IV. Public Health Implications

The previous section of the PHA used a screening analysis to select contaminants of concern for the TSCA Incinerator. In the screening, ATSDR compared the highest measured or estimated ambient air concentrations for all eight groups of contaminants with protective health-based comparison values. Through that process, arsenic, cadmium, and chromium were found to warrant further evaluation, and all other air contaminants considered were safely below levels of public health concern. This section presents a more detailed analysis for the three contaminants requiring further evaluation, considering issues such as background concentrations, potential air quality impacts due to emissions from the TSCA Incinerator, and toxicological evaluations for both short-term (acute) and long-term (chronic) exposures and for both non-cancer and cancer health outcomes.

Residents near the TSCA Incinerator are exposed to airborne arsenic, cadmium, and chromium that originate from several nearby emissions sources. Extensive ambient air monitoring data suggest that the amounts of these metals in the air are below levels expected to cause adverse health effects. Ongoing monitoring will help ensure that ambient air concentrations of these metals remain at safe levels in the future.

The remainder of this section presents ATSDR's detailed evaluations for arsenic (Section IV.A), cadmium (Section IV.B), and chromium (Section IV.C). Concluding statements (Section IV.D) discuss the adequacy of the data supporting ATSDR's evaluations and present recommendations for ensuring that inhalation exposures to the contaminants of concern remain at safe levels in the future.

IV.A. Arsenic

ATSDR selected arsenic as a contaminant requiring further evaluation because the highest annual average concentration of arsenic measured near ETTP (0.000809 $\mu g/m^3$) was approximately four times greater than the corresponding health-based comparison value for cancer effects (0.0002 $\mu g/m^3$). To put potential inhalation exposures to arsenic into perspective, ATSDR considered the following observations:

- **Consistency with modeling results.** As Appendix B notes, the independent panel chartered by the Governor of Tennessee conducted a dispersion modeling analysis of the TSCA Incinerator's emissions. That analysis estimated that the incinerator's emissions alone contribute 0.000148 $\mu g/m^3$ to annual average concentrations at the point of maximum impact. This estimated concentration is more than five times lower than the highest annual average concentration measured in the area. There can be many reasons why modeling and monitoring results differ, but a logical explanation is that contributions from other air emissions sources account for the difference between the measured concentrations and the modeled concentrations.

- **Comparison with typical airborne arsenic levels.** ATSDR's Toxicological Profile for Arsenic reports that average air concentrations of arsenic in remote areas of the United States typically range from <0.001 to 0.003 $\mu g/m^3$ (ATSDR 2000a). The measured arsenic levels

near the TSCA Incinerator are at the lower end of this range. ATSDR makes this comparison only to demonstrate that residents near ETTP are not exposed to unusually high amounts of airborne arsenic.

- **Toxicological evaluation.** ATSDR's toxicological evaluation considers the public health implications of exposure to the measured concentrations of airborne arsenic, regardless of where it originated. According to a literature review of numerous studies of arsenic exposure in humans and experimental animals, the lowest found exposure concentration that has been associated with non-cancer adverse health effects is 0.7 $\mu g/m^3$ (ATSDR 2000a). Specifically, a case-control epidemiological study among residents near a smelter found that exposures at this level were associated with a greater risk for stillbirths, compared with the risk for residents in a non-exposed group (Ihrig et al. 1998). ATSDR notes, however, that the highest annual average concentration of arsenic measured near the TSCA Incinerator is more than 850 times lower than the exposure concentration that might be associated with increased stillbirths. Because the measured airborne levels of arsenic are dramatically lower than exposure concentrations found to be associated with non-cancer health effects in humans and experimental animals, ATSDR concludes that inhalation of airborne arsenic near ETTP is not expected to cause similar non-cancer effects among local residents.

  What is a "cancer effect level"? ATSDR defines a cancer effect level as the lowest exposure dose in a study, or group of studies, that produces significant increases in the incidence of cancer between the exposed population and its appropriate control population.

  The National Toxicology Program (NTP), part of the U.S. Department of Health and Human Services, has classified arsenic as a "known human carcinogen." Accordingly, ATSDR assessed whether exposure to airborne arsenic near the TSCA Incinerator might be associated with cancer outcomes. Such assessments typically consider long-term exposure concentrations. In this case, the highest long-term average ambient air concentration of arsenic measured near ETTP is 0.0004 $\mu g/m^3$ — an average based on nearly 10 years of monitoring at a location immediately downwind from the site. In contrast, ATSDR's review of the literature has reported arsenic-related cancer effect levels in humans ranging from 50 to 380 $\mu g/m^3$ (ATSDR 2000a). Therefore, the highest exposure concentration measured near the TSCA Incinerator is more than 100,000 times lower than the cancer effect levels reported in six different studies of human exposures. Given this large margin, ATSDR does not believe the measured concentrations of arsenic pose a significant health concern for cancer outcomes.

In summary, modeling studies predict that the TSCA Incinerator has little impact on ambient air concentrations of arsenic. This observation is consistent with the fact that measured airborne arsenic levels near the TSCA Incinerator fall within the range of concentrations measured in other remote locations of the United States. Using both these observations and a review of the toxicological and epidemiological literature, ATSDR concludes that inhalation exposures to airborne arsenic near the TSCA Incinerator are not expected to cause adverse health effects. Refer to Section IV.D for recommended actions to ensure that future exposures to arsenic near the TSCA Incinerator remain at safe levels.

IV.B. Cadmium

ATSDR selected cadmium as a contaminant requiring further evaluation — the highest annual average concentration of cadmium measured in the vicinity of ETTP (0.001963 $\mu g/m^3$) was approximately three times greater than the corresponding health-based comparison value for cancer effects (0.0006 $\mu g/m^3$). After evaluating all information available on airborne cadmium near the incinerator, ATSDR made the following observations:

- **Consistency with modeling results.** The highest measured annual average concentration of cadmium (0.001963 $\mu g/m^3$) was 15 times greater than the peak ground level impacts (0.000129 $\mu g/m^3$) predicted by air dispersion modeling conducted by the Governor of Tennessee's independent panel. While the exact reasons for this discrepancy are not known, a reasonable explanation is that airborne levels of cadmium near the incinerator originate from many different sources, while the dispersion modeling analysis only considered the incinerator's air quality impacts.

- **Comparison with typical airborne cadmium levels.** Ambient air concentrations of cadmium have been measured at two locations near the TSCA Incinerator (see K2 and K6 in Figure C-3) from 1994 to the present — almost the entire history of the incinerator's operations. Over this entire time frame, the average concentrations at these locations were 0.00044 $\mu g/m^3$ and 0.00033 $\mu g/m^3$, respectively, both of which fall below the lower bound of the range of average cadmium levels typically observed in urban areas across the country (0.003–0.040 $\mu g/m^3$) (ATSDR 1999a). ATSDR acknowledges that the general consistency between cadmium levels near ETTP and those measured in other parts of the country does not mean that the contamination levels near the TSCA Incinerator are safe or acceptable. Rather, ATSDR presents this information primarily for perspective, to indicate that local residents are not being exposed to unusually high amounts of cadmium.

- **Toxicological evaluation.** ATSDR's toxicological evaluation considers both non-cancer and cancer outcomes associated with inhalation exposure to airborne cadmium. To evaluate non-cancer outcomes, ATSDR compared the measured concentrations near the TSCA Incinerator with exposure levels that have been shown to cause, or are suspected of causing, adverse health effects, whether in human or in experimental animals. More than 30 available peer-reviewed studies provide quantitative data related to inhalation toxicity of cadmium (ATSDR 1999a). Overall, the lowest concentration reported to produce non-cancer health effects, whether from acute or chronic exposure, is 13 $\mu g/m^3$ — an exposure concentration that caused increased non-cancerous cell growth in the lungs of experimental animals (ATSDR 1999a). All measured ambient air concentrations of cadmium near the TSCA Incinerator are at least 1,000 times lower than this level, which suggests that residents' inhalation exposures near ETTP are not at levels expected to cause non-cancer health effects. ATSDR acknowledges that using effects levels observed in animals to evaluate human exposures involves considerable uncertainty. It should be noted, however, that the lowest exposure concentration of cadmium shown to cause adverse non-cancer outcomes in humans (23 $\mu g/m^3$) is on the same order of magnitude as that shown to cause adverse outcomes in animals.

