LIST OF ON-GOING R&D PROJECTS OF CIL
[As on 01.04.2021]

Sl.No.	Name of the projects and its details	Date of start	Date of completion	Approved outlay [Rs. In lakh]
1	**Underground Trapped Miner Location system [project code: CIL/R&D/1/35/10]** Implementing Agencies: TCS/CMC, Kolkata and CMPDI, Ranchi. **Objectives:** ➢ Establishment of a reliable system capable of achieving the primary goals of: o Locating trapped miners during/after a disaster. o On line monitoring and facilitation of miners for regular operations through data and voice communication along with alerts. A composite network will be developed and will be demonstrated at the identified mine Jhanjra in Eastern Coalfields Limited.	Jan. 2010	June 2021 No trial has been undertaken under this project within revised schedule of June 2021 As such, project could not be completed.	507.45 [TCS/CMC: 470.47; CMPDI: 36.98]
2	**Design and development of an integrated system for monitoring and control of man and machine, to enhance safety and security in mines.** **[** Project code: **CIL/ R&D/1/52/2012]** Implementing Agency: CIMFR, Dhanbad & Aryan It Solutions(AITS), Dhanbad and CCL, Ranchi **Objectives:** ➢ To develop an integrated system for management of man and machine along with safety and security. ➢ To keep record of all activities. ➢ To track incoming and outgoing transport vehicles. ➢ Ensure proper vehicle utilization in coal mines.	Jul. 2012	May 2017 [Could not be completed till date to some un-avaoidable reasons]	437.29 [CIMFR: 60.59 AITS: 376.70]

Sl. No.	Name of the projects and its details	Date of start	Date of completion	Approved outlay [Rs. In lakh]
3	**Development of guidelines for prevention & mitigation of explosion hazard by risk assessment and determination of explosibility of Indian coal incorporating risk based mine emergency evacuation and re-entry protocol. [** Project code: **CIL/R&D/1/60/2016]** Implementing Agencies: CIMFR, Dhanbad, IIT-ISM, Dhanbad, S&R Division, CIL (HQ), Kolkata and SIMTARS, Australia **Objectives:** i.) To conduct risk assessment for identifying the gaps and shortcomings in existing fire & explosion prevention technology in Indian mines. ii.) Characterisation of coal dust with respect to explosibility and self-heating characteristics from different coalfields of India iii.) Optimization of suitable inert material for mitigation in laboratory condition by 20 litre explosion chamber. iv.) Simulation of coal dust explosion initiated by methane explosion along with study of effect of different inertizing agents in 30 m long propagation tube. v.) Computational Fluid Dynamic (CFD) simulation of coal dust explosion in laboratory condition and its application to real time situations. vi.) Development of guidelines for prevention and mitigation of fire and explosion hazards in underground coal mines. vii.) Study and analysis of existing system of emergency response system prevailing in Indian coal mining industry with a view to find out its limitations. viii.) To develop risk assessment based Mine Evacuation & Re-entry Protocol to Support Emergency Response Decision System for underground coal mines of India.	15th April 2016	14th April 2021	2413.21 [IIT-ISM: 1617.07 , CIMFR: 796.14]

Sl. No.	Name of the projects and its details	Date of start	Date of completion	Approved outlay [Rs. In lakh]
4	**Indigenous Development of Through The Earth (TTE) Two- Way Voice Communication System for Underground Mines.** [Project code: CIL/R&D/01/62/2016] Implementing Agencies:IIT, Bombay and CMPDI, Ranchi . **Objectives:** ➢ To develop a wireless system that would support two – way voice communication and study the effect of various earthy materials present in different underground mines on developed Through The Earth (TTE) communication system.	15th Oct. 2016	March 2021	129.56 [IIT, Bombay: 111.56 CMPDI:18.00]
5	**Requirement of air in mine for Mass Production Technology**. [Project code: CIL/R&D/01/63/2016] Implementing Agency: UMD, CMPDI(HQ), Ranchi **Objectives:** ➢ Optimization of ventilation requirement for mass production technology with special reference to Indian coal mines. ➢ To find out minimum infrastructure required in terms of inclines, shafts, fan, drifts, fan capacity etc for a mine where mass production technologies can be introduced. ➢ To study the effect of particulate matters emitted from diesel equipment in underground mines and effects of formation of aldehydes and ketones on a mine environment in UG mines.	1st Nov. 2016	30th Sept. 2021	491.27

