**SUBMISSION OF THE INTERVENOR BHOPAL GROUP FOR INFORMATION AND ACTION TO THE BHOPAL ENVIRONMENTAL REMEDIATION OVERSIGHT COMMITTEE ON REMEDIATION OF GROUND AND SOIL WATER, AND OTHER TOXIC WASTE, IN AND AROUND THE FORMER UNION CARBIDE FACTORY, BHOPAL IN COMPLIANCE WITH THE ORDER OT THE HON'BLE HIGH COURT OF JUDICATURE OF MADHYA PRADESH AT JABALPUR IN WRIT PETITION 2802 OF 2004 (ALOK PRATAP SINGH v. UNION OF INDIA & ORS.) DATED 21ST. JULY, 2010**

1. The intervenor, Bhopal Group for Information and Action (BGIA), to file the following submissions with the Bhopal Environmental Remediation Oversight Committee (hereinafter "Oversight Committee"), in compliance with the Hon'ble High Court of Judicature of Madhya Pradesh at Jabalpur Order of 21st July, 2010. The Hon'ble High Court allowed BGIA to place before the Oversight Committee reports and expert studies on the problem and the Operational Plan for the Preparation of Remediation Activities in and around the abandoned former Union Carbide factory at Bhopal.

2. The proposed Operational Plan is aimed at detailing the steps that need to be taken in three Phases over a period of two years for a thorough scientific assessment of the depth and spread of toxic contamination in the soil and ground water in and around the Union Carbide factory at Bhopal.

3. The proposed Operational Plan follows established international standards of assessment and is based on the opinions and suggestions of international experts in environmental assessment and remediation. It is submitted that the proposed Operational Plan offers the Oversight Committee with a feasible plan consistent with the principle that for remediation of hazardous waste, the best available technology must be used to avoid perpetuating the environmental harm while remediation. The plan is in keeping with the Order of the Hon'ble High Court of Judicature of Madhya Pradesh Order dated 23rd June, 2005, whereby BGIA, with other intervenor organisations, were accepted as intervenor to ensure a solution consistent with the community expectations and scientific consensus.

4. BGIA submits that similar to the disaster caused by the leakage of toxic gases on the night of December 2-3, 1984 from the Union Carbide factory, the ongoing environmental contamination in and around the abandoned factory site is an unprecedented situation that requires high degree of expertise and competence for its meaningful resolution.

5. That in adjudication of the scientific and technical issues this Honourable Court is expected to follow well established standards that require that "best available technology" is made available for the resolution of the ongoing unprecedented environmental situation in Bhopal. Courts in India have reiterated that for hazardous waste remediation, the best available technology must be used to ensure that there is no further environmental damage and risk to human life. In *Law Society of India v. Fertiliser & Chemicals Travancore Ltd.,* AIR 1994 KER 308, the Hon'ble High Court of Kerala held, in a public interest litigation brought against the possible leak of an ammonia storage tank in Willingdon Island area, Cochin, that:

> "On the findings and conclusions we have decoded from the mass of materials placed before us, we have to make our own final decision in the matter. We are fully aware of the fact that directing the first respondent to decommission the ammonia tank would certainly involve very far-reaching and serious economic issues as well as issues relating to loss of employment to

large number of persons. Certainly these issues involve vital and serious consequences. But we have to balance these issues with the real and intelligible potential possibility of a catastrophic accident to the ammonia tank resulting in extermination of all living beings in Willingdon Island, City of Cochin and nearby places. We have found that the catastrophic failure of the tank is not a remote possibility, but a credible and contingent possibility to be reasonably anticipated on the facts unfolded in the case. We feel that we have to discharge our obligation informed of the fact that the human population of Cochin City and Willingdon Island should not be compelled to remain under the dark shadow of a genocide. Life on earth can never be peaceful if it is shrouded in perpetual anxiety and fear of extermination on account of an avoidable human activity. It is the plain and clear negation of the most basic human right and gross violation of the fundamental right guaranteed under Article 21 of the Constitution of India." (para 191)