  ATSDR also evaluated potential cancer outcomes associated with cadmium exposures, considering that NTP has classified cadmium as a "known human carcinogen." When

evaluating potential cancer risks, ATSDR usually assesses potential lifetime average exposure levels. The highest long-term average ambient air concentration of cadmium near ETTP is 0.000044 μg/m^3, which is based on nearly 10 consecutive years of monitoring data collected at a location immediate downwind of the TSCA Incinerator. ATSDR's review of carcinogenic outcomes associated with cadmium found cancer effect levels in animals and humans ranging from 13.4 to 100 μg/m^3 (ATSDR 1999a). In this case, the cadmium exposures near the TSCA Incinerator are more than 300,000 times lower than the lowest cancer effect level derived from the literature. Accordingly, ATSDR concludes that the TSCA Incinerator's emissions do not result in nearby residents' exposure to cadmium at levels associated with cancer effects.

Overall, all information ATSDR reviewed to date suggests three key findings for cadmium: 1) the TSCA Incinerator has relatively minor air quality impacts; 2) the inhalation exposures that residents might experience are not unusually high when compared with those observed in other parts of the country; and 3) the actual exposure levels are not expected to cause adverse cancer or non-cancer health effects. Section IV.D discusses future actions that are warranted to ensure that cadmium exposures remain at safe levels in the future.

IV.C. Chromium

Evaluating ambient air contamination of chromium often presents challenges: chromium exists in multiple forms, each having a significantly different toxicity. The most common forms found in ambient air are trivalent chromium and hexavalent chromium. Trivalent chromium is relatively benign and is actually an essential nutrient for humans. Hexavalent chromium is considerably more toxic, both for cancer and non-cancer outcomes. Complicating matters is the fact that most commonly used environmental sampling and analytical methods measure ambient air concentrations of total chromium, without specifying the relative amounts of the hexavalent and trivalent forms.

When conducting the screening analysis (see Section III), ATSDR initially assumed that all chromium is present in the more toxic hexavalent form. Under this assumption, both modeled and measured levels of total chromium exceeded the health-based comparison values for hexavalent chromium. The following paragraphs present ATSDR's more detailed evaluations of exposures to chromium, which consider the reality that total chromium includes both trivalent and hexavalent forms:

- **Consistency with modeling results.** The highest annual average concentration of total chromium reported for DOE's monitoring network is <0.0064 μg/m^3, at a monitoring station on the perimeter of ETTP.3 For comparison, the dispersion modeling analysis conducted by the Governor of Tennessee's independent panel estimated that the highest annual average air concentration of total chromium attributed to the TSCA Incinerator's emissions was only 0.000153 μg/m^3. The considerably higher measured levels of total chromium probably reflect the influence of air emissions sources other than the TSCA Incinerator.

3 The annual average concentration was calculated from a data set in which chromium was not detected in several samples. When calculating annual average concentrations, DOE apparently replaced non-detect observations with the detection limit to generate an upper-bound estimate of actual chromium levels. This is why a "less than" symbol appears before the annual average concentration.

- **Comparison with typical airborne chromium levels.** Two ambient air monitoring stations at ETTP measured ambient air concentrations of total chromium for almost the entire history of the TSCA Incinerator's operations. Over nearly 10 years of monitoring at stations K2 and K6 (see Figure C-3 for their locations), the long-term average ambient air concentrations of total chromium were 0.0006 $\mu g/m^3$ and 0.0005 $\mu g/m^3$, respectively.

  The total chromium concentrations measured around ETTP clearly fall within the range of concentrations reported for similar settings. For instance, ATSDR reports that average airborne concentrations of total chromium in rural settings are generally lower than 0.010 $\mu g/m^3$ (ATSDR 2000b). Similarly, ambient air monitoring that EPA recently conducted at a remote location near Louisville, Kentucky, found an annual average concentration of total chromium of 0.0027 $\mu g/m^3$ (EPA 2002). Moreover, ongoing ambient air monitoring in Nashville for an EPA nationwide monitoring network has shown that average concentrations of total chromium are approximately 0.004 $\mu g/m^3$ (ERG 2004). In short, extensive ambient air monitoring data collected elsewhere in the country suggest that the annual average concentrations of total chromium measured near ETTP are not unusually elevated.

- **Toxicological evaluation.** ATSDR's toxicological evaluation focuses on hexavalent chromium, which is the most toxic form of chromium likely to be encountered in the environment. To assess potential non-cancer outcomes, ATSDR considered EPA's reference concentration (RfC) for hexavalent chromium particulates, which is 0.1 $\mu g/m^3$. By definition, an EPA RfC represents an exposure concentration that is likely to be without harmful health effects throughout a lifetime of continuous inhalation exposure. Because the highest long-term average measured concentration of total chromium (0.0006 $\mu g/m^3$) is more than 150 times lower than the RfC, ATSDR concludes that residents' exposures to chromium near the TSCA Incinerator are not expected to cause non-cancer health effects, even if one assumes that all of the airborne chromium is in the more toxic hexavalent form.

  According to NTP, hexavalent chromium is a "known human carcinogen." Consensus agencies have not classified the carcinogenicity of trivalent chromium, but ATSDR has noted that epidemiological studies in industries where workers are exposed to trivalent chromium have been consistently negative (ATSDR 2000b). Therefore, the evaluation of potential cancer outcomes in this PHA focuses primarily on hexavalent chromium exposures. ATSDR would prefer to base this evaluation on measured ambient air concentrations of hexavalent chromium, rather than on measures of total chromium. As is typical, however, at many sites that ATSDR evaluates, no data are available on the relative amounts of hexavalent and trivalent chromium in the air near the TSCA Incinerator.

  Nonetheless, ATSDR believes the available data provide ample insights on the potential for cancer outcomes resulting from inhaling hexavalent chromium, even without the chemical speciation data. Specifically, ATSDR's Toxicological Profile for Chromium presents 11 different cancer effect levels: 10 for studies of human exposures (mostly occupational) and one for an animal study (ATSDR 2000b). The lowest cancer effect level reported is 40 $\mu g/m^3$ for an occupational cohort that was exposed to a mixture of trivalent and hexavalent chromium. In contrast, the highest long-term average exposure concentration near the TSCA Incinerator is more than 66,000 times below the lowest cancer effect level. Such a large margin of safety provides assurance that the exposures that community members near ETTP experience do not reach levels known to be associated with cancer outcomes.

An important consideration in this evaluation is the chemical form of chromium found in the air near the TSCA Incinerator, given that hexavalent chromium appears to be a much more potent carcinogen. While the chemical speciation issue cannot be resolved from the available measurements, ATSDR notes that a growing body of evidence from EPA monitoring networks is showing that hexavalent chromium typically accounts for less than 10% of total chromium in ambient air (e.g., Swift et al. 2003). Moreover, studies have suggested that hexavalent chromium typically accounts for less than 1% of air emissions of total chromium from municipal waste incinerators (ATSDR 2000b). The qualitative insights on chemical speciation combined with the large margin between exposure levels and cancer effect levels strongly suggest that the TSCA Incinerator does not emit chromium in amounts believed to be associated with cancer outcomes.

The previous evaluation shows that air emissions of chromium from the TSCA Incinerator appear to contribute only slightly to ambient air concentrations of chromium near ETTP. Further, the measured ambient air concentrations of total chromium fall within the range of concentrations expected for a rural location. While the relative amounts of trivalent chromium and hexavalent chromium in ambient air near ETTP are not known, ATSDR's evaluation strongly suggests that realistic estimates of inhalation exposures are below levels of health concern, both for cancer and non-cancer outcomes.

IV.D. Summary

The foregoing is ATSDR's evaluation of public health implications of exposure to arsenic, cadmium, and chromium in ambient air near the TSCA Incinerator. For all three metals, the available sampling and modeling data suggest that emissions from multiple local sources, and not just the TSCA Incinerator, contribute to the measured airborne concentrations. Regardless of the predominant source of the metals, the airborne concentrations measured near ETTP are reasonably consistent with those measured in rural and suburban areas across the country. Further, and more importantly, inhalation exposures to the measured concentrations are at levels well below those observed to be associated with adverse health effects, both in animals and in humans.

