

As Requested by the Solid Waste Advisory Committee,
The Department of Environment and Conservation Submits These

Responses to Comments from the Public on
Bulk Survey for Release Program and Disposal in Class I Landfills

In this document, comments are in bold and responses are in italics. Closely related comments are sometimes grouped together for one response.

I. Issues regarding the Bulk Survey for Release (BSFR) program of the Division of Radiological Health

Comments about the BSFR material and Open Records

A. Why were people never told radioactive waste would be disposed of in the landfill in the development of the BSFR program?

B. TDEC has declined to disclose information about the companies involved in generating BSFR waste that was being put in Middle Point Landfill citing T.C.A. 68-202-217. This law states that information supplied to TDEC is defined as proprietary and is confidential. Why does Tennessee law protect the polluters instead of the people? Is TDEC helping the nuclear waste generators be excused from liability for the waste they generate?

C. Why does proprietary information statute, T.C.A. 68-202-217, supersede the Tennessee Public Records Law?

D. Why is info about generators being kept confidential? It should be released. Who are the generators?

A – D. The first question in this group appears to assume that no radioactive waste went into Tennessee landfills prior to the BSFR program. This is incorrect. Wastes similar to those that go through the BSFR program now, were going into Tennessee landfills, although in smaller quantities, prior to the development of the current program. The main difference is that the Division of Radiological Health made case by case decisions for each waste stream. The change that occurred with the development of the BSFR program was simply one of how the regulatory decisions were made, setting a standard applicable to the waste materials ahead of time, rather than making case by case decisions. The criteria for this program include the setting of 1 millirem/yr or less as the acceptable level of dose exposure at the disposal site. This is more conservative and protective than the levels allowed under the Nuclear Regulatory Commission (NRC) petition process.

It is also important to understand that other waste streams going into landfills have as much radioactivity, or occasionally more, than the BSFR program. One of these is medical waste, whether it comes from homes (when patients dispose of bandages, diapers, etc.) or from doctors' offices or hospitals. Another is ash generated by burning wood, which has higher levels of radioactivity than the materials disposed in the BSFR program. Some demolition debris such as marble, brick, or concrete can have as much radioactivity as BSFR waste. One reason for this is naturally occurring uranium, thorium, and their decay products.

The generators are not the U. S. Departments of Energy or Defense, and the waste materials are not nuclear weapons components or related materials, or highly radioactive components of nuclear electric power plants. Generally speaking, the generators are licensees of the U. S. Nuclear Regulatory Commission or a state radiological health program. The waste materials are primarily construction/demolition debris, soils, concrete rubble, and similar materials which have extremely low levels of incidental radioactive material, derived from decommissioning projects at commercially operated nuclear facilities. It is what remains after the waste materials that need to go to a licensed low-level radioactive waste disposal facility have been segregated out and properly disposed.

The identity of the generators is business-sensitive information. From a business perspective, it is important to the licensed waste processors to protect what amounts to their customer list from other processors, for business-competitive reasons. Protection of such information is provided for in statute and regulations. That information is available during inspections, but in most cases is not reported to TDEC/DRH.

The information about the generators is not relevant to ensuring compliance with the waste acceptance criteria established to protect the public and the environment.

The Open Records Law (T.C.A. §10-7-503(a)) states, "...all state, county, and municipal records...shall at all times, during business hours, be open for personal inspection by any citizen of Tennessee, and those in charge of such records shall not refuse such right of inspection to any citizen, unless otherwise provided by law." The final unless clause allows for exceptions to be made either by other statutes or by common law. Therefore the proprietary information provision in T.C.A. §68-202-217 is one of many such statutes.

Comments about the BSFR licenses and inspections

E. The name of this program, Bulk Survey for Release, does not contain the word "radioactive" or "nuclear." Were those words purposely omitted so as not to garner public attention?

F. We have been assured by TDEC that all radioactivity going into Middle Point Landfill is carefully monitored to keep the levels extremely low. Our question is, who does the monitoring?

G. Does TDEC have anybody watching the processors, those private corporations bent on making money, as they separate out what is “safe” for us from what is not? Who monitors the processors? How? And how often? Is all monitoring done by reports, or are inspectors physically present?

H. Confusion over the terms BSFR and special waste – neither uses the term radioactive in regards to this specific issue – some folks find this misleading.

I. Not enough oversight of BSFR program / it is “self-regulating” / inadequate records kept

J. State officials do not inspect the facilities often enough – the landfill and the licensed processors.

K. Another fact which TDEC has not taken into account is that radiation which is taken into the body through food or water or inhalation has far more damaging effects on living tissue than does radiation from an external source.

E – K. The name, Bulk Survey For Release, came to be used because it is descriptive within the context of the DRH regulatory program. “Bulk Survey” refers to the scanning of the material without removing it from the container it is in. “Release” refers to the conditions under which material is allowed to leave the control of the licensee. Since most everything the division deals with involves radiation and radioactivity, those terms were not used because they do not add distinguish this activity from others the licensees are engaged in.

Description of the TDEC/DRH BSFR licenses and the licensing process:

There are four waste processors currently authorized by Tennessee radioactive material licenses to dispose waste with volumetric radioactive contamination to Tennessee landfills in what we now refer to as the BSFR program.. The licenses under which the authorizations are made use the term “radioactive” throughout. The licensees are Duratek Services, Inc., Oak Ridge, IMPACT Services, Inc., Oak Ridge, TOXCO, Inc., d/b/a TOXCO Materials Management Center, Oak Ridge, and RACE, LLC, Radiological Assistance, Consulting and Engineering, Memphis. Duratek Services, Inc. in Memphis was previously authorized for this activity in a license authorization first issued to its predecessor Frank W. Hake Associates on March 13, 1997.

Duratek Services, Inc., Oak Ridge, operates its volumetric disposal program under licenses originally issued to Scientific Ecology Group, Inc. on October 29, 1985, and June 4, 1991. The program is designated by Duratek as the Bulk Waste Assay Program (BWAP). The BWAP program components authorized for designated landfill disposal were authorized February 23, 2000.

Although not a part of the BWAP/BSFR process, Duratek is also authorized under these licenses to receive, possess, store, handle, and transfer radioactive waste when packaged in accordance with U.S. Department of Transportation requirements, and when associated with transport container opening, unpackaging, packaging, decontamination, refurbishment, survey, release for unrestricted use, process equipment activities, waste processing activities, sampling/analysis, calibration of radiation protection equipment, free release of asphalt/concrete to industrial landfill, and metal melting operations.

IMPACT Services, Inc. operates its volumetric disposal program under a license originally issued to ATG Nuclear Services, LLC on September 13, 2000. The program is designated by IMPACT as Volumetric Clearance for Disposal (VCD) and was authorized July 6, 2001.

Although not a part of the VCD/BSFR process, IMPACT is also authorized for licensed material when present as contamination for unpacking, segregating, sectioning, packaging, non-abrasive and abrasive decontamination of surface contaminated materials, survey for unrestricted release of potentially contaminated materials, refurbishment and storage of empty radioactive material containers, conveyances (including railcars), and casks, research and development testing, OREX processing (liquid), or transfer to a licensed or exempt recipient.

TOXCO, Inc. operates its volumetric disposal program under a license originally issued to Quadrex Corporation on November 5, 1982. Volumetric disposal was first authorized April 16, 1991 and the authorization was expanded May 6, 1997. The program is now designated by TOXCO as Volumetric Clearance for Disposal (VCD).

Although not a part of the VCD/BSFR process, TOXCO is also authorized for receipt, possession, storage, handling, unpackaging, processing, decontamination, survey for unrestricted release, repackaging, loading for transport, transfer, instrument calibration, sorting and segregating, compaction, and lead processing.

RACE, LLC operates its volumetric disposal program under a license issued April 24, 2000. The program is designated by RACE as Bulk Survey for Release (BSFR) and was authorized March 5, 2001.

Although not a part of the BSFR process, RACE is also authorized for possession associated with radioactive waste processing activities including DAW and metals processing, abrasive blasting, non-chemical decontamination, cutting, shredding, compaction, super-compaction, storage, storage for decay, sorting, disassembly, packaging, survey for release, sealed source processing for disposal, resin processing, liquid absorption and solidification, and instrument calibration.

An application for the BSFR process is received by the Division of Radiological Health. For an application requesting authorization to perform an activity such as BSFR the amount of information will be very detailed and voluminous. The application will include information specific to the BSFR program including the landfill that has agreed to

receive the material, the environment of the landfill and the individual radionuclide concentration limits requested. The application will be reviewed by the licensing section to determine if it has the required information for any request of this type, including an appropriate Radiation Safety Program to protect the public around the facility where the process will take place and the workers. Most applicants for a BSFR process are already established licensees with programs in place and they will need to submit additional information specific to performing BSFR. If any information is found to be lacking or not submitted a letter requesting that information will be sent to the applicant within 60 days.

For a BSFR application, which also includes a second location of concern, the landfill receiving the conditionally released waste, a more involved analysis will take place in conjunction with the above process. This analysis will evaluate the submitted information to determine if the applicant has demonstrated that the dose to members of the general public, who would reside around, and, in the future, on the receiving landfill, will not be greater than 1 millirem per year (1 mrem/y). (Note that this dose limit is 100 times less than the exposure limit allowed by the regulations to any other member of the general public from any other type of activity regulated by the Division.) The guidelines for this analysis can be found in the Division's State Regulations for Protection Against Radiation Rule 1200-2-5-.121.

To address the majority of these requirements the applicant will submit a detailed analysis using the RESidual RADiation (RESRAD) computer model developed by Argonne National Lab. This environmental assessment model is the gold standard used internationally for determining radiation doses from radioactive material through recognized exposure pathways (external, inhalation, radon, ingestion, water and soil). The submission will include all the information necessary for the Division to independently determine that the radiation dose to the maximally exposed individual at and around the landfill will not be greater than 1 millirem per year. The submitted information will include a complete computer printout showing the specific input values (parameters) used by the applicant, including justification for the parameter values selected and the computer generated individual radionuclide concentration values.

The scenario evaluated will be the resident farmer scenario that RESRAD is programmed to evaluate. This scenario assumes that a family builds a house on the landfill, sinks a well into the groundwater under the landfill, eats crops grown on the landfill, eats meat and drinks milk from livestock raised on the property, consumes fish from ponds or lakes affected by the radioactivity in the landfill and ingests soil from the daily activities associated with the scenario. Thus, the effects of internal consumption of the radioactive material are considered.

The Division reviews the parameter values for appropriateness to the specific landfill. If any parameters are in question the values and their justification are addressed with the applicant until an agreed upon value can be reached or until sufficient information is provided to the Division justifying the applicant's value. If a different parameter is agreed upon the applicant must resubmit a new computer printout using the new values. Next the Division performs an independent run of the RESRAD program using the

accepted parameters to insure that the results agree with the applicants. This action will identify if different versions of the code have been used (the most recent version will, with few exceptions, always be used) and/or if the applicants code has had any changes from the Argonne Code.

Additional analysis is performed for determining the dose to the landfill workers both during the operational phase of the landfill and during the post closure period.

After all issues with this part of the review have been resolved, a memo is sent to the licensing section informing them that the RESRAD part of the application is approved.

Assuming that all normal licensing issues have been resolved, the license (or amendment to an existing license) is issued. The complete package of information is referenced in the license and then filed and forwarded to the field office for use in inspections.

Description of the TDEC/DRH inspection process:

The purpose of inspection is to assess licensee performance by determining whether the licensee is using radioactive material safely and whether an individual or organization is in compliance with established standards, such as regulations, license conditions, and the licensee commitments submitted in support of a license (and incorporated by "tie-down" conditions).

