

**Assessment and Remediation of
Hazardous Waste Contaminated Areas in
and around M/s Union Carbide India Ltd.,
Bhopal
(NEERI & NGRI)**

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**Tender Document for
Detoxification, Decommissioning
and Dismantling of UCIL Plant
(IICT)**

Remedial Issues

- **Operation of UCIL (1969 – Dec, 1984)**
 - Tarry Residue 350 plus metric ton
 - Off quality pesticides and contaminated soil (1.1 million ton)
 - Ground Water Quality
- **Post Dec, 1984**
 - 70 ltr. of Mercury Spillage
 - 1500 mt of corroded Plant structure

NEERI's Earlier Efforts

- **NEERI did a study in 1996 for EIL/UCIL on assessment of contaminated areas due to the past waste disposal practices of UCIL**

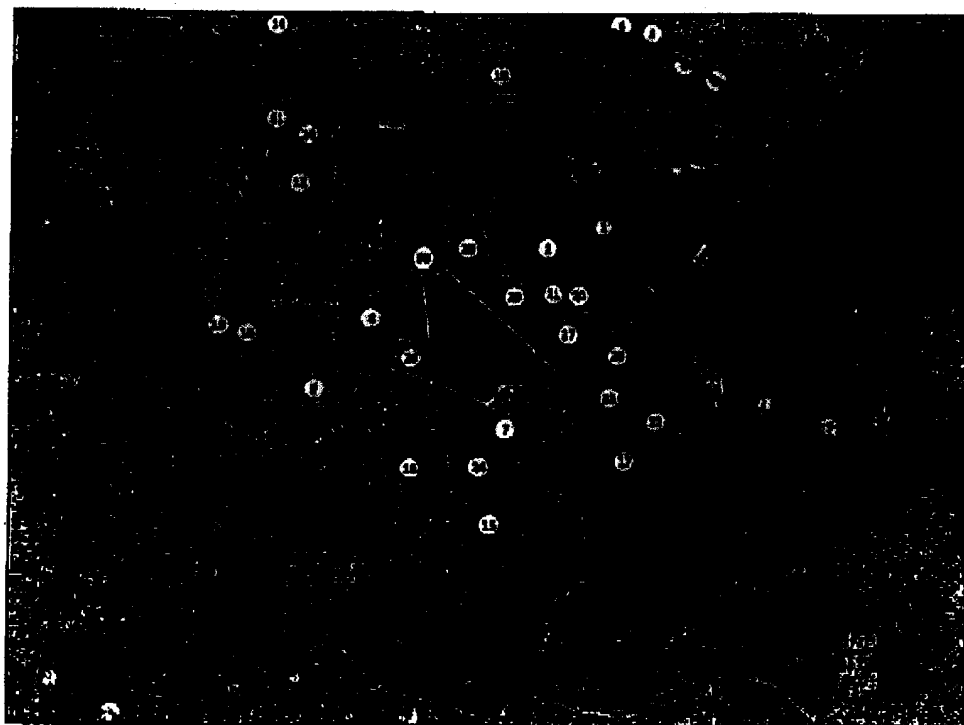
Geo-Physical and Hydro-geological Studies

Work carried out:

- **Electrical resistivity tomography across the open space in UCIL premises (Total nine sites) to find anomalies and possible underground dumps**
- **Environmental drilling at five selected locations within the premises for hydro-geological characteristics of the UCIL location**
- **Modelling of the ground water flow**

