MEMORANDUM
TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

DATE: June 19, 2007

TO: Municipal Solid Waste Advisory Committee
through Paul L. Sloan, Deputy Commissioner, TDEC
and Tracy Carter, Senior Director, Air Resources

FROM: Lawrence E. Nanney, Director, DRH

SUBJECT: The Tennessee Bulk Survey for Release (BSFR) program

The Bulk Survey for Release (BSFR) program is jointly administered by the Divisions of Solid Waste Management (DSWM) and Radiological Health (DRH)[1], based on a Memorandum of Agreement and a division of regulatory responsibilities between these agencies.

DSWM regulates the receipt and disposal of BSFR material at Class I solid waste landfills, through its Special Waste Approval process. DRH regulates the waste processing companies which send these wastes to a few (five), specifically identified and approved landfills, through its regulatory process for licensing and inspecting the possession of radioactive materials.

BSFR material has been characterized in media reports on this issue as "low-level radioactive waste". The implication of such a characterization has led people to believe that these materials can only be properly disposed in a licensed low-level radioactive waste (LLRW) disposal facility, of which there are three (3) in the U. S. This is both confusing and untrue.

BSFR material is primarily construction/demolition debris, soils, concrete rubble, and similar materials which have very low levels of incidental radioactive material, derived from decommissioning projects at commercially operated nuclear facilities licensed and regulated by the U. S. Nuclear Regulatory Commission (NRC) or Agreement State radiological health programs. It is what remains after the waste materials that need to go to a licensed LLRW disposal facility have been segregated out and properly disposed.

To clarify the confusion regarding LLRW requires understanding that the definition of "low-level radioactive waste" has no lower endpoint, below which something is considered "not radioactive". The foods we eat (e.g., beans, potatoes, bananas, nuts), the building materials used in our homes (e.g., concrete, brick, granite), and our own bodies (e.g., potassium), contain measurable, naturally occurring radioactivity. Since everything in the world is radioactive to some degree, that definition, taken literally, would imply that all waste materials need to go to a licensed LLRW disposal facility.

[1] See Attachment I for a description of the program responsibilities of the Division of Radiological Health.

It is implicit in this definition of LLRW that common sense is expected to prevail, acknowledging that all solid waste in the country cannot be, and does not need to be, sent to one of three licensed LLRW disposal facilities. These facilities are constructed and operated to standards designed for the disposal of LLRW containing radioactivity at the upper end of one or more of three broad classes of LLRW.

The way LLRW is "defined" and regulated throughout the nation allows room for discretion and for decisions to be made which are reasonable in the context of assessment of acceptable risk and of other facilities available for safe disposal.

What are the risks associated with the BSFR program?

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 member of the public, now or in the distant future.

A dose of 1 millirem per year is generally accepted worldwide by the radiation protection profession and in national and international publications and guidance as negligible. The risk associated with that dose is consistent with, and in many cases significantly less than, that considered by the U. S. Environmental Protection Agency (EPA) as acceptable for radiation and other carcinogenic materials that it regulates, for which the theoretical dose/response relationships assume that there is no exposure level to which some level of risk cannot be attributed. To quantify that associated risk, it is equivalent to a theoretical one-in-a million probability of cancer induction.

To put that dose (1 millirem per year) and its associated risk into perspective, it is important to understand that each member of the public receives a radiation dose of approximately 300 millirems per year from naturally occurring background radiation in the environment. Also, many members of the public are exposed to other sources of radiation such as diagnostic medical procedures (x-rays and nuclear medicine scans), which almost always exceed that dose by a wide margin. Medical therapeutic doses of radiation administered to individuals for treatment of cancer are typically several million times that dose.

Another example that illustrates the level of protection offered by the 1 millirem per year criterion is a comparison with allowable limits set by both EPA and the states under the Safe Drinking Water Act. Under both federal and state rules, the allowable limit for radiation dose from drinking water is 4 millirems per year, which would be received by all persons served by that water system. The BSFR program is designed so that the maximum dose that could be received from this material being disposed in Class I solid waste landfills is 1 millirem per year, ¼ of the amount allowed from public drinking water, and to only a few individuals, as will be illustrated below.

There are many conservative factors applied in determining the maximum amounts of radioactive material to be allowed for disposal through the BSFR program, to be consistent with the 1 millirem per year dose criterion. Various scenarios are taken into consideration to ensure the protection of 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.

One scenario considered in determining acceptable disposal limits is that of the "resident farmer". This scenario 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 is assumed 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.

TENNESSEE DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF RADIOLOGICAL HEALTH

Mission Statement

The mission of the Division of Radiological Health, within the Department of Environment and Conservation, is to protect and improve the health of Tennessee's citizens through the prevention of radiological conditions that could be a threat to good health, and to treat, through education, enforcement, and remediation, radiologically hazardous conditions that might affect the health or environment of Tennesseans.

