Prefeasibility Report for setting up of Rare Material Recovery (RMR) Plant within the premises of Paradeep Phosphates Limited (PPL), Paradeep, Odisha.

1. Executive Summary
   i. Company Profile
   Heavy Water Board (HWB), a constituent unit of Department of Atomic Energy (DAE), Govt. of India, is engaged in the production of Heavy Water since last four decades. As part of the diversification activity, HWB has been entrusted with responsibility for extraction and recovery of Rare Material (Uranium & other Rare Earth Elements) from Wet process Phosphoric Acid (WPA) using Solvent Extraction technology. **The product from RMR Plant will be utilized by Department of Atomic Energy for pursuing various activities in the country.** RMR Plant has been declared as strategic and will be set up within the existing premises of Paradeep Phosphates Limited in an area of about 42 acres. Total capital cost (instant) of the project is Rs. 273.33 crore.

ii. Project Details
   - **Raw material requirement**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Raw Material</th>
<th>Quantity</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WPA (non-consumable)</td>
<td>100 m³/hr.</td>
<td>PPL Paradeep</td>
</tr>
<tr>
<td>2</td>
<td>Solvents (makeup)</td>
<td>2.85 Kg/hr.</td>
<td>In-house (HWB)</td>
</tr>
<tr>
<td>3</td>
<td>Bentonite (consumable)</td>
<td>200 kg/hr.</td>
<td>Purchase</td>
</tr>
<tr>
<td>4</td>
<td>Flocculent (consumable)</td>
<td>2.0 kg/hr.</td>
<td>Purchase</td>
</tr>
<tr>
<td>5</td>
<td>Hydrogen Peroxide (consumable)</td>
<td>48 kg/hr.</td>
<td>Purchase</td>
</tr>
<tr>
<td>6</td>
<td>Sulphuric Acid (consumable)</td>
<td>1400 kg/hr.</td>
<td>Purchase</td>
</tr>
<tr>
<td>7</td>
<td>Oxalic Acid (consumable)</td>
<td>70 kg/hr.</td>
<td>Purchase</td>
</tr>
<tr>
<td>8</td>
<td>Sodium Carbonate (consumable)</td>
<td>300 kg/hr.</td>
<td>Purchase</td>
</tr>
<tr>
<td>9</td>
<td>Sodium Hydroxide (consumable)</td>
<td>800 kg/hr.</td>
<td>Purchase</td>
</tr>
</tbody>
</table>

   - **Water system & other utilities**
     - Source: PPL Paradeep
     - Water: 40 m³/hr.
     - Steam: 22 T/hr.
     - Compressed Air: 600 NM³/hr.
Air pollution source & control management
Gaseous emissions (Inerts with HF) from Phosphoric Acid Concentrator will be trapped by H$_2$SiF$_6$ scrubbing and water scrubbing. Emission will be kept within the limits of SPCB.

Liquid effluents
- Liquid effluent (3m$^3$/hr. containing about 20% Na$_2$SO$_4$) will be generated during solvent regeneration in solvent extraction. This will be sent to Na$_2$SO$_4$ recovery unit to make saleable sodium Sulphate powder.
- Acidic effluent (6m$^3$/hr.) generated from various section in plants, are sent to Effluent Treatment Plant.
- The treated effluent from ETP will be recycled to plant for use in process, floor washings, irrigation, gardening etc. and Solid waste from ETP will be disposed through authorised vendors.
- Cooling Tower blow down will be sent to RO plant. RO reject will be sent to sludge holding tank of ETP.

Solid Waste management
- About 3.15 tons per year of spent activated carbon will be generated which will be disposed of through SPCB authorized vendors.

Green belt development
- Green belt will be developed in an area of 33% as per the guidelines of MoEF.

Power requirement
- Power requirement of 6000KW for the plant will be met from Grid Corporation Odisha.

