible roadmap, aiding the Ministry of Coal in its ambitious endeavor to realign the country's energy policy towards hydrogen. He emphasized that coal currently fulfills approximately half of the nation's com-

mercial energy demand. However, looking ahead to the year 2047, when the GDP is projected to surge from 3.2 Trillion USD to 32.8 Trillion USD, and the population is expected to reach 1.6 billion, the increased quality of life for the masses will inevitably lead to a substantial rise in energy consumption. This surge may surpass the capacity of traditional energy sources to meet the demand. In light of this impending energy challenge, Hydrogen emerges as a promising solution to address these evolving energy needs.

In fact, though dependence on coal as a primary energy would go down to 31% by 2047 in terms of quantity, the total coal consumption in India may be higher than what it is today.

He referred to the increase in coal production in the recent times and congratulated all the players – Coal India Limited and its subsidiaries and also commercial miners who have come into the picture only recently and had made meaningful contributions to coal production which had touched 892 MT in 2022-23 – record growth of 13% over production in 2021-22. He was very confident that coal production will reach 1 billion tonne and we can look forward to the day when import of power grade coal will stop altogether and India may become a net exporter of Coal.



Shri Amrit Lal Meena delivering the 62nd Holland Memorial Lecture through video conferencing

Referring to the need for improving the transportation infrastructure for coal he stated that under PM Gati Shakti Scheme, CIL and Railways together with major coal producing states - Chhattisgarh, Odisha and Jharkhand are focusing on this important issue which, ultimately may become a gamechanger. In fact, the thinking is to provide 2 – 3 lanes in the Railway Trunk system exclusively for coal movement. Attention is also being

paid to developing the Land-cum-Sea-cum-Land route for coal transportation from eastern coast, where coal production centers are situated to western coast where the consumption centers are located. Initially, the transportation cost might be slightly higher, but it will result in expedited coal supply to customers. Over time, this approach is expected to become more cost-effective.

The industry is getting ready to play its due role in achieving Net-Zero targets and Coal India Limited and subsidiaries are setting up Solar Parks for producing solar power to meet their internal requirements. For this purpose the abandoned and closed mines are to be developed in Eco-parks and Energy parks.

He concluded with the hope and confidence that Indian coal industry would not only meet the country's requirement of non-coking coal but also reduce the import level of metallurgical coal.

Shri N N Gautam, Special Secretary - Events, MGMI, Delhi Chapter expressed his privilege in proposing a vote of thanks to the esteemed Guests and Participants, including Government Officials, Industry Leaders, Academicians, Researchers, Scholars, Speakers, Delegates, Media Representatives, and Distinguished Participants.

He expressed sincere gratitude to Shri Amrit Lal Meena for honouring his commitment to deliver the Holland Memorial Lecture, even amidst official responsibilities that took him away from Delhi. Shri Gautam highlighted Shri Meena's exemplary leadership, which has contributed to remarkable growth in coal production and dispatch. He conveyed his confidence in Shri Meena's leadership propelling the Indian Coal industry to greater heights. Gratitude was also extended to the Guest of Honour, Shri Pramod Agrawal ji, Chairman of Coal India Limited, for his presence and valuable insights shared.



Shri N N Gautam addressing the gathering

Acknowledging the significant strides made by Coal India Ltd. under Shri Meena's leadership, Shri Gautam expressed optimism in the continued growth of the coal sector under his guidance to meet the nation's requirements. He thanked Dr Veera Reddy, Director (Technical), Coal India Limited and President of MGMI, for effective leadership and the privilege of hosting the memorial lecture through the Delhi Chapter of MGMI.

Shri Gautam credited Shri U Kumar, Past President of MGMI, as the driving force behind the successful organization of the event. He conveyed appreciation to Shri P S Upadhaya, Chairman of MGMI Delhi Chapter, the Organizing Secretary, and Dr Peeyush Kumar for their roles. Special recognition was given to other organizing committee members – Shri M N Jha, Shri S K Grover, and Shri Pankaj Kumar Jha for their dedicated efforts in making the event a grand success. The support of MGMI Delhi Chapter members and the management of Hotel The Grand was also acknowledged with heartfelt thanks.

National Seminar on “Meeting the Challenges - Blue Hydrogen”

This seminar was an added attractive feature of the Holland Memorial Lecture. The forefront of the team that organized this seminar comprised the following :

Session Chairman :

Shri Alok Perti, IAS (Retd), Former Secretary, Ministry of Coal

Session Coordinator :

Dr Peeyush Kumar, Organizing Secretary and Council Member, MGMI and OSD, Clean Energy, Ministry of Coal

Learned Speakers :

Shri V R Sharma, Vice Chairman, Jindal Steel and Power Limited.

Shri Rajiv Agarwal, Director (Technical), Engineers India Limited (EIL)

Shri Balasaheb Darade, MD, New Era Cleantech

Shri Yamdo, ED, Oil India Limited (OIL)

Shri Mukund Rajan, Sr DGM BHEL Heading Coal to Chemical business

Shri Alok Perti, IAS (Retd), Former Secretary, Ministry of Coal very briefly touched upon what is Green and Blue Hydrogen. Hydrogen is a gas that has been identified as the cleanest form of fuel. Green Hydrogen, which excludes any role for fossil fuels in its

production is the best type of Hydrogen. This is produced from renewable energy sources like solar and wind energy, while blue hydrogen which is produced by the use of fossil fuels with arrangement for capturing CO₂ and sequestering or utilizing it.



Engaging the audience is Shri Alok Perti as he takes the stage to speak

Historically, Hydrogen has been produced by few European countries for a long time using hydrolysis of water and used basically for transportation industry. Lately India has also started utilizing hydrogen in a very small way for transportation purposes.

Going into the details of pre-requisites for improving production of blue hydrogen and making it more economical, he listed the following for detailed attention :

- (i) Source /raw material
- (ii) Technology
- (iii) Infrastructure including safety requirement
- (iv) Investment
- (v) Utilization

The event had the good fortune of having **Shri V R Sharma, Vice Chairman, JSPL** as a speaker. Shri Sharma is a pioneer on Coal Gasification on which his company JSPL has done pioneering work and company's steel making facilities at Angul in Odisha is utilizing this technology. He talked on various aspects of Coal and covered the following :

- (i) India is blessed to have huge reserves of fossil fuel - coal and should aim at maximum extraction and utilization of the same with a view to meeting our domestic requirement and by reducing / stopping import of thermal coal.

- (ii) For reducing carbon footprints, the best route is coal gasification leading to production of Blue Hydrogen, which can be utilized in power generation and steel production and production of a number of useful chemicals etc.
- (iii) Shri Sharma briefly described the technical details of JSPL coal gasification plant at Angul and the group's future expansion plans including production of 7 mtpa DRI at Angul and Raigarh.
- (iv) As of now JSPL is forced to re-inject about 2,000 tons of CO₂ into the atmosphere, which is one of the major challenges for JSPL. However, they have developed a blueprint to convert this CO₂ in to CH₄, which has many usage notably converting it to blue hydrogen.



Taking the podium, Shri V R Sharma addresses the assembled audience

- (v) In future, JSPL plans to produce substantial quantities of Hydrogen with an objective to inject it into their blast furnaces with Hydrogen acting as reducing agent instead of coking coal.
- (vi) Shri Sharma advised the government and Indian coal industry to look into the possibility of creating CO₂ parks for deposit of CO₂ till its proper utilization is established. He further advised to explore the best technical solutions for transportation of Hydrogen through the pipelines to various consumption centers for end use like power generation etc.

Another important speaker was **Shri Rajiv Agarwal, Director (Technical), Engineer India Limited (EIL)**, which again has been doing tremendous work on making the country ready for facing the challenges of climate change and global warming.



Stepping forward, Shri Rajiv Agarwal speaks to the attentive audience

During his speech Shri Agarwal covered the following :

- (i) Decarbonization / Net-Zero Emission
- (ii) Electrical mobility - People are being encouraged to use more and more EVs with number of incentives announced by the Government by creating required infrastructure like charging stations. Increasing use of two wheelers and three wheelers is being witnessed but heavy vehicles are facing problems in terms of adequate capacity of batteries. All stakeholders are working to finding solutions and more and more EVs will be used in future contributing to decarbonization.
- (iii) Increasing efficiencies of various plants like power and steel plants will contribute significantly in decarbonization.

All the above pathways have their own challenges but production and utilization of blue or green hydrogen have their own positive roles to play. Ninety percent of oil refineries as of today use grey/ brown hydrogen for hydro cracking with adverse environmental consequences and aim is to replace grey or brown hydrogen with blue / green hydrogen over a period of time.

He also referred to the excellent work being done by number of organizations like GAIL/NLC/JSPL/Bina Refinery on demonstration plants through various routes. No doubt, these are baby steps, but they have huge potential and he was confident that these would lead to commercial scale operations.

He also spoke about steel and cement industries, which had highly polluting operations on account of use of large quantity of coal. He did hope that these industries move to hydrogen for taking care of the problem.

In conclusion, Shri Agarwal stated that as of today, both on technical and economic considerations, blue hydrogen is the best option as an interim solution for reducing carbon footprint till green hydrogen becomes economically viable.

Shri Balasaheb Darade, MD, New Era Cleantech brought new angle to the deliberations in as much as he has decided to set up a 5 MMTPA coal gasification plant in Maharashtra. Current status of the project is as under :

- (i) An MOU has been signed with the Maharashtra Government at recent World Economic Forum.
- (ii) Land has been allocated within an active coalfield close to a river and existing railway siding.
- (iii) An excellent team of experts in position.
- (iv) Suitable technology being identified.
- (v) They are closely looking at potential coal blocks or a long term coal linkage with CIL.



Shri Balasaheb Darade presenting his thoughts at the event

Shri Balasaheb also elaborated on the following help and support needed from the Government and other stakeholders :

- ◆ Early long term linkage of coal from CIL from one or two mines with good and consistent coal quality.
- ◆ Waiver of coal cess of Rs. 400/t to improve the economics of the plant
- ◆ Viability gap funding.
- ◆ Carbon credit and utilization of captured Carbon.
- ◆ Infrastructure for transportation of Gas to End users.

He concluded by saying that we are already late and should not delay any further in meeting the challenge of utilizing 100 million tonnes of coal for gasification

and develop or adopt appropriate technologies to produce blue hydrogen from our fossil fuels available in abundance in India.

Shri Yamdo, ED, Oil India Limited (OIL) was another asset of the event in as much as his organization Oil India Limited has been producing 10 kg green hydrogen every month starting from April 2022.

This is being used to run buses in the green corridor of Kaziranga National Park They are trying to scale up the production. OIL has also successfully converted Coal to Liquid at their pilot plant but economics is an issue at present.

He also informed the gathering that the Numaligarh Refinery has now been integrated with OIL and will be expanded to a capacity of 9 million tonnes from the present capacity of 3 million tones. Presently the refinery uses 48,000 tonnes of hydrogen for hydro-cracking which will increase 3 times and will generate huge quantities of CO₂ posing challenge of its storage and use. OIL is planning to use this CO₂ as an alternative to Jet fuel/Synthetic Aviation fuel, which will greatly reduce greenhouse emission.



Mr Yamdo delivering his address to the audience during the event

Another practical angle of the issue was presented by **Shri Mukund Rajan, Sr DGM, BHEL**. He stated that BHEL is focusing on High temperature process at their plans to produce hydrogen from coal by utilizing heat present in the coal. BHEL is also using biomass in addition to coal to produce hydrogen. He further added that by enhancing the amount of steam in the process, it will enhance production of hydrogen.



Shri Mukund Rajan presenting his speech during the event

Shri Rajan emphasized on developing and adopting indigenous technology and hoped that the hydrogen produced from coal is going to be the key for achieving net zero goal in India in future.

Dr Peeyush Kumar, Member MGMI Council and OSD, Clean Energy, Ministry of Coal, Secretary, Committee for organizing Holland Memorial Lecture, while delivering the Vote of Thanks, thanked Dr B Veera Reddy, President, MGMI for entrusting the responsibility on MGMI, Delhi Chapter for organizing the lecture and also empowering other chapters to organize various events. He further expressed his heartfelt gratitude to Shri Amrit Lal Meena, Secretary, Ministry of Coal for delivering the 62nd Holland Memorial Lecture. He expressed gratitude to Shri Pramod Agrawal, CMD, CIL for his speech as Guest of Honour. He thanked Shri Alok Perti for presiding over the seminar and the Chairman, MGMI, Delhi Chapter and specially Shri U Kumar and Shri N N Gautam for leading the Delhi team to a very well organized programme. Dr Kumar thanked all the sponsors, speakers, delegates, CIL Delhi office, Media and the Hotel Management for the role played by them in making the event eminently successful. He also offered a very special thanks to the event partners, BML and ICF.