Division's Purpose and Function

The Division of Radiological Health (DRH) strives to protect the citizens of Tennessee whenever ionizing radiation could present a harmful situation to the public health and safety or to the environment. To accomplish that goal, it functions both as a regulatory agency and as a service organization. DRH regulates, by license and by registration, the users of radioactive materials and radiation-producing machines, and responds to incidents and citizens' complaints regarding any source of radiation. DRH is comprised of four main sections that report to the Director's Office. The following describes the function of each section in meeting the Division's goals and objectives:

Director's Office

The Director's Office consists of the Director, Deputy Director, Health Physicist Consultant, Administrative Assistant Director, and Administrative Secretary. These personnel are responsible for all policy, technical, budgetary, contract, and administrative functions of the Division. They serve as official liaison to numerous organizations outside of State government, including the Conference of Radiation Control Program Directors, the Organization of Agreement States, the Southeast Compact Commission for Low-Level Radioactive Waste Management, the U. S. Nuclear Regulatory Commission, the U. S. Department of Energy, the U. S. Food and Drug Administration, and the U. S. Environmental Protection Agency. The personnel that provide these services are located in the Nashville Central Office.

Licensing / Registration / Planning Section

The Licensing / Registration / Planning Section is responsible for licensing the possession and use of radioactive material within the State of Tennessee, licensing the delivery of radioactive waste to Tennessee processing facilities, registering x-ray producing equipment within the State of Tennessee, reviewing "reduced fee" applications for x-ray equipment, and developing and documenting policy issues relating to the Division. This section routinely meets with licensees and registrants in an effort to foster better communication and compliance. File

reviews by concerned citizens, environmental groups, attorneys, licensees, and license applicants are also handled by this section. The personnel that provide these services are located in the Nashville Central Office.

Inspection and Enforcement Section

The Inspection and Enforcement Section is responsible for the inspection of facilities that utilize x-ray equipment and radioactive materials within the State of Tennessee. This section routinely meets with licensees and registrants in an effort to foster better communication and compliance. This section is directly responsible for responding to radiation events and incidents. File reviews by concerned citizens, environmental groups, attorneys, licensees, and license applicants are also handled by section staff in each EAC, upon request. The personnel that provide these services are located in the Nashville Environmental Field Office (EFO), the Memphis EFO, the Chattanooga EFO, and the Knoxville EFO.

Technical Services Section

The Technical Services Section consists of four program areas: Personnel / Environmental Monitoring, Emergency Preparedness / Training, Radioactive Waste Management, and Standards Development / Processing. The key services provided by these programs are:

Personnel / Environmental Monitoring - maintaining the Division's personnel dosimetry program, sampling and surveying areas of the state, including facilities that are not licensed by the Division for possession of radioactive materials (e.g., foundries and metal scrap facilities, pulp and paper plants, water and wastewater treatment plants, and Federally-licensed nuclear power plant and nuclear fuel fabrication plant environs) for background radiation levels and for possible radioactive contamination, assisting inspection and enforcement personnel with inspections at major State-licensed facilities, overseeing radiation measurement equipment acquisition, inventory, and calibration, maintaining the Environmental Protection Agency's (EPA) ambient air and water radiological monitoring stations, and maintaining a database for radioactive material samples and analytical results.

Emergency Preparedness / Training - revising and reviewing the State's emergency plans and standard operating procedures for Sequoyah and Watts Bar Nuclear Power Plants and for the Department of Energy facilities on the DOE Oak Ridge Reservation, training first responders in the counties affected by these plans to respond to emergencies and incidents involving radioactive materials,

training Division staff for emergency response, and maintaining the Division's emergency kits and supplies.

Radioactive Waste Management - monitoring and evaluating all trends in low-level waste generation and processing in the State, and inspecting all high-level waste shipments from DOE-Oak Ridge and other facilities to ensure their compliance with U.S. Department of Transportation regulations.

Standards Development / Processing - drafting regulations to ensure the protection of the public health and safety and the environment from any harmful effects of radiation, and maintaining the Division's database for licensing, registration, inspection, and fee assessment.

All personnel in the Technical Services Section are located in the Nashville Central Office.

Administrative Services Section

The Administrative Services Section is responsible for daily support functions for the Division's technical staff such as answering phones and file management, as well as assisting with the collection of license and registration fees. This section has direct daily contact with the licensees and registrants. Many members of this section participate in emergency exercises with the technical staff in responding to radiation events and incidents. File reviews by concerned citizens, environmental groups, attorneys, licensees, and license applicants are handled by this section depending upon their availability and other workload constraints. The personnel that provide these services are located in the Nashville Central Office, the Nashville Environmental Field Office (EFO), the Memphis EFO, the Chattanooga EFO, and the Knoxville EFO.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

JUN 12 2007

The Honorable Bart Gordon
Member, United States House of Representatives
305 West Main Street
Murfreesboro, TN 37133

Dear Congressman Gordon:

Thank you for your May 21, 2007, letter concerning the Middle Point Landfill in Murfreesboro, Rutherford County, Tennessee. In your letter you expressed concern about the potential risks that certain wastes accepted at the landfill may pose to residents, neighboring property owners, workers at the site, customers of the landfill, the Stones River, and the City of Murfreesboro's drinking water and waste water treatment systems.

On Wednesday, May 30, 2007, members of my staff participated in a conference call with members of your staff and officials from the Tennessee Department of Environment and Conservation (TDEC) for the purpose of answering the questions and requests for assistance presented in your letter. Erica Antonson of your staff e-mailed several questions regarding the landfill to my staff and to TDEC officials for discussion during the conference call. In addition to providing the following responses on behalf of the Environmental Protection Agency (EPA), I am also enclosing a more detailed response from TDEC that addresses your specific questions and concerns. I hope you find this information useful.