The conclusions in this section rest heavily on trends among nearly 10 years of ambient air monitoring data that DOE has collected in the vicinity of the TSCA Incinerator, including at a location believed to be near where the incinerator's emissions have their greatest air quality impacts. While the data generated by DOE appear to be of a known and high quality and provide a sound basis for this PHA's conclusions, an excellent opportunity exists to provide independent verification of DOE's air quality measurements for arsenic, cadmium, and chromium. Specifically, TDEC is currently measuring ambient air concentrations of metals at one of the locations where DOE also measures ambient air concentrations of metals. To provide insights into measurement accuracy, ATSDR recommends TDEC quantify differences between metals monitoring data gathered by DOE and those gathered by TDEC at all stations with co-located samplers. Although the TSCA Incinerator does not appear to be the primary source of arsenic, cadmium, and chromium in the ambient air, ATSDR recommends that DOE and TDEC continue routine ambient air monitoring as long as the TSCA Incinerator processes waste. This will provide assurance that incinerator emissions, in combination with emissions from other sources,

do not result in unacceptable exposures. Section IX of this PHA presents these and other recommendations that ATSDR has made for this site.

V. Community Health Concerns

One objective of this PHA is to respond to specific community concerns about the TSCA Incinerator. This section presents responses to all such concerns that residents have expressed to ATSDR to date. Throughout the health assessment process, ATSDR has compiled a list of community concerns by drawing from ATSDR's database of concerns for the ORR facilities, TDEC's report addressing community concerns (TDEC 1997), and the summary report issued by a group of independent experts chartered by the Governor of Tennessee (Iglar et al. 1998). ATSDR also identified community concerns by talking to local residents, whether at public meetings or through individual communications. The remainder of this section uses a question and answer format to address specific community concerns, which are organized into four topics.

V.A. Community Concerns Regarding Health

Sections III and IV of this PHA present ATSDR's findings regarding the public health implications of exposure to air contaminants released by the TSCA Incinerator. The following questions and answers elaborate on specific health issues of concern to some community members.

Question A-1:

Under certain meteorological conditions, air emissions from the TSCA Incinerator appear to blow directly to ground level at on-site locations. Does this situation present a health hazard to visitors to the property, particularly for exposures to mercury?

Answer A-1:

Many factors determine how contaminants disperse from a stack into the atmosphere. These factors include the stack gas temperature and exit velocity, the stack's dimensions, the stack's proximity to nearby buildings, and local meteorological conditions. Under certain circumstances, stack gas emissions have been observed to blow rapidly to the ground — a phenomenon known as "downwash."

The conditions that cause severe downwash at the TSCA Incinerator typically are short-lived; that is, they likely do not persist for hours on end. ATSDR has received no reports that during downwash conditions, site visitors were ever directly exposed to stack emissions. Further, ATSDR expects that should downwash conditions be observed while visitors are touring the facility, escorts would guide any visitors away from these emissions. Accordingly, ATSDR suspects that visitors' exposures to air emissions during downwash conditions are extremely limited, if they occur at all.

A community member asked ATSDR specifically about whether this scenario could lead to mercury exposures that would cause visitors to get sick. Such an outcome is unlikely for two reasons. First, the TSCA Incinerator has extremely strict Waste Acceptance Criteria for

materials that contain mercury to ensure that emissions are safely below levels that would lead to unacceptable air quality impacts. Second, according to ATSDR's Toxicological Profile for Mercury (ATSDR 1999b), the lowest air concentrations of mercury that have been shown to cause adverse health effects following exposures over short time frames (e.g., hours) are more than 20,000 $\mu g/m^3$. Considering that none of the metals reached concentrations of even 1 $\mu g/m^3$ at off-site locations, it is highly unlikely that mercury concentrations could reach harmful levels for acute exposures, even when considering direct downwash of the plume.

Question A-2:

Are workers at the TSCA Incinerator at risk for developing adverse health effects, due to their occupational exposures?

Answer A-2:

As noted earlier in this PHA, ATSDR's role at the ORR facilities is to evaluate environmental health issues, not occupational health issues. Nonetheless, ATSDR recognizes that many residents have health concerns specific to occupational exposures.

There are several resources that residents can consult for more information on occupational health issues. Web sites maintained by DOE (http://cedr.lbl.gov) and NIOSH (http://www.cdc.gov/niosh/2001-133.html), for example, describe ongoing worker health studies at several existing and former DOE facilities. One reference available is a NIOSH study that found no evidence of significant occupational exposures to hydrogen cyanide and related compounds at the TSCA Incinerator (Blade and Worthington 1996). Further, the independent panel's summary report (Iglar et al. 1998) and ATSDR's review of thermal treatment technologies (ATSDR 2002) comment on more general occupational health issues observed at incineration facilities. ATSDR has placed copies of these references at the Oak Ridge Field Office, in case residents wish to read more about related occupational health issues.

Question A-3:

Will ATSDR establish a health clinic for residents who live near the TSCA Incinerator?

Answer A-3:

ATSDR does not establish site-specific health clinics. In a February 22, 1999, letter from Donna E. Shalala, Secretary of Health and Human Services, to The Honorable William H. Frist, M.D., United States Senate, Secretary Shalala stated that ATSDR and CDC cannot provide direct primary medical services to communities. ATSDR and CDC can, however, support the existing medical care systems to address public health concerns of communities that are near nuclear plants. ATSDR is working with ORRHES, EPA, TDEC, the Tennessee Department of Health, and DOE to plan appropriate public health follow-up activities to address the concerns of communities regarding the nuclear weapons complexes. In August 2002, the ORRHES recommended that formal consideration of establishment of a clinic, clinical evaluations, medical monitoring, health surveillance, health studies, or biological

monitoring be postponed until the ATSDR public health assessment process identified and characterizes an exposure of an off-site population at levels of health concern. As Sections III and IV of this PHA explain, ATSDR found no evidence of local residents being exposed to unhealthful levels of air pollution in the vicinity of the TSCA Incinerator. Accordingly, ATSDR does not believe follow-up public health activities are necessary to address the releases from the TSCA Incinerator.

Question A-4:

Does ATSDR's evaluation consider peak emission rates expected to occur from the TSCA Incinerator, such as those during TRV events?

Answer A-4:

Yes. This PHA examines both routine and peak exposures as characterized by average and maximum concentrations among ambient air monitoring data. It also presents detailed evaluations of TRV events, which are assumed to lead to the highest short-term exposures, given that incinerator gases are released without first passing through air pollution controls. ATSDR's evaluation found that both short-term and long-term exposures did not reach levels expected to cause adverse health effects.

Question A-5:

Does the TSCA Incinerator release beryllium at levels of health concern?

Answer A-5:

No. Ambient air monitoring for beryllium has occurred over nearly the entire history of the TSCA Incinerator's operations at the location predicted to have the greatest air quality impacts. As Table C-3 shows, even the highest concentration of beryllium measured to date was lower than protective health-based comparison values. Therefore, ATSDR concludes that the air emissions of beryllium from the TSCA Incinerator are not at levels of health concern.

V.B. Community Concerns Regarding Environmental Contamination

Section III and Appendixes A through C of this PHA present ATSDR's evaluation of the air exposure pathway for the TSCA Incinerator. The following discussion addresses concerns that community members have previously expressed to ATSDR about local air emissions sources, measured environmental contamination levels, and potential ecological effects from the incinerator's emissions.

Question B-1:

Do available monitoring data form a sufficient basis for conclusions on this site?

Answer B-1:

As Appendixes A and C show, multiple parties have conducted numerous sampling and monitoring studies to characterize the TSCA Incinerator's emissions and air quality impacts. These studies considered the contaminants of greatest concern for incineration facilities, focused on locations where air quality impacts are expected to be greatest, and were conducted over almost the entire history of the incinerator's operations. ATSDR believes that the available emissions monitoring data and ambient air monitoring data are generally consistent and provide an adequate basis for scientifically defensible public health conclusions regarding the TSCA Incinerator.

Question B-2:

To what extent do air emissions from sources other than the TSCA Incinerator, particularly the nearby power plants, contribute to local air pollution?