Dr Peeyush Kumar extending a vote of thanks

A GLIMPSE OF THE 62ND HOLLAND MEMORIAL LECTURE AND NATIONAL SEMINAR ON “MEETING THE CHALLENGES - BLUE HYDROGEN”



Lighting of Lamp



A picture depicting the dais at the seminar

TALK BY SHRI PARTHA S BHATTACHARYA

Mining, Geological and Metallurgical Institute of India organised a Talk by Shri Partha S Bhattacharya, Chairman, Peerless General Finance & Investment Company Limited and Former Chairman, Coal India Limited, at Hyatt Regency, Kolkata in the evening of Saturday, 10th June at 6.30 P.M. The guest of Honour on the occasion was Shri Pramod Agrawal, Chairman, Coal India Limited. Members, with their spouse / family, were also invited to the event. The number of attendees exceeded 150.

The event commenced with Shri Ranajit Talapatra, Honorary Secretary, MGMI welcoming the guests and members and inviting Shri Bhattacharya, Shri Agrawal and President, MGMI, Dr B Veera Reddy on the dais. They were felicitated by Dr Reddy with flower bouquets. Dr Reddy then presented a short introduction of Shri Agrawal, his leadership qualities and the appreciable performance of Coal India Limited under his chairmanship. Shri Agrawal was poised to retire in June and Dr Reddy wished a very active life for him.

In his address Shri Agrawal talked about his experience of working in various positions in his career, especially at Coal India Limited. He suggested that MGMI's ambit need be expanded and it should take active roles by suggesting policy-related issues to the

Government. He felt, in the present day, more importance should be given to metal sector, minor minerals and rare earth elements, demand for which are on the increase.

A memento was presented to Shri Agrawal by Dr Reddy.

Shri Bhattacharya talked about his association with MGMI. He spoke about Coal India from an outsider's view. He told how during the leadership of Shri Agrawal the performance of Coal India, including production and supply, improved substantially. He suggested that now Coal India should give attention to quality of coal being supplied to the consumers. He pointed out that quality of Indian coals supplied to consumers are much below the world standard and the consumers are ignorant of it. Improvement of quality will improve the brand value of the company.

Shri Bhattacharya was presented a memento by Dr Reddy.

The event concluded with Vote of Thanks by Shri Talapatra.

Shri V K Arora presented a book written by him to Shri Agrawal and Shri Bhattacharya.

The guests joined the members present for the dinner that followed.





ENSURING SAFETY AND WORKFORCE WELLBEING IN INDIAN MINES : A VITAL IMPERATIVE

A conversation with Shri Prabhat Kumar, DG, DGMS



Shri Prabhat Kumar currently holds the esteemed position of Director General at the Directorate General of Mines Safety, where he serves with distinction. He completed his studies in Mining Engineering at NIT Rourkela in 1986, and later obtained an MBA degree in 1992. Beginning his career at Coal India Limited in 1986, he progressed through various roles until 1998. Shri Kumar is widely recognized as a highly accomplished mining engineer, possessing extensive experience and exceptional strategic vision.

In 1999, Shri Kumar joined the Directorate General of Mines Safety, assuming different positions such as Deputy Director, Director, and Deputy Director-General of Mines Safety throughout India. In September 2020, he assumed the role of Chief Inspector of Mines and Director-General.

Shri Prabhat Kumar has acquired an extensive wealth of expertise in regulating and facilitating mining operations in the coal, metalliferous and oil mining sectors. He is renowned for his unwavering dedication to occupational safety and health concerns in Indian mines, as well as his efforts in mineral conservation. He serves as an inspirational mentor to his colleagues and skillfully leads a team of talented professionals, employing interactive and motivational leadership that fosters a willingness to deliver their best efforts. He has chaired numerous technical sessions in various conferences and seminars. Considering his extensive knowledge and experience, readers of the MGMI publication can greatly benefit from Shri Kumar's invaluable insights in the development of appropriate legislation, rules, regulations, standards, and guidelines.

Could you share some information about your background and how you came to be a part of the Directorate General of Mines Safety? What experiences or factors contributed to your position as one of the most respected authorities on mine safety in India?

I did my B. Tech. in Mining Engineering from National Institute of Technology (NIT) Rourkela in the year 1986; thereafter I worked in Coal Industry for about 12 years. In 1999, I was selected through UPSC for the post of Deputy Director of Mines Safety, in DGMS, Ministry of Labour and Employment, Government of India. Since then, I have served in DGMS in different capacities as Deputy Director, Director and Dy. Director General and became Chief Inspector of Mines (CIM)/ Director General and Head of the Organization in September 2020.

Could you please provide an overview of the safety protocols that are implemented by the DGMS and

which you consider significant in today's coal and metalliferous mines to safeguard the wellbeing of workers in India? These may be measures such as regular safety inspections, training programs, hazard identification and risk assessments, as well as emergency response plans.

DGMS administers the provisions of the Mines Act, 1952 and its subordinate legislation, i.e., The Coal Mines Regulations 2017, The Metalliferous Mines Regulations 1961, The Oil Mines Regulations 2017, The Mines Rules 1955 etc. DGMS also administers the provisions of Electricity Act 2003, Central Electricity Authority (measures relating to Safety and Electric Supply) Regulation 2010 with relation to the usage of electricity in mines.

The aforesaid provisions are ensured by the regular inspection of mines, granting of permissions / exemptions /

relaxations / approvals, development of Standards and updating Safety Legislation, adequate measures to ensure compliance and awareness initiatives to inculcate safety and health culture amongst work-persons and stakeholders.

We all know that safety training is extremely important for workers before commencing their work in the mines, and also refresher training periodically there after, to ensure accident - free operations. Now a days a lot of contractual operations are also being resorted to by mining companies besides engaging their own personnel. What is your opinion about the adequacy of such training being given to the workers, including the topics covered, the frequency of training, and about any certifications or qualifications required to work on - site? How can the DGMS ensure that properly trained workers are being deployed?

Provisions have been made in the Mines Vocational Training Rules 1966 (MVTR 1966), for the initial training, refresher and change of job training of the persons employed in mines. All the persons are to be properly trained in the mine vocational training centres, before employing them in mines. There is no differentiation between the regular and the contractual employees as far as the Mines Act 1952, is concerned. The MVTR 1966 are being amended to incorporate better training related facilities as per the demand of fast changing mining scenario, advancement in technology and other Global scenario.

What is your opinion about the emergency response plans of mining companies, especially about the short-comings in them, if you have noticed any? Could you please also tell us about your Directorate's emergency response plan in case of accidents or incidents in the mining industry?

Emergency response plans are prepared by the individual mines / mining companies customised to their local conditions. DGMS officials facilitate this through their inputs. With regard to the emergency response of this Directorate, the officers of this Directorate posted in the respective regions attend the mines, whenever any emergency exists and extend all possible cooperation and guidance to the mining companies. In addition to this, Directorate also keep watch on rescue preparedness of the mine; infrastructural as well as operational aspects are looked

into. We also facilitate the conduct of all India mines rescue competitions every year among the different companies and they are awarded suitably basing on their performance during the rescue operations.

Crisis Management Plan (CMP) of the Ministry of Labour and Employment (MoLE) incorporating the detailed plan and action for dealing with the emergency situation has been framed and uploaded in the official website. Nodal officers at MoLE, New Delhi and all zonal offices of DGMS have been appointed for the purpose. A permanent control room has also been established at the Ministry for prompt execution at the times of emergency.

What measures does DGMS take to prevent occupational diseases among workers in the mining industry? Do you think the mining companies and broadly the mineral industry are doing enough to safeguard the health and safety of workers and also of the people living in the neighbouring areas?

Provisions have been made in the Mines Act 1952, Rules and Regulations made thereunder to safeguard the mine workmen from occupational health and diseases in mines. Some important provisions are : Occupational health surveys at the mine, free medical treatment, notice of diseases, investigation into occurrence of causes of disease, initial medical examinations before employment and periodical medical examination of workers after every five years in general and after three years in case of persons employed in Asbestos mines.

If as a result of any medical examination, a person is found to have contracted any notified disease compensation will be paid as per the Workmen Compensation Act 1923. Besides the above, this Directorate conducts Occupational Safety and Health Awareness Programmes and Health check-up camps for prevention and early detection of Notified diseases.

How does the directorate ensure that workers are provided with the latest and most appropriate personal protective equipment (PPE) available for the specific job and hazard?

The responsibility of providing the worker with personal protective equipment (PPE) available for the specific job and hazard lies with the Owner, Agent and Manager of the respective mines. Compliance of the above provisions are checked during routine inspections by the

officers of this Directorate and suitable actions are taken to annul the shortcomings. Awareness camps are also organised for workmen regarding benefits of use of PPEs.

Could you please give us your views and insight into the methods that the DGMS employs to engage with mining companies and workers in identifying and addressing safety concerns, such as feedback mechanisms, reporting systems, and consultation processes?

In addition to the routine inspections of the mines by the officers, provisions have been made in the statute for the workers participation in the safety management through different forums like, safety committees, workmen inspectors, tripartite and bipartite safety review meetings, annual safety week celebrations, etc. Also, safety concerns of the workmen are conveyed to this Directorate in the form of representations from the trade union representatives, individual grievances / complaints, through public grievance portal etc., which are being addressed in a time bound manner. Safety Management Plan (SMP) is also a tool to identify hazards and come up with mitigation strategies.

In recent years we have seen allocation of coal blocks through auction to many companies which are not traditionally mining companies and as such do not have prior experience in this field. Do you think it is necessary to strengthen the measures and strategies that DGMS implements to minimize and manage the risks of mining-related accidents and injuries, including hazard identification and mitigation, safety equipment and technology, and incident investigation and reporting?

Safety of persons employed in mines are to be ensured as per the provisions of The Mines Act 1952 and the Rules and Regulations made thereunder. Mines are managed by persons holding technical qualifications and also the statutory certificates issued by the DGMS like, First and Second Class Mine Manager's certificate of competency, Overmen / Foremen certificate of competency, Mining Sirdar / Mining Mate certificate of competency etc. Thus, it hardly matters whether the allocation of coal blocks is made for the companies having any traditional experience or not.

There are several instances of allocation of Coal Bed Methane blocks by the Ministry of Petroleum and

Natural Gas to oil and gas companies for extraction of CBM and allocation of coal blocks in overlapping areas by the Ministry of Coal to other companies for coal mining. For CBM extraction oil and gas companies are likely to drill large number of bore-holes across the coal seams, some of these may be directional holes within the coal seams. Will it not be difficult for the coal mining company to ensure proper safety against possible inundation, especially in coalfields like Jharia and Raniganj where there are multiple seams and also many old and abandoned workings?

Ensuring safety of persons is the top most priority. Strategy for CBM / Coal extraction is under formulation with the above objectives.

For CBM extraction hydrofracturing of coal within the seams may be employed, which invariably involves injection of sand and other additives in water under high pressure to generate long and deep fractures and keep them open for long periods so that CBM recovery can be maximized. This will surely cause great loss of coal seam integrity. When mining is taken up subsequently coal pillars, barrier pillars, longwall faces etc, are unlikely to have the original strength to withstand cover loads and mining - induced stresses. The conditions of revenue-sharing allocation of the blocks are such that there cannot be a long interval of time to allow for restoration of original in-situ situation before mining is taken up. How do you think we can ensure adequate level of safety in such a scenario and is there any need to bring in some regulatory changes?

Regulatory authorities, scientific & technical institutions like CSIR-CIMFR, NIRM, IITs or other institutions and experts in mine planning / safety / conservation / environment / economics and other stake holders will have to work together to achieve the optimal result.

What is your opinion about the methods employed to manage fatigue in workers, particularly those working long hours or night shifts, such as scheduling, rest breaks, and work rotation?

The working hours of the persons working in mines are governed by the statutory provisions under the Mines Act 1952 and the rules made thereunder. Provisions have been made under the Coal Mines Regulations

2017, for the ergonomically designed operators seat, provision of air conditioned cabin in the Heavy Earth Moving Machinery (HEMM), fatigue alarm, etc. for reducing the fatigue of the workers.

Would you like to discuss any recent safety measures or advisories that DGMS has adopted or prescribed for improvement in safety standards or innovations that DGMS has implemented in the mining industry?

Now Risk based inspections of the mines through Shram Suvidha Portal has been introduced. Pro-active measures like safety awareness campaigns, safety talk with the workmen on the spot, job specific and Simulator training to the workmen, inspection of inaccessible areas with the Drone / UAV (Unmanned Aerial Vehicle) technology are also being taken up. Provisions have been made to plan, design, develop & operate the mine as per the recommendations of the scientific studies.