Inspections involve periodic visits to a licensee's facility and/or temporary jobsite by our inspectors, observations of licensed activities, interaction with licensee personnel, and transmission of the inspection findings. In the case of BSFR licensees, physical inspections are supplemented by the licensee's periodic submissions of required reports, which allow DRH staff to assess the ongoing compliance of the licensee's activities in between inspection visits.

The inspector evaluates a licensee's implementation of its radiation safety program. The following areas of the program are where attention is primarily focused:

- (a) security and control of licensed material;*
- (b) shielding of licensed material;*
- (c) comprehensive safety measures*
- (d) radiation dosimetry program;*
- (e) radiation instrumentation and surveys;*
- (f) radiation safety training and practices; and*
- (g) management oversight.*

A determination regarding safety and compliance with DRH requirements is based on direct observation of work activities, interviews with licensee workers, demonstration by appropriate workers performing tasks regulated by DRH, independent measurements of radiological conditions at the licensee's facility and where appropriate, a review of selected records.

Emphasis is placed on observing licensee performance as it relates to staff training, equipment operation and adequacy, overall management of the licensed program, and integration of safety. A direct examination of licensed activities and discussions with cognizant workers provide the inspector with reasonable assurance of a licensee's ability to safely use radioactive material.

DRH has inspected each of the operations that process BSFR material either 5 or 6 times in the period from 2001 to the present. This is a total of 26 inspections at 5 facilities, as one licensee has two locations. Not all of the inspections looked at the BSFR operations. One reason for this is that these licensees conduct other activities that pose greater risk than the BSFR program does when looking at the seven factors mentioned above. These inspections found a total of 71 violations. Four of these violations were in regard to the BSFR activities. The BSFR violations were for things like using an incorrect protocol or incorrect calculations. All four of these violations were corrected promptly by the companies.

In addition, DRH has an established environmental monitoring program and routinely samples various media (soil, sediment, water) at some licensed facilities in the State. Samples are analyzed at the State's radiochemistry laboratory. DRH also has placed radiation dosimetry at certain facilities. These monitors measure the cumulative direct radiation exposure at the site boundaries. These monitors are exchanged quarterly.

Comments related to the level of risk associated with the BSFR material in general

L. TDEC has given repeated assurances that citizens of Rutherford County (and elsewhere in the state) will not be harmed by a miniscule dose of one millirem of radiation per year, and that we will receive no more than that amount from the BSFR program (even if our descendants become farmers and live on the dump). Because the Citizens to ENDIT have some knowledge about radiation, we reject these simplistic explanations.

M. What will happen after post-closure? Will there be leaks? Who will take responsibility for it?

N. What will happen in 100 years?

L – N. These comments are also addressed below from the standpoint of the Division of Solid Waste management. This response is from the DRH perspective. The waste acceptance criteria for the BSFR program are extremely protective of human health and the environment. BSFR material is limited in several ways so that it cannot contribute a radiation dose of more than 1 millirem per year to any person, now or in the distant future.

There are many conservative factors applied in determining the amount of radioactive material to be allowed for disposal through the BSFR program, to be consistent with the

1 millirem per year dose criterion. TDEC/DRH uses measurements, for those parameters which can be measured, and calculations, as appropriate, to project future doses, and to establish acceptable criteria that wastes must meet in order to qualify for disposal through this program.

Various scenarios taking into account the potential for receipt of radiation dose, both from external sources and from sources internal to the body, are evaluated to ensure that nearby residents, and workers who might come into contact with these materials during transportation, disposal, or other routine landfill operations, during both the operational and post-closure phases of the landfill's life, would not receive greater than 1 millirem per year.

One scenario considered in determining acceptable disposal limits is that of the "resident farmer". This scenario is not considered likely to occur, but if it were to, it would represent the worst case for exposure of an individual to a potential radiation dose. This scenario employs a very comprehensive and sophisticated computer model, and assumes that, once the landfill is released from post-closure monitoring, a farmer buys the landfill property, builds a house on top of the wastes disposed there, resides there, drills a well, and uses the water to drink, cook, bathe, and irrigate crops. It assumes that the farmer has livestock that eat the crops and grass and drink the water, and that the farmer consumes the crops, livestock, and milk from the cows. While in reality there will be a soil cover placed over the site, this scenario assumes no cover, that is, it assumes direct contact with landfilled wastes. In determining the projected radiation dose from groundwater use, it is assumed that the synthetic liner, which is designed to prevent landfill leachate from entering the groundwater, doesn't exist. The disposal limits are established such that, even in this most extreme scenario, the dose received by a resident farmer would not exceed the 1 millirem per year dose criterion, at any time from the present out to 1000 years in the future.

The BSFR program is based on numerous such conservatisms, which, when combined with other factors that come into play from a practical and operational standpoint, would lead to the actual dose to any individual being much less than the projected dose criterion of 1 millirem per year. Any potential dose from BSFR material to individuals living adjacent to, as opposed to living on, the landfill would be expected to be much closer to zero than to 1 millirem.

O. The measurement of a millirem is hypothetical, not measureable and verifiable. Furthermore, the computer formula by which that number was arrived at by the DOE, and paid for with taxpayers' dollars, is kept secret from the public. It has not been verified or validated.

O. *The millirem is a subunit of the rem, an internationally recognized unit of radiation dose equivalent that is used by all countries and health physics professionals, "...for radiation protection purposes, for engineering design criteria, and for legal and administrative purposes." An equivalent unit commonly used in the International System of units is the Sievert (one Sievert equals 100 rems or one hundred thousand millirems).*

The rem, or millirem ($1/1000^{\text{th}}$ of a rem), takes into account both physical and biological factors associated with the exposed person or specific organ. References to the rem (millirem) can be found in any number of books on Health Physics and current journal articles published on radiation response. It is “calculated” by taking the measured “absorbed dose” (rads) and multiplying it by a factor (the Relative Biological Effectiveness) that takes into account the varying damaging effect for each type of radiation (e.g., alpha, beta, gamma, neutron, high energy proton, fission fragments, etc.). This “calculation”, with other factors that account for physical and biological factors allow for the determination of the effective radiation dose to a specific organ or area of the body. The concept of millirem is used daily throughout the world to express the radiation dose received by an individual or that could possibly be received at a given location from a specific source. Measurements of effective dose (millirem), for gamma and x-ray radiation, can be performed using properly calibrated radiation detection instruments.

The RESRAD model is not a secret and can be downloaded by anyone. Go to <http://web.ead.anl.gov/resrad/home2/> where not only can the program be downloaded but the manual for using the program, which includes the equations and the rationale for the values chosen for the equations are discussed in great detail. Other documentation for the code is also available at the website including:

“Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil”

“Assessing the Impact of Hazardous Constituents on the Mobilization, Transport, and Fate of Radionuclides in RCRA Waste Disposal Units”

“RESRAD Benchmarking Against Six Radiation Exposure Pathway Models”

“External Exposure Model Used in the RESRAD Code for Various Geometries of Contaminated Soil”

“Evaluation of the Area Factor Used in the RESRAD Code for the Estimation of Airborne Contaminant Concentrations of Finite Area Sources”

Other documents are also available at the web site addressing the use of probabilistic analysis in using the RESRAD Code, which is an advancement in the model’s ability, and a quality assurance (QA) section to verify that the program is running properly.

A search of the Internet will turn up approximately 26,400 documents that deal with the RESRAD family of codes. It should be noted that the other codes in the family are based on the methodology and work used to design the RESRAD code used for the BSFR analysis.

The code itself can be obtained from the Department of Energy (DOE), with certain restrictions, upon supplying a valid request. The source code is understandably

controlled for quality assurance purposes to keep the code from being modified or corrupted, distributed, and used to generate incorrect information because it would not have undergone proper tests. A request for the code can be made to Dr. William Alexander, Health Physicist, who is with the DOE Office of Environmental Management and one of the RESRAD sponsors.

It is important to understand what is meant by "verification" and "validation". Verification refers to the task or procedure by which a mathematical solution to a complex problem is tested for internal mathematical consistency and accuracy, or in other words, that "... the numbers and calculations in the code are correct... ". If you put a set of parameter values into an equation, which has been coded into a computer model, you should get the same results from hand calculations as are obtained from putting the same parameter values in the equation that was coded into the model.

Validation refers to the task or procedure by which the mathematical model is tested against accurately measured, independent sets of field or laboratory observations made over a range of conditions for which application of the model is intended.

Benchmarking is another analysis used for computer codes. Benchmarking consists of solving the same set of problems with several different computer codes and comparing results.

RESRAD has been extensively verified, validated, and benchmarked, and those processes are summarized, with references to the professional literature, where they are described in detail, in the RESRAD user's manual. Some specific examples from the manual follow. RESRAD was verified internally by its developers at Argonne National Laboratory in 1989, and by an independent contractor in 1994.

The RESRAD code has been benchmarked in several studies. Some of those studies were performed by the code's developers, while others were conducted by a third party. During the period 1990-1994, RESRAD was benchmarked against six existing computer models. Among those six were the NRC's NUREG/CR-5512, later codified for use on personal computers as the DandD code, and the EPA's PATHRAE-EPA and PRESTO-EPA-CPG, the validation of which has been extensively documented elsewhere.

In 1995, EPA and DOE published a report on the benchmarking of RESRAD and two other computer models, MMSOILS and MEPAS. These codes were also independently benchmarked by the Consortium for Environmental Risk Evaluation in 1998, for both chemical and radiological constituents.

At the international level, RESRAD was included in the International Atomic Energy Agency's (IAEA's) two multimedia code validation studies. IAEA's Biosphere Model Validation Study Phase II (BIOMOVs) included seven computer codes from seven countries, and focused on uranium and its decay products. IAEA's Validation of Environmental Model Predictions (VAMP) study included eleven computer codes and real world data collected after the Chernobyl accident. The user's manual characterizes

the validation of RESRAD as follows: "The RESRAD prediction of total ingestion dose matches very well with the estimated total ingestion dose (from observational data)."

The RESRAD user's manual, in its section 5.4, Discussion and Conclusions, states, "The RESRAD code is the most extensively tested, verified, and validated code in the environmental risk assessment and site cleanup field. It has been used widely by DOE, other federal and state agencies, and their contractors. In 1994, the NRC approved the use of RESRAD for several applications, including dose evaluation by licensees involved in decommissioning, NRC staff evaluation of waste disposal requests, and dose evaluations of sites being reviewed by NRC staff. ... The EPA used RESRAD in its rulemaking for cleanup of sites contaminated with radioactivity ... the California State Department of Health Services uses RESRAD for all decontamination and decommissioning sites as a confirmation of contractor dose/risk assessment." It concludes with the statement, "It has been proven that RESRAD is the most effective tool for evaluating radiologically contaminated sites."

Given its acceptance by the various users listed above, and the fact that RESRAD addresses the burial issue by allowing for evaluation of a cover over the contamination, with the capability to input appropriate parameters for density, precipitation rate, erosion rate, and other pertinent parameters, it is reasonable to conclude that the manner in which RESRAD is used in the BSFR program is consistent with the verification, validation, and benchmarking it has received.

P. When does Tennessee plan to increase the 1 mrem measurement? What will the max be? When will other landfills in TN start taking BSFR materials?

P. We do not plan to increase the one millirem dose limit.

Q. Are people in sensitive populations protected?

Q. Yes, 1 millirem/year is very protective. For comparison, consider the following allowable doses for various classes of radiation workers and members of the public. These standards have been set by the Nuclear Regulatory Commission and are applied by all Agreement States. They are considered to be fully protective of human health.