Answer B-2:

The air that local residents breathe contains trace contamination that originates from many different sources, including industrial sources, mobile sources, and natural sources. Section II.E.1 of this PHA identifies several local air emissions sources and describes, in general terms, how they affect local air quality. For additional perspective on power plants, ATSDR examined the most recent TRI data for all electricity-generating facilities within 25 miles of ETTP and found the following:

Facility Name (as listed in TRI)	*Total Air Emissions of Toxic Chemicals in 2001 (Pounds)*
U.S. DOE East Tennessee Technology Park	83
U.S. TVA Kingston Fossil Plant	5,926,225
U.S. TVA Bull Run Fossil Plant	4,305,815

This previous data compilation shows that the local power plants emit far greater quantities of toxic chemicals into the air than does the TSCA Incinerator. ATSDR cautions about what readers should infer from the data shown above, because comparisons of total TRI emissions does not consider a) releases of all contaminants, b) the toxicity of the individual chemicals emitted, and c) important air dispersion behavior. For instance, because the power plants have such tall stacks, the plants' emissions can travel long distances (and become increasingly less concentrated) before they ever reach ground level. In summary, ATSDR presented the TRI emissions data above to respond to a very specific community concern; however, it is important that these data be considered in proper context.

While this PHA does not focus on environmental health issues specific to the local power plants, ATSDR notes that the ambient air monitoring data collected in the vicinity of the TSCA Incinerator reflect potential air quality impacts from the local power plants, the TSCA Incinerator, and other air emissions sources. Therefore, this PHA implicitly considers how air emissions from nearby TVA facilities affect air quality near the TSCA Incinerator.

Question B-3:

Does the TSCA Incinerator contaminate environmental media other than air, whether through direct discharges (e.g., wastewater) or through indirect pathways (e.g., air contaminants depositing onto soils and being taken into the food chain)? If so, does this contamination present a health hazard?

Answer B-3:

The analyses in this PHA focus almost entirely on direct inhalation exposures to airborne contaminants near the TSCA Incinerator, which presents the most likely pathway by which residents might come into contact with site-related contaminants. ATSDR also considered the specific issues raised in the comment, regarding potential contamination of other environmental media:

- **Direct discharges.** Residuals from the TSCA Incinerator are managed according to applicable permits and waste management regulations; no residuals are released directly into the environment.

  The incinerator's liquid residuals, for instance, are pumped to ETTP's wastewater treatment plant, known as the Central Neutralization Facility. The treated water eventually flows into the Clinch River. To fulfill permit requirements, DOE regularly tests the treated water in outfalls to the Clinch River. The testing must measure concentrations of numerous contaminants, including metals, radionuclides, and selected organic compounds. ATSDR reviewed data summaries for these sampling efforts, which show that contaminant levels in the water discharged from ETTP to the Clinch River have been consistently below maximum limits established in the environmental permits (DOE 1991–2002).

  ATSDR also considered the fate of the ash and sludge residuals that the TSCA Incinerator generates. Since 1991, DOE has handled these wastes according to EPA's waste management regulations. These regulations require DOE to test the ash and sludge for chemical contamination, and then to handle the materials accordingly. Depending on the testing results, the ash and sludge are either treated further or sent off site (typically to landfills) for waste management. Thus, solid residuals also are not released directly into the environment.

- **Indirect contamination pathways.** Residents have asked that ATSDR consider the possibility that pollutants released by the TSCA Incinerator might eventually contaminate other media. For example, contaminants in air emissions might deposit on soils or surface waters, and then become available for accumulation into biota. ATSDR is currently preparing a separate PHA on the extent of environmental contamination that has recently been measured in soils, surface water, and biota at locations outside the ORR property line. That "chemical screening" PHA will consider the possibility of indirect contamination caused by the TSCA Incinerator's air emissions. ATSDR expects that the chemical screening PHA will be completed early in 2005.

Question B-4:

Have emissions from the TSCA Incinerator killed pine trees in downwind locations?

Answer B-4:

In the mid-1990s, residents expressed concern that air emissions from the TSCA Incinerator might have killed a group of pine trees located immediately downwind from the facility. The independent panel chartered by the Governor of Tennessee evaluated this issue and concluded that the pine trees were killed primarily by southern pine beetle infestations. These beetle infestations reportedly have caused extensive damage to local trees throughout and beyond ORR (Iglar et al. 1998).

Question B-5:

Has ATSDR considered ambient air monitoring data collected by TVA?

Answer B-5:

During the March 2004 PHAWG meeting when ATSDR presented its preliminary evaluation for the TSCA Incinerator, a community member recommended that ATSDR contact TVA to determine if that agency has collected ambient air monitoring data relevant to this PHA. ATSDR has since obtained data from TVA, which are summarized in Appendix C of this PHA.

Question B-6:

Are the locations chosen for ambient air monitoring and ambient air sampling adequate?

Answer B-6:

Yes. Parties who conduct ambient air monitoring and ambient air sampling studies face difficult decisions when deciding where to place their equipment. On the one hand, there is often a desire to know ambient air concentrations of contaminants at as many places as possible; on the other hand, operating numerous monitoring stations can be prohibitively expensive. To achieve an appropriate balance, scientists typically conduct and carefully review air dispersion modeling studies before deciding where to place monitoring stations. This was done for the TSCA Incinerator, and ambient air concentrations have been measured at locations (both upwind and downwind) believed to have the greatest air quality impacts. Additionally, ambient air monitoring and ambient air sampling takes places at locations between the incinerator and the nearest residential receptors. As a result, it is extremely unlikely that the current monitoring network is grossly underestimating site-related exposures. Consequently, ATSDR believes the monitoring and sampling data are a sufficient basis for reaching public health conclusions, especially when one considers the consistent insights offered by a review of information on emissions and fate and transport.

Question B-7:

Has DOE measured fugitive emissions from the TSCA Incinerator? If fugitive emissions have not been measured, how can ATSDR reach a definitive conclusion on this site, and should DOE be required to measure these emissions?

Answer B-7:

By their very nature, fugitive emissions are extremely difficult, if not impossible, to measure directly. Consequently, DOE has never measured, nor been required to measure, fugitive emissions from the TSCA Incinerator. ATSDR does not view the lack of fugitive emission measurements as a significant data gap for this PHA for two reasons. First, several design and operational features clearly minimize potential fugitive emissions from this source (see Section III.B.3). Second, the ambient air monitoring data that ATSDR reviewed reflects air quality impacts from all local emissions sources, including the fugitive emissions from the TSCA Incinerator. Consequently, ATSDR's evaluation implicitly considered the incinerator's fugitive emissions, even though they have never been directly measured.

Question B-8:

At what location do air emissions from the TSCA Incinerator have their greatest air quality impacts?

Answer B-8:

Local meteorological conditions determine how emissions move from the incinerator stack to off-site locations. As the wind speed and direction change, so does the location with the highest ground-level concentration. As Appendix B describes, the existing dispersion modeling studies have estimated where the incinerator's emissions are expected to have their greatest air quality impacts over the long term. All the studies ATSDR reviewed place the point of maximum impact within ½-mile of the stack base, in areas where no residents live or frequent. It should be noted, however, that ambient air monitoring stations have been placed at the estimated locations of maximum impact.

Question B-9:

Did ATSDR consider air emissions from local medical waste incinerators and municipal solid waste incinerators?

Answer B-9:

To identify nearby medical waste incinerators and municipal waste incinerators, ATSDR consulted with EPA personnel responsible for tracking the permit status of selected facilities in the United States. Through this consultation, ATSDR learned that there currently are no medical waste incinerators or municipal waste incinerators in the Knoxville metropolitan area that process enough material to fall under EPA's most recent regulations on incineration. Thus, if any medical waste incinerators or municipal solid waste incinerators are located in the Knoxville area, they must process very small quantities of waste. Moreover, air quality impacts from such facilities, if they exist, would presumably be captured in the ambient air monitoring data that ATSDR reviewed for this site.

V.C. Community Concerns Regarding Incinerator Operations

ATSDR identified several community concerns regarding the operation of the TSCA Incinerator, with most expressed during the March 2004 PHAWG meeting. ATSDR's responses to these concerns follow. Recognizing that residents have lingering questions about the incinerator's operations and the extent of regulatory oversight, ATSDR has recommended that TDEC issue annual fact sheets to inform the public of the TSCA Incinerator's ongoing operational status (see Section IX for further information on this and other recommendations).

Question C-1:

Why has DOE not implemented continuous emissions monitoring systems for a wider set of pollutants?

Answer C-1:

As Appendix C indicates, DOE currently conducts continuous emissions monitoring for carbon dioxide, carbon monoxide, and oxygen. Additionally, DOE continuously samples stack gases to measure emission rates of metals and radionuclides. Taken together, these continuous emissions monitoring and continuous emissions sampling efforts meet all applicable regulatory requirements for emissions measurements.

