44-8035

UNITED STATES NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT

REGION III

IE Investigation Report No. 76-01

Subject: Cotter Corporation
Hazelwood, Missouri
License No. SUB-1022 (Terminated)

Allegations regarding the disposal of uranium ore residues were partially substantiated.

Period of Investigation: June 22-24, and August 11, 1976

Investigators: G. A. Phillip (6/22-24/76) — 1-4-77 (Date)

W. B. Grant (6/22-24/76 and 8/11/76) — 1-4-77 (Date)

A. G. Januska (8/11/76) — 1/4/77 (Date)

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Reviewed By: G. T. Lonergan, Chief, Materials Radiological Protection Section — 1/5/77 (Date)

J. A. Pagliaro, Chief, Environmental and Special Projects Section (10/20/76) — 1/5/77 (Date)

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REASON FOR INVESTIGATION

Following receipt of a letter dated June 2, 1976, from the Missouri Department of Natural Resources, forwarding newspaper articles containing allegations regarding the disposal of uranium ore residues, Region III initiated an investigation.

SUMMARY OF FACTS

A report on an inspection conducted by Region III on April 10 and 21-24, 1974,[1/] stated that according to licensee representatives the stockpile of the source material previously stored by Cotter Corporation under License No. SUB-1022 at 9200 Latty Avenue, Hazelwood, Missouri, had been shipped to its facilities in Canon City, Colorado by mid-1973 with the exception of 8700 tons of leached barium sulfate. The report further states: "Records maintained by Cotter Corporation showed that this material contained from 0.05% to 0.1% or approximately 7 tons of uranium as U_3O_8. Licensee representatives stated, and records of invoices paid to B&K Construction Company show, that this material along with approximately 38,000 to 39,000 tons of soil removed from the top 12 to 18 inches of the Latty Avenue site was disposed of in St. Louis County sanitary landfill area No. 1 on Old Bridge Road over the period July 31 through October 12, 1973." The report further states: "This material was hauled to the landfill area and used as cover for part of the several hundred truckloads of garbage and refuse that are shipped to the landfill area site every week. The licensee estimates that the barium sulfate is probably buried under 100 feet of garbage at this time. The trucks were hosed out after hauling this material."

Subsequently, on November 13, 1974, in response to a request from Cotter Corporation, License No. SUB-1022 was terminated.

By letter dated June 2, 1976, the Director, Division of Environmental Quality, Missouri Department of Natural Resources, sent copies of news articles appearing on May 30 and June 1, 1976 in the St. Louis Post-Dispatch which indicated that the information in the inspection report was inaccurate. Specifically, the news articles indicated that:

a) Only 9 tons of waste rather than nearly 40,000 tons of waste and soil had been moved from the Latty Avenue site.

b) The material was dumped at West Lake Landfill rather than St. Louis County landfill No. 1.

In his letter the Director, Division of Environmental Quality, stated that the depth at which the material was reportedly buried must be

1/ RO Inspection Report No. 040-8035/74-01.

incorrect since no St. Louis area landfills contained 100 feet of fill.

It was ascertained that:

a. During the period July 16 to October 9, 1973, over 43,000 tons of waste and soil were removed from the Latty Avenue site.

b. The 43,000 tons of waste and soil were dumped at the West Lake Landfill.

c. The material dumped at West Lake Landfill is covered by about 3 feet of other soil.

The inaccurate information in Inspection Report No. 040-8035/74-01 regarding the identification and location of the landfill area apparently resulted from miscommunication between the inspector and the B&K Construction Company representative. The erroneous information regarding the depth at which the residue was reportedly buried was based upon information furnished by the licensee who expressed this offhand opinion.

Environmental samples were taken and beta-gamma surveys were made at the Latty Avenue and West Lake Landfill sites on August 11, 1976. The Latty Avenue site and environs was revisited on October 20, 1976, for additional environmental samples and alpha, beta-gamma direct surveys. The report for the October 20, 1976 visit appears as Attachment D in this report. The Latty Avenue environmental samples confirm the removal of the bulk of materials but show that some residues remain. The Latty Avenue surveys showed radiation levels exceeding NRC criteria for decontamination of land areas prior to return to unrestricted use. The West Lake Landfill surveys indicated that radioactive material is buried there, and one environmental sample showed a slightly elevated natural uranium concentration. Based on the direct radiation surveys, neither site presents an immediate radiological health hazard to the public.

For the environmental transport pathways evaluated, a hazard analysis indicates that the material disposed of at the West Lake Landfill does not pose any immediate hazard to the public presuming the presence of 7 tons of natural uranium.

Solubility tests of the soil samples were not conducted, however, U_3O_8 combined with barium sulfate is known to be insoluble in water. Groundwater was not available for sampling at the West Lake Landfill site. A sediment and surface water sample was taken from a creek near the Latty Avenue site.

No items of noncompliance were identified during this investigation.

SCOPE OF INVESTIGATION

This investigation was conducted to determine the circumstances relating to the disposition of about 8700 tons of leached barium sulfate from the former licensee's facility at Hazelwood, Missouri and consisted of a review of pertinent records, independent sampling and measurements and interviews of individuals.