- individual members of the public - 100 millirems per year*
- embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman - 500 millirems*
- occupational dose limit for minors - 500 millirems per year*
- occupational dose to adults - 5,000 millirems per year*

R. In 1972, a Canadian scientist Dr. Abram Petkau found in his research that the destructive efficiency of low-level radiation causes low-level exposure to result in damage to cells that is 1000 times worse than the damage caused by the same amount of radiation concentrated in a high level burst. From this discovery came

what scientists call “the Petkau effect”: that the amount of damage done by low-level exposure is dependent on the length of time living tissue spends in the radiation field, not on the relative radiation field strength. Does this fact not damage TDEC’s model of the future farmer in Rutherford County living on Mt. Trashmore?

S. TDEC would have us believe that naturally occurring radiation is all around us, and therefore it is safe. This is contradictory to what the National Academy of Sciences says in the BEIR VII report (2006) about the effects of ionizing (low-level) radiation: A comprehensive review of the biology data led the committee to conclude that the risk would continue in a linear fashion at lower doses without a threshold and that the smallest dose has the potential to cause a small increase in risk to humans. Should SWAC accept the authority of the BEIR VII report, authored and reviewed by many of the nation’s most distinguished scientists, who examine all available data objectively before reaching a conclusion, or of TDEC’s hired scientists, whose jobs are at stake?

S - T. These comments appear to be intended to convey either that TDEC is out of the mainstream of scientific opinion or that there is a lack of scientific consensus on the effects of radiation. Neither is accurate. The Division of Radiological Health is in general agreement with the findings in the report known as BIER VII. That report is the primary basis for the statement made in the presentation to the Committee on July 5 that the cancer risk of a 1 millirem exposure is one in a million. DRH is also in agreement with the concept of the Linear-No-Threshold theory, which has been used for many years for developing radiation standards and risk analysis. That is part of the reason why the division does not maintain that there is zero cancer risk associated with the 1 millirem level, but rather a one in a million cancer risk.

It is important to remember that “low level exposure” (low dose) does not have a specific definition. For example BEIR VII indicates that the report considers low doses to extend from “near zero to 10,000 mrem”. So “low level exposure” or low dose always has to be determined when making comparisons. Our research did not turn up information referred to in the statement that “...the destructive efficiency of low-level radiation causes low-level exposure to result in damage to cells that is 1000 times worse than the damage caused by the same amount of radiation concentrated in a high level burst.”

Dr. Petkau’s research, while not always referred to as the “Petkau Effect” has been reviewed by the National Research council of the National Academies in their reports on the health effects of exposure to low levels of ionizing radiation in their series of reports commonly referred to as the BEIR (Biological Effects of Ionizing Radiation) reports. Particularly BEIR III (1980), BEIR V (1990) and BEIR VII (2006). It is important to remember that “low dose” dose not have a specific definition. For example BEIR VII indicates that it looks at doses from “near zero to 10,000 mrem”. Dr. Patkau, in his initial research looked at calculated doses to a cell membrane (which by the way was not a real cell membrane but one designed for his experiment from Teflon and Lucite, (which formed the cell), and from a CHCL3:CH3OH:n-tetradecane solution of a phospholipids

fraction in 0.1 M NaCl (which formed the membrane)), of 700 mrad (700 mrem) delivered at a rate of 1 mrad/min (1 mrem/min). He compared his calculated dose to research results from a previous study where 3,500,000 mrad delivered at a rate of 26,000 mrad/min.

Additional Information from BEIR VII:

Page 43:

The maximal permissible levels that are recommended in the United States by the National Council on Radiation Protection and Measurements (NCRP) for people exposed to radiation other than background radiation and from medical applications are 1 mSv (100 mrem) per year for the general population and 50 mSv (5000 mrem) per year for radiation workers employed by nuclear-related industries (Federal Register 1987). Considering the levels of background radiation, the maximal permissible levels of exposure of radiation workers now in effect, and the fact that much of the epidemiology of low-dose exposures includes people who in the past have received up to 500 mSv (50,000 mrem), the BEIR VII committee has focused on evaluating radiation effects in the low-dose range <100 mGy ($<10,000$ mrem), with emphasis on the lowest doses where relevant data are available. Effects that may occur as the radiation is delivered chronically over several months to a lifetime are thought to be most relevant.

Page 29:

Although DNA is deemed the most important target for biological damage that leads to health effects, other sites—such as the nuclear membrane, the DNA-membrane complex, and the outer cell membrane—may also be important for some biological effects. Signal transduction from cell membrane phospholipids damaged by free radicals and oxidizing reactions is an important natural process. This is one set of biochemical pathways by which the effects of ionizing radiation may overlap with the effects of endogenous processes, such as macrophage oxidative bursts. These processes may underlie those seen in irradiated cells that have been characterized as “bystander effects” and “adaptation” (see [Chapter 2](#)).

Page 63 (the Summary of Chapter 2):

A bystander effect in which an irradiated cell induces a biological response in a neighboring unirradiated cell has been observed with high-LET radiation for inducing cell lethality, chromosome aberrations, sister-chromatid exchanges, mutations, genomic instability, signal transduction pathways, and in vitro transformation. There is some evidence that long-lived reactive oxygen species or the diffusion of cytokines plays a role in the bystander effect. For low-LET radiation, the bystander effect has been limited to cell lethality and lethal mutations associated with reduced cloning efficiency. Recent results suggest that a bystander effect for cell lethality from soft X-ray irradiation might be observed down to 50 mGy (5,000 mrem) but not below. Until molecular mechanisms of the bystander effect are elucidated, especially as related to an intact organism, and

until reproducible bystander effects are observed for low-LET radiation in the dose range of 1–5 mGy (100 – 500 mrem), where an average of about one electron track traverses the nucleus, a bystander effect of low-dose, low-LET radiation that might result in modification of the dose-response should not be assumed.

U. Radiation from all sources, natural or man-made, accumulates in a person's body throughout a lifetime. We live in an area of the country where levels of radon gas are very high. Thus, we are already at risk for cancer from the radiation we take in from natural sources and from medical procedures. Why contribute further to the public's exposure to radiation by dumping manmade radioactive materials in our landfills?

U. From the commenter's statement it is difficult to determine if she or he is meaning that the actual radioactive atoms accumulate in the body from inhalation and ingestion or that the risk accumulates over a person's lifetime.

Regarding the concept that radioactive atoms from inhalation and ingestion accumulate in the body, this statement is true for only some of the radionuclides, both man-made and naturally occurring. Two concepts, one physical (radioactive) and one biological, determine how long a radionuclide stays within a person after an uptake. The physical half-life is the time in which half the atoms of a particular radionuclide disintegrate, while the biological half-life is the time taken by the body to eliminate half of the material taken in by natural biological means. The biological half-life is not unique to radiation in that it applies to the stable form of a material as well as the radioactive form.

To determine how long a radionuclide remains in the body an effective half-life has to be determined. This effective half-life takes into account both the physical and biological rates of elimination. The equation for determining the effective half-life is:

$$T_{eff} = \frac{(T_{1/2})(T_b)}{T_{1/2} + T_b}$$

Where:

T_{eff} = the effective half-life;
 $T_{1/2}$ = the physical half-life; and
 T_b = the biological half-life

The effective half-life will always be equal to or less than the lower of the physical or biological half-lives.

Examples of physical, biological and effective half-lives are:

Radionuclide	Physical Half-life	Biological Half-life	Effective Half-life
Tritium	4,500 days	12 days	12 days

Carbon-14	2,100,000 days	40 days	40 days
Phosphorus-32	14.3 days	1,155 days	14.1 days
Strontium-90	11,000 days	18,000 days	6,800 days
Plutonium-239	8,800,000 days	73,000 days	72,000 days

While Strontium-90 and Plutonium-239 would effectively accumulate in a person's body, Tritium, Carbon-14 and Phosphorus-32 would be eliminated rather quickly.

Another factor that has to be considered is the amount of the radionuclides ingested. For instance if you had an uptake of 10,000 atoms of Tritium it would all be gone from your body in 159 days (or 13.2 effective half-lives). Being removed from the body at approximately 63 atoms (disintegrations) every day.

An uptake of 10,000 atoms of Plutonium-239 on the other hand would essentially be gone in 950,400 days. Being removed from the body at approximately 1 atom (disintegration) every 95 days.

If the commenter is referring to the accumulation of risk then they are correct that the risk is accumulative. A risk of 1 in 1,000,000 chances of cancer incidence, from 1 mrem of exposure per year, would add up to 30 in one million chances after 30 years of exposure, or 1 chance in 300,000. It should be noted here from the risk standpoint a person living in Denver Colorado is exposed to 30 millirem per year more than someone living in Nashville. Meaning that the person in Colorado is "accumulating" the same risk in 1 year that a person living on the Middle Point landfill would accumulate in 30 years. After 30 years the individual in Colorado would have a 1 in 1,100 chance of cancer incidence.

V. Radiation accumulates in the landfill / Doesn't go away for 5 half lives

V. The RESRAD computer model used in the BSFR program analyzes the doses for 1000 years in the future and takes into account the half-life of each radionuclide.

W. Economics should not be considered when people's health and maybe lives are at stake

W. The level of 1 millirem that was set in the BSFR process as the maximum exposure and is used in the RESRAD model was not set on the basis of economics. It was set on the basis of assessing risk. Risk assessments are fundamental in the development of radiation protection standards. They are the basis for the regulation of radiation and numerous other potentially harmful agents to which we are exposed in our daily lives.

X. Experts have thought many things were safe in the past and learned differently later

X. Many of the examples to which such statements refer are based on situations in which the people working in the field did not have much information and, as they obtained more information, they changed their views based upon evidence. More is known at this point in time about the health effects of radiation than was the case in regard to chemicals that

these commenters may have in mind. There have been many studies of large populations exposed to radiation that have been followed over many years. TDEC is committed to making decisions based on scientific methods and available credible evidence.

Y. Fundamentally we do not know why radiation behaves as it does.

Y. “Why” questions about the natural world are notoriously difficult to answer. However, we do know a great deal about the “what” questions, the nature of radioactivity and its effects, as stated elsewhere in this document.

Z. In the absence of proof that the BSFR material will never cause any harm, it should be banned. The BSFR material should be banned based upon the precautionary principle. Any radioactivity in the location of the landfill is unacceptable.

Z. The precautionary principle has many formulations. The Rio Declaration, signed in 1992 at the UN Conference on Environment and Development by representatives of 178 nations, states, “Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.” We believe the actions of the department in regard to the disposal of BSFR material in Tennessee landfills are consistent with that principle. In this case, both the potential risk posed by the BSFR materials and the scientific uncertainty are low. The regulatory requirements on the processors and on the landfill operator are cost-effective measures to prevent environmental degradation that are reasonable means of addressing the risks posed by radioactive materials, despite the level of uncertainty about the precise level of harm of materials with very low levels of radioactivity. This includes the fact that the 1 millirem/year exposure standard is more protective than the standard that would be applied by the NRC.

Comments related to the level of risk associated with the BSFR material being disposed at the Middle Point landfill

AA. This endangers drinking water for Murfreesboro

BB. Murfreesboro water plant uses coagulation. That does not remove all radionuclides.

CC. Shouldn’t different standards apply when a water supply is within feet of the landfill.

DD. Middle Point landfill is located just feet away from the Stones River, which provides the main source of drinking water for Rutherford County and which empties into Percy Priest Lake, also a major source of drinking water.

AA – DD. In many of the comments, as well as media reports, there has been a lack of clarity about where the Middle Point landfill is relative to the Murfreesboro water intake.