Could you please let us know the role of DGMS and the steps your organization takes to ensure that workers receive fair compensation and benefits,

including adequate medical care and insurance coverage etc, in the event of an accident?

The workers who met with injuries while at work are to be treated at the cost of management with full wages as per the provisions of the Mines Act 1952. The compensation is paid as per the provisions of the Workmen Compensation Act 1923, which is administered by the Commissioner for workmen compensation. The subject matter of medical insurance does not pertain to DGMS.

As we wrap up, could you share your thoughts on the essential reforms that you believe are necessary for the mining industry to achieve complete safety, including any changes to regulations, technology or industry practices?

Mines shall be worked on self-regulation mode. Scientific study shall be the base of mining activities. Technological advancements in the mining industry is a constant process, whenever any technological advancement is made DGMS always remains on the forefront for its implementation to improve the safety standards in the mines and reduce the human drudgery. We along with the mining industry are trying our best to achieve zero harm potential at the work place.

SUSTAINABLE DEVELOPMENT AND JUST TRANSITION : CHARTING A PATH FOR THE COAL SECTOR IN INDIA

Manoj Kumar¹, Shankar Nagachari², Rakesh Dwivedi³

Introduction

The coal industry holds a critical position in India's economy and energy security, playing a vital role in meeting the rising energy demands driven by a growing population, improved electricity accessibility, and the country's developmental requirements. While renewable energy sources have gained attention, coal remains a primary energy source. Notably, India stands as the world's second-largest coal producer, with an annual production of 893 million tonnes in the fiscal year 2022-23. The Ministry of Coal, Government of India, aspires to increase production to 1017 million tonnes in 2023-24 and aims for a staggering 1400-1500 million tonnes by 2030, considering the projected peak demand around 2040. Recently, the Government of India has allocated a substantial amount of Rs 2,980 crore to finance the exploration of coal and lignite reserves, demonstrating its strategic focus on preparing for future mining block auctions.

Simultaneously, India remains dedicated to achieving its climate targets, encapsulated in the five-point agenda, or 'Panchamrit', which outlines key objectives. These include the ambitious goals of establishing 500 GW of non-fossil electricity capacity, fulfilling 50 percent of energy requirements through renewable sources, reducing emissions by 1 billion tonnes, decreasing the carbon intensity of the economy by 45 percent by 2030, and ultimately attaining net-zero emissions by 2070. It becomes imperative, therefore, to advocate for a growth model that is both low carbon and climate-friendly. In alignment with this vision, India has adopted a balanced growth approach, embracing the principles of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC) under the umbrella of climate justice. As part of this strategy, the exploration of alternative coal

utilization methods and other energy sources such as clean hydrogen, coal gasification, methanol, ethanol, among others, is underway. A target has been set to gasify 100 million tonnes of coal by 2030, further emphasizing the country's commitment to sustainable energy solutions.

As the transition to a low carbon economy progresses, the rising prominence of renewable energy resources and the closure of coal mines are expected to have significant implications for the coal sector's growth. It is crucial to consider the potential impact on the livelihood of the workforce, particularly in coal-dependent provinces in India. In central coal-producing districts of the country, coal mining plays a vital role as a source of employment. While 0.5 million individuals are directly employed in the coal sector in India (IEA, 2020), livelihoods of approximately 5 million individuals are indirectly dependent on coal (PTI, 2023). It is imperative, therefore, to approach the transition in the coal sector with a scientific and impartial mindset, aiming to safeguard the livelihoods of those affected. In this context, the concept of "Just Transition" assumes paramount importance, encompassing the principles of justice, fairness, and equity for all stakeholders impacted by the closure of coal mines. Extensive international research has explored the concept of just transition within the coal sector through numerous studies (Mayer, 2018 ; Snell, 2018 ; Harrahill & Douglas, 2019 ; He *et al.*, 2020 ; Dsouza & Singhal, 2021; Shah, 2022). The NITI Aayog, under the India - US Sustainable Growth Pillar of the Strategic Clean Energy Partnership, has recently produced the Report of the Inter - Ministerial Committee on Low Carbon Technologies (NITI Aayog, 2022). This report advocates a significant collaborative endeavour between India and the United

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States. It delves into diverse aspects such as the formulation and evaluation of policy frameworks designed to provide economic opportunities within clean energy value chains for communities adversely affected by the diminishing use of coal. The report also encompasses an examination of stranded coal assets, the human - centric approach to energy transition in India, including an assessment of ongoing projects, the role of coal in deep decarbonization scenarios, the health impacts of coal transitions, as well as the exploration of regional collaboration and strategic measures. This report serves as a valuable resource for understanding the multifaceted dimensions of low carbon technologies and their implications for sustainable development.

Of late CMPDI, in consultation with the World Bank, prepared a study report titled "Best Global Practices for a Just Transition in the Coal Sector" (CMPDI, 2023). In this study, an examination of diverse global practices implemented in various countries have been conducted to assess their efficacy in facilitating a just transition. This paper presents the summarized findings from the studies conducted in India.

Current State of Coal and Future Perspectives

According to the latest data on global energy development, coal plays a significant role, constituting approximately 27% of global primary energy consumption. In India, it stands as a dominant source, contributing nearly 57% of the country's primary energy consumption (BP, 2022). It serves as a backbone for various sectors, including power generation, steel production, and other industrial processes and thus contributes significantly to economic growth, employment generation, and energy security.

The Geological Survey of India (GSI, 2022) has estimated the measured (previously termed Proved) coal resources of the country at 187.11 billion tonnes as of 1st April 2022. The total coal resources, extending up to a depth of 1200 meters, are estimated to be much higher at 361.41 billion tonnes. The substantial proven and recoverable coal reserves have the potential to cater to coal demand for approximately 175 years at current production levels and over 100 years at 1.5 times higher than the existing production rate, which may be anticipated in the coming decades. In addition to its coal reserves, India possesses a substantial geological resource of lignite, estimated as 46.20 billion tonnes. The measured resource of lignite, specifically,

is recorded at 7.37 billion tonnes. This abundance of lignite further contributes to India's energy potential and offers opportunities for its utilization in various sectors.

India's coal production has been steadily growing over the years, making it the world's second largest coal producer after China. In 2022-23, India's coal production reached around 893 million tonnes. Despite the increasing production, the demand for coal surpassed the domestic supply, leading to significant coal imports. India imports coal to bridge the supply-demand gap, with imports reaching approximately 162.46 million tonnes in the fiscal year 2022-23 against 124.99 MT in the year-ago period. The country relies on imported coal to fulfill the requirements of various industries, including power generation, steel, and cement, ensuring sustained economic growth and development. In light of the objective to decrease imports and prioritize domestic production, there is an anticipated surge in coal production in India in the next two decades.

Revenues from taxes and levies constitute a major source of income for the State and Central governments. Coal transportation by rail is a major source of revenue for Indian Railways. Any impact on the coal sector will affect the railway as well as the road transport sector. Coal mining is a crucial source of employment in central coal producing districts of India. Although the direct employment in coal sector is estimated at 0.5 million (IEA, 2020) due to the high proportion of informal works associated with the coal sector, it is estimated that many more are indirectly dependent on coal for livelihood.

The future of coal in India is influenced by several factors, particularly the initiatives aimed at increasing per capita energy consumption. However, these efforts give rise to interconnected issues encompassing technological options, economic considerations, and environmental concerns particularly global warming. The growing awareness of the environmental impact associated with power generation from coal has intensified the pursuit of alternative solutions. Sustainable development objectives further highlight the need for eco-friendly practices and the search for clean coal initiatives to ensure energy security.

Developing nations like China and India find themselves in a challenging situation within the context of this dilemma. They must determine the allocation of resources between their core developmental priorities, addressing the impacts of the evolving climate, and

investing in measures to mitigate greenhouse gas (GHG) emissions. Developed nations have achieved prosperity by utilizing fossil fuels without restrictions. While there is an elegant theoretical argument advocating for a transition to renewable or non-fossil fuel energy, which could potentially generate investments and job opportunities, the practical implementation of such a transition is often fraught with challenges and complications. China has explicitly stated that securing future energy supplies, including alternative sources, takes precedence over phasing out existing energy sources. As a result, countries may find themselves unable to abandon coal-fired power plants, while alternatives are hindered by various factors such as inadequate technology, financial resources, and a lack of skilled and trained human resources, or a combination thereof. Moreover, countries have come to realize that the job opportunities emerging in the "green economy" tend to favor skill and technology-intensive sectors rather than traditional industries (IMF, 2021). One could argue that discussing the retraining and relocation of individuals may be easier in theory than executing it in practice.

In response to these challenges, extensive research and development are being carried out to develop technologies that offer environmentally friendly options for power production (Phoumin, 2015; Krishnan *et al.*, 2019). Innovative approaches such as advanced coal combustion techniques, carbon capture, utilization and storage (CCUS), and integrated gasification combined cycle (IGCC) systems are being explored. These technologies aim to reduce greenhouse gas emissions, enhance energy efficiency, and minimize the ecological footprint of coal-based power generation.

The Government of India has also introduced policies and regulations to promote cleaner coal technologies and encourage the adoption of renewable energy sources. Initiatives like the National Clean Coal Mission and the promotion of ultra-supercritical power plants reflect the commitment to balance energy needs with sustainable practices.

Therefore, the future of coal in India lies in the development and adoption of advanced technologies that enable cleaner and more efficient coal-based power generation, in line with the country's pursuit of sustainable development and environmental stewardship.

It is evident that India has to ensure development on one hand and on the other, it has to fulfil the commitment made to UNFCCC for reduction of emissions. The energymix of India will therefore have share of all the energy resources like coal, oil, gas, renewable energy, etc. It is sensible not to depend solely on one source of energy but rather on a combination of energy resources to safeguard the energy security of the country. In practice, India may need to retain a mix of different technologies in the energy sector for some time until the renewables plus storage ecosystem gets fully robust. It would require considerable R & D and building human and infrastructure capacity to evolve technologies and methodologies that address issues in CCUS related to high capital costs, safety, logistics, and high auxiliary power consumption. Thus, India is confronted with the formidable task of balancing sustainable development objectives with the fulfillment of its commitments to the United Nations Framework Convention on Climate Change (UNFCCC) for reducing emissions.

In practical terms, India may need to maintain a diverse range of technologies in its energy sector until the renewables plus storage ecosystem becomes fully robust. This transition will require significant investment in research and development, as well as the establishment of human and infrastructure capacity to develop technologies and methodologies that address challenges in carbon capture, utilization and storage (CCUS), such as high capital costs, safety concerns, logistics, and excessive auxiliary power consumption.

India's NDC

India's Nationally Determined Contributions (NDC) represent a comprehensive and ambitious plan to address climate change and promote sustainable development. As a signatory to the Paris Agreement, India has committed to taking robust actions to mitigate greenhouse gas (GHG) emissions, adapt to the impacts of climate change, and contribute to the global effort of limiting global warming to well below 2°C.

India's NDC covers both mitigation and adaptation strategies. On the mitigation front, India has set a goal to reduce the emissions intensity of its gross domestic product (GDP) by 33-35% by 2030, compared to 2005 levels. This means that India aims to achieve significant emission reductions while still supporting its growing economy. The NDC also emphasizes the importance of renewable energy. India has committed to generating

40% of its cumulative electric power capacity from non-fossil fuel sources by 2030, demonstrating its strong focus on clean and sustainable energy sources like solar and wind power. The country is also committed to creating an additional carbon sink of 2.5 to 3 billion tonnes of CO₂ equivalent by 2030 through the expansion of forest and tree cover.

To achieve these targets, India has implemented various policies and initiatives. The country has launched the International Solar Alliance (ISA), a coalition of solar-rich countries aimed at promoting the use of solar energy globally. India has also implemented the ambitious Pradhan Mantri Kisan Urja Surakshaevam Utthaan Mahabhiyan (PM-KUSUM) program, which focuses on deploying solar pumps and promoting solar power generation among farmers.

India has made substantial progress in reducing the emissions intensity of its GDP, achieving a 24 percent decrease from 2005 levels by 2016.

In addition to mitigation efforts, India's NDC recognizes the importance of adaptation measures. The country is vulnerable to climate change impacts, such as sea-level rise, changing rainfall patterns, and extreme weather events. India's NDC highlights the need to enhance adaptive capacity, strengthen resilience, and promote climate-resilient practices in various sectors, including agriculture, water resources, forestry, and health.

India's NDC also emphasizes the principles of equity and common but differentiated responsibilities. Recognizing that historical emissions have largely been contributed by developed countries, India emphasizes the need for developed nations to provide financial resources, technology transfer, and capacity - building support to developing countries like itself.

