Proceedings of

112th Annual General Meeting (AGM) of MGMI for the Year 2017-18

Preceded by National Seminar on

Management of Excavation Stability MES-2018

PREAMBLE

The Mining, Geological and Metallurgical Institute of India (MGMI), founded on 16th January 1906, had its 112th Annual General Meeting on the 29th September, 2018 at Biswa Bangla Convention Centre, Action Area-1, New Town, and Kolkata - 700156. The AGM was preceded by National Seminar (MES-2018) on *"Management of Excavation Stability"* from 11.30 A.M. to 16.00 P.M. About 150 mining engineers, geoscientists and technologists attended the seminar aimed at to bring at hand R & D and other technologies, available in different domains of rock-slope engineering, strata control, and underground excavation engineering, besides documenting fundamentals of excavation designs and management. Indian and overseas case studies of excavation management were, in particular, invited. In addition, the following topics were deliberated upon to achieve the seminar objectives:

- Principles and practices of robust slope design, including numerical modeling and back analysis.
- Maintenance of stable slopes, using operational measures such as controlled blasting, depressurization of pit walls and ground strengthening techniques with cable bolting, pressure grouting, etc.
- Modern techniques for monitoring slope stability, including slope stability radars.
- Design and analysis of ground stability in underground mines, including numerical modeling and back analyses.
- Ground stabilization and management of ground stresses.
- Monitoring the stability of underground excavations through appropriate instrumentation.
- Development of dashboards and Trigger Action Response Plans for limiting the effect of excavation failure.

SEMINAR INAUGURATION

The inaugural session of the seminar had its beginning point with the pronouncement of words of welcome by the anchor, and requesting VIPs to take their seats on the dais. Each one then was presented with bouquet of seasonal flowers. The dignitaries subsequently lighted the auspicious lamp with electronic switch to seek blessings of the Divine for the success of the programme. Dr. N.K. Nanda, President MGMI & Director (Technical), NMDC, welcomed the dignitaries and the seminar attendees. In his welcome address, the President thanked the Chief Guest and the President-elect and other participants for having spared their valuable time for the national seminar and the AGM. He briefly talked about the MGMI activities and the vast and varieties of expertise it has of talent, in central disciplines of its members' qualifications. Importance of the topic of the seminar was duly highlighted.

The Inauguration: Dr. L.J. Lorig, Former CEO of Itasca International, Inc., USA, addressing the National Seminar assembly on "Theme exposition". Others sitting on the dais (L to R) are: Shri Rajiw Lochan, Hony. Secretary, MGMI; Dr. N.K. Nanda, President, MGMI & Director (Technical), NMDC; Shri P.K. Sarkar, Chief Guest & Director General, Directorate General Mines Safey; Shri Anil Kumar Jha, President-Elect, MGMI and CMD, CIL; Shri Binay Dayal, Chairman (MES-2018); and Shri P.R. Prasad, Convenor (MES-2018), GM(PAD), CIL.

Supplementing to the importance of the topic seminar, the seminar Chairman & Director (Technical), CIL, Shri Binay Dayal covered a wide field, part of which has been slated in the preamble. Added to his speech had been the data on domestic coal production, especially by CIL. He informed about the enormity of domestic production of coal of 700 Mt (million tonnes) alongwith nearly about 1000 m3 to 2000 m3 of overburden, and wondered regarding its difficult and demanding management, which would present really a huge problem in the years to come before the mining engineers & geo-technologists engaged in coal production. Attached to this would be the problems of handling slope stability for the control of which innovative geo-technical expertise would be needed. Speaking briefly on the occasion, Dr. Loren J. Lorig, Sr. Geoconsultant Expert, USA, expressed his thanks to the organisers and said that he was happy to take part in the S & T programme of the seminar, where he would present a paper on *"Five Things you should know*

about slope stability". He also conveyed his happiness over the switching on of *"Lighting the auspicious lamp"* by electronic device.

Seeking Divine Blessings: Dignitaries lighting the auspicious lamp (L to R): Shri P.R. Prasad, Shri Binay Dayal, Dr. N.K. Nanda, Shri P.K. Sarkar, Shri Anil Kumar Jha, Shri Rajiv Lochan.

The anchor then requested Shri Praveen Ranjan Prasad, Convenor, National Seminar, to introduce Shri A.K. Jha, the invited guest and the doyen of Indian coal industry. In his introductory address, Shri Prasad described Mr. Jha as a mining engineering of extraordinary capabilities in mining and mine management.

Mr. Jha is a M. Tech graduate in Mine Planning and Design of 1983 batch from Indian School of Mines (ISM) – now IIT (ISM) with distinction. He combines a rich and long experience of three-and-a-half decades in mine planning, production, management and technical controls of underground and open cast coal mines. Initially in CMPDI for 14 years, he came over to CIL in 1983 as Junior Executive (Trainee) of the Central Coalfields Ltd. (CCL). He also worked in Manganese Ore of India Ltd. (MOIL), a big mining company, as Director (Production & Planning) discharging various responsibilities. Mr. Jha took over charge of the post of Chairman of Coal India Ltd. (CIL) on May 18, 2018. Shri Prasad exuded confidence on behalf of the office-bearers that his coming as President of the Institute will record a new history of progress in the development of technologies in the three intrinsic fields of the Institute and service to mining industry.

Shri Anil Kumar Jha addressing the assembly.

Shri A.K. Jha then spoke masterly exuding confidence on coal production and future needs of India. He also commended the organizers of the seminar for choosing the topic, the positivities of which are so-much-needed for mine development. At the outset, he observed that in contrast to media reports that the country was facing shortage of coal, he felt otherwise, adding that CIL's infrastructure is optimum and coal production is going up year after year. This year's target is 562 Mt and planned to achieve the target of 1000 Mt by 2025. He pointed out that condition of coal industry is much better in comparison to other mineral sector companies, that are non-coal sectors, and therefore, exploration activities needed boosting.

He said that MGMI, as an Institute of repute for experts in geosciences, mining and metallurgy is not fully engaged in the execution of its responsibilities towards development of the concerned disciplines, dissemination of updated knowledge, and discharge social obligation towards the fraternities. *"The Institute must move ahead to develop more intimate relationships with its members"*, he stressed.

In his message, he also emphasized on building awareness on mine excavation management and its social aspects, which have come to limelight many fold in recent years. He wished that MGMI in co-cooperation with CIL should take requisite measures in this regard.

Concluding, Shri Jha hoped that this National Seminar will present current National and International practices in design, analysis and monitoring of excavation stability for improving safety and economics of mining in coal and metal mines in India.

Experiences of senior international geotechnical expert like Dr Loren J. Lorig, case study of NCL, and experience of other speakers should benefit delegates and the industry as a whole. He wished all success to the seminar which is going to address most important aspects of today's mining industry.

Chief Guest P.K. Sarkar addressing the assembly on Inaugural Address.

Ascending over the programme, Chief Guest Shri P.K. Sarkar was introduced by Ranajit Talapatra, Hony. Joint Secretary, MGMI.

In his illuminating address, Shri P.K. Sarkar first expressed his happiness over the opportunity that he got to be with so many stalwarts associated with the Indian mining & mineral industry, and has also opportune occasion to share concern of DGMS and seek help and support from the seminar participants to improve safety & well-being of mine workers. The theme of the seminar, he affirmed, is rightly chosen and he also eulogized the Mining Geological and Metallurgical Institute of India, the 112-year old Institute, special and highly performing Institute in India, and has maintained global recognition being in the forefront of disseminating knowledge and innovating development in all areas of earth sciences.

Referring to the seminar theme, he said, **"Management of Excavation Stability"** is very relevant, particularly under ever increasing scale of current mining operations." Moreover, he further said. "Contribution of Mining industry to the GDP is to the tune of 2.2% to 2.5 %,but going by the GDP of the total industrial sector, it contributes around 10% to 11%. Economists across the world foresee India's GDP volume to the tune of 5 trillion dollar (about rupees 350 lakh crores) by 2025 from current levels of Rs. 2.59 trillion US Dollar (about Rs. 182 lakh crores). To achieve GDP volume of 5 trillion dollar by 2025 contribution of mining industry must increase exponentially. To share its responsibility towards such growth and energy security of the nation, Coal India has set up an ambitious target of 1 billion tonne coal production by the year 2025." As opencast mining shall continue to be the primary method of mining, achieving 1 billion tonne of coal production, we shall require excavating about 3 billion cu.m of over burden (considering average Stripping Ratio (SR) of 3). If we consider other mining sectors, e.g. iron ore, limestone, bauxite, etc., the volume of earth to be excavated will further increase. Excavation of such volumes will pose large-scale problems related to stability of benches, high walls, overburden dumps, underground openings, etc. Adoption of technology, sharing experiences and R & D work in the field of strata stability, ground control, mine design, etc., may be of great help to counter these challenges. Organizing such a seminar, as that of today, provides a very good platform to find way forward.