While ATSDR can appreciate the desire to have real-time emissions measurements for a broader range of contaminants, reliable continuous measurement devices simply are not available for every contaminant released by incinerators. ATSDR does not view the lack of additional continuous monitoring data as a critical information gap for this site for two reasons. First, ATSDR emphasizes that continuous emissions sampling already occurs for metals and radionuclides — two groups of contaminants that incinerators do not destroy. Second, safeguards are in place to ensure that air emissions of other contaminants do not exceed levels of health concern. For instance, maintaining operating parameters within limits established during the trial burns should ensure that organic compounds and PCBs in wastes are thoroughly destroyed. Therefore, ATSDR believes that DOE's current emissions monitoring and emissions sampling strategies are appropriate.

Question C-2:

If continuous emissions monitoring for PCBs does not occur, how does DOE know that the DRE for PCBs is consistently greater than 99.9999%?

Answer C-2:

No continuous emissions monitoring systems are currently available for PCBs in incinerator exhaust. However, EPA's permitting process for incinerators includes several measures that help ensure that facilities consistently meet required DREs. For instance, through the trial burn process, EPA requires facility operators to demonstrate that their incinerators can adequately destroy wastes, even under unfavorable operating conditions. Further, environmental permits are prepared that establish strict waste acceptance criteria and specify limits on several critical operating parameters in the interest of ensuring that adequate waste

destruction occurs. Finally, continuous emissions monitoring is required for carbon dioxide, carbon monoxide, and oxygen; results from this monitoring can characterize incineration efficiency. Thus, even though continuous monitoring of DREs for PCBs is currently not feasible, multiple safeguards are in place to help ensure (though not necessarily prove) that the required DREs are met.

Question C-3:

How can stack tests conducted every 5 years characterize how air emission rates at the TSCA Incinerator vary from day to day?

Answer C-3:

This question addresses a key issue often debated in connection to regulatory strategies for air emissions sources. Given the costs of conducting stack tests, environmental regulators have long recognized that frequent stack testing can be prohibitively expensive for incinerator operators. Regulators have instead focused on an alternate approach to ensuring safe operation of incineration facilities: carefully establishing waste acceptance criteria and limits on critical operating parameters to ensure (with an adequate margin of safety) that incinerator emissions are not harmful. Periodic stack tests are then used to confirm that the permit conditions are indeed appropriate. ATSDR believes that this is a sensible approach and avoids placing an undue financial burden on incinerator operators to demonstrate regulatory compliance.

Question C-4:

Is all waste material being characterized before being treated at the TSCA Incinerator?

Answer C-4:

Wastes must be thoroughly characterized, whether through testing or demonstrated process knowledge, before they can be treated at the TSCA Incinerator. DOE must retain records of waste characterization efforts, and TDEC periodically reviews records to verify compliance with permit conditions. Failure to perform waste characterization carries serious consequences. For instance, the DOE contractors who operate the incinerator can be subject to expensive fines (and, in extreme cases, criminal investigation) if waste characterization is not adequately performed. Overall, ATSDR has no reason to believe that DOE is treating improperly characterized wastes at the TSCA Incinerator.

Question C-5:

Given that incinerators do not destroy metals or radionuclides, why is incineration used to treat wastes containing these contaminants?

Answer C-5:

It is ATSDR's understanding that DOE is not using incineration to treat wastes heavily contaminated with radionuclides. Rather, the wastes of concern predominately contain toxic

organic constituents (like PCBs) that need to be destroyed. Incineration has been shown to safely destroy these toxic constituents without generating and emitting harmful levels of by-products.

The toxic organic wastes that DOE treats at the TSCA Incinerator also happen to contain small amounts of metals or radionuclides. Recognizing this, DOE designed the incinerator with extensive air pollution controls to remove metals, radionuclides, and other inorganic materials that are not destroyed in the process. Stack testing has shown that the air pollution control devices at the TSCA Incinerator efficiently remove metals or radionuclides from gases leaving the afterburner. Some estimates place these removal efficiencies well over 90%, depending on the metal or radionuclide of concern. Regardless of the actual removal efficiencies, trace amounts of metals and radionuclides undoubtedly pass through the incinerator untreated. However, an extremely large volume of ambient air monitoring data show that these emissions have only marginal impacts on local air contamination levels and the measured air concentrations of metals and radionuclides are below levels of health concern.

Question C-6:

Does DOE operate the TSCA Incinerator outside of the bounds established in the environmental permits?

Answer C-6:

The incinerator automatically shut downs whenever one of several critical operating parameters (see Table 3) falls outside acceptable ranges specified in the environmental permits. These critical operating parameters are continuously measured using automated sensors. Therefore, ATSDR has no reason to believe that DOE or its contractors can or would intentionally operate the incinerator beyond its permitted bounds.

Question C-7:

Given that the TRV remains open when the TSCA Incinerator is not operating, do emissions routinely occur through the TRV during typical process startups and shutdowns?

Answer C-7:

The question correctly notes that the TRV at the TSCA Incinerator is in the open position when the incinerator is not operating. During startup, a process interlock prevents the incinerator from operating until the TRV is in the closed position. Therefore, all combustion gases generated after process startup cannot pass through the TRV. Similarly, during process shutdown, the TRV remains in the closed position until after all combustion gases have passed through the air pollution controls. Therefore, whether during startup conditions, routine operations, or shutdown conditions, incineration gases pass through the air pollution controls and are not vented through the TRV. Only during the 18 events listed in Table 2 were untreated gases released through the TRV.

V.D. Other Community Concerns

The following paragraphs present ATSDR's responses to general community concerns that do not fall under the categories listed above.

Question D-1:

Does trucking hazardous wastes to the TSCA Incinerator present a hazard?

Answer D-1:

As noted previously, the TSCA Incinerator treats wastes generated by multiple DOE facilities, not just the ORR facilities. Selected wastes from other DOE facilities are shipped to the TSCA Incinerator by truck. ATSDR acknowledges that untreated hazardous wastes might be released if any trucks were involved in serious accidents. However, the U.S. Department of Transportation has developed many regulations to prevent such releases or minimize their consequences. For instance, drivers who haul hazardous waste must have special licenses, waste materials must be packaged in containers designed to withstand traumas anticipated in certain accidents, and wastes must be labeled and tracked. ATSDR believes these and other safeguards help minimize any hazards associated with transporting hazardous wastes to the TSCA Incinerator. While none of these regulations can guarantee that no accidents involving waste shipments will ever occur, it is worth noting that the TSCA Incinerator has now operated for 14 years without any accidents involving hazardous waste shipments.

Question D-2:

Has ATSDR evaluated the quality of the monitoring data reported by DOE?

Answer D-2:

ATSDR carefully scrutinized the quality of all sampling results relevant to the TSCA Incinerator, regardless of which party had collected the data. For reasons stated in Appendix C, ATSDR believes the monitoring data provided by DOE are generally of a known and high quality. Moreover, ATSDR sought additional data sources to provide independent verification for the quality of DOE's data. For instance, the consistency between EPA's and DOE's environmental radiation measurements near ETTP provide assurance that the underlying measurements are accurate. Similarly, ATSDR recommends that TDEC conduct similar data comparisons between its metals monitoring data and DOE's (see Section IX).

Question D-3:

Did ATSDR consider findings from researchers at the University of California at Los Angeles (UCLA) suggesting that metals should not be incinerated?

Answer D-3:

During the PHAWG meeting when ATSDR presented its preliminary evaluation of the TSCA Incinerator, a community member noted that researchers at UCLA published a paper suggesting that metals should never be incinerated. After the meeting, ATSDR asked the individual who made these comments to provide a copy of the publication cited. The information provided was not a peer-reviewed publication, but rather a printed copy of UCLA's Center for Clean Technology Web site. Thus, ATSDR has no knowledge of UCLA researchers making the statements attributed to them. More generally, however, ATSDR has already stated its position on the utility of incineration as a waste management alternative: "Thermal treatment technologies [including incineration] are inherently neither safe nor unsafe; whether they are safe depends on how they are designed and operated" (ATSDR 2002).

Question D-4:

Did ATSDR consider findings from DOE's Lawrence Livermore National Laboratory (LLNL) suggesting that radioactive materials should never be incinerated?

