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**Final Report of the Institute for Energy and Environmental Research on the  
Second Clean Air Act Audit of Los Alamos National Laboratory by the  
Independent Technical Audit Team**

by

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**Summary of findings and recommendations:**

1. The Institute for Energy and Environmental Research (IEER) finds that, overall, the second audit was thorough. Within the limitations of the available resources, we also find that the audit was complete.
2. The Independent Technical Audit Team's (ITAT) conduct of the audit was exemplary in its openness. We also appreciate the great effort that LANL made in this regard, without which the ITAT's open conduct of the audit would not have been possible.
3. IEER has one major disagreement with the ITAT report on the second audit. The ITAT's finding that Los Alamos National Laboratory (LANL) was in compliance with the Clean Air Act in 1999 should have been conditional rather than unconditional. A finding of unqualified compliance presumes that LANL did all the scientifically work necessary for compliance. However, LANL did not perform an uncertainty analysis, which is a normal and essential part of scientific work that should be done as part of compliance assessment. IEER does not expect that an uncertainty analysis would indicate an upper bound dose over the compliance limit.
4. The ITAT's finding of compliance should be viewed in the context of lack of operations of the main beam at the Los Alamos Neutron Science Center (LANSCE) during 1999. As the ITAT report notes, an increase in LANSCE operations will need careful attention as regards dose and compliance assessment.
5. IEER agrees with the ITAT's decision to do a third audit.
6. The complex terrain model calculations performed by ITAT represent an important beginning to addressing some of the most important technical issues in relation to dose estimation. They should be viewed as preliminary and illustrative and not definitive. The results cast considerable doubt on the assertion that the doses calculated by LANL using the CAP-88 model are uniformly conservative. The ITAT should have recommended that

LANL carry forward this work as part of its preparation for the third audit. LANL's efforts should include estimation of doses resulting from short-term releases to resident individuals and to transient receptors, should have finer temporal and spatial resolution, and should address all the important sources of emissions. LANL should also review adequacy of weather data by criteria derived from the needs of complex terrain and transient receptor modeling.

7. The ITAT should have cited two additional technical deficiencies – one relating to the method of estimating moisture in silica gel cartridges and one relating to tritium emissions from TA-33 for the week of August 3, 1999. IEER appreciates that the ITAT has recommended a change in the method of estimating moisture content so as to ensure that the estimates will always be conservative.
8. The ITAT should not exempt AIRNET station movement of less than 500 yards from verification calculations.
9. The ITAT should have recommended that LANL review its neutron dose estimates in light of recent research findings in Europe that TLDs underestimate certain neutron doses, sometimes by large margins.

## **Introduction**

The Institute for Energy and Environmental Research (IEER) monitored the second Clean Air Act audit of the Los Alamos National Laboratory (LANL) for the year 1999 by the Independent Technical Audit Team (ITAT) from the beginning to the end. IEER participated in the initial scoping meeting, in the site visits and in the review of documentation and technical issues. IEER reviewed the draft report and provided comments to the ITAT. IEER has been assisted in this work and in the review of the final report by staff of the Concerned Citizens for Nuclear Safety (CCNS), notably Joni Arends, who raised many issues and concerns and provided suggestions and review.

The role of IEER, which did the expert work in the lawsuit filed by CCNS against DOE that led up to the Consent Decree and the independent audits, is to monitor the audits conducted by the ITAT for thoroughness and completeness on behalf of the plaintiff, CCNS. This IEER role includes a review and comments on the final report of the ITAT team. In April 2000, IEER made its report on the first audit public in April. That report is appended to this report on ITAT's second audit.