First, as you may be aware, EPA works closely with TDEC in the implementation of environmental programs across Tennessee and we have full confidence in TDEC's administration of those programs. As the primary agency for implementation and enforcement of many federal environmental programs, TDEC has a long history of well-managed and effectively run programs. With regard to the concerns you have raised, we believe TDEC is taking appropriate steps to address residents' concerns regarding the landfill and we stand ready to assist if needed.

Subtitle D of the Resource Conservation and Recovery Act (RCRA) authorizes EPA to develop national standards for solid waste management and to ensure that states adopt and implement solid waste permit programs that are technically comparable to the federal criteria. EPA fully approved Tennessee's municipal solid waste landfill permitting program on September 16, 1993. The provisions of Subtitle D make TDEC fully responsible for permitting, enforcement and compliance, and oversight of all solid waste management facilities in Tennessee, including the landfill operated by Browning-Ferris Industries (BFI) in Rutherford County. In addition, TDEC is responsible for ensuring that drinking water sources, drinking water treatment facilities, and the waste water treatment plant that receives leachate from the landfill do not pose a threat to the health of local residents, to workers at the treatment facilities, or to the environment. EPA provides oversight to ensure that state programs are in full compliance with federal laws and regulations.

The waste you inquired about at the Middle Point Landfill is waste TDEC officials commonly refer to as Bulk Survey for Release (BSFR) waste. They informed us that the Middle Point Landfill is one of five facilities in Tennessee permitted to receive such waste for disposal. Currently, the BSFR waste comprises approximately one-tenth of one percent (0.1%) of the waste disposed at the Middle Point Landfill. According to Tennessee regulations, BSFR material must have a dose less than one millirem per year to be disposed of in a Class 1 Solid Waste landfill. In comparison, Tennesseans receive an average annual dose of 300 millirems of radiation from naturally occurring sources in the environment.

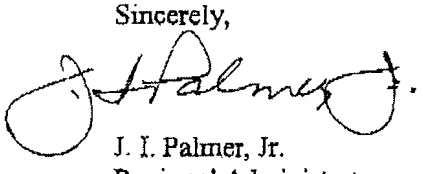
In the enclosed memorandum, TDEC officials have addressed as many of your questions as they are currently able to answer. BFI, the facility owner, has collected leachate samples to be analyzed for radioactivity and expects sample results to be received by mid-June. The leachate is being tested by an independent lab for radiological parameters required under the Safe Drinking Water Act. There is no indication that the liner and leachate collection system have failed. The City of Murfreesboro water supply is periodically sampled and analyzed for radioactivity with the results being reported to TDEC's Division of Water Supply. We understand sampling results have shown no exceedances of drinking water standards.

TDEC has committed to review the results of the analyses conducted on behalf of the owners and operators of the landfill and, as soon as possible, determine if additional sampling and data are needed. EPA will continue to coordinate with TDEC, review any new data, and assist TDEC as needed to address remaining issues.

One concern raised by your staff during the May 30 conference call was inadequate public outreach regarding the BSFR wastes being allowed into the landfill. TDEC officials stated that they are planning to conduct a public meeting soon to give interested citizens an opportunity to learn more about the Middle Point Landfill.

In closing, we believe TDEC is taking appropriate steps to address residents' concerns regarding the landfill and we stand ready to assist if needed. If you have questions or need additional information from EPA, please contact me or the Region 4 Office of Congressional and Intergovernmental Relations at 404-562-8327.

Sincerely,



J. I. Palmer, Jr.
Regional Administrator

Enclosure: Memorandum from Chuck Head to Otis Johnson dated June 4, 2007

cc: Paul Sloan, TDEC
Chuck Head, TDEC

DEPARTMENT OF
ENVIRONMENT &
CONSERVATION

Date: June 4, 2007

To: Otis Johnson
EPA Region 4

From: Chuck Head
TN Department of Environment and Conservation

Subject: Response to Questions from Rep. Bart Gordon
Disposal of Bulk Survey for Release Materials –
BFI Middle Point Landfill – Murfreesboro, TN

Please find below our response to the questions posed by Rep, Gordon to the U.S. Environmental Protection Agency. We appreciate the opportunity to provide you with this information. If you have questions or concerns, please give me a call at 615 532-0998 or contact me via e-mail @ chuck.head@state.tn.us

Introduction

The news reports on this subject have not accurately portrayed the issues. Bulk Storage for Release (BSFR) material is not constituted primarily of the shielding used at nuclear reactors or from Department of Energy or Department of Defense weapons projects, nuclear weapon materials or internal components of nuclear electric utility power plants. It is primarily construction debris, soils, debris and similar materials from decommissioning projects at U. S. Nuclear Regulatory Commission or Agreement State licensed and regulated commercial facilities. These materials have very low levels of incidental radioactive material. In recent news stories these BSFR materials have been characterized as 'low-level radioactive waste". It is a misrepresentation to refer to BSFR material as "low level radioactive waste" because it does not meet the definition of low-level radioactive waste and using this terminology unnecessarily alarms the public. It should be noted that in other states BSFR material and similar materials have been exempted from further regulatory controls, assumed to not be radioactive, and disposed in landfills.

Additionally, BSFR material undergoes a multi-tiered evaluation under Tennessee regulations and only BSFR material that has an equivalent dose of 1 millirem/year is approved for disposal in Class I Solid Waste Landfills. In Tennessee, each year residents receive an average annual dose of 300 millirems of radiation from naturally occurring sources in the environment. Federal & state drinking water regulations have set a dose limit of 4 millirems/year as the safe drinking water standard, meaning that the total dose from all pathways for BSFR material disposal is ¼ of the federal and state safe drinking water standard.