Strategies and Actions for Just Transition in Coal Sector

As iterated in India's long-term low carbon development strategy (LT-LCDS) submitted to UNFCCC (Mo EFCC, 2022), safeguarding India's energy supply can only be achieved through maintaining a diverse mix of supply sources, which includes rational utilization of coal.

Coal consumption in India is anticipated to reach its peak around the year 2040, after which it is expected to gradually decline. This decline may lead to a phased approach for the closure of coal mines, starting with low-capacity mines that require closure based on just transition principles. Furthermore, some coal

mines will also cease operations during this transitional period due to reasons such as depleted reserves, safety concerns, and economic viability issues. It is crucial to ensure proper closure procedures for these mines in order to safeguard the income of individuals who depend on them, and prevent any loss thereof.

To secure the livelihoods of individuals reliant on coal mines, coal handling plants, coal washeries, and related community services, it is imperative to establish a policy framework and initiate capacity building efforts without delay. By doing so, we can ensure the smooth closure of coal business based on the principles of a just transition. This proactive approach will allow the coal sector to develop a comprehensive mine closure framework and build a strong capacity to implement closure practices aligned with the principles of a just transition. These preparations will be crucial as the long-term tapering of coal demand begins, ensuring a sustainable future for the coal sector.

In this regard, "Just Transition in coal sector" in the Indian context will require a focus on the following aspects :

- Supporting social and physical infrastructure
- Ecological restoration of affected areas
- Building capabilities of communities
- Seeding new livelihood generating activities

This needs to be complemented with requisite financing mechanisms and institutional frameworks involving coal companies, stakeholders as well as administrative and regulatory bodies.

India has established a framework for the restoration of mined-out areas, which has been implemented through various issuances. The first framework was issued in 2009, followed by subsequent updates in 2013 and 2020. A separate framework was issued in 2022 specifically for mines closed prior to 2009 MoC, 2022). The coal mining industry, under the guidance of the Ministry of Coal, takes a proactive approach to mitigate the effects of mine closure. This is achieved by allocating a substantial amount of funds in the form of an Escrow Fund and through Corporate Social Responsibility (CSR) initiatives. Arguably, this represents the largest mandatory support system aimed at addressing the challenges arising from mine closure. A comprehensive policy is adopted to minimize any adverse impacts during coal mining operations, as well as after the closure of coal mines. The Right to Fair Compensation

and Transparency in Land Acquisition, Rehabilitation and Resettlement (RTFCTLARR) ensures that individuals providing land for coal mining receive an attractive compensation price. Moreover, Coal India Limited offers compensatory employment opportunities to the land providers, further contributing to their well-being.

The global coal mining industry has witnessed a significant reduction in direct employment due to the introduction of new environmentally friendly technologies. Lessons drawn from different countries can be condensed into three key thematic pillars aimed at mitigating the adverse effects of job losses in coal mining. These pillars are Institutional Governance, which includes centralized, regional, and local initiatives; People and Communities ; and Repurposing Land and Infrastructure Assets.

A comprehensive collection of the Best Global Practices is accessible for countries with varying geopolitical and economic conditions, encompassing a diverse range of socio-economic strata as mentioned below :

- Ukraine, Romania and Russia;
- USA, Canada and Germany;
- European Member States, Czech Republic, Greece, Poland, Slovakia and Kosovo and
- Turkey
- India

In India, the closure of coal mines is expected to have a gradual impact, as coal production is projected to increase until 2040. Adequate provisions for funds have been made, and by utilizing these funds in a structured and coordinated manner, a smooth transition can be achieved. By aligning the available funds and resources with existing welfare schemes, the overarching goal of a Just Transition can be effectively pursued.

Coal-dependent countries must proactively strategize and prepare for a long-term Just Transition within the sector. The global experience concerning Just Transition exhibits significant variations in terms of the roles and responsibilities assigned to different stakeholders, encompassing technical and environmental closure of coal mines, as well as obligations to support affected individuals and communities. The process of Just Transition planning initiates well in advance of mine closures, necessitating inclusive dialogues among diverse stakeholders to shape the transition vision. In order to make informed decisions, it is crucial to understand the broader interconnections between coal and the

local economy, as the social impacts stemming from mine closures extend across various segments of the workforce and communities. Consequently, the G20 or developed countries can play a supportive role in the Just Transition process of coal-dependent nations by offering essential financial and technological assistance. This aid would facilitate the adoption of low-carbon economic activities, there by ensuring the sustainability of coal-dependent communities in coal regions.

The regions of West Bengal, Jharkhand, Chhattisgarh, Odisha, Madhya Pradesh, Telangana, along with certain parts of Uttar Pradesh, Maharashtra, and Andhra Pradesh are anticipated to experience the most significant effects of coal transitions. These transitions will have implications on the people residing in these areas. A total of 266 districts in India are reported to have at least one industry dependent on coal, indicating that these districts will likely be impacted in varying degrees as coal transitions. This reality poses a substantial challenge for India today. The task at hand involves transitioning entire regions and districts while simultaneously creating sustainable livelihood opportunities for a population comparable in size to that of smaller countries. Balancing the achievement of development and climate goals adds further complexity. The sheer scale and magnitude of this transition make it unparalleled in the history of coal transitions worldwide.

The Ministry of Coal (MoC) recognizes the significance and lasting effects of Just Transition in Vision India@2047. As a result, the MoC has prioritized this concept and outlined several sub-goals to work towards achieving a Just Transition. To accomplish these goals, the MoC has established defined strategies and outlined specific actions that need to be taken. These include :

- Developing a comprehensive mine closure plan : The MoC aims to create a well-rounded and thorough plan for mine closures. This plan will encompass various aspects, ensuring that closures are carried out efficiently, responsibly, and with due consideration for environmental and social factors.
 - Creating and enabling statutory regimes and institutional arrangements : The MoC recognizes the importance of establishing robust legal frameworks and institutional structures that facilitate the smooth execution of mine closures. These regimes and arrangements will provide the necessary guidelines and support for a successful Just Transition.

- Building a roadmap for mine closure till 2047 and beyond : The MoC is committed to charting a clear path for mine closures that extends beyond the year 2047. This long-term roadmap will outline the necessary steps, milestones, and targets to ensure a seamless transition in the coal sector while addressing the associated socio-economic and environmental challenges.
- **People and communities**
 - Ensuring the livelihoods of affected people : In the context of coal transitions, it is crucial to prioritize the well-being of people and communities who may be affected by the changes. One key aspect is to ensure the preservation of livelihood opportunities for those individuals who rely on the coal industry. Efforts must be made to support and facilitate a smooth transition by identifying alternative employment options, providing necessary skills training, and assisting in job placement or entrepreneurial initiatives.
 - Sustenance of social and other infrastructures : The sustenance of social and other vital infrastructures is of paramount importance. As coal transitions unfold, it is vital to maintain the functioning of essential services such as healthcare, education, transportation, and utilities. These infrastructures form the backbone of communities and play a crucial role in their overall development and well-being. Ensuring their continuity and effectiveness throughout the transition process is essential to minimize disruptions and ensure the smooth functioning of daily life.

By focusing on these aspects, policymakers and stakeholders can help mitigate the potential challenges faced by people and communities during coal transitions. Through proactive measures and targeted support, the aim is to facilitate a just and sustainable transition that takes into account the needs and aspirations of all those affected.

- **Leaving a sustainable environment**
 - Environment remediation : When considering coal transitions, it is crucial to prioritize the creation of a sustainable environment for future generations. This involves taking steps

to remediate and restore the environmental impacts caused by coal-related activities. Efforts should be made to address issues such as land degradation, water pollution, and air quality deterioration resulting from coal mining and associated processes. Implementing effective remediation measures will help restore ecosystems, protect biodiversity, and ensure the long-term sustainability of the affected areas.

- Repurposing land and asset : Repurposing land and assets formerly used for coal-related activities is an essential aspect of leaving a sustainable environment. It is important to identify alternative uses for these areas that align with environmental and social objectives. This could involve initiatives such as land rehabilitation for agriculture or forestry, development of renewable energy infrastructure, or creating green spaces for recreational purposes. Repurposing assets, such as infrastructure and facilities, can also contribute to sustainable development by repurposing them for new industries or community services.

By focusing on environmental remediation and repurposing land and assets, coal transitions can leave behind a sustainable environment that supports the well-being of communities and promotes ecological integrity. Figure 1 illustrates the ecological restoration undertaken by Bharat Coking Coal Limited (BCCL) on 294 hectares of mined-out land and overburden (OB) dumps until the year 2018-19. These efforts ensure that the legacy of coal-related activities is transformed into opportunities for a greener and more sustainable future.



Figure 1 : Ecological restoration efforts carried out by BCCL in mined-out areas

It is reported that (PIB, 2022) over the past three years, Coal / Lignite Public Sector Undertakings (PSUs) have successfully established eight eco-parks on rehabilitated mining lands through sustainable mine closure practices. These former mining sites have undergone significant transformation and now stand as stable, environmentally-friendly areas of remarkable beauty. Several of these sites have already been seamlessly integrated into the local tourism circuit, and Coal / Lignite PSUs are actively collaborating with the respective State tourism departments to incorporate additional parks. These sites are expected to generate revenue for self-sustainability and provide employment opportunities for the local community. The development of eco-parks and tourism sites on reclaimed land is a primary focus for Coal/Lignite PSUs, with plans to create over 30 new eco-parks and expand the existing ones in the next 4-5 years.

Through the invaluable lessons acquired during this process, the closure framework will undergo gradual refinement, aiding in capacity building and establishing a robust structure for effectively managing future mine closures in the long term.

Some of the prominent best practices in the Indian Coal Mining Sector are described below :

- Formerly abandoned quarries are now serving as a valuable source of potable water for nearby communities.
- Mining companies are providing irrigation water to support and encourage farming activities in the region.
- Old water-filled quarries or final mine voids are utilized for pisciculture, promoting the cultivation of fish.
- Important infrastructure facilities like schools, hospitals, and houses are handed over to local governments for ongoing community use.
- Reclaimed mined-out lands are transformed into eco-parks, creating recreational spaces and connecting them to the tourism circuit.
- Reclaimed mined-out lands are utilized for orchards and agricultural purposes, fostering the growth of orchards and crops.

Recommendations for a Just Transition in the Coal/Lignite Sector

So far, in the coal / lignite sector, workers who lost their jobs due to mine closures have been able to find employment in new mines through re-location efforts. However, as the sector approaches its peak coal production, it is anticipated that there will be a decline in job opportunities. This can be attributed to two primary factors. Firstly, the increasing mechanization of processes within the sector is expected to reduce the need for human labour. Secondly, the opening of new mines in different geographical areas is also contributing to the potential decrease in employment opportunities.

In consideration of India's dependence on the coal sector for its energy security, the nation is contemplating the implementation of a transition program. This program aims to address various aspects, including environmental measures for remediation and the introduction of alternative economic activities to sustain livelihoods. Countries that heavily rely on coal as a primary energy source can draw upon the best global experiences and practices to establish a comprehensive and equitable framework for a smooth transition.

As per the provisions of the Paris Agreement in 2015, participating parties were obligated to take into account the importance of a fair transition for the workforce and the creation of good quality jobs. These endeavours are meant to align with each country's individually defined development priorities. Additionally, in 2010, Rosemberg emphasized that job losses should not be seen as an inevitable outcome of climate policies, but rather as a result of insufficient investment, social policies, and foresight (Rosemberg, 2010).

Hence, the primary objective of a just transition initiative is to support and rejuvenate livelihoods that face the risk of adverse impacts. The success of this endeavour relies on the process itself, its participants, and its objectives. Workers, employers, civil society, and governments collaborate as active partners in devising transition and transformation plans that encompass environmental considerations, social justice, and poverty alleviation. Coal-dependent countries undertake various welfare schemes to ensure the well-being of employees, families affected by projects, corporate social responsibility activities in mining areas, environmental improvement initiatives, and the implementation of activities derived from public consultations. It is

crucial, therefore, for any country heavily reliant on coal as a primary energy source to identify and address the gaps that need to be filled in order to achieve a comprehensive and equitable just transition.

Development mechanisms are influenced by a multitude of factors. These factors encompass the overall governance experience of a country, the historical context of transitions in specific regions and other relevant aspects. However, among these factors, the existing institutional framework holds paramount importance. The institutional framework serves as the foundation upon which development processes are built, providing the structure, regulations, and guidelines that shape the trajectory of progress and change. It plays a central role in determining the effectiveness and efficiency of development initiatives and influences the outcomes and impacts they generate. Thus, a robust and adaptable institutional framework is crucial for fostering sustainable and inclusive development.