The landfill is approximately .6 miles downstream of the main intake point, not upstream. There is an auxiliary intake that is approximately 8.7 miles downstream of the landfill, in the East Fork Stones River where it is part of Percy Priest Lake. The city has been monitoring the water near the Walter Hill dam about 1.3 miles downstream from the landfill for about 15 years and has never detected any contaminants at a level anywhere near a level of concern.

Discharge of treated leachate from the Middle Point landfill is piped to the Murfreesboro wastewater treatment plant for further treatment, and is not sent to the water treatment plant. The water plant uses lime softening which does remove some but not all radionuclides. However, the tests done by Murfreesboro of the raw water at Walter Hill dam do not indicate the need for any removal of radionuclides.

TDEC continues to enforce Safe Drinking Water Regulations per EPA guidelines to ensure that the public water supply is not impacted by point and non-point sources of bacteriological agents, toxic chemicals, carcinogens, and radioactive materials above regulatory limits. No evidence whatsoever of any impact, from the presence of BSFR material in Middle Point Landfill, on either the raw water supply or finished drinking water for Murfreesboro has been observed.

EE. Any radioactivity near Murfreesboro's water source is not acceptable

EE. If that were the standard, not only would all solid waste be banned from the Middle Point landfill, but we would also have to ban the use of fertilizers in river/stream-bottom agriculture. Also, nuclear power plants, coal-fired power plants, other coal-fired boilers and other industrial sources of both natural and man-made radioactivity are located on water sources. Many potential hazards to water supplies are located or operated in close proximity to water sources. Examples include marinas with fuel supplies, watercraft powered by gasoline, diesel, and batteries, intensive livestock operations, etc.

Questions related to out-of state waste coming to Tennessee

FF. Why should Tennessee import low-level radioactive waste from throughout the USA? If it is safe, why is it necessary to ship it across country to us?

GG. TDEC has stated that it is common practice for other states to accept LLRW into municipal landfills. Why then is concrete and soil not deposited somewhere along the way between here and California, or Washington state, or Michigan or Connecticut? Are there no states willing to take it?

HH. Why is this waste being trucked long distances to TN

FF – HH. The BSFR program is attractive to facilities in other states where the evaluation of requests for disposal approval continues to be performed on a case-by-case basis. Reviews of such requests often require exceedingly long periods of time, and the predictability of regulatory requirements are sometimes lacking. Even though

Tennessee's program has more protective standards than what would apply in many other jurisdictions, the timeliness and predictability can cause facilities to choose it.

Four (4) companies are licensed by TDEC/DRH to conduct BSFR activities. These companies grew out of the low-level radioactive waste processing industry, which chose to concentrate in Tennessee for a number of business and economic reasons.

In 1980, the U. S. Congress passed the Low-Level Waste Policy Act, which allowed the States to form compacts to facilitate the siting of regional low-level radioactive waste disposal facilities. In 1983, Tennessee joined the Southeast Compact, which included the State of South Carolina and its existing, licensed, low-level radioactive waste disposal site located at Barnwell, SC.

Barnwell was perhaps the most successful disposal site in the nation, and the circumstances seemed favorable to replace Barnwell, whenever it might close, with another facility to be sited in North Carolina. The Compact structure allowed for the importation of low-level radioactive waste from unsited states and compacts. Prospects looked good for the Southeast Compact.

Several factors helped create favorable business and economic conditions for the development of a waste processing industry based in Tennessee, including:

- Most of the nuclear electric utility industry is located in the eastern half of the United States.*
- Tennessee is centrally located in the eastern U. S., and had unfettered access to the Barnwell site.*
- The disposal pricing structure used by Barnwell was based primarily on the volume of waste to be disposed.*

The business plan for this industry was to process low-level radioactive wastes to achieve volume reduction and to put the waste materials into more stable forms for disposal at Barnwell. These businesses grew, and soon much of the low-level waste going to Barnwell was being volume-reduced in Tennessee first.

Predictably, this led to reduced revenues for Barnwell. A new pricing structure, based less on volume and more on radioactive content, soon followed. Since that time, it has been a sparring match between waste processors and the licensed low-level waste disposal sites, both competing for business in a tightening market, as low-level waste generators took actions themselves to reduce their own waste generation.

The BSFR program had its beginning in efforts by the low-level waste processing licensees to find safe and cost-effective alternatives for disposing of some bulky wastes, containing extremely low levels of radioactive material, generated in the conduct of their own licensed activities. Tennessee DRH began receiving requests to utilize a rule, which is in place in the regulations of the NRC, DRH, and most of the NRC-Agreement States, which authorizes the granting of license approvals for alternative disposal procedures.

Once criteria for safe disposal were developed, a number of the waste processing licensees began to submit license applications for authorization to analyze and dispose of similar wastes from other licensees.

At first these requests were evaluated on a case-by-case basis. That is typically how it still is done by other States and the NRC, however, it is not an efficient process. Long delays in other States and with the NRC are the norm.

When a backlog of unreviewed requests began to mount, DRH moved to develop the framework for a structured regulatory review process, which has evolved into what has come to be known as the BSFR program.

Today, Tennessee has an efficient and well-regulated program for disposing of waste materials containing extremely low levels of radioactive materials. There exist an established regulatory framework, criteria for waste acceptance, and a program for evaluating candidate wastes to assure they meet the criteria. The program has proven to be a popular means of disposal for those wastes that can meet its very strict criteria, which are fully protective of human health and the environment.

II. Do you know why California made it illegal to dispose of Low Level Radioactive Waste in landfills?

II. That is not an accurate statement of what California did. In 2002, after the Governor vetoed a bill that had a broad scope, he signed an executive order that was much narrower. Executive Order D-62-02 directed that a moratorium be put in place “on the disposal of decommissioned materials into Class III landfills and unclassified waste management units”. This moratorium does not apply to Class I or II landfills and does not apply to materials that are generated from the ongoing operation of licensed facilities. We do not understand the reasoning for what California did, although the Governor did make a statement about why he vetoed the broader bill.

Comments urging continuation of the Middle Point moratorium or a statewide ban.

JJ. The moratorium should be continued.

KK. Tennessee should ban disposal of BSFR waste like other states have

LL. 16 other states have banned disposal of radioactive waste. TN should, too, and not be their dumping ground.

MM. Since TDEC says other states landfill this waste, TDEC should say which states do and identify the landfills.

NN. If other states are disposing of this material, which ones, how much, etc.

OO. The disposal of BSFR waste should be stopped

JJ – OO. Neither the present moratorium nor a ban on BSFR waste going into landfills has the effect of stopping all radioactive waste. As was stated above, there are many other waste streams that have as much or more radioactivity.

The Nuclear Regulatory Commission and those states that are Agreement States regulate the possession and use of radioactive materials. In order for a state to become and maintain its status as an Agreement State, that state must meet compatibility requirements which include certain basic standards and regulations. Some of these standards include dose to a member of the public, effluent release standards, and disposal requirements. All operating facilities that utilize radioactive materials may release materials under certain criteria.

The NRC and most Agreement States have regulations providing for alternative methods of disposal. The NRC has approved the disposal of slightly radioactive materials at landfills in Michigan, Vermont, and New York. Other states which have regulations similar to Tennessee's rule allowing alternative means of disposal (1200-2-5-.121) and the NRC's are: Alabama, Arizona, Iowa, Arkansas, Colorado, Florida, Illinois, Iowa, Louisiana, Maine, Massachusetts, Minnesota, Mississippi, Nebraska, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Utah, Washington, and Wisconsin. This is not to imply that all of these have a program like the BSFR program, just that they have regulations that allow at least for the disposal of slightly radioactive materials through a petitioning process.

There are decommissioning standards (license termination rules) which the NRC has promulgated, and which Agreement States must adopt, which allow residual radioactivity, distinguishable from background, to remain in place at the site that does not result in a dose exceeding 25 millirems per year.

Other states can allow disposal on a case-by-case basis with specific licensing actions. Each state would need to be queried to determine specific amounts.

Comments expressing distrust of the generators or processors of BSFR material

PP. Processors are making money and therefore are untrustworthy

QQ. More radioactive waste may be buried within a container of less radioactive waste to escape detection when measurements are only take outside of container.

RR. State should require all waste in a container to be same type.

PP. – RR. TDEC expects that the various people and entities it regulates are honest and will comply with the law, but is ready to enforce the laws it administers if they are not. It is a given in all environmental regulatory programs that the regulations are applied to all people, governments, corporations, and other entities. Many of these are in business

to make money. Others, such as local governments, utilities, and state agencies have limited resources and are charged with making appropriate decisions with taxpayer or ratepayer funds. A common element of regulatory programs is self-monitoring and either keeping or submitting records of monitoring results. There are penalties, including criminal ones, for falsifying such information. TDEC has referred a number of such cases to District Attorneys and U.S. Attorneys over a number of years and staff have testified in some proceedings which went to trial, rather than resulted in guilty pleas. TDEC staff have also revoked licenses of operators of water and waste water plants who falsified information or were negligent in their duties.

A generator or processor trying to dispose of wastes that exceed the limits established under the BSFR program would be taking a significant risk. Measurements are not taken only on the outside of the container. Materials are also sampled and analyzed for concentrations of radioactive material to assure compliance with license requirements. The BSFR program requires waste in a container to be within certain density ranges, in accordance with federal guidelines. Successfully hiding the disposal history of waste that is subject to accountability under at least two different radioactive material licenses would be challenging. The difficulties associated with intentionally circumventing the controls that are in place relative to BSFR disposal would be formidable.

Other Comments

SS. Why aren't these materials dumped in all landfills if they are safe? Why only a handful of landfills receiving these wastes?

SS. The five landfills that accept BSFR wastes are all Class I landfills which are designed to accept various type wastes. All landfills are not the same. DRH has only given approval for these five landfills to accept this waste.

TT. When does the EPA step in and investigate water supply and public safety?

TT. EPA has authority to investigate any matters that come to its attention that are within its jurisdiction. The Regional Administrator of the EPA Region IV (the southeastern US) sent a letter to Congressman Gordon on June 12, 2007 that explained the actions that have been taken in regard to the BSFR waste going to the Middle Point landfill and certain issues regarding the landfill, and concluded saying, "we believe TDEC is taking appropriate steps to address residents' concerns regarding the landfill and we stand ready to assist if needed."

UU. When has the NRC physically inspected Middlepoint? What were the results of inspection?

UU. The Nuclear Regulatory Commission has no regulatory authority at Middle Point and has not inspected the facility. Middle Point is not licensed either by the NRC or by DRH.

VV. Are costs of treating people with cancer / other health impacts considered?

VV. Because it is the position of TDEC that the effects of this program will not be distinguishable from cancer rates without the program, such costs have not been considered.

WW. The meters used for publicity (recently on televised news reports and newspapers) do not measure the radioactivity below the surface of the landfill. Furthermore, the meters must be held within inches of the material being tested and for an extended period of time. We question whether this is how the testing is being done at the Tennessee landfills receiving radioactive waste?

XX. DRH staff admitted that the way they measured radioactivity at Middlepoint landfill was not the technically proper way to do it.

WW. – XX. During the July 17, 2007 meeting at Fleming Training Center, an individual expressed concern that the WSMV I-team news presentation which showed a DRH staff member holding a radiation survey instrument in the air where the camera could see it was not representative of a proper survey technique (holding the instrument in the air). The staff member explained that many radiation measurements were made and that only a few seconds of filmed footage were chosen to be aired on the news. He further explained that the surveys performed were at the request of the attending media to perform ambient background surveys, and noted to the media present that it was not the intent of the survey efforts to be reflective of the concentration of radioactive material in the landfill. That explanation was aired in the same newscast.

