Minutes of Review Meeting of ongoing projects under S&T Scheme of Ministry of Mines held on 18-19 May 2017 at NFTDC Hyderabad.

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1. Development of viable technique for assessment of reclaimed land and for safety of structures under settling environment, NIRM, Karnataka. (File No. 14/37/2012)

**Implementing Institution:** National Institute of Rock Mechanics, Champion Reefs, Kolar Gold Fields-563117, Karnataka.

- **Project Cost:** Rs. 137 lakhs
- **Duration:** 3 years
- **Project Start Date:** 28.1.2013
- **1st Release:** Rs. 59.50 lakh dt 28 Jan 2013

**Objectives:**

(i) In-situ geophysical measurements of P and S wave velocity for evaluating soil stiffness and other relevant parameters for assessing settlement potential.
(ii) Non-destructive testing of ground and structures based on integrated geophysical techniques; (iii) Laboratory Measurements on rock samples; (iv) analysis; (v) derivation of relationship between rock mass and measured properties; (vi) methodology for evaluation of sub surface stability.

**Work Done**

(i) Procurement actions that were delayed for nearly 2 years could be completed by December 2016;
(ii) In-situ (Chennai metro & Chenab Bridge (Railways) and lab measurements completed by March 2017;

**Pending work:**

(iii) Subsidence studies in identified coal mining area of SCCL
(iv) Analysis and derivation of model is underway and is slated to be completed by Dec 2017;
(v) Validation and report preparation will be completed by March 2018;

**Remarks and Recommendations:**

(i) Project has been delayed primarily due to procurement related issues;
(ii) PERC suggested taking up mining site as in SCCL to validate the project
(iii) Project Extension given up to 31 March 2018
(iv) Next tranche of funds if required by NIRM shall be released as per U/C and expenditure certificates.
2. Estimation of seismic hazard in and around the mines out areas of Kolar Gold Fields, NIRM, Karnataka. (File No. 14/29/2012)

Implementing Institution: National Institute of Rock Mechanics, Champion Reefs, Kolar Gold Fields-563117, Karnataka

- Project Cost :Rs. 63.57
- Start Date 28.1.2013
- Duration:3 years
- Amount of first Release : Rs. 56.71 lakh

Objectives:
(i) Monitor seismic activities and locate their hypocenter.
(ii) Identify the regions where seismic events occur within a depth of 200m which would affect the dwellings.
(iii) Estimate the seismic hazard in the mines of Kolar Gold Fields.

A network of eight sensors (five on the surface and three in boreholes) has been designed to monitor the rock mass response due to the abandoned and water-logged gold mine around Kolar Gold Fields, and to quantify and monitor the seismic hazard. The monitoring will detect strong and unexpected changes in rock mass behaviour in real time with online data processing and analysis.

Work Done:
(i) Procurement of equipments completed
(ii) Construction of seismic stations completed
(iii) Installation of sensors done and in operational status
(iv) Seismic monitoring in progress

Pending Work:
(v) Seismic data acquisition is a continuous activity and is more of stochastic nature; Data to be acquired for at least a year which will be till May/June 2018
(vi) Analysis of and interpretation of data is also done in parallel;
(vii) Identification of potential risk zones and seismic risk hazard are the most important outcomes of this project and there will be clarity on this after at least 9 months of data acquisition (March 2018)
(viii) Final report

Remarks and Recommendations:
(i) Project has been delayed primarily due to procurement related issues;
(ii) As the outcome of the project, namely identification of potential risk zones and quantum of hazard is entirely dependent of collection of longer term data of over a year, it is necessary for the project to continue till June 2018.
(iii) Project Completion date extended till 30 June 2018 and last tranche of funds if required by NIRM be released as per U/C and expenditure certificates.
3. Beneficiation of low grade iron ore and tailings by selective flocculation
(File No. 14/20/2012-MetIV)

Implementing Institution: Indian School of Mines, Dhanbad.

Project Cost: Rs. 30.984 Lakhs               Duration: 3 years
Project Start Date: 18.3.2013               1st Release: Rs. 21.86 lakh

Objectives:

(i) Identification, collection and characterization of low-grade iron ore & tailings samples.
(ii) Formation of flocculation scheme for their beneficiation.
(iii) Identifying the best flocculant and optimizing the parameters.

Work Done:

(i) Selective flocculation was investigated using starch, polyacrylic acid, polyacrylamide, guar gum, with caboxymethyl and sodium hexametaphosphate as dispersants;
(ii) Mineralogical studies done on tailings show iron grade to be 56.49% and being made up of hematite, goethite, limonite along with gangue minerals of kaolinite, quartz and gibbsite;
(iii) All four flocculants gave enhancement above 63% and typically in the range of 63-67%; highest enhancement up to 66.7% was achieved using starch as the flocculant and recovery was 88%

Pending Work

(iv) Final report submission

Remarks and Recommendations:

(i) It was observed that scale up potential of selective flocculation has to be seen from techno-economics perspective which at present seems not viable
(ii) Project stands completed and the final report be submitted
(iii) Remaining funds to be released on submission of final report, U/C and expenditure certificates.

5. Development of Super Thermal Aluminium (STAL) conductor for Indian Power Sector;
(File No. 14/20/2013-Metal IV)

Implementing Institutions: Jawaharlal Nehru Aluminium Research Development & Design Centre, Nagpur- 440 023 and Non-Ferrous Technology Development Centre, Hyderabad- 500058.

Project Cost: 495.40 lakhs (Total for both agencies) | Rs. 226 Lakhs (JNARDDC, Nagpur) and Rs. 269.40 Lakhs (NFTDC, Hyderabad)

Project Start Date: 13.1.2014   Duration 3 years
Amount of first release: Rs. 10 lakhs (JNARRDC); Rs. 10 lakhs (NFTDC)
Additional Disbursals:
Rs. 56 lakhs (JNARDDC); Rs. 64 lakhs (NFTDC) dt. 13.8.2014
Rs. 112 lakh to JNARDDC & Rs. 124.4 lakh to NFTDC dt 15.7.2015

Objectives:

To develop Super Thermal Resistant Aluminium Conductor with high capacity, optimum thermal and mechanical properties while carefully selecting and controlling alloy additions and thermo-mechanical treatments for the benefit of Indian Electrical (Transmission & Distribution) sector

Current Status & Work Done: (January 2014 till March 2017)

JNARDDC:
Cast bar with 0.2-0.3% Zr carried out and produced. All alloys were subjected to different heat treatment conditions to optimize the conductivity and mechanical properties; Heat treatment trials of wire rods and multi stage ageing heat treatment done to achieve 59 to 60% IACS conductivity in 36 hrs. and 0.25% Zr was found to be optimum. Wire rods of 9.2 mm (containing 0.25 % Zr) produced with help of Minex Metallurgical Ltd; 250 kg industrial trial conducted in a cable manufacturing company.

NFTDC:
(Material - Process know-how - Process equipments - Product Developments)
(i) Al-Zr-Y Material development with Yttrium (0.08-0.14%) additions developed and an optimized new alloy composition of Al-0.25Zr-0.1Y achieved after multitude of experiments on composition, casting conditions, annealing, wire drawing and final ageing experiments; (ii) An end to end process technology line designed, fabrication and commissioned; A state of art (a) Linear caster, (b) wire rod section rolling mill; (c) modification existing wire drawing equipment in place; (iii) extensive experiments on thermo-mechanical processing conducted to achieve the golden target of 165/60/24, viz, STAL AT3 conductor material with 165 MPa tensile strength, 60% IACS conductivity and ageing time of only 30 hrs; (iv) an alternate direct horizontal casting process under study which will reduce the process equipments cost and reduce the overall process steps as well as time. Out of 5 major tasks and milestones, four have been completed by NFTDC. The last milestone pertains to pilot production of 1.5 tons of Al-0.25Zr wire in the diameter of 3mm and stranded product of cable with invar core is underway.

