TETR

10/25/82 Certified Original
L Tyson

PDR
Docket 40-8820
(formerly 40-8355)

RADIOLOGICAL ASSESSMENT
REPORT FOR
AMAX INC. PROPERTY LOCATED
AT PARKERSBURG, W. VA

Report to AMAX, Inc. as per Agreement dated
July 20, 1978

RADIOLOGICAL ASSESSMENT REPORT FOR

AMAX, INC. PROPERTY LOCATED AT PARKERSBURG, W. VA.

VOLUME 1

Prepared by ATCOR, INC.,
a Division of Chem-Nuclear Systems, Inc.

R. G. Levesque
Manager, Decommissioning

December 1, 1978

ATCOR

Table of Contents

ATCOR

1. Introduction

ATCOR, Inc. and AMAX Specialty Metals Corporation (ASMC) formalized an agreement dated July 20, 1978 in which ATCOR agreed to perform a radiological assessment survey of the former ASMC plant site near Parkersburg, West Virginia which was then owned by the L.B. Foster Company and is presently owned by AMAX, Inc. in accordance with ATCOR's technical proposal to ASMC dated July 5, 1978.

Our technical proposal submitted to ASMC was approved in principle by the U.S. Nuclear Regulatory Commission, and it is included as Appendix A.

ATCOR's field technicians began the on site radiological assessment survey on July 25, 1978 and completed the on-site phase of the work on October 11, 1978.

All samples requiring gamma and alpha spectro analysis were transmitted to Teledyne Isotopes located in Westwood, New Jersey on October 13, 1978.

Data obtained and discussion of the results follow:

2. Instrumentation

2.a. Gamma radiation measurements were obtained at one meter above defined surfaces using a pressurized ion chamber. The instrument used was a Reuter Stokes, Environmental Radiation Monitor, Model RSS-111 which was factory calibrated in July, 1978. This instrument was source checked daily prior to use using a Cobalt-60 gamma standard.

Background at point "P" was taken each day the instrument was used. Appendix B, table 2a summarizes the daily fluxuation in background levels.

2.b. Gamma radiation grid scan readings, gamma probe readings of holes for radiation profile, and gamma flux measurements of field samples were made using a 1 inch x 1 inch NaI scintillation detector. The instrument used was a Ludlum, Model 3, equipped with a model 44-2 probe. This instrument was source checked daily prior to use using a Cobalt-60 gamma standard.

Background at about six inches from the ground surface and at a depth of two feet below the surface was also taken each day the instrument was used. Appendix B, table 2b summarizes the daily fluxuation in background levels.

2.c. Smears for loose surface contamination and airborne sample evaluations were determined using an alpha scaler. The scaler system utilized was an Eberline Portable Scaler, Model PS-2 equipped with an Eberline detector, Model RD-13A. This system was standardized daily using an Th-230 source.

2.d. Other field instruments used were:

2.d(1). Beta-gamma measurements - Eberline E-120 instrument equipped with HP 177C probe

2.d(2). Fixed alpha - Eberline, LIN-LOG Alpha Survey instrument, PAC-4S equipped with AC-3-7 alpha scintillation probes.

2.d(3). Fixed beta-gamma measurements - Eberline E-120 instrument equipped with HP-210 probe

The above instruments were calibrated by Eberline Instrument Corporation or Rutgers University prior to the start of the assessment survey. Each instrument was source checked daily prior to use.

3. Survey Methodology and Analysis Techniques

3a. Changes to Protocol

3a(1). Extensive gamma scan surveys including radiation profiles of subsoil were made of an area adjacent to the manufacturing site as shown in figure 3.a(1) where L.B. Foster may relocate their manufacturing buildings.

3.a(2). About eight man days of work effort was expended in removing loose material in the bottom of four man ways which is a part of the manufacturing site's drainage system which discharges at the shore of the Ohio River. Figure 3.a(2) shows the approximate locations of the manways which were cleaned.

3.a(3). In some grids the measured dose rates exceeded the measuring capacity of the Reuter Stokes RSS-111. In order to determine the dose rates in these grids, the following technique was used:

(a) A measurement was made in an adjacent grid with the RSS-111 and with the E 120/HP 177C.

(b) A ratio of dose rate to E 120/HP 177C reading was determined.

(c) A reading at one meter in the grid which exceeded the RSS-111 capabilities was then determined with the E 120/HP 177C.

(d) The reading was then multiplied by the ratio determined in 3a (3)(b) and the result was recorded as the measured gamma dose rate.

3.a(4). The technique used to water jet hole in the refuse areas was performed as described in Appendix A with the following additional safety precautions:

(a) Water in each jetted holes was allowed to drain to the subsoil.

(b) The air above each jetted hole was analyzed for explosive gasses, using an MSA Explosimeter, Model 2.

(c) When tests indicated the presence of an explosive gas, the water jet pipes were not exhausted until additional tests substantiated the absence of explosive gasses.

(d) Water jet pipes were extracted mechanically with all personnel evacuated from the local area.

(e) Scan readings of the holes were made with all metal portions of the probes used covered with plastic and tape.

3.a(5). Radiation profiles of radioactivity beneath the manufacturing building floors were not made because of interference with L.B. Foster manufacturing activities within the buildings and because of the potential of pyrophoric reactions. In all instances, the results of gamma scans surveys in the buildings indicated that the radioactivity beneath the floor resided along the building foundation footings. Holes were water jetted outside the building along the footings and are considered to be representative of the radioactivity beneath the flooring.

3.a(6). All samples submitted to Teledyne Isotopes were analyzed by gamma spectro analysis and a representative number were then analyzed by alpha spectro analysis.

3.b. Unexpected Findings

3.b(1). The radioactivity in soil of the manufacturing site where drums of ore and ore residues had been stored was localized to the top twenty-four inch layer. The concentration at a depth of 2 to 4 inches generally exceeded the surface concentration by a factor of 2 to 4 and thereafter dropped off to background at a depth of about 24 inches.

3.b(2). The water jet operations conducted in the refuse area caused three (3) of the holes to generate a minor pyrophoric or chemical reaction where white smoke was noted. In each water jetted hole where the minor reactions were noted, the explosimeter detected levels in excess of the lower explosive limit. In total four (4) holes were determined to have detectable concentrations of flammable atmospheres. In three (3) of the holes the concentration of the flammable atmosphere decayed to non-detectable in 168 hours.

3.b(3). An area of about 700 square feet on the Monongahela property was determined to be contaminated above natural background levels. Figure 3b (3) locates this anomaly.

3.b(4). The presence of radioactive fallout was reported in the samples submitted to Teledyne Isotopes for analysis. A portion of this fallout is considered to be recent due to the relatively high concentrations of short-lived isotopes present.

3.c. Man-Hours Expended for On-Site Work

ATCOR employees and subcontractors expended 1, 962 man-hours exclusive of time associated with travel on-site.

3.d. Man Rem Exposure

0.440 Rem was total recorded film badge exposure for ATCOR employees and subcontractors. This exposure was expended during the on-site radiological assessment phase of this project.

3.e. Analytical Techniques

Teledyne Isotopes analyzed all samples delivered by ATCOR by standard gamma spectro analysis techniques. Their alpha spectro analysis procedure was as follows:

3.e(1). After gamma spectro analysis was performed, the sample was divided and a known quantity was measured out.