YY. Although the MCL for radionuclides is 4mg/l, the MCLG is zero. Why are we not aiming for the goal?

YY. MCLGs (Maximum Concentration Level Goals) are non-enforceable public health goals that apply to drinking water. Many chemicals have MCLGs of zero, but the enforceable limits set in regulations are MCLs (Maximum Concentration Levels) for drinking water, which are set at higher levels. If the commenter is suggesting a comparison of leachate to drinking water, they are not comparable.

ZZ. Have BSFR wastes gone to Dickson County landfill?

ZZ. No TDEC licensee has ever been authorized to send BSFR material to any landfill other than the five landfills previously identified, which do not include the Dickson County landfill.

AAA. No landfill that exceeds EPA standards for gross alpha or gross beta should be allowed to receive BSFR material.

AAA. There is no EPA standard for gross alpha or gross beta for landfills or leachate from a landfill. Drinking water standards are not applicable to leachate.

BBB. Have standards been loosened in recent years?

BBB. No.

CCC. One of the “special waste” items that BSFR tells us is being placed in municipal landfills is called “ash.” Is this ash the residue from incinerating radioactive materials in Oak Ridge? Is this ash from Oak Ridge being buried at Middle Point? At other municipal landfills in Tennessee?

CCC. Materials that meet the isotopic limitations specified in the license can be disposed of as BSFR waste. Such materials could include ash. BSFR materials could originate from licensees located in Oak Ridge and the surrounding areas.

A number of comments were received that are summarized below that were largely supportive of the BSFR program as currently operating. We do not think it is necessary to respond to these.

Standards are scientifically based

TDEC does oversee and enforce

BSFR material is not a problem / not significantly different from C&D waste

Disposal of BSFR materials in landfill is safe

Disposal of BSFR materials in landfill saves space in LLRW landfills for what needs to go there

Although assumption is no safe level / linear threshold, some risks are tiny / not demonstrable

Unlike some issues where health effects were not known, this is an issue that has been studied for a long time now.

Would like to see assessment of radioactivity of phosphate, oil pipe residuals, dirt, Chattanooga shale

Would like to see comparison with EPA’s safe level for radon

TN has one of best rad health programs in the state. Exposures from dental machines are 50% of national level.

Medical procedures and radon are two areas where there are important issues of people being exposed to radiation.

BSFR should not go to landfills designed to take radioactive waste because the BSFR material is so low in radioactivity it would be a waste of those facilities.

TN BSFR program is not backwards or out of control. It is a model. Japanese came here to study it for adoption there.

Potassium has natural radiation. A truck of 10-10-10 fertilizer would not pass BSFR standards.

A single smoke detector has the level of radiation that BSFR allows for a truckload.

If Tennessee ends program, licensees will be able to dispose at the federally allowed level which is 5 times higher.

II. Issues regarding the regulation of the Middle Point Landfill, the special waste approval process, and the regulation of landfills generally. Although most of this section is under the jurisdiction of the Division of Solid Waste Management, DRH and other divisions have also contributed to these responses.

Comments relating to Public Notification and Communication

A. At time of the recent request for permitting the expansion of the landfill, people were told that nothing but ordinary garbage would be disposed of in the landfill. People were lied to.

A. The description of wastes being accepted at the Middle Point landfill was spelled out in both the application and also in the draft permit (which was available for review at the local library), as well as appearing in the Daily News Journal public notice published on December 20, 2005. The description reads “... the waste materials to be accepted are domestic waste, commercial waste, institutional waste, municipal solid waste, construction and demolition waste, farming waste, shredded tires, dead animals and special waste with approval from the Division of Solid Waste Management”. During the public meeting held at the local school for that expansion, special wastes, including sludge from the Metro Nashville waste water treatment plant were specifically discussed, and questions were asked and answered. Although there might be disagreement about what was said, there should be no disagreement about things that were in writing at the time.

B. Why were people not informed when the special waste approval was given for BSFR or other special wastes? State needs to put forth greater effort to inform citizens about comment opportunities.

B. Special wastes are a subset of solid waste. Therefore they are appropriate for disposal in landfills and can be accepted at all class I landfills. The reason for the special waste approval process is so that the necessary special handling procedures may

be applied and the landfill can determine whether they wish to accept the waste with the special conditions or not. The numbers of special waste applications (up to 750 per year, statewide), coupled with the costs to publish each one (which can be several thousand dollars for each notice in a large metropolitan newspaper) and the increased time such notices would take, would make it extremely difficult, if not prohibitive, to handle a public notice process for all of them. The regulations governing landfills specifically state that special wastes may be received at all landfills, subject to the Division approval. The regulations are available online and were subject to public notice and hearing, when they were adopted.

Comments about the radioactivity sensor at the landfill gate

C. One reason TDEC has given us for the safety of Middle Point is the monitor placed at the gate of the landfill. Does a TDEC employee man that device, or is it manned by somebody employed by BFI? Who calibrates the monitor, and how often? Is this measuring done by BFI, a corporation with the reputation of being one of the worst polluters in the country?

D. Who does monitoring at the landfill? Does TDEC staff do it?

C-D. Solid Waste Management staff inspects the landfill for various components. As the questions relate to who operates the scales and the radiation detectors at the landfill, the answer is the landfill staff.

E. We can think of many ways to fool such a monitoring device. The load of radioactive material is hauled in a truck with a metal body. This would block an accurate measurement, especially if it is lined with lead. How the material is placed in the truck, nearer to or further from the monitor, would determine how accurate the reading is. The speed of the truck through the monitoring area would affect the reading. Does TDEC ever physically inspect the trucks?

F. Would manner of placement of hotter waste within a load tend to shield it from the meters at the scales? Would the construction of the truck? The speed of the truck?

E-F. This comment seems to imply that the radiation monitors at the scales are the only “check” to make sure that the waste meets the concentration criteria. That determination is made by the licensed processor before the material is ever sent to the landfill. The landfill’s monitors are a “double check” to make sure that the materials meet the landfill’s waste acceptance criteria.

Comments about the various wastes accepted at the landfill

G. About 150 kinds of special waste going to landfill. Concern about all of them.

G. There are approximately 170 special waste approvals for the Middle Point landfill. However, that does not mean that there are as many different waste streams. For example, if more than one generator ships the same material to Middle Point, there will be a separate Special Waste approval for each generator of the same stream. An example of this would be slag from aluminum processors across middle Tennessee. The special waste approval process requires that a narrative and analytical data be submitted, describing the waste materials and how they are generated. It should be noted that some special waste approval requests are denied, and the wastes must then go to a hazardous waste management facility or other appropriate disposal/processing facility. Also some approvals are for one-time events rather than an ongoing waste stream.

H. Please provide TCA giving permission to landfill such wastes and regulations governing implementation of law.

H. The authority is granted under TCA Sections 68-211-102, 68-211-104, 68-211-105, 68-211-106 and 68-211-107 (can be found online at: <http://michie.lexisnexis.com/tennessee/lpext.dll?f=templates&fn=main-h.htm&cp=>), and the regulations pertaining to special waste approval process are found at Tennessee Rule 1200-1-11-.01(4). The Tennessee Solid Waste Management regulations are also available online at: <http://www.state.tn.us/sos/rules/1200/1200-01/1200-01-07.pdf>

I. Is Middle Point accepting medical waste, biohazards, hazardous or toxic wastes, or tires?

I. Although this question is beyond the scope of the Solid Waste Advisory Committee's present task, it is a good question and shall be responded to here for informational purposes. All of Tennessee's Class I landfills receive a certain amount of medical wastes, mostly untreated medical wastes directly from the citizen's households (e.g., soiled bandages, diapers, used insulin syringes, etc.), but also receive some treated from medical waste processors, who receive and manage medical wastes from doctors offices, clinics and hospitals. The only listed hazardous wastes that Tennessee allows into Class I landfills is household hazardous waste – in short, those materials (such as mercury thermometers, cell phone batteries, discarded pharmaceuticals, etc.), which people toss into their household trash. Whole tires have been prohibited from land disposal for a number of years because they can work up to the surface of the landfill over time. You may have noticed a stockpile of tires on the Middle Point property during the past few months. These tires were being ground up into chips: the steel from the chips was being recovered, and the chips then used in the drainage layer. This activity is an example of a waste that is being beneficially reused.

J. Concerned about risks of exposure to combined radioactive and hazardous pollutants being worse than each exposure alone. The RESRAD model does not account for this.

K. Dan Hirsch, President of the Committee to Bridge the Gap, a Los Angeles-based public policy organization focused on nuclear questions, and he is the former Director of the Stevenson Program on Nuclear Policy at the University of California, Santa Cruz, offers very good reasons why the BSFR practice--of using municipal landfills to store radioactive materials—should be ended:

There are many reasons for the general practice of putting radioactive waste in radioactive waste facilities and regular garbage in regular landfills: municipal landfills are not required to meet the siting, design, monitoring or operational requirements of licensed radioactive waste disposal facilities. . . . To give just two examples of reasons why: (1) The safety of disposal of radioactive materials is strongly influenced by the capacity of soil to retard migration of specific radionuclides. *Municipal garbage contains large amounts of organic complexing compounds that can dramatically increase the migration rates for radionuclides.* (2) Licensed radioactive waste disposal sites are required to conduct fairly extensive monitoring for radioactivity. Municipal landfills are not.

J – K. We are not aware of any credible research or scientific literature indicating a synergistic effect from exposure to a combination of radioactivity and chemical agents. The chemicals that TDEC and EPA require landfills to monitor for are ones that are likely to be in the leading edge of any ground water plume for characteristics such as solubility. The radioactive components of BSFR waste do not have those characteristics.

The United Nations Scientific Committee on the Effects of Ionizing Radiation paper on SOURCES AND EFFECTS OF IONIZING RADIATION, UNSCEAR 2000 REPORT Vol. II, looks into this in some detail. The report states "Combined exposures to radiation and other physical, chemical or biological agents in the environment are a characteristic of life. The characteristics and effects of combined exposures are reviewed in Annex H, Combined effects of radiation and other agents". Although both synergistic and antagonistic combined effects are common at high exposures, there is no firm evidence for large deviations from additivity at controlled occupational or environmental exposures. This holds for mechanistic considerations, animal studies and epidemiology-based assessments. Therefore, in spite of the potential importance of combined effects, results from assessments of the effects of single agents on human health are generally deemed applicable to exposure situations involving multiple agents." Also, conservatism used by TDEC in the input parameters for the modeling and in the other limits of the program would make any effects unlikely to have a significant impact on the 1 millirem per year dose.

L. Has waste containing radium disposed of at the landfill?

L. Yes, for waste that went through the BSFR licensees, it would be within the concentration limits approved in the BSFR process. It is important to note also that radium occurs naturally in soil, rocks, and groundwater in Tennessee. Therefore, the soils existing at the site or brought in from other areas to be used as cover on the landfill will likely contain radium. Tons of non-BSFR material such as construction debris (concrete and bricks) will often contain significant concentrations of radium.

M. Smells from the landfill are bad

M. Odors coming from the landfill have been a recognized problem. These odors have been reduced as the landfill gas extraction system has been improved. Also, the odors have declined since the Division issued an Order restricting the acceptance of sludge from wastewater treatment plants in Davidson County. While it is unrealistic to think that all the odors will be eliminated, we hope to minimize them as much as possible.