The proposed framework for institutional governance in managing the just transition process necessitates a harmonious collaboration among various stakeholders, including the federal / central government, province/ state government, local government, civil society, coal companies, and other relevant entities. Each of these stakeholders has distinct roles and responsibilities within this framework :

Federal / Central government : The federal or central government plays a crucial role in formulating policy and regulatory changes to facilitate the development of a just transition mechanism. This mechanism should address both environmental concerns and the well-being of individuals and communities. Additionally, the government's task is to attract public and private capital to revitalize livelihoods affected by the transition.

Provincial / State government : The province or state government is responsible for implementing the Rehabilitation and Resettlement (R & R) policy. They are also in charge of executing specific welfare schemes to support populations impacted by mine closures. Furthermore, the province or state government provides assistance and support to local government bodies involved in the transition process.

Local government : Local government entities play a vital role in fostering a synergistic approach to repurpose mines by closely aligning with local development plans. They ensure that social protection networks are

in place to support affected individuals and communities throughout the project's progression. Moreover, local governments are responsible for the operation and maintenance of public infrastructure that remains available after mine closures, ensuring sufficient staffing and supporting infrastructure.

Coal Companies : Coal companies have a key role in focusing on environmental resources and physical infrastructure. This includes undertaking technical and biological restoration efforts and repurposing land and mine assets to minimize the environmental impact of mining activities.

Civil society : As an important stakeholder, civil society actively participates during the design stage of the just transition process. They provide valuable input and assistance to the executing authorities, contributing to the effective implementation of the transition initiatives.

By engaging in collaborative efforts and fulfilling their respective roles within this framework, these stakeholders can work together towards achieving a successful and equitable just transition.

Further recommendations include the recognition that the transition away from coal will necessitate significant financial resources. These resources will be required for various purposes, such as ecological restoration in abandoned mines, the development of new employment opportunities and industries, as well as the reskilling and retraining of affected workers. The closure of coal mines, both in the short and long terms, is expected to have a detrimental impact on the already resource-deprived economies of coal-bearing regions. It is imperative, therefore for the developed countries to lend their support to the just transition process in coal-dependent regions by providing financial assistance that surpasses the capabilities of the affected nations' existing provisions.

Additionally, as a global just transition model begins to take shape, drawing on the experiences of Europe and North America, countries heavily reliant on coal as a primary energy source must diligently prepare themselves. This preparation should entail thorough consideration of specific concerns related to energy security, environmental sustainability, and social implications, while ensuring a robust framework is in place. The developed nations have an opportunity to facilitate the just transition process in coal-dependent countries by offering the necessary financial and technological aid. This

assistance would enable the adoption of low-carbon economic activities, ultimately sustaining the livelihoods of coal-dependent communities residing in coal regions.

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A COMPREHENSIVE INTRODUCTION TO EFFECTIVE SAFETY MANAGEMENT STRATEGIES IN THE MINING INDUSTRY

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Introduction

Mine safety is a broad term referring to the practice of controlling and managing a wide range of hazards associated with the life cycle of mining - related activities. Mine safety practice involves the implementation of recognised hazard controls and/or reduction of risks associated with mining activities to legally, socially and morally acceptable levels. While the fundamental principle of mine safety is to remove health and safety risks to mine workers, mining safety practice may also focus on the reduction of risks to plant (machinery) together with the structure and orebody of the mine.

Mining is inherently hazardous and risky profession, provides basic raw material to run the economy and has critical role to play in growth of the nation. Mining provides employment to large number of people and safety of all these is of paramount importance. One of the primary reasons for safety issues in Indian mining is the inadequate implementation and enforcement of safety regulations. While safety guidelines and protocols exist, their effective implementation and strict enforcement across all mining operations are often lacking. This situation leads to a higher risk of accidents and occupational hazards for workers.

The mining industry in India also faces challenges related to outdated infrastructure and technology. Many mines still rely on outdated machinery, which increases the risk of accidents. The lack of modern equipment and safety technologies limits the ability to monitor working conditions and respond promptly to potential hazards (Tripathy et al., 2018). Additionally, issues such as inadequate training and awareness among workers contribute to safety concerns. Insufficient training programs on safety protocols and emergency procedures can lead to a lack of preparedness when accidents occur. Increasing awareness about

safety practices and providing comprehensive training to all mining personnel is crucial for minimizing accidents and promoting a safety - oriented culture.

It is important to note that the Indian government has recognized the need for improvement in safety standards within the mining industry. Efforts are being made to enhance safety regulations, promote technological advancements, and strengthen enforcement mechanisms. The Ministry of Mines, Ministry of Coal has introduced initiatives such as technological roadmap for coal sector etc., to encourage the adoption of modern mining techniques and equipment to improve safety and productivity. However, despite these efforts, accidents continue to occur in Indian mines, resulting in loss of life and injuries. Addressing the safety challenges in the mining industry requires a multi-faceted approach involving stricter enforcement of regulations, investment in modern technologies, comprehensive training programs, and fostering a culture of safety among all stakeholders. It is crucial for mining companies, government authorities, and industry organizations to collaborate closely to prioritize safety and implement measures that effectively prevent accidents. By adopting a proactive approach and implementing robust safety practices, it is possible to reduce the number of accidents and create a safer working environment for miners in India's mining industry.

To enhance the safety, firstly, it is imperative to understand and identify the major safety related risks associated with mining (Tworek et al, 2018).

2. Major safety related risks

Based on the literature, past accident reports and industrial experience, some of the major risks concerns associated with present mining industry are :

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- Unscientific Mining : In Open Cast Projects, when benches and haul roads are not maintained in accordance with the design parameters it causes dump/pit slope failure.
- Improper upkeep / maintenance of Machineries causing accidents involving equipment.
- Mine Fires mostly to the Coal seam / stockyard, equipment, coal handling plants, oil fire.
- Explosion caused due to Mine gases. Explosion caused while carrying of explosives in unsafe manner, improper storage of explosive at Magazine (Sahu, 2023).
- Injury to persons working in mine by –
 - a. Fly rocks, vibration after blasting in mine
 - b. Inadequate illumination
 - c. While shifting of machineries
 - d. Skidding / Toppling / rolling back of heavy machineries
 - e. Fall / Slip of persons while working in mine
 - f. Electrocutation/Burn injury while working in electrical circuit, electrical machineries, handling cables etc.
 - g. While handling big tyres of Heavy dumpers / trucks
 - h. Improper & unsafe driving
 - i. Caught in moving parts of machineries
 - j. Improper parking of vehicles / machineries
- Mine flooding / Inundation due to breach of dam/bund of river / nallah. Any blockage in the upstream or downstream side of river flowing nearby, Inrush of rain water into mine pit.
- Environmental issues - Air, water and noise pollution caused due to mining and transportation of minerals. Soil erosion, fauna and flora, local culture and employment dependent on forest produce getting destroyed.
- Health related hazards caused in the mining areas - Physiological effects of dust & noise on machine operators, dealing with oil, lubricants may result in to eye irritation, itching & skin problems etc. (Wachter, 2014)

Considering the above stated major risks associated with mining, safety measures may be taken to improve the safety standards to avoid mis-happening and for preparedness of any accident.

3. Safety measures that may be taken to improve safety standards :

- Formulation and implementation of Health and Safety Policy which should be in line with national and international best practices adopted by leading mining players.
- Internal and External Safety Audits conducted periodically of each project. The recommendations should be followed by corrective measures taken by responsible personnel within the allocated time frame.
- Development of a Competency framework for each designation of employees. Training modules should be designed and implemented based on skill gap analysis and identification of desirable areas where training is to be provided (Wang et al, 2020).
- As per regulation 104 of Coal Mines regulation, 2017, the mine management should implement Safety Management Plan (SMP) which shall contain a defined mine safety and health policy of the company; a plan to implement the policy; how the mine or mines intend to develop capabilities to achieve the policy; principal hazard management plans; standard operating procedures (SOP); ways to measure, monitor and evaluate performance of the safety management plan and to correct matters that do not conform with the safety management plan; a plan to regularly review and continually improve the safety management plan; a plan to review the safety management plan if significant changes occur; and details of involvement of mine workers in its development and application (CMR 2017).
- SMP should give adequate priority on developing Principal Hazard Management Plan (PHMP) consisting of identification of operation-wise hazards and risks associated with the hazard along with the controlling measures, SOP / COP for each operational activity and the official responsible to ensure the same.
- The SMP shall include the specific guidelines for emergency withdrawal and re-entry protocol based on Triggered Action Response Plan (TARP) for all principal hazards potential to cause multiple fatalities.

- Job Safety Analysis (JSA) should be done before the start of any job assigned. It is ensured by the In-charge before start of work that all the risks involved has been explained to the concerned employees.

- Use of PPE kit by each individual deployed in mine should be a must.

The basic steps to ensure the safety management in all verticals of the operations are (Verma et al., 2016) :



Figure 1 : Basic steps to ensure the safety management

The steps mentioned in the Figure 1, is elaborated below for better understanding:

- Hazard Identification** : This component involves conducting thorough assessments to identify potential hazards and risks in the mining operations. It includes identifying geological risks, machinery hazards, chemical exposures, and other site-specific risks (Tripathy et al., 2018).
- Risk Assessment** : Once hazards are identified, a risk assessment is conducted to evaluate the likelihood and severity of potential incidents or accidents. This step helps prioritize risks and determine appropriate control measures.
- Control Measures** : This part outlines the specific measures and controls that will be implemented to mitigate identified risks. It includes engineering controls (e.g., machinery safeguards), administrative controls (e.g., safety procedures), and personal protective equipment (PPE) requirements.
- Emergency Response** : A crucial aspect of safety management is preparing for emergencies. This section should detail emergency response plans, evacuation procedures, communication protocols,

and training programs to ensure workers are prepared to respond effectively in case of accidents, fires, or other emergencies.

- Training and Education** : Comprehensive training programs should be established to educate workers about safety protocols, hazard awareness, emergency response, and proper use of personal protective equipment. Ongoing training and refresher courses should be provided to maintain a culture of safety.
- Monitoring and Inspection** : Regular monitoring and inspections are essential to ensure compliance with safety standards. This component involves conducting routine inspections, safety audits, and utilizing monitoring technologies to identify any deviations or potential hazards.
- Incident Reporting and Investigation** : This part focuses on establishing a systematic process for reporting and investigating incidents. It includes protocols for reporting near-misses, accidents, and injuries, as well as conducting thorough investigations to identify root causes and implement corrective actions.

- viii. Safety Communication : Effective communication plays a vital role in maintaining a safe working environment. This component involves establishing clear channels for safety communication, such as safety meetings, safety bulletins, and safety committees, to promote awareness and encourage feedback from workers.
- ix. Continuous Improvement : Safety management plans should emphasize continuous improvement through regular review and evaluation of safety performance. This includes analyzing incident data, soliciting feedback from workers, and implementing improvements to enhance safety standards.

Further, for better understanding of the safety management and measures to be taken for enhancement of safety, some major identified activities along with few major measures to be adopted are illustrated below in section 4.

4. Activity-wise safety measures required to be taken :

Few major activities are identified and the safety measure to avoid hazards or minimizing the risk associated are given below :

- i. *Safety measures to avoid Pit slope failure in OC mines*
 - Slope stability study for the quarry should be conducted regularly. Regular monitoring of pit slopes for assessing its stability should be carried out with peg and survey instrument or as advised by the scientific body. Slope Stability Radar (SSR) may be deployed for the real time monitoring of pit slopes.
- ii. *To avoid unauthorised entry near hazardous operations : -*
 - Proper fencing / strong parapet wall should be constructed all around the mine workings with security check posts at desired locations to prevent unauthorised entry of villagers to the mine area.
 - A separate road for villagers should be provided by the side of the haul road. Traffic signal should be installed with 24 X 7 manned crossings for villagers.
 - Photo identity cards should be issued to all the employees and biometric system of attendance should be followed.

- Outbound loaded GPS enabled trucks or authorised vehicles can be issued with RFID tags (unique identification). RFID based Automatic boom barriers may be installed at all the entry and exit points of Mines and Railway Sidings so that only authorized vehicles/ tippers can enter/exit into the mine premises which eliminate the possibility of any pilferage, illegal transportation and helps to regulate vehicle traffic and transportation routes.
- iii. *Steps should be taken for improvement in quality of Supervision : -*
 - To improve the quality of supervision, qualified, competent supervisors including statutory manpower should be appointed in sufficient number.
 - All frontline supervisors should be imparted training periodically to update their knowledge and skill.
 - Training of Security guards deployed for securing mine area may be arranged regularly.
- iv. *To prevent accidents caused by heavy earth moving machinery (HEMM) and other associated machinery following steps should be followed : -*
 - Vocational training modules of special category should be identified and training should be imparted as per revised modules.
 - All the dumpers should be fitted with load indicator and overloading of trucks to be strictly prohibited.
 - Check list of all the safety features should be prepared and it should be ensured that no HEMM is operated unless all the safety devices are in perfect working order.
- v. *Safety measures at Coal Handling Plant (Interim Crusher) : -*
 - All the persons deployed at the crusher should be imparted specialized training.
 - Competent persons should be authorized for inspection of each and every safety devices according to a pre circulated checklist and record should be maintained. Surprise checks should be carried out by the engineer and proper record should be maintained.
 - Disciplinary action should be taken against defaulters, bypassing the safety devices.

