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T-378

Bechtel National, Inc.

Interoffice Memorandum

To G. K. Hovey

Subject Cleanup of Am-241 in Tonawanda, NY

File No. 1700/155

Date January 19, 1987

From J. F. Schlatter JFS

Of

At Ext.

Copies to J. F. Nemec (w/o)
R. D. Glenn (w/att.)
W. C. Borden (w/att.)

As you requested, I obtained additional information about the cleanup of Americium-241 from a sewage plant in Tonawanda, NY. I talked on Friday afternoon (1/16) with Stan Waligora, the TMA/Eberline project manager. He was most helpful, and sent me a background report (copy attached).

The report gives background and technical detail. From talking with Stan, it appears that all state agencies have approved the cleanup plan and work may start "soon". There are three main areas of contamination: (1) about 30 tons of ash containing 300 pCi/gm of Am-241 in an incinerator at the sewage plant; (2) a large volume of contaminated ash in a landfill, containing an estimated 3 Curies; and (3) contaminated sewer lines. The plan is to ship the incinerator ash to Barnwell and stabilize the landfill material in place. I'm not sure about plans for the sewer lines.

Stan said the Township officials have been very cooperative. (They need to get the cleanup done. Their sewage plant only has two incinerators, and one is out of service because of this problem.) He said there have been some environmental groups making noise about the site. (Note: I need to find out more about how these groups view stabilization in place.)

Stan gave me the names of two contacts in the Town government: Ron Moline, Supervisor; and Roy Svensson, engineering department. Both can be reached at 716-877-8800.

I don't know the exact location of the sewage plant. From Stan's description, it is near the Niagara River upstream from Ashland/Seaway. I believe it is probably within about two miles of Ashland/Seaway.

I will take this information into account in developing a public information plan for the Ashland activities.

JFS:jfs
Attachment: As stated

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RECEIVED

JUN 8 1984

SUPERVISOR'S OFFICE

HIGHLAND Corr 2684 12/5/84 AJD

STATE OF NEW YORK—DEPARTMENT OF HEALTH

INTEROFFICE MEMORANDUM

To: See Below

From: Karim Rimawi, Director - Bureau of Environmental Radiation Protection KR

Date: June 6, 1984

Subject: Draft Report - Am-241 Contamination in Town of Tonawanda

Attached please find a copy of the draft report on the Am-241 contamination problem in the town of Tonawanda. Copies of this report have been distributed to members of the Advisory Committee on Radioactive Material in the Environment. A copy of the cover letter sent to members of the Committee is also attached.

I would appreciate your review of the attached report and providing me with any corrections or comments that you may have.

As you know, the Committee will be meeting to discuss this issue on June 12, 1984. The meeting is scheduled for 10:00 a.m. and will be held in Room 2293 of the Corning Tower Building. We are looking forward to your participation in this meeting.

Att.

TO:
Dr. Axelrod
Dr. Randolph
Mr. Leavy
Dr. Huffaker
Dr. Hetling
Dr. Stasiuk
Dr. Matuszek
Mr. Slocum
Dr. Vianna
Dr. Smith-Blackwell
Mr. O'Brien
Dr. Banks
Dr. Merges
Mr. Lacey
Mr. Schrank
Dr. Bradley
Mr. Kelly
Mr. Dunkleberger
Dr. Fakundiny
Mr. Moline
Dr. Thomas/Mr. Barry

Foreward

The attached draft report discusses the Americium 241 contamination problem that has been discovered recently in the Town of Tonawanda, New York. It summarizes the information related to this problem and the activities taken by the State in response.

The contamination appears to have resulted from the discharge of Americium 241 into the sanitary sewer line by EAD Metallurgical, Inc., a company that produced foils for use in smoke detectors between 1977 and 1983. Questions relating to whether the discharge involved any violations of regulatory, permit or license condition requirements is currently under investigation by legal staff, and is not addressed in this report. Also, this report does not address the liability questions and who will be ultimately responsible for the financial cost of the remedial actions required to correct this problem.

The report includes recommendations by the Bureau of Environmental Radiation Protection staff. These are not Department of Health positions.

Some of the estimates of concentrations, total amounts of Am-241 in a number of locations, potential intake by employees and associated risks are given to two significant digits. This does not imply a high degree of accuracy of these estimates, but only to make the calculations easily reproducible.

This draft has been compiled quickly in order to provide information for the review of the members of the Department of Health's Committee on Radioactive Materials in the Environment prior to their June 12th meeting. Some of the material included is based on hasty notes taken by Bureau staff during meetings. For the sake of providing the information to the Committee members as soon as possible, this information has not been properly reviewed by staff from the Department of Health or other State agencies. Thus, some of the information may be inaccurate. Also, some of the sample analysis results became available following the writing of certain portions of this draft. While some of the numerical estimates are likely to change when all data become available, we believe that most of the conclusions drawn in this report will not be altered by the new data.

Comments should be sent to the Bureau of Environmental Radiation Protection. All comments will be considered and we will attempt to incorporate all corrections in the final report.

1. Introduction

a. Background on EAD Metallurgical Inc.

EAD Metallurgical, Inc, Town of Tonawanda, New York, received a license for use of radioactive materials in March, 1977, from the State Department of Labor (DOL). The principle product was foil elements for use in smoke detectors. Each foil contained microcurie amounts of Americium 241. The original license was for 10 curies of Americium, but this was later amended to allow a larger possession limit, and at the time EAD terminated operation, the allowed possession limit was 200 curies of Americium 241.