6. The pitfalls of using less optimal – quicker or disposal – means of disposal are demonstrated by the decision to dispose the stored 40 metric tonnes of lime sludge from the former UCC factory at a landfill in Pithampur, Dhar District, Madhya Pradesh. The disposal was recommended despite a lack of consensus in the technical sub-committee, and a failure to conduct appropriate studies. It was also conducted without consultation with the local community in Pithampur. The local community has since seen a spate of health problems related to the dumping of toxic waste, that have developed consequent to the transfer, and a full inquiry has been publicly promised.

7. The remediation plan being placed before the Oversight Committee was filed as part of an interim application before the Hon'ble High Court of Judicature, filed on 11st August, 2005 (IA 6809/2005). The Interim Application is still pending. The remediation plan is annexed hereto and marked as **Annexure 1.**

8. BGIA respectfully reiterates the following facts from its interim application (6809 /2005) filed before the Hon'ble High Court in WP 2802/2004.

Extracted numbered paragraphs from Intervenor's Application dated August 11, 2005.

21. That the **major reason for delay in responding to the environmental disaster was the active part in downplaying the assessment of hazard at the factory site by the government scientific agency NEERI**, which carried out a series of unscientific studies that produced conclusions favorable to Union Carbide.

22. That the National Environmental Engineering Research Institute **(NEERI) had insufficient experience and expertise** to characterize the waste remaining at the Union Carbide Factory site, or to assess the depth and spread of contaminants in soil and ground water in the nearby communities. An internal document [Annexure XLI] from Union Carbide describes NEERI's weakness in this area in the following words :

> *"NEERI's experience is mainly limited to Environment Impact Assessment of a new project or an Operating Plant. Investigation and remediation of a closed chemical plant site like Bhopal is a first of its kind in India and* ***there is no one including NEERI having any experience for this kind of work****."*

26. That NEERI **enjoyed a special relationship with the Union Carbide Corporation** because NEERI's

research was perceived by Union Carbide to be easily malleable and methodologically unprofessional in UCC's favor, and, that UCC chose to fund NEERI because NEERI is a Government agency whose research UCC understood would not come under intensive scientific scrutiny by monitoring agencies such as the MP Pollution Control Board. These facts are made clear from Union Carbide's internal documents.

> *" NEERI is a well known Government sponsored institute whose investigations are well accepted by monitoring agencies such as State Pollution Control Boards, as well as Government departments." [ Annexure LI]*
>
> *"It was noticed that State Pollution Control Board did not question the investigations and recommendations of NEERI. If the work is carried out by any other agency, the Board follows up and examines the work critically, and more so if UCIL is involved. Strategy: from the foregoing, it is advisable to entrust the work to NEERI…" [Annexure LII].*

27. That Union Carbide Corporation understood and made use of NEERI's weaknesses in order to enable research that was beneficial to **Union Carbide, and was able to exploit** those weaknesses by hiring their own private consultants, the Arthur D. Little Company (ADL) to guide and advise NEERI on methodology..

> *"NEERI's Weaknesses*
> - *Not used to developing standards of contamination where not available*
> - *Likely to recommend unrealistic standards of contamination without sufficient back-up.*
> - *Found to ignore standard sampling procedures." [Annexure LI]*
>
> *"Hence, M/s A.D. Little, USA (ADL), who have vide been appointed as Consultant to UCIL, to advise and guide in investigation, development of EMP & carrying out remediation work to restore the plant site making it suitable for light engineering industry." [Annexure LI]*

The annexures in the application 6809/2005 are not reproduced as part of this submission and are available if necessary.

9. That the Intervenor- BGIA's purpose in presenting the above paragraphs is to highlight the need for thorough scrutiny of the competence and record of performance of scientific agencies to be selected for the purpose of assessment and remediation. In view of the fact that the issues raised in the August 11, 2005 application are eminently relevant to the subject matter under consideration. The Oversight Committee must consult all reports and studies and ensure that the remediation plan is consistent with the scientific consensus and represents the best available solution to solving the intractable problem of the contamination of the soil and ground water.