Mine design is greatly challenging task, and mine operators must ensure that through the meticulous application of sound geotechnical engineering practices, safe open pit mine slopes are designed and maintained in any geological environment in which mine is being operated. Important factors to be considered for maintaining effective ground control (safe working conditions) include:

- Strength of rock,
- Geological structure,
- Presence of water – Surface water (including extreme rainfall events) and groundwater,
- Slope geometry,
- Potential weakening of strata due to heavy blasts, poor blasting or excavation practices,
- Presence of nearby underground mine voids,
- Vibration due to blasting and seismic events,
- In-situ or mining-induced stresses, and
- Time dependent deterioration of rock/soil materials.

These factors should be considered in detail while designing mine by making geological investigations (detailed exploration), using knowledge of geotechnical engineering and computer software.

In any mine, unstable strata can have many ramifications, including:

- **Safety factors:** Loss of life or injury to persons working in the mine and living in nearby areas.
- **Economic factors:** Disruption of operations, loss of property, loss of equipment & cost of restoration.
- **Environmental factors:** Failure mine waste dumps can cause stoppage of natural flow of water bodies, block natural drainage system and contaminate water.
- **Social factors:** Loss of worker's income, loss of worker's confidence, loss of corporate credibility and increased legal liability.

Planning & designing of a mine is done with available data, obtained from exploration, which has got its own limitation. While doing actual mining operation, new geological information are obtained, which should be used to modify the mine operations dynamically on day-to-day basis.

A very good Safety Management Plan (SMP), based on risk management principles, should be prepared and implemented to counter potential dangers to men and machine. Principal Hazard Management Plan incorporating Trigger Action Response Plan (TARP) should, too, be prepared, using all the available information, technology and expertise involving all the stakeholders. Preparation and implementation of effective SMP will considerably reduce losses due to potential slope/ ground failure.

"I hope this National Seminar will bring up current National and International practices in design, analysis, and monitoring of excavation stability for improving safety and economics of mining of coal and metal in India", Mr. Sarkar wished.

Experiences of senior international geotechnical expert like Dr. Loren J. Lorig, Case Study of NCL and experience of other speakers will certainly benefit delegates and the mining industry as a whole.

"I wish the seminar all the success which hopefully will address the most important aspects of today's mining industry", he concluded.

As an adjunct to his address, Shri Sarkar gave useful informational data on national mining scenario. Considering its usefulness to experts in mining and mine-owners. Same is reproduced below:

a) In Coal mines - (2015-17)

- In BG coal mines 20 % fatal accidents were caused by fall of roof.
- BG + OC together 19% accident are caused by fall of roof & side.

b) Metal mines

- In BG metal mines 43 % fatal accidents are caused by fall of roof.
- BG +OC together 20% accident are caused by fall of roof & side.

(c) Coal OC-Major accident fatalities 4+

Period (1997 - 2017)-21yrs

Total fatalities in OC- 688

[OC = Opencast; UG = Underground]

– due to excavation instability in OC-123 fatalities occurred which were caused by 85 accidents. This is 18 % of total fatalities. Out of 85 accidents, 3 (three) were major accidents (3+ fatalities) which is 3.5% of 85 , but these 3.5% accidents caused 38 fatalities out of 123 which is 31% of fatalities caused by excavation instability

He felt seminar topic very much relevant and in demand of the time too.

- Considering the growth of open pit mining which has put a challenge of ensuring excavation stability as we go deeper, on the strength of gigantic earth moving machine and technological improvement.
- Accident figures highlights the importance to prevent major failure of bench and dump in order to achieve better safety standards in open pit mining.

In case of excavation failure, causes of accidents are known and so can be prevented by

(a) Proper design of exaction at the planning stage,

(b) Subsequent planning during working,

(c) Proper monitoring of bench and dump stability,

(d) Avoiding whimsical and unscientific approach to produce more deviating from design and planning criteria and systematic way of working.

Root cause of major accidents are, however, organizational factors which generally lie with top leadership. He advised that we need to inculcate a culture to adhere to logic and technical requirements of an operation. Suggestion came from the Chief Guest as:

"Making a bench which is steeper than designed one, may give more production in last quarter a FY but the production will slow down in 1st quarter in next FY. We all understand that there is no real benefit but there is risk due pressure from top to do more production, compromising safety during the last quarter. (ex NLC Analysis)"

In view of what has been said above, "we need to inculcate a scientific temper in us to progress in a sustainable way for the sake of the country and society, avoiding the harmful tendency of satisfying individual wellbeing and ambition over country's wellbeing." He subsequently informed **"What DGMS is doing?"** DGMS is working to ease from requirements of the various permission/approval by replacing them with standards wherever possible, as a step towards self-regulation.

We are working to include rescue recovery of OC in rescue rules.

As training and education plays important role to achieve production and safety , amendment of MVTR is under consideration at GOVT level. Many changes have been proposed to make it an effective instrument to give life to the present VT Rule by bringing dynamism and talent in training matter.

He said, "DGMS has opened up to the requirement of industry and ready to review the existing standards and policies for the overall benefit of mining and the country.

In our efforts to do so, DGMS wish to work as a team for the well-being of the society, and I seek your co-operation in our efforts."

[OC = Opencast, MVTR = Mine Vocational Training Rule]

(From L to R: Shri Rajiw Lochan, Hony. Secy, MGMI; Dr N K Nanda, President MGMI & Director (Tech), NMDC; Shri P K Sarkar, Director General, Directorate General of Mines Safety; Shri Anil Kumar Jha, Chairman, Coal India Ltd; Shri Binay Dayal, Director (Tech), Coal India Ltd; Shri Praveen Ranjan Prasad, GM & Convenor MES 2018).

The pre-seminar Proceedings Volume, MES-2018, was released by the dignitaries and they were then facilitated with the presentation of mementoes. The inaugural session concluded with vote of thanks by Shri Rajiw Lochan, Secretary, and MGMI to all concerned with the programme. All the attendees were then invited for a fellowship at tea and refreshments.

TECHNICAL SESSION

After tea intermission, the programme of the technical session was set in motion by the announcement of the anchor followed by a brief introductory address from the dais by the Chairman of the session, Prof. (Dr.) O.P. Varma, Executive President, Indian Geological Congress, with Shri Praveen Kumar Prasad on his left as Rapporteur. Prof. Varma thanked the Council MGMI for inviting him to Chair the Session. Fondly recollecting his past association with MGMI Council and other activities, he exulted great happiness that he was here again with so many members of the Institute, including largely pupils of ISM – the Institution which he has served devotedly in professional life and with which he still continues with intimate relationships.

Before calling the first speaker, Prof. O.P. Varma lovingly remembered the rapporteur, Praveen Ranjan Prasad, since his birth and who with due respectful Indian traditions received him at the entrance of the Biswa Bangla Convention Centre. Shri P.R. Prasad was presented to the audience as Rapporteur. He then laid down road-map in brief for paper contributors – placing 25 mts for presentation & 5 mts for interaction with other seminar delegates – Prof. Varma invited the first speaker Dr. Loren J. Lorig of Itasca International, Inc., USA, to come on the dais to take his seat (Fig.). Welcoming to Dr. Lorig, Chairman said that you are our prime host and we are all eager to listen to the five features that can help maintain excavation stability at mines. In your expertise, you are globally famed geotechnical engineer with working experience of nearly 3½ decades. You are also one of the few experts in numerical models to give solution to stability supports to mining methods. We value much your knowledge and extensive experience in the subject of excavation stability in open cast mines and their transition into underground cave mining. With these words of welcome and his introduction to the assembled delegates, Prof. Varma asked him to present his paper on *"Five Things you should know about slope stability"*.

His primary stress was on slope stability, and in his view modern day mining requires optimization of pit slopes to ensure that the slopes are stable and economic to mine. Inasmuch as several methods are available to help design and monitor the stability of the slope, there are five major aspects that geotechnical engineers should know when they are involved in slope stability studies, namely:

1. Collection of appropriate data from the project site and the challenges of sampling bias,
2. Problems coupled with using average values in the design of excavations,
3. Impacts of extreme natural events on ground stability,
4. Importance of design validation and future trends in slope design, and
5. Analysis and monitoring for enhanced security of personnel and resources.

He also dwelt upon the case histories which justified the impact of each on these items. On completion of the presentation, the paper was open for interaction. The paper evinced good interaction from the Indian managers. Only the abstract of his paper is printed on page 1 of the pre-Seminar volume, published by MGMI.