3.e(2). Equal portions by weight were chemically digested and one sample was separated for Uranium and the other for Thorium.

3.e(3). The samples were electroplated on nickel discs.

3.e(4). The discs were then placed in a chamber in which a vacuum was created.

3.e(5). The samples were then counted using a BaS scintillation phospher and the results were reported in pci per gram.

4. <u>Survey Data</u>

4.a. Grid Format

The manufacturing site and the refuse areas were gridded into 25 foot x 25 foot areas. The corners of each grid were marked with a wooden stake or other field expedient method. Figure 4a is a plan view of the manufacturing site which further indicates how the grids are displayed. Figures 4a(1) through 4a(8) displays the numbered grids.

4.b. Tables of Gamma Radiation Measurements

4.b(1). Results of the gamma scan measurements at about six (6) inches above the surface as determined with the 1 inch x 1 inch NaI scintillation detector are contained in table 4.b(1) as per their assigned grid numbers as displayed in figures 4.a(1) through 4.a(8).

4.b(2). The dose rate at one meter above the point where the highest gamma flux was noted with the scintillation detector for each grid was measured using the pressurized ion chamber. The results of these measurements are documented in table 4.b(2) in μR per hour.

4.b(3). The area along the railroad siding was gridded. The gridsat the railroad siding were assigned by selecting the grid which had an assigned number from figures 4.a(1) through 4.a(8). For example, N-16 at the railroad siding is adjacent to and directly south of grid 16 which is shown on figure 4.a(1).

4.b(4). Results of the gamma scan measurements at about six (6) inches above the surface as determined with the 1 inch x 1 inch NaI scintillation detector for the railroad grids are contained in table 4.b(4)

4.b(5) The dose rate for each railroad grid determined at one meter above the point where the highest gamma flux was noted is contained in table 4.b(5).

4.b(6). The grids in the twenty-five (25) foot extension area were numbered as described in 4.b(3) and were scanned with the scintillation detector. The results are documented in table 4.b(6).

4.b(7). The dose rates for the twenty-five (25) foot extension area were not measured with the pressurized ion chamber and, therefore, data is not available for those grids.

4.b(8). The area surrounding the manufacturing site was scan-surveyed using the 1 inch x 1 inch NaI scintillation detector and the areas where activity exceed twice background determined at point "P" are shown on figure 4.c(3). All areas other than those which are indicated were determined to be less than twice background. The area shown on figure 4.a(8) in the north west corner is the only anomaly not associated with site drainage systems discussed in section 6.c of this report.

4.b(9). The north-west anomaly outside of the 100 foot extension area is adjacent to a vehicle wash station next to the employee parking lot. Radiological survey for this area indicated the following:

1. Max NaI reading 35 K counts per minute with 1" x 1" NaI detector.

2. Area about 50 square feet.

3. Activity noted to depth of 18 inches.

Note: This radioactive material was located in Parcel A and has been removed and placed within the manufacturing site as per agreement between L. B. Foster and AMAX Specialty Metals Corporation.

4.c. Results of Surveys of Site Drains and Runoff

4.c(1). Four (4) water samples were collected from rain water within various drainage sites and was sent to Teledyne Isotopes for gamma spectro analysis. The results are contained in table 4.c(2) (page 119a).

4.c(2). Three (3) soil samples were taken at the Ohio River; one upstream on the eastern bank, one downstream on the eastern bank, and one in the sediment tank at the discharge of the storm drain line. These samples were analyzed by gamma spectro analysis by Teledyne Isotopes. The results are contained in table 4.c(2).

4.c(3) Figure 4.c(3) displays the areas within the 100 foot extension area surrounding the manufacturing site. These identified areas are numbered and described as follows:

(A) Bank on natural swale which is part of surface runoff and which drains south along the fence to the railroad.

(B) Drainage area south of area identified as Fig. 4.a(8) which leads onto the adjacent property.

(C) Location of a small pile of rubble.

(D) Drainage field of several culverts which drain from the manufacturing site located west of building #4.

(E) Pond area which contains surface runoff water. In this area, a fifty-five gallon drum containing radioactive soil was found.

(F) Refuse dump containing parts of a metal building and also a pile of bricks.

4.d(9) An area next to a vehicle wash station located outside of 100 foot extension area.

4.c(4) Figures 4.c(4)(A) through 4.c(4)(F) details the radiation scan measurements associated with the areas identified in 4.c(3) above. These measurements were made using the 1" x 1" NaI scintillation detector.

4.c(5) Figure 4.c(4)(B) and its continuation have letter designations where holes were augered. Radiological scan measurements were made, samples were collected and the samples field counted with the 1" x 1" NaI scintillation detector. The results of these measurements are contained in table 4.c(5).

4.c(6) Figure 3.b(3) is an overlay which indicates the position of radioactivity found on the adjacent property. This area is a natural low point where contamination build up could be expected from the continuation of the southwest drainage path from the manufacturing site. The following table contains data for this anomoly:

Surface radiation reading:	4 K counts per minute as measured with 1" x 1" NaI detector
Area size:	500 to 700 square feet
Depth of deposit:	18" (average)
Max. reading at depth of 8 inches:	12 K counts per minute as measured with 1" x 1" NaI detector

4.d Soil Analysis

4.d(1). Soil from manufacturing site grids at surface and at two (2) feet which exceeded five (5) times natural background were sampled. The samples were field-counted using the 1 inch by 1 inch NaI scintillation detector in the L.B. Foster office complex. These samples were left in containers at the L.B. Foster facility after determining the gamma flux. The results of these field measurements are contained in table 4.d(1).

4.d(2). Soil from the railroad grids at the surface and at two (2) feet which exceeded five (5) times natural background were sampled and analyzed as described in section 4.d(1). The results of these measurements are contained in table 4.d(2).

4.d(3). Representative samples which were field-analyzed by ATCOR were sent to Teledyne Isotopes for specific analyses. The results are contained in Teledyne Isotope Reports in section 4.d(3).

4.d(4). Figure 4.d(4) shows the general information associated with water jet holes where soil which was washed from the hole was analyzed and where measurements were obtained using the 1 inch x 1 inch NaI scintillation detector.

4.d(5). Table 4.d(5) contains the data in K counts per minute as determined with 1 inch x 1 inch NaI scintillation detector from water jetted holes which are displayed on figure 4.d(4).

4.d(6). Soil from the twenty-five extension grids at the surface and at two (2) feet which exceeded five (5) times natural background were sampled. The samples were field counted using the 1 inch by 1 inch NaI detector in the L.B. Foster office complex. These samples were left in containers at the L.B. Foster facility after determining the gamma flux. The results of these field measurements are contained in table 4.d(6).

4.d(7). Surface soil samples from grids 398 through 1422 which exceeded 5 times natural background and in which no water jetting was conducted were sampled. These samples were field counted using the 1 inch by 1 inch NaI detector in the L.B. Foster office complex. The results of these field measurements are contained in table 4.d(7).

4.e. Results of Surveys of L.B. Foster Manufacturing Buildings

4.e(1). The gamma dose rates and gamma scan measurements have been included in section 4.b.

4.e(2). Loose surface contamination smears were taken in the major buildings of the L.B. Foster facility. The field data is contained in survey reports listed as 4.e(2).