1. Is the Bulk Survey for Release (BSFR) material disposed at BFI Middle Point Landfill a threat to water quality in the Stones River?

   NO. There are two ways that BSFR material could impact the Stones River; (1) the physical transport of the material into the river and (2) ground water containing radionuclides flowing into the river

   Physical transport of the waste material is prevented. Upon arrival at the landfill the waste is immediately covered with other waste, and all waste is covered again at the end of the workday with soil or tarps. The cover systems are maintained to keep the disposed waste material in place. This makes it highly unlikely that any material can leave the landfill via the air or surface transport.

   Ground water can be impacted by leachate from the landfill. Rainfall, which infiltrates the landfill and comes into contact with the waste, is directed into the leachate collection system along with any liquids present in the landfill. At Middle Point a portion of the leachate is directed to the Murfreesboro wastewater plant and the remainder is transported to an offsite commercial wastewater treatment plant for treatment.

   There are indications of increasing concentrations of barium in the ground water at monitor well MW-2. The contaminant levels are still below the Maximum Contaminant Level (MCL) for drinking water. A ground water assessment is underway to determine if the increasing barium concentrations are from naturally occurring sources or due to leachate from the landfill. Since MW-2 is near the river, water quality could eventually be impacted. Leachate will be tested for radioactivity in order to assess the potential impact to the river.

2. Is the leachate sent to the Murfreesboro Wastewater Treatment Plant (WWTP) a threat to the workers at the WWTP? Has the leachate been tested for radiation levels? What are the plans for testing the leachate and who will do the testing?

   Normal actions taken to protect workers from the health effects of exposure to leachate are fully protective of workers from any potential exposure to the radioactive constituents of BSFR materials. Our Division of Radiological Health (DRH) has for many years sampled the sludge, influent, and effluent at certain other wastewater treatment plants which receive radioactivity in wastewater from licensed users in accordance with applicable state and federal regulations. Data is on file which demonstrates the absence of any radiological hazard from any man-made radionuclides as are typical of BSFR materials. Federally sponsored studies support this conclusion.

   The leachate has not been tested for radionuclides by the State, however, in March, the Division of Radiological Health initiated a process that would implement improvements in the BSFR program to make it even more protective of human health and the environment. One of the proposed improvements would require the analysis for radiological constituents of any leachate to be released to a wastewater treatment plant in order to assure compliance with the sewer disposal limits of State Regulations for Protection Against Radiation (SRPAR).

   Because the leachate has not been monitored for radioactivity, the specific radionuclide levels in the leachate are not available. However, BFI/Allied Waste collected leachate samples to be analyzed for radioactivity and expects sample results to be received in mid-June. The leachate is being tested by an independent laboratory for radiological parameters required under the Safe Drinking Water Act. Results should be available in a couple of weeks.

3. How much BSFR material has been disposed of at BFI Middle Point?

   BSFR materials constitute only slightly greater than 0.1 % of the total wastes disposed at the BFI Middle Point landfill. From 1999 through May 2007, 11,146.7 tons of BSFR material was disposed at BFI Middle Point Landfill. For that same period, 9,362,738.7 tons of solid waste was disposed at the BFI Middle Point landfill. This is only 2 % of the total amount of BSFR material that is allowed to be disposed of at the BFI Middle Point Landfill. Given the amount of BSFR material actually disposed, the annual projected dose is approximately 0.02 millirem/year.

   Records prior to 1999 are not readily available for review, but TDEC will provide this data at a later date.

4. Does the BSFR material present a threat to Rutherford County residents due to radiation levels?

   No. The BSFR program does not pose a threat to anyone. The criteria for accepting waste under the BSFR program is extremely protective of human health and the environment. BSFR material is limited to no more than 5% of the total amount of solid waste a landfill is permitted to accept and it cannot contribute more than 1 millirem per year to any member of the public. To put that in perspective, the public is exposed to approximately 300 millirems/year from naturally occurring background radiation. Another example which illustrates the level of protection offered by the 1 millirem/year dose is a comparison with allowable limits set by both EPA and the state for drinking water. Under both federal and state rules the allowable limit for radiation dose from drinking water is a dose of 4 millirems/year while the maximum dose from BSFR material being disposed in the BFI Middle Point landfill is 1 millirem/year.

   There are many conservative assumptions used in determining allowable concentration limits for disposal of this material into approved Class I Solid Waste Landfills. For example, the model used to calculate the dose and acceptable disposal limits assumes that 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, bathe, and irrigate crops. While in reality there will be a soil cover placed over the site, the model assumes no cover, that is, the model assumes direct contact with the wastes. The model also assumes the farmer has livestock which eats the grass and drinks the water. The resident farmer consumes the crops, livestock, and milk from the cows.

   In determining the projected radiation dose from the groundwater pathway, no credit is taken for the protective action of the geomembrane liner or for the protective action of subsurface soil below the state-required liners. This is part of the landfill design to prevent landfill leachate from entering the groundwater.

   All these factors constitute conservative assumptions which would lead to the actual dose to any individual being far less than the projected dose of 1 millirem per year.