10. BGIA also reiterates the following reports for the reasoned consideration of the Oversight Committee in any consideration of a remediation plan for the consideration of the Hon'ble High Court in this matter.

11. The Centre for Science and Environment (hereinafter "CSE"), which has been filed before the Hon'ble High Court, one of the most respected scientific organisation in India, issued a report in December 2009, that concluded that not only within the factory site, but also outside, the soil samples contained toxic chemicals (chlorinated benzene compounds and organochloride pesticides and four out of the five heavy metals tested). The concentration of pesticides found in all water samples was upto 59.3 times the mandatory water standard affixed by the Bureau of Indian Standards (IS: 14543).

The report further concluded that not only is the UCIL the only source of the conta indentmination of ground water and soil, but:

> *"The topography of the area also points towards contamination of the ground water due to the UCIL".*

In addition, the CSE Report concluded that the closed UCIL factory continues to be a source of contaminants for the surrounding area. The report is annexed hereto as **Annexure 2.**

12. In 1999, University of Exeter undertook the collection of 33 samples of soil and 22 samples of groundwater from in and around the factory site. They found heavy concentrations of carcinogenic chemicals and heavy metals like mercury. Mercury was found at between 20,000 to 6 million times the expected levels: and elemental mercury was discovered to be widely distributed across the plant premises Twelve volatile organic compounds, most greatly exceeding EPA standard limits, were found to have seeped and continue to seep into the water supplies of an estimated 20, 000 people in local area. VOCs were registered in the following quantities in a water well of the Atal Ayub Nagar community in Bhopal, just north of the Union Carbide factory. Three water wells in this community, northeast of the factory, were discovered to have the most severe contamination. This report is annexed hereto as **Annexure 3.**

13. The toxic waste has been dumped around the Union Carbide factory between 1977 and 1984, when the Bhopal Gas Tragedy brought a tragic and abrupt halt to the operations of the plant. According to the German aid development agency (GTZ), a technical proposal entitled "Final and Complete Remediation of the Abandoned Factory Site of the Union Carbide", submitted to the Madhya Pradesh Pollution Control Board, Respondent No. 3 herein, approximately 25, 000 tonnes of contaminated solid material may exist at the site. A copy of the report is annexed hereto and marked as **Annexure 4.**

14. The Sambhavna Trust Clinic conducted a "Morbidity Survey Relating to Water Contamination" prepared in August 2006 which concluded that the soil and water contamination has resulted in an increase in the morbidity pattern among the population staying near the UCIL factory and surrounding area of the solar evaporation ponds, which were used in a shocking and reckless disregard of the consequences of such an act, to dump extremely toxic material around the factory site. A copy of the report is annexed hereto and marked as **Annexure 5.**

15. It is respectfully submitted that the below toxic waste disposal units - or other such environmental, health and safety regulations compliant facility - are recommended:

**A. GTZ, Eschborn, Frankfurt, Germany**

GTZ is active in over 120 countries in Africa, Asia and Latin America. The facility is already involved in an Indo-German collaboration with the Central Government for over 40 years that includes hazardous toxic waste management, dealing with obsolete pesticides, and environmental policy.

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B. **Ekokem Oy Ab, Helsinki, Finland**

This facility is owned by the Finnish government (34.1%), municipalities (28.2%) and industry (37.7%). It has ISO 9001, ISO 14001, EMAS, OHSAS 18001 and other key certifications and more than 20 years of experience. The plant utilises, renders harmless or safely disposes off some 120,000 tons of hazardous waste every year. The plant processes hazardous organic chemical waste, contaminated soil, inorganic hazardous waste and other industrial wastes. The company has much experience of disposing of obsolete pesticides from developing countries. The incineration of waste takes place in the kilns at a temperature of about 1300 ºC with an oxygen surplus of at least 6 % in the kiln and its after-burning chamber. This ensures complete incineration.