4.e(3). Airborne samples within buildings designated by numbers 3 and 4 of figure in appendix A were obtained and field-analyzed. The results are contained in survey reports as 4.e(3).

5. Decontamination of Site Drainage

5.a(1). Figure 3.a(2) shows a plan view of the property with a buried storm drainage system which originates somewhere on the old section of the manufacturing site and terminates at the Ohio River. This figure indicates the approximate location of four (4) manways where the drainage piping is accessible. These manways indicated gamma levels above background as determined with a 1 inch x 1 inch NaI scintillation detector. Due to construction of the bottom of the manways, some loose deposits were noted and subsequently removed.

5.a(2). The manway sides is of red brick construction with a porous clay grouting. The bottom was a cement pour with the drain piping traversing the cement as a half pipe. Figure 5.a(2) is a side view of a manway and also indicates the survey points where radiological data was obtained.

5.a(3). Results of radiological surveys prior to decontamination efforts are contained in table 5.a(3) for each manway.

5.a(4). Decontamination was performed on the lower cement and brick walls by lowering a man into the manway with a boom derrick and having the man remove all loose debris on the cement and in the cement culvert. He then washed the cement and lower section of bricks with damp rags and toweling. Some mechanical decontamination was attempted using a pneumatic needle scaler device. This technique did not reduce the levels significantly and this technique was terminated. Samples of various wall deposits were obtained and were counted as follows:

(a) A portion of the deposit was ground to a fine powder.
(b) A portion of the deposit was placed on the bottom of a planchet in a quantity to just cover the planchet surface with a film.
(c) The planchet was then counted for gross alpha in dpm.

5.a(5). Data for deposits which were analyzed using the procedural steps 5.a(4) (a) through (c) are contained in table 5.a(5).

5.a(6). The debris and other low level radioactive waste generated in this decontamination effort was placed in plastic bags which were transferred to and stored in the closed area off the laboratory used by ATCOR during the on-site work.

5.a(7). Results of the radiological surveys taken after the decontamination effort are contained in table 5.a(7).

5.a(8). The radiological surveys of all manways indicate that the red brick or clay grout have higher concentrations of natural occurring radionuclides found in standard building materials. In addition, manway #4 has higher ambient radiation levels than the other three manways. This manway is located in a different soil deposit, and the higher radiation levels indicated in this manway are most likely from the natural radioactivity within this particular deposit.

5.a(9). The storm drain system terminates at the Ohio River. Radiological measurements along the eastern bank of the Ohio River was determined in the ten (10) foot intervals in both the south and in the north directions. This data is contained in table 5.a(9).

5.a(10). Three samples at the Ohio River were obtained and analyzed by gamma spectro analysis by Teledyne Isotopes. This data is contained in table 4.c(2).

6. Discussion of Data

6.a Buildings

6.a(1). The gamma dose rates at one meter within the L.B. Foster manufacturing buildings in areas where no Thorium bearing material is thought exists are about 75 percent of natural background at Point "P" which is 12.2 μR per hour. It is thus apparent that the existing five (5) inch cement flooring attenuates the natural gamma radiation. Many references state that five (5) inches of concrete will reduce the Radon emanation rate to about 85 percent of the rate without Radon barrier. These references also state that higher gamma dose rates can be expected with the Radon barrier because of the increase in Rn-222 progeny. This Radon buildup, if present, was more than compensated for by the five (5) inches of concrete.

6.a(2). The numerical value of RSS-111 measurements at one meter in μR per hour divided by Ludlum readings at six (6) inches above the surfaces in K counts per minute at Point "P" is 5.5. In areas described in 6.a(1), the average ratio was about 4.8. This reduction in the ratio was most likely due to gamma buildup of scattered radiation. In areas where radioactivity was noted under the concrete, the above ratio approached the value described in section 6.d(5).

6.a(3). All smear data for the building structures are less than or equal to the minimum detectable counts (MDC) reported at the 90% confidence value, calculated as follows:

$$MDC = 1.645 \left[\frac{Cb}{ts} + \frac{Cb}{tb}\right]^{0.5}$$

where, Cb = background count rate
ts = sample count time
tb = background count time

6.a(4). The airborne data taken on 8/7/78 and 8/8/78 for L.B. Foster building numbers 3 and 4 indicated no long-lived component in the field airborne grab samples. The sample decay rate for the samples were 5.8 hours and 4.0 hours based on gross alpha counting techniques. Results were reported as equivalent Th-230 activity. Where high concentrations of Thoron (Rn-220) exist, the air sampling technique used will detect, by half-life determination, Thorium B (Pb-212). The rapid loss of activity indicated Radon (Rn-220).

6.a(5). The airborne sampling technique used does tend to impinge Radon (Rn-222) onto the filter media. The loss of this activity by decay and by release back to the atmosphere is typical of what can be expected from Radon.

6.b Manufacturing Site

6.b(1). The northern portion of the manufacturing site contains foundations of building structures which have been dismantled. The cement floors, some original asphalt paving, and retainer walls along the railroad siding still exist. Contaminated soil in some areas exists upon these surfaces.

6.b(2). Drain piping from tiles on the northern portion of the manufacturing site penetrates the retainer wall at the railroad siding. Evidence of soil contamination was detected behind the retainer wall by placing the 1 inch by 1 inch NaI scintillation detector into the drain piping. Readings through the drain piping behind the retainer wall were in the order of 200 K counts per minute.

6.b(3). The personnel assigned to perform this radiological assessment survey performed the majority of their work in areas where the average radiation background was higher than the L. B. Foster personnel working at this site. The mathematical average of radiation exposure was derived by dividing the total man rem from film badge records by the total man hours spent on site. The result was about 0.22 millirem per hour.

6.c Data for Water and Site Drainage

6.c(1). The south western drainage area runs off the L. B. Foster property and onto the adjacent property. The surface activity in the adjacent property where the land has been tilled for farming does not contain activity above twice background.

6.c(2) The surface gamma scan measurements in the flood plain associated with the south west drainage path are higher than the actual stream bed. These streams did not contain running water during July through September unless there were were periods of heavy rainfall. During wet periods, these streams discharge significant quantities of water.

6.d Soil

6.d(1). In many samples, Teledyne Isotopes has reported low levels of fallout from weapons testing. Table 6.d(1) lists the fallout isotopes found in many of the surface samples and Ohio River discharge point sample.

Table 6.d(1).

Isotopes Identified with Weapons Testing

Radionuclide	Half-life
Zr-95	65.5 day
Ru-103	39.8 day
Co-137	30.2 year
Ce-144	284.4 day

6.d(2). The oxides of Cerium (group IVB) and Ruthenium (group VIII) are relatively insoluble and are expected to wash off the property as a function of natural errosion caused by rainfall. Teledyne Isotopes reported the concentrations at the outfall of the storm drain system at the Ohio River as listed in table 6.d(2).

Table 6.d(2).

Radionuclides at Effluent of Storm Drain at Ohio River

Radionuclide	Concentration
Ru-103	1.11×10^{-1} pci/gm
Ce-144	2.77×10^{0} pci/gm

6.d(3). The fission yield for Ru-103 and Ce-144 for fast and thermal fission are almost identical and their respective fallout percentages are also similar. Therefore, the concentration at the time of formation and time of its deposition would be about the same. Substituting values from tables 6.d(1) and 6.d(2) into $A=A_o e^{-\lambda t}$ and setting the initial values of Ao for both formulae equal, the elapsed time was determined to be slightly less than four (4) years. This result is a fair agreement with the reported fallout which occurred in West Virginia.