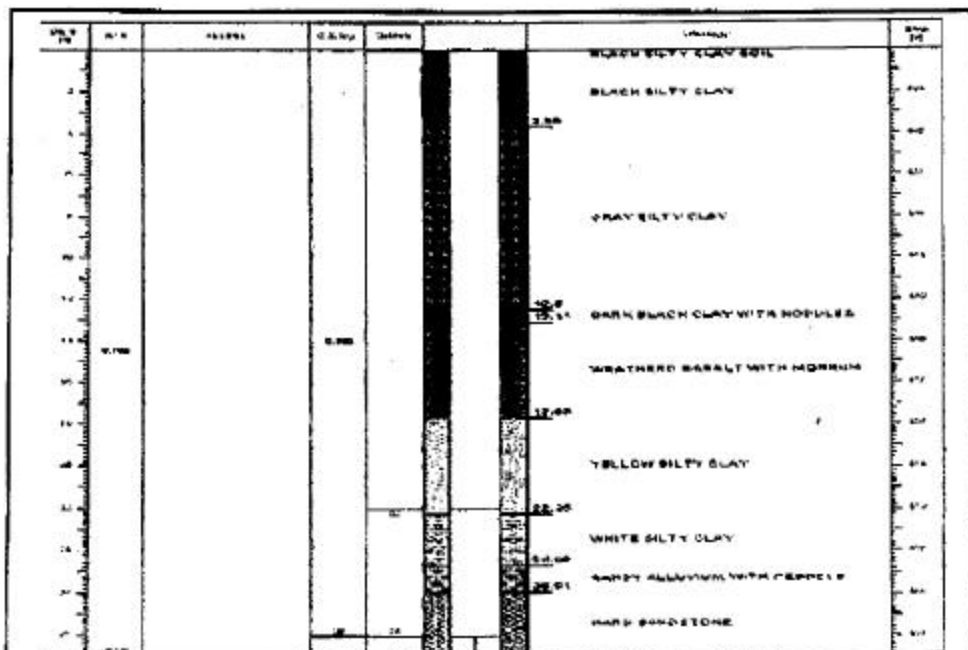
Number of Samples	Bore well A	Bore well B	Bore well C	Bore well D	Bore well E
	Depth in meters				
1.	0.3	0.3	0.3	0.3	0.3
2.	0.6	0.6	0.6	0.6	0.6
3.	0.9	0.9	0.9	0.9	0.9
4.	1.2	2	2	2	2
5.	2	3	3	3	3
6.	3	4	4	4	4
7.	4	6	6	5	6
8.	5	6	6	6	6
9.	6	7	7	7	7
10.	7	8	8	8	8
11.	8	10	8	9	9
12.	9	14	10	10	11
13.	11	18	12	12	13
14.	13	18	14	14	15
15.	15	20	16	16	17
16.	17	22	18	18	19
17.	22	27*	20	22	21
18.	27		25*	27*	26*
19.	32*				