CONCLUSIONS

1. About 8700 tons of leached barium sulfate containing about 7 tons of U_3O_8 were mixed with about 39,000 tons of soil at the Latty Avenue site as reported by the licensee during the April, 1974 inspection. The residue-soil mixture was transported to the West Lake Landfill area in St. Louis County where it is covered by approximately 3 feet of other soils instead of 100 feet as reported by the licensee during the April, 1974 inspection.

2. Environmental soil samples indicate the continuing presence of some uranium and thorium ore process residues at the Latty Avenue site. Beta-gamma surveys performed by IE:III personnel at that site on August 11 and October 20, 1976, indicate levels of direct radiation exceeding the criteria established by NRC for decontamination of land areas prior to release for unrestricted use. Further, these levels were found to be greater than those reported by the licensee in his application for termination of the license dated May 10, 1974.

3. Based on direct radiation measurements of the material present at the West Lake Landfill and at the Latty Avenue site, neither location presents an immediate direct radiation health hazard to the public.

4. It is estimated, using uniformly conservative assumptions, that the concentration of natural uranium in the West Lake Landfill could result in increased airborne concentrations of radon 222 and its progeny, directly over buried materials, of about one-half of the 10 CFR 20 limits for unrestricted areas.

5. It is known that significant increases in indoor radon 222 concentrations can be experienced in dwellings built in or on disposed tailings. Physical and chemical differences between tailings materials, however, prohibit a direct comparison between what might occur in dwellings constructed in the West Lake Landfill as against the results of previous studies. A complete environmental impact analysis, specific to the materials at the landfill, should be performed to quantify the potential for radon buildup in dwellings built at the landfill.

DETAILS

Introduction

By letter dated June 2, 1976, Mr. Kenneth M. Karch, Director, Division of Environmental Quality, Missouri Department of Natural Resources, forwarded to Region III copies of articles published in the St. Louis Post-Dispatch on May 30 and June 1, 1976 which he stated in his letter ". . . presented evidence that some seven tons of uranium were dumped in 1973 at the West Lake Landfill in St. Louis County by an Atomic Energy Commission subcontractor removing radioactive waste material from a site in Hazelwood, Missouri." Mr. Karch stated in his letter that: "The investigation by the Post-Dispatch indicates that AEC did not know the correct location of the dumping, the local geology, nor the actual concentration of uranium dumped. The depth cited must also be incorrect since no landfills in the St. Louis area contained 100 feet of fill." A copy of Mr. Karch's letter with news articles attached is attached to this report as Exhibit A.

By letter dated June 17, 1976, Region III responded to Mr. Karch pointing out that Cotter Corporation, which was responsible for the burial, was an AEC licensee, not an AEC subcontractor and advising him, therefore, that the matter would be investigated by NRC. A copy of Region III's letter is attached to this report as Exhibit B.

Background

In early 1966 the Continental Mining and Milling Company, Chicago, Illinois, purchased from the Atomic Energy Commission ore residues which were stored at the St. Louis Airport. The material was moved from that site during 1966 to the 9200 Latty Avenue, Hazelwood, Missouri site. Continental Mining and Milling Company possessed License No. SMA-862 for this program. In January 1967 the Commercial Discount Corporation of Chicago, Illinois took physical possession of the stockpile. License No. SMC-907 was issued to Commercial Discount Corporation on December 29, 1966 allowing possession of the residues, removal of moisture and shipment to the Cotter Corporation facilities in Canon City, Colorado. In December 1969 the remaining source material was sold to Cotter Corporation who obtained License No. SUB-1022 dated December 31, 1969. The AEC's invitation to bid listed the following residues for purchase: 74,000 tons of Belgium Congo pitchblende raffinate containing about 113 tons of uranium; 32,500 tons of Colorado raffinate containing about 48 tons of uranium; and 8700 tons of leached barium sulfate containing about 7 tons of uranium.

In August 1970, Cotter Corporation began drying and shipping the remaining residues from the St. Louis site to their mill in Canon City, Colorado at the rate of about 400 dry tons of material per day. This operation was performed for Cotter Corporation by B&K Construction

Company and continued until about November 1970. During the August to November period, all of the residues were shipped to Canon City with the exception of approximately 10,000 tons of Colorado raffinate and 8700 tons of leached barium sulfate. There was no further activity at the Latty Avenue site until mid-1973.

During an inspection conducted in April 1974, a Region III inspector was informed that during the period July-October 1973, the remaining Colorado raffinate was shipped to Canon City without drying and the leached barium sulfate along with 38,000 to 39,000 tons of soil had been disposed of in a landfill area in St. Louis County. The leached barium sulfate contained from 0.05% to 0.1% uranium as U_3O_8. Twelve (12) to eighteen (18) inches of the topsoil was stripped from the Latty Avenue site and disposed of with the leached barium sulfate.

