50-22

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Westinghouse Electric Corporation

3 Gateway Center
Box 2278, Pittsburgh, Pa. 15230

Law Department
January 29, 1965

Mr. Frank Karas
Atomic Energy Commission
Division of Reactor Licenses
Washington 25, D. C.

Re: Test Reactor WTR Facility
Waltz Mills Use of Land Over
Filled Basin

Dear Mr. Karas:

In accordance with my telephone conversation with Mr. Farbstein, I am sending to you a copy of a report on residual activity in three retired WTR basins. Small amounts of radioactive material are in the back-filled basins as described and identified in the accompanying report. The report indicates the times at which 10 CFR 20.304 requirements will be met. These time requirements will be used as a basis for a restrictive covenant on the land. Mr. Farbstein and I will work out the details of such restrictive covenant if you find the report satisfactory.

If you have any questions, please contact me.

Very truly yours,

Vincent W. Campbell

cc: Mr. Charles Farbstein

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FILE COPY - Appendix

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RESIDUAL ACTIVITY IN RETIRED WTR BASINS

As described in the WTR - 171 reports of September 24, 1962 and April 22, 1963, it became necessary to store large quantities of contaminated water in created basins subsequent to the fuel rod meltdown at the Westinghouse Testing Reactor on April 3, 1960.

Three basins designated as No. 1, No. 2, and No. 3 were used for storage of the contaminated water. They were located on the Waltz Mill Site as shown on Drawing No.1. (The cyclone fences surrounding them have since been removed). Drawing No.2 is the official Commonwealth survey and shows the dimensions of the basins. The property is owned in fee simple by Westinghouse Electric Corporation.

The elevation of the basins is a minimum of 10 feet above Calleys Run and there is no evidence of ground water at the elevation of the pits. The clay bed under these basins has extremely low permeability with no evidence of any subsurface leakage from the basins. There are no useable wells within one-half mile of the basins and the Westinghouse property line is approximately one-third mile from them. Surface drainage is into Calleys Run which in turn empties into Sewickley Creek. Water samples are periodically collected from both streams and analyzed for radioactivity. Average results have been 10^{-8} to 10^{-7} $\mu c/ml$ which creates no public health hazard.

A study of each basin was made during June, July, and August, 1962. The amount of radioactivity and the type of radioactive material in samples taken from various locations in their bottoms was determined. Soil samples were collected in the general vicinity of these basins and were analyzed by the same techniques to establish the natural background. The results were indicated in the WTR - 171 reports. The basins were drained and subsequently back-filled with the earth which was originally excavated.

By use of the "1.2 decay rule" for mixed fission products (which the 1962 analysis definitely showed were present as illustrated in Appendix B), the radioactivities as of June, 1964 have been calculated as shown in Appendix A. The following information is summarized:

	Total mc (above background) in basins - 1962	Total mc (above background) in basins - 1964
Basin No.1	132	69
Basin No.2	4	2.1
Basin No.3	400	209
TOTAL	536	280

In June, 1964, a radiation survey was performed to determine the beta-gamma intensities at the surface of the three basins. The results showed readings in the range 0.05 to 0.15 mr/hr. These levels satisfy the requirements of 10CFR20.105b in regard to unrestricted areas.

Being approximately 2 1/2 years old in August, 1962, the mixed fission products are now approximately 4.3 years of age. From the data listed in Appendix B, the isotopic activities in the basins are shown below in millicurie units.

Nuclide	Basin No.1	Basin No.2	Basin No.3
Ce^{144}	8.3	0.25	25.1
Pr^{144}	8.3	0.25	25.1
Cs^{137}	6.9	0.21	20.9
Ba^{137}	6.2	0.19	18.8
Co^{60}	2.1	0.06	6.3
Pm^{147}	13.8	0.42	41.8
Sr^{90}	11.7	0.36	35.6
Y^{90}	11.7	0.36	35.6
	69.0	2.10	209.2

The 1962 determinations indicated that approximately 11% of the radioactivity was from Sr^{90}. In 1964 the theoretical amount should be 17%.

