Comments on NEERI report on Assessment and Remediation of Hazardous Waste Contaminated Areas in and around M/S Union Carbide India Ltd, Bhopal, June 2010
Centre for Science and Environment, New Delhi

1. Study corroborates our analysis done in October-November, 2009 that the UCIL site is heavy contaminated with chlorinated benzene compounds, organochlorine pesticides, carbmate pesticides (Carbaryl and Aldicarb. It also confirms that this contamination has nothing to do with the gas accident, but is caused by UCC/UCIL dumping and disposing off waste indiscriminately on the site. All pesticides found in the soil and water samples were manufactured at the site and heavy metals, especially chromium and mercury were part of the process of manufacture.

2. Our study was done in conjunction with the Central Pollution Control Board (CPCB) and soil samples were jointly picked-up from the site. The CPCB analysis, though not yet made public, corroborates our analysis. Both the studies show very similar trends and pattern on the presence of various contaminants that were tested.

3. It is important to point that both CSE and CPCB study were limited in scale and we had recommended detailed investigation of the site before designing the decontamination plan.

4. However, the investigation as reported by NEERI into the extent of contamination is still incomplete. The NEERI report accepts that large parts of the site are covered with thorny bushes, roads and concrete structures and water bodies. These sites have not been investigated through geophysical methods for identification of waste dumps or tested for contamination. The study, according to the report, was restricted to a relatively limited area.

5. NEERI has based its findings on the extent of contamination on 90 soil samples collected at different depths from the 5 boreholes. In addition 27 surface and subsurface soil samples were also checked from inside the plant and 24 samples from outside the plan and 30 samples from areas adjacent to the plant.

6. It finds:
• Aldicarb not detected in any surface soil samples, but found in subsurface soil samples – shows either a dumpsite or contamination of soil.

• Carbaryl detected in most of surface and subsurface soils, at varying concentration – from 0.038 mg/kg to as much as 10729 mg/kg.

• 1-naphthol (alpha-naphthol) detected in most of the surface and subsurface soil samples throughout plant with a varying concentration from 0.511 to as much as 1460 mg/kg.

• Three isomers of HCH detected in soil samples.

• Dichlorobenzene was detected in few subsurface samples with concentration ranging up to 0.165 mg/kg. NEERI has not tested 1,3 dichlorobenzene, 1,4 dichlorobenzene and 1,2,3 trichlorobenzene all of which were found in our study.

• Mercury found in most surface and subsurface soil samples, up to 4.17 mg/kg

7. But in spite of finding such widespread contamination, the report concludes that "waste disposal area as reported by NEERI in its report of 1996 (done for UCIL as clients) was 7 ha." In addition to this, contamination has spread to open areas (emphasis ours) within the plant premises possibly due to surface runoff.

8. All this makes NEERI suggest that the area requiring containment is limited. "Moreover, the open areas in and around the abandoned manufacturing units, sheds, buildings are likely to be contaminated during the decontamination and decommissioning activities to be taken by BGTRRD through suitable contractor. The quantum of such areas is estimated to be 9 ha. Thus the total contaminated area within UCIL premises would require remediation is about 16 ha (9 ha+ 7 ha that NEERI had indentified for its clients UCIL in 1996)

9. This is when, earlier in the report, it has been made clear that the entire site could not be inspected because of lack of access. Furthermore, the samples collected from across the site, at random points, had high levels of toxins. It is therefore, clear that the entire site would need to be re-surveyed and samples collected to check the scale of contamination. Once this is done, the plan for decommissioning and decontamination can be finalized.

10. The report also clearly underestimates the extent of potential groundwater contamination and its spread in neighbouring areas.

11. It is important to recall that in its 1996 study NEERI had not found any groundwater contamination. However, all subsequent studies, done by government and non-government organistions, have found groundwater contamination. CPCB collected groundwater samples in October-November 2009 and found a-HCH, g-HCH and d-HCH at a number of places in varying concentrations. A large number of the above compounds along with volatile organic compounds were detected in the groundwater in Indira Nagar, which is situated at a distance of 2.4 km from the factory site.

12. CSE study had also found contamination of all groundwater samples with the same chemicals found in the soil within the UCIL premises. The groundwater sample collected from the hand pump near Chaurasia Samaj Mandir in Shiv Nagar was the most contaminated. It has highest concentration of carbaryl, lindane and mercury. This place is more than 3 km away from the UCIL factory.