In May, 1983, the company notified DOL that it had terminated operations due to economic conditions. In June of 1983, the remaining supplies, radioactive wastes, and equipment were sent by truck to Mexico. The trucks, estimated to contain 79 curies of Am-241, were impounded in Texas. They were allowed to continue the trip to Mexico after repackaging to meet transportation regulations.

EAD employees had performed a "decontamination" of the facility, but DOL found that the facility did not meet its criteria for release to unrestricted use, and advised EAD to try again. The second attempt was also unsuccessful, and a commercial firm (ENSA) was hired by EAD in 1984 to complete the decontamination.

In the process of decontamination, ENSA found indications that there could have been releases of Am-241 to the sanitary sewers while EAD was in operation, or during earlier decontamination efforts, or both (Attachment 1). They alerted DOL to the possibility that there could be off-site contamination, and that the State Department of Environmental Conservation (DEC) should be alerted to this fact.

b. Discovery of the Contamination Problem

On April 26, 1984, a joint inspection of the EAD facility was conducted by personnel from DEC and DOL. The inspection included radiation measurements and collection of several samples. Radiation measurements in the sanitary sewer leading from the EAD facility indicated the presence of radioactive materials in the line.

The Town of Tonawanda has a relatively new sewage treatment plant, which includes an incinerator to effect a volume reduction in the sludge. Attachment II describes the STP and details the sewage flow and treatment system. It also gives the amounts of ash produced between January 1975 and April 1984 (Cam, 84). Some of the ash from the incinerated sludge was used as a top cover at the nearby sanitary landfill. The DEC representative obtained a sample of the ash from incinerator #2, shut down in July 1983, at the sewage treatment plant, and from an area in the landfill where the material was placed at the surface about two years ago. Both samples contained easily measurable levels of Am-241, the incinerator ash having 500 $\pm$ 150 and the two years old ash having 300 $\pm$ 100 pCi/g. (All samples, other than water and wipe samples, are reported in concentrations per dry weight.

Following the analysis of these samples, personnel from DOH and DOL visited the sewage treatment plant and landfill. At the plant, about 40 wipe samples were taken to determine the extent of in-plant contamination. Radiation instrument surveys were carried out through the landfill, and areas were found where radiation levels were several times the background in the area. The finding of elevated radiation levels at the landfill, together with high levels of Am-241 in the incinerator ash indicated there was wide-spread contamination, which probably happened over a period of time, and was associated with the EAD operation, the only facility in Tonawnada using Am-241 in appreciable amounts.

2. Evaluation of Off-Site Contamination

   a. Surveys Conducted and Samples Taken

Following the initial indications of off-site contamination, plans were made to perform more detailed measurements to evaluate the problem. Attachment III contains descriptions of some of these surveys together with the results obtained. DOH personnel from Albany brought a FIDLER (Field Instrument for Detection of Low Energy Radiation) scintillation probe to Tonawanda. This instrument uses a large (5 in.) thin sodium iodide crystal which is very effective in detecting low energy gamma or x-ray photons. It was originally developed for measuring Plutonium contamination, but also works quite well with the 60 KeV photon associated with Am-241, when set appropriately.

The FIDLER was adjusted so as to allow measuring three separate count rates for each point surveyed. These correspond to gross counts, 60 KeV peak and 17 KeV peak. Readings corresponding to these three settings are indicated on the figures showing survey results.

Town Landfill:

The incinerator ash has a distinctive reddish color, so visual identification of areas where ash lay on the surface of the landfill was possible. The FIDLER and a smaller (2 in. diameter) Eberline PG-2 probe were used to characterize the Tonawanda landfill. Measurements at about 7 inches above ground taken at points defined by a 50 foot x 50 foot grid across the landfill, after reference stakes had been set up at 100 foot intervals. These measurements showed that levels of Am-241 contamination were detectable, and as one might expect, varied from area to area. The 60 KeV photon is easily attenuated in soil, so once the ash is covered with a few inches of clean fill, it is not easily seen. The highest reading obtained by the survey coincided with an area identified as having ash at the surface. This area was then surveyed using a 25 foot x 50 foot grid pattern.

In addition to radiation measurements, soil and ash samples were taken from the landfill and from the drainage area around it. Water samples were collected from a number of rainwater collection areas on-site as well as from drainage ditches and adjacent storm sewer systems. Seven leachate wells on or near the site were also sampled.

Figures 1 and 1a show the results of the radiation survey at the landfill and Figure 2 shows the location of soil and water samples taken from the landfill or adjacent areas. The results of these are given in tables 1 and 2.

STP:

More detailed surveys using the FIDLER were also conducted in the STP incinerator building (Attachment III). The survey confirmed the presence of contaminated ash in incinerator #2, in a truck in a loading area and some solidified ash cinders (clinkers) that have been saved by STP staff since April 17, 1979. Work areas and the roof of the building did not show any abnormally high radiation levels. Additional wipe samples, ash, clinker, sludge and soil samples were collected.

The results of the analysis of the sampels taken from the STP are listed in tables 3, 4 and 5.

