Recommendations resulting from International Seminar on "Exploration of Oil, Gas, Coal, Minerals and Ground water: Modern Techniques and Appliances "organized by ISM Alumni Association Kolkata Chapter in association with IIT(ISM), Dhanbad and Geological Survey Of India

1. As emerged from the proceedings, modern concept of exploration of Earth resources has changed. The Exploration of Earth resource essentially must include inputs from geological and geophysical studies, scope for value addition of the resource, study of ground water and surface water, mineability of the resource and environment implications, sustainability, risk and safe guards. All the data should be generated for and with feasibility considerations. Such composite study will administer confidence in investors and final outcome will be "bankable".

2. Policies of the Government should be transparent and investor friendly. The exploration and extraction policies are to be integrated and responsive to global supply situations. The global best practices are to be adopted with efficiency, conservation and value realization in mind.

3. For understanding a deposit, geo-statistical and 3D modeling should be made mandatory where frequent use of modern appliances which include soft ware, be made, for perfection and interpretation. Such studies will enable to depict three dimensional models for better understanding of a deposit. Development of appropriate manpower in similar lines for the disciplines of geology, geophysics and mining for all kinds of deposits of minerals, coal, oil and gas should be encouraged as a National Policy.

4. There is frequent change of priorities for explorers and developers of minerals/ rock resources in response to market demand which in turn depend on the profitability and innovations for alternatives. For example, rapid strides in non-conventional renewable energy resources like solar and wind would bring down the demand for the coal and petroleum but increase the demand for minerals that go in the new developments of solar and wind power. We must watch and study such developments and modify our exploration strategy and priorities, particularly for rare earth minerals. For example, right at the moment lithium bearing minerals are in great demand for upsurge of the battery storage era. We have no clues for such resources in India as we never seriously looked into them. The government must also be open and responsive to such challenges, and interact with the groups that are in the know of all these.

5. Along with minerals, ground water exploration and study of surface water must be integrated in any exploration for Earth resources. Availability of ground water free of contamination and rate of depletion should be given prime importance as both need to be assessed for mining or mineral industries for various purposes. Exploration work must delineate the groundwater resources along with mineral deposits. The study must emphasize, should mining and extraction proceed, remedial measures like desalinization, recharge of depleting aquifers, rain water harvesting and similar matters are required or not. Contamination (Arsenic, Fluorite etc) is another serious global issue which must be combated on war footing both for

industries as well as society. It will not be out of place here to suggest, have collaboration with world renowned laboratories working on this issue to reach viable solutions.

6. Aquifer mapping, yield estimation and vulnerability assessment must be speeded up to catch up with global scenario. We as a Nation, are lagging behind in these exercises.

7. We must make exploration of Earth resources a continuous process in spite of falling market, e.g., for a particular earth resource, though intensity may change from time to time as suggested in points (3&4). This is only possible when exploratory rights and results are efficiently tradable among credible parties. Creating regulatory framework for standardization and accuracy for responsible and sustainable private participation in all the minerals sectors.

8. Studies on brine. Geothermal source and water with oil and gas should be integrated for value added extraction of other commodities like lithium, potash etc. A modern day mineral processing for extraction of these be implemented. Scientists may be sent to reputed laboratory for up dated know how of mineral processing to isolate such elements.

9. OIL & Gas exploration / exploitation sector must be specially looked into. For example, oil industries hardly make 30 per cent recovery in normal exploitation, but it need to apply EOR (Early Oil Recovery) techniques efficiently for exploitation / exploration, and also need to monitor micro-seismicity in oil boreholes to know the extent of the effects of hydro-fracturing for efficient management and development.

10. Search for minerals for noble metals like gold, precious metals to be intensified using modern techniques and appliances. Recovery of gold and other noble metals, etc, from source rocks must also be encouraged with support.

11. Processing and mineral engineering should be reinforced by upgrading techniques and using modern appliances. For example many graphite deposit could be up graded to battery grade by using suitable mineral engineering techniques. An encouraging policy framework for investment is necessary that will enhance the risk appetite of the investors.

12. A ' National Mineral Policy Study Institute ' having expertise and mandate for providing knowledge to the policy making of all kinds of minerals, major and minor, is an urgent requirement and must be set up urgently to provide guidance to the rational and pragmatic policy making.

13. Initiative to develop a simple user friendly and uniform system of classifying and reporting reserve and resources along with in-built guide lines at different stages of exploration, is UNFC, as it is self sufficient and contains essential parameters. This thus can be used as a very good tool to develop exploration and can take care of resource base of a country and above all can take care of sustainability of resource vis a vis Society.

14. Environmental management and social license is the major impediment for the growth of the minerals sector. Ignorant and indiscriminate handling of environmental and social demands by the regulatory agencies and the industries are causing premature shutdown of mines. We need to have strong monitoring and advisory agency to ensure preventive measures to have

exploration and exploitation activities without blemish. We always find the faults after damage is done because of weak monitoring system. A national level Institute capable of giving proper guidance to the government and its regulators, and advice to the developers, with an idea to pre-empt such occurrences, by being proactive and providing safeguards, will help stop disruptions and sudden suspension and closure that wreak havoc to the life and livelihood of the biodiversity and the people.

15. Minerals are exhaustible resources but communities depending on them are permanent. To encourage sustainability, mineral extraction companies must be encouraged to use natural resources in terms both rewards and penalty scheme so that they can, by business transformation, corporate social responsibility and value addition, supply sustainable benefits to the communities when the mineral reserves are exhausted.

16. Talent attrition is now one of the major concern of the sector. It is also because of the restrictive and not-so encouraging business environment. The minor minerals sector, even when profitable, by its structure only encourages the non-qualified people to enter into the extraction business. This sector can generate quality employment if it is developed in right direction considering responsible ownership, profitability, integration with construction and realty sector, etc, as well as expansion opportunities of the developers.

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