DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances
and Disease Registry
Atlanta GA 30333

July 23, 2002

Mr. George C. Pangburn, Director, DNMS
U. S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Dear Mr. Pangburn:

Enclosed please find a copy of the health consultation for the American Chain and Cable Cabot Corporation (a/k/a American Chain Cable), Reading, Berks County, Pennsylvania, dated July 18, 2002. The Agency for Toxic Substances and Disease Registry was asked to evaluate the impact on the public's health resulting from the potential exposure to radiological material known to have been disposed of at the American Chain and Cable location and it was determined an exposure investigation was warranted.

Please address correspondence to the Chief, Program Evaluation, Records, and Information Services Branch, Division of Health Assessment and Consultation, Agency for Toxic Substances and Disease Registry, ATTN: American Chain and Cable Cabot Corporation, 1600 Clifton Road, NE (E56), Atlanta, Georgia 30333.

If there are any questions, please direct them to Paul Charp, the health assessor, at (404) 498-0365.

Sincerely yours,

Max M. Howie, Jr.
Chief, Program Evaluation, Records,
and Information Services Branch
Division of Health Assessment
and Consultation

Enclosure

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Health Consultation

(EXPOSURE INVESTIGATION)

AMERICAN CHAIN AND CABLE CABOT CORPORATION
(a/k/a AMERICAN CHAIN CABLE)

READING, BERKS COUNTY, PENNSYLVANIA

JULY 18, 2002

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

(EXPOSURE INVESTIGATION)

AMERICAN CHAIN AND CABLE CABOT CORPORATION
(a/k/a AMERICAN CHAIN CABLE)

READING, BERKS COUNTY, PENNSYLVANIA

Prepared by:

Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substance and Disease Registry

BACKGROUND AND STATEMENT OF ISSUES

The Agency for Toxic Substances and Disease Registry (ATSDR) Region III office requested a review of radiological data associated with the Cabot Corporation's American Chain and Cable site (ACC) in Reading, Pennsylvania. The request was in support of a petition for a public health assessment ATSDR received on March 6, 2002 [1]. In the petition, ATSDR was asked to evaluate the impact on the public's health resulting from the potential exposure to radiological material known to have been disposed of at the ACC location. To address the issues associated with the radiological data, ATSDR reviewed the available information and determined that an exposure investigation was warranted. With ATSDR at the exposure investigation activity were the Nuclear Regulatory Commission (NRC), the Environmental Protection Agency (EPA), and the Pennsylvania Department of Environmental Protection (PaDEP).

ACC, and its predecessor owners and operators have been in Reading from 1904. When the site was operated by ACC, it operated under license SMC-1562 with the Atomic Energy Commission (now the NRC) to possess naturally occurring radioactive materials (source materials). Previous operators held other licenses to use radioactive materials. The facility received Malaysian ores containing tantalum and trace amounts of uranium and thorium [2]. Through the electric arc processes used at ACC, the concentrations of tantalum were increased from 2% to 15%. In the processing, uranium and thorium were segmented and concentrated into the waste material (slag). The slag was cooled and reportedly broken into fragments and disposed within the site's slag dump area [3]. The American Chain and Cable site is associated with a Brownfields pilot project in Reading[1]. The EPA has defined Brownfields as abandoned, idled or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination.

The company decided to halt tantalum production in 1968. Between 1969 and 1983, decontamination activities were undertaken. In 1985, a confirmatory survey in support of the NRC license termination, identified areas of radiological contamination in the buildings and grounds above the prescribed NRC release criteria. This required addition decontamination activities that occurred between 1988 and 1989. A second confirmatory survey in 1993 continued to find elevated levels of contamination [3]. In the 1990s, Cabot decided to decommission the facility and plans were developed to raze the buildings on site. The decommissioning plans included radiation surveys in the buildings and the surrounding property, ultimately leading to site remediation. At that time, the NRC informed Cabot that the site did not meet the guidelines of the NRC and until these guidelines for contamination levels were met, no demolition could occur at the site [4]. Additional work by Cabot cleaned the buildings to NRC guidelines and the NRC confirmed the clean up, releasing the buildings for unrestricted use [5] and demolition. Therefore, the remaining issue at the site, portions of which are now owned by the City of Reading, is the status of the old radioactive slag dump used during the ore processing.