The Finnish Funding Agency for Technology and Innovation and Finpro are planning with their co-partners to set up an innovation centre in India, the intention being to make the Finnish innovation system well-known and increase joint innovation activities between Finland and India

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**C. Earth Tech, Alberta, Canada**

The Swan Hills Treatment Centre owned by the government of Alberta and operated by Earth Tech Canada Inc has more than 20 years of experience.. The destruction and removal efficiency rate of the Swan Hills Treatment Centre exceeds the licensed requirement for DRE of 99.9999% for organic materials, typically operating at a DRE level of 99.999999%. It has been used to destroy dioxins and PCBs. The facility is networked with waste management service providers for onsite jobs such as waste collection, waste labeling/packaging, documentation or transportation of hazardous wastes. It is certified ISO 14001 OHSAS 18001. Earth Tech Canada has over 8,400 professional and support personnel in 150 offices worldwide, including the U.S., Canada, Mexico, South America, Europe, Australia, and Asia/Pacific.

EARTH TECH (CANADA) INCORPORATED
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16. That in conclusion the Intervenor organisation wishes to emphasize that transparency in the planning and execution of the work of scientific assessment of the depth and spread of contamination, participation of the victims and potential victims at all stages of the project and systems for long term scientific monitoring as well as monitoring by the neighbourhood community are vital to a sustainable solution to the problem of hazardous contamination in Bhopal.

**Submitted on behalf of Bhopal Group for Information and Action**

**By Satinath Sarangi**
**Authorised representative**

# ANNEXURE - 1

**Proposed Operational Plan for the Preparation of Remediation Activities in and around the abandoned Union Carbide factory at Bhopal**

***Introduction***

Various Studies, Reports, soil and groundwater investigations have been performed and in some cases monitoring is currently ongoing. There should be enough and suitable data to draw a clear picture of the site and get an idea of the dimensions of the pollution. However, the existing data were never compiled and summarized completely and comprehensively, plus, existing gaps were neither properly identified, nor really filled. It is assumed, that there are still considerable gaps regarding the selection of appropriate, effective and suitable remediation methods and techniques, not to speak of the still incomplete picture of the status of real contamination of the site and its vicinity.

Therefore and as the primary step a comprehensive baseline summary including a **gap analysis** is recommended as basis for further action on site.

Some of the hazardous waste from the site such as chemicals, debris, tarry residues, other material (approx. 400 tons) were collected in 2005 stored in one of the sheds within the factory premises. The waste is contained in drums, big plastic bags and other containers. While these need to be disposed off currently this waste is secured, is not exposed to the elements and not leaching any contaminants in to the environment.

The expertise and services of UNESCO and the Archaeological Survey of India (ASI) will be very much required for the challenging task of dismantling, decontamination and reconstruction of plant structures, machinery and building. Already, UNESCO has shown interest in this direction. Further, and parallel to other actions, the site should be properly fenced (in particular the rear part of the site where uncontrolled access is possible) and secured by guards (not only the road entrance).

It may not be possible to dispose off hazardous and toxic or contaminated material, waste, or whatever will be found in Bhopal or Madhya Pradesh or even in India. It therefore might be appropriate to consider shipping for treatment in countries such as Germany, Canada and Denmark where the most appropriate and efficient facilities are available.

Even today it is not possible to select and decide on any specific remediation methods, techniques or strategies, since the data available on the extent and character of contaminants is not clearly known yet. However, as soon as a final site investigation would have been done, the base for action would be immediately clear and remediation techniques could be selected on the basis of a risk assessment study and a feasibility study, which may take only very few months. It would not be very difficult to propose options and carry out a feasibility study with proper and solid cost estimates.

A small variety of options is available in particular in Germany with a high experience gained in similar cases. However, given the current lack of knowledge on the extent and the type of contamination, especially with respect to ground water, appropriate, effective and feasible methods still need to be selected. A comprehensive site investigation and characterisation (detailed Phase II investigation – see below) is inevitable.

