Project title: **To Find Methodology of Safe Liquidation of Thick Seam of Raniganj Coalfields: Design & Development & Show-Casing Demonstrative Trials at Khottadih Colliery, ECL** **Project Code: CIL/R&D/1/58/2014** **Project No.: GC/MT/CIL/100/2014-15**	**Executive Summary:** Though coal remains in the mainstay in India for decades to come, technology-shift in favour of opencast mining has made underground coal production more or less stagnant for decades. Thick coal seam mining has suffered the maximum. Indian mine operators are mostly using stowing with conventional Bord and Pillar, a variant of Room and Pillar depillaring. Blasting gallery method is not being practiced due to various reasons. Top coal caving or other mechanized high-production methods, though established world over, have not been tried. On the contrary, more than 95% of manpower is employed in underground coal mines for their livelihood and sustenance in life. We are still developing 3 times (in plan area) more than what we are depillaring. More specific to winning of thick seams, the liquidation of developed seams is the major stumbling block. Management of mining-induced stresses especially on remnants during depillaring and mitigation of spontaneous heating/fire occurrence are becoming unsurmountable on umpteen occasions. This research study has been taken up by CSIR-CIMFR in collaboration of ECL to address these two broad issues in a comprehensive manner following "tandem approach" as described in this study report. In other words, researchers of ground control aspects and of fire/ventilation may be involved in a "tandem approach" so that a) early detection of spontaneous heating/fire so as to implement remedial measures to mitigate them at the earliest b) ribs should serve the purpose of i) providing temporary support during depillaring and ii) ribs should collapse if un-extracted and in goaf, it should not provide any resistance to impending caving. c) loss of coal in the goaf need to be minimized to the barest minimum possible Suitable support system for the high roof needs to be chosen, as a conventional support system has its own limitations. Under such technical backdrop, the prime objective of this project is to design a feasible and optimal method of safe liquidation of coal in the thick seams, out of existing methods for extraction of seams in Raniganj coalfields, and to validate the same at B2 panel (selected) of R-VI seam (5.4m thick) at Khottadih Colliery, Pandaveshwar area, ECL. While designing and showcasing demonstrative trials, the two important aspects i.e., ground control and spontaneous heating/fire propensity aspects were considered tandemly in a way to increase the number of coal pillars per panel. At Khottadih Colliery, the incubation period of coal seams is around 90 days i.e., high proneness to spontaneous heating. It has been observed that initiation of spontaneous heating in working districts are not solely

	dependent on the intrinsic property of coal (moisture, volatile matters, ash and fixed carbon, pyrites, mineral matter etc.) but also on extraneous parameters like mining, Goaf Frictional Ignition and environmental conditions. It is, thus, imperative that the feasible mining methods and environmental conditions, as well as spontaneous heating characteristics of coal seams, need to be adjudged together for addressing by and large the problems of thick seams extraction. The entire project is divided into two sections for a better understanding of "tandem approach" and deliverables successfully accomplished. The first Section-I (Ground Control) deals with the design of mining methods for effective ground control management to ensure safe liquidation of the thick coal seams. The designed ribs were expected to provide natural support, though temporarily, during slicing, but designed to fail after completion of slicing operation out-bye of them. The cable-bolting assisted liquidation method is found to be feasible in semi-mechanised conventional mining as it could show-cased here to increase the recovery of coal and provide better strata control and management. The second Section-II (related to Ventilation) deals with the aspects related to spontaneous heating/mine fire, related causes, symptoms and remedial measures. The tandem approach has thus, subsumed both aspects as detailed in Section I and Section II, of the study report, with the following conclusions and recommendations: i) The analysis of the data obtained from geotechnical instruments installed as per instrumentation plan given in Fig 5.12 and also data of physical observations of the strata movements show "no significant" change of "stress" and "deformation" (Fig. 5.16), that may be detrimental to safe depillaring operations, except the temporary hassles related to the „main fall". The main fall got delayed and the production in sub-panel B2A was stopped for 40 days by the inspectorate. The induced blasting with notching from the start of the panel, though suggested, could not be implemented. In spite of such inabilities of not-following the imperatives, the pre-mature sealing of the panel B2A (a regular phenomenon at Khottadih) could be avoided. This only strengthen the confidence of applying tandem approach. At places, roof coals were left unextracted as heightening not done. In sub-panel B2B, the notching was made, the ribs could be judiciously reduced, heightening made and the mine management did not experience delayed main fall and had a successful narrative for all the stakeholders. ii) Induced caving by drilling long holes from the goaf edges and then suitably blasted down was found to assist in mitigating the abutments in the working areas and, therefore, is recommended. After the main fall, smooth and regular caving was achieved in both the sub-panels. iii) Because of the judicious extraction of ribs and better caving management, the left-out coal in the goaf was within the manageable limit as far as spontaneous heating/fire is concerned. iv) R- VI seam is found to be more prone to spontaneous heating as indicated by determined critical and crossing point temperatures.

	v) The thickness of the coal seam is in the range of critical value (5-8m) and, therefore, susceptible to spontaneous heating from the Goaf Frictional Ignition point of view. vi) Moisture content and Volatile Matter content in coal are contributing factors in spontaneous heating and it may facilitate the ignition process during roof falling. Control in loss of moisture and establishing fire-ladder (Fig. 5.1, Section II) may be helpful in avoiding the occurrence of heating in the goaf. vii) Intake air quantity is required to be cool and of sufficient quantity in the order of 1800 m /min (Table 1). Initially, the pressure drop across the panel is required to be maintained as low as possible. viii) Fire control measures, viz. Application of water mixed with sodium silicate (Fig. 6.8, Section II) and ventilation control (Fig. 7.5, Section II) are found effective, however, its application in a more systematic manner is required, including minimizing the effect of diurnal change in Barometric pressure. This research project has an important deliverable i.e. to optimize the number of pillars to be extracted in a panel even in case of low-incubation coal seams like R-VI seam. The researchers and implementers are happy to receive the final review-comment of CIL R&D board attended by experts, suggesting in straight succinct terms about the accomplishment (pl. refer Appendix I). The research, therefore a path-finder, may be used to design a feasible and optimal method of coal extraction in many such thick seams in Raniganj and Jharia Coalfields in future propositions.