Answer D-4:

During the same PHAWG meeting in March 2004, a community member noted that DOE had previously reported that radioactive materials should never be incinerated. ATSDR obtained a copy of the report that appeared to form the basis for this comment (DOE 1990). The report evaluated whether DOE should install and operate an incinerator at LLNL to treat mixed LLW. After considering many factors, the authors of the report did in fact conclude that a new incinerator should not be constructed. It is important to note that the authors did not conclude that mixed LLW should never be incinerated; rather, the conclusion was that this incineration did not need to take place at LLNL, in part because these wastes could be shipped to other DOE installations that already have permitted incinerators.

Overall, the report that ATSDR obtained suggests that whether incineration is an appropriate waste treatment technology ultimately needs to be decided on a case-by-case basis. As stated earlier, the purpose of this PHA is not to enter into the debate on the utility of incineration, but rather to assess the public health implications of environmental releases specifically from the TSCA Incinerator.

Question D-5:

Is the white smoke in the incineration emissions harmful?

Answer D-5:

A major by-product of incineration processes is water. Because the stack gases at the TSCA Incinerator are typically at least 170 degrees Fahrenheit, some of the water in the air emissions exists as vapor. Once these gases come into contact with cooler ambient air, some water vapor condenses and becomes steam, which is visible. Of course, the incinerator

emissions include trace amounts of other contaminants, as Section III of this PHA describes. Still, a large volume of measured and modeled data indicate that residents are not exposed to these chemicals at levels expected to cause adverse health effects.

Question D-6:

If most TRV events are caused by power outages, how does DOE collect air samples during these events?

Answer D-6:

The TSCA Incinerator and the off-site ambient air monitoring networks draw from different power sources. As evidence of this, valid air samples have been collected at the off-site monitoring network during several of the TRV events that were caused by power outages.

VI. Health Outcome Data

Health outcome data, or measures of disease occurrence in a population, can provide information on the general health status of a community. ATSDR scientists evaluate health outcome data in PHAs to evaluate the possible health effects in a population that is known to have been exposed to enough environmental contamination to experience health effects. As the previous sections of this PHA have explained, ATSDR has found no evidence of residents being exposed to the TSCA Incinerator's emissions at levels of health concern.

Over the past few decades, government agencies, academic researchers, and other parties have completed several epidemiological studies to evaluate incineration facilities. While none of the studies focused specifically on the TSCA Incinerator, the studies do provide useful perspective on environmental health issues at incineration facilities. The following paragraphs summarize two extensive literature reviews of selected, peer-reviewed environmental health studies on incinerators and related facilities. Occupational health studies are not considered below, but Section V provides some information on occupational health concerns associated with incineration facilities.

Epidemiological studies show that well-designed and properly operated incinerators generally can destroy wastes without presenting a substantial health risk to nearby residential populations.

- **ATSDR's review of health outcome data.** Since its inception, ATSDR has conducted or funded six health studies that focused on environmental health concerns associated with incineration facilities in the United States. In 2002, ATSDR reviewed the findings of these studies (ATSDR 2002). With one exception, the studies found no association between residents' proximity to incinerators and any biomarkers of exposure or adverse health effects. The exception was a study that found residents near a former incineration facility had a higher prevalence of self-reported respiratory symptoms (though not a higher prevalence of physician-diagnosed respiratory disease) than did residents in the study's control population.

ATSDR concluded that this incinerator, because it operated without any air pollution controls and had a record of extremely poor waste handling practices, was "…not representative of hazardous waste combustion facilities operating today" (ATSDR 2002). From all studies combined, ATSDR concluded that hazardous waste incineration could be done in a safe manner, depending largely on the incinerator design and operational details.

- **NRC's review of selected epidemiological studies.** In 2001, NRC published a review of selected epidemiological studies conducted around incineration facilities in the United States, the United Kingdom, France, Taiwan, and Australia (NRC 2001). NRC concluded that the epidemiological studies provide no evidence of an association between exposure to incinerator emissions and acute or chronic respiratory symptoms among exposed residential populations. NRC acknowledges, however, that the failure to detect effects might reflect methodological limitations of epidemiological studies, such as evaluating small study populations and not fully considering impacts from confounding factors. In its review of epidemiological studies and other issues pertaining to incineration facilities, NRC ultimately concluded that "…a well-designed and properly operated incineration facility emits relatively small amounts of [air] pollutants, contributes little to ambient concentrations, and so is not expected to pose a substantial health risk" (NRC 2001).

In summary, no researchers have conducted epidemiological studies of residents who live in the vicinity of the TSCA Incinerator. However, ATSDR's environmental health evaluations presented earlier in this PHA strongly suggest that such a study is not warranted, given that residents are not exposed to site-related contaminants at levels of health concern. Further supporting this conclusion are health outcome data suggesting that well-designed and properly operated incinerators — such as the TSCA Incinerator — can destroy wastes in a safe manner without compromising the health of local residents.

VII. Children's Health Considerations

Because children often are at greater risk than adults of being exposed to toxic chemicals, and because 8% of the residential population within 3 miles of the TSCA Incinerator are children (age 6 year and under), ATSDR specifically considered children's health issues when preparing this PHA. Children are more likely than adults to suffer from adverse health effects due to environmental exposures for several reasons, such as:

- Children's developing bodies can be particularly sensitive to environmental exposures during certain critical growth stages, especially when children are exposed to contaminants known to cause developmental effects.
- Children weigh less than adults. Thus, when children and adults ingest or inhale the same amount of chemicals, children receive a greater dose than adults, on a pound of contaminant per pound of body weight basis.
- Because children often spend more time outdoors than do adults, children can be more likely to come into contact with contaminated soils and to inhale greater amounts of outdoor air pollution.

Throughout the PHA process, ATSDR considered these and other children's health issues. For instance, when selecting health-based comparison values for the exposure evaluation, ATSDR identified, when available, comparison values protective of children's exposure and of health conditions more common in children, like asthma. As one example, ATSDR used EPA's air quality standards to screen air contamination levels for lead, ozone, and particulate matter. EPA developed these standards to protect the health of sensitive populations, including children.

ATSDR identified one environmental health issue of particular concern to children for this site: elevated airborne levels of ozone and fine particulates. Many children who live near the TSCA Incinerator, just like children who live in numerous urban and suburban areas across the country, have a greater risk of suffering from ozone- and particulate-related adverse health effects than do adults.

Ozone and PM2.5 are general air quality issues for the Knoxville metropolitan area. This pollution is caused by numerous air emissions sources, both local and distant. Air emissions from the TSCA Incinerator appear to contribute little to the region's ozone and PM2.5 problems.

ATSDR's concern stems partly from the fact that ozone and PM2.5 levels are generally highest during the afternoon hours on sunny summer days, when most children are not in school and are likely to be playing outdoors. Another reason for concern is that people with asthma have been identified as a sensitive population for both ozone and PM2.5 exposure, and asthma is more prevalent among children than among adults (Mannino et al. 2002). Finally, children might not seek or understand information in important air quality forecasts. These factors are of concern because asthmatic children or children who engage in moderate to strenuous exercise (e.g., swimming and running) during poor air quality days are at risk for respiratory problems.

Fortunately, many resources are available to help prevent children from exposure to unhealthful levels of ozone and PM2.5. As noted earlier, TDEC issues air quality forecasts, and the local media usually broadcast them. Parents should encourage their children, especially asthmatic children, to play indoors on days when levels are predicted to be unhealthful. Further, EPA's Web site now includes a tremendous amount of information on ozone, PM2.5, and related air quality issues. Adults are encouraged to access this information, whether from their home computers or those at local libraries, at www.epa.gov/airnow. Additionally, EPA has recently launched a Web site that targets health-related air pollution information to children. The site, *Air Quality Index for Kids!*, is available in English and Spanish at www.epa.gov/airnow/aqikids.

VIII. Conclusions

ATSDR has reached the following conclusions regarding the TSCA Incinerator:

1. The TSCA Incinerator efficiently destroys organic wastes, but in so doing releases trace amounts of contaminants into the air. Nevertheless, an extremely large volume of high-quality environmental data, both measured and modeled, confirm that the amounts of contamination released during both routine and non-routine operations have not harmed local residents. Accordingly, **ATSDR classifies releases from the TSCA Incinerator as creating no apparent public health hazard.** This is the conclusion category ATSDR uses when environmental exposures are known to occur, but not at levels expected to be harmful.