Analysis of a sample from the mixed media filter outflow of the STP showed no detectable Am-241, indicating the majority of the activity remains in the ash. This filter is the last major treatment unit in the sewage treatment process used at the Tonawanda STP.

EAD and Surrounding Areas:

The evaluation of contamination on-site is being characterized by ENSA, Inc., a contractor of EAD. DOL has ordered EAD to submit a plan for decontamination of the site.

A survey of this area was carried out on May 17, 1984 (see figure 3). A few locations with elevated readings were found and soil samples were collected at these spots. A water sample and a sediment sample were aslo collected from the bottom of a storm sewer from a manhole which is next to the EAD property. A sediment sample was also collected from Two Mile Creek, near the outflow of the storm sewers. This was done to check for contamination that may have resulted from reported pumping of flood water at EAD. The results of these samples are given in tables 6 and 7.

Worker Home:

In the afternoon of May 17, 1984, a house in Tonawanda was surveyed. There was no indication of contamination in the area of shrubs and rose bushes. The owner of the house indicated that he had brought home some sludge from Tonawanda STP and placed it in the rose bushes area (figure 4).

Niagara Landfill:

Since March 1984, ash produced at STP has been shipped to the Niagara Landfill, also in the Town of Tonawanda. This landfill was also surveyed (figure 5) and soil samples were collected. During the survey, a truck carrying a load of fresh ash arrived at the site. An ash sample was also collected from this load. The results of the analysis of samples collected at this site are given in table 8.

Sewer Lines:

EAD was asked by the State to characterize the contamination in the sewer line between EAD and the Tonawnada STP. No data are available at this time. It should be noted that the EAD site decontamination process may lead to additional discharges into the sanitary system, should such practice be allowed to continue.

b. Survey and Sample Results

The survey and samples analyzed show that Am-241 contamination resulting from the ash is present in the STP and Town Landfill. The contaminated ash samples analyzed have concentrations that range from 160 ± 40 pCi/g to 750 ± 190 pCi/g.

In the STP the contaminated ash is found in three locations: incinerator #2, hopper #2 and a truck bed. This ash has been produced prior to July 1983. A large proportion of the wipe samples taken at the STP show detectable levels of Am-241. Assuming that these samples were wipes of 100 cm^2 area, the observed levels are within the regulatory limits (see section 4 of this report) for removable contamination, with the exception of one sample taken from the locker room sink on May 2, 1984.

The ash currently produced shows a low concentration of Am-241 of 10 ± 2 pCi/g.

Am-241 contamination is readily observed in areas of the Town Landfill, where the bulk of the contaminated ash was disposed. These areas coincide with those where ash is seen to be spread at the surface because of its characteristic brown color. One sample of the ash taken from the landfill shows a concentration of 300 ± 100 pCi, which is similar to those taken from incinerator #2 at the STP. One water sample taken from rain water accumulated at the surface in the landfill shows a gross alpha concentration above the detection limit. The measured concentration in this sample was 19 ± 15 pCi/l. Leachate wells and runoff water samples did not show any concentrations exceeding the detection limit.

The survey of the Niagara Landfill did not show any evidence of ash with high Am-241 concentrations. The ash sample collected at the site (10 ± 3 pCi/g) confirmed the result obtained from a prior sample of the ash being currently produced.

The EAD vicinity survey revealed the presence of a number of hot spots. While the sediment sample from the manhole near EAD did not show any detectable Am-241, the one taken downstream from Two Mile Creek had a concentration of 4.8 ± 1.2 pCi/g. It is not clear whether this is a result of runoff from EAD grounds or resulted from reported pumping of flood water at EAD facility into the storm sewer system. Additional sediment samples will be collected from Two Mile Creek.

In addition to the samples discussed above, air filters collected by Erie County between 8/80 and 11/80 from an air sampler located at the roof of Riverview School (near the Tonawanda Landfill) showed no detectable Am-241. These were scanned in two large groups to see if Am-241 could be detected. No detection limits are available as these filters were not individually measured.

c. Results of the Aerial Survey

The U.S. Department of Energy (DOE) was requested and agreed to arrange for EG&G to conduct an aerial survey of the affected areas in an attempt to measure Am-241 contamination, and to characterize the background radiation levels in the area. The survey, which was carried out during the week of May 20, 1984, covered the EAD facility, the Tonawanda Sewage Treatment Plant and Landfill. NRD, another facility which manufactures Am-241 foils in Grand Island, and the Grand Island Sewage Treatment Plant were also covered by the survey, even though there has been no indication that a similar problem existed there.

The lower limit of detection depends upon flight specific conditions, including altitude, pass spacings and speed, the detection instruments used, the nature and distribution of the radioactive material measured and the size and depth of the contaminated area. The general background radiation level in an area is also expected to affect this limit. The lower level of detection for this flight is expected to be approximately given as follows (telephone conversation from Harvey Clark on 5/25/84):

Size of Contaminated Area	Concentration in Surface Layer LL D (pCi/g Am-241)
400 foot diameter circle	20-40
40 foot diameter circle	about 50
10 foot diameter circle	700-1000 pCi/g

Complete analysis results of the aerial survey are not expected to be available for two to three months. However, preliminary data can be summarized here (Clark, 84).