Pending work: (April – Sept 2017)

JNARDDC: To continue heat treatment and cold work studies;
NFTDC: 1kM long stranded cable is being developed as the final product

Remarks and Recommendations:

(i) Committee appreciated the extensive work done (approx 90% completed) in this ambitious project in material to end product development including process equipments design and development;

(ii) project is on more or less on schedule given the magnitude of the process development and 1kM long stranded cable product.
(iii) The project teams in JNARDDC and NFTDC asked for 6 month extension (till Sept 2017) so as to complete large scale melting trials in industrial setting (by JNARDDC) and 1kM long product development which requires 1.5 ton of melting, casting, wire drawing and stranding of the alloy.

(iv) As the two institutions have made the substantial progress, the extension is granted up to 30 Sept 2017 and the two institutions should submit the final technical report.

(v) IP asset creation and technology transfer to potential cable manufacturers should be taken on completion of the project.

6. Development of process for making value added materials from ilmenite mineral; 
(File No. 14/05/2013-MetIV)

Implementing Institution: IMMT, Bhubaneswar.

Project Cost: Rs. 24.90 Lakhs  Duration: 3 years  
Project Start Date: 03.1.2014  1st Release :  Rs 7.80 lakh dt 3.1.2014 
                                      2nd Release:  Rs 9.80 lakh dt 2.6.2015

Objectives:

The aim and objective of present proposal work to develop a process for making value added materials from ilmenite mineral

Work Done: (I Yr and II Yr)

(i) Recruitment of project personals and procurement of equipment/ chemicals etc.
(ii) Preparation of TiO2 slag from ilmenite by thermal plasma.
(iii) Optimize the process conditions to produce high grade TiO2 slag.
(iv) Titanium carbide (TiC) powder by using titania rich slag and charcoal reaction followed by leaching.

Remarks and Recommendations:

(i) The project period of 3 years stand completed in March 2017.
(ii) In line with the recommendation of the midterm review done on 17th May 2016, Director, NFTDC reviewed the project in IMMT Bhubaneswar; pending work since May 2016 have been completed with regard to conversion of titanium rich slag into TiC; Director, NFTDC advised the IMMT project team to see if TiN can be made by simple reaction with nitrogen gas within the next 3 months, though this is not part of the original project objectives.

(iii) The project stands completed and final report can be submitted. IMMT team was keen on continuing the project to see the possibility of producing TiN.

(iv) While the project team is encouraged to explore TiN synthesis, it is recommended that the project be completed and closed by 30th Sept 2017.

(v) On submission of U/C, the actual expenditure be released in the third tranche.
7. **Value addition in mine waste tailing materials through geopolymer formation**  
*File No. 14/15/2013-Metal IV*

**Implementing Institution:** Dept. of Mechanical Engineering Christ University, Faculty of Engineering, Kumbalagodu, Kaniminike, Bangalore- 560060

Project Cost: Rs. 12 lakh  
Duration: 3 years  
Start Date: 5.5.2014  
Amount of first release: Rs. 5 lakh dt 5th May 2014

**Objectives:** In this project a geo-polymerization technique is used to stabilize iron ore mine tailings waste so that they can be completely recycled and res used.

**Remarks and Recommendations by Review Committee:**

(i) In the previous review held on 30th April 2016, it was recommended that long term weathering tests and further optimization of process parameters for varying inputs of IOT, GGBS and Fly Ash;

(ii) It is given to understand that the original PI has left the Institute and Co-PI is now handling the Project.

(iii) The Project Team did not come for this review on 18-19th May 2017;

8. **Development of Copper Bio-leaching methodology/Technique from Tailing Waste at Hindustan Copper Limited, Khetri**

**Implementing Institution:** BITS, Pilani, Rajasthan 333031

Project cost: Rs. 30.38 lakh  
Duration: 3 years  
Start Date: 2.5.2014  
1st release: Rs. 16.38 Lakh, dt 2nd May 2014  

**Objectives:**

(i) Isolation/selection & identification of target micro-organisms

(ii) Lab scale study of process parameters for tailing bioleaching

(iii) Fabrication of pilot plant & process optimization

(iv) Use of bioleached tailing as biofertilizer

**Work Done (May 2014 – May 2017):**

All of the above activities stand completed except column leach to provide continuous culture system to overcome the limited supply of biomass; Preliminary studies to use the treated tailings (after bioleaching) for making bricks were attempted (which is not part of the objectives)
Remarks and Recommendations by Review Committee:

(i) The project stands completed in May 2017. The members observed that the project team has not apprised itself of all the earlier work done in India, which was pointed out in the earlier review as well;

(ii) The project team has requisitioned 6 month extension which is not warranted just to continue column leaching trials;

(iii) A detailed project report to be submitted to SSAG as well as Hindustan Copper Limited. In the final report, a clear flow sheet to be provided to HCL clearly outlining the starting Cu Conc./Cu recovered and Cu in treated tailings with mass, energy and water balance. Techno-economic evaluation of the process to be included in the final report. As per U/C, any outstanding expenditure can be released against 3rd Tranche.

(iv) The final report to be submitted before 30th September 2017.

9. Recoverable Reserve Estimation using Gaussian Copula based ore body simulation along with Open Pit and Stope Optimization Techniques

Implementing Institution: NIT Rourkela and IIT KGP

Project cost: Rs. 24.52 lakh  Duration: 3 years
Start Date: 8.5.2014
First release: Rs. 9.06Lakh; Rs 4.53L each to NIT Rourkela & IITKGP, dt 8th May 2014
Second Release: Rs 7.06 Lakh; Rs 3.53L each to NIT and IITKGP dt 18th Oct 2016

Objectives:

(i) Development of a non-Gaussian geostatistical simulation models using copula functions.
(ii) Estimation of copula parameters and spatial covariance model parameters using maximum likelihood algorithm.
(iii) Application of the proposed algorithm in the copper data set.
(iv) Development of economic block model using the underground cost data and development of computer code

Work done (till May 2017)

- Mine visit and data collection work have been completed. One more visit may be required to collect production sample data to validate the model.
- Copula based v-transformed non-Gaussian model is developed and parameters are estimated using maximum likelihood algorithm
- Copula based simulation map has been generated and now being tested on copper data set.
- Computer code on network flow algorithm is developed and tested on copper data set.
- Computer code on floating cone algorithm has been developed and now being tested on underground stope optimization.
Remarks and Recommendations:

(i) The project duration of three years is to end by May 2017. Given that the nature of the project is theoretical and simulation based, it can be considered completed;

(ii) Validation of the simulation models and algorithm has to be applied in an actual mining environment; in earlier review held on 17th May 2016 at Kolkata, it was pointed that validation with actual mine data is needed and its application to be tested. The project team is to interact with Malanjkhand Copper Mine of HCL as indicated in their annual report;

(iii) On submission of U/C till 30th June 2017 and the final report, the remaining funds be released as per actual expenditure till June 2017.

10. Purification of commercial rare earth oxides, e.g. Ceria, by molten salt fusion and re-crystallization. (File No. 14/8/2014-Metal IV)

Implementing Institution: Non-Ferrous Material Technology Development Centre (NFTDC), P.O. Kanchanbagh, Hyderabad

Project Cost: Rs. 108.28 lakh; Duration: 2 years
Start Date: 16.12.2014 1st Release: Rs. 68.35 lakh dt 16th Dec 2014
2nd Release: Rs 35.93 Lakh dt 4th July 2016

Objectives:
(i) Application of molten salt fusion method to dissolve the impure, commercial grade ceria in melt and subsequent production of cerium sulphate, a starting precursor for all cerium based compounds, exploration of melting using induction/microwave heating.
(ii) Purification of ceric sulfates through multiple re-crystallization.
(iii) Synthesis of gadolinia/samaria doped ceria, with sinter-active properties, through carbonate precipitation route etc.