[1] EPA Brownfields Assessment Demonstration Pilot fact sheet dated July 1998. The fact sheet can be located on the internet at http://www.epa.gov/brownfields/html-doc/reading.htm.

ATSDR is addressing the radiation levels associated with the slag pile and in the surrounding neighborhood in this public health consultation and exposure investigation. We will be basing our recommendations on various data sources: the 1993 confirmatory survey; the second confirmatory survey performed in 1995 [6]; recent radiation exposure readings performed by ATSDR Region III staff and the EPA during a visit to the site in March 2002 and; the current radiation readings collected during the exposure investigation.

DISCUSSION

Review of previously collected data

In March 2002, ATSDR and the EPA visited the ACC site and measured gamma radiation exposures at the site perimeter. These measurements estimated the exposure rate to residents who may be near the site. The only location where the dose rate was elevated was along the fenced slag pile near a jogging trail. At that time, the observed dose rate was 30 microrem per hour (μrem/h, 0.3 microsieverts[2]/h; μSv/h). The EPA informed ATSDR that the background rate for this area was less than 0.1 μSv/h, equivalent to 10 μrem/h [7].

In a previous visit to the site, the PaDEP reported to ATSDR Region III that the highest radiation reading they found was 60 microroentgens per hour (μR/h)[3] on a walking path. PaDEP also reported they found radiation readings at other locations around the site perimeter that were 4 to 5 times higher than background [8].

In 1993, the Oak Ridge Institute for Science and Education (ORISE), under a contract with the NRC performed a confirmatory survey at the site to evaluate conditions at the site [3]. For the exterior soil sampling locations, ORISE selected areas near previous sampling points as well as locations at a distance from the site for determination of background levels of uranium, thorium, and the radiation exposure rate. The measured backgrounds were 2.67 picocuries per gram (pCi/g, 0.098 becquerels/g; Bq/g) and 2.52 pCi/g (0.093 Bq/g) for uranium and thorium. The measured background exposure rate was 11 μR/h. ORISE collected and analyzed soil samples for uranium and thorium from most of the ACC site. Their results showed that most of the samples were indistinguishable from these background readings. However, samples collected from those areas where the exposure rate was elevated showed significant variation from background. In these samples, the uranium concentration in surface soils ranged from approximately background to a maximum of 78 pCi/g (2.9 Bq/g). Thorium concentrations ranged from approximately background to a maximum of 51 pCi/g (1.89 Bq/g).

In the 1995 report [6], and based on 10 soil samples from exterior areas around the site, ORISE reported that the soil concentrations of uranium were below the detection limits selected for the

[2] In the SI system of measurements, the Sievert has replaced the REM. One Sievert (Sv) is equal to 100 rem.
[3] The term exposure (roentgen) and dose (rem or Sievert) when used in radiological safety and health physics refer to different methods of measurement. In general, when discussing gamma radiation, the units of rem, Sievert (Sv), and roentgen (R) can be considered identical.

confirmatory survey. These samples may not have been collected from those areas where elevated levels of radioactive contamination were detected in the 1993 survey. The 1995 results reported the thorium concentrations, corrected for the thorium background, ranged from 0.8 pCi/g to 9.2 pCi/g (0.03 to 0.34 Bq/g). The NRC has established that thorium should not exceed 10 pCi/g (0.37 Bq/g) as a cleanup level [6]. Recently, the state has corresponded with the NRC with serious concerns regarding the findings of the 1995 report by pointing out large inconsistencies in the waste manifests, soil radioactivity determinations, radiation readings, and potential problems with the dose assessment performed by the NRC [9].