Tonawanda:

An area of 3-mile x 3-mile was covered (the area becomes narrower at the northern end as the flight pattern followed the East branch of the Niagara River). The survey included two flights, one at 300 foot elevation with 500 foot spacings and another at 100 foot elevation with 170 foot spacing. Hover surveys were carried out over the Tonawanda STP sludge tanks and portions of the Two Mile Creek. The contamination in the Tonawanda Landfill was the only Am-241 contamination that could be detected.

Grand Island:

Two 1-mile x 1-mile areas were surveyed. The first area was centered around the NRD facility. The second was centered around the Grand Island STP. The presence of Am-241 in NRD was easily detected. The survey, however, showed it to be well-localized on-site with no evidence of spread beyond areas it is expected to be. No evidence of Am-241 was observed in the Grand Island STP. The results of the aerial survey do not indicate any areas of significant Am-241 contamination that have not been covered by the ground surveys.

d. Estimated Activity Off-site

Information for obtaining detailed estimates of activity off EAD site is not available. However, one can make order of magnitude estimates based on the results of the samples available. Reporting estimates in the following to two significant figures is for ease of reproducing the calculation, and does not imply that level of accuracy of these estimates.

Sewer Lines:

No data are available at this time to enable us to estimate activity of Am-241 in the sewer lines.

STP:

The main contamination in the Tonawanda STP occurs in the ash in incinerator #2, hopper #2 and the truck containing ash and clinkers produced on or before July 1983. The total weight of these is estimated at 30 tons (verbal telephone communication).

Four samples have been taken the contaminated of ash or clinkers in the STP (other than one sample of clinkers collected on 4/17/79). Three of these have been analyzed with measured concentrations of 500 ± 150, 750 ± 190 and 180 ± 40 pCi/g. If one assumes the average concentration of 480 ± 290 pCi/g to represent the concentration in the ash, a total activity of about 14 ± 9 mCi Am-241 is estimated to be present in the STP.

Town Landfill:

As EAD started production in late 1977, we'll assume that the production of ash contaminated with Am-241 began in January 1978. Also, as indicated above, ash produced in July 1983 has an average concentration of about 480 ± 290 pCi/g. On the other hand, a sample of ash produced in May 1984 has a measured concentration of 10 ± 2 pCi/g. It is not known when the reduction in concentration occurred. We will assume that it occurred at the end of 1983.

During the period from January 1978 till January 1984, the STP produced a total of 10026 tons of ash. All of this ash except for the 30 tons still in storage at STP, was sent to the Town of Tonawanda Landfill.

The average concentration of Am-241 in this ash will be assumed to be equal to the average concentration in five samples of ash analyzed so far (one 1979 clinker, one 1981 ash, and 3 1983 ash samples). The average concentration in these samples is 380 ± 250 pCi/g.

The total Am-241 activity in the landfill is thus estimated at 3.8 ± 2.5 Ci.

3. Estimates of Public Health Impact

a. Characteristics of Americium 241 and Risk Estimates

Americium is a transuranic element with atomic number 95. Am-241 does not occur naturally, but is produced from the decay of Pu-241. It decays with a half-life of 458 years by emitting alpha particles with energies between 5.388 and 5.544 MeV. The alpha decay is followed by a number of gamma rays, conversion electrons and x-rays that are produced in the daughter atom. The main photons emitted are 60 and 26 KeV gamma rays (0.36 and 0.026 photons/transformation respectively) and L x-rays of neptunium with energies centered about 18 KeV (0.38 photons/transformation).

Due to the fact that photons emitted in the decay of Am-241 are of low energy, the external exposure rates from Am-241 are small (8.7 mrem/hr at 1 m per Ci). Thus Am-241 would present a significant risk only if deposited internally. Americium may enter the human body through inhalation, ingestion or wounds. Its absorption through intact skin is small.

The absorbed fraction of Americium entering the human body is deposited primarily in the liver and skeleton with lesser amounts in the kidney and spleen (NCRP, 80). The effective half-life for Am-241 is 40 years for the liver and 140 years in the bone (NCRP, 80). ICRP-30 (ICRP, 79) gives the biological half-life for Americium as 40 years for the liver and 100 years for bone, and assigns Americium compounds (including oxides) to inhalation Class W.

The fraction of Americium transferred from the GI tract to body fluids is small. ICRP-30 gives a value of 5×10^{-4} for this fraction. 45% of the Americium transferred to body fluids is assumed to be translocated to bone, 45% to the liver and the remaining 10% is translocated to the remainder of other organs, or is excreted.

Using ICRP-30 methodology, Oztunali and Roles (NRC, 84a) calculated the 50 year dose committment to a number of organs that will result from the inhalation or ingestion of 1 pCi Am-241. The whole body equivalent 50 year dose committment for 1 pCi inhaled is 0.56 mrem/pCi for Class W. On the other hand, this value for the ingestion of 1 pCi is 4.6×10^{-3} mrem/pCi.

BEIR III estimates the lifetime risk of cancer mortality induced by continuous lifetime exposure to a total dose of 1 rad low LET radiation to be 67×10^{-6} (absolute model) or 169×10^{-6} (relative model). UNSCEAR (1977) report gives the estimated risk as $75 - 175 \times 10^{-6}$. NCRP uses the risk factor of 10^{-4} per rem (NCRP, 84), which is approximately the geometric mean of the ranges given by these reports.