- Brief safety talk should be given at the start of the shift and also whenever maintenance work is undertaken.
- Dust suppression system (water spraying) at the receiving hopper should be installed and it is used regularly.
- Regular dust survey (once at least in every month) should be conducted at the crusher area as per statutory provisions.
- The manager should be assigned to identify the group of persons who are deployed in areas prone to generate air borne dust and to get them medically examined by an expert agency at an interval of not more than 6 months. (Perret et al., 2017).

vi. Safety measures while loading of coal at the Coal Yard :-

For ensuring safety of the persons engaged in the coal transportation, the following precautions should be taken :-

- Roadworthiness of each and every vehicle entering the coal stock yard to be certified by the Colliery Engineer.
- Proper fencing/strong parapet wall is erected around the coal yard to avoid unauthorised entry.
- SOP framed for the operations related to coal in the stock yard (unloading, loading & transportation) should be displayed in Hindi & revised whenever there is any change in the conditions.
- A copy of the SOPs should be circulated to all concerned and should also be explained to the employees through safety talks at the beginning of the shift.

vii. Safety measures while dumping of Waste rock :-

Scientific pit and dump slope stability study should be carried out regularly for the quarry and dump slope to ensure their stability (Dash, 2019).

- Any spoil bank exceeding 30 metre in height shall be benched so that no bench exceeds 30 metre in height and overall slope shall not exceed 1 vertical to 1.5 horizontal.
- The toe of a spoil - bank shall not be extended to any point within 100m of a mine open-

ing, railway or other public work, public road or building or other permanent structure not belonging to the owner.

- Warning notices in local language should be displayed prohibiting unauthorised entry towards the toe of the spoil bank.
- Fencing / strong parapet wall should be provided around the mine workings on the top bench to prevent unauthorised entry in active mining area.
- Monitoring devices (Visual inspection, Survey instruments and SSR) for assessing the dump stability and for giving prior warning before such failure may occur, should be used to ensure the safety of the equipment and the persons working in the mine.
- No person shall approach or be permitted to approach the toe of an active spoil bank/dump where he may be endangered from material siding or rolling down the face.
- Monsoon preparation plan should be implemented with increased monitoring to prevent any accumulation of water on Dump as well as toe area.
- Drains of sufficient size should be made to accommodate the rain water all around the dump.
- Continuous monitoring should be ensured through Dump supervisors, Asst Managers and via CCTV Cameras.
- Dewatering should be ensured before advance of Dump in new area.

viii. Safety measures while performing blasting operations :-

- SOP for blasting operations, Code of Practice for handling explosives should be framed and circulated to all concerned.
- Duties of Blasting I/c, Blasting Overman should be framed and circulated to all concerned.
- Separate Training Module should be prepared for Blasting Crew covering all aspects of Blasting operations.
- Only approved type of explosives should be used.

- Duties of Magazine Clerk should be framed including issue of explosive and accessories after check of shelf - life.
- Adequate amount of cast-booster should be used with the non - cap sensitive explosive charge to ensure complete detonation.
- Strict restrictions should be imposed on carrying of mobile phone to charging site by blasting workers. All mobile phones should be confiscated and kept in a wooden box in custody of blasting overman before start of charging.
- Use of Mobile Blasting Shelter should be as per approved design for taking shelter.
- Use of Siren should be made essential for blasting clearance.
- Checklist should be framed for posting of guards and before granting blasting clearance.
- Procurement of approved type exploder should be made mandatory for blasting operations.
- SOP should be framed for dealing with Misfired Shots & Transport of Explosives.
- Regular Vibration monitoring should be done to assess effect on Dump and nearby structures.

ix. *Safety measures while transportation of vehicle/ heavy machineries :* -

- Installation of Proximity sensors should be ensured in all Dumpers.
- Provision of Beacon Lights and Fixing of Red flags on long post should be made on all light vehicles.
- SOP for Stockpiling & dumping should be framed & implemented.
- SOP for operation of Dozers should also be made.
- Installation of CCTV cameras should be ensured at every coal & overburden dumps.
- Procurement of speed guns for surveillance of dumpers.
- Implementation of RFID (Radio Frequency Identification) system for coal dispatch trucks.

Through testing and experience, the mining process has been tweaked to add resources and safety. The best practices in mining are less dangerous, more conscientious and more productive than previous procedures. Additional safe practices can increase safety standards in mining projects.

5. Safe Practices for increasing the safety standards

Some of the best safe practices which can help in increasing the mining safety standards are enlisted below for readily adoption.

5.1. Prioritize Planning

Whether in surface or underground projects, it's critical for miners to develop thorough plans before beginning work. Taking time to calculate the best approach can help the process to go more smoothly and protect the wellbeing of the whole crew.

Assessing the environment can inform drilling design and blasting operations. Careful investigation of the rock characteristics, stresses and probable aftermath can decrease the unknowns and improve the sequence of events.

Surveying the area can be easier with mining technology because the right software can display the various outcomes for your proposed plans. Consulting digital models can help you explore a variety of scenarios. You can have more confidence moving forward with well-thought-out steps.

5.2. Maintain Rigorous Standards

Exercising regular inspection and adherence to mining regulations can set high expectations for workers. You can instill a sense of responsibility and attentiveness on your job site by meticulously enforcing safety rules.

Generating a positive perspective on safety standards can make checklists and protocol a necessity in the eyes of workers rather than an extra step.

Encouraging feedback from workers on areas for improvement can create a better setting. A culture of safety can get everyone behind the endeavour to secure mining practices.

5.3. Wear Personal Protective Gear

Labour intensive jobs all have specific personal protective gear needs, and mining is no different. Head-to-toe protection can shield miners from impacts, chemicals and extreme temperatures.

Sturdy clothing and accessories like steel-toed footwear are essential to keep workers safe. Hard hats tailored to the nature and purpose of the mining project can protect from severe injuries, as rock fall is a common cause of incidents. Don't forget to put on your equipment before entering hazardous zones.

Adequate fits in personal protective equipment can maximize the defence capabilities of the gear, and defective clothing should be replaced immediately.

5.4. Improve Visibility

From on-site vehicles to underground tasks, a clear view of the surroundings can minimize accidents. Dark pathways and work areas can put you in jeopardy because it's more likely for you to make mistakes with low visibility.

Underground illumination can enhance visual examinations of an area, which is vital for pre- and post-blasting procedures. Ensure personal lighting devices and stationary lamps can withstand all weather conditions. This can offer constant light sources and keep mining crews from unexpected blackouts.

Enough visibility can avert crashes for vehicles, too. Working headlights on machinery and mobile equipment can alert drivers to nearby personnel, preventing perilous collisions.

5.5. Manage Vibration and Noise Levels

Controlled explosions in quarrying reverberate through the earth and emanate loud sounds, and powerful mining machinery also adds elements of vibration and noise.

Strategic drilling can ease the tremors, especially in techniques where buffer holes are inserted in advance. Millisecond blasting can delay the explosions slightly with a series of holes to reduce the intensity of sound and shaking.

Suppression supports can take the noise down to an appropriate level. Blast mats can absorb the force from the detonation and help contain strong emissions of gas.

5.6. Account for Harsh Temperatures

The spectrum of temperatures that miners spend time in can impose stresses on the body. Long work hours in an intense setting can weaken miners, leading to heat exhaustion, dizziness and confusion. Freezing areas can also impact workers with cold-related sicknesses like lack of coordination and inconsistent breathing.

These kinds of impairment in crew members could influence the wellbeing of others if they can't carry out their duties.

Hydration, sufficient coverings and periodic breaks from these conditions can lessen the risk of cold or heat stress.

5.7. Ventilate Harmful Gases

As noxious vapours naturally occur in mines, workers can inhale these and suffer from poisoning. High concentrations of particular gases can collect, and in certain cases, they can combust.

Knowing the signs of gas poisoning can allow you to catch leakage before it hurts anyone. For instance, overexposure to carbon monoxide can cause headache and breathlessness. Gas detection devices bring more dependable monitoring.

Effective ventilation systems can redirect the gases and increase air flow. More air dilutes the gases to an acceptable and breathable proportion for suitable air quality.

5.8. Implement Rock Burst Prevention Measures

Environmental changes and human-made blasts can shift rocks and dislodge large pieces from rock walls. Falling rock can strike workers and induce serious injuries, so it's beneficial to set up protective systems. Fastening anchors and barriers in vulnerable areas can hold back fragments to protect miners.

On the outskirts of a site, ditches and berms can soften the decent of dropping rocks in surface projects. However, bolting, scaling and barring the overhanging rock faces can serve as early deterrence. Attaching steel mesh draping or mats to the sides of the mine could also intercept stray chunks of rock.

5.9. Stay Aware of Fire Risks

The materials in mines increase the possibility of fire, and if you're mining coal or working in a gas-rich region, this elevates your risk for tragic scenarios.

Because underground shafts and tunnels are tightly enclosed, smoke and flames can quickly become overwhelming. The compact pathways also can provoke the spread of fires, covering ground swifter than workers may notice.

Fire suppression apparatuses can combat the flames, and sensors can alert workers to the danger. Remaining vigilant to fire stimulants and hazardous conditions can ready workers to react to the initial moments of the

fire. Wearing fire-resistant protective gear can reduce the extent of burns, too.

5.10. Watch for Dust Hazards

Loose silica dust or coal particles can travel through the air in denser portions than normal when mining. These specks can disturb the respiratory system, depending on their size and makeup.

Vacuum devices, screens, transfer shoots and wet fan scrubbers can capture the tiny bits and clear the air for workers.

Respiratory protection is also critical because miners are susceptible to lung issues. Respirators and ventilation masks can ward off airborne impurities that miners might confront.

5.11. Keep Electrical Safety in Mind

Like most other job sites, mines use power tools, lights and other electrical equipment, which need electricity. Sending electricity through these locations and transporting machines litters the space with extension cords and wires.

These cords and electronics in damp mines can raise the risk of electrocution or electric shock, but maintaining electrical safety can protect workers from the hazard. Grounding the system, incorporating resilient cords and insulating the connections can manage the currents.

You can also bundle the cords to prevent tangling and move them out of walkways to avoid tripping.

5.12. Emphasize Communication

Relaying information about the conditions and progress of mining activities is crucial. Lines of communication should be handy so that workers can warn others about questionable areas or accidents as soon as possible.

Signs designating hazardous areas can visually convey safe areas, and clear labels can provide clue to workers

in on how or when to use their equipment and tools.

Mobile devices are currently used to pass on updates, but the signal for these can be weak or non-existent underground. On-site communication systems are another technique for transferring messages to miners.

5.13. Take Advantage of Professional Training and Refreshers

After learning the routine, workers can start to feel comfortable in their roles, but they can also forget vital procedures. Their caution can wane as they settle into the routine. Reminders about the regulations from supervisors and co-workers can create a sense of accountability. Refresher training courses can also help you to go through the process with confidence.

The right procedure for mining can equip miners to handle surprises and variations. Knowledgeable miners can push the industry forward in safety measures.

Apart from the safety measures and best practices, adopting modern and latest technologies can have a significant impact on mining operations, including safety and productivity, environmental protection, business opportunities for small and large enterprises, contractors and employment opportunities. The convergence of information technology with the operational technology and in the various processes of mining projects will certainly help in better visibility of the data flowing along the circuit of operations, which further may help in data driven decision making. The process by which companies embed technologies across their businesses to drive fundamental change is called Digital Transformation. The Digital Transformation can create a more agile and profitable business, with improved decision-making and employee empowerment. Moreover, digitalization can reduce geological uncertainty, market volatility, operational risks and improve health, safety, and environmental impact (Figure 2).



Figure 2 : Benefits of Digital Transformation in mining.