Second paper titled *"Successful Remediation of a Destabilized Pit Slope & Keeping it Productive for Another 4 Years: A Unique Experience"* was presented by Dr. P.K. Rajmeny, formerly Advisor to Itasca, ABGM (South Africa), and currently, Advisor (Geotechnical), HZL Ltd., which he joined in 1979. "He has rendered unusually valuable services in HZL, reckoned as mass blasts in underground mines, and using geotechniques helped control back breaks of production blasts", the Chairman said adding that is the recipient of the coveted National Geoscience Award-2009.

A case history of an open pit mine was discussed in the third listed paper, entitled *"Case study: Strategic recovery & management of coal face after major dump deformation at Khadia (NCL)"*, jointly authored by P.K. Sinha, M.K. Prasad, Suman Saurabh and Manish Kumar – all officers working in NCL. The paper was presented by M.K. Prasad, General Manager, Khadia Project, NCL.

M.K. Prasad began his presentation with the well-known observation that large opencast mines are associated with handling of voluminous quantity of overburden. At such mines, deployment of dragline and shovel dumper combination requires appropriate planning for dump accommodation and coal extraction, with due consideration to safety hazards regarding dump failures, apart from other statutory provisions.

Turning spotlight on working at Khadia OCP – one of the oldest in Singrauli Coalfields – method of work adopted is dragline-cum-shovel-dumper combination of mining. The mine has developed in three sectors – Central, Western & Eastern – with total strike length at 3.8-4 km.

At such a huge OCP, study of mine-wise specific conditions and use of advance instrumentation for survey and monitoring has become an important aspect of mine operation. Dealt with in the paper is a case study of dump deformation at the project and the method adopted for safe recovery of coal face. The authors offered a positive message by having faced the risk of slope instability in dragline dumps; a dedicated geotechnical cell was formed to improve the factor of safety of such dumps, while considering the profitability of the mine.

Presenting a useful case study, the authors suggested that large mechanized mines entail a comprehensive planning, taking into consideration results of different case studies of mines of similar mining conditions. As groundwater at dump sites always poses a threat of dump slide, precautionary measures for water logging at dump bases are mandatory. A study of dump profile for stability should always be continually adopted. Full paper can be read on pages 11-26 of the pre-Seminar Volume.

Symbolizing wonder of the world, a very spectacular paper from non-mining sector on *"Assessment of global slope stability of left and right banks of Chenab bridge by 3 DEC"*, authored jointly by Varun, B. Damjanac, L. Lorig, J. Aglawe and R.R. Mallick came up next for presentation by J. Aglawe. The assembled delegates were first informed that the design and construction of Chenab River Bridge, under discussion, is a part of Udhampur-Srinagar-Baramulla rail link (USBRL) project in the State of J & K (India). It's an extremely challenging engineering feat. When complete, it would be at 359 m above the river valley with highest bridge deck and the seventh longest arch span (main spam 467 m) for any bridge in the world. The bridge spans the Chenab river in the valley with very steep slopes, generally of good quality but highly fractured rock-mass.

Adding the speaker focused evaluation of slope stability and deformation for both the left bank and the right bank abutments under static loading conditions, using 3 DEC software (Three-dimensional Distinct Element Code Itasca. 2013). The 3 DEC, he said, stimulates the response of discontinuous media, such as jointed or fractured rock-mass, that is subject to either static or dynamic loading. 3 DEC is unique in its capability to explicit representation of a number of discontinuities that are expected to have critical effect on both deformation and stability for Chenab bridge abutment.

The speaker then elaborated the steps for carrying out the discontinue analysis, including development of a representative discrete fracture network model using information on geometrical and spatial characteristics of joint sets, obtained from the site characterization programme; use of a ubiquitous joint model to represent the strength anisotropy and calibration of such a model using numerical tests; evaluation of abutment stability and deformation without support; and finally evaluation of performance of support measures.

The completion of this paper signalled to lunch time. All the attendees were invited for a luncheon in a side hall. On being back from lunch hour, the session continued for two more papers. The Chairman, however, digressed for a while to greet Shri L.K. Bose and Smt. Bose. He walked to their seats & hugged to express real joy on their coming to the meeting. Shri L.K. Bose, Mining Engineering graduate from ISM, is a doyen of mining industry backed by nearly four decades of professional experience in planning and design of large open cast and underground mines, coal mines in particular. A versatile genius having shared a number of responsibilities as mining expert. He enrolled as member of the Institute in 1983 and also served as its Secretary from 1995-96.

To resume the technical session after lunch, Chairman called upon Srikant Annavarapu, Technical Advisor, Itasca India Consulting Pvt. Ltd., based in Nagpur, to read his paper on *"Development of a geotechnical trigger-action response plan for underground mines"*. Eulogizing achievements of Dr. Annavarapu, former Associate Professor, Department of Mining Engineering of IIT Kharagpur, Chairman said that the author has a wide range of expertise in underground mine geotechnical engineering, mine planning and mine design of several block cave mines around the world, viz. USA and Indonesia. He has taught underground metal mine design courses and mineral economics at IIT Kharagpur. After serving IIT, he has opened his consulting firm in Chennai With these laudable remarks of the Chairman, Dr. S. Annavarapu spoke convincingly on the Trigger Action Response Plans, carried out from the data obtained from geotechnical instruments monitoring the ground response. He said that the technique can help reduce the response time to the ground reaction so that appropriate operating and/or geotechnical measures could be undertaken to address the changes in the ground conditions in mining activity. "Lately, growing attempts are noted to enhance the monitoring of the stability of critical excavations and initiation of suitable Trigger Alert Response Plans (TARP) to assist in addressing geotechnical issues so that necessary remediation could be started early", he viewed.

The development of TARP systems will help reduce the response time for handling geotechnical events so that personnel and critical equipment and excavations are not compromised due to inaction, or, delayed action. A system of geotechnical auditing and ground response analysis will also help in the development of improved excavation and support design. The components of a typical TARP system and how the current systems are described of excavation stability monitoring can be integrated into the system to help improve safety in the mines. The development of a preliminary TARP system in a block cave mine in Indonesia was also presented. (Full text appears on pp. 22-30 of the pre-Seminar Vol.).

The last paper of the technical session – a joint contribution of five authors – on *"Effective and cost-effective slope monitoring potential through application of 3D terrestrial laser scanner in Indian surface mines"* was presented by J.K. Singh, a graduate of 1985 in Mining Engineering from Indian Institute of Technology, IIT Kharagpur. After graduation, he served Tata Steel Collieries Division as mining engineer from 1985 to 1987. Thereafter, he came over as a scientist to CSIR-CIMFR, Dhanbad, to work on problems, related to geotechnical engineering and slope stability in surface and underground mines.

The paper, jointly authored by J.K. Singh, V.K. Singh, Ajit Kumar, S.K. Roy and Ritesh Kumar, was presented by the first author. Striking a note that gradually increasing depths of open cast mines reduce safety of men and machines and bring in greater chances of mine slope failures with possible stoppage of working, thereby causing loss of production, and decrease in workers' morale, and other setbacks. To overcome mine slope failure, though available monitoring technology using radars is effective, cost of procurement & maintenance make it prohibitive. The advent of 3D Terrestrial Laser Scanners (TLS) with almost 1/5th the cost of slope monitoring by radar, coupled with sophisticated monitoring software, provide a possible, effective and cost effective monitoring solution for both periodical and continuous slope monitoring applications. In addition, the TLS provides high density point clad data for 3D mine surface modeling and excavation volume computations precisely and rapidly. The paper on the whole summarizes the monitoring and mine modeling aspects of 3D TLS for ensuring safety of high-wall and dump slopes.

The Chairman, in concluding remarks, elaborated on *"Geological information system, the only key to management of evacuation stability"* and said that the process of evacuation is used for various activities, but evacuations in mines are of different kinds and for specific needs, that is to win valuable minerals & mineral materials from the ground with safety. In mines, rock-envelopes are of host rock/wall rocks that may be stable, or stable, and they are of countless varieties, that makes each and every mining project geologically & geotechnical different. In homogeneous rocks removal of minerals may, however, be easy, and in inhomogeneous ones, on the other hand, the process may present problems. The host rock, originally simple & hard, may turn to become rogue (weak) due to modification in several ways – alteration, stresses, igneous activity, earthquakes, landslides, shearing, etc. Therefore, decipherment of full knowledge of geology of the bedrock is essential to aid excavation

stability. One must go to Geological Information System to be established for each mine, inclusive of data on geological setting (structural & tectonics included), geo-engineering, geo-hydrological, geo-chemical & mineralization characteristics. Apart from geological data, second prime factor to manage excavation stability is the human resource that must be technologically sound, healthy, and rough & ready to face the situations at mines. He further said, "May be in due course robots are used to make the operation entirely automated, but even robots need a manager". In his last word, the Chairman, once again, emphasized that bedrock geology investigations are the crucial factors to devise technology to check excavation stability. Acclaiming role of mining, economic growth cannot take place without mineral raw-materials, and modern civilization cannot be sustained and improved unless mining of minerals continues, but today's need is that it must be green, clean and sustainable.