Exposure Investigation

Because of the discrepancy of the radiation exposure readings collected by the state and the federal agencies, the purpose of ATSDR's exposure investigation was to determine if the readings collected by the NRC, EPA, and the PaDEP were representative of the contamination at the site. If the readings collected by the other federal and state agencies could be verified, ATSDR would develop realistic exposure and dose scenarios for the site. ATSDR would also determine if the variation in the radiation readings collected at the site could be explained by the characterization or lack thereof, at this location. The exposure investigation would also determine if any migration of contaminants into the surrounding neighborhood, based on radiation exposure readings, had occurred.

Site Observations

The area surrounding ACC is industrial with residential areas across the street from numerous abandoned structures. There are many physical hazards associated with these buildings including rusted metals, construction debris, and dilapidated roofs. The area around the slag pile is heavily vegetated and a locked fenced surrounds the pile as well as the entire ACC site. The area immediately around the pile is fenced and locked with appropriate radiation warning sites in clear view. The bank of the pile, with an estimated 60° slope, leads to the Schuylkill River. There is some visible evidence that perhaps portions of the slag pile have passed under the fence.

During the measurements collected inside the slag pile fence, no materials indicative of slag were observed; however, construction debris, asphalt, tires, and similar materials were seen. Outside this fence, ATSDR observed piles of construction debris, bricks, overgrowth of vegetation, rusting metal, and similar materials.

Radiation Exposure Readings

For the exposure investigation, ATSDR used a calibrated handheld sodium iodide scintillation system coupled to a spectrometer to obtain a gamma radiation spectrum and to collect dose rate measurements. The purpose of the spectrum was an attempt to identify radiological contaminants present at the site. The radiation exposure readings were collected along the fenceline at the top of the slag pile as well as the foot of the pile near the river. Exposure readings were also taken at random locations on the pile and on city owned sidewalks along Tulpehocken Street. Exposure

readings were also collected in an area on the site thought to be representative of background. All radiation readings were stored in the scintillation system and later transferred to a spreadsheet for data reduction and analysis.

The background exposure rates, collected at the property boundaries are shown in Table I. The data indicate that the background does not vary significantly at the edges of the site. For the readings collected around the site during this exposure investigation, the appropriate background reading was subtracted from the measured exposure rate to obtain a corrected exposure.

Table I. Background exposure rates for American Chain and Cable

Exposure Reading Locations	Exposure rate ± Standard Deviation (μR/h)
Outside slag pile fence; ground contact	5.1 ± 1.2
Railroad tracks at bottom of pile; ground contact	5.9 ± 1.4
Gravel lot adjacent to Tulpehocken Street; ground contact	5.7 ± 1.1

ATSDR collected exposure readings at the top of the slag pile and lower portions of the pile. The exposure readings were not uniform; the results suggested the slag is heterogeneous in its composition or randomly dumped. For example, the exposure rates found on the slag pile, corrected for background, ranged from background to a maximum exposure rate of over 100 μR/h. Comparable readings were observed by the other agencies using their radiation detection equipment.

Outside the upper fence bounding the slag pile, ATSDR also collected readings approximately every 9 feet for a distance of over 120 feet. After this distance, the vegetation prevented additional exposure measurements. The exposure rate (corrected for background) along the fence ranged from background to a maximum reading of 7 μR/h. Measurements collected along the fence at the bottom of the pile near the river, however, were much different. During these measurements, ATSDR as well as the EPA and the NRC found exposures ranging from background to 54 μR/h. The maximum reading was found at a location where it appears that erosion from the pile has extended beyond the fence.

ATSDR also collected radiation exposure rates in the middle of Tulpehocken Street and on the city sidewalks along Tulpehocken Street. The exposure rates, corrected for background, ranged from background to less than 3 μR/h.

Dose Assessment Scenarios

For the estimation of radiation dose received from an inadvertent intruder, ATSDR computed the mean and standard deviation for all readings in each of the following locations: top area of the

pile; lower edge of pile near the river, upper fence line and; along Tulpehocken Street. These data are presented in Table II.