N. How can we be sure of what is disposed of in the landfill?

N. Records are kept and provided to the Department. Both the Divisions of Radiological Health and Solid Waste Management inspect their respective licensee/permittee. TDEC's records regarding these inspections are open and available to the public

Comments about the operation at Middle Point and SWM oversight of it

O. There were questions about the number of violations discovered during Landfill inspections and how many Notices of Violation were issued. Poor operation by BFI / turnover of staff. TDEC needs to “tighten up” oversight of operation.

O. The Division currently conducts both routine and surprise inspections at the facility, as well as investigating citizen's complaints, issuing citations and pursuing enforcement where necessary. Between June of 1998 and March of this year, there were 139 compliance-related inspections made at the Middle Point landfill. This does not include routine construction inspections made for the purpose of verifying that the appropriate QA/QC measures were being followed during construction of expansions and modification at the facility. During the same time frame, at least two NOVs were issued and one of those had to be followed up with a compliance review meeting. The State has no control over personnel turnover at the landfill, but BFI must comply with its permit and the regulations in any event. The Division of Solid Waste Management also issued three enforcement Orders to Allied during that time frame. The civil penalties assessed in these Orders exceeded \$100,000.

Q. TDEC has forgiven violations by BFI including recently adding garbage to closed area without a synthetic liner and a recent spill from valve.

Q. The Division of Solid Waste Management did authorize additional disposal of waste in the area of the landfill that has only a clay liner. This was done because the area had subsided since it was closed in the 1990s resulting in a sagging profile. This is an undesirable situation in that it causes the pooling of runoff and additional infiltration and increases the amount of leachate generated. The Division is continuing to investigate the recent release from the valve and leachate collection line to see if further enforcement is warranted.

R. TDEC doesn't have resources it needs for proper oversight.

R. *TDEC strives to do the best job it can with the resources it has. The record of inspections done at the Middle Point landfill, 139 in 9 years, reflects an appropriate level of oversight.*

Comments about the liner

S. Understand no liner in Section 1 of landfill / oldest part.

S. *This is incorrect. When the Middle Point landfill was originally permitted in late 1988, clay liners were required. The regulations were changed in 1993 to require that new cells at Class I landfills include a composite liner system, consisting of at least a 5 foot thick clay buffer, overlain by a recompacted clay liner of lower permeability, and a welded (and tested) flexible synthetic membrane liner (usually 60mil High Density Polyethylene). Above the composite liner is another level of high permeability material such as gravel in which a system of pipes is laid to collect leachate. The Middle Point landfill collects the leachate and treats it. The liner system beneath Section 1 is a clay liner only.*

T. Hole has been punched in liner. Have those leaks been repaired? Can they be repaired if they are buried under tons of garbage?

T. *During the installation of the landfill gas extraction system at the Middle Point landfill, eighteen holes were accidentally drilled through the HDPE component of the bottom liner by the contractor employed by the landfill. To correct this, with Division of Solid Waste Management approval, BFI overdrilled each of the locations, keeping the borehole open with a temporary steel casing, examined the damaged areas with downhole video cameras, and repaired punctures with a low-permeability mixture of neat cement and bentonite grout. These grout plugs extend from the bottom of the borehole up into the waste a minimum distance of ten feet.*

U. Plastic liner is only designed to last life of landfill plus 30 years – may not last that long.

U. *There is no technical publication which supports this assertion. State regulations mirror EPA regulations concerning this standard. Such HDPE landfill liner longevity data as is available, including data from both EPA technical publications and manufacturer's Material Safety and product data sheets indicates that the viable lifespan of HDPE landfill liner material is measured in terms of centuries, and not in decades. One evaluation concludes that if an HDPE membrane is properly designed, manufactured and installed, that "...it expected that an HDPE geomembrane in an MSW landfill should last for about 400 yr."*

Please see the following references for technical justification of this requirement:

Sources:

Envirocon Systems, Inc. Web Site, Frequently Asked Questions, address:
<http://www.enviroconsystems.com/faq.htm>

Peggs, Ian D., "Geomembrane Liner Durability: Contributing Factors and the Status Quo", 2003, I-Corp International, Inc., p. 20

Rowe, R. Kerry, "Geosynthetics and the Minimization of Contaminant Migration through Barrier Systems Beneath Solid Waste", 1998, Sixth International Conference on Geosynthetics, p. 52

V. Dime-sized hole in plastic liner can leak 3300 gallons of leachate per day.

V. It appears that the source document for this quote was an EPA publication which discussed the relative strengths and weaknesses of various liner construction materials. The ultimate point of that document was that the most effective (and environmentally protective) liner system is comprised of a composite, consisting of a combination of compacted low-permeability clay overlain by a welded (and tested) flexible membrane liner (usually a 60 mil High Density Polyethylene, (HDPE)). The state of Tennessee has required a composite liner system for all Class I landfill construction since 1993. The context of the "dime-sized hole" scenario equals 3300 gallons per day of leakage was used as an example of the amount of water that would be released if the flexible membrane liner was suspended in mid-air and had an infinite pool of water 1 foot deep on top of it. In reality, the flexible membrane liner rests on top of a 2 foot thick recompacted clay liner, which is itself on top of a low-permeability geologic buffer of at least 5 foot thickness. In short, the plastic liner lies on top of at least 7 feet of compacted (and tested) clay. For Tennessee's required composite liner system, under real world circumstances, a dime-sized hole (1 square centimeter) in the plastic liner would be expected to allow the transmission of 0.141gallons per day (that is 18 ounces, or 2 and 1/4 cups per day).

Sources:

American Society of Civil Engineers: "Design of Waste Containment Liner and Final Closure Systems", Seminar Manual, 1999, Tab 2

Giroud, J.P., and Bonaparte, R., "Leakage through Liners Constructed with Geomembranes", 1989

Comments about leachate

W. Leachate samples exceeded EPA standards for drinking water for gross alpha and beta.

W. Drinking water standards are those standards which are applicable at the tap in your kitchen, not at the leachate collection sump, which is where these samples were taken. Leachate is a waste water, not drinking water. It is instructive to note that milk, to which the EPA drinking water standards do not apply, routinely contains over 1300 pCi/liter of naturally-occurring Potassium 40 (K-40), exceeding the K-40 levels in the leachate samples collected by DRH staff in 7 of the 9 landfills tested.

X. Since manufacturers of exit signs claim that they do not dispose of wastes in a landfill, why is such illegal disposal happening (based on tritium)?

X. Tritium exit signs in facilities may have been placed facility many years ago, and the person replacing the sign or doing demolition or remodeling on a building (e.g., apartment building, dorm, old mall, etc.), may not be aware that the sign contains tritium. A single exit sign can contain as much as 25 curies (or 25 trillion picocuries) of tritium. There is enough tritium in a single exit sign to contaminate over 170 million gallons of leachate to the levels seen in the Middle Point leachate. Middle Point generates and average of around 2.2 million gallons of leachate per month, which means that the disposal of a single exit sign could create the same levels of tritium as measured in Middle Point’s leachate for a period of 6 years and 5 months.

Y. Is BFI/Allied Waste taking the leachate samples? Where are they being taken? At how many sites? How often? What is being tested for? Are independent laboratories ever used to evaluate those samples? How frequently have these tests been performed over the last 10 years?

Z. Did Allied Waste personnel collect the leachate sample(s) recently? Why didn’t TDEC staff do it?

Y – Z. DRH staff collected leachate samples at the five landfills that accept BSFR wastes and at four “background” landfills. The “background” landfills were comparable Class I landfills that do NOT accept nor have they ever accepted BSFR wastes.

At a typical Class I landfill, leachate is collected as part of the regulatory monitoring program. According to the regulations, the permit holder is required to conduct this collection activity. The landfill may collect its own samples and typically employs a consulting company or private laboratory to do so.

AA. Comparison of leachate sample results from different landfills is apples and oranges. Only proper method is viewing samples from single facility over time.

AA. These samples were collected by DRH staff who routinely collect samples of various media throughout the state using the same methodology. The samples were analyzed by the Department of Health’s radiochemistry lab, which is certified by the EPA, using the same analytical methods. The purpose of comparing these samples of leachate was to compare leachate from landfills receiving BSFR waste to leachate from landfills that do not. For this purpose we think this is a valid comparison. We would agree that these samples would not be a valid basis for comparison if the purpose were to address the issue of potential exposure. However that was not the purpose. We would note that opponents of the BSFR program have compared these results to analysis of leachate from California without mentioning differences in analytical methods, which render the comparisons inappropriate.

BB. On the question of leachate tests, Dan Hirsch, President of the Committee to Bridge the Gap, a Los Angeles-based public policy organization focused on nuclear questions, and he is the former Director of the Stevenson Program on Nuclear Policy at the University of California, Santa Cruz, says, “Leachate from the Middle Point Landfill—one of those participating in the BSFR disposal program—

measured 3395 picoCuries of gross beta radioactivity per liter of leachate, with an error margin of +/-286. . . . The standard Maximum Concentration Limit (MCL) in drinking water is 50pCi/L. By contrast, of fifty landfills sampled in California several years ago, none had gross beta levels in leachate anywhere approaching those levels. 42 of the 50 landfills tested in California had gross beta levels below the MCL. The highest value found for any of the 50 landfills in California was 450 pCi/L, seven and a half times lower than the Middle Point Landfill leachate.

CC. One of the tests of Murfreesboro's drinking water has shown an elevated level of tritium, a radioactive isotope of hydrogen, which, if inhaled or ingested, is known to increase risk of cancer, birth defects, miscarriages and genetic abnormalities. According to the EPA website, "Its (tritium's) most significant use is as a component in the triggering mechanism in thermonuclear (fusion) weapons. Very large quantities of tritium are required for the maintenance of our nation's nuclear weapons capabilities."

DD. A letter from TDEC's laboratory in Lebanon to Murfreesboro's director of Water Quality Control states, "Note that the presence of tritium is becoming an issue of interest on the national level, thought to be due to the apparent disposal of tritium-containing self-luminous exit signs in municipal landfills, the leachate from which is commonly processed at waste water treatment plants." One of TDEC's scientists at the July 5 meeting also stated that these signs are a source of radioactivity. Can TDEC prove that these signs are responsible for the tritium in our drinking water?

EE. Because Exit signs contain the radioactive substance tritium, it is a violation of the rules of the Nuclear Regulatory Commission to dispose of them in landfills. We want to know, how many such Exit signs have been disposed of in Middle Point Landfill? If these signs are indeed the source of tritium in our drinking water, why are they being disposed of illegally? If they are not the source, then are we getting debris from the nation's nuclear arms production? Whatever the sources of tritium in Middle Point, we want its dumping to cease.

FF. Since manufactures of exit signs say do not dispose in landfill, why is such illegal disposal happening (based on tritium)?

GG. If the tritium is not from that source, is it from nuclear weapons?

HH. Leachate samples exceeded EPA standards for drinking water for gross alpha and beta.

II. No landfill that exceeds EPA standards for gross alpha or gross beta should be allowed to receive BSFR material.

JJ. Why are Tennessee landfills so much higher in radioactivity in leachate than California's, where most are below drinking water levels?

KK. One of the commenter indicated that the comparison of leachate sample results from different landfills is apples and oranges, and that the only proper method to compare sample results is viewing samples from a single facility over time.

BB – KK. To the best of our information, including conversation with Murfreesboro water system personnel, there has been no tritium detected in Murfreesboro drinking water. There was tritium detected in a sample of leachate collected from the landfill collection system.