Visit to Cotter Corporation, Lakewood, Colorado

On June 22, 1976, the following information was obtained during a visit to the Cotter Corporation, Lakewood, Colorado offices. Mr. David P. Marcott, Executive Vice President of Cotter Corporation, stated that all of the source material once stockpiled at the Latty Avenue site had been shipped by rail to its facility in Canon City, Colorado, except the approximate 8700 tons of leached barium sulfate. The material had very low concentrations of uranium, from 0.05% to 0.1%, and it was considered commercially impractical to further process this material to remove the uranium. He indicated that it would be necessary to process the material with several hundred pounds of hydrochloric acid to leach a pound of uranium from each ton of the barium sulfate. If the uranium could be leached out using water the licensee would certainly have processed the material rather than disposing of it. He indicated that for this reason he was confident that the uranium remaining in the leached barium sulfate now located in a landfill would not leach out into the groundwater. He said that the average uranium content of ore currently being processed by the mining industry was 0.16% which is greater than that disposed of in the St. Louis area. He indicated that some ore being processed by Cotter Corporation contains 0.65% uranium. He indicated that in his opinion the uranium contained in the leached barium sulfate did not constitute any threat to the environment wherever it is now located.

Marcott further advised that he visited the site on more than one occasion in 1973. He indicated that on one occasion Mr. Robert Davis of B&K Construction Company drove him around the area and pointed out to him the landfill area where the material would be dumped. He said he could not recall the name or location of the area. It was his recollection that the landfill area had a large deep pit. It was on this basis that he had expressed the opinion that the material was probably buried under 100 feet of soil and garbage. He indicated that he also visited the Latty Avenue site on another occasion and personally saw the trucks removing the dirt from the premises.

Marcott stated that B&K supplied weight sheets along with the invoices submitted for payment for disposing of the barium sulfate and dirt from the Latty Avenue site. These invoices also included charges for the Colorado raffinate shipped by rail to Canon City during the same period of time.

Mr. Duane A. Dughman, Vice President-Finance of Cotter Corporation, provided copies of 11 invoices for the period July to October 1973. These invoices showed a total of 48,544.70 tons of material were trucked to a disposal site which is not identified on the invoices. The invoices also showed that 10,763.41 tons of material were shipped by rail during the same period.

Dughman stated that he had reviewed all related records in Cotter's files and none of them identified the landfill area to which B&K Construction had taken the material. Dughman stated that the only papers relating to the Latty Avenue site not contained in the master files in the Lakewood, Colorado offices were the weight sheets that had accompanied B&K's invoices. He indicated that these had been retained at the Canon City facility. He made an inquiry by telephone of personnel at the Canon City facility concerning the weight sheets and was advised that they couldn't be located. It was indicated that Mr. Warren Goff, who was away and not scheduled to return for several days, was the only one who could locate them.

Copies of the 11 invoices were obtained and copies of them, with the cost entries deleted, are attached to this report as Exhibit C.

Visit to West Lake Landfill, Bridgeton, Missouri

On June 23, 1976, the following information was obtained from Mr. Vernon Fehr, Superintendent of Plant No. 1 West Lake Landfill.

Fehr indicated that he recalled that about three years ago, B&K Construction Company had dumped what he understood to be clean fill in an area adjacent to the office building. He indicated that he had seen the material being dumped and it looked like ordinary dirt to him. Since clean landfill is useful as cover, there is no charge for dumping it and no records are maintained of its receipt. It was his recollection that the dumping of the material did not involve any formal arrangements. The truck drivers just came to the site and he told them where to dump it. He stated that he could identify the specific location where the material was dumped and estimated that it was three feet down. While he recalled that a large quantity of material was dumped, he was somewhat doubtful that it totalled 39,000 tons.

Fehr advised that in 1974 the Missouri Department of Natural Resources advised West Lake to discontinue dumping in two areas on the site, one of those being the area where the B&K material was located. He indicated that this area was full anyway. He went on to say that the State required them to sink wells around the area so that samples of the groundwater could be obtained. He indicated that the State

obtained and analyzed groundwater samples from the wells and did not report any problems regarding their findings. He said the wells are still there.

Telephone Contacts with Ryckman, Edgerley, Tomlinson & Associates, St. Louis Missouri

On June 23, 1976, telephone contacts were made with Dr. E. Edgerley and with Mr. Phillip K. Feeney of Ryckman, Edgerley, Tomlinson & Associates, an environmental engineering firm that provided consultant services to Cotter Corporation on health physics and site decontamination.

Dr. Edgerley stated that while he had visited the Cotter Corporation Latty Avenue site when the residues were being dryed and shipped to Canon City, Colorado, he had no personal knowledge concerning the disposal of the material remaining onsite after these operations were discontinued.

Mr. Feeney stated that he was aware that the topsoil was stripped from the Latty Avenue site and trucked to a landfill but he did not know which one. He indicated that arrangements regarding the disposal operations were made directly between Cotter Corporation and B&K Construction Company. Feeney stated that he visited the site to perform a termination survey after being informed that the disposal operations were completed. During the first survey he made he found one small spot above 0.6 mR/hr. He instructed B&K to remove some dirt from this area which he indicated would be a truckload or less. Subsequently, he returned to the site and found less than 0.1 mR/hr. By letter dated May, 1974, the results of Feeney's survey were furnished to Cotter Corporation. A copy of this letter with its attachments appears as Exhibit D in this report.