In this table, the locations are where ATSDR collected the values and how those measurements varied. The confidence level is a measure of how sure we are of the measured value. For example, in the case of the upper fenceline, we believe that if 100 readings were collected, 95 of those readings (95%) will between 7.5 and 9.5 μrem/h.

Table II. Statistical Evaluation of the measured dose rate at selected locations.*

Parameter	Pile	Upper Fenceline	Lower Fenceline	Tulpehocken Street
Average	31	8.5	26.4	6.8
Minimum	5.1	4.6	5.9	4.9
Maximum	113.7	12.1	59.6	8.8
95% Confidence Level	14.7	1.0	14.4	1.1

* Values are expressed in microrem per hour. The dose was estimated from the exposure rate using the estimated relationship of 1 to 1 for gamma radiation exposure to dose. The values are not corrected for background.

With respect to the radiation dose estimates for the pile, if one removes the hot spots[4] that were located within the area, the average dose is reduced to 18 μrem/h with a 95% confidence level ± 5 μrem/h. This still indicates that the radiation associated with the slag pile is about twice the dose rate as other areas around ACC and about 3 times higher than the typical backgrounds as measured by ATSDR.

Selection of an appropriate scenario

The selection of an appropriate exposure and dose scenario is paramount at this site as the selection of the scenario can drive the health-based recommendations. The data suggest that the pile has significant spots of elevated radiation exposure. If one were to be extremely conservative, then the use of these hot spots would be the driving force for public health actions. However, these elevated readings not only are difficult to localize, but the time an inadvertent intruder would have to spend on these exact locations may not be realistic. Therefore, ATSDR is proposing two scenarios for the purposes of dose estimations. In addition to these scenarios, ATSDR performed a statistical simulation, called a Monte Carlo simulation, of the estimated radiation dose, the estimated time at that dose level, and the estimated time one might spend at that particular dose level. The parameters used for this stimulation are given in Table III. For the adjusted values, ATSDR removed all readings greater than 30 μR/h as these readings included

[4] The term "hot spot" can have several meanings. For the purposes of this public health consultation, ATSDR is defining a hot spot as an area where the reading was 3 times or more higher than the measured background.

the hot spots and thus were considered significantly above background which adversely affected the site-wide average readings.

Table III. Values and distributions used in Monte Carlo Simulations*

Simulation value	Pile	Lower Fence	Pile (adjusted)†
Lowest dose value	0	0	0
Average dose	31	26.4	17.5
Highest dose value	115	59.6	29.3
Lower time limit‡	1	1	1
Average time	8	2	8
Upper time limit	12	8	12
Distribution type§	Extreme value	Extreme value	Exponential

* The values in the table are expressed as microroentgens per hour (μR/h) and are corrected for background.

† The adjusted values are only using those estimated doses measured by ATSDR that were less than 30 μR/h.

‡ The time limits are expressed in hours at a particular location

§ The distribution type was determined by the software automatically fitting the data to the appropriate distribution.

Scenario One

For this scenario to estimate the maximum dose, ATSDR will assume that an individual will occupy these areas. The estimated occupancy factors include spending 8 hours per day for 200 days per year (excluding winter and severe weather conditions) on the pile at the location of the highest measured dose rate and 2 hours per day at the lower fence line location of the maximum dose. The remainder of the day would be in an area representative of background. Therefore, ATSDR estimates the total dose, above background, to be 195 millirems per year (mrem/y).

Scenario Two

The more realistic scenario is one in which an individual would have limited access to the site because of the locked fence, security patrols, and planned Brownfields city activities. For this scenario, the individual would be exposed to the average dose rate 1 hour per day on both the pile and at the lower fence for 200 days per year. Using these values, the annual estimated dose is about 32 mrem/y above background.

Results of Monte Carlo Simulations

The simulations ran for 10,000 cycles to achieve the most probable statistical estimate of the radiation dose an inadvertent intruder would receive at the site. The results of the simulations are given in Table IV that shows the dose ranges from background to over 250 mrem/y if the locations with the highest detected readings are used. If the adjusted values (all readings that were less than 30 μR/h) are used, the maximum estimated dose was less than 130 mrem/y. It is important to note, however, that the variation in the estimated doses is quite large as represented by the standard deviations of the average estimated dose.