Tritium exit signs in facilities may have been placed facility many years ago, and the person replacing the sign or doing demolition or remodeling on a building (e.g., apartment building, dorm, old mall, etc.), may not be aware that the sign contains tritium. A single exit sign can contain as much as 25 curies (or 25 trillion picocuries) of tritium. There is enough tritium in a single exit sign to contaminate over 170 million gallons of leachate to the levels seen in the Middle Point leachate. Middle Point generates and average of around 2.2 million gallons of leachate per month, which means that the disposal of a single exit sign could create the same levels of tritium as measured in Middle Point’s leachate for a period of 6 years and 5 months

The samples reported by TDEC were collected by DRH staff who routinely collect samples of various media throughout the state using the same methodology. The samples were analyzed by the Department of Health’s radiochemistry lab, which is certified by the EPA, using the same analytical methods.

We would note that opponents of the BSFR program have compared these results to analysis of leachate from California without mentioning differences in sample collection, analytical methods, or geographical variations, which render the comparisons inappropriate.

However, if comparisons to California are considered:

The comments, “Why are Tennessee landfills so much higher in radioactivity in leachate than California’s, where most are below drinking water levels” and, “Leachate from the Middle Point Landfill—one of those participating in the BSFR disposal program—measured 3395 picoCuries of gross beta radioactivity per liter of leachate, with an error margin of +/-286. . . . The standard Maximum Concentration Limit (MCL) in drinking water is 50pCi/L. By contrast, of fifty landfills sampled in California several years ago, none had gross beta levels in leachate anywhere approaching those levels. 42 of the 50 landfills tested in California had gross beta levels below the MCL. The highest value found for any of the 50 landfills in California was 450 pCi/L, seven and a half times lower than the Middle Point Landfill leachate. . . .”, require a closer look at the California data, which will show that these statements cannot truly be determined and in some cases are incorrect.

First, the state of California did not collect each of the samples and they were not all analyzed at the same lab. Each landfill, or waste management company, collected the samples, had them analyzed at a laboratory of their choice, and prepared the report they submitted to the California State Water Resources Control Board.

Second, some of California's samples for gross alpha-beta activity could not be performed by using EPA Method 900.0, the EPA standard for alpha analysis. These samples were analyzed for alpha activity using SMWW Method 7110 because EPA Method 900.0 lacked sensitivity. Another problem with some of the California data was a reduction in counting efficiency for gross alpha/beta-particle analysis that "...no longer permits an accurate assessment of sample activity...". It should also be noted that these problems increase the uncertainty, or error margin, mentioned by Mr. Hirsch as being a concern with the Tennessee results. The California data does not indicate error margins for comparison.

Third, gross beta numbers in the table appear to be averages and not maximum totals as Tennessee's were reported. For example the number quoted above by Mr. Hirsch for California's highest gross beta samples is not the maximum detected at the Bradley landfill. Several samples were taken with a range of concentrations between 187 and 940 pCi/L. For the Redwood landfill the reported number is 270 pCi/L with a reported range of 222 to 325 pCi/L. The reported numbers appear to be averages or medians. It is also unclear if gross beta numbers were adjusted by subtracting the naturally-occurring Potassium-40 activity. TDEC's gross beta numbers are NOT adjusted for Potassium-40 activity.

Information NOT discussed about the California landfill results includes that at least 3 tritium leachate samples exceeded 150,000 pCi/L. Tennessee's highest tritium leachate concentration is 45,966 pCi/L, 6.6 times LESS than California's highest reported limit (from direct leachate sampling) of 304,000 pCi/L.

Leachate could only be sampled from 26 of the landfills because the other landfills did not have a leachate collection system. The California draft report (that has never been finalized) notes that "Of the 26 lined landfills, the leachate in 16 exceeded drinking water MCLs for at least one radioactive measurement."

Comparing leachate numbers to EPA drinking water standards:

Leachate is not drinking water, and there are no EPA standards for gross alpha and gross beta in leachate. It is instructive to note that milk, to which the EPA drinking water standards do not apply, routinely contains over 1300 pCi/liter of naturally-occurring Potassium 40 (K-40), exceeding the K-40 levels in the leachate samples collected by DRH staff in 7 of the 9 landfills tested. Also, note that the EPA drinking water standards for gross alpha and gross beta are adjusted to compensate for naturally-occurring radioactive materials. The leachate samples have not been similarly adjusted.

Information specific to tritium levels in leachate:

Tritium occurs naturally in the environment in very low concentrations. Most tritium in the environment is in the form of tritiated water, which is easily distributed in the atmosphere, water bodies, soil, and rock.

In the 1950s and early 1960s, tritium was widely dispersed during the above-ground testing of nuclear weapons. The quantity of tritium in the environment peaked in 1963 and has been decreasing ever since. The elevated levels being found in landfills are not consistent with other environmental levels which have been observed.

There is no evidence, and it is considered highly unlikely, that any of the tritium in leachate in Tennessee landfills is from nuclear weapons activities, for the reasons which follow.

All landfills tested by the State had elevated levels of detectable tritium. Tritium has also been identified in landfill leachate throughout the United States and abroad.

A recent study of tritium in municipal solid waste leachate in New York and New Jersey looked into other leachate sampling from other locations (including California) and reported that "...the mean concentration of tritium in ten municipal solid waste landfills (in New York and New Jersey) was 33,800 pCi/L with a peak value of 192,000 pCi/L. A 2003 study in California reported a mean tritium concentration of 99,000 pCi/L with a peak value of 304, 000 pCi/L. Studies in Pennsylvania and the UK produced similar results." "In a study in the United Kingdom ... reported a mean and maximum level in tritium of 24,900 and 126,500 respectively." "Even more recent studies of 59 landfills in Pennsylvania were conducted by the Pennsylvania Department of Environmental Protection in 2004 and 2005. In 2004, they found mean and maximum levels of tritium in municipal solid waste leachate of 24,000 pCi/L and 93,500 pCi/L, respectively. Levels in 2005 were similar with a mean of 20, 900 pCi/L and a maximum of 182,000 pCi/L. The mean concentration from all these studies is 28,200 pCi/L."

Each of these studies attribute the tritium in landfill leachate to discarded tritium self-luminous exit signs that have been improperly disposed. Tritium exit signs are bought by contractors to put in buildings. The signs are labeled to indicate that they should be returned to the manufacturer for disposal. Apparently, however, this does not always happen. Over the years, the buildings are renovated or demolished, and through indifference or inattention to requirements, the signs are inappropriately disposed in the normal trash. This appears to be a nation-wide issue.

Tritium exit signs are possessed under a general license, which means a person is not required to show proof of licensure prior to possession. The "general license" does not have stringent receipt, possession, and disposal requirements, as do materials possessed under a "specific license", such as BSFR materials.

According to the NY/NJ study "The Product Stewardship Institute (PSI of the University of Massachusetts (2003) estimates that over two million exit signs have been registered in

the United States in the 20 year period between 1983 and 2002.” It is important to note that a single tritium exit sign typically contains several million-million picocuries of tritium, thus even a single sign can significantly elevate the tritium level in leachate.

It is also relevant to note that 20,000 picocuries/liter (pCi/l) is the EPA established maximum level for tritium in community water systems. DRH is not aware that tritium has been detected in Murfreesboro’s drinking water.

Comments about monitoring of ground water

LL. Monitoring wells too deep / not properly installed / Likely to miss contamination

LL. On November 4, 2005, the Division of Solid Waste Management made the determination that the Groundwater Monitoring program was sufficient to provide adequate monitoring of groundwater quality beneath the Middle Point landfill. The down-gradient monitoring wells are placed in soils over and in bedrock fractures. These wells communicate with deep groundwater in the fractures, and with shallow water in the soils over the bedrock.

MM. One monitoring well found hot for VOCs another had methane – what does that mean?

MM. Monitoring Well 3 (MW-3) has been influenced by leachate releases from the leachate lines twice. The leachate contained the VOCs that showed up in MW-3. There has been another incident recently in which MW-2 has detected some possible leachate. At this time we are investigating what the source of this is.

Any porous subsurface feature near a landfill is capable of collecting/transporting methane gas from the landfill. Monitoring wells penetrate the subsurface around landfills somewhat like methane gas wells penetrate waste in the landfill. This is why groundwater monitor wells can have methane in them.

NN. Landfill not required to monitor for radionuclides

NN. While Class I landfills are not required by SWM to monitor for radionuclides, those landfills which receive the BSFR waste have sensing devices at the entrance point and wastes are screened prior to disposal. The chemicals that TDEC and EPA require landfills to monitor for are ones that are likely to be in the leading edge of any ground water plume for characteristics such as solubility. The radioactive components of BSFR waste do not have those characteristics.

Comments regarding landfill gases

OO. There is another problem of toxicity that could come from burning methane at the landfill. I will quote from a web source on this:

When halogenated chemicals (chemicals containing halogens – typically chlorine, fluorine, or bromine) are combusted in the presence of hydrocarbons [such as methane], they can recombine into highly toxic compounds such as dioxins and furans, the most toxic chemicals ever studied. Burning at high temperatures doesn't solve the problem as dioxins are formed at low temperatures and can be formed as the gases are cooling down after the combustion process. www.energyjustice.net/lfg/

The only way to prevent this pollution is to remove toxic substances from methane before it is burnt. Is this being done at Middle Point?

OO. The composition of landfill gas is primarily methane and carbon dioxide. There are only trace amounts of volatile organics present. The actual composition of landfill gas is:

<i>Methane (CH₄)</i>	<i>45% to 58%</i>
<i>Carbon Dioxide (CO₂)</i>	<i>32% to 45%</i>
<i>Nitrogen (N₂)</i>	<i>0% to 3%</i>
<i>Hydrogen (H₂)</i>	<i>Trace to less than 1%</i>
<i>Carbon Monoxide (CO)</i>	<i>Trace (an indicator of possible subsurface fire)</i>
<i>Hydrogen Sulfide (H₂S) and other sulfur compounds</i>	<i>Varies (Normally 10-200ppm)</i>
<i>Moisture</i>	<i>Up to 14% (increases with gas temperature).</i>
<i>Volatile Organic Compounds (VOCs)</i>	<i>Typically 0.25% to 0.50%</i>

The Middle Point landfill landfill gas collection and control system is fully regulated by the Division of Air Pollution Control. A Title V Operating Permit (Permit Number 548535) was originally issued for this activity in May of 1999.

PP. If methane gas is burned or vented, will that release radioactivity?

PP.

Background Information about the regulation of air emissions from municipal solid waste landfills by EPA and the Division of Air Pollution Control

Municipal solid waste types potentially accepted by MSW landfills include: MSW, household hazardous waste, industrial non-hazardous waste, and construction and demolition wastes, and other non- hazardous wastes. Landfill gas is produced by microorganisms within the landfill under anaerobic conditions. As the waste decomposes, it breaks down to form landfill gases (LFG), such as methane, smog-causing volatile organic compounds (VOC) and some small amounts of air toxics.

The rate of emissions from a landfill is governed by gas production and transport mechanisms. Production mechanisms involve the production of the emission constituent in its vapor phase through vaporization, biological decomposition, or chemical reaction. Transport mechanisms involve the transportation of a volatile constituent in its vapor phase to the surface of the landfill, through the air boundary layer above the landfill, and

into the atmosphere. It is generally accepted that the bulk of the gas generated will be emitted through cracks or other openings in the landfill surface.

Landfills are the single, largest anthropogenic source of methane emissions in the United States and methane is a potent greenhouse gas that contributes to global warming. In addition to methane (55 percent by volume), carbon dioxide is the other primary constituent of LFG, approximately 40 percent by volume. Nitrogen content in LFG is initially high and declines sharply as the landfill proceeds to age and go through the decomposition phases. In the last phase of decomposition, the gas production of methane, carbon dioxide, and nitrogen (5 % by volume) become fairly steady.