6. Various IT initiatives for improving safety standards

Some of the immediate IT based solution for the mining industry to adopt for enhancing safety as well productivity in overall operation are :

- **Man machine tracking** : Network for tracking of Man & Machine inside the mine. Every person & machine may be provided with a smart token, which can provide their real time exact location in the mine.
- **Online record keeping of Man and Machinery** – For HEMM Report, manpower report, production report, project monitoring reports, consumables report, drilling reports etc.
- **e-Safety Management Plan** – For login and view risk assessment worksheet & control plan of hazards, adding & updating Work Plan, and printing quarterly report.
- **Use of Terrestrial Laser Scanners & Slope Stability Radars** for faster, reliable and accurate surveys and slope monitoring.
- **Truck Management System** : Real time GPS based tracking of trucks, Geo-fencing and Event based sms alert.
- **Automation of Weigh bridges** : Automatic weighment of Trucks & Automatic comparison of weights at Mine end and Railway siding.
- **RFID based access control of Trucks** : RFID based access control of Trucks at entry

& exit points of Mine end and Railway siding.

- **Integrated coal management Software (ICMS)** : Various Dashboards related to production of coal, Projection of truck requirement in advance, Third party integration, CCTV footage
- **Use of Simulators** - for training at Mining Project.
- **Use of Safety Mobile App** - for Incident reporting, digital library, shift checklists, e-SMP, Social wall, Dashboard etc.

7. Conclusion :

The safety of workers in the mining field is non-negotiable and of utmost importance. However, complying with the necessary safety standards is a challenging task that demands the attainment of high professional benchmarks. To address this, it is crucial to establish and implement a competency framework across all mining projects, clearly defining the roles and responsibilities of every individual involved. Additionally, a well-developed review mechanism is necessary. Any deviation from safety standards should be treated seriously, and every near-miss incident should be documented and subjected to root cause analysis. The findings and lessons learned from these incidents should be widely disseminated within the organization. Furthermore, if deemed necessary, amendments to the Safety Management Plan and Standard Operating Procedures (SOPs) of the projects should be implemented based on these findings.

By adhering to the aforementioned practices and strategies, the Mining Industry can effectively and appropriately address the safety challenges it faces.

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ADDRESSING SAFETY CONCERNS IN OIL AND GAS FIELDS : EFFECTIVE MEASURES FOR RISK MITIGATION

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Introduction

The management of oil and gas poses a significant worry for the individuals working in the oil and gas industry. The presence of highly flammable substances in the form of liquid and gaseous hydrocarbons is a leading cause of severe fires and explosions (Laik, 2019). Oil and gas are highly flammable substances, so these are handled with the utmost care from a safety perspective. Consequently, all individuals involved in the operation and maintenance must make every possible effort to prevent accidents and fires. Within oil and gas installations, there is a potential risk of unintentional release of flammable liquids, including natural gas. Any electrical spark from equipment or the presence of static electricity, whether generated during operations or in any other circumstance, can lead to a dangerous fire or explosion.

The significance of the oil and gas industry are well recognized. Throughout the processes of exploration, extraction, refining, and transportation of oil and gas, this industry carries substantial risks to both human lives and materials. In order to minimize the diverse hazards to life, property, and the environment, it is crucial to adhere to strict and mandatory safety practices. It is essential not to overlook any of these practices and to maintain vigilant safety monitoring at all times.

Workers in the oil and gas industry face potential risks in their daily operations. In this paper, the authors have thoroughly examined the safety hazards associated with the extraction of oil and gas. They have also explored topics such as area classification and the scope of hazards, ignition sources, the usage of electrical equipment in these industries, type testing for flameproof equipment, and general precautions to mitigate safety challenges in the oil and gas field.

Safety Hazards near Oil & Gas Installations

In the vicinity of oil and gas installations, there is a release of higher hydrocarbons, which, when mixed with air, can create an explosive atmosphere. Various types of equipment and materials are utilized, making it crucial to properly identify and control hazards in order to prevent injuries and fatalities. The following are some of the hazards associated with this drilling mechanism.

1. Vehicle collision
2. Struck-by/caught-in/caught between
3. Explosion and fires
4. Falls
5. Confined spaces
6. Ergonomic hazards
7. High pressure lines and equipment
8. Electrical and other hazardous energy
9. Machine hazards
10. Planning & Prevention

Vehicle Collisions : Vehicle crashes are the leading cause of fatalities among oil and gas extraction workers during the transportation of oil and gas from well sites. It has been reported that Transportation incidents in the United States continued to be the most common type of fatal event in 2021, with a total of 1,982 fatal injuries. This represents an 11.5 percent increase from the previous year. These incidents accounted for 38.2 percent of all work-related fatalities in 2021 (BLS, 2022).

Struck-by / Caught-in / Caught-between : These sources encompass a range of potential hazards, including but not limited to moving vehicles, falling equipment, and high-pressure lines. The fatalities are a direct consequence of incidents involving these sources during the occurrence of on-site fires. It is imperative to recognize and address these specific hazards to enhance the safety measures and prevent future incidents

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resulting from being struck by, caught in, or caught between hazards in the presence of fires.

Explosions and Fires : During the process of oil and gas drilling, flammable gas vapours and liquids are consistently present at the installations. If not adequately controlled, various sources of ignition, such as open flames, sparks caused by friction, static electric charges, or lighting near heated surfaces, can pose a significant fire hazard. There are cases where auto-ignition may also occur.

The gas emitted during separations is typically piped away from the installations and burned off through flaring. However, if the flame is extinguished, significant amounts of unburned gas can be released into the atmosphere, creating the risk of a potential explosion. The presence of pyrophoric iron sulphide in pipelines and vessels can also lead to an explosion upon contact with air.

Falls : Employees working in the oil and gas sector frequently encounter the need to access platforms and equipment situated at considerable heights above the ground. It is crucial to establish adequate fall protection protocols to mitigate the risk of accidents and injuries resulting from falls occurring on masts, drilling platforms, and other elevated apparatus. OSHA's (Occupational Safety and Health Administration) Harwood Grant Training Materials provide comprehensive coverage of the various factors contributing to slips, trips, and fall hazards within the oil and gas industry.

Confined Spaces : Within the oil and gas industry, workers occasionally need to enter storage tanks and other confined spaces near a wellhead. These confined spaces pose a potential hazard as there is a risk of ignition of flammable vapours or gases within them.

Ergonomic Hazards : Workers in the oil and gas industry are exposed to ergonomic injury risks, including tasks such as lifting heavy items, bending, and pulling heavy loads. However, these risks can be mitigated or even eliminated by implementing pre-task planning, utilizing suitable tools, ensuring proper placement of materials, and educating workers about the associated risks.

High Pressure Lines and Equipment : The failure of connections that secure high-pressure hazards from compressed gases or high-pressure lines can lead to struck-by hazards. Additionally, internal erosion of lines can cause leaks or line bursts, thereby exposing workers to high-pressure hazards associated with compressed gases or high-pressure lines.

Electrical and Other Hazardous Energy : Normal electrical equipment cannot be used in the oil and gas industry due to the potential for creating explosion and fire hazards. Special types of electrical equipment, such as flameproof, intrinsically safe, purge-protected, and increased safety equipment, are used in these industries.

Machine Hazards : Throughout the process of oil and gas extraction, workers may encounter a diverse range of rotating wellhead equipment, which encompasses top drives, kelly drives, pumps, belt wheels, and conveyors. These machines pose safety hazards to workers on a regular basis.

Planning & Prevention : It is essential for each drilling, servicing and other companies to establish its own safety programme and possess comprehensive knowledge about area classification and combustible media. This knowledge is crucial in order to ensure the correct utilization of electrical equipment. In the absence of a wide-ranging knowledge, there is an increased risk of accidents, injuries, and equipment malfunctions.

Area Classification

Two prevalent classifications globally recognized are (Marshall, 2007; Holdstock, 2022) :

- In accordance with the National Electrical Code (NEC) of the USA.
- In line with the standards set by the International Electrotechnical Commission (IEC).

Area Classification According to NEC

NEC Classification is widely used in the American Continent for areas other than mines, while the Mine Safety & Health Administration (MSHA) covers mined areas. NEC classifies combustible media as follows :

Class 1 designates areas where explosive gases or vapours are present

Class 2 pertains to locations with explosive dust, such as grain mills.

Class 3 covers areas where loose fibers and flying particles are present, such as textile industries.

It's important to note that mining, specifically methane-fire damp, falls under the purview of the Mine Safety and Health Administration (MSHA) rather than the NEC Code.

Within Class 1, groups are categorized based on flammable gases, vapours, and liquids.

Group A includes acetylene, Group B encompasses hydrogen, Group C comprises ethylene, and Group D consists of propane. Group A gases pose the highest hazard, while Group D gases are considered the least hazardous.

Class 2 focuses on combustible dusts, which are further grouped as follows :

Group E includes combustible metal dust like magnesium (Division I),

Group F involves carbonaceous dust such as carbon and charcoal (Division I and II)

Group G entails non-conductive dust like flour or grain flour, which is a fine powder derived from wheat.

Class 3 pertains to ignitable fibres.

According to the NEC, the extent of hazard is categorized into divisions :

Division 1 denotes areas where hazardous media can exist under normal operating conditions, during repair and maintenance, or due to leakage caused by faulty operation or breakdown.

Division 2 signifies areas where hazardous media will only exist under abnormal circumstances resulting from accidental failures.

Area Classification According to IEC

The IEC classification is widely adopted in Europe and is also used in most countries around the world. The Bureau of Indian Standards follows the same area classification pattern as prescribed by the IEC.

Combustible media as per IEC

The classification according to IEC is as follows :

Group I : Pertaining to underground coal mines where Methane/Firedamp is present.

Group II : Pertaining to surface industries and other locations excluding coal mines.

Group II is further subdivided as follows :

Group IIA : Reference gas used is propane.

Group IIB : Reference gas used is Ethylene.

Group IIC : Reference gas used is Acetylene and Hydrogen.

Among these, Group IIC gases are the most hazardous, while Group IIA gases are the least hazardous.

The extent of the hazardous area should be as follows :

Zone 0 : A hazardous area that persists for 24 hours.

Zone 1 : An area where a flammable atmosphere is likely to occur under normal operational conditions. This includes:

- i. Any cellar or pit below ground level.
- ii. An area within a radius of at least 1.5 meters from the opening of any vent, extending in all directions.
- iii. In the case of a floating roof tank, the space above the roof and within the shell of the tank.
- iv. In the case of a fixed roof tank, the area surrounding the tank within 3 meters from the tank's end or roof, and inside the enclosure up to its top level.

Zone 2 : An area where a flammable atmosphere is likely to occur under abnormal operating conditions. This includes :

- i. An area within 8 meters of separators and heater treaters.
- ii. An area within a radius of at least 3 meters from the discharge of a release valve.
- iii. An area within a radius of at least 1.5 meters of the pit.
- iv. An area extending 8 meters vertically above and 16 meters horizontally in all directions from pumps handling flammable liquids and natural gas.
- v. An area surrounding a floating roof tank within 3 meters of the tank's end or roof and inside the enclosure up to the top level of the enclosure roll.

In Zone 1 hazardous areas, only intrinsically safe and flameproof electrical equipment should be used. In Zone 2 hazardous areas, only flameproof, increased safety, or pressurized electric apparatus and equipment should be used.

Sources of ignition

1. Electrical equipment can act as potential sources of ignition for flammable petroleum vapor mixtures through the generation of :
 - electric arcs, when current carrying contacts are separated or
 - electric sparks, which are produced when an electric current jumps across a gap between two conductors.
2. Stray electric currents can also contribute to ignition, originating from various sources such as :
 - high voltage overhead transmission lines

- electric welding machines
- vicinity of cathodically protected sources and pipelines and vessels

3. Static Electricity

I. Mechanism of charge generation (charge separation)

Examples of electrostatic generation are :

- a. Passage of liquid through pipes and filters ; e.g. during fuelling of vehicles and loading tanks
- b. Settling of solid particles in liquids as when rust and sludge particles settle in a tank.
- c. Static charging of particle-laden gas
- d. Generation of static charge on a person
- e. Static charging by induction
- f. Impingement of solids on solids, e.g. during sand blasting
- g. Bubbling of gas through liquid, as when air trapped in a liquid rises to the surface.

II. Mechanism of static discharge

Electric charges which accumulate on a body may

- i. be discharged harmlessly to earth or
- ii. be discharged harmlessly through a bonding connection which provides a path for the recombination of separate charges or
- iii. be discharged as a spark through the medium surrounding the charged body.

4. Lightning

Ignition incidents have occurred when vapours emanating from vents on tankers, mobile fuelling vehicles, and storage tanks were ignited by direct lightning strikes. However, these fires were usually promptly extinguished, as the fire zone was confined to the flammable vapours escaping from the vent.