IEER has reviewed the final report of ITAT's second audit of LANL's compliance with the Clean Air Act during 1999.<sup>1</sup> IEER is in general agreement with the thrust of the ITAT's findings as regards compliance so far as the letter of the Federal Facilities Compliance Agreement (FFCA) is concerned. IEER is also generally in agreement with the technical details of the ITAT findings (with exceptions, including one major item, as specified below). Overall, IEER also finds that the audit was thorough. Within the limitations of the available resources, we also find that the audit was complete. We especially appreciate that the ITAT took the initiative to

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<sup>1</sup> Independent Technical Audit Team, *Independent Technical Audit of Los Alamos National Laboratory with the Clean Air Act, 40 CFR 61, Subpart H in 1999*. Neeses, S.C.: Risk Assessment Corporation, RAC Report Number 4-DOJ-LANLAudit-2000-FINAL, December 2000.

address the issue of complex terrain modeling, which has been raised by IEER since the beginning of the first audit. Further, the ITAT, led by Dr. John Till, made extraordinary efforts to have an open process, address a variety of issues, including ones that were not directly within the scope of the audit, so far as it was reasonably possible to do so. In this regard, IEER especially appreciates the ITAT recommendation that the term “Kiva,” which has special cultural significance for Native Americans, not be used by LANL to refer to its facilities.

The site visits, the process of discussion of the issues, the sharing of documentation, the preparation and discussion of the draft report and the logging of comments and responses, have been exemplary. We also appreciate the great effort that LANL made in this regard, without which the ITAT’s open conduct of the audit would not have been possible. We find that the DOE as a whole at national level has a great deal to learn from the process of the audit. IEER also agrees with the ITAT decision to carry out a third audit.

IEER does have several concerns about the ITAT report both as regards some of its findings and as regards its recommendations, or lack thereof, in certain areas. We consider these issues below.

### **Uncertainty Analysis**

In its comments on the draft report, IEER requested that the ITAT’s finding of compliance with Subpart H be conditioned by a statement that LANL had performed no uncertainty analysis. The ITAT replied that “question remains an outstanding one in our correspondence with the EPA.” We agree that the EPA should clarify this issue. We also believe that that EPA should require LANL to perform such analysis in view of LANL’s past failure to do it. However, the ITAT also stated that the EPA should address the issue and that “[i]t is not LANL’s responsibility to evaluate this uncertainty in their determination of compliance.” (Appendix F, p. F-3). For this reason the ITAT did not address the issue of uncertainties in its final report.

IEER finds this to be a narrow view by the ITAT of its own responsibilities and, more importantly, of the responsibilities of LANL in regard to the character of scientific work on environmental issues, both for purposes of compliance and for purposes of the scientific integrity of the work. It is true that the EPA regulation does not explicitly call for a determination of uncertainties. However, uncertainty analysis is a normal and routine part of scientific work, notably when assertions are being made that the calculations being done are “conservative.” There has been no conclusive demonstration of that assumption by LANL.

We do not expect that regulations should set forth the details of how normal scientific work should be carried out. For instance, they do not specify that calculations should be double-checked. But the ITAT has insisted that LANL do so within the context of compliance. This is reasonable and proper not only from the scientific point of view, but also from the regulatory point of view. When LANL certifies compliance, it is simultaneously a legal and scientific statement. IEER cannot agree that the lack of specificity in the regulation about uncertainty analysis absolve LANL of the responsibility to do it. The ITAT’s acceptance of the LANL’s bureaucratic approach to interpreting the regulation is incorrect and should be modified. It sets a poor precedent that would allow poor scientific practice in other areas if every detail is not written down in the regulation.

Our conclusions in this regard are strengthened by the preliminary results of the complex terrain modeling. The results, even though on an annual average basis for just one source, do not indicate a uniform conservativeness of the use of the CAP-88 model. This underlines the need for uncertainty analysis until a fully validated system that ensures conservative calculations is in place

Further, IEER has always taken the position that proper scientific procedure and credibility of the work with the public should be an essential part of the process even when the final finding would not be affected. The calculated dose is, in this case, so much below the allowable maximum that an uncertainty analysis would be very unlikely to show an exceedence of the 10 mrem dose at any conventionally used upper confidence bound. Thus, we do not expect such an analysis to call into question ITAT's main finding. But this should not relieve LANL of the responsibility of carrying it out. IEER continues to believe that the finding of compliance should be conditional, based on the failure of LANL to do an uncertainty analysis.