2. Because of potentially unhealthful levels of ozone and fine particulate matter, general air quality in the Knoxville metropolitan area is sometimes poor. Such air quality problems are not, however, unique to Knoxville: they are found in many urban and suburban settings in the United States. The occasionally poor air quality does not result from a single source (e.g., the TSCA Incinerator), but rather results from industrial and motor vehicle emissions over a broad area. People exposed to the infrequently elevated ozone and fine particulate matter levels could experience adverse health effects, such as lung irritation, aggravated asthma conditions, and difficulty breathing. Health effects are expected to be most likely among sensitive populations, which include children, the elderly, and people with respiratory conditions.

3. TDEC's collection of air samples at existing DOE sampling locations provides an excellent opportunity to verify independently the quality of DOE's ambient air monitoring measurements for metals. While general trends from the two data sets are qualitatively similar, TDEC needs to use a more sensitive laboratory analytical method to quantify the accuracy of DOE's measurements.

4. The Public Health Action Plan (Section X) outlines completed, ongoing, and future actions that various agencies will take to evaluate environmental health issues related to this site.

IX. Recommendations

ATSDR recommends the following actions, either to provide greater confidence in this PHA's conclusions or to ensure that residents are not exposed to unhealthful levels of contaminants in the future. The recommendations are classified into two categories:

Public Health Recommendations

DOE, EPA, and TDEC should continue operating their routine ambient air monitoring networks at ETTP to measure metals and radionuclides — two groups of contaminants that the TSCA Incinerator does not destroy.

TDEC should continue to issue air quality warnings on days when ozone or fine particulate concentrations in the Knoxville metropolitan area are expected to reach potentially unhealthful levels.

Local residents should heed air quality warnings issued by TDEC, which typically encourage residents (especially children, the elderly, and those with respiratory conditions) to remain indoors and to avoid any moderate or strenuous exercise. It is especially important for parents to communicate these warnings to their children, who often either do not seek or do not understand information on air quality.

TDEC should achieve lower detection limits in its metals monitoring network (particularly for arsenic, cadmium, and chromium) such that the measurements can be used to independently verify the quality of DOE's ambient air monitoring data.

Recommendations to Help Improve Communications on Environmental Health Issues

Even though the TSCA Incinerator does not present a public health hazard, some community members remain very concerned about the site's air emissions. Providing the public with annual fact sheets summarizing environmental conditions at the TSCA Incinerator might help address these concerns. Accordingly, TDEC should issue annual fact sheets that document the environmental status of the TSCA Incinerator. The fact sheets should address issues such as inspection outcomes, regulatory compliance issues, and other important agency oversight activities.

After achieving lower detection limits for metals, TDEC's annual environmental monitoring reports should quantify differences between metals monitoring data gathered by DOE and those gathered by TDEC at stations with co-located samplers. Any notable discrepancies should be documented and explained.

For purposes of transparency, both DOE and TDEC should improve the annual reporting on their environmental monitoring networks. Recommended improvements include identifying the specific sampling and analytical methods used, presenting the method detection limits, and better documenting data quality (e.g., completeness fractions, estimated measurement precision, and comments on measurement accuracy).

X. Public Health Action Plan

This Public Health Action Plan describes specific actions that have been taken, are scheduled to be taken, or should be taken by numerous parties, including ATSDR, DOE, EPA, and TDEC. The purpose of this plan is to document past public health activities and set priorities to ensure that ongoing operation of the TSCA Incinerator will not cause harmful human health effects to occur in the future. This plan addresses issues specific to the TSCA Incinerator — it does not consider the many other public health actions that pertain to the other ORR facilities.

Actions Completed

From 1991 to the present, DOE has completed several tests to measure emissions from the incinerator. ATSDR, an independent panel chartered by the Governor of Tennessee, and DOE have modeled how these emissions move through the air. DOE, EPA, and TDEC have conducted extensive ambient air monitoring to characterize the TSCA Incinerator's potential air quality impacts.

In June 1997, TDEC prepared a report titled *Responses to the 101 Questions from Citizens Presented to the Tennessee Department of Environment and Conservation*. The report addresses health, environmental, and operational concerns regarding the TSCA Incinerator.

In January 1998, an independent panel chartered by the Governor of Tennessee prepared a report that evaluated community health concerns related to the TSCA Incinerator.

In March 2004, ATSDR conducted a site tour of the TSCA Incinerator and presented preliminary information on this PHA to the Public Health Assessment Working Group.

Actions Ongoing

DOE, EPA, and TDEC continue to conduct ambient air monitoring near the TSCA Incinerator.

ORRHES continues to meet to provide a forum for communication and collaboration between citizens and the agencies that are conducting public health activities at ORR.

To fulfill permit renewal requirements, DOE has plans to prepare a human health risk assessment and ecological risk assessment of selected environmental releases from the TSCA Incinerator. Both risk assessments will be completed after environmental agencies approve DOE's written risk assessment plans.

Recommendations for Further Action

DOE, EPA, and TDEC should continue their routine ambient air monitoring for metals and radionuclides in the vicinity of the TSCA Incinerator.

TDEC should prepare annual fact sheets documenting the environmental status of the TSCA Incinerator. These fact sheets should address inspection outcomes, regulatory compliance issues, and other agency oversight activities. If requested, ATSDR will assist TDEC with preparing a

visually appealing fact sheet for the first year, which will then be usable as a template in the future.

TDEC should achieve lower detection limits in its ambient air monitoring networks for metals. Once this is done, TDEC should compare its ambient air monitoring data for metals measured at stations K2, PAM35, and PAM42 to the data that DOE collects simultaneously at the same stations. TDEC should summarize its quantitative comparison in future annual environmental monitoring reports.

TDEC should continue to issue air quality warnings on days when ozone or fine particulate concentrations in the Knoxville metropolitan area are expected to reach potentially unhealthful levels.

XI. Authors, Technical Advisors

Jack Hanley, M.P.H.
Environmental Health Scientist
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

Paul A. Charp, Ph.D.
Senior Health Physicist
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry

John Wilhelmi, M.S.
Senior Chemical Engineer
Eastern Research Group, Inc.

XII. References

[ATSDR] Agency for Toxic Substances and Disease Registry. 1994. Toxicological profile for chlorodibenzofurans. Atlanta: US Department of Health and Human Services; May 1994.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1998. Toxicological profile for chlorinated dibenzo-p-dioxins (update). Atlanta: US Department of Health and Human Services; December 1998.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1999a. Toxicological profile for cadmium (update). Atlanta: US Department of Health and Human Services; July 1999.

[ATSDR] Agency for Toxic Substances and Disease Registry. 1999b. Toxicological profile for mercury. Atlanta: US Department of Health and Human Services; March 1999.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2000a. Toxicological profile for arsenic (update). Atlanta: US Department of Health and Human Services; September 2000.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2000b. Toxicological profile for chromium (update). Atlanta: US Department of Health and Human Services; September 2000.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2002. Public health reviews of hazardous waste thermal treatment technologies: a guidance manual for public health assessors. Agency for Toxic Substances and Disease Registry, Division of Health Assessment and Consultation. March 2002.

Blade LM and Worthington KA. 1996. Health hazard evaluation report 96-0071-2854: Lockheed Martin Energy Systems, Inc; July 1996.

[DOE] US Department of Energy . 1990. Final Report of the Director's Internal Panel on the Decontamination and Waste Treatment Facility (DWTF). Lawrence Livermore National Laboratory. February 21, 1990.

[DOE] US Department of Energy .. 1991–2002. Oak Ridge Reservation Annual Site Environmental Reports (for years 1991 through 2002). All reports accessible at: http://www.ornl.gov/aser. Last accessed 08 February 2005.

[DOE] US Department of Energy . 1997–2002. Annual Reports for the Radionuclide National Emission Standards for Hazardous Air Pollutants. TDEC provided copies of the reports submitted for calendar years 1997 through 2002.

[DOE] US Department of Energy . 2001. TSCA Incinerator Stack Metals Emissions Data for Operating Period, February 2000–November 2000. March 15, 2001.

[DOE] US Department of Energy . 2002. TSCA Incinerator Metals Emissions Data for Calendar Year 2001. Revision 1. April 5, 2002.

[DOE] US Department of Energy . 2003a. Annual TSCA incinerator rolling totals reports for 1991–2003. Reports provided by Mike Ambrose (DOE) to John Wilhelmi (ERG) in September 2003. Reports dated July 23, 2003.