Sl. No.	Name of the projects and its details	Date of start	Date of completion	Approved outlay [Rs. In lakh]
6	**Development of Guidelines for Increasing the Height of Overburden Dumps at Opencast Coal Mines in India.** [Project Code: CIL/R&D/01/64/2017] Implementing agencies: Slope Stability Cell, OC Division, CMPDI (HQ), Ranchi and IIT, Delhi **Objectives:** ➢ To make scientific guidelines for increasing the height of the overburden dumps at opencast coal mines through a detailed geotechnical characterization and stability analysis of coal mine overburden dumps in India to meet techno-economic and operational challenge to go for the most efficient overburden dump design, that is steep enough to be safe and flat enough to be economically acceptable.	1st June 2017	31st May 2021	428.08 [CMPDI- 378.45 IIT, Delhi- 49.63]
7	**Development of Virtual Reality Mine Simulator (VRMS) for improving safety and productivity in coal mines. [** Project code: **CIL/R&D/01/67/2017]** • Implementing Agencies: IIT-ISM, Dhanbad, UMD, CMPDI, Ranchi, BCCL , NCL and UQ SMI- JK Tech Pty. Ltd., Australia • **Objectives:** • Development of an immersive 360-degree Virtual Reality Mine Simulator (VRMS) to simulate workplace environment for mines safety training under various scenarios and development of safety training strategies using various training aids at IIT-ISM, Dhanbad in collaboration with UQ SMI- JK Tech Pty. Ltd., Australia	01st Sep. 2017	May 2022	1410.40 [IIT-ISM-1320.40 CMPDI:90.00]

Sl. No.	Name of the projects and its details	Date of start	Date of completion	Approved outlay [Rs. In lakh]
8	**Development of guidelines for design of all tiers of shovel-dumper dump above dragline dump, with delineation of phreatic surface, within dragline dump, throughout the year and validation study on two dragline mines of Coal India Limited (CIL)** [Project code: CIL/R&D/01/68/2018] • Implementing agency: BIT, Mesra, S&R Division, CIL, Kolkata • **Objectives:** ❖ To develop guidelines for design of all tiers of shovel-dumper dump above dragline dump with delineation of phreatic surface within dragline dump throughout the year and assessment of its impact on stability to reduce the land requirement for external dumping in opencast excavation, with due consideration of safety. ❖ The proposed guidelines will be applicable to all the mines of Coal India Limited, where shovel and dragline dumps exist.	1st May 2018	January 2022	75.30
9	**Design guidelines for underground coal extraction beneath massive competent strata: a case study validation**. [Project code: CIL/R&D/01/70/2018] • Implementing agencies: WCL, Nagpur; and CIMFR, Dhanbad • **Objectives:** ❖ To provide implementable solution to a severe geotechnical problem while extracting coal below massive competent strata (Basalt traps). Maori mine of Kanhan area, WCL [where coal measures are overlain by massive Basalt Traps of volcanic origin] has been identified for execution of the project.	1st May 2018	30th April, 2020 [Delayed due to DGMS permission]	407.685 [WCL-255.907 CIMFR-151.778]

Sl. No.	Name of the projects and its details	Date of start	Date of completion	Approved outlay [Rs. In lakh]
10	**Design of cost effective process flowsheet for improved washing efficiency of Indian Coking and Non-coking coals.** [Lab scale only] **[** Project code: CIL/R&D/02/07/2017] **Objectives:** ❖To develop a suitable beneficiation strategy to effectively utilize the high ash Indian coals for production of low ash product which can be used in metallurgical and thermal power stations. Through this objective, the country will be able to augment and meet the requirement of washed coal, either through designing new washing circuits and/or by improving the washing efficiency of the existing washeries. ❖The outcome of the project will be useful to CIL in making decisions on selection of an appropriate equipment (for coarse coal), just by washing the given coal in both Dense Medium Cyclone and Batac Jig simultaneously at the pilot-scale. Based on the relative performance results obtained from the trial runs, it will be possible to decide upon the type of washing unit needed.	17th Apr. 2017	25th June 2021	238.65 [IIT-ISM-223.65 ; CMPDI: 15.0]
11	**Demonstration of Coal Dry Beneficiation System using Radiometric Technique**. Project Code: CIL/R&D/2/05/10 Imple. Agencies : CMPDIL, Ranchi ; Ardee Hi-Tech Pvt Ltd, Vishakhapatnam & BCCL, Dhanbad **Objectives:** ❖ To develop a demonstration scale plant for dry deshaling of coal based on modified radiometric detection and pneumatic removal technology (ArdeeSort).	01st Sep. 2010	31st Dec. 2020 [As field trial could not be undertaken till date. As such, project could not be completed within revised schedule].	2565.70 [CMPDI-1814.40, ArdeeHi-Tech-751.30]