The operation plan for the holistic investigation of the abandoned Union Carbide factory site in Bhopal comprises of three steps or Phases.

- **Phase I** is a desk top study to establish a Baseline Document considering all available results
- Based on this study, available data will be compiled and checked for consistency and data gaps will be identified.
- During **Phase II** and **Phase III** data gaps identified during Phase I will be closed and missing data for the holistic understanding of contamination present will be obtained by additional investigation. A sampling and analysis plan will prepared, specifying the way data gaps will be closed. In a first step, additional investigation will address the direct Union Carbide site, in a second step the impacted surroundings of the site up to 5 km distance and radius will be included.

The operation plan considers also the decontamination, dismantling, reconstruction and conservation of plant structures, machinery, facilities and buildings still present on site.
Therefore the following scope is envisaged:

- Site cleaning, collection of any kind of waste still being present and removal of uncontaminated loose parts, plants etc. must be carried out. Existing vegetation especially grass, shrubs, tress should be cut and removed.

- A Health, Safety and Environmental (HSE) site management is absolutely important for safe performance of the planned action. The site management system should include all procedures and provide SOP's (Standards Working Procedures) for all works and processes. Training and education measures for staff working on the site and residents of neighbourhood communities must also be included. Enforcement of the HSE management on site must be provided by site supervisors.

- It is strongly recommended to establish an internationally recognized and accepted Health and Safety System (HASP) and adopt it to each step of the project.

| ***Phase*** | | ***Issue*** | ***Activities*** | ***Duration*** | ***Schedule*** |
|---|---|---|---|---|---|
| **I** | **1.1** | Collecting, reviewing and evaluating existing available data | Collect and compile all existing reports, studies, accounts, articles, verbal information from eyewitnesses and NGOs and other relevant data on the *site and the effected vicinity of the site regarding existing contamination*: e.g. biota, soil, ground and surface water, buildings, residual plant components, water supply | 1 month | Month 1 |
| **I** | **1.2** | Baseline summary | Compile evaluated data and prepare a baseline summary indicating the present state of knowledge on the contamination present (chemicals, extent in soil and groundwater, known and suspected contamination sources, pathways and receptors), from evaluated data start to produce a site conceptual model that can further be developed and completed with each of the following investigation steps. Identify the impacted site's surroundings and include them in the site conceptual model. | 1 month (parallel to 1.1.) | Month 1 |
| **1** | **1.3** | Plans for conservation of plant structures as Modern Industrial Heritage. | Invite experts from Archaeological Survey of India and UNESCO for an inspection and survey of the plant structures, machinery and buildings that need to be conserved as Modern Industrial Heritage. | 1 month (parallel to 1.1) | Month 1 |
| **I** | **1.4** | Gap analysis and Phase I Report | Identify and address data gaps and inconsistent data and recommend additional investigations for groundwater and soil wherever required, to obtain a holistic knowledge on the site and its surroundings regarding the extent and type of the contamination, the potential sources, pathways and receptors, prepare sampling and analysis plan for soil and groundwater based on the baseline study and the results of the gap analysis, prepare a report and stepwise complete the site conceptual model | 1 month | Month 2 |
| **I** | **1.5** | Inform all stakeholders and make decisions | Organise meeting(s) of all stakeholders and:<br>Inform on findings from literature assessment (Report Phase I)<br>Present and discuss work plan for PHASE II<br>Achieve approval of work done and accordance on all further steps from all stakeholders | 1 month | End of Month 2 |

Activities within Phase I can be started immediately.