6.d(4). Appendix B, table 2b indicates that the measured gamma background level in the soil decreased by about eight (8) percent within 48 hours and another eight (8) percent after one month. The initial reading on the day that the hole was augered was 3.0K counts per minute. After 48 hours, the average reading was 2.6K connts per minute. This initial decrease is to be expected and was due to the disturbance of equilibrium values of Rn-222 progeny because of natural venting of Rn-222 at the surface of the augered hole. The variances in the measurements may be a function of soil moisture content. Since all holes were measured after a twenty-four (24) hour period, the radiological profile data obtained should be compared with a natural background of 2.8 K counts per minute.

6.d(5). The numerical value of RSS-111 measurements at one meter in μR per hour divided by Ludlum readings at six (6) inches above the surface in K counts per minute can be used as an indicator of the presence of Thorium bearing material. At Point "P", the above defined ratio is 5.5, and in grids determined to be most contaminated, the average ratio as previously defined is about 2.1.

7. Calculations

7.a Method for calculation of volume

7.a(1). Determination of Contaminated Volume of Soil The grids and other defined areas which exceed twice background were determined. The depth to which the deposit of radioactive material exceeded twice background was then determined each of the above areas. The total volume was then calculated by summing the products of each surface area by the depth of the deposit. The following is a summary of the above defined products:

	Area	Cubic Feet
(a)	100 ft. extension east of grids No. 1 - 16 1,500 square feet x 1.5 feet..................	2,250
(b)	25 foot extension east of grids No. 1 - 16 10,000 square feet x 1.5 feet..................	15,000
(c)	Grids No. 1 - 192 with no concrete beneath 53,750 square feet x 2.0 feet..................	107,500
(d)	Grids No. 1 - 192 with concrete beneath 23,125 square feet x 0.25 feet..................	5,800
(e)	Grids No. 193 - 395 3,125 square feet x 1.5 feet..................	4,700
(f)	25 foot extension North of Grids (between Grid No. 1 & 129) 6,250 square feet x 1.5 feet..................	9,400
(g)	100 foot extension West of Grids No. 193 - 395 1,825 square feet x 2.0 feet.................. 3,125 square feet x 0.5 feet.................. contaminated rubble..........................	3,650 1,550 450
(h)	Area in grids No. 398 - 1422 (See figure 7a(1)) 83,750 square feet x 2 feet.................. 39,375 square feet x 4 feet.................. 34,700 square feet x 7.5 feet.................. 18,750 square feet x 14 feet..................	167,500 157,500 260,300 262,500
(i)	South west drainage flood plain 28,000 square feet x 2 feet..................	56,000
(j)	Build up on adjacent property S.SW of mfg. sites 700 square feet x 2 feet..................	1,400
(k)	Sediment catch tank at Ohio River Estimated volume in tank..................	7

(1) Area along railroad siding
19,700 square feet x 2.5 feet.............. 49,250

Volume 7.a(1) 1,105,000 $ft.^3$

7.a(2) Contingency volume estimates
Removal of contaminated soil will most likely result in the cross contamination of the underlying soil which then has to be removed and controlled. This additional depth is estimated to be four (4) inches over the areas defined in 7(a)(1). In addition, the building rubble placed over the northern portion of the manufacturing site grids would also have to be considered as being radioactive as there is very little chance it could be removed practically without it being mixed with contaminated subsoil. The sum of these two volumes are:

Volume 7.a(2)..............122,600 $ft.^3$

7.b Determination of total tons of material which is contaminated:

$$\# \text{ Tons} = (\text{Total volume}) \times (\rho \text{ of } H_2O) \times (\text{Sp.G}) \times \left(\frac{\text{ton}}{2{,}000 \text{ lbs}}\right)$$

$$\# \text{ Tons} = 1.23 \times 10^6 \text{ ft}^3 \times 62.4 \frac{\#}{\text{ft}^3} \times 1.9 \times \frac{\text{ton}}{2{,}000\#}$$

Tons = 73,000 tons

7.c Airborne concentration within Buildings No. 3 and No. 4 in terms of working levels.

7.c(1) Airborne activity reported as equivalent ^{230}Th = 7.3×10^{-11} μci/ml*
* maximum value in 4.e(3).

7.c(2) Correction for decay during sampling based on ^{222}Rn using the following formula:

$A_o = Ae^{\lambda T}$ where $A = 7.3 \times 10^{-11}$ μci/ml
$\lambda = 0.693/t_{1/2}$
T = ½ sample time + time between sampling and counting.

Assume $t_{1/2}$ = 19.7 minutes based on Radium-C

$$A_o = 7.3 \times 10^{-11} \frac{\mu ci}{ml} \times e^{\frac{0.693}{19.7 \text{ min}} \times 40 \text{ min}}$$

$$A_o = 7.3 \times 10^{-11} \frac{\mu ci}{ml} \times 4.1$$

$A_o = 3 \times 10^{-10}$ µci/ml of ^{222}Rn; assuming approximate radioactive equilibrium of ^{222}Rn with its progeny.

7.c(3) Determination of working levels (WL)
Note: If ^{222}Rn is in equilibrium with its short lived daughters, then 100 pci/liter of ^{222}Rn is equivalent to 1 WL (Dept. of Health, 1978)

$$\#, WL = 3 \times 10^{-10} \frac{\mu ci}{ml} \times \frac{10^3\ ml}{l} \times \frac{10^6\ pci}{\mu ci} \times \frac{WL}{100\ pci/l}$$

$$\#, WL = 0.003\ WL$$

7.d Calculation of dose rate decrease from a series of line sources with gross simplification

7.d(1) Formula used $\phi = B \frac{SL}{4\pi a}$

or $a_1 \phi_1 = a_2 \phi_2$ . . . formula 7.c(1)

7.d(2) Gamma scan at various distances from the 100 foot extension area north of the manufacturing site with the NaI detector yielded the following:

A, distance	Measured Flux	Adjusted Flux*
In feet	In K cpm	In K cpm
37	4.8	2.6
87	3.9	1.7
133	3.1	0.9

7.d(3) Substituting ϕ at 37 feet in formula 7.c(1) and solving for expected flux at distances of 87 feet and 133 feet, the following adjusted flux levels were obtained:

ϕ 87' = 1.1 K cpm
ϕ 133' = 0.72 K cpm

7.e Estimates of activity present on site

In order to determine an accurate estimate, one should integrate $\frac{da}{dv} = S_v d_v$ over the entire site. We have multiplied the average specific activity by the total volume calculated in 7.a(1) plus 7.a(2). This result may differ from the actual condition by as much as an order of magnitude, but the difference is considered moot.

$A_T = V_T \times$ ave. concentration*

$$A_T\ 1.23 \times 10^6\ \text{ft.}^3 \times 6.5 \times 10^1\ \frac{\text{pci}}{\text{gm}} \times \frac{453.6\text{gm}}{\#} \times \frac{(1.9 \times 62.4\#)}{\text{ft}^3}$$

$A_T = 4.3 \times 10^{12}$ pci or 4.3 curies of which 80% is ^{232}Th and 20% ^{238}U.

*based on weighted averages for ^{232}Th + ^{238}U without daughter products.