5. Does the BSFR material present a threat to BFI Landfill workers or landfill customers due to radiation levels?

   No. Again, the BSFR program does not pose a threat to anyone. The BSFR material disposed of at BFI Middle Point Landfill has no external radiation exposure hazard associated with it, nor would any individual exposed to dust at an occupational level be subjected to any hazard from inhalation/ingestion. The allowable limits for disposal are below those for which the U. S. Department of Transportation would consider the shipment to be radioactive for purposes of manifesting, labeling, or placarding the transporting vehicle.

   There are radiation detectors at the Middle Point landfill. They are very sensitive and in working order. We know this because trucks carrying residential and hospital waste set-off these detectors on a regular basis. Most often this occurs when a resident who has received a nuclear medicine procedure and gone home with some residual radioactive material from the test in their body, and some of that radioactive material finds its way to the landfill in the form of personal hygienic wastes. Occasionally, the waste may come from a similar source arising from hospital disposals. In contrast, trucks carrying BSFR materials have never activated the radiation detectors at the Middle Point landfill.

6. Does the BSFR material present a threat to the City of Murfreesboro water supply due to radiation levels?

   No. As discussed, there is no indication that the liner and leachate collection system for the landfill have failed. The City of Murfreesboro water supply is sampled and analyzed for radioactivity. Reports of the analysis are reported to the Division of Water Supply.

   Given that the BSFR material contains radioactivity at extremely low levels even if the BSFR material did enter surface water and get into the drinking water supply, the maximum radiation dose a person could receive (allowing for no dilution of material into the ground water) would be 1 millirem/year or less which is ¼ of the safe drinking water limit (4 millirems/year) for public water supplies.

7. Is there a release of leachate from the BFI Landfill into the local ground water?

   There is no indication of an on-going release of leachate. About two years ago, a broken force main spilled leachate near well MW 2. The force main was upgraded and replaced. Ground water monitoring points in the area potentially affected are monitored four times per year. As discussed above, this same well is contaminated with barium and is under assessment.

   Eight monitor wells and two springs are used as monitoring points for the groundwater monitoring system. This monitoring system is used to detect and keep track of any leachate being released from the landfill into groundwater in soils and in bedrock. This detection system is monitored by the facility and data is reviewed by TDEC. Samples are collected and analyzed two times per year for compliance monitoring of the facility.

8. Is there testing for radioactive constituents in the raw water entering the Murfreesboro Water Treatment Plant? Is there testing for radioactive constituents in the finished water? Please explain the testing, results, frequency and reasons for testing.

Tennessee's drinking water program requires all new sources being developed for a water supply to be tested to ensure that the treatment being proposed is adequate for the source. This was done at the time the City of Murfreesboro was developing plans to use the East Fork of the Stones River (1966). The state has not had any reason to request additional sampling of the Murfreesboro Water System due to the BFI Middle Point Landfill. All finished water radionuclide sampling results have shown the water distributed to local citizens at or below the detection limit for radionuclides. Given the data we received from required sampling under the TN Safe Drinking Water Act, the sampling completed by the City of Murfreesboro and the type and nature of the low activity BSFR material disposed at the BFI Middle Point Landfill, the TN Department of Environment and Conservation does not believe the BSFR material disposed at the BFI Middle Point Landfill presents a threat to the City of Murfreesboro water supply.

The City of Murfreesboro, on its own initiative, began monitoring the raw water at the Walter Hill Dam for a number of contaminants in 1992. Results for Gross Alpha, Gross Beta, Radium 226, and Radium 228 have not shown any level of concern. The highest level of Gross Beta found during this period of time was 4.7 pCi/L, well below the trigger level of 50 pCi/L which requires additional monitoring for radioactivity.

Prior to 2002 the Murfreesboro Water System was required to test the drinking water for Gross Alpha and Radium 226 every 4 years. Sample analysis for Radium 228 was not required unless Radium 226 exceeded 3.0 pCi/L. They were also not required to test for Gross Beta particle activity. Upon revision of the radionuclide requirement, they were required to sample and test for Gross Alpha, Radium 226 and Radium 228. If the Gross Alpha activity had been greater than 15 pCi/L (picocuries per liter) the system would have been required to test for Uranium. In the sample results from the 2003 finished water sampling event for Gross Alpha activity, Radium 226 and Radium 228 were all below the detection limit. In 2005, Murfreesboro sampled the finished water for Gross Beta activity and Gross Alpha activity. The results for the Gross Beta activity were very low and did not warrant any further testing. The Gross Alpha particle results were again below detection level. If there was contamination in the raw water or water supply from any of the particles or emitters listed below, it would be detected in the gross alpha and gross beta analysis.

Sampling Protocol for Drinking Water Supplies – Radioactivity

Radionuclide Source	Detection Level	MCL
Alpha Particles		
Gross Alpha	3 pCi/L	15 pCi/L (includes Radium 226 but not Radon or Uranium)
Radium 226	1 pCi/L	5 pCi/L
Radium 228	1 pCi/L	5 pCi/L
Beta Particles		
Gross Beta	4 pCi/L	4 millirem/year (total Gross Beta)
Generally radium 226 and 228 are removed during lime water softening process at water treatment plant		

More detail can be reviewed on the EPA website http://www.epa.gov/radiation/understand/index.html . This discusses alpha and beta particles and radiation. This website discusses radionuclides: http://www.epa.gov/safewater/radionuclides/basicinformation.html .

The City of Murfreesboro has elected to sample the raw water behind the Walter Hill dam ahead of its regular scheduled raw water-sampling event.