13. According to the report, the National Geophysical Research Institute (NGRI) re-visited its previous survey of 1996 to estimate the geophysical conditions on the site.

14. It's study showed that the subsurface in the area comprises the following: black soil, followed by silty soil, fractured sand stone and hard sandstone as bedrock. The combined thickness of black soil and silty soil was inferred to be 15.3 to 58.9m and hard sandstone to be 16.9. to 69.6 below ground level. In other words, as in most areas of the country, the soil profile is not uniform – it is well understood in naturally formed

geophysical structures, there will be variations. In this case as well, the subsurface area spread over 35 ha areas, has silty soil and fractured layers at varying depths. It cannot be assumed that the entire area is impervious and will not result in any contamination.

15. The well inventory studied by NGRI confirms this pattern, found across the Vindhyan formations and valleys, occupied by alluvium and basalt. The borewells in the site have water at depth of as little as 9.5 metres. The study also finds that shallow groundwater exists in certain parts. The well hydrograph indicated a water level variation from 3.4 m to 23.37 m.

16. NGRI has based its conclusions that the aquifer is confined, only on the drilling of boreholes at just five sites and an exiting borewell near the main entrance. This is completely inadequate and in fact, this particularly finding is not confirmed by the reports analysis itself.

17. The HERT technology (high resolution electrical resistivity tomography) was used in the current study. This technology is used to identify possible dump areas, using resistivity profiling. This technology is not used to decide on the geophysical characteristics of the land or to determine if the entire area is impervious.

18. The use of HERT has only established what was earlier known that there are three dumpsites – Site I, North of the formulation plant, Site III, South of the Storage tank and police post and Site V, between the neutralization tank and the solar evaporation pond. This does not mean that it has been able to establish that the soil is contaminated or not at other sites.

19. The report finds that the groundwater flow direction is in the southeast direction. It also reports that aquifer conditions are variable and may change over time.

20. The sampling of soil and groundwater samples was done in three periods (April 2009, January 2010 and May 2010). It must be noted that these are not post-monsoon period and therefore, the study has not been able to study the runoff and changes in hydrology as well as possible contamination. In addition, the report admits that confirmatory sampling of boreholes was not possible. The well inventory was carried out by NGRI in November 2008 calling it as post-monsoon monsoon monitoring, but this certainly does not qualify as post-monsoon study.

21. In fact, just comparing table 7 with table 29, 30, 31, 33, it is evident that contamination with toxins like carbaryl and HCH isomers has been detected at 3 metres depth. Therefore, the conclusion of the report, “the depth wise review of individual boreholes in terms of distribution of various contaminants within UCIL premises, indicate that maximum depth of contamination at present is restricted to 2 m” is clearly erroneous.

22. The report contradicts its own findings that the subsurface area consists of black soil, with varying layers of silty soil, fractured layers and clay and hard sandstone. It also defies all knowledge about geology and hydrology to suggest that the entire area of just the factory premises has a unique geology, not found anywhere else, where there is just one clay and hard sandstone layer, which was built, so that the contamination would not permeate into the sub-soil and water level. In other words, UCC and UCIL, when they built the factory, chose this site, because they could dump hazardous material in the

open, knowing that there was a clay layer, which would ‘protect’ them from any spread and seepage of contaminants.

23. The data on groundwater contamination in adjoining areas of the UCC/UCIL factory is in variance with tests done by CSE. While the study has confirmed and corroborated our study, which showed high levels of contamination in the factory compound – finding the same chemicals were had found at even higher levels in some cases – its suggests that this contamination has not spread. It is also interesting that the study has found one contaminant – chromium, which was used in UCC/UCIL, but not others. This requires more extensive research on the aquifer movements in and around the UCC/UCIL factory, so that the extent of contamination can be ascertained and the need for draining aquifers for remediation can be known.

24. Before designing groundwater remediation it is very important to prepare an aquifer profile, which has not been done in the current study. Groundwater remediation is a very difficult exercise and can only be designed once the level of contamination in the entire area has been studied. Merely pumping out water, cleaning it and re-pumping it back into the aquifer will not work.