2. Introduction of Project Proponent/Background information
i. Identification of the project and project proponent
- The proposed Rare Material Recovery plant will be located within the premises of PPL Paradeep and will be utilized for extraction of Rare Material from Phosphoric Acid.
- Details of project proponent are as under:

<table>
<thead>
<tr>
<th>R. Prakash</th>
<th>Chairman &amp; Chief Executive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heavy Water Board</td>
</tr>
<tr>
<td></td>
<td>Department of Atomic Energy</td>
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<tr>
<td></td>
<td>Government of India</td>
</tr>
<tr>
<td></td>
<td>Vikram Sarabhai Bhavan,</td>
</tr>
<tr>
<td></td>
<td>Anushaktinagar, Mumbai-94</td>
</tr>
<tr>
<td></td>
<td>Phone: 022-25486505/25560870</td>
</tr>
<tr>
<td></td>
<td>Fax: 25563243/25563360</td>
</tr>
</tbody>
</table>
ii. **Brief description of nature of project**
   - The proposed Rare Material Recovery plant will be located within the premises of PPL Paradeep and will be utilized for extraction of Rare Material from Phosphoric Acid by using solvent extraction technique. The product from this plant will be utilized by Department of Atomic Energy.

iii. **Need for the project and its importance to the country or region**
   - The product from this plant will be utilized by Department of Atomic Energy, thus RMR Plant has been declared as strategic. The production of Rare Material will make our country self-reliant, which will enable sustaining various activities of DAE.

iv. **Demand-supply gap**
   - India is having limited resources of Rare Material and there are issues with regards to import of Rare Material to India. By extraction of Rare Material from Phosphoric Acid using Solvent Extraction technology developed by HWB, our country will become self-reliant in production of this strategic material. As the product from this plant will be utilized by Department of Atomic Energy, RMR Plant has been declared as strategic.

v. **Imports vs indigenous production**
   - It is necessary to augment production of Rare Material from alternate source (Phosphoric Acid) so that dependency on imports is reduced.

vi. **Export possibility**
   - The product generated will be utilized for requirement of DAE.

vii. **Domestic/export markets**
   - The product will be utilized for requirement of Department of Atomic Energy.

viii. **Employment generation (Direct/indirect) due to project**
   - About 225 Nos. of persons will be deployed for the operation and maintenance of this unit.
   - Local laborers will be deployed during construction activities.

3. **Project Description**
   i. **Type of project including interlinked and interdependent projects, if any.**
      - The proposed project will be interlinked to existing Phosphoric Acid Plant of Paradeep Phosphates Limited.
ii. **Location**

- The site is within the premises of PPL Paradeep. The site coordinates are Latitude: 20°16'04"N and Longitude: 86°37'34"E.

**Site Location:**

![Site Location Image]

**Plant Layout:**

![Plant Layout Diagram]
ii. Details of alternate sites considered and basis or selecting the proposed site

- Land is available at Paradeep Phosphates Limited premises and they will supply the raw material Phosphoric Acid. The proposed project envisages pipeline transportation of feed material wet Phosphoric Acid and returning the same material after processing. It is essential that the site should be contiguous to Phosphoric Acid Plant of PPL to minimize pipe lengths and power.

iii. Size or magnitude of operation

- The RMR Plant will be established in an area of 42 acres and having feed processing capacity of 100 m$^3$/hr. of Phosphoric Acid.

v. Project description with process details

- The Rare Material Recovery Plant proposed to be set up at PPL, Paradeep, is for extraction and recovery of Rare Material from Wet process Phosphoric Acid (WPA) using Solvent Extraction technology developed by HWB using in-house solvents like TOPS-99 & TOPS-03 and TOPS-08. The design processing capacity of this plant is 100 m$^3$/hr of feed WPA with a RM content averaging 105 ppm. The end product of this facility will be Yellow Cake.

The Rare Material Recovery Plant is divided in two operational areas. The first area is called as General area and comprises of pre-treatment, Cycle – 1 & 2 of solvent extraction, utilities, chemical storage & handling and post treatment unit. The operations in this section are very similar to conventional Phosphoric Acid Plant. The second area is called as Controlled area, comprising of final product (Yellow Cake) unit. Radiation related operations are carried out in controlled area under the regulation of AERB.