Sl. No.	Name of the projects and its details	Date of start	Date of completion	Approved outlay [Rs. In lakh]
12	**High ash coal gasification and associated upstream and downstream processes [Coal to Chemicals, CTC)** **[**Project code:CIL/R&D/03/03/2017] **Implementing Agencies:** IIT-ISM, Dhanbad, IIT, Roorkee, CMPDI, Ranchi, MCL, Sambalpur, ECL, Sanctoria and CCL, Ranchi. **Objectives:** ❖ To convert high ash (preferably 35-45%) Indian coal to value-added chemicals through indigenous developed coal gasification technology with proper environmental considerations through R&D efforts.	20th Jul. 2017	19th Jul. 2020	2160.721 [IIT-ISM-1872.007; IIT,Roorkee-131.804; CMPDI-156.910]
13	**Development of a methodology for regional air quality monitoring in coalfield area using satellite data and ground observations.** **[**Project code: **CIL/R&D/04/08/2017]** • Implementing Agencies: Geomatics Department, CMPDI (HQ), Ranchi and National Remote Sensing Centre (NRSC), ISRO, Hyderabad. **Objectives:** ❖To develop a methodology for air quality monitoring and modeling by analysis of satellite data at regional level and collection of ground based observations with emphasis on dust (PM_{10}, $PM_{2.5}$), NO_x, SO_x in coal field areas.	15th Mar. 2017	Dec. 2021 [Delayed due to delay in procurement of equipment]	709.82 [NRSC-589.87; CMPDI-119.95]
14	**Restoration of Orchid flora of Makum Coalfield areas of Digboi Forest Division.** **[**Project code: CIL/R&D/04/09/2018] **Objectives:** ❖ The prime aims of above project are inventorization of the orchids found in NEC areas, mass multiplication of the rare, endangered and threatened orchids and re-introduction in wild for germplasm conservation of important orchids of Digboi forest region, which will help them in colonizing the forest that may be developed in future on the mined areas and mine-dumps and to Conserve them outside the range (ex-situ conservation) in orchidaria at RFRI, Jorhat and NEC, Margherita.	20th Jan. 2019	19th Jan. 2022	45.14

Sl. No.	Name of the projects and its details	Date of start	Date of completion	Approved outlay [Rs. In lakh]
15	**Development and adoption of Real-Time Prognosis System (RTPS) for cost effective safe operation of mobile machinery: show-cased demonstration of dumper fleet. [Project code:CIL/R&D/01/71/2019]** Implementing agencies: IIT, Kharagpur, CIMFR, Dhanbad, Lulea Technological University (LTU), Sweden and ECL, Sanctoria. **Objectives:** ❖ The prime objective of the project is the development of surface mining asset utilization framework, based on advanced technology and demonsration of above framework in a conventional surface mine with shovel-dumper combination with a specific aim to show-case demonstration of prognosis technology for dumper fleet with better utilization and safety**.**	16th Dec.2019	15th Dec. 2021	440.30 [IIT - 180.36 ; CIMFR, -180.00 LTU- 79.94]
16	**Development of suitable Paste Fill material from Fly Ash (Power Plant Reject) and its transportation system to underground coal mines for stabilization of working as an alternative of sand stowing for increasing the percentage of extraction of coal with due regard to safety and environment to ascertain its cost effectiveness in Sarni UG Mine, Pathakhera Area, WCL. [Project code:CIL/R&D/02/10/2019]** Implementing agencies: WCL, Nagpur and CIMFR, Dhanbad **Objectives:** ❖ To ascertain the Strength of fly ash paste as stowing to withstand sufficient abutment pressure. ❖ To increase % of extraction of coal over the present Wide & Stall method through introduction of fly ash paste filling ❖ To ascertain cost effectiveness ❖ To improve the Safety and excavation rate of coal mining ❖ To ascertain the effect on Surface Subsidence. ❖ To ascertain the impact on environment. ❖ Optimum utilization of Coal Reserve. ❖ To comply the conditions of MoEF & MPPCB & DGMS.	16th Dec.2019	15th Dec. 2021 (DGMS not convinced to grant permission for field trial, as such further progress is stalled)	352.76 WCL-2379.28 CIMFR-73.48