Visit to B&K Construction Company, St. Ann, Missouri

On June 24, 1976, Mr. Robert S. Davis, Vice President, B&K Construction Company, was interviewed. Davis stated that the amount of material shown on the invoices submitted to Cotter Corporation was disposed of by trucking to the West Lake Landfill during the period July 16 to October 9, 1973 with the exception of 5,000 tons. He indicated that this 5,000 tons represented topsoil stockpiled in one corner of the Latty Avenue site. He had removed it and then returned it to the site after disposal operations were completed. This topsoil along with other topsoil was used to dress the site. He felt that he should be paid for handling the stockpiled topsoil and that the 5,000 tons was included in the amounts on the invoices sent to Cotter Corporation.

Davis stated that while there was no charge for dumping the material at West Lake, he had arranged to have the individual operating the scales there to record the weights of each truck on sheets of paper. He indicated he was required by Cotter Corporation to submit these weight sheets with the invoices. Davis provided copies of the weight sheets which bear the heading "B&K Dirt Hauling" and the date. The following information is

recorded: truck number, gross, tare, and net weights. A spot check was made of the totals of the net weights shown on the sheets as well as the totals of the net weights for a billing period with the weights on the covering invoice. No discrepancies were found. There were a total of 104 weight sheets associated with these invoices. The total weight of material trucked to the disposal area shown on the invoices was 48,544.70 tons. Subtracting the 5,000 tons of topsoil referred to above, the amount of material trucked to the disposal area was 43,544.70 tons. The invoices also show a total of 10,763.41 tons of material were shipped by rail to Canon City.

Although the above invoices and weight sheets did not indicate the disposal area to which the material was taken, Davis stated that it was taken to the West Lake Landfill. He offered for review a job card record relating to the Latty Avenue site and several entries were noted for the period July 16, 1973 to October 10, 1973 which indicated residue was taken to West Lake from Cotter, Latty Avenue.

Davis also stated that in addition to using his own trucks, he arranged for much of the hauling to be done by other trucking firms. He made available for review from his records, bills from these firms. Weekly billing statements, with drivers time tickets attached, covering the period August 3, 1973 to October 12, 1973 were noted from Walker Trucking Service, Ferguson, Missouri. These billing statements contain the notation "Latty Avenue to West Lake." Billings were also reviewed which had been received from the following: Bruce Barnes Truck Service, St. Louis; Vic Koepke Excavating and Grading Company, Bridgeton; and H. Reeder Hauling, Inc., St. Louis. On at least some of these billings, there are entries showing that material was hauled from "Latty Avenue" or "Cotter" to West Lake.

It is concluded that the material in question is now buried under about three feet of clean soil at the West Lake Landfill. While little significance was attached to the actual location of the disposed material at the time of the 1974 inspection, the licensee was notified, by letter dated November 1, 1974, that the disposal did not appear to be within the intent of the Commission's 10 CFR 40 regulations (Exhibit E) concerning alteration of source material to obtain a mixture no longer subject to licensing.

Visit to Latty Avenue, Hazelwood, Missouri Site and West Lake Landfill, Bridgeton, Missouri Site

On August 11, 1976, two Inspection and Enforcement Region III inspectors visited the Latty Avenue site and West Lake Landfill site for the purposes of performing radiation surveys and collecting environmental samples. The Region III inspectors were accompanied by Mr. Stephen Nagle to the Latty Avenue site and Mr. Clarence Stein to the West Lake Landfill site. Messrs. Nagle and Stein represented the State of Missouri Division of Environmental Quality, Department of Natural Resources.

The results of the August 11, 1976 surveys of the Latty Avenue site and the West Lake Landfill site with a narrative and reference material are attached to this report as Attachment A.

Results of the analyses of the environmental samples taken on August 11, 1976 from the Latty Avenue site and West Lake Landfill site are attached to this report as Attachment B.

Measurements performed at the West Lake Landfill and analyses of samples from the area have been reviewed. The following hazard analysis is based on the measurements and analyses and on information derived from personnel of the former licensee.

Direct Radiation - West Lake Landfill

Beta-gamma measurements made at three feet from the surface indicate two general areas where readings above background were noted. These measurements indicated 0.06 mrad/hr maximum. The measurements at contact indicated 0.8 mrad/hr maximum, and about 0.1 mrad/hr average. Thus, for continuous exposure the maximum gonadal or whole body dose would be:

$$0.06 \text{ mrad/hr} \times 8.76 \times 10^{3} \frac{\text{hrs}}{\text{year}} \cong 500 \text{ millirads/year or approximately}$$

500 millirems/year.

However, the area has been closed for dumping by Missouri DNR and is essentially unoccupied.

Calculated Atmospheric Concentrations of Rn-222 at West Lake Landfill

West Lake Landfill area sample analytical results do not indicate the presence of significant natural uranium activity. These surface samples, however, would not be expected to be representative of material which is reportedly covered by overburden with a thickness of approximately one meter.