The WPA will be drawn from the storage of Phosphoric Acid Plant of PPL and pumped to RMR Plant. RM recovery from WPA involves the following major steps:

- Pre- treatment of Wet Phosphoric Acid (WPA)
- Solvent Extraction of RM from Phosphoric Acid
- Product Yellow Cake precipitation
- Post-treatment of Phosphoric Acid after the recovery of Rare Material.

**Pretreatment of WPA**

WPA from Phosphoric Acid plant contains organic matter or humus, suspended & dissolved solids and Gypsum. These solids are removed by flocculation and bentonite clay treatment normally carried out in clariflocculator. A significant portion of the organic
matter (dissolved or in colloidal state) is also removed at this stage. The organics present in Phosphoric Acid form Gunk with solvents/extractants and collects at the organic/aqueous interface. This hinders operation of the solvent extraction equipment besides leading to loss of solvent with the Gunk.

After removal of suspended particles and organic matter from acid, the valency of RM present in the Phosphoric Acid is adjusted by dosing with oxidant i.e. hydrogen peroxide. The hydrogen peroxide dozing is done in ppm level.

In case the acid obtained after clarifloculation and filtration is found to contain humic matter, the acid is contacted with organic solvents in a mixer-settler unit for Gunk removal. The pre-treated acid is stored in Treated Acid Tank for sending it to the Solvent Extraction Unit.

**Solvent Extraction**

The pre-treated Phosphoric Acid containing RM is sent to the first stage of Extraction Cycle-1. The extraction is carried out in a multi stage liquid-liquid extractor unit. The solvent used in synergistic ratio of TOPS-99 and TOPS-03 in heavy normal paraffin medium. About 85% of RM gets transferred to the solvent phase. The solvent entrained in the aqueous phase is separated out by passing through after-settler and coalescer at the outlet of all liquid-liquid extractor units. The solvent and aqueous entrainments are separated out and join the main outlet streams at collection tanks. Administrative controls involve laboratory analysis once in every shift for organics in acid at the outlet of all liquid-liquid extractor. The depleted Phosphoric Acid from the liquid-liquid extractor unit is sent for post-treatment of the acid before re-routing back to PPL.

The enriched solvent phase is stripped of RM using concentrated Phosphoric Acid in liquid-liquid extractor unit.

The enriched strip acid from Cycle-1 is oxidized to hexavalent state by hydrogen peroxide. The solvent extraction of this acid is done in liquid-liquid extractor unit where the RM gets transferred to the solvent. The depleted acid joins the feed to Cycle-1 Extraction. Re-extraction and stripping in Cycle-2 accomplishes further concentration, before the RM precipitation is taken up.

**Product Recovery**

The enriched solvent is scrubbed, water washed, 30% sulphuric acid wash and water wash to remove impurities. Then it is saponified with Sodium Hydroxide (NaOH) and stripped by solution of Sodium Carbonate (Na$_2$CO$_3$) to form RM rich sodium carbonate solution in aqueous phase. The Sodium radicals which got
transferred to the solvent in this process are removed by regenerating the solvent with sulphuric acid before the solvent is recycled to Cycle-2 Extraction unit. The aqueous phase is sent to coalescer to remove entrained solvent.

The aqueous phase containing RM rich sodium carbonate solution (RM Complex – I) is sent to Final product (Yellow cake) unit where it is treated with Sodium hydroxide to precipitate end product (RM Complex –II) in wet form which is filtered and stored as crude Yellow cake.

**Post treatment of Phosphoric Acid after recovery of rare material**

The return Phosphoric Acid stream contains traces of entrained solvent which needs to be removed to prevent loss of solvent as well as to render it suitable for further processing at PPL. The acid stream is sent to coalescer to reduce solvent content to <100 ppm followed by Lamella separator, after-settler and then finally to Activated Carbon beds (if required) to reduce organic content to <50 ppm. The Phosphoric Acid after post treatment is returned to PPL. A part of the return acid stream is sent to Phosphoric Acid Concentrator for preparation of MGPA to be used as strip acid. The process flow sheet is attached as figure:
vi. Raw material required along with estimated quantity, likely source, marketing area of final product/mode of transport of raw material & finished product.