Estimating doses in terms of whole body equivalent allows us to use these risk estimates for Am-241. Thus, using the 10^{-4} per rem risk factor, one can estimate the cancer mortality risk associated with Am-241 to be 5.6×10^{-8} per pCi inhaled, and 4.6×10^{-10} per pCi ingested.

As seen above, the risk associated with the ingestion of a certain amount of Am-241 is two orders of magnitude lower than the risk associated with inhaling a similar amount. Thus, unless one assumes significant contamination to drinking water, ingestion of Americium in amounts that will lead to doses equivalent to those from inhalation is highly unlikely for the short term (100 years), and this pathway will not be considered.

b. Groups at Risk

When evaluating the public health impact in the case of the contamination in Tonawanda, one needs to consider the various groups that are likely to have been exposed to the Americium and the likely pathways that would lead to their exposure. In tracing the material since it left the EAD plant, one can divide the various groups into two segments: (1) the Town employees; and (2) the general public.

The Town of Tonawanda employees that are likely to have come in contact with the Americium fall into three subgroups:

1) those entering the sewer line between EAD and the Sewage Treatment Plant (STP)
2) Sewage Treatment Plant employees
3) Town of Tonawanda Landfill employees

The general public exposure can result from:

1) migration of ash from the STP or the landfill via air or water runoff;
2) frequenting the landfill to dump trash or to ride motor cycles; or

3) use of ash in homes for gardens or as fill.

The major exposure pathway to the workers at the sewage plant is from airborne activity. The process of incineration of sewage sludge leads to dusty areas where dry ash is handled, or transported. Similarly, workers at the landfill could be exposed to airborne ash placed on the ground surface and disturbed by landfill operations. This airborne dust might also be carried by the wind to residential areas near the landfill.

c. Worker Exposure

Workers who enter the sewer line between EAD and the STP are not likely to inhale any Americium. The external exposure is fairly small. The only potential pathway for exposure in this case would arise from eating or smoking without washing hands or from wound contamination. As the potential hazard from biological materials in the sewer line is likely to exceed that from radioactivity, one would assume that proper hygiene was practiced by these employees.

The groups most likely to have received the largest exposure to Americium are those employed at the STP, especially those frequenting the dust room (which contains the ash hoppers) and the loading areas, and the employees operating heavy equipment at the landfill.

In order to estimate the exposure to these individuals, a number of assumptions need to be made relative to the suspended Americium concentration in work areas, time spent in such areas, breathing rates, in addition to the assumptions introduced in the dose conversion factors presented in 3a. above. The dose for a worker is estimated making the following conservative assumptions (in the sense that they are viewed as maximizing the estimated dose):

1) Am-241 concentration in ash is constant = 500 pCi/g
2) Dust mass loading in air 300 ug/m^3 of particles with AMAD of 1 um
3) A worker breathes 10 m^3/day, 5 days/week, 50 weeks/year
4) A worker spends 1 hr/day in air satisfying assumption 2 above. The other 7 hours are spent in an atmosphere where the dust loading is 100 ug/m^3.

Under these assumptions, a worker would have inhaled 940 pCi of Am-241 during the six year period (1977-83) that EAD operated. This will result in a 50 year committed whole body dose equivalent of 530 mrem. The risk of cancer mortality associated with this dose is estimated to be about 5×10^{-5}. This represents an increase of 1/3000 of the expected mortality rate from cancer.

Due to the uncertainties associated with the assumptions made in estimating the activity of Am-241 inhaled by the Town employees, it was felt that a whole body scan (both lung and skeleton) of a representative sample was necessary to determine if any measurable uptake has occurred Four employees, two from the STP and two from the Town landfill were selected from those most likely to have been exposed to dust. These travelled to the New York University's Institute of Environmental Medicine, in Tuxedo, New York, where whole body counting was performed. The lower level of detection for these measurements was 250 pCi lung and 1000 pCi skeleton. No Am-241 was detected in excess of the lower level of detection in any of the four employees.

d. General Public Exposure

Exposure to a member of the public not frequenting the landfill may result from:

1) Airborne releases from the STP
2) Airborne fugitive dust from the landfill
3) Due to water runoff from the landfill or the STP
4) Due to leachate from the landfill
5) Americium in water flowing out from the STP
6) From discharging to the storm sewer system contaminated water from EAD when pumping flood water

Water: While no drinking water supplies have been identified that may have been directly impacted by any water releases, the various possible water contamination routes have been sampled. Analysis of the filter medium in the outflow of the STP showed no measurable Am-241 contamination. Sediments were

collected from the Two Mile Creek, downstream from the landfill and from the storm sewer system outside EAD. Water samples were also collected from 7 leachate wells in the landfill.

Air: In order to determine historical airborne radioactivity from the STP and landfill, air (hi vol) filters were obtained from Erie County and from DEC. Erie County filters collected between August and November, 1980, were examined and showed no detectable Am-241 content.

Soil samples were collected from areas adjacent to the STP and landfill. In addition, if requested, we will collect and analyze some dust samples from houses near the landfill.

While not all samples have been analyzed, all indications obtained so far point to no significant public exposure to Am-241 migrating through air or water from the contaminated locations.