Work done: The following activities have been completed
2. Recrystallization and purification of ceric sulphate-impurities analysis using ICP-OES.
3. Reactor design, material of construction, accessories for scaling up to 10 kg product.
4. characterization of Gd doped cerium oxide.
5. Batch operations proved in pilot plant scale of 10kg product (25 kg input)
6. Final Electrochemical characterization of Doped Ceria in Fuel Cell application
7. Techno economics study based on batch operations & development of business Plan for make in India; this process is being considered for purification of other RE oxides as well.

Remarks and Recommendations by Review Committee:

(i) This is the only on-going project in the area of rare earths and the project is completed on schedule and the process - knowhow realized;

(ii) The pilot plant design and fabrication of all elements are completed and the members witnessed the on-going operation of the pilot plant;
(iii) Committee appreciated the TRL 3 to 7 translation in this project and appreciated operation of pilot plant in December 2016; the pilot is in operation since then.

(iv) PI and the team are encouraged to file patent and quickly move quickly to further scale up.

(v) Final Project Report to be submitted. Final tranche amount of Rs 4.0L to be released on receipt of any pending U/C and final report.

11. Integrated approach for development of process models and pilot production of aluminium alloy extrudates using porthole dies (File No. 14/12/2014-Metal IV)

Implementing Institution: Jawaharlal Nehru Aluminium Research Development & Design Centre (JNARDDC), Amravati Road, Wadi, Nagpur.

Project Cost: Rs. 298.06 lakh Duration: 3 Years
Start Date: 15.12.2014; 1st Release: Rs. 50.52L dt 15th Dec 2014;
2nd Release: Rs 194.02 L dt 21st July 2016

Objectives:

1. Flow stress data generation for various grades of aluminium alloys at different strain rates and in temperature range of 350 degree C to 50 degree C.
2. Development of process models for 3xxx and 6xxx series aluminium alloy extrudates based on flow stress data, numerical simulation and extensive press trials.
3. Product based die development and component development for industry

Work Done (Since 15th Dec 2014 till May 2017>> 2.5 years)

(i) Extrusion press and allied equipment has been ordered and it is expected to be installed in the next few months.
(ii) die manufacturing for typical prototypes;

Pending Work:
Extrusion experiments on actual die and press to be taken up on commissioning of press.

Remarks and Recommendations:

(i) The members urged the Director JNARDDC to take up necessary steps to complete the press related activities at the earliest;
(ii) This project has been sanctioned to JNARDDC with a view to bring in all requisite technical infrastructure as in software for deformation studies as well as die design, flow stress evaluation in UTM, die fabrication, extrusion press and allied equipment and product development for industry under one roof;
(iii) It is important that this project be completed in this FY 2017-18 and using all of these facilities, JNARDDC should serve the industry and run this facility on self financing contract R & D basis from FY 2018-19 onwards;
(iv) As per U/C as on 30th June 2017, the next tranche be released;
(v) As the extrusion press is currently under manufacture, the project PDC is extended till 31st March 2018 (3 months extension from original PDC of 31st Dec 2017) and it should close by 31st March 2018.
(vi) Once installation and commissioning of the extrusion press is completed, JNARDDC should conduct a one-day workshop for industry; thereafter JNARDDC should explore joint product development with industry and other institutions.

12. Development of low density emulsion explosives for energy efficient blasting in environmentally sensitive areas; 14/22/2014-Metal IV

Implementing Institution: Indian School of Mines, Dhanbad

Project Cost: Rs. 29.134 Lakhs  
Project Start Date: 16.12.2014  
Duration: 3 years

1. To develop low density emulsion explosives for energy efficient blasting in environmentally sensitive areas.
2. An investigation into influence of various properties of low density explosives on detonation behavior.
3. A comparative study between confined and unconfined VOD of explosives.
4. A study on influence of detonic behavior of developed explosive on blast fragmentation and blast performance.

Work Done (Dec 2014 till May 2016)
(i) Raw materials identified and physical suitability confirmed
(ii) Some laboratory and field trials completed
(iii) VOD with various densities of low density emulsion explosives
(iv) Digital video camera with accessories is still under procurement with additional funds from institute

Pending Work

Detailed study on fragmentation and blast performance to be done (objective (4))

Remarks and Recommendations:

(i) It was observed in the earlier review held on 17th May 2016 at Kolkata that project was getting delayed due to procurement actions; in the last one year, there has been some progress on this front and three out of four objectives listed above are done;
(ii) The project is due to end in Dec 2017 and the PI has requested extension for 3 months to complete the studies;
(iii) The interim progress report is very sketchy; U/C submitted so far shows unutilized funds to the tune of Rs 3.13L (31st March 2017) out of Rs 18.95 L released.
(iv) A more detailed technical progress report be submitted with U/C as on 31st June 2017 and next tranche of funds be released as per expenditure status in the U/C.
(v) Project PDC is extended by 3 months up to 31st March 2018.
(vi) Final Technical Report to be submitted on or before 31st March 2018.
13. Physico-chemical processing of low grade Chromite ore for beneficiation and agglomeration of fines for recovery of metal values; 14/23/2014-Metal IV

Implementing Institution: Jadavpur University, Kolkata

Project Cost: Rs. 47.0 Lakhs  
Duration: 3 years

Project Start Date: 25.12.2014  

Objectives:

(i) The intention of this project is enrichment to increase the chromium/iron ratio for the production of the high carbon ferrochrome/charge chrome. In addition
(ii) Fines generated at the mine sites to be utilized by agglomeration of the fines in the form if briquettes.
(iii) Further low grade ore need to be treated for the reduction of phosphorous content in the ore to make value added low phosphorous ferrochrome high temperature and corrosion resistant materials.

Work Done: (till May2017)

Progress Report not available in detail.

Remarks and Recommendations:

Based on the presentation, the review committee observed that the process being adopted is very complicated;
(i) PERC asked the PI to report within a week, the pending work to be done;
(ii) Detailed technical report on the progress made so far to be submitted for taking further view on this project.


Implementing Institution: Aligarh Muslim University, Aligarh-202002

Project Cost: Rs. 28.5375 lakh  
Duration: 3 years

Start Date: 29.12.2014  
1st Release: Rs. 19.5285L dt 29th Dec 2014  
2nd Release: Rs 4.3785L dt 18th Feb 2016

Objectives:

(i) To synthesize nano-photocatalyst which can operate under visible light by doping semiconductor with some metal/non-metal/transition metal by sol-gel and hydrothermal reaction technique?
(ii) To characterize the synthesized nano-photocatalyst using standard analytical technique such as FTIR, UV/Vis, SEM, TEM and XRD.
(iii) To determine the efficiency of the photocatalyst by monitoring the reaction of few selected organic compounds as a function of time under visible light
Current Status and Work Done (Till May 2017)

(i) In this project three semiconductors, such as TiO₂, ZnO and Bi₂O₃ doped with a variety of metal ions such as La, Mn, Ce and Nb at varying concentration have been synthesized using sol gel, hydrothermal and conventional heat treatment method.

(ii) Samples characterized by X-ray diffraction (XRD), UV-Visible Spectroscopy, Fourier transform infrared (FTIR) and Scanning Electron Microscopic (SEM) techniques. The XRD analysis of synthesized photocatalyst was found to exhibit characteristic peaks for crystallized phase. The SEM analysis displays the surface morphology. The UV-Vis absorption spectra of synthesized powder reveal absorption edge shift towards longer wavelength upon doping with metal ions.

The prepared materials show enhanced photocatalytic activity for degradation of selected organic pollutants, under visible light source. The higher activity may be attributed to absorption of more visible light leading to generation of higher photo-generated electron hole pairs and efficient separation of photo-induced charge carrier.