Presentation of papers was followed by a brief session on technical discussion and collection & compilation of recommendations from the seminar participants, invited experts and Sr. members of MGMI, who had graced the occasion. In his introductory remarks chairman said that outcome of the debate may not be restricted to mere achievements of objectives scripted on papers to be read only by participating scientists, technologists & engineers alone, but it should outreach to the mining industry as a whole, also to Govt. of India & State governments.

Stressing the point that excavations have to be made for mining minerals and excavations have to be stable, but on the other hand, they may turn out to be unstable. It's for these unstable excavations that the solution has to be found out. The recommendations of this seminar, hopefully, will fulfil the vacuum due to not having handy curative technology for unsafe excavations. Question-answer session followed and it emphatically pointed out that there is a need for sensitization of the mining industry on "maintenance of excavation stability". To achieve these objective following recommendations were made:

- First and foremost pertains to Geotechnical Information System (GIS) that must be developed with appropriate components. A core group to be constituted by MGMI in consultation with leading mining experts and geosciences associations experts to prepare outlines of such a system.
- The Seminar noted that surface and underground mines are expected to become more challenging and excavation stability problems to become more complex in the years to come. It is thus essential to manage stability of mining excavations to help improve safety and economics of the mines, maintaining green mining methods.
- New methods of design, analysis and monitoring should be developed and integrated into the mine designs and operations. Available tools and processes, including numerical modeling of geotechnical issues, should be introduced in mine-design processes and necessary skills be innovated for maintaining stability of the excavations.
- Modern instrumentation should also be installed in mines to help improve understanding of rock-mass response to excavation in rock as well as that in soil. Data from such instrumentation program should be integrated with mine operations for better scheduling and planning.
- Suitable processes for back analysis of geotechnical responses be developed and used in the monitoring of excavation stability. Development of Trigger Action Response Plans and live numerical models can assist in improving safety and economics of mining operations.
- Steps should be taken to collect appropriate levels of geotechnical data for understanding the rock response and adopt best global practices in the management of excavation stability.

Wrapping up the programme of S & T Session, the chairman expressed his delight for the calm & quiet hospital environment during the session. He also conveyed hearty congratulations to the organizers for having arranged one-day seminar on the vital and thematic topic. Thanks were also given to the paper contributors, rapporteur, and all others who helped the session to signify exemplary objective achiever.

Felicitations to the Speakers by Prof (Dr) OP Varma

Dr. Loren J. Lorig

Dr. P K. Rajmeny

Shri M K Prasad

Dr. Srikant Annavarapu

Shri PR Prasad

Shri Suman Saurabh

60th Holland Memorial Lecture

at

Biswa Bangla Convention Centre

Newtown, Kolkata

on

29th September 2018

by

Dr Kirit Shantilal Parikh

Chairman, Integrated Research and Action for Development (IRADe)

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60th Holland Memorial Lecture

The 60th Holland Memorial Lecture by Dr. Kirit Shantilal Parikh, Chairman, Integrated Research and Action for Development (IRADe), scheduled to be delivered from 16.00-17.30 hrs, unfortunately couldn't be delivered owing to sudden & serious illness of the speaker. Copies of the lecture were made available to the attendees for perusal & record; all were, however, greatly disappointed by his personal absence. The compiler of the report finds all steps of his professional career self-illuminating, highly acclaimed, celebrated and illustrious. He is eminent expert on energy policy & economics – known at home and abroad. We all really missed him so much.

The lecture titled *"Future Coal in Power Generation"* is largely based on the final report of the study by IRADe for the Global Technology Watch Group, set up by the Department of Science & Technology, Coal Road Map for India (2018). Although the lecture write-up is replete with reliable data on various topics such as *'India's hydrocarbon reserves', 'Role of clean coal technologies in controlling local air pollution', 'Role of CCS in controlling CO_2 emissions', 'Power generation scenario'*, and several other related issues, very pertinently useful for scientists, engineers, and researchers. It couldn't be reproduced in these pages for reasons of academic ethics, but on having no-objection from MGMI; the IGC will welcome its publication in IGC Journal's next issue for wider publicity and usefulness. Gist of the lecture, nevertheless, is given below:

Coal faces severe challenges from environmental considerations. Local air pollution, emission of CO_2 and even land degradation due to mining, all call for reduced use of coal. Major use of coal in India is for power plants. Dramatic reduction in cost of solar power and battery technology, expected by many, might make coal power generation economically less attractive. In the lecture write-up, these issues are well discussed along with some scenario for future use of coal in power generation.

Future of Coal in Power Generation*

Dr Kirit Shantilal Parikh

I am honoured to have been invited to give Holland Memorial Lecture and join the ranks of many illustrious persons who have given this lecture before.

Indians have an ambivalent attitude about the legacy of British rule in India. The railways and the steel frame helped unite India, though many feel that the steel frame is too rigid and has kept us backward. They created many research and development institutions, which helped India in its industrial and technical growth. Among these is the one created by Sir T H Holland, Mining, Geological and Metallurgical Institute of India (MGMI).

On the other hand, India was one of the richest countries of the world when Robert Clive landed in India and one of the poorest when India became independent. The worst part was that the British rule created among Indians a sense of diffidence. However, there were many Britishers who nurtured a sense of inquiry and scientific attitude among Indians and we must be grateful Britishers like Sir T H Holland for their contribution to India's scientific development.

Coal in India's Economy

Coal has been the major energy resource of India. India is short of oil and gas but coal reserves are relatively abundant. Coal has been the mainstay of our energy use. Table 1 shows the energy resources of India.

Table 1: India's Hydrocarbon Reserves

Resources	Unit	Proved	Inferred	Indicated	Production in 2016-17	Net Imports in 2016-17	Reserve/ Production Ratio	
		(P)	(I)		(Q)	(M)	P/Q	(P+I) / Q
Coal (as on 31.03.2017)	Mtoe	58655	13440	57113				
Extractable Coal**	Mtoe	20882	6860-12685		271.7	77.6	77	102-123
Lignite (as on 31.3.2017)	Mtoe	1874	3478	7452				
Extractable Lignite	Mtoe	1874			13.0		145	
Oil (2005)	Mt	604.1			36.01	214	17	17
Gas (2005)	Mtoe	1161			29	17	40	40
Coal Bed Methane	Mtoe	96			0.52			

* Balance Recoverable Reserves

1 Indicated Gas resource includes 320 Mtoe claimed by Reliance Energy. In addition, GSPC has indicated about 360 Mtoe of reserves, which have not yet been certified by DGH.

2 From deep seated coal (not included in extractable coal reserves)

** Extractable coal from proved reserves has been calculated by considering 90% of geological reserve as mineable and dividing mineable reserve by Reserve to Production ratio (2.543 has been used in 'Coal Vision 2025' for CIL blocks); and range for extractable coal from prognosticated reserves has been arrived at by taking 70% of indicated and 40% of Inferred reserve as mineable and dividing mineable reserve by R:P ratios (2.543 for CIL blocks and 4.7 for non-CIL blocks as per 'Coal Vision 2025').

Sources :

http://petroleum.nic.in/sites/default/files/ipngs1718.pdf

Energy Statistics 2018

"Indian Petroleum & Natural Gas Statistics 2016-17"

**This is largely based on the final report of the study by IRADe for the Global Technology Watch Group set up by the Department of Science and Technology, Coal Road Map for India (2018)*

Note:

Conversion factors: 1 Million Tonne of Coal = 0.41 Mtoe

1 Million Tonne of Lignite = 0.2865 Mtoe

1 Billion Cubic Meter of Gas = 0.9 Mtoe

1 Million Tonnes of LNG = 1.23 Mtoe

Extractable coal can last for 77 years at the rate of production of 2017-18. However, if the coal production keeps growing at 5 % per year, then we can run out of coal including that from indicated and inferred reserves in less than 40 years.

Coal use in different sectors is given in Table 2.

Table 2: Industry wise Consumption of Thermal /Non Coking Coal in India 2016-17 (Million Tonnes)

Industries	In Million Tonnes	Percentage share
Power	527.26	67%
Industry	16.96	2%
Others	246.83	31%
Total	**791.05**	**100%**

Source: http://mospi.nic.in/sites/default/files/publication_reports/Energy_Statistics_2018.pdf

We see that power sector is the major user of coal consuming 67% of thermal coal used in the country. I will therefore look at the power sector.

Projection of requirement of coal in the power sector without any consideration of environmental concerns give us an upper bound of how much coal power sector would need in the future. Table 3 shows projection we have made with a multi-sectoral inter-temporal activity analysis optimizing model. In this coal efficiency improvement has been assumed at 1% per year. Also all new coal plants are to be super critical.