Persons Frequenting Landfill: Persons frequenting the landfill are expected to receive some exposure, mainly due to inhalation of suspended contamination. This is particularly the case for bikers who use the landfill in dry periods. While appropriate data for estimating the intake of Am-241 for such a group are not available, one may obtain estimates based on certain assumptions. We will assume:

1) A person rides a bicycle on the landfill an average of 5 hours/week
2) Dust loading during this period is 300 ug/m^3
3) 20% of area used by cyclist has uncovered ash
4) Am-241 concentration in ash is 500 pCi/g
5) Air volume inhaled is 20 m^3/day

Under these assumptions, one can calculate a total intake of 0.75 pCi in a period of six years. This leads to a committed whole body dose equivalent of 0.4 mrem. The risk of cancer mortality associated with this dose is 4×10^{-8}.

Homes: In response to our questioning, only one employee indicated that he had taken a few bushels of ash to use in his rose garden. A survey of the garden (using the FIDLER instrument) showed the radiation levels within the rose garden to be less than those on the lawn (see 2a).

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Limits for allowable soil contamination in unrestricted areas do not exist except in Code Rule 38 (DOL). U.S. Environmental Protection Agency (EPA) has established the radiation dose guideline for soil contaminated with transuranic elements such that no individual will receive a radiation dose in excess of 1 millirad per year to the lung and 3 millirad per year to the bone from exposure to the contaminated soil (EPA, 77). NRC has determined that a soil concentration of 30 pCi/g Am-241 will satisfy the EPA guideline (NRC, 81).

NRC has issued a branch position addressing dealing with soils contaminated with U and Th following their discovery. These are given in attachment IV. This guideline outlines a graduated system of controls over the contaminated soil that depends upon the concentration of the contaminant. A similar guideline has been proposed by NRC for use in this case (NRC, 84b). The criteria proposed for disposal of Am-241 by burial in a local site can be summarized in the following table:

Option #	Am-241 Soil Concentration pCi/g	Suggested Disposal Restrictions
1	30	No restrictions on burial method
2	250 (insoluble)	Minimum depth of 4 feet felow surface Material stablized to prevent its transport away from the site Notation in the deed
3	NA	
4	2500 (insoluble)	Minimum depth of 4 feet below surface Material is stablized to prevent its transport away from site Restrictions on future land use Notation in the deed

c. Coordination of State Activities

Due to the fact that several State Agencies are involved in the EAD situation, an interagency task force under the direction of Dr. Axelrod, Commissioner of Health, was set up to coordinate activities of the Agencies. William Stasiuk, of DOH, was appointed as the task force coordinator.

6. Need for Further Actions

The actions taken by the State agencies and the available results have been presented above. A number of questions remain unanswered. The need for further actions by the State to obtain more detailed information on these questions is examined briefly in the following:

a. Whole Body Counting of Additional STP or Landfill Employees:

In view of the fact that Am-241 uptake has not been observed in any of four employees scanned, and in view of calculated uptake under conservative assumptions, we feel that additional whole body scans are not likely to show measurable uptake by any of the employees. However, some employees feel that they have been exposed to higher levels of dust than those already scanned, and thus may have been subject to greater intake of Am-241. In order to reassure these workers, and possibly others, who were exposed to less amounts of dust, a small number may be selected for a whole body scan. Interviews will be held June 8 with each of the concerned workers to determine the extent of their exposure to contaminated dust.

b. Characterization of Material Buried in the Town Landfill:

If the decision is made to exhume the material in the landfill and dispose of it in a low level radioactive material waste site, a detailed characterization will be necessary. However, if it is decided to stabilize the material on site, such a detailed characterization may not be necessary. As this is expected to be a costly operation, we propose to take one or two cores at the site and analyze samples from one. While this does not give us a detailed picture of the activity below the surface, it will be used, in conjunction with the description of the operation by the landfill operators, to give a general idea of how the material is buried on site.

c. EAD Decontamination Plan

New York State Department of Labor has requested such a plan from EAD. Once approved by DOL, this will be used for the decontamination of the site.

5. Remedial Action Options

The areas that need to be considered, other than the EAD facilities, are the Town of Tonawanda Landfill, the Niagara Landfill, the Sewage Treatment Plant (STP), and the sewer line between EAD and STP.

In determining the need for remedial action, one needs to consider the levels of contamination, applicable regulatory limits and the exposure pathways to man. The options for the various sites will be examined individually. The feasibility and cost of the proposed action need also to be considered when examining the options.

a. Niagara Landfill:

This landfill is currently receiving the ash produced at STP. It started receiving ash in March 1984, about 10 months after EAD terminated its operations. Ash received by this landfill is normally buried as waste. In some cases the ash has a cover of about 10 feet of uncontaminated material. Any Americium contamination in the ash would result from the continuing discharge by EAD during their decontamination process, release of accumulated material in the sewer line back into the sewage flow, and from the residual contaminant in the sewage treatment plant itself, whether in the sludge holding tanks, the incinerator or the hopper.

Two questions need to be addressed: (1) Should any action be taken with regard to the ash already in the landfill; and (2) should the practice of sending ash to it be discontinued.

Two samples of ash produced following March 1984 have been analyzed. The observed concentrations were 10 ± 2 pCi/g and 10 ± 3 pCi/g. We will assume that the average concentration calculated from these samples is representative of the activity in the ash that has been disposed of in the Niagara Landfill. As this concentration is well within the NRC proposed guideline of 30 pCi/g for control of material already in the environment, there appears to be no need for remedial action.