(i) The members while reviewing this project on April 30, 2016 advised improvement in increasing the absorption wavelengths beyond 450 - 500 nm via further studies on dopants; (ii) process scale-up to make cost effectively higher quantities of pure doped oxide semi-conductors; (iii) design of reactors for dye/organic pollutant degradation in collaboration with other institutions.

Towards this end the following have been successfully synthesized;

a) Synthesis, characterization and photocatalytic performance of Er and Nd doped ZnO nano particles;

b) Synthesis, characterization and photocatalytic performance of Y and V co-doped ZnO nano particles;

c) Synthesis of Fe substituted ZnWO₄ solid solution using hydrothermal method.

d) Synthesis, characterization and evaluation of photocatalytic activity of Nd substituted Bi₂Sn₂O₇ solid solution photocatalyst;

e) Synthesis of CdS-rGO nano composite using Photo deposition method.

Remarks and Recommendations by Review Committee:

(i) Committee appreciated the work done far in terms of lab scale synthesis and characterization of doped oxide semi-conductors as well as their performance demonstration in the visible light spectrum;

(ii) PI is advised to take up initiatives to acquire IP assets as the latest set of compounds show photocatalytic activity better than the commercially available TiO2 based materials.

(iii) Scale up to kg levels should be explored.
(iv) The project is on schedule and the output is more than the original objectives; the project shall be completed by within the original PDC of 31st Dec 2017 and the final report submitted.
(v) Based the latest U/C, the next tranche of funds can be released.

15. Development of hard and high temperature refractory material/aggregate from saprolite (File No. 14/35/2014-Metal IV)

Implementing Institution: Jawaharlal Nehru Aluminium Research Development & Design Centre (JNARDDC), Amravati Road, Nagpur

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<th>Project Cost: Rs. 40.91200 lakh</th>
<th>Duration: 3 Years</th>
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<td>2nd Release: Rs. 8.19420 L dt 16th June 2016</td>
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Objectives:
(i) To study the various process parameters for possible use of saprolite in refractory industries.
(ii) To develop refractory material/aggregate from saprolite

Current Status and work done (Dec 2014 – May 2017)

- Samples of saprolite of various size (-11+8, -8+4, -4+2, -2 mm) have been prepared for sintering studies; Experiments on sintering studies have been carried out with various parameters such as temperature, size of sample, residence time and heating -cooling rate. The tests has been done on temperature (800-1650°C), residence time (1- 7 hours), various granules size and heating and cooling rate indicate recovery of granules after sintering is in the range of 80-90%.

- Sintered granules of saprolite have been characterized for chemical, mineralogy and morphology by SEM. The studies indicate presence of mullite, cristobalite and quartz minerals; Tests have been done with additives. Granules have been prepared by mixing saprolite with additive (china clay). Sintering tests has been done on various temperatures and characterized the granules as well as required properties have been studied.

- Studies on pre-calcination followed by WHIMS on raw saprolite have been done. The magnetic intensity of 10000-20000 gauss indicates reduction in iron content. Leaching tests has also been carried out on raw saprolite for reduction in iron content.

- Properties of sintered saprolite granules such as bulk density, porosity and refractoriness have been determined; Test of product for suitability in refractory castable industry has been done from outside agency/ local refractory industry.

Remarks and Recommendations:

(i) The project objectives have been met;
(ii) PI to explore if the aggregate materials with reduced silica can substitute imported china clay;
(iii) Translational product development to be done;
Project to complete on schedule in Dec 2017;  
A more detailed progress report to be submitted; based on the latest U/C as on 31st July 2017, next tranche of funds can be released.

16. **Study of alkaline-carbonatite complexes as potential resource for REEs, Nb-Ta and U-Th**/ File: 4/49/2014-Metal IV

**Implementing Institution:** IIT Roorkee

Project Cost: Rs. 38.575 Lakhs;  
Duration: 3 years

Project Start Date: 09.02.2015;  
1st Release Rs. 25.891 lakh dt 09.02.2015

**Objectives:**

(i) The main objective of the study is to characterize carbonatite and related rocks as potential resource for REEs (mainly LREE), Nb-(Ta) and U-TH through comprehensive mineralogical and geochemical study.

(ii) The other objective is to prepare comprehensive exploration models for this mineralization.

**Work Done: I Yr and II Yr (Feb., 2015 – April, 2017)**

1. Field-work: Detailed geological fieldwork has been carried out in carbonatite/syenite bearing localities – Sevathur, Samalpatti and Rasimalai areas in December, 2015. The fieldwork in Pakkanadu area has been carried out during summer break (2016).

2. Completed preparation of geological map and sample location plan of all of the above areas; mesoscopic and petrographic study of all rock samples.

3. About 60 samples are prepared and these ready for major, minor and trace elements analyses. Trace element analyses of the samples are partially completed.

4. Data already collected from Purulia (West Bengal) and Sung Valley (Meghalaya) in past are in the stage of finalization.

**Pending Work:**

1. Analysis of trace elements including REEs using XRF and ICP-MS.
2. Separation and analysis of key minerals.
3. Second phase fieldwork, if necessary
4. Data compilation and report writing

**Remarks and Recommendations:**

(i) The committee observed that more than two years have elapsed and there is hardly any significant finding in terms of analysis and identification of RE elemental tenors; The RE elemental analysis could have been carried out in this period itself; it is doubtful if XRF will be able to give any data at ppm levels and ICP-MS available with GSI could have been accessed;
Nearly two-thirds of the funds have already been released in the first tranche itself and detailed progress report is yet to submitted;

This project is to be reviewed again by Dec 2017; if there is no significant progress particularly in analysis, it can be short closed by Dec/Jan 2018 which is the original PDC.

### 17. Development of Nickel containing steel from Chromite over burden;
14/51/2014-Metal IV

**Implementing Institution:** IIT KGP and IMMT, Bhubaneswar (Jointly)

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<td>Duration</td>
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**Objectives:**

The main objective of the proposed project is to develop a nickel containing steel from Chromite over burden.

**Work Done: I Yr and II Yr (Dec 2014 till May 2017)**

(i) Procurement of Equipment/Chemicals: Purchased the Metallurgical upright microscope with image analysis system from this project and successfully installed;

(ii) Collection of Chromite Over Burden from Sukinda Mines: The Ni containing Chromite Over Burden has been collected for the project work 4. Characterization of Chromite Over Burden: The sampling was made from the bulk sample of Chromite Over Burden obtained from Sukinda Mines by cone and quarter method. The representative samples were taken from Chromite overburden for XRD and chemical analysis;

PERC in its review meeting held on 17th May 2016 at Kolkata recommended that the progress achieved over nearly 1.5 years was a concern and a two member expert team drawn from PERC, viz, Prof SP Mehrotra and Director, NFTDC were to visit and further review the project. The project was reviewed by the expert member team on 8th March 2017 at IMMT, Bhubaneswar; the following are the work done during the period **May 2016-May 2017** as presented by the project team.

- Two different grades of over burden were collected and characterisation (High grade-0.67% Ni and low grade – 0.28% );Reduction roasting experiments were carried out and enriched Ni content 1.33% in high grade and 0.44% in low grade.
- After magnetic separation and smelting, Ni content in the alloy is 5% in high grade and 1.6% in low grade
- Two different batches of Ni based master alloys have been prepared in induction furnace (Fe-1.3% Ni and Fe-3.3%Ni, S-0.04%)
• Modified Ni containing steels have been prepared using an air induction melting furnace and their properties were evaluated.

Remarks and Recommendations:

The expert member committee of PERC recommends the following work to be carried in next one year:

1. CSIR-IMMT, Bhubaneswar:
   1.1 Sampling should be done and digest the large quantity of samples for chemical analysis;
   1.2 Complete analysis of raw materials and products in each unit operations. (Including material balance);
   1.3 Alternative method can be evaluated using fluidised bed reactor for reduction roasting. Optimise and benchmark against at Fluidised bed roasting, (C, S, energy and productivity);
   1.4 After magnetic separation and smelting, Ni content in the alloy is 5% in high grade and 1.6% in low grade COB. In both cases the carbon content of the alloy was around 3.7% which is high and needs to be brought down to 1% or below;
   1.5 Approximately 10kgs of FeNi pig iron (3-5% Ni) from several batches of large scale smelting will be prepared and supplied to IIT, Kharagpur for steel making.