Table 3: Coal Requirement for Power Sector (MT)

Year	Capacity (GW)	Generation (Billion Kwh)	Coal Requirement (MT)
2015	143	999	680
2020	216	1511	1022
2030	440	3081	2071
2040	836	5862	3930
2050	1398	9799	6557

The projected requirement is huge and would involve substantial import of coal. Can we absorb this level of coal use?

Coal faces severe challenges from environmental considerations. Local air pollution due to emissions of particulates and SOx, emissions of CO_2, displacement of people and land degradation due to mining are growing concerns. What role can clean coal technologies play here?

Major use of coal in India is for power plants. What are the implications for coal of dramatic reduction in cost of solar power and battery technology that is expected by many? Would it make coal power generation economically less attractive?

Role of Clean Coal Technologies in Controlling Local Air Pollution

The government already requires that coal plants have modern electro-static precipitators. One needs to make sure that these trap particulates of 2.5 micron size. This should involve some retrofitting of old plants and additional investment in new plants.

Controlling SOx NOx emissions requires FGD, flue gas desulfurization. Also selective catalytic reduction (SCR) can clean up the plant further. This is somewhat more expensive. Yet, coal power may still remain competitive with other alternatives. We have explored the role that FGD can play in a multi-sectoral inter-temporal optimizing model that considers various alternative power technologies and optimizes power production with a 40 year horizon. It considers the investment required as well as the operating costs of different types of plants. Table 4 shows the characteristics of different plants considered.

Table 4: Characteristics of Different Coal Based Power Plants

Technology	Sub critical PC Boiler with ESP	Super-critical PC Boiler with ESP	Ultra-Super Critical PC Boiler with ESP	Sub-critical PC Boiler with ESP, FGD, SCR	Super-critical PC Boiler with ESP, FGD, SCR	Ultra Super-critical PC Boiler with ESP, FGD, SCR
Net Plant efficiency (%)	34.38%	35.92%	37.19%	33.18%	34.73%	35.96%
Auxiliary power (%)	7.27%	7.18%	9.92%	10.50%	10.27%	12.88%
S.F.C. (Kg/ kWh) coal GCV 2800 Kcal/kg	0.89	0.85	0.83	0.93	0.88	0.85
Capital Cost# INR Cr/MW	5.90	6.30	7.01	9.28	9.69	9.96
O&M# INR Lakh/MW	97	96	104	121	122	125
LCOE (INR/kWh)	2.35	2.4	2.62	3.23	3.28	3.38
CO_2 emission (kg/MWh)	1015	971	938	1059	1010	977
SO_2 emission (kg/MWh)	10.1	9.6	9.3	0.3	0.3	0.3
NOx emission (kg/MWh)	4.5	4.2	4.1	0.5	0.5	0.5
Particulate emission (kg/MWh)	1	1	0.9	0.1	0.1	0.1

Source: GTWG Report (2018)

Cost in 2016 prices Source: IRADe Analysis, and Chapter 5 prepared by IIT-B and IIT-M

It is seen that plants with ESP, FGD and SCR have higher initial capital cost over plants with only ESP. The costs are 57%, 54% and 42% higher for sub-critical, super-critical and ultra-super-critical plants respectively. However, the CO_2 emissions are higher per kWh. The emissions of particulates, SOx and NOx are 85 to 95% lower.

What is of interest is to see what it would cost in terms of foregone growth in GDP or consumer income. Also what is the economically justifiable level of use of these technologies?

We generate two scenarios, one with all plants have ESP and another in which all plants have ESP, FGD and SCR. We call the scenarios as follows:

- **DAUPM:** Dynamics as usual with ESP that controls Particulate Matter emissions. Economical choice of technology no restrictions except as per government policy no new subcritical plants.
- **PMSOxNOx:** Only new plants with all pollution control technologies (ESP,FGD+SCR) are permitted

The results are summarized for 2030 and 2050 in table 5.

Table 5: Generation in bkWh by Different Technologies

Scenario	DAUPM		PMSOxNOx	
Technologies	2030	2050	2030	2050
Coal				
Sub Critical	700	453	703	694
Super Critical	2363	9337	48	58
Sub Critical FGD	3	1	356	196
Super Critical FGD	3	1	1972	8865
Total Coal	**3081**	**9799**	**3079**	**9813**
Gas	47	5	54	10
Diesel	0	0	0	0
Nuclear	15	7	15	7
Hydro	54	19	54	19
Renewable	27	14	27	14
Total Generation	**3224**	**9844**	**3229**	**9863**
Share of Coal Generation (Per Cent)	**96**	**100**	**95**	**99**

Source: Chapter 6, GTWG report

What is interesting to see is that the share of generation from coal based plants exceeds 95 % in both the scenarios. The emissions under the two scenarios are summarized in table 6:

Table 6: Emissions under the Two Scenarios

Scenario	DAUPM			PMSOxNOx		
Year	SOx	NOx	CO_2	SOx	NOx	CO_2
2010	7	3	673	7	3	673
2020	15	6	1493	8	4	1547
2030	30	13	3017	8	4	3135
2040	57	25	5716	9	6	5940
2050	94	41	9530	10	8	9932
2010-50 (MT)	1534	672	155042	346	197	161034
2010-50 from the whole economy (GT CO_2)			298			303

The reductions in SOx and NOx emissions inPMSOxNOx scenario are substantial but seem much less than what one would have expected from the emission coefficients in table 4. This is because the existing sub-critical coal plants in 2017, after which no sub-critical plants are built, continue to operate for many years and have not been retrofitted with SOx NOx control devices. In fact from the cumulated emissions over 2010-50 of these sub-critical plants are 289 MT of SOx out of total 346 MT and 129 MT of NOx out of total 197 Mt.

With the PMSOxNOx scenario the emissions of SOx and NOx come down substantially. This suggests that if we want to control local air pollution, end of the pipe measures should be adequate. The question is how much do they cost?

We measure this in terms of the impact on Gross Domestic Product and on private consumption, which is an important element of consumer welfare. Table 7 shows these.

Table 7: Macro Impact of SOx and NOx Control

Year	GDP Trillion 2007-08 Rs		Per capita consumption '000 2007-08 Rs/year	
	DAUPM	PMSOxNOx	DAUPM	PMSOxNOx
2010	53	53	21	21
2020	110	110	30	29
2030	242	240	69	68
2040	546	542	164	162
2050	1078	1068	399	394
CAGR 2010-30	7.91	7.88	6.17	6.09
CAGR 2010-50	7.83	7.81	7.67	7.63

Table 7 shows that there is very little difference in the growth rates of GDP and per capita consumption. Thus SOx, NOx and particulate emissions control does not involve any significant cost to the economy.

However, if you look at CO_2 emissions in table 6, there is no reduction in it, if anything there is a small increase. For this we need to explore carbon capture and storage (CCS).

Role of CCS in Controlling CO_2 Emissions

We consider two alternative technologies of CCS.

- Supercritical Pulverized Coal (PC) boiler with MEA-based CCS
- Supercritical PC boiler with oxy-fuel combustion (OFC)-based CCS

"Post-combustion technology means that the CO_2 is captured after the combustion of the coal (or other fossil fuel) has taken place. This can be done using various processes such as adsorption, absorption and membrane separation. Generally, in absorption, CO_2 is absorbed over a solvent such as Mono-ethanolamine (MEA) (Johnsson, 2011) and is then exposed to higher temperatures where CO_2 is stripped off from the solvent. Other solvents such as ammonia may also be used for such a process. Post-combustion processes are the most matured ones at this point of time. However, solvent regeneration is an energy-intensive process and leads to significant losses in the energy output of the plant. The energy penalty here is thus, mainly due to the solvent generation (Johnsson, 2011). …

Oxy-fuel combustion systems use pure oxygen or a nitrogen-free gas mixture instead of air for the combustion of a hydrocarbon fuel to produce a flue gas that consists primarily of water vapor and CO_2. This produces a flue gas stream with CO_2 concentrations greater than 80% by volume. The water vapor is then removed by cooling and compressing the flue gas stream. Oxy-fuel combustion requires an upstream air separation unit (ASU) to produce oxygen stream with a purity of 95–99%. Further treatment of the flue gas may be needed to remove air pollutants and non-condensed gases (such as argon and nitrogen) from the flue gas before the CO_2 is sent to storage." (Sreenivas Jayanti et al, 2018)

Table 8 gives the technological and cost details of the two technologies.