Sl. No.	Name of the projects and its details	Date of start	Date of completion	Approved outlay [Rs. In lakh]
17	**Bench Scale Study on reducing ash content (mineral matter) from Washery Grade Coking coal and high ash non-coking coal through oil agglomeration** **[Project code: CIL/R&D/02/09/2020]** Implementing agencies: NML, Jamshedpur and CED Deptt., CMPDI **Objectives:** ➢ Identification of coal blocks/mines of non-coking coal and coking coal to assess the suitability for oil agglomeration. Coking coals from mines of Rajrappa, Topa, Konar & Non-coking coa of Magadh of CCL and Non-coking coal from Jagannath, Hingula and Lakhanpur mines of MCL will be used for this study. Both CCL and MCL have agreed to provide 150 kg of each coal ➢ Indigenous development of suitable oil agglomeration process unit including Oil separation, drying and palletization of clean coal (indigenously fabricated) suitable for Indian coal bearing high ash level at 1 kg laboratory scale. ➢ Characterization of raw coal to assess suitability of the agglomeration process. ➢ Carrying out oil agglomeration experiments on selected Indian coal to optimize operational parameters. ➢ Physical separation/chemical extraction of oil from agglomerated clean coal. ➢ Drying process optimization for clean coal to make it free flowing for power plant application. ➢ Palletization of agglomerated clean coal.	1sr Oct. 2020	30th Sept. 2021	53.62 NML - 36.16 CMPDI– 17.46

Sl. No.	Name of the projects and its details	Date of start	Date of completion	Approved outlay [Rs. In lakh]
18	**Development of an indigenous optical fiber based instrument for measuring in-the-hole Velocity of Detonation [VOD] and analyze the performance of explosive in field condition.** **[Project code: CIL/R&D/01/72/2021]** Implementing agencies: Innovation Cell, CMPDI in association with Mine Electronics Division, CMPDI (HQ), Ranchi & Blasting Division, CMPDI **Objectives:** ❖ To develop Indigenously Velocity of Detonation (VOD) measurement instrument which can be used for determining VOD of in-hole explosives as well as all other cartridge explosives, detonators and accessories ❖ To Develop fiber optic cable-based data acquisition system with ±10 nanosecond accuracy ❖ To Implement in-built safety features for security and authenticity of users and products being tested ❖ To develop calibration facility for ensuring accuracy of the instrument ❖ To develop in-built computational capability for auto report generation.	10th February 2021	9th February 2023	495.97 CMPDI - 495.97
19	**Effect of Blasting on Opencast Mine Dump and Development of Relationship between Blast Induced Vibration and Dump Design.** **[Project code: CIL/R&D/01/73/2021]** Implementing agencies: Blasting Division, CMPDI; BIT, Mesra and IIT-ISM- Dhanbad **Objectives:** ➢ Study the existing dumps and to evaluate the dynamic characteristics dump materials. ➢ To assess and investigate the impacts of the dynamic stresses generated due to blasting on the dump slopes at different maximum charge per delay. ➢ Assessment of stability of OB dump slopes through Limiting Equilibirum Method, Finite Element Method and	10th February 2021	9th February 2023	344.22 CMPDI- 238.36 BIT,Mesra- 33.00 IIT-ISM-Dhanbad-72.86

	discrete element framework considering blast-induced vibrations. ➢ Comparative study of dump slopes based on Limiting Equilibrium methods, Finite Element method and Discrete Element Method. ➢ Development of Relationship between Blast Induced Vibration and Dump Design ➢ Framing design guidelines for the stability of OB dump slopes with suitable strengthening measures considering dynamic loading			
20	**Design and Development of Drop Test Facility for Pit Bottom Buffer, used in Underground Coal Mines.** **[Project code: CIL/R&D/01/74/2021]** Implementing agencies: CMERI, Durgapur & ECL, Sanctoria **Objectives:** Design and development of drop test facility for bottom buffer to restrict sub-standard pit bottom installation in underground mines	10th February 2021	9th February 2023	248.61 CMERI, Durgapur – 248.61 ECL, Sanctoria- Nil
21	Forensic investigation related to Geo-technical aspects in order to stabilize the foundation soil of expansive nature and implement suitable ground improvement technology to sustain and enhance the optimum overburden dump height. **[Project code: CIL/R&D/04/11/2021]** Implementing agencies: Civil Engineering Division, CMPDI(HQ), Ranchi and RI-IV, CMPDI, Nagpur; VNIT, Nagpur and WCL, Nagpur **Objectives:** ➢ To obtain the physio-mechanical properties of foundation soil: Shear strength parameters, flow parameters of the foundation soil & OB dump material and to perform the geotechnical characterization, interpretation based on the preliminary field monitoring data ➢ To critically analyse and evaluate the failure pattern of the existing dump through finite element modelling and numerical simulation, ➢ To propose and design suitable stabilization methodology to improve the	10th February 2021	9th February 2023	492.26 RI-IV, CMPDI - 359.33 VNIT, Nagpur – 132.93 WCL-Nil