5. Non-electrical sources of ignition

- i. Smoking
- ii. Internal combustion engines
- iii. Materials susceptible to spontaneous combustion
- iv. Frictional ignition

Electrical equipment used in hazardous areas must be certified by competent agencies such as the Flameproof and Equipment Safety Laboratory of CSIR-CIM-FR, Dhanbad, or Electronics Regional Test Laboratory

(ERTL) (East) Kolkata. Additionally, the equipment should be approved by the Directorate General of Mines and Safety (DGMS) for underground coal mines and the Petroleum and Explosives Safety Organization (PESO) for surface industries.

Electrical Equipment used in Oil and Gas industry

During oil and gas production, the following electrical equipment are commonly utilized :

1. Flameproof Motors

- All motors used in the oil and gas industry should be designed as flameproof and increased safety.
- Flameproof motors are specifically built with enhanced pressure sustaining strength compared to standard motors.
- The joint between the end shield and stator housing typically consists of a spigotted joint, ensuring a 12.5 mm flamepath and a maximum gap of 0.15 mm.
- Bolts connecting the end shield and stator housing are constructed with a field strength of 240 N/mm².
- The shaft and the inside or outside bearing cover (Floating Gland) form a flameproof joint.
- The floating gland and end shield form a floating joint.
- Terminal studs are designed with adequate creepage and clearance.
- The cover and terminal box body can be equipped with a flange joint, spigot joint, or threaded joint.
- In the case of a threaded joint, the direct axial length should be a minimum of 8 mm, with a requirement of engaging at least 5 full threads.
- Cable termination in the terminal box can be accomplished using either a double compression cable gland or a sealing box.
- The sealing box should be filled with cement (Epoxy) or a cold setting sealing compound.
- To ensure proper sealing, the sealing box typically includes two holes – one for filling the compound and the other for releasing air to prevent the formation of air bubbles.

Figure 1. illustrates a representative example of a flameproof motor.

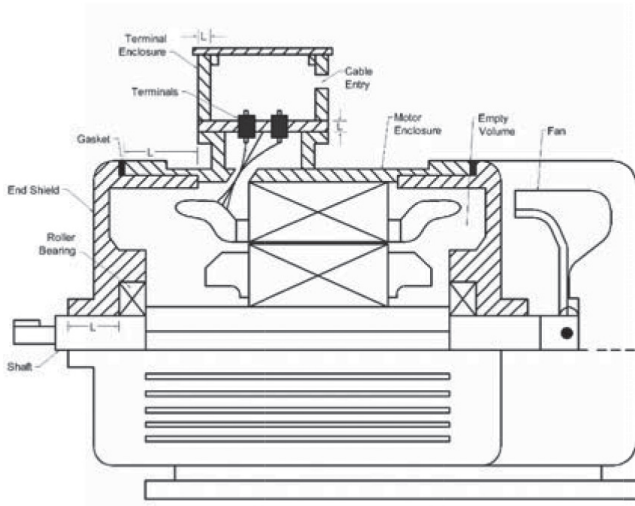


Figure 1. : Flameproof Motor Illustration

2. Flameproof Light-fittings

When it comes to flameproof light fittings, the following points should be considered :

- Flameproof light fittings are equipped with toughened glass for enhanced durability.
- The glass is secured using a glass retaining ring and fixed in place with cement or epoxy potting compound, providing a covering of at least 10 mm in length on three sides.
- Interconnecting wire nipples or bushings are utilized to pass wires between the glass enclosure and terminal enclosure, ensuring a sealed connection with epoxy.
- A wire guard is included to safeguard the glass component from any mechanical impacts.
- The wire guard should have a maximum mesh size of 50x50 mm².
- These lighting fittings are suitable for various lamp types such as metal halide (MH), CFL, etc., with the maximum ratings specified in the test certificate.

Figure 2. showcases a typical example of a flameproof light fitting.



Figure 2. : Illustration of a Flameproof Light Fitting

3. Flameproof Control Panels/Junction Boxes

Control panels and junction boxes are essential components as they play a vital role in operating various electrical equipment. They are utilized to regulate the power supply to motors, lighting fixtures, pumps, and other devices. Additionally, control panels or control gear boxes are equipped with features that enable the initiation or stoppage of power supply, indicating the ON / OFF status, and measuring electrical parameters such as voltage and current. Control panels and junction boxes should be flameproof to ensure the safety of electrical systems in potentially hazardous environments, preventing the risk of fire and explosions caused by electrical faults or external sources. A few examples of flameproof control panels and junction boxes are displayed in Figure 3.



Figure 3. : Flameproof Junction box/ Control panel

Key Tests for Flameproof Products

The following tests for flameproof products are essential to ensure their effectiveness in preventing flame transmission and maintaining high safety standards.

(i) Design Evaluation and Physical Examination

Flameproof or explosion-proof enclosures undergo crucial tests to ensure their effectiveness. These enclosures are designed to withstand internal pressure and prevent the transmission of flames from within to potentially explosive environments. Compliance with the IEC60079-1 : 2014 code is vital, particularly in relation to the flamepath and gaps between metal-to-metal and metal-to-non-metal components. The code strictly prohibits non-metal-to-non-metal flamepaths.

For external connections, indirect methods are preferred, typically through an integral or non-integral terminal box. Cable entry devices, such as compression-type cable glands, must be independently explosion-proof. It is crucial to prevent flame transmission through gaps between non-metallic cable sheaths and compression neoprene rings.

Glass windows and covers should be toughened and securely sealed to the metal housing, effectively

preventing flame passage. Individual housing for each apparatus should be flameproof, ensuring that explosions cannot propagate between enclosures through cable entry devices.

(ii) Determination of Explosion Pressure : Explosion Pressure Test

The tests (refer to Figure 4.) involve igniting the explosive gas mixture within the flameproof enclosure and measuring the maximum pressure using a piezoelectric pressure transducer. This maximum pressure, known as the reference pressure, determines the enclosure's mechanical integrity. The test requires moving the pressure sensor and spark plug five times to ensure thorough assessment. The reference pressure is influenced by various factors such as air humidity, ignition source orientation, spark energy, gas release through gaps, and internal enclosure contents. Due to expected variations in these parameters, the standard mandates conducting the test five times and considering the highest value as the reference pressure.

This particular test holds immense importance in evaluating the mechanical integrity of the system or enclosure. Factors like humidity, ignition source orientation, and spark energy influence results, necessitating multiple tests for accurate reference pressure determination.

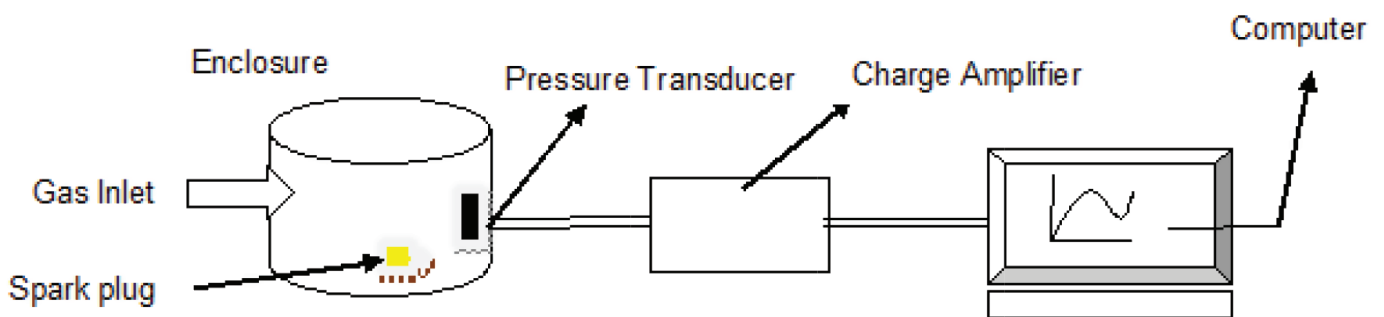
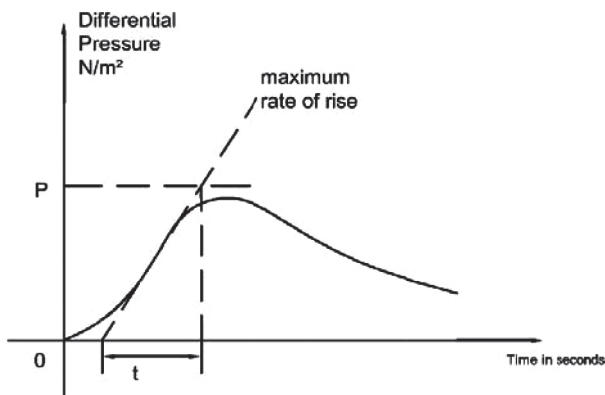


Figure 4. : The dynamic explosion pressure recording system

Figure 5. illustrates the dynamic pressure variation over time, providing a visual representation of how the pressure changes throughout a specific period.



P= Maximum explosion pressure
t= Pressure rise time

Figure 5. : Dynamic pressure variation over time

(iii) Non-Transmission of an internal ignition

In the non-transmission of internal ignition test, a flameproof enclosure is surrounded within a polythene bag along with the same flammable mixture. The flammable mixture inside the enclosure is ignited, and the test is deemed successful if no flame or combustible product escapes into the outer explosive atmosphere. Additionally, the mixture within the polythene bag is intentionally ignited to evaluate its conformity. This test is conducted to assess the design effectiveness of flameproof products.

(iv) Static over pressure test

To ensure proper testing, the enclosure must undergo a static pressure test. This test requires applying pressure equal to 1.5 times the reference pressure or a maximum of 3.5 bar, whichever is higher. For the mentioned terminal enclosure, a minimum duration of 10 seconds with a static overpressure of 8 bar is required during testing. The static pressure test offers advantages such as verifying the enclosure's ability to withstand high pressures and ensuring its integrity, thereby enhancing safety and minimizing risks of failure.

Precautions during Maintenance and Repair

The following precautions during maintenance and

repair are necessary to ensure the safety and effectiveness of the work :

- (i) When performing any maintenance, repair, or testing on electrical equipment within a hazardous zone, it is necessary to obtain a written work permit from the responsible engineer in charge of the installation. The permit should outline the precautions to be followed and the procedures to be adhered to during the work. Once the tasks are completed, the permit must be returned to the issuing authority.
- (ii) When excavation work is involved, it is important to take sufficient precautions to prevent damage to underground oil, gas pipelines, water pipelines, and telecommunication cables. Additionally, it is crucial to ensure that the excavation does not hinder the access of fire tenders to the work site in case of an emergency.
- (iii) Prior to commencing any electrical repairs, it is essential to verify that the electrical supply line has been de-energized. Effective measures should be taken to prevent accidental re-energization of the electrical supply line.
- (iv) If a megger is utilized to test the insulation of a cable from the supply end, it is necessary to maintain the integrity of the covers on the flameproof equipment until the test is completed. Only an intrinsically safe megger should be used for this purpose.
- (v) When dealing with electrical circuits containing solid-state equipment, megger tests should not be conducted.
- (vi) If a blow-lamp is to be used, it is important to ensure that the area is free from gas. Tests should be conducted using an approved instrument or explosimeter to measure the concentration of flammable gas in the atmosphere.
- (vii) Adequate provisions for fire fighting should be made available. It is imperative that individuals involved in electrical repair work are knowledgeable about the proper use of fire extinguishers.
- (viii) For overhead transmission lines, it is crucial to maintain the specified minimum safe clearance

between the ground level and the electrical transmission line as outlined below in Table 1. :

Table 1. : Safe clearance for overhead electrical transmission lines

Voltage of transmission line	Minimum safe clearance above ground in meters
Low and medium	5.79 m
High	5.96 m
Extra high	5.96+0.3 m for every 33 KV or part there of

(ix) The resistance of the earthing path to earth should be regularly checked and recorded for pressure vessels, storage tanks, electrical equipment (such as pumps, motors, generators, engines), and lightning arresters used for lightning discharges. The resistance should be low, not exceeding 7 ohms, and the path should be short and direct.

Conclusions

The following vital safety measures and maintenance practices is essential for ensuring the efficient and safe operations :

- 1) The design of electrical equipment should not be altered in any way, as certified by a testing house.
- 2) Flanges should be cleaned and reassembled to maintain the specified air gap in the flange joint, which should be verified.
- 3) All bolts and studs should be in place, and broken studs must be promptly replaced.
- 4) Terminal boxes should be dry, free from dust and moisture, and filled completely with compound if applicable.

- 5) Shaft glands should have the recommended clearance, which needs to be checked.
- 6) Oil-immersed apparatus should have oil filled up to the specified level.
- 7) Glass fittings should be intact with retaining rings.
- 8) Overload and earth leakage relays should be correctly set.
- 9) A maintenance schedule should be established for flameproof and other specialized electrical equipment. Electricians and their assistants should receive training in proper maintenance techniques.

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