* Occurrence of groundwater

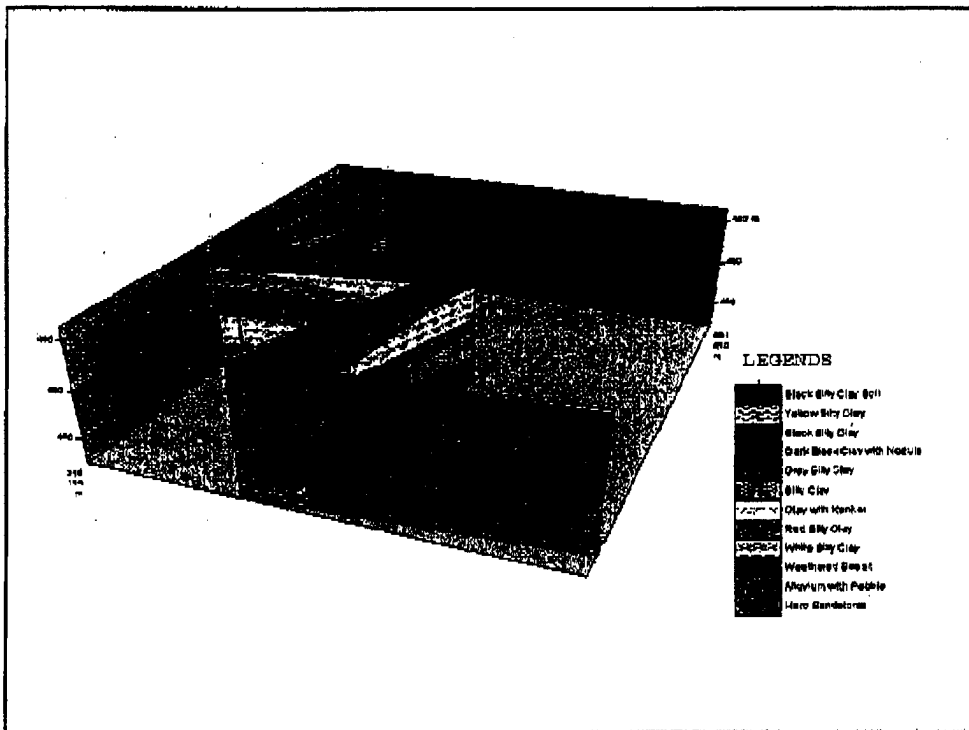


Quality of Groundwater in and around UCIL premises (mg/l)										
Sample ID	Aldicarb	Carbaryl	o-naphthol	HCH	HCH	HCH	Dichloro-benzene	Chloro-toluene	Mercury	
GW-01	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-02	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-03	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-04	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-05	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-06	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-07	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-08	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-09	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-11	ND	ND	ND	ND	ND	ND	0.0002	0.0001	ND	ND
GW-12	ND	ND	ND	ND	ND	ND	0.0002	0.0002	ND	ND
GW-13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-23	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-26	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
GW-27	3.4	ND	ND	ND	ND	ND	0.0003	ND	ND	ND
GW-28	3.7	ND	ND	ND	ND	ND	ND	0.00011	ND	ND
GW-29	3.4	ND	ND	ND	ND	ND	0.0001	0.00005	ND	ND
GW-30	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND: not detected



Litholog and drill-time log at a Bore well



Soil

- Soil within the UCIL premises is contaminated.
- Only two downstream soil samples out of five in the near vicinity of the UCIL premises and solar evaporation pond showed presence of pesticides
- Rest of the downstream samples did not show any presence of identified contaminants

Benchmarking with International Standards

- USEPA Screening Standards (Dec.2009) prescribe two sets of contaminant specific standards to determine the need for remediation Viz. Standards for Industrial Soils and standards for the ground water protection
- Most of the Soil samples in the UCIL premises do not conform to the USEPA standards for ground water protection, especially for HCH isomers and mercury.
- The ground water samples from the all the five drilling bores at different locations within the UCIL premises do not show presence of identified contaminants
- In all five bore well water samples on downstream side (within 3.5 km radius), outside the UCIL premises do show presence of pesticides and organics. Therefore these wells need to be sealed.

Remediation's Needed

Soil Remediation

- Most of the suspected underground dumps are limited to 1.5 to 2.0 m depth. Only one suspected dump is expected to be 6 to 8 m deep over a small area
- Earlier estimates of tarry and other waste need to be re-visited since there are 4 dumps which have not been considered in earlier waste excavation exercise
- Assessment of these 4 dumps would also need further characterisation for disposal purposes after excavation
- Tarry (earlier estimates of 350 ton) at UCIL site is mostly the result of pre 1984 fire at UCIL site.

Remediation quantities

Soil

Total area of UCIL	: 30 Ha
Open area(not covered by concrete or foundations)	: 14.2 Ha
Solar Evaporation Ponds	: 10 Ha
Suggested depth of excavation	: 2.0 meters
Total volume of soil to be excavated for remediation (including dumps)	: 6,50,000 CUBIC METERS (Approx) (1.1 million tons)
Estimated waste after Dismantling/ Detoxification of UCIL plant structure	: 300 tons

Remediation Options

Soil

- Contaminants found are to be considered for remediation:
- The important contaminants are HCH isomers as these are listed as Persistent, Organic Pollutants (POP) having very long half life periods and mercury
- Most of the solvents are volatile in nature and are not persistent

Technological Options and Suitability

- Thermal remediation (retorting or incineration) not suitable due to low concentrations and huge volume as well as due to the presence of mercury.
- Soil washing and chemical treatment (Not suitable for same reasons and presence of clay)
- Bio-remediation (Not suitable due to presence of POP)
- Secured land filling is suitable, quick and easy