8. Summary and Conclusions

8.a Radiation Exposure to Workers

Although the dose rate on the L. B. Foster facility varies significantly, the dose rate to the L. B. Foster employees would be less than the 0.22 mr/hr average to our employees who conducted the radiological assessment survey. This conclusion is based on the following:

L. B. Foster work is conducted in buildings where the dose rate is typical of normal background and conducted from heavy pipe moving equipment which provides shielding for the operator who traverses contaminated zones.

8.b Radiological exposure to airborne activity

Based on conservative assumptions and mathematical calculations, it was determined that exposure to employees is less than 0.05 WL and, therefore, no remedial action is required due to airborne activity.

8.c Tracking or spread of surface activity.

Based on surface contamination determined to be present in buildings, no hazard from loose surface contamination was found. Some cross comtamination due to vehicular traffic was determined to be present on the site, but was considered minor with consideration for all activities being conducted.

8.d Isotopic composition of Site Activity

Based on Teledyne Isotope Reports for samples submitted, the concentration of activity contains significantly more Thorium than Uranium. The Th nat/Unat concentrations is about 12 on a weight basis.

8.e Concentration of soil radioactivity

Based on sample data, the Th nat plus Unat concentrations exceed 1/20 of one per cent by weight.

8.f Migration of activity

Very little of any radioactivity has migrated from the site due to windborne effects, but surface run off of radionuclides is occurring south west of the manufacturing site. This has resulted in radioactive build up in areas off the site in an area used currently as farm land. Stabilization of the radioactivity is required.

8.g Radiation Levels

The measured dose rates on the section of the L.B. Foster property designated as the manufacturing site has radiation levels which exceed five times natural background. There are also significant areas both on the site and adjacent property which exceed twice natural background. The levels of twice radiation background do exceed the Surgeon General's recommended value and, therefore, requires an evaluation of the effects on man if this condition were allowed to exist. (See Transparancies 8g.)

8.h Pyrophoric Materials

The section of the L.B. Foster manufacturing site which is located south of the railroad tracks does contain a flammable solid along with the soil contamination. Because of the presence of flammable solids (Mg and Zr), any remedial action required for the site must consider this additional hazard as well as the radioactivit_.

8.i Migration of Activity as a Function of Depth

Based on Teledyne Isotopes samples, it was determined that the progeny of Thorium-232 and Uranium-238 are about in secular equilibrium with their parents at all depths.

TECHNICAL PROPOSAL

TO

AMAX SPECIALTY METALS CORPORATION

July 5, 1978

APPENDIX A

ATCOR

Introduction

AMAX Specialty Metals Corporation, pursuant to meetings of May 12, 1978 and June 22, 1978 with the U.S. Nuclear Regulatory Commission, Region II, has agreed to submit a plan for a radiological assessment survey of the L.B. Foster Company facility located in Washington, West Virginia. Figure 1 is a diagram of the facility and identifies specific areas referenced in the survey plan.

Purpose

The purpose of conducting the survey will be to determine:

1. The radiation levels existing at the facility (including within and under existing structures) and surrounding environs.
2. The existing contamination levels on and in soil in areas where drums of ore and residue from the ores had been stored.
3. The extent of downward migration of radioactivity in areas where source material is detected.
4. The migration of radioactivity due to rainfall in natural and man-made drainages.
5. Isotopic composition of the radioactive materials.
6. The quantity of radioactivity, if any, that may have been inadvertently included within facility refuse areas which were basically cut and fill type.
7. The existence of loose surface contamination within buildings to obtain information on tracking of radioactivity.
8. Airborne concentrations from Radon-Thoron daughter products in closed structures.

Survey Methodology

In order to obtain radiological data that is accurate and that can be corroborated, it will be necessary to grid off the site. The grid size selected was 25 feet by 25 feet. The grid system will apply to the actual area presently in use as a manufacturing site. Figure 2 identifies the manufacturing site for the purpose of this survey.

1.a Radiation scan survey. Each grid will be scan-surveyed by transversing the area in paths approximately 3 to 5 feet apart using 1 inch by 1 inch (1 x 1) NaI scintillation detectors with the probe held at about six (6) inches above the surface. The data recorded for each grid will be multiples of natural background for that instrument. The maximum and minimum measurements will be documented as a minimum. If significant variances in the scan readings are noted within a grid, then sufficient additional measurements will be made to describe these variances and permit construction of isodose lines. Natural gamma background will be determined each day by recording the instruments' count rate at about six (6) inches above earth which has not been affected by previous facility operations. The planned point for determining natural background is indicated as point "P" on Figure 2.

1.b Radiation measurement. At the points where the maximum gamma scan readings were noted and at points, if any, where significant variances were noted in 1.a, the dose rates at one meter above these surfaces will be measured with a pressurized ion chamber and documented. (Reuter-Stokes RSS 111 or equivalent.) Natural background will be determined daily at point "P" and documented.

1.c Areas immediately surrounding the manufacturing site. 25 foot by 25 foot grids immediately outside the perimeter of the manufacturing site will also be included in the grid system and treated as if it were a part of the manufacturing site. These areas are shown on Figure 3. The adjoining areas to a distance of 100 feet from the manufacturing site will also be scan-surveyed with the 1 x 1 NaI scintillation detector. Areas indicating twice natural background will be documented and the dose rate at one meter above the surface will be measured and documented. If radiation levels exceed two (2) times natural background at 100 feet distance, then the area will be increased and measurements will be documented to distances where three (3) continuous readings at ten (10) foot increments show less than two (2) times natural background as determined at point "P". Pressurized ion chamber readings will be taken at one meter above all anomalies which exceed two (2) times natural background as determined with the gamma scintillation scan survey.

2. Soil contamination. Areas where ores or ore residues had been stored and those grids within the manufacturing site that indicate by gamma scan five (5) times natural background (excluding the suspected AMAX Specialty Metals Corporation and The Carborundum Company's refuse areas shown on Figure 4) will be augered to a depth of not less than two (2) feet. Representative samples of the soil removed by the augering will be placed in plastic bags which will be identified by grid number. The bags containing the samples will be removed to a low background area where they will be measured by surrounding the 1 x 1 NaI scintillation detector as much as practical with the bagged soil. Background will be measured daily at the point where this evaluation will be performed by surrounding the detector probe with surface soil obtained from point "P" shown on Figure 2. This soil will be packaged, labeled, and surveyed as previously described. The measured count rate from each bag of soil will be recorded in terms of background.

Approximately ten (10) percent of the number of samples, including those that have the highest measurements, along with two (2) samples of background soil will be sent to an independent laboratory, such as Teledyne Isotopes, for isotopic analysis and specific activity determination.

3. Soil radioactivity as a function of depth. At each grid where holes had been augered, measurements using the 1 x 1 NaI scintillation detector will be obtained by lowering the probe into the hole and recording the measurement in terms of background. Background for this will be determined daily by measuring the radiation at specified depths in a hole at point "P" shown on Figure 2. Measurements will be taken with the detector probe at the following depths from the ground surface: 0, 0.5 feet, 1 foot and 2 feet. If the radiation profile exceeds twice background at a depth of two (2) feet, then additional augering will be effected, soil samples will be collected and measured, and gamma profile measurements will be made until successive one (1) foot measurements indicate less than twice background.