DOE US Department of Energy. 2003b. TSCA Incinerator TRV History. Report provided by Mike Ambrose (DOE) to John Wihelmi (ERG) in September, 2003 (report undated).

DOE US Department of Energy . 2003c. Environmental monitoring plan for the Oak Ridge Reservation, Oak Ridge Operations Office; March. DOE/OR-1066/R5.

Dunn JE Jr, Sallie R, Gibson LV Jr, Kinner LL, Peeler JW, Shigehara RT. 1998. Field test to determine deployment potential of three candidate multi-metals monitoring techniques at the Toxic Substances Control Act Incinerator. Prepared for the U.S. Department of Energy; June.

Dunn JE Jr, Kinder KK, Calcagno JA, Davis WT, Geisler TJ, Allen MW et al . 2003. Evaluation of mercury continuous emission monitors at the U.S. DOE TSCA Incinerator. Presented at the Air and Waste Management Association's 96th Annual Conference and Exhibition, San Diego, California; June.. Paper #70249.

Engineering-Science, Inc. 1988a. TSCA trial burn report for Martin Marietta Energy Systems, Inc. K-25 Incinerator. Prepared for Martin Marietta Energy Systems, Inc.; August.

Engineering-Science, Inc. 1988b. RCRA trial burn report for Martin Marietta Energy Systems, Inc. K-25 Incinerator. Prepared for Martin Marietta Energy Systems, Inc.; August.

[EPA] US Environmental Protection Agency. 1989. March 20 Letter from Greer Tidwell (EPA, Region 4 Administrator) to Ronald Hultrgen (DOE, Oak Ridge Operations) and Clyde Hopkins (Martin Marietta Energy Systems, Inc.).

[EPA] US Environmental Protection Agency. 1996–2003. Environmental Radiation Data. Quarterly Reports Numbers 86 to 115. EPA Office of Radiation and Indoor Air.

[EPA] US Environmental Protection Agency. 1997. Exposure Factors Handbook. U.S. Environmental Protection Agency. Document #EPA/600/P-95/002Fa. August 1997.

[EPA] US Environmental Protection Agency. 1998. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities: Volumes 1–3. Peer Review Draft. US Environmental Protection Agency. Document #EPA530-D-98-001; July.

[EPA] US Environmental Protection Agency. 2002. West Louisville air toxics monitoring study results. Region 4, Science and Ecosystem Support Division; February 7.

[EPA] US Environmental Protection Agency. 2003. National Air Quality and Emissions Trends Report. 2003 Special Studies Edition. EPA/454/R-03-005; September.

[EPA] US Environmental Protection Agency. 2004a. Toxics release inventory data for reporting year 2001. Available at: http://www.epa.gov/tri. Last accessed 8 February 2005.

[EPA] US Environmental Protection Agency. 2004b. National emissions inventory data for calendar year 1999. Available at: http://www.epa.gov/ttn/chief/net/. Last accessed 8 February 2005.

[EPA] US Environmental Protection Agency. 2004c. Letter from JI Palmer Jr. (EPA Regional Administrator) to the Honorable Phil Bredesen (Governor of Tennessee); June 29.

[EPA] US Environmental Protection Agency. 2004d. Ambient air monitoring data. Available at: http://www.epa.gov/air/data/. Last accessed 8 February 2005.

[EPA] US Environmental Protection Agency. 2004e. Environmental radiation measurements. Available at: http://www.epa.gov/enviro/html/erams/. Last accessed 8 February 2005.

[EPA] US Environmental Protection Agency. 2004f. EPA green book: non-attainment areas for criteria pollutants. Available at: http://www.epa.gov/air/oaqps/greenbk/. Last accessed 8 February 2005.

[ERG] Eastern Research Group, Inc. 2004. Raw ambient air monitoring data collected in 2003 under EPA's Urban Air Toxics Monitoring Program; April.

Iglar A, Martin F, Miller T, Pardue W, Parker FL, Thackston EL et al. 1998. Governor of Tennessee's independent panel to review the operation of the Department of Energy Toxic Substances Control Act (TSCA) Incinerator at the East Tennessee Technology Park.; January 29.

Ihrig MM, Shalat SL, Baynes C. 1998. A hospital-based case-control study of stillbirths and environmental exposure to arsenic using atmospheric dispersion model linked to a geographical information system. Epidemiol 9(3):290–94.

IT Corporation. 1989. RCRA trial burn report for a dual purpose RCRA/TSCA Incinerator at the U.S. Department of Energy's K-25 Facility in Oak Ridge, Tennessee. Prepared by International Technology Corporation for Martin Marietta Energy Systems, Inc.; August 31.

IT Corporation. 1990. Beryllium and lead emissions performance test burn report for a dual purpose RCRA/TSCA Incinerator at the U.S. Department of Energy's K-25 Facility in Oak Ridge, Tennessee. Prepared for Martin Marietta Energy Systems, Inc.; September.

IT Corporation. 2000. Reapplication for the Toxic Substances Control Act Incinerator Part B Resource Conservation and Recovery Act Incineration Permit and the Toxic Substances Control Act Polychlorinated Biphenyl Incineration Approval. Volume 5. IT Corporation. February 1997; revised March 2000.

IT Corporation. 2001. Oak Ridge ETTP Site TSCA Incinerator air performance test: IT Project No. 803138. Prepared by IT Corporation for Bechtel Jacobs; February.

IT Corporation. 2002. Field testing of particulate matter continuous emission monitors at the DOE Oak Ridge TSCA Incinerator; East Tennessee Technology Park, Oak Ridge, Tennessee. Document #BJC/OR-980; March.

Mannino DM, Homa DM, Akinbami LJ, Moorman JE, Gwynn C, Redd SC. 2002. Surveillance for asthma, United States, 1980–1999. MMWR 51(SS01):1–13.

Martin Marietta Energy Systems, Inc. 1988. Air performance test report for the K-1435 RCRA/TSCA Incinerator. Document number K/HS-250; December.

Martin Marietta Energy Systems, Inc. 1995. Air performance test report for the Oak Ridge Site Toxic Substances Control Act Incinerator. Document number K/TSCA-SCS-RPT-3002; September.

[NRC] National Research Council, Committee on Health Effects of Waste Incineration. 2000. Waste incineration and public health. Washington, DC: National Academy Press.

PEI Associates, Inc., and Metcalf and Eddy of Ohio. 1987. Performance test report for sampling and analysis at the DOE Oak Ridge PCB Incinerator. Prepared for International Waste Energy Systems; September.

Radian 1997. Reapplication for the Toxic Substances Control Act Incinerator Part B Resource Conservation and Recovery Act Incineration Permit and the Toxic Substances Control Act Polychlorinated Biphenyl Incineration Approval. Volumes 1–12. Radian International LLC; February.

Swif t J, Oommen R, Dayton DP, Bursey J, Heindorf M. 2003. Hexavalent chromium monitoring program during the 2001 pilot project in Detroit, Michigan. Presented at the Air and Waste Management Association's 96th Annual Conference and Exhibition: San Diego; June.

[TDEC] Tennessee Department of Environment and Conservation. 1991. Operating permit issued pursuant to Tennessee Air Quality Act. Tennessee Air Pollution Control Board; October 2.

[TDEC] Tennessee Department of Environment and Conservation. 1996–2002. Environmental monitoring reports. Department of Energy Oversight Division. Annual reports from calendar years 1996 to 2002.

[TDEC] Tennessee Department of Environment and Conservation. 1997. Responses to the 101 Questions from Citizens Presented to the Tennessee Department of Environment and Conservation; June.

[TDEC] Tennessee Department of Environment and Conservation. 2003. Notice of Violation. Letter from JW Stewart (TDEC) to LL Radcliff (DOE). April 7, 2003.

[TDEC] Tennessee Department of Environment and Conservation. 2004. Tennessee revised recommendation for PM2.5 Area Designations and Technical Support Documentation. May 7 letter from Betsy L Child (TDEC) to JI Palmer Jr. (EPA Regional Administrator).

TRC Environmental Corporation. 2001. Trial burn of the TSCA Incinerator: US Department of Energy, Oak Ridge East Tennessee Technology Park, Oak Ridge, Tennessee. Prepared for the U.S. Department of Energy; September 7.