2. IIT, Kharagpur:
   2.1 In steel making, minimum dilution may be attempted with low cost steels. Two different batches of overburden, FeNi pig iron containing S – 0.04%. High S and C content of the feed alloy was brought down by diluting the feed alloy with large quantity of very low S & C steels during induction melting of the alloy. This needs to avoided as it will substantially increase the cost of production of targeted Ni–steel;
   2.2 Approximately 5 melts to be carried out using an air induction furnace;
   2.3 After reaching the desired chemistry and complete microstructural characterisation, mechanical property evaluation needs not to be carried out for this project.

3. Based on the latest U/C and the technical report submitted the next tranche of funds can be released to the two institutions;
4. The project to be completed as per the above recommendations. The project PDC is extended by 3 months till 31st March 2018.

18. Production of geopolymer based construction material from pond ASH: an industrial waste; 14/54/2014-Metal IV

Implementing Institution: Gandhi Inst. of Engg and Technology, Odisha.

Project Cost: Rs. Rs. 28.955 Lakhs  
Project Start Date : 29.12.2014  
Duration: 3 years2016  
1st Release Rs. 13.805 L dt 29th Dec 2014;  
2nd Release Rs. 9.30 L dt. 8th Feb 2016
Objectives:

1. To replace cement by industrial waste such as pond ash based geopolymer as a novel construction material.
2. To study the effect of alkali on geopolymer (GP) for high compressive strength to establish cost effective and quality technology.
3. To study the corrosion behavior of the pond ash based geopolymer.

Work Done: (I Yr, II Yr & III Yr (till May 2017))

1\textsuperscript{st} Year: The concentrations of sodium silicate and sodium hydroxide in the aqueous phase of the system are proved as crucial synthesis parameters. Under the optimum synthesis conditions defined in this work, the Pond Ash based inorganic polymeric materials has developed compressive strength 19 MPa for one day curing. Based on these test results, the following conclusions are drawn; higher temperature curing in oven at 70°C and above examined to increase strength;

2\textsuperscript{nd} Year: Pond ash of sizes was used with other brick materials such as aggregates, sand and gravel were optimized with geopolymer additives as in alkali, superplasticizer, natural fibers. Mechanical strength tested in 3point bend test and compressive loading. Corrosion resistance in HCl, H2SO4 & H3PO4 studied;

3\textsuperscript{rd} Year: Study of corrosion and electrochemical activity to be studied further; Further characterization to be done and compared.

Remarks and Recommendations:

(i) First and Second year work done satisfactorily;
(ii) Corrosion (atmospheric and aqueous) on longer periods to be completed within the duration of the project (Dec 2017).
(iii) PI and institution may explore translation of this work with technology to start-ups or SMEs locally and utilize other funding avenues for such a translation from dept of MSME. Automatic brick/construction block making machine along with mixer should be explored in further research to make larger numbers to prove efficacy;
(iv) Based on the latest U/C, next tranche can be released; Final technical report to be submitted by December 2017.

19. Development of TDR based wireless system for slope stability monitoring in opencast mines; 14/59/2014-Metal IV

Implementing Institution: National Institute of Technology, Rourkela, Odisha

Project Cost: Rs. 22.588 Lakhs  
Project Start Date: 15.12.2014  
Duration: 2 years

1\textsuperscript{st} Release Rs. 15.12 L dt 15.12.2014  
2\textsuperscript{nd} Release Rs. 9.6012 L dt. 21.09.2016  
(plus additional grant included)

Objectives:

(i) To monitor the slope movements in NALCO and MOIL opencast mines using time domain reflectometry (TDR).
(ii) Development transmission of TDR readings using RF/wireless communication in opencast mines for online monitoring.

**Work Done : (I Yr and II Yr (till May2016)**

The Dongri Buzurg Manganese Ore mine of M/s. MOIL is one of the oldest operating manganese ore mines of the company. About 35,000 tons of such fines have been accumulated at the Dongri Buzurg mine. From the last few years due to instability of footwall benches, local failures are happening. For warning of the major slope failures, it is proposed to install real time monitoring system, for the particular mine site.

**Remarks and Recommendations:**

(i) In the previous mid-term review held on 17th May 2016 at Kolkata, it was observed by the review committee that that work done till then months, was more of problem description and the work done and pending are not clear; Project duration also only two years and PDC is Dec 2016 and PI to send detailed progress report together with PPT for evaluation. Director, NIRM and Director, MECL to review and give further recommendation;

(ii) A detailed technical report and latest U/C are required to be furnished; The PDC has already ended as on Dec 2016. Based on these inputs, further decision shall be taken.

**20. Prospecting / Exploration of Platinum Group of Metals within Nega Hills Ophiolite at THengahu Ridge-Moke Area, Nagaland.**

Project Cost : Rs. Rs. 49.50 Lakhs  
Project Start Date : 29.12.2014  
Duration: 3 years  
1st Release Rs. 7.425 L dt 29.12.2014  
2nd Release Rs. 39.90 L dt. 18.02.2016

**Objectives:**

1. To demarcate the potential zones for PGE in the area;
2. To estimate PGE contents in mafics and ultramafics by NiS fire-assay in combination with ICP-MS;
3. To establish petrogenetic relationships of the rocks with major, trace & REE data

**Work Done (Jan 2015-May 2017)**

1. Geological mapping covered 15sqkm
2. Contour mapping covered 1sqkm
3. 400 rock samples collected and 70 analyzed at NGRI, Hyderabad
4. One bore-hole drilled up to 50 m depth for ultramafic PG and 8 core samples analyzed;
5. Detailed report under preparation

**Remarks and Recommendations:**

(i) The project to be completed by 31st Dec 2017 as per original PDC
(ii) The utility of the prospecting /exploration done to be brought out
(iii) Based on the latest U/C and the detailed report, the next tranche can be released.
21. Novel synthesis routes for high purity kesterites (CZTS:Cu-Zn-Sn-S; Cu-Zn-Sn-Se) and development of cost kesterites based solar PV cells and modules; (File No. 14/34/2014-Metal IV)

**Implementing Institution:** Nonferrous Materials Technology Development Centre, (NFTDC) Hyderabad

Project Cost: Rs. 101 lakh
Duration: 3 year
Start Date: 21.5.2015
1st Release: Rs. 42.712 L dt. 21.05.2015

**Objectives:**
1. Kesterite based solar cell of efficiency > 8%.
2. Synthesis and characterization of CZTS and CZTSSe type solar materials.
3. Optimize the methodology of coating the kesterite on Mo coated glass/A1 substrate
4. Design, Fabrication and characterization of solar cells based on CZTS and CZTSSe
5. Performance evaluation of CZTS and CZTSSe based solar cells and improve the efficiency by modifying the synthesis methodology and composition of S,Se,Cu,Sn & Zn.
6. Module level design, development, performance evaluation at STC and PTC etc.

**Work Done: (1st and 2nd Year till May 2017)**

Important process equipments, namely thermal evaporation unit and refurbishment of magnetron sputtering units and sulphurization apparatus in place within the first 9 months of the project; deposition of all layers obtained and subsequent to final heat treatment kesterite phase formation obtained; a complete process - flow sheet has been developed;

Two non - vacuum processes, namely direct co-precipitation (chemical) and was converted to nano inks for deposition; preparation of individual sulphide and high energy milling have been studied; Deposition of inks via screen printing followed by heat treatment conducted and kesterite phases confirmed;

First cell was prepared with all five layers in a multi layer configuration via magnetron sputtering, thermal evaporation of Mo/Cu/ZnO.