This is the most important point on which IEER disagrees with the ITAT's final report.

### **Complex Terrain Model**

The ITAT has done LANL, the EPA, the US government, and the public at large a very important public service by taking up the challenge of performing an initial set of calculations that take some account of the complex terrain of LANL and its environs. We understand that the limitations of time and resources do not permit more refined or extensive calculations. Only annual average dispersion factors were calculated for the purposes of comparison with the EPA-approved flat-terrain model (CAP-88).

The ITAT's calculations should be viewed as preliminary and illustrative. They are not in any way definitive. Among other limitations, they cover only one source and assume a uniform average release from that source. The available meteorological data have considerable gaps, requiring assumptions that could lead to significant uncertainties. Almost all calculations were for annual averages, whereas some of the most important questions relate to short term releases.

The finding that some (6%) of the  $\chi/Q$  values were higher in the complex terrain model compared to the CAP-88 model provides a clear indication that LANL calculations cannot be accepted to be conservative in all cases. Moreover, the ITAT's tentative explanation that some of the greatest discrepancies may be because the CAP-88 model shows plume lofting effects, while the complex terrain model, CALPUFF, generally does not, is not convincing and does not reflect the details of some of the calculations that have been presented.

Specifically, in the West sector azimuth graph in Figure 3 of the main report, CALPUFF shows generally similar plume lofting effects to CAP-88. In fact, the effects as estimated by CALPUFF are somewhat more complex than those estimated by CAP-88. The latter show a single relative maximum, while the former indicate that a second local maximum may occur under some circumstances (though the curve in Figure 3, West azimuth, appears to be flat). For instance, in the South sector graph of Figure 3, CALPUFF shows a more complex pattern than CAP-88.

CALPUFF indicates a local minimum at about 600 meters, and a local maximum beyond that, at about 1,000 meters. CAP-88 is incapable of depicting such effects.

There is no reason at this time to assume that the CALPUFF model is more or less accurate than CAP-88 for annual average calculations for short distances (100 meters to a few hundred meters from the source). These issues can and should be resolved by LANL by more detailed work.

The ITAT's finding that some of the  $\chi/Q$  values resulting from the use of CALPUFF exceed those of CAP-88 (including five CALPUFF estimates that are larger than those of CAP-88 by more than a factor of two) shows the crucial importance of uncertainty analysis so long as CAP-88 continues to be used as the compliance method.

During the initial discussions of the second audit, LANL admitted the desirability of investigating the issue of the complex terrain model. The ITAT has made partial and illustrative calculations that have opened up new questions. Even annual average calculations and a single source show that CAP-88 may not be conservative at some locations, even though it may be conservative at many or most locations.

The ITAT's section on complex terrain modeling in the final report indicates that further work on complex terrain modeling might await a ruling from the EPA. While IEER would agree that the use of complex terrain models for regulatory compliance purposes would have to be approved by the EPA, this does not and should not be a bar to LANL pursuing a scientific investigation of the matter on its own. The EPA cannot dictate to LANL what science LANL should or should not do.

The ITAT should indicate to LANL that it expects LANL to continue the work on the complex terrain model that the ITAT has so admirably begun. This work on the complex terrain model should be extended to short-term releases and transient receptors (see next section). This work will also enable LANL to make a more scientific investigation of the claim of conservativeness of CAP-88.

Finally, IEER has not had the opportunity to study the model runs in detail. We therefore reserve judgment on the details of the calculations and conclusions until the time that IEER has completed that review. After that work is complete, IEER will file additional comments on this matter, if it has any, with CCNS and make them public.