Table IV. Results of Monte Carlo simulations for the American Chain and Cable Site*.

Statistic	Dose	Adjusted dose
Number of simulations	10,000	10,000
Average	64	36
Standard deviation	34	18

* The dose is reported as millirem per year based on 200 days per year and varying the radiation dose and the time spent in the contaminated areas.

Because of the wide range of doses generated by the Monte Carlo software, the percentile breakdowns were also calculated. The percentile value, on a scale of 100, indicates the percent of a distribution that is equal to or below that value. The simulation performed at the American Chain and Cable site generated percentile ranking of the doses. Table V shows the percentile ranking. For example, 10% of the estimated doses were less than 27 mrem/y for the pile or 15 mrem/y for the pile, removing all readings greater than 30 μR/h.

Table V. Percentile rankings for the estimated radiation doses*.

Percentile	Dose	Adjusted dose
10	27	15
50	57	33
90	108	59

* The percentile is a value on a scale of 100 that indicates the percent of a distribution that is equal to or below its value. The radiation dose is expressed as millirem per year.

The results of the exposure scenarios can be compared to a number of different radiation dose guidelines and regulations established by the EPA, NRC, and ATSDR. These dose values are based either on the program goals for clean up or health. Health based guidelines or regulations are based on peer-reviewed scientific literature and on evaluations by expert panels. Table VI gives the guidelines and regulations on which ATSDR is basing its conclusions of the exposure investigation.

Table VI. Regulatory limits or guidelines for radiation exposure.

Agency	Dose Limit	Type*	Basis for Dose Limit†	ATSDR finding
EPA	15 mrem/y	Guideline	Remediation	Above
NRC	25 mrem/y	Guideline	Decommissioning	Above
ATSDR	100 mrem/y	Guideline	Health	Below
EPA	100 mrem/y	Regulatory	Health	Below
NRC	100 mrem/y	Regulatory	Health	Below

* A guideline is a principle or procedure used to assist in the interpretation of regulations. Regulations are laws into effect by formal public announcements by government agencies to enforce particular statutes under their jurisdiction. Many regulations undergo a public review before adoption by the agency.
† The basis for the dose limits vary with respect to purpose of the program.

In addition to the information supplied in Table VI, the NRC also developed guidelines for release of areas for unrestricted use. These guidelines are composed of a NRC Branch Technical Position (BTP) [11] that states that the concentration of uranium and natural thorium should not exceed a concentration of 10 pCi/g as based on EPA clean up standards. In the 1993 confirmatory survey the reported values exceeded the BTP; however, in the 1995 final report, the reported levels of uranium and thorium were less than the limits expressed in the BTP. ATSDR has not been able to verify if any remediation occurred between 1993 and 1995, especially since we located areas of elevating radiation readings on the pile, evidence of elevated readings at the lower area of the fence near the river, and no indication of soil disturbances and the fact that the overgrowth on the site contained mature trees.

CONCLUSIONS

ATSDR developed 2 exposure scenarios and performed a simulation of potential exposures for individuals living around the American Chain and Cable site in Reading, Pennsylvania. Of these scenarios, the most plausible scenario (Scenario 2), suggested that the potential annual exposure was less than 35 mrem/y, less than the ATSDR Minimum Risk Level (MRL) of 100 mrem/y [10]. This estimated exposure of 35 mrem/y was similar to the average dose estimated by the simulation once the areas of elevated readings were omitted from the simulation.

Based on these data, ATSDR believes the gamma radiation exposure rates associated with the slag pile are not at a level of public health concern. ATSDR bases this conclusion using its MRL. In order for a member of the public to exceed this MRL, they would have to: 1) locate the most radioactive area of the pile and 2) stay in that exact location for an entire year to approach the ATSDR MRL. The gamma exposure rates found by ATSDR in this exposure investigation are similar to the results previously obtained by the EPA, the NRC, and the Pennsylvania Department of Environmental Protection. That is, the readings vary greatly depending on the location. This also indicates that the site may be not suitable for unrestricted release.