Ground Water

Only option is pump and treat

- Contaminated water of 5 wells to be pumped, treated with activated carbon and recharged back to the ground. Spent activated carbon will be incinerated in a dedicated hazardous waste incinerator
- Chemical treatment with advanced oxidation processes such as Fenton is not suitable due to low concentration and huge volume
- Bio-chemical treatment methods are not suitable for same reasons

Underground Dumps

- **Careful excavation of identified suspected dumpsites without causing cross contamination of any kind**
- **Appropriate collection and storage of the collected waste material**
- **Characterization and classification after excavation as per Hazardous Waste (Management and Handling) Rule, 2008**
- **Incineration of incinerable waste and secured land filling of the remaining waste in established Treatment Storage Disposal Facility (TSDf), preferably within UCIL premises**

Recommendations

Soil

- **Secured land fill would be with vents retrofitted with activated carbon scrubbers to prevent escape of Methyl Mercury/ Mercury vapors if any**
- Option I- Secured Landfilling in the established and authorized TSDf**
- **Excavation of the soil and Transportation to authorized TSDf**
 - **Stabilization at TSDf and secured land filling**
- Option II (preferred): Creation of the Secured Land fill at UCIL premises**
- **Construction of secured land fill at site**
 - **Capping and closure of the secured land fill**
 - **(All these activities as per Hazardous Waste (Management and Handling) Rules, 2008) & CPCB guidelines**

Need of Immediate Measures

- Seal 5 contaminated wells outside UCIL premises
- Repair broken compound wall
- Prevent dumping from nearby locality
- Prevent children and others to enter UCIL premises

Cost for Construction, Operation, Capping and Post Closures Monitoring of the Secured Landfill

- Size : 400mX400mX5m

Items	Amount in Rs
Construction	50 Crores
Land filling, Compaction & leveling	15 Crores
Closure & Capping	15 Crores
Post closure monitoring (for 30 years)	20 Crores
Total	100 crores

* Does not include land & transportation cost as it is assumed land fill would be created at UCIL premises

Tender Document for Detoxification, Decommissioning and Dismantling of UCIL Plant

Scope of Work

To prepare a Technical and Tender Document for
Detoxification, Dismantling and Decommissioning
of the Union Carbide Plant in Bhopal

Includes:

- ✧ **Methyl Isocyanate Plant & Phosgene reactor**
- ✧ **Sevln Plant**
- ✧ **Storage Areas**
- ✧ **Pipe Rack**
- ✧ **Plant Structure**

Status of the Existing Plant

- ❖ Both the MIC and Sevin plants are in a highly corroded state
- ❖ Most of the equipment and piping are missing or broken
- ❖ Structure is highly corroded and unsafe

Tender Document Contents

- ❖ Technical details of equipment
- ❖ Detoxification methods as per International norms
- ❖ Procedures for dismantling and decommissioning of equipment and piping
- ❖ Hazardous waste disposal from the above equipment and pipelines
- ❖ Safety measures as per International norms
- ❖ Detailed drawings
- ❖ Process flow schemes for detoxification
- ❖ Specifications of new equipment

Time Requirements

- ★ The total cost estimated is 110.0 crores, for the entire operation.
- ★ Total time estimated to carryout the operations is 24 months after award of the work

Utilization of the waste after Decommissioning

- ★ The waste metal after detoxification cut into unusable pieces after decommissioning can be sent for re-rolling.
- ★ After detoxification, the waste generated may be sent for secured land fill.

**Probable Agencies in India who can
take up the Detoxification, Dismantling
and Decommissioning work**

- ✪ **Engineers India Limited**
- ✪ **Jacobs Engineering, Mumbai**
- ✪ **Punj Lloyd Consulting
Engineers, New Delhi**
- ✪ **Enfab Industries Pvt. Ltd.,
Hyderabad**
- ✪ **Krish Technologies, Hyderabad**

Thank You