Table 8: CCS technologies Costs and Emissions

Technology	Supercritical PC with MEA based CCS	Supercritical PC with CCS +OFC
Net Plant efficiency (%)	29.05%	26.44%
Auxiliary power (%)	24.93%	31.69%
S.F.C. (Kg/ kWh) coal GCV 2800 Kcal/kg	1.06	1.16
Capital Cost# INR Cr/MW	19	23
O&M# INR Lakh/MW	246	221
LCOE (INR/kWh)	6.61	6.76
CO_2 emission (kg/MWh)	121	132
SO_2 emission (kg/MWh)	0	0
NOx emission (kg/MWh)	0.6	0.7
Particulate emission (kg/MWh)	0.1	0
Net Plant efficiency (%)	29.05%	26.44%
Auxiliary power (%)	24.93%	31.69%
S.F.C. (Kg/ kWh) coal GCV 2800 Kcal/kg	1.06	1.16
Capital Cost# INR Cr/MW	19	23
O&M# INR Lakh/MW	246	221
LCOE (INR/kWh)	6.61	6.76
CO_2 emission (kg/MWh)	121	132
SO_2 emission (kg/MWh)	0	0
NOx emission (kg/MWh)	0.6	0.7
Particulate emission (kg/MWh)	0.1	0

We develop two scenarios, where the total CO_2 emissions over the period 2010 to 2050 that India can make are given by 133 GT and 156 GT. These limits are imposed in the scenarios. These are arrived at looking at the global carbon budget and allocating it to different countries giving each country the same per capita allocation based on their population in 1990 and 2010. The two scenarios with carbon budget (CB) are as follows:

- CB156: a carbon budget of 156 GT from 2010- 2050 imposed
- CB133: a carbon budget of 133 GT from 2010-2050 imposed

Table 9: shows power generation in the different scenarios

Scenario	DAUPM		CB156		CB133	
Technologies	2030	2050	2030	2050	2030	2050
Coal						
Sub Critical	700	453	446	54	96	12
Super Critical	2363	9337	34	4	5	1
Ultra Super Critical	3	4	2	0	0	0
Sub Critical FGD	3	1	2	0	0	0
Super Critical FGD	3	1	2	0	0	0
Ultra Super Critical FGD	3	1	2	0	0	0
Super Critical PC with MEA CCS	3	1	469	6120	154	1005
Super Critical CCS OFC	3	1	3	1	1	1
Total Coal	**3081**	**9799**	**960**	**6179**	**256**	**1019**
Gas	47	5	47	10	22	3
Diesel	0	0	0	0	0	0
Nuclear	15	7	1806	1968	1968	1968
Hydro	54	19	292	600	376	600
Renewable	27	14	73	724	382	5129
Total Generation	**3224**	**9844**	**3178**	**9481**	**3004**	**8719**
Share of coal (percent)	96	100	30	65	9	12

With a carbon budget of 156 GT, there is still 65 % generation is from coal in 2050. It may also be noted that MEA CCS is selected and not CCSOFC. However, with a tighter budget of 133 GT, coal power generation is only 12 %. It shows it is cheaper to go for nuclear, hydroelectricity and renewables.

The macro-economic impact carbon constraint on GDP and per capita consumption is shown in table 10. The impact is not very large on GDP but somewhat larger on private per capita consumption, which is 4 % lower in CB156 and 11 % lower in CB133 in 2050. The cumulative loss will be substantial as can be seen in table 11.

Table 10: Macro Impact of Carbon Constraint

	GDP Trillion 2007-08 Rs/year			Per capita consumption Thousand 2007-08 Rs/year		
Year	DAUPM	CB156	CB133	DAUPM	CB156	CB133
2010	53	53	53	21	21	21
2020	110	111	110	30	28	27
2030	242	239	233	69	66	62
2040	546	534	524	164	158	149
2050	1078	1058	1015	399	384	359
CAGR 2010-30 (%)	7.91	7.85	7.72	6.17	5.96	5.66
CAGR 2010-50 (%)	7.83	7.78	7.67	7.67	7.57	7.38

Table 11: Reduction in cumulated GDP and Consumption (Trillion 2007-08 Rs) Compared to DAUPM (DAUPM value – Scenario Value)

	GDP		Consumption	
Year	CB156	CB133	CB156	CB133
2010-20	-3	3	6	15
2010-30	10	50	33	80
2010-40	80	195	101	246
2010-50	212	554	277	684

Impact of Steeper Decline in Renewable Costs

The significant increase in renewable generation with the tighter carbon budget of 133 GT has assumed fall in renewable technologies costs is modest. There are many however, who expect a much steeper decline in renewable costs and rapid increase in their efficiency.

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Presidential Address

for

112th ANNUAL GENERAL MEETING

at

Biswa Bangla Convention Centre

Newtown, Kolkata

on

29th September 2018

by

Dr N K Nanda

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Dr Narendra Kumar Nanda

Dr Narendra Kumar Nanda is Director (Technical) National Mineral Development Corporation, Hyderabad. He put 25 years of specialized service in mineral exploration, mine operation, mine development and production related activities before getting elevated as Director (Technical) in Dec. 1, 2008. As Director (Technical) currently he shoulders the responsibilities of Exploration, Research & Development, Mining Project Execution, Mergers and Acquisitions, Joint Ventures, 3 MTPA Steel Plant of the company (NMDC) at Nagarnar and Chattisgarh and Foreign Projects (Legacy, Tanzania Gold Project, Kopano) of his company to name a few.

Holder of First Class Mines Manager Certificate (Restricted), Dr Nanda obtained his B. Tech (Mining) and M. Tech (by research) both from Indian School of Mines, Dhanbad in the year 1982 and 2000 respectively. He was awarded Ph.D by the Vijay Nagar Sri Krishanadevaraya University, PG Center, Nandihalli, Sandur, Bellary on the subject "Beneficiation Studies on Iron formations of Donimalai Range"

Before joining NMDC, he acquired experience in different mines of copper and limestone. Taking initiative at NMDC to prepare a strategic growth plan for the company in its core area of mining as well as diversifying into value added sectors like Steel and Pellet goes to his credit. Besides, the NMDC got benefitted for his initiatives on Capital expenditure (CAPEX) increase from Rs. 134.34 Cr. during 2007-08 to Rs. 3679 Cr (101%) during 2015-16, incorporating NMDC Global international investment division of NMDC, accomplishment of NMDC's first ever foreign asset acquisition in Legacy Iron Ore - an ASX listed company having Iron Ore and gold assets in Australia with NMDC having majority stake (Dr Nanda has been working as Chairman, Legacy Iron Ore in Australia since its stake is taken by NMDC since 2012), forming a JV called Kopano-NMDC Pvt. Ltd. in South Africa in 2010 for developing mineral assets in South Africa, mainly coal, successfully completing the integrated load trial of Bailadila Deposit 11B Project (7 MTPA capacity) on 29.03.2015, setting up of 1.2 MTPA Pellet Plant in Donimalai in the state of Karnataka which is nearing its completion.

Besides being President of MGMI, he is Chairman - Mining Engineers' Association of India, Hyderabad Chapter, Chairman – Mines Safety Association of Karnataka (MSAK), Member - Committee under Section 12 of Mines Act, under Ministry of Labour, Member - Mining Examinations Board, Controller of Examinations, Director-General of Mines Safety, and FIMI.

In addition to the post of Director, Technical NMDC, Dr Nanda is holding following additional responsibilities:

1. Chairman, Legacy Iron Ore Company Ltd., Australia (NMDC is having a major share in this company)
2. Vice-Chairman, KOPANO Iron Ore Co. Ltd., South Africa (A JV Company of NMDC)
3. Director I/C– J&K Mineral Development Co. Ltd., Jammu (A JV Company of NMDC)
4. Director, NMDC Power Ltd. (A subsidiary Company of NMDC)
5. Director NMDC-CMDC Ltd. (A JV Company of NMDC Ltd.)
6. Director Chattisgarh Mining Ventures Ltd (A JV company of NMDC Ltd)
7. Director Jharkhand-NMDC Limited (A JV Company of NMDC Ltd.)
8. Director Karnataka Vijaynagar Steel Limited (A wholly owned subsidiary of NMDC)
9. Director NMDC Steel Limited (A wholly owned subsidiary of NMDC)

Good Afternoon!

Dignitaries on the dias and off the dias, dear members, participants, guests, ladies and gentlemen.

Minerals are valuable natural resources which forms the raw material for many basic industries and are a major resource for development. The history of mineral extraction in India dates back to the days of the Harappan civilization. The wide availability of the minerals provides a base for the growth and development of the mining sector in India.

The country is endowed with huge resources of many metallic and non-metallic minerals. Mining sector is an important segment of the Indian economy. Since independence, there has been a pronounced growth in the mineral production both in terms of quantity and value. India produces as many as 95 minerals, which includes 4 fuel, 10 metallic, 23 non-metallic, 3 atomic and 55 minor minerals (including building and other materials).