After submission of the deliverables of Phase I to the High Court and the Remediation Group meetings are required among all relevant stakeholders such as survivors organizations, state and central government agencies, and NGOs for finalization of Phase II activities.

| *Phase* | | *Issue* | *Activities* | *Duration* | *Schedule* |
|---|---|---|---|---|---|
| **II** | **2.1** | Inventory of hazardous waste on site for later removal and disposal | Organise proper inventorisation and characterization of the waste. | 1 month | Month 3 |
| **II** | **2.2** | Organize proper packaging and labelling<br>Organise proper transport<br>Arrange disposal at a suitable TSDF (most probabaly in the EU) | Prepare removal and containment plans for the above waste for transport and eventual treatment of accumulated waste, get approvals for transport, disposal and if required export to another country (follow BASEL Convention requirements); identify private operator to carry out work. | 1 month | Month 4 |
| **II** | **2.3** | Supervision of removal and disposal activities | Supervise the removal and disposal activities for compliance with regulations, the contract and health and safety requirements | 0,5 month | Month 5 |
| **II** | **2.4** | Investigation and inventory of existing plant components | Plan and carry out:<br>Detailed inspection, survey and analysis of all plant components that are still in place: containers, cauldrons, reactors, tanks, pipes, etc. on residual chemicals, contaminations and other material; quantification of items with the participation of experts from ASI and UNESCO. | 2 month | Month 3 and 4 |
| **II** | **2.5** | Investigation of existing buildings and building components | Plan and supervise::<br>Identify analyses and quantify all production residuals, raw materials and products left back in containments, vessels and tanks .<br>Detailed analysis of contamination of buildings and building components: take samples and analyse; quantification of existing components<br>Preparation of a decontamination, decommissioning, reconstruction and conservation plan for all plant structures, facilities and buildings with major help from ASI and UNESCO. Preparation of detailed Health and Safety plans (HASP) for the above work including Standard Operation procedures (SOP's) for all work steps. | 2 month parallel to 2.1 | Month 3 and 4 |
| **II** | **2.6** | Preparation of tender documents (for sub-contracting) for decontamination, dismantling, reconstruction and conservation work, | Prepare Tender Documents for decontamination, dismantling, reconstruction and conservation of facilities and disposal of residuals left back in tanks, pipes etc. | 1 month parallel to 2.1 | Month 4 |
| | **2.7** | Supervising above work | Supervise the demolition, decontamination, reconstruction activities for compliance with regulations, the contract and health and safety requirements | | Month 4 and 5 |
| **II** | **2.8** | Health and Safety Planning | Preparation of detailed Health and Safety plans for the above work including Standard Operation procedures (SOP's) for all work steps. | 1 month parallel to 2.4 | Month 3 and 4 |

| | | | | | |
|---|---|---|---|---|---|
| **II** | **2.9** | Preparation of Tender Documents for sub-contracting, based on the sampling and analysis plan derived from the gap analysis, for Site investigation works including drilling of soil borings, groundwater monitoring works, sampling and chemical analysis | Prepare Tender Documents for site investigation work | 1 month | Month 5 |
| **II** | **2.10** | Investigation of biota, soil and subsoil on contaminations | Plan and supervise :<br>Detailed analysis of biota; detailed analysis of soil: layer wise, sample collection each 0.5 m thickness: drill boreholes and take samples according to a drilling plan; analyse samples | 6 months overlapping 2.1 and 2.4 | Month 4 to month 9 |
| **II** | **2.11** | Investigate all water bodies, investigate storm water discharge from site | Plan and supervise :<br>Detailed analysis of Surface water bodies (nallahs, creeks, lakes, ponds, etc. if existing) according to plans; | 3 months parallel to 2.8 | Month 5 to month 7 |
| **II** | **2.12** | Groundwater investigation | Plan and Supervise<br>Detailed sampling and analysis of existing ground water wells, drilling of additional boreholes and installation of additional wells as per results of gap analysis and sampling. Set up a numerical fate and transport model for groundwater. | 4 month parallel to 2.8 | Month 7 to 9 |
| **II** | **2.13** | Sampling of ground and surface water on regular bases (periodically 4 times/a) | Based on results from step 2.12: plan and carry out<br>Ground water and surface water sampling and analysis every three months to find out trends and seasonal dependencies within one year | 1 month per period | Month 8 to month 19 |
| **II** | **2.14** | Prepare a holistic analytical report including risk assessment for the site and site conceptual model | Compile and assess all analysis and investigation results, evaluate results and draw conclusions (findings and recommendations) with respect to a holistic risk assessment, select and identify appropriate remediation technique and prepare final rehabilitation action plan and Health and Safety Plan (HASP) for onsite labours and neighbouring people | 2 month | Month 9 to 10 |
| **II** | **2.15** | Prepare Tender (for subcontracting) for site remediation (soil and groundwater) | Preparation of Tender Documents for soil and groundwater, disposal/treatment of contaminated soil, Assist in tendering process, contract negotiation and prepare for site supervision during remediation works | | |
| **II** | **2.16** | Inform stakeholders on regular bases and make common decisions where required | Ongoing:<br>Organise regular meetings of all stakeholders and:<br>1. Inform about progress of detailed investigations on Union Carbide factory area<br>2. Inform on preliminary findings and recommendations<br>3. Achieve accordance on **every further** step from **all** sides | | Month 3 to month 19 |