<table>
<thead>
<tr>
<th>S. No</th>
<th>Raw Material</th>
<th>Quantity</th>
<th>Source</th>
<th>Storage</th>
<th>Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wet Phosphoric Acid</td>
<td>100m³/hr.</td>
<td>PPL, Paradeep</td>
<td>Dynamic</td>
<td>Through pipelines</td>
</tr>
<tr>
<td>2</td>
<td>Solvent Mixture</td>
<td>2.85Kg/hr.</td>
<td>Purchase</td>
<td>Under circulation</td>
<td>By road</td>
</tr>
<tr>
<td>3</td>
<td>Bentonite</td>
<td>200 kg/hr.</td>
<td>Purchase</td>
<td>Storage tanks</td>
<td>By road</td>
</tr>
<tr>
<td>4</td>
<td>Flocculent</td>
<td>2.0 kg/hr.</td>
<td>Purchase</td>
<td>Storage tanks</td>
<td>By road</td>
</tr>
<tr>
<td>5</td>
<td>Hydrogen Peroxide</td>
<td>48 kg/hr.</td>
<td>Purchase</td>
<td>Storage tanks</td>
<td>By road</td>
</tr>
<tr>
<td>6</td>
<td>Sulphuric Acid</td>
<td>1400 kg/hr.</td>
<td>Purchase</td>
<td>Storage tanks</td>
<td>Through pipelines</td>
</tr>
<tr>
<td>7</td>
<td>Oxalic Acid</td>
<td>70 kg/hr.</td>
<td>Purchase</td>
<td>Storage tanks</td>
<td>By road</td>
</tr>
<tr>
<td>8</td>
<td>Sodium Carbonate</td>
<td>300 kg/hr.</td>
<td>Purchase</td>
<td>Storage tanks</td>
<td>By road</td>
</tr>
<tr>
<td>9</td>
<td>Sodium Hydroxide</td>
<td>800 kg/hr.</td>
<td>Purchase</td>
<td>Storage tanks</td>
<td>By road</td>
</tr>
</tbody>
</table>

vii. Resource optimization/recycling and reuse envisaged in the project, if any should be briefly outlined
   - The effluent generated from this plant will be treated in ETP and will be recycled back.

viii. Availability of water its source, energy/power requirement and source should be given.
   - Water source: PPL Paradeep
   - Water requirement: 40m³/hr.
   - Steam: 22T/hr.
   - Compressed Air: 600NM³/hr.
   - Power requirement: 6000KW

ix. Quantity of wastes to be generated and scheme for their management/disposal.
   - About 3.15 tons/year of spent activated carbon will be generated which will be disposed of through SPCB authorized vendors.
x. Schematic representations of the feasibility drawing which give information of EIA purpose
4. Site Analysis
   i. Connectivity
      ▪ Site is well connected by Cuttack-Paradeep road, which is at a distance of 03Km from site.
      ▪ Nearest railway station is Paradeep railway station which is at a distance of 02Km from site.
      ▪ Nearest airport is located at Bhubaneswar which is at a distance of 130Km from site.
   
   ii. Land form, land use and land ownership
      ▪ Land form and land use details will be incorporated in the EIA report.
   
   iii. Topography of the site
      ▪ Topography details of the site will be incorporated in the EIA report.
   
   iv. Existing land use pattern
      ▪ Existing land use pattern will be incorporated in the EIA report.
   
   v. Existing infrastructure
      ▪ The proposed Rare Material Recovery plant will be established in open land within the existing premises of PPL Paradeep.
   
   vi. Soil classification
      ▪ Will be incorporated in the EIA report.
   
   vii. Climatic data from secondary sources
      ▪ Climatic data from primary and secondary sources will be incorporated in the EIA report
   
   viii. Social infrastructure available
      ▪ Data will be incorporated in the EIA report

5. Planning Brief
   i. Planning concept (Type of industry, facilities, transportation etc.)
      ▪ Type of Industry: Rare Material Recovery Plant will be established within the premises of Paradeep Phosphates limited for extraction of Rare Material from Phosphoric Acid.
   