The total value of mineral production (excluding atomic & fuel minerals) during 2017-18 has been estimated at Rs 1,13,541 crore, which shows an increase of about 13% over that of the previous year. During 2017- 18, estimated value for metallic minerals is Rs 53,029 crore or 47.7% of the total value and non-metallic minerals including minor minerals is Rs 60,512 crore or 53.3% of the total value.

During 2017-18, mineral production was reported from 32 States/Union Territories (actual reporting of MCDR from 22 states and estimation of minor minerals for all 32 States/Union Territories) of which the bulk of value of mineral production (excluding fuel and atomic minerals) of about 93.65% was confined to 10 States.

Auction of concessions for major minerals (other than coal, petroleum and natural gas) was done for the first time in the history of mineral administration in the country. 33 blocks were successfully allocated. However, 60 auction attempts failed during this period. The consensus emerged that the Mineral Auction Rules need to be amended and have been done on 30/11/2017.

Making an economic mineral discovery is the goal of geologists and geo-scientist around the world, but these efforts can also be extremely difficult, costly, and time-consuming, and most companies engaged in exploration end up walking away empty-handed.

With auction and upfront commitment, even at the best of times, mining can be expensive, risky, and tricky. That's why investors and miners will want you to source even more data to see a clearer picture of the deposit, and see how it could take shape as a mine.

Exploration data, codified resource reporting, metallurgical tests, environmental assessments, 3d models, and mine designs can increase confidence in the project with an in-depth Feasibility Study and help in appropriate decision.

The other area which has come to occupy the central stage is "Corporate Governance". 'Board should govern not manage'. 'Board should show the right path, it is management which should actually work on the path'. 'Board ought to be transparent and vigilant in protecting shareholders interest'. Board should be independent of management etc'. These are now the buzz words. Bankruptcy and collapse of big Corporates have taught the Corporate World a lesson and Corporate governance has been ushered in to boost credibility and step up the sagging morale of Directors. While the seminal ideas on Corporate Governance can be traced to Barle and Means study of modern corporations and its ownership and control in 1932 in the context of Corporate scandals in USA, it was in the 90s that Corporate governance emerged as a powerful idea for reforming listed companies and for expanding capital markets. This also coincided with the globalization of financial markets and reduced international barriers for industry and trade. The effort, in sum, appears to be towards more efficient regulation through amendments to listing agreements and company laws as well as updated standards of accounting, reporting and disclosures. Thus, corporate governance became an important agenda for the multilateral organizations such as World Bank, IMF, BIS, UN System, Comsec. and the OECD.

Presidential Address by Dr N K Nanda, Director (Tech) NMDC at the 112th Annual General Meeting on 29th September, 2018 at Biswa Bangla Convention Centre, New Town, Kolkata.

In India, Corporate body are either State owned or privately owned, of which some of them are listed in the Stock Exchanges and bulk of it still continue to be with State. In Private Sectors, there are yet a number of corporate bodies which are closely held and the issues of corporate governance in these enterprises have been agitating the mind of the policy makers in private as well as government sectors as these Corporates have tremendous power and resource and its mal-governance will be disastrous for the society, nation and democratic world. Misdeeds of East India Company in India during 18th and first part of 19th century, bankruptcy of many Corporates viz. Enron, ASEAN Tiger are pointer.

Recognizing the importance of corporate governance, SEBI (Stock Exchange Board of India) had constituted a Committee to develop guidelines on Corporate Governance.

We at MGMI have been maintaining a very high standards of Corporate governance with an elected council which remains the mainstay of this professional body for more than 100 years

Corporate bodies are the engines of growth of the society. The makes the Corporate Sector grow and the society at large moves on. In this context it is quite apt to quote Archimedis 'Give me a Lever long enough and a fulcrum strong enough and single handed I can move the World'. Yes, Corporate Governance can be the fulcrum with Board as the 'Lever long enough', the whole Corporate world can move on, as never before.

It is therefore, necessary that MGMI may re-engineer itself from a knowledge sharing organization to take the leadership of the mineral industry and professionally elevate the industry into a high pedestal of Indian Economy that if rightfully deserves.

As awareness and resultant competition increases, only the fittest and the fastest amongst the provider organizations will survive. It is, therefore, be imperative for the MGMI to look beyond the present horizons and find out how the mineral industries are being developed to meet national objectives. More importantly why and how the developed countries, are ensuring competitiveness in productivity, price, quality and market ability of their mineral resources and products.

Having an age-old tradition is well but at the same time embracing new changes to remain relevant with a world-class quality of professionals is equally important. There is no reason why MGMI cannot become a pan India and globally accepted professional body. What is needed is positive mindsets and conviction in fighting the cause of mineral industry at all fronts.

Let us hope, we can make it.

Thank You.

112th Annual General Meeting

After tea-break AGM was held. Office-bearers of the Institute, including President-Elect, A.K. Jha, Outgoing President N.K. Nanda, and Hony. Secretary Rajiw Lochan were on the dais. A formal note of warm welcome was given by the Secretary, and the dignitaries on the dais were greeted with bouquets. The Incoming President thereupon addressed the assembly:

Addressing dignitaries, Institute's members, participants, guests and others, President Anil Kumar Jha in his maiden thought-provoking address exhorted the assembly to accomplish aims of the Institute with greater involvement of Institute's members, other societies, & mining industry.

Shri AK Jha addressing in 112th AGM

He said that for the success of any organization the important attributes are clarity of vision, commitment to performance, clear business plan, and tenacity to pursue the business goals, resilience in the face of adversities, and cumulative team-work. I am proud to say that I have the confidence in the ability of my Coal India team to adapt to changes and challenges, and to deliver the results of the thought-of programmes of the Institute during the coming year. He further said that as the country's leading primary commercial energy provider, Coal India Limited, is in constant limelight, more so in the present times. There is an increased expectation of the nation from Coal India now than ever before to fulfill the expanding coal demand. Coal India has risen to the challenge and delivered on targets as is reflected in the information given from time to time.

Elaborating his thoughts, the President conveyed that progressively by the August ending of the current fiscal, the Company has produced 23 million tones (Mt) more coal than comparable period during the previous year. Coal off-take was around 22 Mt higher during this period. Importantly, coal dispatch to power sector was 22.2 Mt more during April-August 2018, compared to similar period last fiscal. The production growth since the beginning of the fiscal year has been in consistent double-digit till now. Average rake loading too has been consistently higher. This being the performance, why Coal India is unfortunately under criticism for failing to deliver? The fallacy is in the perception but not in the performance, and of course, Coal India takes it as constructive criticism and this only impels us to further to raise the bar and build up our performance to even higher orbits.

One more thing that has to be taken into cognizance is that unlike other organizations, which operate within boundaries and under the comfort of controlled climates, Coal India is without this luxury. Coal India has to operate in the open under scorching heat and freezing cold. We do not have the liberty of choosing our environment but are left to the vagaries of the nature. And, we perform round the clock throughout the year. So, the harsh elements of the nature do affect our production at times. This is not an excuse but the reality.

"Coal is expanding its horizons constantly. The company has set an aspirational 682 Mt production target and 652 Mt production target for 2018-19." It is said that it is always better to aim high and miss than aim low and hit. *"But all our efforts are optimistically focused on aiming high and hit"*, he asserted.

"And, Mining companies when they plan higher production and productivity such a scale of growth requires appropriate technologies to increase production and improve mineral recovery without adversely affecting safety standards. *"No amount of emphasis can be repetitive on safety"* he proclaimed.

While there has been increased emphasis on the use of modern equipment and technologies for mining, upgraded technical skills for design of large mining operations, analysis and monitoring of large excavations, *the safety of operations at times is still found wanting*. The development of appropriate technical skills based on global best practices is imperative for assisting in the safe and efficient operation of the mines. The large-scale operations may require the mining of steeper and larger mine slopes and the improvement of mineral recoveries in the underground mines", the President cautioned.

Advising, he said, "It is necessary to incorporate the world's best practices into each aspect to accelerate development in order to be global leader. To reduce the dependence on imported raw-materials, the mining industry in India is poised for larger domestic production of critical minerals such as coal, iron ore, limestone as well as base and precious metals. Larger open pits and open cast mines along with deeper and larger underground mines will be challenging tasks. The relevance of excavation stability in modern day mining cannot be over-emphasized, but it is the necessity."

In a cautionary note, he said, "While the industry is struggling with lower mineral prices and increasing costs of vital inputs, new technologies will also be required for smart and efficient mining operations. An up gradation of the required skill-sets for the employees will also be needed. Reducing the exposure of men and machines to high hazard areas in the mines requires the knowledge of the development of these high-risk slope zones and how to manage their behavior."