**Pending work (3rd Year of project 2017-18)**

(i) continuous optimization of vacuum based + non vacuum based processes
(ii) Solar cell fabrication and testing

**Remarks and Recommendations:**

(i) The project is on schedule and all the materials synthesis and deposition done; solar cell fabrication has been initiated.
(ii) Based on the latest U/C and progress report submitted, the next tranche can be released.

22. Thin Film and Thin Wire Sensors for Metallurgical Industries

**Implementing Institution:** Nonferrous Materials Technology Development Centre, (NFTDC) Hyderabad

Project Cost: Rs. 179.49 lakh
Duration: 3 years
Start Date: 29.12.2015
1st Release : Rs. 114.75L dt. 29.12.2015
Current Status & Work Done: (1\textsuperscript{st} and 2\textsuperscript{nd} Year till May 2017)

(i) Multi – Layer thin film thermocouple design completed
(ii) Deposition processes comprising of magnetron sputtering and plasma spray optimized to obtain Pt-PtRh thin film thermocouple on alumina & Ni Super alloy substrates;
(iii) Thin film Temp sensors tested against standard thermocouples in a furnace test bed up to 700 C in phase I tests
(iv) Thin film Ni-Cr sensors for strain measurements done on Kapton tapes and is under testing

Pending Work (3\textsuperscript{rd} Year till May 2018)

(i) Testing of thin film TC up to 1400 C in furnace test bed;
(ii) Preparation of EMI/EMC shielding for application in molten salt bath
(iii) Development of Thin Film TC for casting apparatus

Remarks and Recommendations by Review Committee:

(i) The project is on schedule and all the materials synthesis and deposition done; sensors are fabricated;
(ii) Based on the latest U/C and progress report submitted, the next tranche can be released.

23. Synergistic Utilization of aluminium industrial wastes for geopolymeric building materials

Implementing Institution: JNARDDC, Nagpur

Project Cost: Rs. 40.0 lakh Duration: 3 years
Start Date: 29.12.2015 1\textsuperscript{st} Release: Rs. 13L dt. 29.12.2015

Objectives:

1. To study the synergistic effect of aluminium industrial rejects on geopolymerization process with red mud/flu ash as base materials;
2. To develop marketable building materials such as brick, blocks and tiles from geopolymerized raw material combinations.

Work Done (Jan 2016 till May 2017)

- Seventy different raw materials were collected from various industrial units and the samples were processed, segregated, fractioned and characterized by chemical (wet analysis and XRF), mineralogy (XRD), morphology (SEM) and physical (particle size) methods.
- Mix designs were prepared for geopolymerization and products (bricks & blocks). 380 trials were carried out with different mix designs comprising various combinations of raw materials. Starting with 78 mix designs were identified for having good synergy among the raw materials in the mix designs (in terms of good
crushing strength, better physical stability, porosity, alkali leaching, efflorescence, density and durability); 15 mix designs are identified for conducting pilot plant trials.

The following tests were conducted:

a) **Crushing strength**: geopolymer bricks prepared with aluminum industry rejects and biomass combinations conformed IS-3495 (Part-1):1976 specified that the compressive strength of the building bricks should not less than 3.5 MPa. The strength of bricks manufactured with different Aluminum wastes raw materials and compositions is of the order 10 to 24 N/mm$^2$ after 28 days of curing.

b) **Efflorescence**: Studied the amount of soda leaching on the surface of the bricks as per IS: 3495 (Part3) : 1976 had the rating of Efflorescence not more than Moderate.

c) **Water absorption test** was carried out as per IS: 3495 (Part-2):1976 after immersion in cold water for 24 hours, shall have water absorption not more than 20%.

d) **Dry density** of different major raw materials and block of different compositions after curing were calculated according to IS Code: 2720:1982.

e) **Leach studies** indicated lowering of pH value from 11.98 to 10.65 over a period of 45 days. The stability vs. time indicated zero leaching of soda beyond five days at ambient temperature.

The following products were developed:

- In addition, **light weight foamed geopolymer(LWFGEOP)** and **sandwich structure** of **hard-foam-hard geopolymer** blocs also developed from rejects and waste materials originated from aluminium industry (such as red mud, overburden laterite, fly ash, PLK, KK and saprolite combinations); The **LWFGEOP** developed from aluminium industry rejects have shown crushing strength values in the range 5-8.5 MPa and found suitable for non load bearing applications, interior decoration and aesthetics.

- Apart from aluminum industrials waste, steel industrial wastes are also shown characteristic behavior in the process of geopolymerization and product development. SAIL-BSP wastes indicated crushing strength up to 15 MPa, very good water absorption (i.e. less than 20%) and zero efflorescence on the brick surfaces specified as per Indian Standard Codes.

- The study further identified good synergy among aluminum industry rejects - steel industry rejects with or without biomass rejects for preparation of geopolymer based building blocks.

- Biomass based ash are characterized with high amount of amorphous silica and act as very good bonding materials for many solid rejects from aluminium and steel industry rejects posses very low silica content.

**Pending work**: Activities relevant to setting up of mini-pilot plant for scale up studies.

**Remarks and Recommendations:**

(i) Significant amount of work has been accomplished in the first half of the project in 16 months;
(ii) As an industrial partner (M/s Swarnalata Holdings) has been chosen right from the beginning with financial/lower participation (70% project funded and 30% co-funding from industry partner), translation to pilot plant and marketable products should become feasible;

(iii) Based on the latest U/C and progress report, the next tranche of funds can be released.

### 24. Recyclability strategy for value added utilization of Iron/manages ore tailing /low grade ore evaluation for energy storage capacities

**Implementing Institution:** IMMT, Bhubaneswar

**Project Cost:** Rs. 35.0 lakh **Duration:** 3 years

**Start Date:** 29.12.2015 **1st Release:** Rs. 25L dt. 29.12.2015

**Objectives:**

1. Determining the leaching condition of iron/manganese ore tailings or low grade ores and comparing the results with the conventional method;
2. In situ and ex situ precipitation of main metal value with selective removal of other impurities;
3. Determining the electrochemical properties of precipitated product including detailed characterization;
4. Investigate the possibility of using precipitated product as raw materials for the preparation of electronic materials, including analyses of its chemical composition, physical and electronic properties of products;
5. To test the process, developed in laboratory scale, and in a bench scale of capacity;
6. To prepare the techno-economic feasibility report based on bench scale data.

**Work Done (Jan 2016 – May 2017):**

1. The project sanction was in 29.12.2015 and while the project commenced from 1st April 2016.
2. Equipment Electrochemical workstation with impedance analyses has already been processed and will shortly reach at Institute. Literature survey has been Low-grade manganese ore was collected from various resources.
3. Leaching of typical ore from Orissa has been done. Effect of oxalic acid, H2SO4 and T and Time t were investigated. The precipitate bi metallic product and their heated product to be studied for its potential application as electrode material for energy storage application.