Bulk Survey for Release Program

The Nuclear Information and Resource Service (NIRS) has issued a report critical of Tennessee's Bulk Survey For Release (BSFR) program that was the subject of a recent television news story.

The report confuses Department of Energy self-regulated practices with commercial nuclear energy activities regulated by the U.S. Nuclear Regulatory Commission and Agreement States and has a number of factual errors and misrepresentations, including its portrayal of Tennessee's BSFR program. This information is provided to help put this information into better perspective.

- Naturally occurring radioactivity is found in nature and materials all around us, thus very low-level radioactive material is disposed of everywhere, all the time.
- Tennessee is unique in that it has more waste processors than other states due primarily to the role played by the Oak Ridge Reservation in the development of atomic energy. Tennessee is not the only state, however, that allows very low-level radioactive material in landfills.
- Materials that are candidates for the BSFR program are of such low levels other states generally would exempt them from further regulation as a radioactive material and allow their unrestricted disposal, while Tennessee has developed a regulatory framework for it.
- The Bulk Survey for Release program was developed in order to have a standardized process to analyze materials with extremely low levels of radioactive contamination for disposal in specified Class I landfills. These levels of contamination, while detectable with modern equipment, pose no hazard to human health or the environment by being disposed of in this manner. Examples of materials analyzed under the program are bulk materials such as building rubble, metals, soils, asphalt, paper, plastics and wood.
- There are currently four licensees in Tennessee authorized to conduct the BSFR program. They are IMPACt, RACE, Toxco, and Duratek/Energy Solutions. Nuclear power plants or other entities with very low-level radioactive material may send their waste to one of the four licensees. The materials may be evaluated at the generator's site before going to the licensee's facility for required sampling and analysis. The sampling and measurement process must indicate the material meets BSFR criteria prior to it being disposed of as part of this program. It would further have to pass through detection monitors at the landfill site.
- The criteria are extremely conservative for accepting material under the BSFR program. BSFR waste cannot contribute more than five percent of the total landfill waste, and it cannot contribute a dose of more than one millirem per year to any member of the public. To put that in perspective, the public is exposed to approximately 300 millirems per year in Tennessee from naturally occurring radiation in the environment.
- The department is currently in the process of implementing improvements in the BSFR program that will make it even more protective by requiring additional and more detailed sampling methodology and practices.
- Any material that does not meet the strict requirements of the BSFR program would need to be disposed of in a radioactive waste facility, of which there are three commercial facilities in the United States.
- By allowing waste that does not pose any significant risk to be disposed of under the BSFR program, space in the limited number of radioactive waste facilities can be conserved for the material that truly requires that type of disposal.

HEALTH PHYSICS SOCIETY

Specialists in Radiation Safety

CONSUMER PRODUCTS CONTAINING RADIOACTIVE MATERIALS

HEALTH PHYSICS SOCIETY FACT SHEET

Everything we encounter in our daily lives contains some radioactive material, some naturally occurring and some man-made: the air we breathe, the water we drink, the food we eat, the ground we walk upon, and the consumer products we purchase and use. Although they might be familiar with the use of radiation to diagnose disease and treat cancer, many people, when they hear the terms "radioactive" and "radiation," tend to think of mushroom clouds and the monster mutants that inhabit the world of science fiction movies and comic books. Careful analyses can identify and quantify the radioactive material in just about anything. This document describes a few of the more commonly encountered and familiar consumer products that can contain sufficient radioactive material for it to be distinguished from background with a simple handheld radiation survey meter.

Smoke Detectors. Most residential smoke detectors contain a low-activity americium-241 source. Alpha particles emitted by the americium ionize the air, making the air conductive. Any smoke particles that enter the unit reduce the current and set off an alarm. Despite the fact that these devices save lives, the question "are smoke detectors safe?" is still asked by those with an inordinate fear of radiation. The answer, of course, is "yes, they are safe." Instructions for proper installation, handling, and disposal of smoke detectors are found on the package.

Watches and Clocks. Modern watches and clocks sometimes use a small quantity of hydrogen-3 (tritium) or promethium-147 as a source of light. Older (for example, pre-1970) watches and clocks used radium-226 as a source of light. If these older timepieces are opened and the dial or hands handled, some of the radium could be picked up and possibly ingested. As such, caution should be exercised when handling these items.

Ceramics. Ceramic materials (for example, tiles, pottery) often contain elevated levels of naturally occurring uranium, thorium, and/or potassium. In many cases, the activity is concentrated in the glaze. Unless there is a large quantity of the material, readings above background are unlikely. Nevertheless, some older (for example, pre-1960) tiles and pottery, especially those with an orange-red glaze (for example, Fiesta® ware) can be quite radioactive.

Glass. Glassware, especially antique glassware with a yellow or greenish color, can contain easily detectable quantities of uranium. Such uranium-containing glass is often referred to as canary or vaseline glass. In part, collectors like uranium glass for the attractive glow that is produced when the glass is exposed to a black light. Even ordinary glass can contain high-enough levels of potassium-40 or thorium-232 to be detectable with a survey instrument. Older camera lenses (1950s-1970s) often employed coatings of thorium-232 to alter the index of refraction.

Fertilizer. Commercial fertilizers are designed to provide varying levels of potassium, phosphorous, and nitrogen. Such fertilizers can be measurably radioactive for two reasons: potassium is naturally radioactive, and the phosphorous can be derived from phosphate ore that contains elevated levels of uranium.