He wished & underscored that MGMI has always been in the forefront in organizing topical workshops and seminars useful to technocrats and scientists associated predominantly with the mining industry. This coming together of talent on a common platform help generate the required debate on the appropriate path forward in the interest of the industry, and the country as a whole. Being the oldest professional body addressing the needs of the minerals industry, the onus is certainly on MGMI to be a trailblazer, initiating the necessary discussions in relevant forum and proving the necessary platforms for disseminating knowledge and information to its members to help them serve their industry in a more contemporary fashion.

The President at the end sincerely acknowledged the unremitting efforts put in by the entire team of MGMI who have completed their tenure rendering commendable service to the Institute.

To follow the next agenda item, the Secretary presented the minutes of the 111th AGM, held in Kolkata on the 10th Nov. 2017, for adoption. The minutes were confirmed without any amendment. The Council Report, Audited Balanced Sheet, & Statement of Accounts for the year, ending March 31, 2018 were then presented for adoption & the same were adopted unanimously by the General Body.

Award Ceremony

MGMI awards, as noted below for the year 2017-18, were subsequently given:

- **Dewan Bahadur D D. Theacker Coal Mining Gold Medal** awarded to Dr Ajay Kr Jha, for his outstanding contribution in Coal Mining.
- **Prof. S K Bose Memorial Award** for Excellence in teaching of Mining Engineering awarded to Prof. B K Shrivastva, Coordinator, Centre of Advanced Studies, Department of Mining Engineering IIT, BHU.
- **Dr J Cogging Brown Memorial Gold Medal** for Geological Sciences awarded to Prof (Dr) Om Prakash Verma, Executive President and Hony Editor, Indian Geological Congress.
- **R P Bhatnagar Award**, awarded to Dr Alok Tripathy, Scientist in Mineral Processing Department, CSIR – Institute of Mineral and Material Technology, Bhubaneswar (Gold Medal and cash Award Rs. 5,000/-).
- **Prof. H B Ghose Award** for the Manager having best safety performance during the year 2017-18 to Shri Raj Kishore Singh, Manager, Gare Palma of underground mine of IV/4 of Hindalco and Shri Arun Kumar Das, Manager having best Safety performance during the year 2017-18 of Sarisatolli Coal mine of CESC Ltd. of Opencast.
- **John Dun Medal** awarded to Dr Prabhakar Sangurmath, General Manager (Co-ord), Hutti Gold Mines Co. Ltd.

- **D N Thakur Award** for outstanding contribution in Earth Sciences awarded to Dr Tapas Kr Mallik former Director Marine Wing, GSI.
- **Prof (Dr) Mahendra Pratap Singh Memorial Coal Science Award** for significant contribution in the field of highquality scientific work on Coal exploration and characterization to Dr Ashok Kr Singh, Sr Principal Scientist and Head of Research Group, CSIR (Gold Medal and Cash Award Rs. 15,000/-).
- **Indranil Award** for outstanding contribution in Ferrous Metallurgy to Dr Gadadhar Sahoo, Sr Manager, Physical Metallurgy Group, RDCIS (SAIL).
- **Lala Ramkishore Singhal Award** for outstanding contribution in the field of Conservation of Minerals to Dr Danda Srinivas Rao, Sr Principal Scientist and Professor AcSIR, CSIR Bhubaneswar.
- **Institute's Gold Medal** awarded for the best paper in order of merit read in the OGM and published in the Transactions for the paper on **"Utilisation of Low Grade Chromite Ore for the Production of Carbon Free Ferrochrome"**. The paper authored by Prof (DR) Rajib Dey, Amit Kr Bhandari, Maharshi Ghosh Dostidar, Sidhartha Mukherjee and Mahua Ghosh Chaudhuri, Prof in Metallurgical and Material Engineering Department of Jadavpur University.
- **MGMI Branch Membership Growth Award** for the highest enrolment of Members awarded to MGMI Hyderabad Chapter for 2017-18.
- **MGMI Branch Activity Award** for the highest no. of Technical Activities awarded to MGMI Ranchi Chapter for 2017-18.

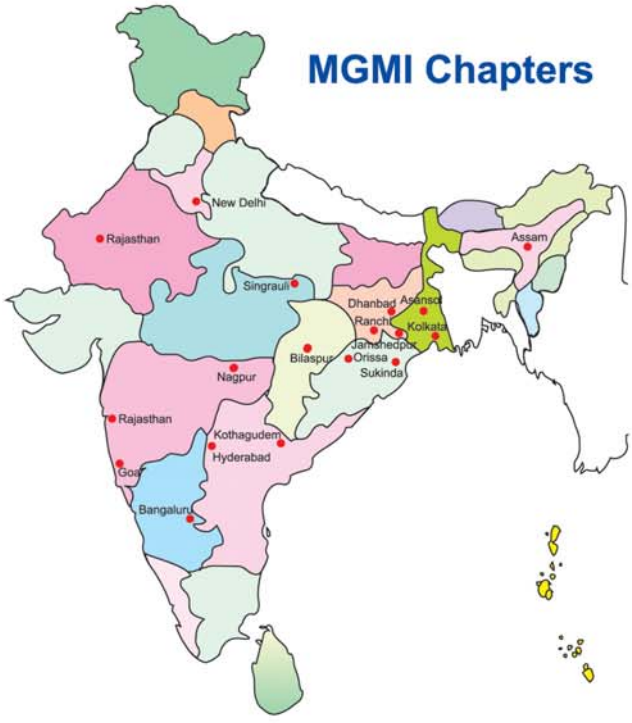
Student Awards for 2016-17

- **Pickering Medal** for the Best Student in Mining Engineering awarded to **Shri Tejaswi Agarwal** of IIT (ISM), Dhanbad.
- **Hayden Medal** for the Best Student in Applied Geology awarded to **Shri Abhinav Kumar** of IIT (ISM) Dhanbad.
- **Yule Medal** for the Best Student in Mining Machinery awarded to **Shri Ankur Varma** of IIT (ISM) Dhanbad.
- **McNally Bharat Medal** for the Best Student in Mineral Engineering awarded to **Shri Akash Chandra** of IIT (ISM) Dhanbad.
- **Dr. Hari Narayan Medal** for the Best Student in Applied Geophysics awarded to **Shri Vikas Kumar Jaiswal** IIT (ISM) Dhanbad.
- **Oil India Medal** for the Best Student in Petroleum Engineering awarded to **Shri Shlok Rai** IIT (ISM) Dhanbad.
- **Chandrakala Medal** for the Best Student in Petroleum Engineering awarded to **Shri Abhisek Kumar** IIT, Kharagpur.
- **S Lal Medal** for the Best Student in Mining Engineering awarded to **Shri Priyadarshi Suman** of IIEST, Shibpur
- **Indranil Medal** for the Best Student in Metallurgy awarded to **Ms Asmita Chakraborty** of IIEST, Shibpur
- **Indranil Medal** for the Best Student in Metallurgy awarded to **Ms Priya Akshay Mehta** of IIT, Kharagpur.
- **Smt. Nirja Sahay Medal** for M.Sc (Applied Geology) awarded to **Shri Sanket** of IIT, Kharagpur.
- **La Touch Medal** for the Best Student in Geology (3yrs degree course) awarded to **Km Kuhoo Madhav** of IIT, BHU.
- **La Touch Medal** for the Best Student in Geology (2yrs degree course) awarded to **Km Arpita Tripathi** of IIT, BHU.
- **Kalyan Mukherjee** "61 Geology" Medal for the Best Student of M.Sc (Geology) awarded to **Shri Sandip Choudhuri** of University of Calcutta.
- **Roberton Medal** for the Best Student in Mining Engineering awarded to **Ms Khushi Sahu** of IIT, BHU.
- **Nava Bhrath Ferro Alloys Medal** for the Best Student in B.Tech Mining Engineering awarded to **Shri R Sanjay Kumar** of Kakatiya University.
- **SCCL Gold Medal** for the Best Student in Mining Engineering awarded to **Shri Gandhe Sai Kiran** of Kakatiya University.

After that, announcement was made about the newly-elected Council members of MGMI for the years, 2018-21; total six, as listed below:

1. Shri Anup Biswas,
2. Prof. Bhabesh Chandra Sarkar,
3. Shri Virendra Kumar Arora,
4. Dr. Netai Chandra Dey,
5. Shri Akhilesh Choudhury, and
6. Shri Anil Kumar Karmakar

The day's illuminating and busy programme ended with a vote of thanks by the Honorary Secretary, Rajiw Lochan who spoke warmly about the help he had received from office-bearers and employees of MGMI, he thanked them all so sincerely. Heartfelt thanks were also given to the paper contributors, Chairman & Rapporteur of the National Seminar, attending members of MGMI, and the management of Biswa Bangla Convention Centre. Grateful thanks to the two Presidents – Shri A.K. Jha & Dr. N.K. Nanda – were conveyed for having spared time from their so busy preoccupations to grace the occasion. He thanked the Organizations who provided substantial amount of sponsorship to make the program a success.



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