The regulations do not specify a level of contamination below which waste can be disposed of as non-radioactive waste, except for the special case of H-3 and C-14 in certain specific media. Thus, technically, the 30 pCi/g limit is developed for deciding whether remediation of an existing situation is needed and not for allowing the disposal of waste containing less than this limit.

Since a certain degree of control still can be exerted on the ash still being produced at STP, the practice of disposing of it in Niagara Landfill warrants further examination. The decision whether to alter the process should be examined in view of the public health impact and the ALARA principle, rather than in terms of the regulatory definition of radioactive waste.

Assuming a concentration of 10 pCi/g and using the same assumptions used in 3c. above, one can obtain an estimate for the 50 year dose committment to a worker at the site. For each year of work, the estimated whole body committed dose equivalent is 2 mrem. The lifetime risk of cancer mortality associated with this dose is estimated to be less than one per million. Noting that the Americium reservoir is being continuously depleted, one would not expect the Am-241 concentration to continue at this level for any significant length of time. As the incremental increase in risk is not expected to exceed 10^{-6}, we feel that there is no need to alter the current practice of disposing of the ash in the Niagara Landfill.

b. Town of Tonawanda Landfill

Immediate action was not determined to be required as the site did not pose an immediate health threat. In fact, the large amount of rainfall at this time of the year helps suppress potential air resuspension of Americium. In order to minimize any unnecessary exposure to the landfill workers, it was recommended to the Town of Tonawanda that dust suppressants such as calcium chloride, or water, be used when covering ash in the landfill.

The presence in this landfill of contaminated ash with concentrations in the hundreds of pCi/g warrants remedial action. Two options will be examined: (1) removal to a low level radioactive waste site; and (2) stabilization on site.

Removal to a low level radioactive waste site:

Availability of a site:

As the concentration of Americium 241 in any part of ash is not likely to exceed 100 nCi/g, the Richmond, Washington, site will accept it for disposal as low level radioactive waste.

Cost: EAD started production in late 1977 and terminated operations in May 1983. A sample of ash generated at the STP in July 1983 showed an Am-241 concentration of 500 ± 150/pCi/g. On the other hand, ash produced in May 1984, had a concentration of 10 ± 2 pCi. The exact time of the drop of Americium concentration is not clear. We will assume that all ash produced between January 1978 and January 1984 is subject to remedial action. STP reports a total ash production (Attachment II) of about 10^4 tons during this period. Over 76,200 55-gallon drums would be required to package the ash (assuming a density of ash of 0.63 g/cm^3). The cost of disposal of such an amount is estimated to exceed $22.8 million. This estimate does not include the cost of the required detailed radiological characterization of the site, removal and packaging of the material, nor the restoration of the site.

On-site Stabilization:

In a letter dated May 10, 1984, from T.E. Murley to Commissioner H.G. Williams (NRC, 84a), NRC suggested using criteria similar to those described in their Branch Technical Position on "Disposal or On-site Storage of Thorium and Uranium Wastes from Past Operations) (NRC, 81) (Attachment IV).

The measured concentration of Am-241 in all samples of ash produced on or prior to July 1983 exceeds the 30 pCi/g limit. Furthermore, it does not seem likely that the concentration in any portion of the ash exceeds 2500 pCi/g. This is born out by the fact that all concentrations observed in five different samples of ash produced at differing times are less than 1000 pCi/g.

Thus, Option 2 appears to be applicable in this case. As most of the material at the landfill is already buried to depths which may exceed the suggested four foot depth, Option 2 criteria can be easily applied. Should the State use this option, noting the deed and requiring restrictions on future land use need to be considered, as well as the need for a routine radiological monitoring program in order to assure that material is not migrating off-site.

It should be pointed out that removal of the ash also involves additional risks associated with exposure to workers, potential spread off-site and transportation of the material to a disposal site. No attempt at quantifying these risks is made here.

c. Sewage Treatment Plant (STP)

The contamination in the STP was found to be limited to the ash produced on or before July 1983. The concentration of Am-241 in contaminated ash or clinker samples collected at the STP ranges from 160 ± 40 to 750 ± 190 pCi/g. The volume of this ash is estimated to be about 1900 cubic feet. The contaminated ash is currently stored in incinerator #2, which has been inactive since July 1983, hopper #2 and in the bed of a truck in one of the loading areas. Thus, in addition to the ash, it should be assumed that incinerator #2, hopper #2, and the truck are contaminated, and remedial actions to be considered need to address both ash and equipment.

As the material in the STP is still controlled and has not been disposed of in the environment, proper handling and disposal is required. This should be done subject to review and control of the appropriate regulatory agency, i.e. DOL.

Option 1:

Regulations require the material be disposed of as radioactive waste by packaging and shipping in accordance with U.S. Department of Transportation requirements to a licensed low level radioactive waste disposal site.

The disposal of 1900 cubic feet of material is expected to cost at least $77,500 (not including decontamination or handling cost).

Option 2:

The total amount of Am-241 in the ash is estimated, assuming uniform contamination, to be about 14 ± 9 mCi. The total amount of activity in the Town Landfill is estimated to be 3.8 ± 2.5 Ci. Thus, the amount of Am in the STP is expected to be less than 2% of that already in the Town Landfill. Adding this ash to the landfill is not expected to increase the health risks by an appreciable amount. Thus, if the State selected the option to stablize the material on site, the STP ash may be added to the Town landfill under a special exemption.