According to information provided by the licensee, the covered material consists of approximately 7 tons of natural uranium in about 8,700 tons of barium sulfate and about 39,000 tons of soil. Thus, an approximate natural uranium weight percentage of the mixture would be 0.015 percent. With a natural uranium specific activity of 6.77×10^{-7} Ci/g, the specific activity of the mixture would be approximately 1.0×10^{-10} Ci/g or 1.0×10^{-4} uCi/g. Analysis of two surface samples from the Latty Avenue site (source of the covered material) indicated natural uranium concentrations of approximately 1.0×10^{-4} uCi/g, which supports this estimate of average mixture concentration. The Ra-226 analysis showed an average concentration of about 1.0×10^{-3} uCi/g for the two samples.

Calculations have been performed to estimate radon-222 emanation from the ground, due to buried material with an average Ra-226 concentration of 1.0×10^{-3} uCi/g below a depth of 100 cm. These calculations indicate a total release of approximately 0.1 uCi/sec of radon-222 from the ground due to the covered tailings mixture. It should be noted that the assumed depth of burial yields a reduction of about a factor of three below what emanations would exist, assuming no cover.

Additional calculations were performed using the "virtual point source" method for determining average air concentration of radon-222 above the covered material. The area was estimated to be approximately square, with a dimension of forty meters. This calculation yielded an approximate $\frac{\chi}{Q}$ atmospheric dispersion coefficient in the center of the area of 1.7×10^{-2} sec/m^3.

Applying this coefficient to the release rate of 0.1 uCi/sec yields an average increase in background air concentration of 1.7×10^{-3} uCi/m^3 directly over the covered tailings, which is about one-half of the 10 CFR 20 unrestricted area concentration limits. This Rn-222 contribution in air, due to the buried materials, would be indistinguishable from background within a few hundred meters from the landfill. Based on the conservatism of assumptions, this atmospheric concentration of Rn-222 is considered an upper limit. Calculations are appended to this report as Attachment C.

Other Pathways

Pathways other than direct exposure and inhalation of radon-222 and progeny do not appear to be significant. No likely means of an ingestion pathway were identified, and inhalation due to fumigative dusting can be discounted since the material is covered and not subject to becoming airborne. An evaluation of the potential for groundwater contamination could not be made in the absence of information concerning the hydrogeologic character of the local area. Three shallow (about 20 feet) wells in the area were all found to be dry at the time the IE:III inspectors visited the site, precluding collection and analysis of groundwater samples. As noted above, barium sulfate and U_3O_8 are known to be insoluble in water.

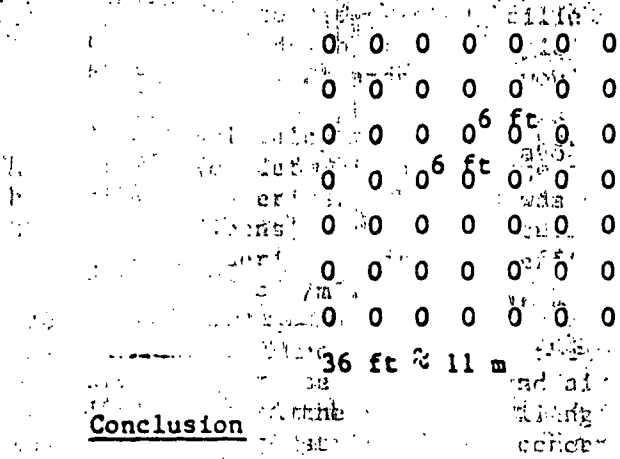
Future Development

It is noted that the radium 226 concentration of materials presumed buried at the West Lake Landfill approximates that found in tailings materials used for leveling, aggregate and backfill under or around the foundations of dwellings in certain western Colorado communities. Some of these Colorado dwellings experience indoor radon 222 concentrations capable of yielding exposures approaching those implied in the occupational limits of 10 CFR 20. Differences in the physical and chemical natures of the West Lake Landfill and the western Colorado tailings, however, suggest a lower radon release fraction for materials of the type buried at the land fill. Recognizing the potential for radon buildup in

dwellings and the uncertainties concerning certain parameters needed to estimate that potential at the West Lake Landfill, a complete environmental impact assessment is necessary to accurately evaluate the hazard potential for this pathway.

Comparison with 10 CFR 20 Criteria

Finally, it should be noted that a licensee may bury up to about two tons of natural uranium per year (in twelve increments) within criteria contained in 10 CFR 20 concerning depth (4 feet) and spacing (6 foot spacing between locations). Thus, in four years, eight tons could be disposed of in forty-eight one-sixth ton batches buried in a grid with six foot centers. Such a grid would comprise an area significantly smaller than that found in this case, while containing about the same quantity of disposed uranium.



Conclusion

Seven tons of uranium could be disposed of by burial in accordance with 10 CFR 20.304 in an area significantly smaller than that now existing at the West Lake Landfill. Based on our estimates of maximum potential exposure conditions by various pathways, it is concluded that the material now present at the West Lake Landfill does not represent a radiological hazard by any pathway yet identified. Based on studies of the use of uranium tailings for backfill and leveling under and around residence foundations in Colorado, it is estimated that increased indoor radon and radon progeny concentrations could be experienced in structures built directly in or on the disposed tailings. An environmental impact analysis is required for an accurate estimate of the hazard potential for this pathway.