**Remarks and Recommendations:**

1. This is the first mid-term review for this project and the following inputs are given by the review committee:
   1.1 Leaching study can be done only for low grade Mn ore;
   1.2 Comparison of leaching efficiency to be done in various acidic conditions;
   1.3 Elucidate the mechanism of leaching w r t phase and composition;
   1.4 Compare with commercial pure Mn and Fe oxide and establish efficiency and other correlation with respect to low grade ore;
1.5 Optimize Mn/Fe ratio in product so as to suit battery electrode application;
1.6 Microwave digestion to be explored both for analysis as well as for leaching

(i) The project is sanctioned on 29.12.2015 and the start date is to be taken as 29.12.2015 and not 01st April 2016. Once the sanction is given, many activities such as procurement etc can officially start; Literature survey is expected to be done even prior to proposal submission;
(ii) Overall quantum of work is rather limited given that bulk of the work to be done is in lab scale with hardly any dependence on external factors; Quantum of work to be enhanced to justify three years as per the inputs given above.
(iii) Based on latest U/C and detailed progress report, next tranche of funds to be released;
(iv) Project PDC is to be maintained as Dec 2018

25. Assessment and Prediction of land surface deformation due to underground mining in northern Aravalli range of hills using microwave remote sensing datasets and ground based observation

Implementing Institution: ISM, Dhanbad

Project Cost: Rs. 45.0 lakh Duration: 3 years
Start Date: 29.12.2015 1st Release: Rs. 25.6L dt. 29.12.2015

Objectives:

1. Scatterer characterization of field surface under study;
2. Study of PSI (Persistent Scatterer Interferometry) approaches
3. Processing of high resolution time series Synthetic Aperture Radar Interferometric datasets to estimate displacement parameters
4. Quantitative validation of PSI approach by ground based observations
5. Development of Surface Subsidence Prediction model for underground mining environment

Work Done (Jan 2016 till May 2017):

1. Field observation and InSAR dataset collection (ongoing);
2. Processing of time series InSAR dataset (ongoing)
3. Validation of PSI with ground based observations (ongoing);

Pending work:

1. Continuation of processing and validation
2. Predictive Model Development

Remarks and Recommendations:

1. The project can be completed in less than 3 years and the PI is advised to finish in 30 months;
2. Based on the latest U/C and the progress report submitted, the next tranche of funds can be released.
26. Rare Earth mineral concentration in the beach sands of Uttara Kannada coast: their economic viabilities and sustainable mining.

Implementing Institution: SDM College of Engineering, Dharwad, Karnataka

Project Cost: Rs. 29.44 lakh  Duration: 3 years
Start Date: 29.12.2015  1st Release: Rs. 18.20560L dt. 29.12.2015

Objectives:
1. Detailed sedimentological, mineralogical and geochemical studies on heavy minerals to identify source material, transport pattern and mode of concentration of RE minerals
2. Delineate pockets of Zones of placer and RE minerals concentration and estimate their economic viability etc

Remarks and Recommendations:
(i) PI did not attend the project review; SOMETAL to write to PI asking for detailed progress report and latest U/C.

27. Development of Standard protocol of field audiometry for notifying noise induced hearing loss.

Implementing Institution: NIMH, Nagpur

Project Cost: Rs. 40.0 lakh  Duration: 3 years
Start Date: 29.12.2015  1st Release: Rs. 23.60 L dt. 29.12.2015

Objectives:
1. Scientific validation of field audiometry with standard protocol;
2. To prescribe maximum permissible background noise levels for conducting audiometry in Indian scenario;
3. To propose guidelines for conduction audiometry for DGMS

Work Done (Jan 2016 till May 2017):
1. Procurement of audiometer and audiometry booth completed
2. Request letter to four mining companies sent for their participation to conduct the study in their mines;
3. Approval from Institutional Ethics Committee and approval from mining companies pending

Remarks and Recommendations:
(i) Committee observed that NIMH has done significant amount of work in the field of noise pollution, biomarkers and this project is to quantify the data in actual mining conditions and with mine workers as the subjects;
(ii) Lack of progress in obtaining permissions from mines is the main issue in all of these studies; a review has to be conducted by Director NIMH with DGMS and
representatives of mining companies in an invited workshop to outline the contours of this study to take this initiative forward;

(iii) Usefulness of this study is never under question as quantitative data of this kind is not available for our miners and mines.

(iv) Nearly 60% of funds have already been given in first tranche itself to cover equipment and HR costs.

(v) Latest U/C to be submitted.

28. Study of feasibility of treatment of seepage water from Chromite mine quarries

Implementing Institution:  NIT Rourkela

Project Cost: Rs. 32.0 lakh  Duration: 3 years
Start Date: 12.01.2016  1st Release: Rs. 16.0 L dt. 12.01.2016

Objectives:

1. Identification of specific locations of contaminants
2. Develop spatial contamination level of region
3. Isolate and identify chromium degrading organism
4. Provide optimum condition for consortium to reduce chromium contamination
5. Design of bio-reactor to treat seepage water

Work Done (Jan 2016 till May 2017):

1. Collection of seepage water samples from South Kaliapani Chromite mines (Odisha);
2. Physiochemical and metal concentration analysis of samples
3. Isolation of Cr resistant bacteria and identification of bacterial isolate.
4. Reduction of Cr by isolated bacteria and determination

Pending Work:

1. Identification of effective microbial consortium;
2. Process optimization
3. Design of bio-reactor and continuation of experiments
4. Cost and techno economic analysis

Remarks and Recommendations:

1. The committee observed that earlier work done in treatment of waste water from leather tanneries which essentially treat Cr contamination has to be looked into by the PI. CLRI of CSIR had done that work which has been translated to field applications in leather tanning operations;
2. Phyto remediation using plants that hyper accumulate Cr has been shown to be successful; PI should consider this approach as well as it is easy to scale up and do comparative assessments of bacterial vs. Phyto remediation; A combination of the two can also seen as a potential process option.
3. Effective microbial consortium for Cr resistance has not yet obtained; Next steps in this area should be outlined at the earliest;
4. Sizing of the system to handle 5 to 10 Kilo liters/day of seepage water has to be considered for design of reactor;
5. U/C submitted as on 31\textsuperscript{st} March 2017 shows positive balance; Latest U/C be submitted and next tranche of funds can be released.

29. Developing downstream application of strip cast aluminium alloys (AA8011 & AA3003)

**Implementing Institution:** JNARDDC & VNIT, Nagpur; NALCO

Project Cost: Rs. 31.0 lakh  
Duration: 3 years
Start Date: 13.01.2016  
1\textsuperscript{st} Release: JNARDDC Rs. 15.L dt. 13.01.2016  
VNIT Rs. 6L dt. 13.01.2016

**Objectives:**

1. Develop processing parameters and texture evolution suitable for increasing the formability by optimizing cold reduction and annealing temperature
2. Improve surface characteristics by anodizing

**Work Done (Jan 2016 till May 2017):**

1. Alloy 8011 produced by twin roll casting was selected for study and lab scale experiments on deformation and recrystallization completed;
2. Cold rolled and recrystallization TRC sheet were characterized and properties evaluated for suitability for forming operations;

**Pending Work:**

1. NALCO to supply Twin Roll Cast AA 8011 TRC sheets for further evaluation
2. A local industry to supply AA 3003 sheets for optimizing anodizing parameters.

**Remarks and Recommendations:**

1. Given the facilities available with JNARDDC and VNIT, and that the project is to be done in lab scale settings to arrive at optimum process schedules, it is observed that the project can be completed much before 3 years. The quantum of output in the past 15 months could have been much higher and the project could be completed in just 2 years.
2. The project team is urged to finish the deliverables by March 2018 itself.
3. A more detailed progress report should have been submitted. Based on the latest U/C and submission of a more elaborate technical progress report, next tranche of release of funds can be given.

30. Simulation of simultaneous rock fractures at multiple scales

**Implementing Institution:** BITS Pilani, Goa Campus

Project Cost: Rs. 30.0 lakh  
Duration: 3 years
Start Date: 10.03.2016  
1\textsuperscript{st} Release: Rs. 6L dt. 10.03.2016
Objectives:

1. To build a scaling based FEM software which can analyze simultaneous crack growth at multiple scales;
2. Prediction of rock fragment size and size distribution after blasting;
3. Cost optimization for rock clearance before mining excavation

Work Done (April 2016 till May 2017):

1. Appointment of project staff;
2. Procurement of work stations for simulation work;
3. HR development of project staff in current state of art in rock fracture simulation
4. Single crack propagation using FEM
5. J – Integral computation
6. Talks with GM (Projects) of NALCO for conducting tests.