STP Decontamination Criteria:

The regulatory limits for acceptable fixed and removable contamination are given in table 10. These limits are required to be achieved by the decontamination process.

Should it prove impractical to achieve these limits at a reasonable cost, an examination of the accessability of the contaminated areas and the estimated exposure to workers need to be considered in setting an acceptable residual contamination level.

d. Sewer Lines

The surface contamination limits (table 10) assume the unrestricted release of areas and equipment, with the inherent assumption of potential continuous use and lengthy contact with the contaminated surfaces. The disposal of radioactive materials in the sewer system is allowable by the regulations, subject to the limits given in table 9. While the regulations require the material disposed of in this method be "readily soluble or dispersible," it is possible that certain amounts of the material will be fixed to the sewer line through sedimentation, absorption or ion exchange. The discharge of material at the allowable concentration limit of 8×10^{-4} uCi/ml may lead to fixed and removable contamination of the sewer lines that exceed the limits in table 10.

This raises the question of whether the limits for fixed and removable contamination given in table 10 are appropriate to apply in this case. NRC's letter of May 10, 1984, (NRC,84b) states that although table 10 limits are not directly applicable to contamination in the sewer line, they may be used as a conservative goal in evaluating contamination in the underground sewer line. The decision whether to use these limits should be made taking into consideration the nature and levels of the existing contamination, the risks associated with continued use and eventual replacement of the lines, and the cost of achieving the decontamination.

Some of the alternatives that should be examined include no action, flushing the sewer lines, replacement or use of a parallel line, leaving the current one in place. In view of the fact that no information is available at this time on the contamination in these lines, no further discussion of alternatives is presented here. If data are available, they will be provided for discussion at the meeting.

d. Ground Water Contamination:

A sump pit 8' x 8' area and 11' deep at EAD has been found to be contaminated. The pit sides we supported with concrete blocks, but the bottom is dirt. EAD has been asked by DEC to investigate the potential of ground water contamination. Results of the investigation are not available at this time.

7. Staff Recommendations

On the basis of the available information and discussions of risk and cost estimates described in the report, the staff recommends the following remedial actions be taken as soon as possible:

a. Sewage Treatment Plant - Town of Tonawanda ONLY PROBLEM IS AT INCINERATOR #2

1) DOL issue an order to EAD to decontaminate the STP

2) Decontamination waste including contaminated ash and clinkers produced during or before July 1983 can be buried at the Town Landfill

3) The regulatory limits for surface contamination should be used as a target for decontamination of equipment surfaces. Inaccessibility and limited potential future exposure may be considered in relaxing these limits should it prove a hardship to achieve them.

4) Continue to dispose of current ash at Niagara Landfill

b. Town of Tonawanda Landfill:

NRC COSTELLO

1) Stabilize material on site. Cover with clean soil to a minimum depth of four feet. NOTATION TO DEED.

2) Make a notation on the deed indicating the estimated ash volume and Am-241 activity buried and delineating the areas where material is buried.

3) Issue a Commissioner's Order restricting future use of the land to activities that do not involve disturbing the soil at a depth below four feet and to exclude farming.

4) Include both sediment in runoff areas and some leachate wells in the routine State monitoring network.

c. EAD Site:

Continue decontamination according to DOL regulatory requirements. Since waste may include foil pieces which may exceed NRC's Part 61 limits for shallow land burial, this waste should be excluded from burial at the Town Landfill.'

d. Niagara Landfill:

No further action is needed.

e. Sanitary Sewer Lines:

No recommendations are made pending the results of the characterization of contamination in these lines.

f. Storm Sewers and Two Mile Creek

Since observed concentration in samples analyzed is well within the 30 pCi/g action level, no action is recommended, unless additional sampling data indicate otherwise.

References

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EPA, 77	42 FR 60956-60959
ICRP, 79	"Limits for Intake of Radionuclides by Workers," ICRP Publication 30, 1979
NRCP, 80	"Management of Persons Accidentally Contaminated with Radionuclides," NCRP Report No. 65, Issued April, 1980.
NCRP, 84	"Exposures from the Uranium Series with Emphasis on Radon and its Daughters," NCRP Report No. 77, Issued April, 1977
NRC, 81	September 15, 1981 Memorandum from R.E. Cunningham to H.D. Thornburg
NRC, 81a	46 FR 52061-52063
NRC, 84a	"De Minimis Waste Impacts Analysis Methodology," prepared by O. I. Oztuneli and G.W. Roles, NUREG/CR-3585, February, 1984
NRC, 84b	Letter from Thomas E. Murley to Commissioner Henry G. Williams, dated May 10, 1984
UNSCEAR, 77	"Sources and Effects of Ionizing Radiation," United Nations Scientific Committee on the Effects of Atomic Radiation, 1977 Report

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STATE OF NEW YORK—DEPARTMENT OF HEALTH

INTEROFFICE MEMORANDUM

To: Ronald Moline, Tonawanda Supervisor

From: William J. O'Brien, Radiological Health Specialist, Buffalo Area Bill O'Brien

Date: May 31, 1984

Subject: Personnel involved in Am-241 Investigation

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