Typically, LFG also contains a small amount of non-methane organic compounds (NMOC). Most of the NMOC emissions result from the volatilization of organic compounds contained in the landfill waste. Small amounts may be created by biological processes and chemical reactions within the landfill. This NMOC fraction often contains various organic hazardous air pollutants (HAP), other greenhouse gases, and compounds associated with stratospheric ozone depletion. The NMOC fraction also contains VOC. The VOC emissions are heavily influenced by the ethane content of LFG. The EPA reports that the average NMOC concentration released from the surface of a landfill is 2,420 ppmv as hexane from landfills that are known to have co-disposal of MSW and non-residential waste.

The EPA has regulated the emissions of a variety of air pollutants from large MSW landfills. EPA's landfill regulations have achieved a 53% reduction in emissions of odorous compounds, VOC, and air toxics such as benzene, carbon tetrachloride and chloroform. By reducing methane emissions and NMOC, EPA's regulations also increase safety on and near landfills. Capturing and using LFG yields substantial energy, economic, environmental, air quality, and public health benefits. The EPA's regulations which are enforced by the Division of Air Pollution Control are geared toward cost effective recovery of energy from LFG. A control device may be a flare, or a device that utilizes the energy content of the gas, such as an internal combustion engine, a turbine, or a boiler. The LFG is often filtered, dewatered, and used as a fuel. LFG can even be treated and introduced into the natural gas pipeline system.

At Middle Point

Middle Point has a LFG collection system that meets EPA's regulatory requirements and the capture efficiency of this system approaches 85 percent. NMOC is reduced by approximately 98 weight-percent. Having this collection system with energy recovery (with electricity going back into the grid) and its associated emissions is far superior to the uncontrolled emissions from the landfill – so, it is indeed safer to combust the LFG. The combustion of LFG does produce some small amount of particulate matter similar to natural gas. The concern about nuclear particulate (radioactive particles) is unfounded except for the background radiation that naturally occurs in the area. The naturally occurring radon concentrations found in many homes in Middle Tennessee are a much

larger concern for public health and safety. In conclusion, the health risks are significantly reduced at landfills that collect and control landfill gas.

Reference: FR/Vol. 64, No. 36/Wed., February 24, 1999, Rules and Regulations.

61FR9919, March 12 1996, NSPS and Emission Guidelines, Subparts
WWW and Cc of CFR Part 60.

Comments about other siting or operational aspects

QQ. Karst terrain - contaminants go fast to ground water

QQ. Any natural conduits in soil or bedrock (like karst or cave features) are stabilized or removed prior to, or as the landfill is built. In the case of the latest approved expansion at the Middle Point landfill, the entire 70 acre footprint was excavated down to the bedrock in order that a close inspection could be conducted and any visible fissures, cracks, openings, or other potential pathways be seen and corrected during construction.

RR. Retention pond has spillway to bare area. Is it monitored?

RR. The Division of Solid Waste Management does not require that the outfall of the sediment ponds be monitored. The facility does have an NPDES Multi-sector Stormwater discharge permit (registration number TNR053250), however, and must annually sample and report the analytical results on approved Stormwater Discharge Monitoring Report form no later than March 31st. These reports go to the Division of Water Pollution Control.

SS. Proximity to water source for city doesn't make sense for reasons additional to BSFR . Shouldn't different standards apply when a water supply is within feet of the landfill.

SS. The landfill is approximately .6 miles downstream of the main intake point, not upstream. There is an auxiliary intake that is approximately 8.7miles downstream of the landfill, in Percy Priest Lake. The city has been monitoring the water near the Walter Hill dam about 1.3 miles downstream from the landfill for about 15 years and has never detected any contaminants at a level anywhere near a level of concern.

TT. Concern about runoff to river when it rains (not just for BSFR)

TT. The landfill is designed in order that any rain that falls where the waste is exposed (on the working face) is channeled into the leachate collection system. Rain which falls on the sides of the landfill is channeled into the sediment pond system designed expressly for that purpose. These ponds are designed to allow the sediment to settle out before the water released to the Stones River.

UU. Buffer is being disturbed. They dig in it.

UU. This is not a violation. An area between the landfill and the river along Highway 231 has been used as a borrow soil source. This area is separated from the river by a ridge that normally prevents sediment created by the excavation activity from reaching the river. Permitted landfill operations does not exclude soil excavation from this area.

Comments about the future after the landfill is closed

VV. What will happen after post-closure? Will there be leaks? Who will take responsibility for it?

VV. The owner/operator is required to maintain the landfill cap and perform routine monitoring for fifty years after the last load of waste is placed and the final cap has been completed. Allied has put into place with the State, a bond to ensure the closure and maintenance of the landfill for the entire post-closure period.

Other comments

WW. Trucks are a hazard on Jefferson Pike

WW. While the Division has required Allied to improve the entrance to minimize any possible backup, traffic flow on roadways is not regulated by TDEC, but is addressed in various ways by the Department of Safety, the Tennessee Department of Transportation, local law enforcement, and possibly zoning ordinances.

XX. Dirt from trucks gets cars dirty

XX. Trucks leaving the landfill drive through a tire wash to minimize the amount of dirt/mud being tracked onto Jefferson Highway.

YY. Landfill is degrading the area

YY. TDEC does not regulate the indirect impact of the landfill on the surrounding area.

ZZ. Permit should be revoked.

ZZ. Tennessee regulations governing solid waste processing and disposal at Rule 1200-1-7-.02(5)(c) specify those conditions which must exist in order to terminate a permit. These conditions do not exist at this time.

AAA. Too much out-of-county waste is coming to Middle point.

AAA. United States Supreme Court cases have decided on several occasions that state and local governments cannot exclude waste based upon the fact that it is generated outside of a county or state. The Court ruled that the attempts to do so violated the interstate commerce clause of the U.S. Constitution.

BBB. How much money does the state and county make from waste disposal at Middle point?

BBB. The total amount received from all landfills in the state is \$1.10/ton of waste until July 1, 2007 and it then increased to \$1.25. Of that amount, seventy five cents goes to the Solid Waste Management Fund for solid waste grants to counties (to fund improvements at publicly owned solid waste facilities, for instance), statewide services such as household hazardous waste events, and technical services to cities and counties. The fifteen cents increased in this year's legislative session, which also goes to the Solid Waste Management Fund, is specifically earmarked to fund TDEC's investigations of old, closed landfills. The other thirty five cents goes to TDEC to provide for inspection and oversight of some 1,330 registered facilities. We do not know what the county receives.

The Division of Radiological Health has a fee of one and a half cents per pound on all material that is received at the processors. This is paid by the four processors of BSFR waste, among other licensees, but it is not just paid on the basis of BSFR material, but all material they process, regardless of where it goes for disposal.

CCC. Should BSFR waste be placed in a monofill?

CCC. There is no compelling reason (such as reactivity, etc.) that these materials should be managed in a monofill.

III. Issues regarding the Solid Waste Advisory Committee itself

A. Why is there no doctor on committee? No biologist? No molecular biologist? Should get that expertise elsewhere.

A. The Solid Waste Advisory Committee was established by statute to advise the Commissioner on implementation of the Solid Waste Management Act. This Act, passed in 1991, set forth a massive planning effort statewide to institute and maintain a comprehensive, integrated, statewide program for solid waste management. The General Assembly established in the statute the various disciplines needed to adequately advise the Commissioner. These disciplines are solid waste and environmental professionals statewide.

The undergraduate major of Ms. Stetar, the SWAC's expert consultant, was biology. Her Master's degree is in health physics, and she is also a nationally certified, Certified Health Physicist.

B. Why only 5 or 6 of members present at the July 17 hearing?

B. The July 5th meeting of the Solid Waste Advisory Committee was the Committee's introduction to their new legislated mandate to make recommendations concerning the

Bulk Survey for Release Program by September 3, 2007. At that meeting, TDEC staff presented a timeline of future meetings needed for the Committee to meet the September 3, 2007 deadline for making recommendations to the General Assembly. Because of prior commitments and other conflicts, some were not available for the July 17 public hearing. However, all have been provided with a written transcript of that meeting for their consideration in their deliberations. Ten members and two ex-officio members were present at the July 24 public hearing.

C. How many members are from counties of the 5 landfills receiving the BSFR waste?

C. Two members are from Shelby County-Ted Fox and Karen Birkenstock.

D. Is Committee really listening to / considering people's concerns?

D. The SWAC is made up of solid waste and environmental professionals from across the state. In choosing their various professions, members of the Solid Waste Advisory Committee have committed to protect the environment, health and safety of Tennessee's citizens. Further, as appointees of the Commissioner of the Department of Environment and Conservation, the Committee advises the Commissioner on issues relative to the Solid Waste Management Act. The Solid Waste Management Act declares in its public policy statement, "...on furtherance of its responsibility to protect the public health, safety and well-being of its citizens..." and the Committee functions responsibly in this role.

E. TDEC employees on SWAC have conflict of interest. One has already put views in writing.

E. TDEC employees function as staff to the Solid Waste Advisory Committee. The Solid Waste Assistance staff establishes the meetings, arranges speakers and distributes materials to the Committee relative to topics to be discussed. The Director of Solid Waste Management and Senior Director for the Land Programs provide input to the Committee from the TDEC Commissioner's perspective to assure the Committee has a full understanding of issues facing the Department, allowing them to make better decisions relative to the Solid Waste Management Act. When there are legal aspects to the matters under consideration, the Office of General Counsel also provides assistance.

F. Don't be afraid to be broad in your recommendations, for example C&D waste should be recycled.

F. Since the Solid Waste Management Act was passed in 1991, the Solid Waste Advisory Committee has been providing advice and direction to TDEC on solid waste issues. The same law that was passed in this year's session addressing BSFR also directs the Solid Waste Advisory Committee to develop recommendations to find higher value uses for materials than land filling; to reduce or eliminate food waste, yard waste, household hazardous waste, chemicals or other materials which decompose into a liquid or gas.

This Committee shall include in those recommendations how construction and demolition wastes can be ground, mulched or disposed on the construction site. After the Committee makes its recommendations regarding BSFR waste, it will be able to study and begin to develop the recommendations on the broader issues.

G. Should have ban on disposal of various wastes like other states.

G. When developing recommendations concerning uses of materials being landfilled, food waste, yard waste, household hazardous waste, chemicals or other materials which decompose into a liquid or gas the Committee will look at a variety of options/alternatives for dealing with these materials which may include bans.

H. The SWAC needs a consultant who knows landfills and has expertise in the field of solid waste. The consultant has a conflict of interest because she worked for TDEC and she works in the field of radiation.

H. The Committee has such expertise. TDEC proposed contracting with a consultant with health physics expertise because the Committee does not have that background. We do not agree that having worked with TDEC in the 1980's or in the field is a conflict of interest.

I. The public comment period should be extended.

I. Because the legislature gave the committee 60 days to complete its task, there is no room for additional time for public comment. On July 5, the committee announced its schedule for the 60 days, which has been posted on the department's web site and has been the subject of numerous media reports. Almost half of the 60 days was dedicated to receiving comment from the public.

IV. Issues with Contractor working for the Committee

A. She is biased because she is a former TDEC employee.

B. She is biased because she works in the radiation field

A-B. It has been over twenty years since Ms. Stetar was employed by TDEC. We do not think this represents a conflict of interest. Many former TDEC employees represent clients every day in matters involving TDEC.

It is precisely because she has expertise in the field of the health effects of radiation that we recommended her to the Committee. We thought this expertise, as well as her independence, would be helpful to the committee