The ATSDR exposure investigation did not collect soil samples to estimate the extent of contamination within the slag pile. However, based on the review of the available information, ATSDR considers the contamination in the soils to be a public health concern. ATSDR bases this conclusion on the results of the 1993 and 1995 confirmatory surveys. These surveys seem to be contradictory with respect to detected concentrations of contaminants as consistent with our measurements of hot spots.

ATSDR is concerned, in the case of additional site characterization and/or remediation, that activities resulting in soil disturbances could lead to potential public health issues. This is especially true since one of the radiological contaminants, thorium, if present in the air, is very restrictive with respect to public exposure (Code of Federal Regulations, Title 10, Chapter 20; 10CFR20, Table II). This regulation limits the thorium concentration in air to 4 pCi/L, an amount if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 50 mrem, one half of the ATSDR MRL.

ATSDR radiation measurements collected along Tulpehocken Street did not find significantly elevated radiation readings. In general, the readings were representative of the background readings we observed prior to collecting the measurements. Therefore, no evidence that radiological materials are present in the residential areas.

RECOMMENDATIONS

To address the uncertainties associated with this exposure investigation and to address concerns of the petitioner, the Pennsylvania Department of Environmental Protection, and the US Nuclear Regulatory Commission, ATSDR makes the following recommendations specific for the American Chain and Cable site:

1. A more detailed dose assessment be performed by the state and federal regulatory agencies using realistic exposure scenarios for this site;
2. Consideration be given to further characterization of the pile; and
3. Public meetings should be held in the city of Reading to educate the public to the hazards and risks associated with radiation exposure.

ATSDR, if requested, will review any additional data collected for this site and will modify these recommendations as needed.

Paul A. Charp, Ph.D.
Senior Health Physicist

REFERENCES

1. Request for a public health assessment (2002). Letter transmitted to ATSDR from resident in Reading, Pennsylvania.

2. Craig K and DW Reisenweaver (1994). Decommissioning plan for the main processing building and surrounding area at the Reading, Pennsylvania site. Prepared by NES Inc. for the Cabot Corporation. NES Inc. Danbury, Connecticut.

3. Berger JD and BM Smith (1993). Confirmatory radiological survey for portions of the Cabot Corporation Reading Facility. Reading, Pennsylvania. Oak Ridge Institute for Science and Education, Oak Ridge, Tennessee. June 1993.

4. Letter from John Austin, Division of Waste Management, US Nuclear Regulatory Commission to R.S. Barron, Cabot Corporation dated November 17, 1994.

5. Letter from Michael Weber, Division of Waste Management, US Nuclear Regulatory Commission to A. Campitelli, Cabot Corporation dated February 17, 1995.

6. Abelquist EW and JL Payne (1995). Confirmatory survey of the main processing building and adjacent exterior area. Cabot Corporation, Reading, Pennsylvania. Final Report. Oak Ridge Institute for Science and Education, Oak Ridge, Tennessee. April 1995.

7. Electronic mail from Jennifer Hubbard to Paul Charp dated March 11, 2002. Subject: FYI: Update on Reading, PA sites.

8. Agency for Toxic Substances and Disease Registry (2002). ATSDR Record of Activity from Jennifer Hubbard to Paul Charp dated February 1, 2002.

9. Letter from David J. Allard, Director, Bureau of Radiation Protection, Pennsylvania Department of Environmental Protection to Larry Camper, Chief, Decommissioning Branch, Office of Nuclear Materials Safety and Safeguards, US Nuclear Regulatory Commission dated May 2, 2002.

10. Agency for Toxic Substances and Disease Registry (1999). Toxicological Profile for Ionizing Radiation. Atlanta, Georgia: ATSDR.

11. Nuclear Regulatory Commission (1981). Disposal or Onsite Storage of Thorium or Uranium Wastes From Past Operations. Federal Register, Volume 46, page 52061. October 23, 1981.