| | | | | | |
|---|---|---|---|---|---|
| **II** | **2.17** | Inform all stakeholders and achieve accordance on further steps | Organise final meetings of all stakeholders and:<br>1. Inform about findings and recommendations from PHASE II<br>2. Present and discuss work plan for PHASE III<br>3. Achieve accordance of **all** stakeholders on all **further** steps<br>4. Discuss remediation objectives (status of site after remediation has ended) | | Month 10 etc. |

The activities of Phase III could run in wide parts parallel to and in close connection with the one of Phase II. Since the measures are similar and the equipment used and staff employed will be the same:

| Phase | | Issue | Activities | Duration | Schedule |
|---|---|---|---|---|---|
| III | 3.1 | Prepare Tender Documents for subcontractors for a site investigation work in the vicinity of the Union Carbide factory site | Preparation of Tender Documents based on the sampling and analysis plan derived from the gap analysis, for Site investigation works including drilling of soil borings, groundwater monitoring works, sampling and chemical analysis | 1 month | |
| III | 3.2 | Investigate biota, soil and subsoil on contaminations | Plan and supervise :<br>Detailed analysis of biota; detailed analysis of soil: layer wise in strata of 0.5 m thickness: drill boreholes and take samples according to drilling plan; analyse samples | 6 months | Month 8 to month 13 |
| III | 3.3 | Investigate all water bodies and water types on contamination | Plan and supervise:<br>Perform a detailed analysis on existing wells based on the results of the Baseline Summery under Phase I. Install new monitoring and pump wells if necessary and test (pump test packer tests, MIP tests, geophysics, hydro chemically and hydro mechanically) them accordingly. Investigate also deeper or different aquifers within the fractured bedrock, provide a detailed plume analysis and detect any DNPL/LNPL, if present. Set up a numerical fate and transport model for groundwater.<br>Detailed analysis of surface water bodies (nallahs, creeks, lakes, ponds, etc.) according to sampling plans;<br>Detailed sampling and analysis of ground water and well water. | 3 to 5 months parallel to 3.2 | Month 9 to month 11 |
| III | 3.3 | Sampling of ground and surface water on regular bases (periodically 4 times/a) | Based on results from step 2.4: plan and carry out<br>Ground water and surface water sampling and analysis every three months to find out trends and seasonal dependencies. | 1 month per period | Month 12 to month 23 |
| III | 3.4 | Prepare a holistic analytical report including risk assessment for the site and site conceptual model s | Compile and assess all analysis and investigation results, evaluate results and draw conclusions (findings and recommendations) with respect to final rehabilitation work (remediation master plan) | | Ongoing |
| III | 3.5 | Information meetings for stakeholders / decision making | Refer to Phase II steps 2.7 and 2.8:<br>Include results from Phase III | | Ongoing |