Pending work:

1. Simultaneous crack growth simulation;
2. Multiple Scale optimization
3. Conducting of blast trials at NALCO and validation of simulation

Remarks and Recommendations:

1. It has been pointed out to the PI both at the time of project proposal evaluation prior to sanction as well as during this mid-term review, the need for validation of simulation in actual mine blasts. It is reiterated that trials and NALCO and validations is to be pursued vigorously in the second year.
2. The pending work in the next 12-18 months to be elaborated more for the purpose of project monitoring.
3. The next tranche can be released on receipt of latest U/C.

31. Mineralogical and Geochemical Characterization of Indian Glauconites for alternative potassium fertilizers

Implementing Institution: IIT Bombay, Mumbai and NGRI, Hyderabad

Sanction Number (Date & Year): F No. 14/77/2015- Met. IV Date: 29.02.2016

Project Cost: Rs. 55.0 lakh Duration: 3 years
NGRI Rs. 12.5 L dt 29.02.2016

Objectives:

1. Mineralogical and geochemical characterization of Indian Glauconites
2. Preparation of database containing major, trace and REE characteristics
3. Understanding sedimentological and stratigraphical influence on glauconite composition
Work Done (March 2016 till May 2017)

1. Main emphasis in the first year was on collection of samples. Glaucophane samples were collected from 15 stratigraphic units across India. Most extensive studies were carried out on Mesozoic glauconites which include Ukra Hill Member in Kutch basin, Bryozoan Limestone Formation and Lameta Formation in the Narmada basin, Karai Shale Formation in the Cauvery basin and Mahadek Formation in the Meghalaya basin.

2. Mineral chemical data of glauconite samples on more than 600 points by EPMA. Most glauconite samples contain >6 wt% K₂O. Total Fe₂O₃ content of samples are found to be highly variable from 15 to 35%

3. Trace and REE analysis of 27 samples. Samples of the Ukra Hill Formation contain less REE and those in Lameta Formation contain high REE.

4. Mineralogical analysis by XRD on 15 glauconite separates

Pending Work:

1. Glaucophane sample collection from another 5 stratigraphic units
2. Mineral chemical data of glauconite samples on another 600 points
3. Understanding detailed sedimentological and stratigraphical context of glauconite for at least 5 stratigraphic units.
4. Major element analysis of bulk rock samples of glauconite on 50 samples.

Remarks and Recommendations:

1. Significant amount of sample collection was done in this study from 15 units across India and EPMA analysis has been done; K₂O content in most samples are found to be above 6wt%; Mineralogical analysis by XRD (phase identification was also completed on glauconite separates;

2. The milestones given in the proposal for the first year are met and the project is on schedule;

3. Based on the latest U/C and the technical report already submitted, the next tranche of funds to be released.

32. Enhanced Recovery of Manganese as Electrolytic Manganese di oxide (EMD) from ferro-manganese mine tailings

Implementing Institution: Siksha O Anusandhan Univ, Bhubaneswar

Project Cost: Rs. 30.0 lakh  
Duration: 3 years  
Start Date: 29.02.2016  

Objectives:

1. Biological synthesis of electrolytic manganese through bioleaching from ferro manganese mine tailings utilizing Mn biomining micro organisms

Work Done (April 2016 till May 2017):
1. Mine tailing sample collection from Sanindipur Mn Mines in Odisha and analysis of Mn content and particle size distribution;
2. Diversity analysis of micro organisms inhabiting Manganese mining site
3. Isolation and identification of cultivable Mn solubilizing species and Mn tolerance studies

Pending Work:

Effect of process parameters as in Temperature, pH, particle size, pulp density, and carbon concentration to be done to obtain recovery percentages

Remarks and Recommendations:

1. The committee observed that PI should demonstrate if this approach is feasible for scale up given that such low concentrations as available in mine tailing (21g/100kg);
2. Heap leaching vs. bio rector leaching has to be quickly studied;
3. Rate of biomineralization or Mn solubilization enhancement has to be looked in to.
4. EDS cannot give accurate analysis; ICP-OES or AAS has to be employed;
5. A more focused approach is required and the end product should be well defined.
6. The technical report should be improved;
7. Based on the latest U/C next tranche of funds can be released.

33. Development of a real time Instrument/System to measure bath ratio, alumina concentration, bath temperature and superheat of the aluminium electrolysis bath

Implementing Institution: JNARDDC, Nagpur

Project Cost: Rs. 29.93 lakh  Duration: 3 years
Start Date: 13.01.2014  1st Release:  Rs. 11.876 L dt. 13.01.2014 &
           2nd Release:  Rs. 13.806 L  dt 03.06.2015

Objectives:

1. To develop a real time instrument/system to measure bath ratio, alumina concentration, bath temperature and super heat of the aluminium electrolysis.

Work done (Jan 2014 – March 2017):

- **Melt System & Sampling Method Optimization:** Laboratory trials were carried out on synthetic and plant bath for optimising various parameters like crucible size, thermocouple type, acquisition rate, cooling rate etc. to fix the design of probe. These parameters play very important role in obtaining the required cooling curves for further analysis. Laboratory experiments were carried out for varying composition (%AlF$_3$, % Free Alumina, etc) of the bath. Cooling curves (1000°C to 400°C) of the bath were recorded by developed software in visual basic. During the experiments it
was noted that information regarding the bath chemistry was locked in curves within the above mentioned temperature range.

- **Plant Trials:** Experiments were carried out at Indian aluminium industry and recorded the cooling curve of actual plant bath from various different pots. During these experiments it was noted that the technique used for estimating the bath chemistry at laboratory scale works well for industrial setup too.

- **Data analysis of cooling curves has been carried out using MATLAB.** Various data analysis techniques were tried to establish the relationship of cooling curve with bath properties. Differential thermal analysis was carried out by taking temperature difference between actual sample and theoretical sample (according to Newton’s law of cooling) at each point of cooling curve and these curves were analyzed using Fast Fourier Transformation. Slope of cooling curve was also analyzed to establish the relationship of cooling curve with bath properties. Among all the methods adopted during experiment, it was noted that Slope method was found most suitable for establishing relationship between bath parameters and cooling curve.

- **Correlation with Lab experiments and Plant Trials:** Various points and slope values were analyzed for varying compositions of the bath to establish the relation with various bath parameters. It was well established that the methods adopted for determining the bath chemistry at laboratory scale matched with industrial scale.

- **Algorithm for finding out operating temperature and liquidus temperature** was developed on the basis of laboratory and plant data. This algorithm was adopted/embedded in the system for calculating operating and liquidus temperatures.

- **Algorithm for estimating the aluminium fluoride** composition was developed on the basis of Laboratory and plant data. Algorithm of estimating the Free Alumina composition was developed on the basis of Laboratory experiments only. This algorithm was adopted/embedded in the system for calculating free alumina and excess aluminium fluoride.

- **Plant Level Validation:** Final plant measurements for validation were carried out at NALCO Smelter plant by developed instrument/system. Measurements were carried out in 25 numbers of different pots. During validation trial it was observed that
instrument developed showed consistent results and there was no problem in operating the instrument in industrial environment.

- Quantitative Comparison of values obtained by measurement using developed instrument and by conventional method was carried out and found to be within acceptable limits. Thus, the developed instrument could be alternative test method which can replace the conventional existing time consuming laboratory method. The additional advantage of real time measurement of bath parameters helps the industry to take instantaneous corrective measure for controlling the aluminium electrolysis cell.

- **Project has been completed and FINAL REPORT already submitted.**

- Filing for patent for the Instrument is under progress

**Remarks and Recommendations by Review Committee:**

1. The review committee found that the slated objectives have been fully achieved.
2. Translation from laboratory trials to plant level experiments has been successfully completed.
3. Both hardware and software were developed and optimized.
4. IP assets are being looked in to by the institute.
5. The project can be considered completed and the final report has also been submitted. The final report can be sent to Director, NFTDC for post completion review for closure.
6. As the final U/C and the Report has been submitted, the lat tranche of funds can be released.