4. Surface runoff. All drainage paths of surface water run off, either natural or man-made, (including storm sewers) which may contain sediments from the site, will be evaluated by checking the discharge path for evidence of contamination. Gamma scan surveys along the likely discharge paths will be made. If evidence of contamination is found, the scanning will continue until the levels along the path are less than twice natural background. Gamma scan of the next collection point further down the discharge path will also be checked to verify that buildup had not occurred further downstream. The results of all such scan surveys will be documented. Areas indicating greater than five (5) times natural background will also be monitored for gamma dose rate at one meter above the sedimentation with the pressurized

ion chamber. In addition, augered samples will be obtained and measurements will be made to determine the depth of radioactivity in the sediment. Representative samples of these sediments including samples that are not on Foster-owned property will be analyzed by independent laboratory for isotopic content and specific activity determinations. If water is present in these streams at any time during the conduct of this survey, then one (1) liter samples will be obtained and identified by sample location. Samples will be sent to an independent laboratory for isotopic analysis.

5. Isotopic composition. Samples will be packaged and and transferred to a laboratory which shall determine the natural thorium and uranium content by mass spectro analysis and by GeLi gamma spectro analysis. All samples transferred to the independent laboratory will be counted by gamma spectro analysis and certain select samples will also be analyzed for ^{238}U and ^{232}Th by mass spectro analysis techniques. Both analyses will be required to establish percent equilibrium between parent and daughters. The size of the sample will be selected to insure that the laboratory can determine activity in the range of one picocurie per gram of soil. Each sample will be identified by grid, stream sediment, or control background.

6. Refuse area. ATCOR has been advised by AMAX Specialty Metals Corporation that the refuse areas used by AMAX Specialty Metals Corporation and The Carborundum Company had not been intentionally used to dispose of either radioactive or pyrophoric material. However, there is a possibility that this material may be present in some areas. Figure 4 identifies areas where mechanical augering will not be conducted due to potential for pyrophoric material. In these areas, sampling and surveying operations will be conducted using the following techniques for personnel protection. Pipes

will be jetted into the ground to a depth of twelve (12) feet using water. The pipes will be sunk in rows separated by about eight (8) feet and at intervals along the row of about nine (9) feet apart such that the holes will form equilateral triangles. A gamma scan will be performed at each hole in depth intervals of two (2) feet as measured from the surface with the data recorded in terms of background. Background for this survey will be the measurement at the two (2) foot depth as determined at point "P" on Figure 2. If scan results exceeding two times background are noted, representative samples of the soil removed by water jet process will be collected and monitored to determine if the hole is within a pocket of activity or if measurement is from radioactivity in the vicinity of the hole. The procedure used to determine gamma levels of samples will be the same as used for determining the mechanically augered samples. Due to the potential of pyrophoric material being present, samples will not be sent to an independent laboratory for analysis. If, during the conduct of this survey, it is determined that the program requires expansion to adequately define the extent of radioactivity in the refuse area, then those additional samples will be obtained as necessary; such as by increasing the area defined on Figure 4, by increasing the depth of holes, and by decreasing the spacing between holes.

7. <u>Loose surface contamination</u>. A minimum of twenty (20) smears of floor areas and areas where loose surface contamination would build up will be taken within each of the buildings. The smear technique to be used will be by wiping selected areas with dry filter cloth discs having a diameter of about two (2) inches, applying moderate pressure over one hundred (100) square centimeters. These smears will be counted in Eberline MS-2 scaler equipped with RD-13 alpha detector, or equivalent. Sample count time will be sufficiently

long to have a minimum detectable activity of 10 dpm at the ninety percent (90%) confidence level. Scaler background count rate and scaler efficiency for natural thorium will be taken daily and documented when counting is being performed.

8. Airborne radioactivity. Air samples will be taken for approximately one hour at a sample flow rate of twenty (20) liters per minute in each of the two (2) manufacturing buildings after they have been secured or closed over a normal weekend period. The sample will be dated and counted using scaler equipment described in Section 7 for ten (10) minute counting times. These samples will be recounted daily over the project to determine half-life of the particulate matter collected. Data to be recorded for each sample will be alpha net counts/ten (10) minutes, date and time of count for each building sampled. Each such building should be sampled twice during the period of on-site data collection for the assessment survey.

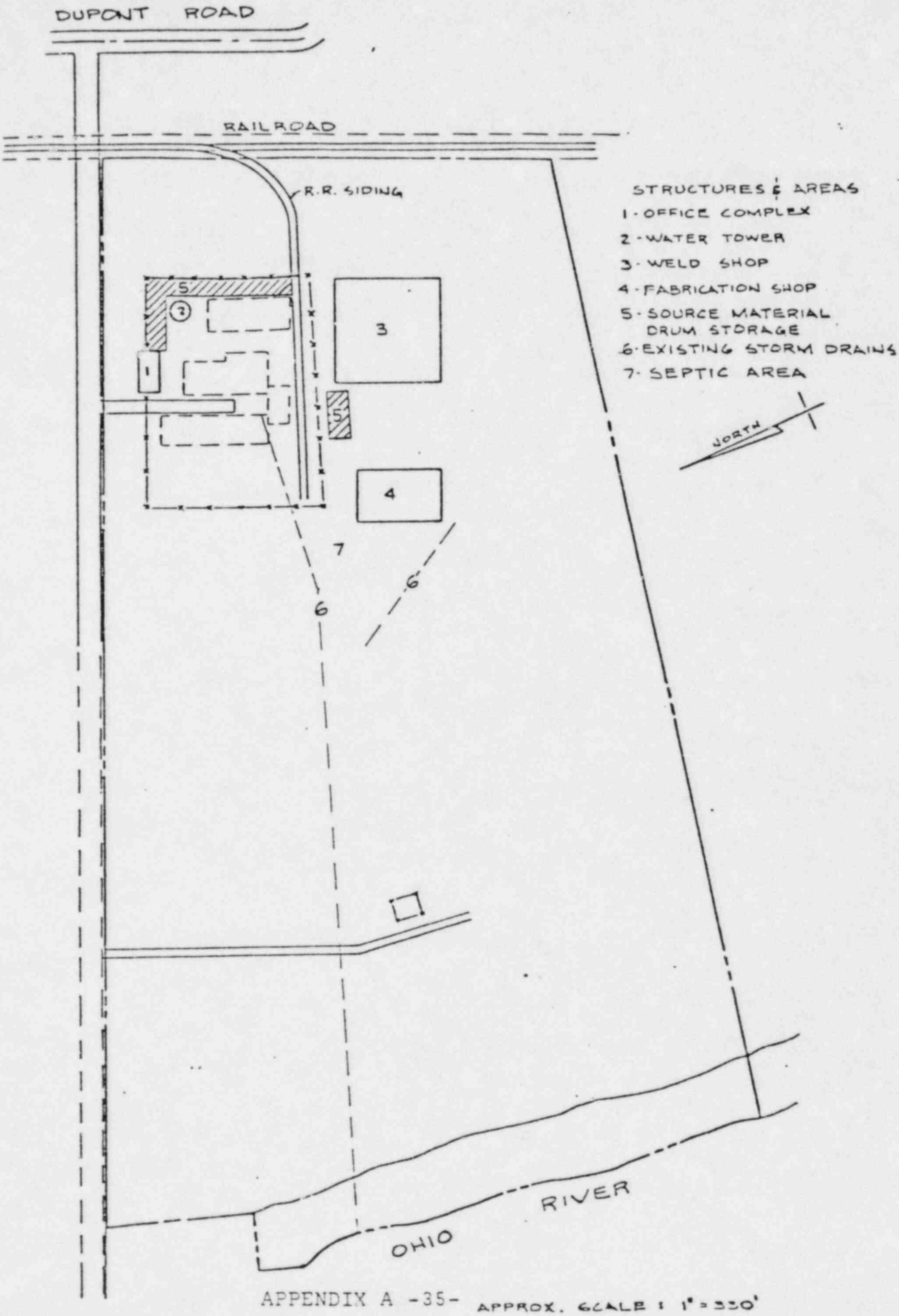
Note: The structures in the manufacturing area, exclusive of refuse areas as shown in Figure 4, will be surveyed on the grid system. Where gamma scan surveys indicate two (2) times background, it will be necessary to remove portions of the cement flooring in order to perform required surveys. Upon completing the necessary surveys, the holes will be refilled with compacted soil and the cement floor will be patched to match the original flooring.