Attachments:
1. Attachments A, B, C and D
2. Exhibits A-E
3. References 1-4

ATTACHMENT A

During a survey performed by this office on August 11, 1976, to determine the effectiveness of Cotter Corporation's decommissioning of their Hazelwood, Missouri (Latty Avenue) site, a difference in the radiation readings supplied by Cotter and those found by this office was noted.

On May 10, 1974, Cotter reported exposure rates which ranged from 0.01 to 0.4 mR/hr measured at three feet above grade (type of instrument unknown). (Reference 1) These values were the basis for termination of the license by the Directorate of Licensing. (Reference 2) The Region III August 11, 1976 survey, made at the same distance, yielded readings ranging from 0.3 to 0.8 mrad/hr beta-gamma. (Reference 3) Additionally, a survey at one centimeter revealed two areas reading 1.2 and 1.8 mrad/hr beta-gamma. The instrument used by IE:III inspectors in performing these measurements was an Eberline E-500B with an end-window Model HP-190 Hand Probe (1.4-2 mg/cm^2).

The presently acceptable limit for release of ground areas, as implied in the "Decontamination Guide" (Reference 4) is 0.4 mrad/hr, total, or 0.2 mrad/hr, average, with a maximum of 1.0 mrad/hr, all of which are to be measured at 1 cm with a probe of not more than 7 mg/cm^2 of total adsorber. Thus, the NRC Region III survey of August 11, 1976 showed radiation levels at the Latty Avenue site exceeding the acceptable release limits, while the survey performed by Cotter Corporation showed levels within the guidelines. Both surveys indicate a low, non-hazardous radiation level. The difference in results might be attributable to differences in instruments and procedures used. The August 11, 1976 surveys were the first independent examination by NRC of radiation levels at the Latty Avenue site.

ATTACHMENT B

ENVIRONMENTAL SAMPLE
Analytical Results by HSL

Sample No.	Sample Description	Results (uCi/g) Natural Uranium	Ra-226
L-1	Soil	1.2 + 0.1 E-4	1.4 + 0.03 E-3
L-2	Soil	7.5 + 0.1 E-5	5.14 + 0.14 E-4
L-3	Vegetation	2.6 + 0.2 E-5	—
L-4	Wet Sediment From Cold Water Creek	5.3 + 0.4 E-6	—
W-1	Soil	5 + 2 E-7	—
W-2	Soil	5.3 + 0.4 E-6	—

Note:
1) L-1 through L-4 collected at Latty Avenue Site
2) W-1, W-2 collected at West Lake Landfill
3) L-3 vegetation dried, analyzed dry, reported as wet weight
4) L-4 dried prior to analysis
5) A systemic error of + 20% should be assigned to Ra-226 analysis due to uncertainty of the equilibrium between Rn-222 and Rn-226. An 80% equilibrium ratio was assumed.

ATTACHMENT C
Rn-222 Emanation Calculations

1. <u>Rn-222 at the Spoils/Cover Interface</u>

Total release = (area) x (source flux)
= $(1600\ m^2) \times DC_o\ (\lambda/(DS))^{\frac{1}{2}}$

Kraner, et al, the <u>Natural Radiation Environment</u>, 1964

Assume:

$D = 1.5 \times 10^{-2}\ cm^2/sec$

$C_o = (1.0\ nCi/g)(1.6\ g/cm^3)(1 \times 10^{-1})$
$= 0.16\ nCi/cm^3 = 160\ pCi/cm^3$

1×10^{-1} = 10% "emanation power" (fraction escaping solid soil gas Tanner, <u>The Natural Radiation Environment</u>, 1964

$\lambda = 2.099 \times 10^{-6}\ sec^{-1}$

$S = 0.25$

0.25 = soil "void fraction"

Total release = $(1.6 \times 10^7)(1.5 \times 10^{-2})(160)(2.099 \times 10^{-6}/(1.5 \times 10^{-2}/0.25))^{\frac{1}{2}}$
$= (3.84 \times 10^7)(3.5 \times 10^{-5})^{\frac{1}{2}}$

Total release = 2.3×10^5 pCi/sec over $1.6 \times 10^7\ cm^2$

area release = $1.44 \times 10^{-2}\ pCi/cm^2 .\ sec$

2. <u>Rn-222 at the Surface of the Cover</u>

$C_2 = C_1 \exp(-Z(\lambda/D)^{\frac{1}{2}}$

Tanner, <u>The Natural Radiation Environment</u>, 1964

Assume:

$C_1 = 1.44 \times 10^{-2}\ pCi/cm^2 .\ sec$

$D = 1.5 \times 10^{-2}\ cm^2/sec$

$\lambda = 2.099 \times 10^{-6}\ sec^{-1}$

$Z = 100\ cm$

$C_2 = (1.44 \times 10^{-2}) \exp(-100\ (2.099 \times 10^{-6}/1.5 \times 10^{-2})^{\frac{1}{2}})$
$= (1.44 \times 10^{-2}) \exp(-1.18)$
$= (1.44 \times 10^{-2})\ (0.31)$

$C_2 = 4.4 \times 10^{-3}\ pCi/cm^2 .\ sec$

Entire area: $(4.4 \times 10^{-3})\ (1.6 \times 10^7) = 7.0 \times 10^4$ pCi/sec

Therefore, the total emanation rate is about 70 nCi/sec, or about 0.1 μCi/sec.