### **Short-term releases and transient receptors**

Ideally, the calculations of the effects of complex terrain should have been accompanied by estimation of doses as a result of puff releases. IEER understands that the constraints of time and resources made it impossible for the ITAT to do a substantial amount of work in this area. The brief effort that was possible clearly shows the need for continuing the investigation.

Doses resulting from puff releases may be a much more important factor in the dose to the maximally exposed individual (MEI, as currently defined) than indicated by annual average

concentrations. Further, puff releases could also affect transient members of the public at a much larger number of locations than those estimated by annual average calculations.

The estimation of doses from puff releases is essential to investigating whether LANL is using the appropriate assumptions for estimating where the maximally exposed individual might be located in any given year. Until these issues are resolved, the use of CAP-88 cannot be regarded as conservative. In the interim, as LANL pursues and refines complex terrain model calculations, it should make uncertainty analysis a formal and central part of its compliance assessment. The ITAT, should indicate to LANL that it expects that LANL's work in preparation for the third audit should include estimation of doses from puff releases to the MEI and to transient receptors using the complex terrain model.

#### Humidity in Silica Gel cartridges

The ITAT has recommended that LANL adopt the procedure as regards tritium loading calculations suggested by IEER in its comments on the ITAT draft report. This procedure will ensure that LANL calculations are conservative in all cases. The current LANL procedure does not do this. IEER continues to believe that the use of the current LANL procedure should have been cited by the ITAT as a technical deficiency.

#### **AIRNET station re-location**

In view of the highly variable topography of LANL, a distance of as much as 500 yards can make for considerable changes in air concentrations. Further, a relocation of less 500 yards at some locations may also significantly change the azimuthal location of the AIRNET station relative to the source. This would correspondingly change the weather patterns at the station. Therefore a shift of several hundred yards may not be equivalent to substantially maintaining the original identity of the station. Accordingly, IEER believes that LANL should perform calculations to verify that a re-location of an AIRNET station remains equivalent even if the re-location is less than 500 yards. The ITAT has not recommended such calculations. It should do so.

#### **TA-33 tritium release**

IEER does not believe that the two assumptions made by TA-33 for estimating releases for the week ending August 3, 1999 lead to a conservative result. The amount of tritium released during that week remains unknown and shrouded in considerable uncertainty. Specifically, we are troubled by the fact that two crucial pieces of equipment seem to have failed during the same period. The duration of the low temperature in the catalytic converter is unknown. Yet the calculated HT concentration is mysteriously about the same as for preceding and subsequent weeks, while the HTO release estimate for the week was roughly a factor of twenty higher. These problems cannot be compensated with confidence by the assumption that the fan was operating all week. It is by no means established that the assumptions made by LANL overestimate the tritium release. There is a possibility that they may have underestimated the releases. Based on available information, it is not possible for IEER to make a judgment on the issue. In view of the forgoing, of two simultaneous failures of equipment essential to

monitoring, and of anomalous data for the week, IEER continues to believe that the problem with tritium releases for the week ending August 3, 1999 should have been specified as a technical deficiency.

### **Neutron doses**

IEER provided the ITAT with a reference as regards recent research in Europe, which shows that certain neutron doses to workers may be vastly underestimated. We appreciate that the ITAT has obtained this literature. However, in view of the underestimates of neutron doses by TLDs documented in this literature, we find it puzzling that the ITAT has concluded that the TLDs would represent a “possible, but not probable upper bound for the neutron dose.” In view of the potential for TLDs to significantly underestimate some neutron doses, it is our view that the ITAT should have recommended immediate and urgent review of the neutron dose accuracy by LANL, quite independent of any regulatory considerations. LANL should review its doses in light of available literature, make corrections to past records, if warranted, and ensure that future dose estimates are scientifically supported by the most recent research findings. A failure by LANL to do so could cause considerable damage to public confidence that may extend far beyond the realm of possible neutron doses. IEER recommends that the ITAT indicate that it expects LANL to have taken the necessary actions in regard to neutron dose estimation prior to the commencement of the third audit in 2002.