   ii. Population projection
      ▪ The total population in Paradeep municipality is about 68585 as per Census 2011.
iii. **Land use planning (Break up along with green belt etc.)**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Description</th>
<th>Area in acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Built up Area</td>
<td>17.25</td>
</tr>
<tr>
<td>2</td>
<td>Vacant Area for future expansion</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Area for Green Belt Development</td>
<td>5.69</td>
</tr>
<tr>
<td>4</td>
<td>Parking Area</td>
<td>0.1</td>
</tr>
<tr>
<td>5</td>
<td>Area earmarked for township</td>
<td>nil</td>
</tr>
<tr>
<td>6</td>
<td>Area for STP/ETP etc</td>
<td>0.4</td>
</tr>
<tr>
<td>7</td>
<td>Area for solid waste disposal</td>
<td>nil</td>
</tr>
<tr>
<td>8</td>
<td>Area for Roads</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td><strong>42</strong></td>
</tr>
</tbody>
</table>

iv. **Assessment of infrastructure demand**

Modern health facilities are needed in the area.

v. **Amenities/Facilities**

The amenities / facilities to be provided include office, Laboratory, and medical centre within the Plant area. Residential quarters for the Staff will be provided within the housing facility available in PPL Colony.

The requisite site facilities are proposed as follows:
Site Office- A site is proposed for technical & clerical staff and keeping the records.
First Aid -A first aid kit will be provided in the office for giving first aid to the injured persons.
Water Hut - A water hut is proposed for drinking water for employees..

6. **Proposed Infrastructure**
   i. **Industrial Area (Processing area)**
      - Rare Material Recovery plant will be developed in an area of 42 acres and processing area consisting of plant facilities, ETP, utilities area will be developed in an area of 8.55 acres.
ii. Residential area (Non processing area)
   - Non processing area consisting of green belt, raw material storage area, administration building, parking, road and open area will be developed in an area of 8.7 acres.

iii. Green belt
   - Green belt will be developed in an area of 5.69 acres.

iv. Social infrastructure

   Social demands of the area will be taken up as per the Central Government Policy.

v. Connectivity (Traffic and transportation road/rail/metro/waterways etc.)
   - Site is well connected by Cuttack-Paradeep road, which is at a distance of 03Km from site.
   - Nearest railway station is Paradeep railway station which is at a distance of 02Km from site.
   - Nearest airport is located at Bhubaneswar which is at a distance of 130Km from site.

vi. Drinking water management (Source & Supply)
   - Total water requirement will be met from PPL Paradeep.

vii. Sewerage system
   - Sewage pipes will be laid in the plant site for removal and disposal of harmful liquid wastes from the offices, canteen and will be treated in STP.

viii. Solid Waste Management
   - About 3.15 tons/year of spent activated carbon will be generated which will be disposed of through SPCB authorized vendors.

ix. Power requirement & supply/source
   - Power requirement of 6000KW for the plant will be met from Grid Corporation Odisha.

7. Rehabilitation & Resettlement (R&R) plan
   i. Policy to be adopted (Central/state) in respect of the project affected persons including home oustees, land oustees and landless laborers.
      - There is no habitation in the proposed area as the RMRP site is within the existing premises of PPL Paradeep. Hence no displacement of any population in the project area. Therefore, no rehabilitation & resettlement plan has been envisaged.
8. Project schedule & cost estimates
   i. Likely date of start of construction and likely date of completion (Time schedule for the project to be given)
      ▪ We will start construction activities only after obtaining Environmental Clearance from MoEF and after obtaining Consent to Establish from State pollution Control Board, Odisha.
   ii. Estimated project cost along with analysis in terms of economic viability of project.
      ▪ The estimated capital cost (instant) of the project is Rs. 273 crore. Cost of implementation of pollution control systems and environmental monitoring will be around 10 crore.
      ▪ The project is economically viable and will help in production of RM for pursuing various important activities of DAE.
      ▪ Further this plant will make fertilizer free from RM, which otherwise would have got spread out to soils in the cultivation fields.

9. Analysis of proposal
   i. Financial & social benefits with special emphasis on the benefit of the local people including tribal population, if any, in the area.
      ▪ Employment opportunities to local people will increase during civil construction period and other ancillary services.