	bearing capacity of foundation soil in order to maximize the optimum dump height, ➢ field demonstration of the suggested stabilization technique on the site for about 90 m stretch on a pilot model scale basis and ➢ Instrumentation and detailed monitoring of the field demonstration to validate the applicability and adopt suitable corrective measures, if any.			
22	Design and deployment of Ventilation Fan Wind Power Recovery System as an alternate source of Electrical Energy in Underground Coal Mines. [**Project code: CIL/R&D/04 /12/ 2021**] Implementing agencies: IIT-ISM, Dhanbad & ECL, Sanctoria **Objectives:** ➢ Designing experimental model for generating electricity from the exhaust air flow of main Mine Ventilation Fan. ➢ Generating the recovery electricity from the exhaust wind power. ➢ Recycling of electricity using wind turbine and could be fed to the grid or stored by developing suitable set-up. ➢ Reduction of the existing ventilation fan power consumption. ➢ The Field-Trial at real coal-mine.	10th February 2021	9th February 2024	66.70 IIT-ISM, Dhanbad - 66.70 ECL- Nil

Sl. No.	Name of the projects and its details	Date of start	Date of completion	Approved outlay [Rs. In lakh]
23	To develop an Artificial Intelligence (AI) based machine learning solutions to enable prediction of occurrence of fire in Open cast mines extracting locked coal pillars with safety. **[Project code:CIL/R&D/ 05 /01 / 2021]** Implementing agencies: IIT-ISM, Dhanbad **Objectives:** ➢ To develop a hand-held AI based Machine Intelligence solution to predict the occurrence of Fire / No fire, specific to mine location ➢ The proposed tool will be equipped with thermal scanner and display mode indicating a safe range of mine operating parameters and detect occurrence of fire up to a distance of 30 mt.	10th February 2021	9th February 2023	25.99 IIT-ISM, Dhanbad - 25.99
24	**Design of Protective Barrier Pillar against Large Water Head in Underground Coal Mines** **[Project code:CIL/R&D/01/75/2021]** Implementing agencies: IIT (BHU), Varanasi and ECL, Sanctoria **Objectives:** ❖ To examine the mechanism of loading and failure mechanism of water barrier pillars ❖ To develop understanding of stress distribution and water seepage through water barrier and its impact on the pillar strength with the rise in water level. ❖ To estimate barrier pillar width in presence of high water head in different geo-mining conditions. ❖ To provide guidelines for design of water barrier pillars in underground coal mines.	1st May 2021	30th April 2023	87.47 IIT-BHU -87.47

Sl. No.	Name of the projects and its details	Date of start	Date of completion	Approved outlay [Rs. In lakh]
25	**Prediction of particulate matter and gaseous pollutants concentration through Artificial Neural Network [ANN], Probabilistic Neural Network [PNN] and Classification and Regression Tree [CART] models and comparison with CALPUF and AERMOD in Singrauli coal mines** **[Project code:CIL/R&D/05/02/2021]** Implementing agencies: BIT, Mesra ; Environment Division, CMPDI and NCL **Objectives:** ➢ To validate the **prediction accuracy** of the conventionally used softwares AERMOD and CALPUFF under Indian mining conditions. ➢ To **develop intelligent soft computing models** using ANN (Artificial Neural Network), PNN (Probabilistic Neural Network) and CART (Classification and Regression Tree) for the prediction of concentration of particulate matter (PM_{10} and $PM_{2.5}$) and gaseous pollutants (SOx and NOx) from meteorological data and emission data of Singrauli mines. ➢ To compare and validate the **prediction accuracy** of the developed soft computing models and conventionally used softwares AERMOD and CALPUFF	1st May 2021	30th April 2024	85.25 BIT Mesra – 61.14 CMPDI - 24.11