Food. Food contains a variety of different types and amounts of naturally occurring radioactive materials. Although the relatively small quantities of food in the home contain too little radioactivity for the latter to be readily detectable, bulk shipments of food have been known to set off the alarms of radiation monitors at border crossings. One exception would be low-sodium salt substitutes that often contain enough potassium-40 to double the background count rate of a radiation detector.

Gas Lantern Mantles. While it is less common than it once was, some brands of gas lantern mantles incorporate thorium-232. In fact it is the heating of the thorium by the burning gas that is responsible for the emission of light. Such

mantles are sufficiently radioactive that they are often used as a check source for radiation detectors.

Antique Radioactive Curative Claims. In the past, primarily 1920 through 1950, a wide range of radioactive products were sold as cure-alls, for example, radium-containing pills, pads, solutions, and devices designed to add radon to drinking water. The states generally have regulatory authority over these devices. In some cases, a state might even require that these devices be registered or licensed. Most such devices are relatively harmless but occasionally one can be encountered that contains potentially hazardous levels of radium. If there is any question about the safety of such devices, the public is strongly encouraged to contact the state radiation-control program for advice.

For further information contact the following:

National Council on Radiation Protection and Measurements, "Radiation Exposure of the U.S. Population from Consumer Products and Miscellaneous Sources," NCRP Report No. 95, Bethesda, MD, 1987.

U.S. Nuclear Regulatory Commission, "Systematic Radiological Assessment of Exemptions for Source and Byproduct Materials," NUREG-1717, Washington, DC, 2001. (This report is currently available at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/.)

The Health Physics Society Web site (http://www.hps.org) contains a wealth of information about radiation and radioactivity, including an "Ask the Experts" feature where specific questions about radiation and radioactivity will be answered.

The Health Physics Society is a nonprofit scientific professional organization whose mission is excellence in the science and practice of radiation safety. Since its formation in 1956, the Society has grown to approximately 6,000 scientists, physicians, engineers, lawyers, and other professionals representing academia, industry, government, national laboratories, the Department of Defense, and other organizations. Society activities include encouraging research in radiation science, developing standards, and disseminating radiation safety information. Society members are involved in understanding, evaluating, and controlling the potential risks from radiation relative to the benefits. Official position statements are prepared and adopted in accordance with standard policies and procedures of the Society. The Society may be contacted at 1313 Dolley Madison Blvd., Suite 402, McLean, VA 22101; phone: 703-790-1745; fax: 703-790-2672; email: hps@burkinc.com.

Millirem

The millirem is a unit of absorbed radiation dose. A person would get one millirem of radiation from:

- Three days of living in Atlanta
- Two days of living in Denver
- Seven hours in some spots in the Espirito Santo State of Brazil
- An average year of television watching
- A year of wearing a luminous dial watch
- A coast-to-coast airline flight
- A year living next door to a normally operating nuclear power plant

The risk of one millirem of radiation dose is a 1 in a million risk of developing cancer. The relative risk of 1 in a million chances of dying of activities common to our society are:

- smoking 1.4 cigarettes (lung cancer)
- eating 40 tablespoons of peanut butter
- spending 2 days in New York City (air pollution)
- driving 40 miles in a car (accident)
- flying 2500 miles in a jet (accident)
- canoeing for 6 minutes

Acronyms and Abbreviations

ALARA	as low as reasonably achievable
ACE	U.S. Army Corp of Engineers
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EDE	effective dose equivalent
EPA	U.S. Environmental Protection Agency
NRC	U. S. Nuclear Regulatory Commission
RESRAD	Residual Radioactivity (model)
SRPAR	State Regulations for Protection Against Radiation
TDEC	Tennessee Department of Environment and Conservation

Units of measure

Bq	Becquerel(s)
g	gram(s)
Kg	kilogram(s)
mrem	millirem(s)
pCi	picocurie(s)
urem	microrem(s)

Medical Radiation Doses

Procedure	Dose (in millirem)
Chest x-ray	2 - 20
Skull exam	15
Barium enema	54
Bone scan	440
Extremities x-ray	1
Dental x-ray	10
Head/neck x-ray	20
Cervical spine x-ray	22
Lumbar spine x-ray	130
Pelvis x-ray	44
Hip x-ray	83
Upper GI series	245
Lower GI series	405
Diagnostic thyroid exam	50,000 to the thyroid
Diagnostic thyroid exam	35 to the whole body
CT scan	1100

RADIATION MEASUREMENT UNITS
and Conversion factors for International System (SI)

- **Roentgen:** The roentgen measures the energy produced by gamma radiation in a cubic centimeter of air. It is usually abbreviated with the capital letter "R". A milliroentgen, or "mR", is equal to one one-thousandth of a roentgen. An exposure of 50 roentgens would be written "50 R". In the SI units, the roentgen (R) is replaced by coulomb/kg (C/kg).

  1 milliroentgen (mR) ~ 258 nanocoulomb/kg (nC/kg)

- **Rad:** Or, Radiation Absorbed Dose recognizes that different materials that receive the same exposure may not absorb the same amount of energy. A rad measures the amount of radiation energy transferred to some mass of material, typically humans. One roentgen of gamma radiation exposure results in about one rad of absorbed dose. In the SI units, the rad is replaced by the gray (Gy).