3. <u>Atmospheric Dispersion Coefficient</u>

$X/Q = 1/\pi\sigma_y\sigma_z u$

σ_y and σ_z are calculated using the "virtual point source" method described in Workbook of <u>Atmospheric Dispersion Estimates</u>, as follows:

a. for a square area with 40m sides, $\sigma_{yo} = S/4.3 = 40/4.3 = 9.3m$

b. in the area, $\sigma_{yo} = \sigma_y = 9.3m$

c. at 20m (center of area from side), stability class E, and ground-level release, $\sigma_z = 1m$

d. assume annual avg. windspeed is 2 m/sec

$X/Q = 1/(3.14)(1)(9.3)(2) = 1.7 \times 10^{-2}$ sec/m^3

4. <u>Concentration in Air</u>

Concentration = (0.1 uCi/sec)(1.7 x 10^{-2} sec/m^3) = 1.7 x 10^{-3} uCi/m^3

SUPPLEMENTAL REPORT

INVESTIGATION FOR URANIUM/THORIUM

COTTER CORPORATION, LATTY AVENUE SITE, ST. LOUIS, MISSOURI

OCTOBER 20, 1976

Pursuant to the ongoing investigation of possible uranium/thorium contamination at the Latty Avenue site, Messrs. J. A. Pagliaro and G. T. Gibson performed a site inspection on October 20, 1976. The purpose of this inspection was to identify the property owner from county tax records, to survey the property with beta-gamma and alpha survey instrumentation, and to obtain selected soil and vegetation samples for laboratory analyses.

The records reviewed at the St. Louis County Building, 41 South Central, St. Louis, Missouri, were the current county property tax rolls. County personnel stated the tax records examined were dated as of July 1976. The record indicated the following:

Address: 9200 Latty Avenue

Owner: Commercial Discount Corporation
55 East Monroe Street
Chicago, Illinois 60602

Size: 3.5 acres

Telephone communication with DE:III was performed to ascertain whether the property had since been transferred. Additional information was received which indicated Commercial Discount Corporation had transferred ownership of the property in August 1976 to the Bayless Company, 175 Outer Road West, Valley Park, Missouri.

A site investigation was then performed and samples were obtained. Figure 1 indicates the relative position of various buildings, landmarks, and locations of collected samples. The area in Figure 1 encompassing the abandoned garage, abandoned warehouse building, and the abandoned and boarded-up burned building was estimated to be approximately three (3) acres. The entire area, including the warehouse area and plowed field, was estimated to be in excess of six (6) acres.

ATTACHMENT D

A survey of the plowed field utilizing the beta-gamma instruments indicated only background activity (<0.1 mR/hr), except for several small yellow-colored chunks of surface material. The location of the "yellow surface" material is shown in Figure 1. The "yellow surface" chunks ranged in size from 4 x 4 x 1 inches to small flakes. The material was somewhat fiberous in texture. The "yellow surface" material had an apparent beta-gamma flux of 10 mR/hr at contact. Approximately 1.5 pounds of the "yellow surface" was collected for laboratory analysis. Several holes were dug to a depth of 15 inches but no subsurface yellow material was excavated.

Selected soybeans were collected from the plowed field, within ten feet of the "yellow surface" material. Approximately 1/4 pound of soybeans were collected for laboratory analysis. A background control soybean sample was obtained later, a distance of 7 miles from Latty Avenue.

A rusting abandoned hopper, shown in Figure 1, was surveyed for beta-gamma and alpha activities. Survey results showed no significant activity above background (< .1 mR/hr beta-gamma, 500 DPM alpha).

The warehouse building was surveyed with beta-gamma and alpha instruments. The floor of the warehouse was composed of dirt and broken concrete. Several elevated readings above background activity were recorded. The highest apparent location was in the center of the warehouse, beside a support column. Readings of up to 0.8 mR/hr beta-gamma and 30,000 DPM alpha were observed. A "warehouse dirt" sample, consisting of approximately 2 pounds of topsoil was obtained for laboratory analysis.

Preliminary radiological analyses were performed at IE:III using beta-gamma, alpha, and gamma-spectroscopy instrumentation. The samples were then forwarded to ERDA:Health Services Laboratory (HSL), Idaho Falls, Idaho.