Safety. The work incorporated in this proposal will be conducted in such a manner as to protect the general public as well as individuals on the site, whether or not involved in the actual work described by this proposal, and to avoid property damage. All laws, ordinances and regulations relative to safety and the prevention of accidents shall be observed. AMAX Specialty Metals Corporation will consult with ATCOR regarding appropriate safety procedures in all areas where pyrophoric material has been identified by Foster or otherwise is indicated or suspected. In addition, AMAX Specialty Metals Corporation will maintain an employee on site as required to consult regarding the handling of pyrophoric material.

Data Reduction and Report

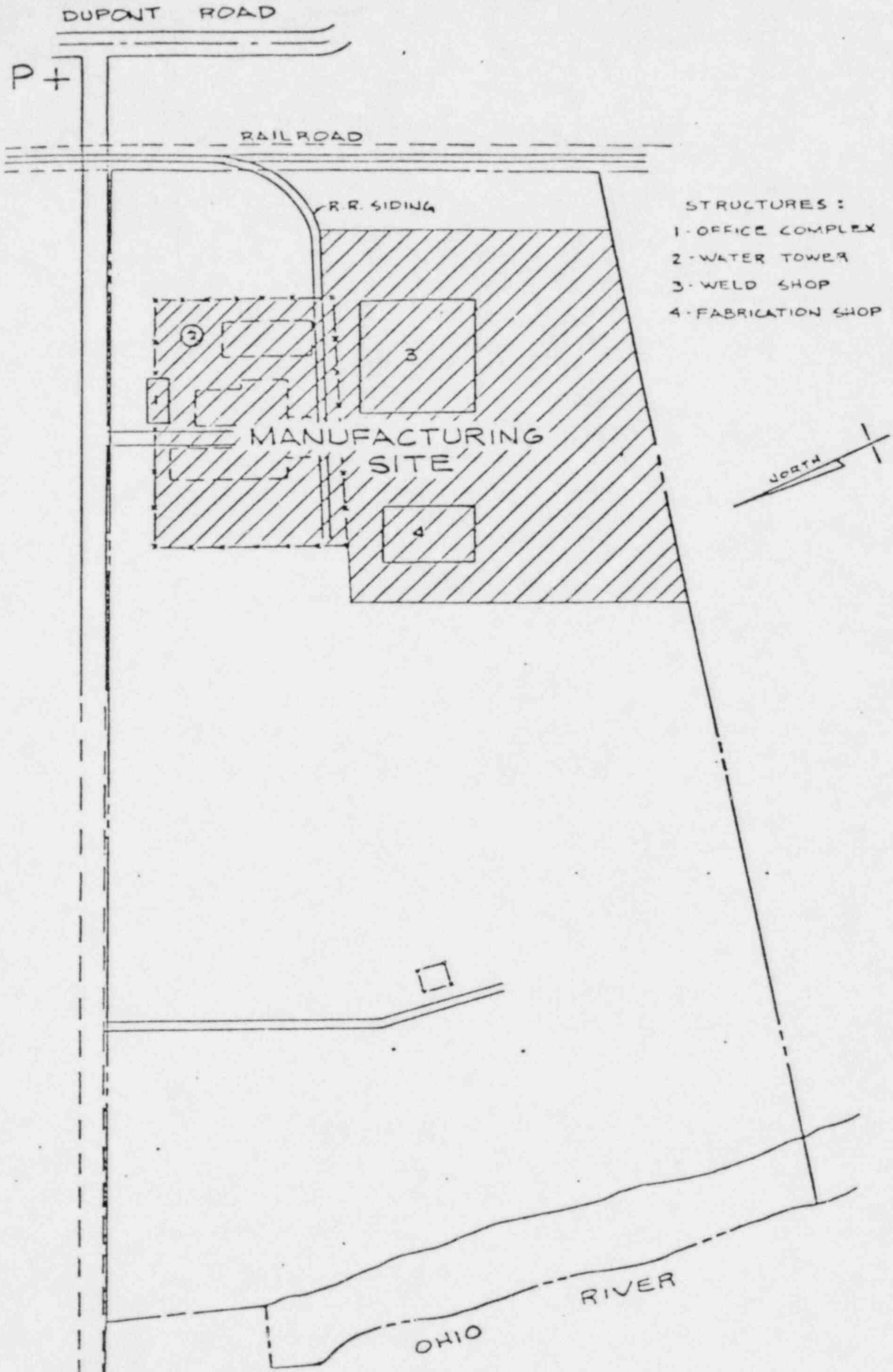
All data will be reviewed and analyzed. A report will be formulated assessing the current conditions at the Foster facility and environs.