  1 rad (rad) = 10 milligray (mGy)
  100 rad (rad) = 1 gray (Gy)

- **Rem:** Or, Roentgen Equivalent Man is a unit that relates the dose of any radiation to the biological effect of that dose. To relate the absorbed dose of specific types of radiation to their biological effect, a "quality factor" must be multiplied by the dose in rad, which then shows the dose in rems. For gamma rays and beta particles, 1 rad of exposure results in 1 rem of dose. In the SI units, the rem is replaced by the sievert (Sv).

  1 rem (rem) = 10 millisievert (mSv)
  100 microrem (μrem) = 1 microsievert (μSv)

1200–2–5–.120 GENERAL DISPOSAL REQUIREMENTS.

(1) A licensee shall dispose of radioactive material only:

(a) By transfer to an authorized recipient as provided in other chapters of these regulations;

(b) By decay in storage;

(c) By release in effluents within the limits in 1200–2–5–.60; or

(d) As authorized under 1200–2–5–.121, 1200–2–5–.122, 1200–2–5–.123 or 1200–2–5–.124.

(2) A person shall be specifically licensed to receive waste containing licensed material from other persons for:

(a) Treatment prior to disposal;

(b) Treatment or disposal by incineration;

(c) Decay in storage; or

(d) Disposal at a land disposal facility licensed under Chapter 1200–2–11.

Authority: *T.C.A. §§4–5–201 et seq., 68–202–203 and 68–202–206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200–2–5–.121 METHOD FOR GRANTING APPROVAL OF ALTERNATIVE DISPOSAL PROCEDURES.

(1) A licensee or applicant for a license may apply to the Division for approval of alternative procedures for disposal of radioactive material generated in the licensee's activities. Each application shall include:

(a) A description of the waste that contains the radioactive material to be disposed, including the physical and chemical properties important to risk evaluation;

(b) The proposed manner and conditions of waste disposal;

(c) An analysis and evaluation of pertinent information about the environment of the disposal site;

(d) The nature and location of other potentially affected licensed and unlicensed facilities; and

(e) Analyses and procedures to ensure that doses are maintained ALARA and within the dose limits in this chapter.

Authority: *T.C.A. §§4–5–201 et seq., 68–202–203 and 68–202–206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200–2–5–.122 DISPOSAL BY RELEASE INTO SANITARY SEWERAGE.

(1) A licensee may release radioactive material into sanitary sewerage if each of the following conditions is satisfied:

(a) The material is readily soluble in water or is a readily dispersible biological material; and

(b) The quantity of radioactive material the licensee releases into the sewer in any one month divided by the average monthly volume of water released into the sewer by the licensee does not exceed the concentration listed in Table III of Schedule RHS 8–30; and

(c) If more than one radionuclide is released, the following conditions shall also be satisfied:

1. The licensee shall determine the fraction of the limit in Table III of Schedule RHS 8–30 represented by its releases into sanitary sewerage. This shall be done by dividing the actual monthly average concentration of each radionuclide released by the licensee into the sewer by the concentration of that radionuclide listed in Table III of Schedule RHS 8–30; and

2. The sum of the fractions for each radionuclide required by (1)(c)1. of this rule does not exceed unity; and

(d) The total quantity of licensed and other radioactive material that the licensee releases into the sanitary sewerage system in a year does not exceed:

1. 5 curies (185 GBq) of hydrogen–3;

2. 1 curie (37 GBq) of carbon–14; and

3. 1 curie (37 GBq) of all other radioactive materials combined.

(2) Excreta from individuals undergoing medical diagnosis or therapy with radioactive material are not subject to the limitations contained in (1) of this rule.

Authority: *T.C.A. §§4–5–201 et seq., 68–202–201 et seq.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994. Amendment filed April 18, 2006; effective July 2, 2006.*

1200–2–5–.123 TREATMENT OR DISPOSAL BY INCINERATION.

A licensee may treat or dispose of radioactive material by incineration only in the amounts and forms specified in 1200–2–5–.124 or as specifically approved by the Division pursuant to 1200–2–5–.121.

Authority: *T.C.A. §§4–5–201 et seq., 68–202–203 and 68–202–206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200–2–5–.124 DISPOSAL OF SPECIFIC WASTES.

(1) A licensee may dispose of the following radioactive material as if it were not radioactive:

(a) 0.05 microcurie (1.85 kBq), or less, of hydrogen–3 or carbon–14 per gram of medium used for liquid scintillation counting; and

(b) 0.05 microcurie (1.85 kBq), or less, of hydrogen–3 or carbon–14 per gram of animal tissue, averaged over the weight of the entire animal.

(2) A licensee may not dispose of tissue under paragraph (1)(b) of this rule in a manner that would permit its use either as food for humans or as animal feed.

(3) The licensee shall maintain records in accordance with 1200–2–5–.137.

Authority: *T.C.A. §§4–5–201 et seq., 68–202–203 and 68–202–206.* ***Administrative History:*** *Original rule filed October 19, 1993; effective January 2, 1994.*

1200–2–5–.161 SCHEDULES.

RHS 8–30

ANNUAL LIMITS ON INTAKE (ALI) AND DERIVED AIR CONCENTRATIONS (DAC) OF RADIONUCLIDES FOR OCCUPATIONAL EXPOSURE; EFFLUENT CONCENTRATIONS; CONCENTRATIONS FOR RELEASE TO SANITARY SEWERAGE