The results of the IE:III analyses showed no detectable activity in either soybean sample. The "yellow surface" sample showed 10 mR/hr beta-gamma and 4,000 DPM alpha at contact with a few grams of material. Gamma scanning with an unshielded NaI crystal indicated the presence of uranium isotopes but not thorium and thorium daughters. The "warehouse dirt" sample showed 0.3 mR/hr beta-gamma and 26,000 DPM alpha at contact with a sample of about 250 g. Gamma scanning with NaI indicated both uranium and thorium and their decay chain products to be present.

The results of alpha spectroscopic analyses of the two soil samples by HSL are presented in Table I below. HSL analyses of the two soybean samples showed only small quantities of naturally-occurring K-40.

TABLE I

Sample	Radionuclide	Alpha Spectroscopic Concentration (uCi/g)
Warehouse Dirt	Th-230	3.61 ± 0.05 E-02
	Th-227	4.4 ± 0.2 E-04
	U-238	6.64 ± 0.06 E-04
	U-234	6.52 ± 0.06 E-04
	U-235	3.09 ± 0.07 E-05
	Ra-226	5.2 ± 0.1 E-04
Yellow Material	U-238	0.3 ± 0.1
	U-234	0.3 ± 0.1
	U-235	0.3 ± 0.1 E-02

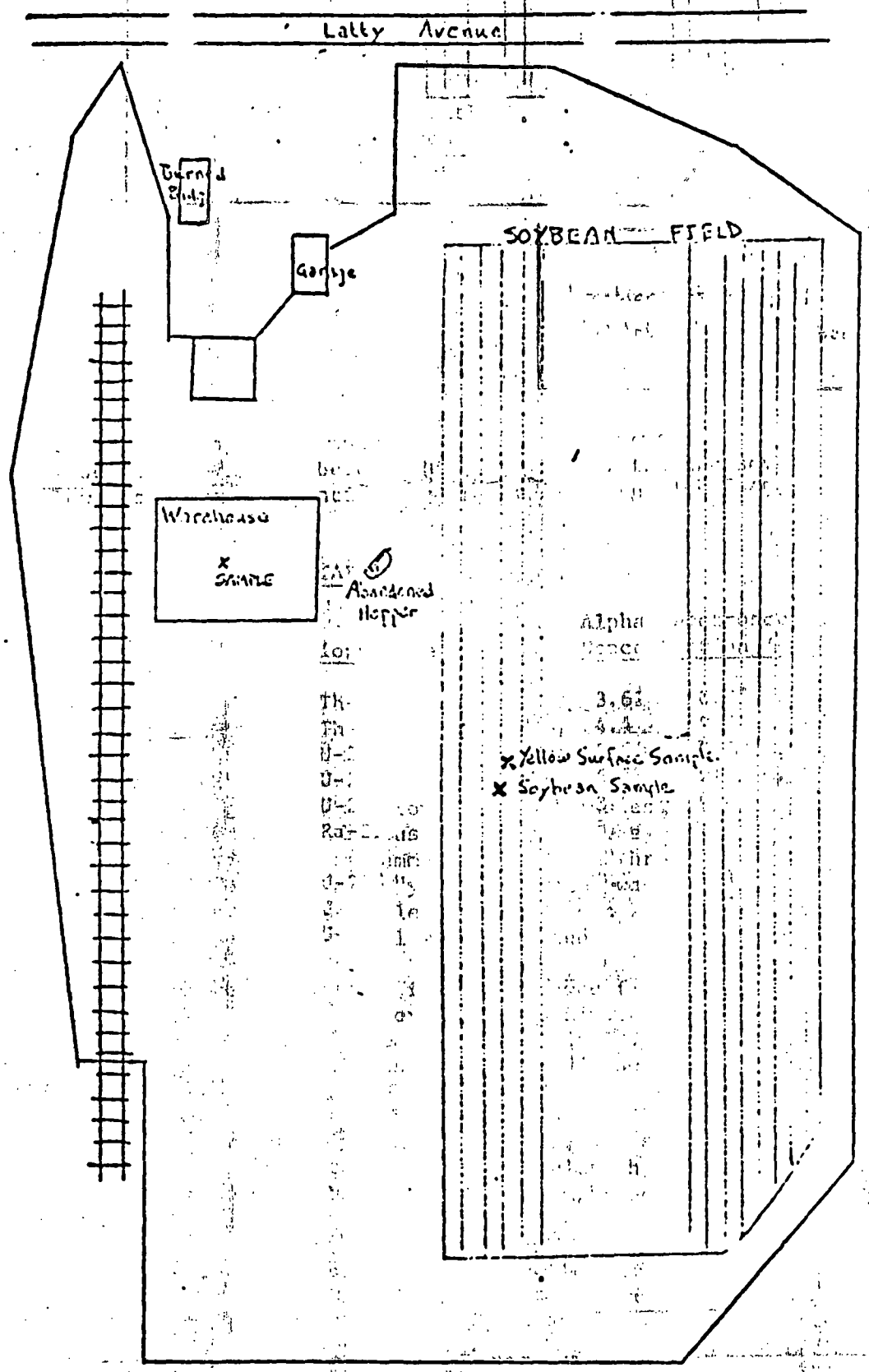


FIGURE 1

Locations of sampling and surveys - 9200 Latty Ave., October 20, 1986