FIGURE #1



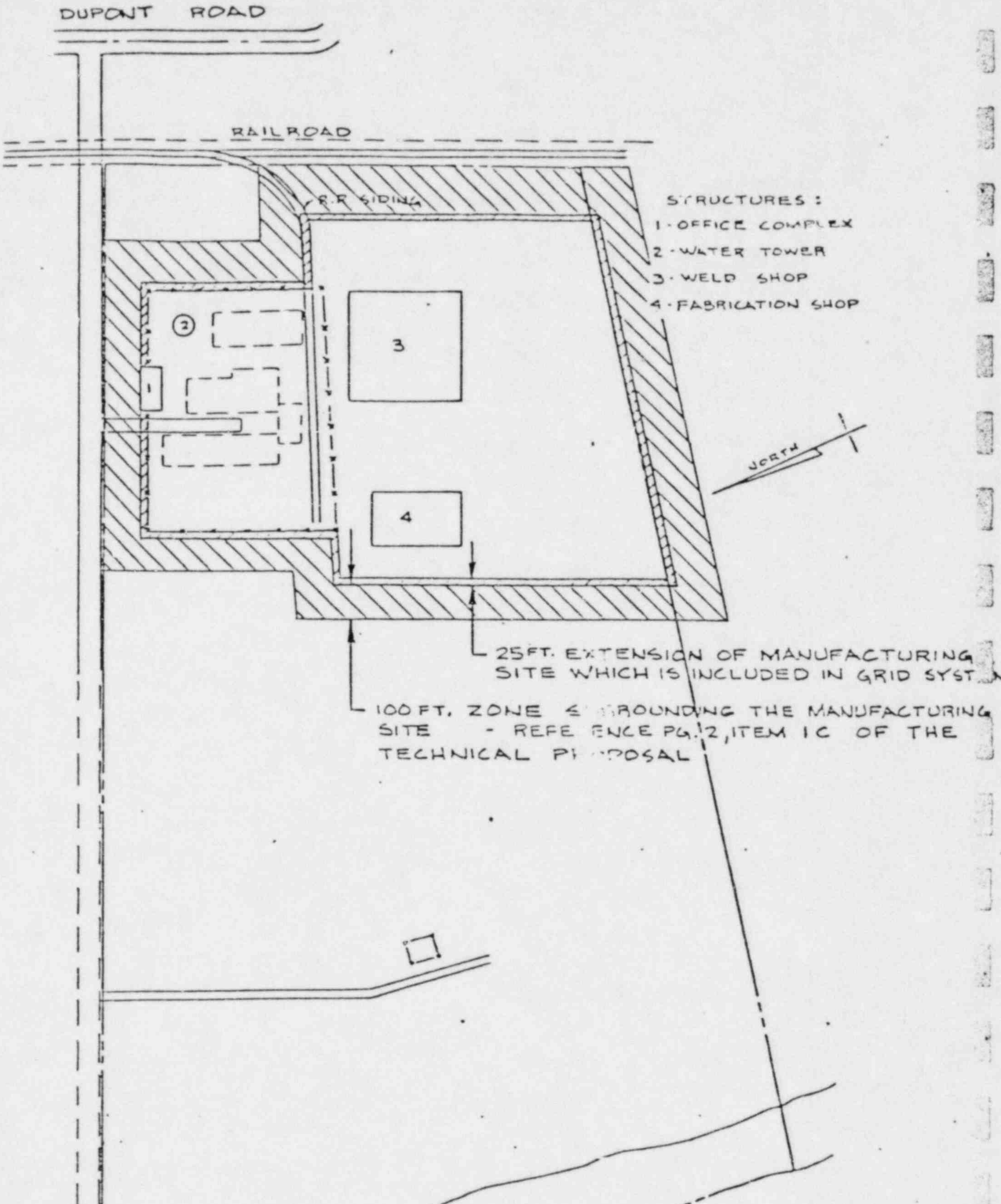
APPENDIX A -35- APPROX. SCALE : 1" = 330'

FIGURE #2



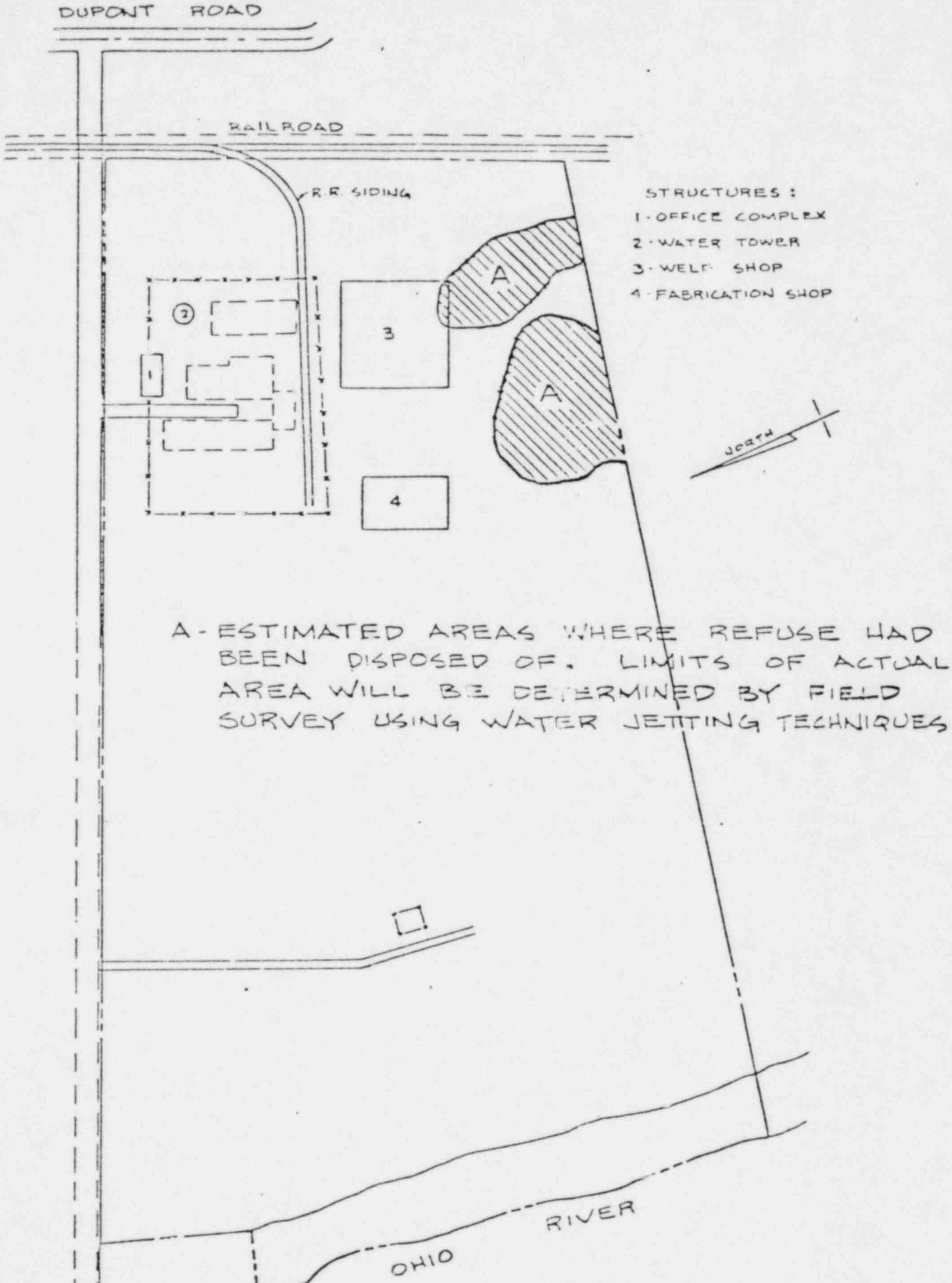
APPENDIX A -36- APPROX. SCALE : 1" = 330'

FIGURE #3



APPROX. SCALE: 1" = 330'

FIGURE 4



 APPROX. SCALE : 1" = 330'

Appendix B

Table 2a.

Reuter Stokes, Model RSS-111

Environmental Radiation Monitor

Daily Background Fluxuations at Point "P"

Lowest	Median	Highest
12.0 μR/hr. on 7/31/78	12.2 μR/hr.	12.4 μR/hr. on 5 separate dates

ATCOF.

Appendix B

Table 2b

Ludlum - Gamma Scintillation Monitor, Model 3
1" x 1" NaI Crystal

Daily Background Fluxuations at Point "P"

at 6 inches above surface

Lowest	Median	Highest
2.1 K cpm on 4 separate dates	2.2K cpm	2.4 K cpm on 5 separate dates

at a 2 foot depth

Lowest	Median	Highest
2.3 K cpm on 4 separate dates	2.6 K cpm prior to 9/1/78	3.0 K cpm on 8/1/78
	2.4 K cpm after 9/1/78	