In 10CFR20.304, certain limits are specified for burial of radioactive materials in soil, and are listed in Appendix C. The activities in the basins as illustrated above exceed the 10CFR20 requirements. Assuming that the materials do not contain over 17% Sr^{90}, the permissible yearly burial would be 4800 microcuries. The area required for burial would be a minimum of 432 sq. ft., and the permissible average radioactivity at the four foot depth would be 11 $\mu c/ft^2$. In these basins, the average radioactivity, as shown in Appendix C, is approximately 8 $\mu c/ft.^2$. Although the cummulative activities exceed the 10CFR20 regulations, the average amount of radioactivity per unit area in these basins is less than that permitted by the Code of Federal Regulations due to out greater square footage.

Based on several assumptions mentioned in Appendix D, it is possible to calculate the time at which the 10CFR20 requirements will be met. The calculations indicate 188, 46, and 231 years (from 1960) for Basins No.1, 2, and 3 respectively.

Despite the long decay times required, it is our conclusion that due to site hydrology, water sample results, and the low radioactivity per unit area, there are no public health hazards from the retired basins. The area is in a most desirable state.

APPENDIX A

1. Basin No. 1

The activity in the basin 4.3 years after the fuel meltdown incident has been derived from the "1.2 decay rule."

$$A_1 t_1^{1.2} = A_2 t_2^{1.2}$$

where A_1 = activity at time t_1

A_2 = activity at time t_2

t_1, t_2 = 2.5 and 4.3 years respectively

$$(132)\ (2.5)^{1.2} = A_2\ (4.3)^{1.2}$$

$$A_2 = \frac{(132)\ (3.00)}{5.75} = 69 \text{ mc}$$

2. Basin No. 2

The activity at 2.5 years was 4 mc.

Therefore, $A_2 = \frac{(4)\ (3.00)}{5.75} = 2.1$ mc

3. Basin No. 3

The activity at 2.5 years was 400 mc.

Therefore, $A_2 = \frac{(400)\ (3.00)}{5.75} = 209$ mc

Total activity in basins 4.3 years (June 1964) after the incident = 280mc.

APPENDIX B

1. Isotopic Fission Product Activity Percentages

1962 Determinations*	1964 Theoretical Percentages[1]		
Ce^{144}	Ce^{144}	---	12%
Pr^{144}	Pr^{144}	---	12%
Cs^{137}	Cs^{137}	---	10%
Ba^{137}	Ba^{137}	---	9%
Zn^{95}	Co^{60}	---	3%
Nb^{95}	Pm^{147}	---	20%
Cs^{134}	Sr^{90}	---	17%
Co^{60}	Y^{90}	---	17%
Sr^{90}			

2. Isotopic Activities in Basins.

Multiplication of the total basin activities in Appendix A by the appropriate factor in the second column above will yield the values given on Page 2.

Example: Basin No. 1; Ce^{144}

69 x 0.12 = 8.3 mc.

* No percentages of activities were given in the WTR - 171 reports for these nuclides except for Sr^{90}, which averaged 11%.

1. R. C. Bolles and N. E. Ballou, Calculated Activities and Abundances of U^{235} Fission Products, USNRDL - 456 (1956).

APPENDIX C

1. 10CFR20 Burial Disposal Limits.

As stipulated in 10CFR20.304, the burial limits for any one location and time are:

Nuclide	Millicuries
Ce^{144}	1
Pr^{144}	1
Cs^{137}	1
Ba^{137}	1
Co^{60}	1
Pm^{147}	10
Sr^{90}	0.1
Y^{90}	1

When there is involved a combination of isotopes in known amounts, the limit for the combination should be derived as follows:

$$\sum_{i=1}^{N} \frac{X_i}{Y_i} \leq 1 \quad \text{for N isotopes in combination.}$$

X_i is the quantity of the ith isotope present.

Y_i is the disposal limit for the ith isotope.

By this combination rule, the activities present in the basins as listed on page 2 exceed the disposal limits.

2. Average Radioactivity per Area.

10CFR20.304 states that twelve burials per year may be made provided (a) the burial depth is at least four feet; (b) the total quantity of buried material does not exceed the limits given in Appendix C; (c) successive burials are separated by distances of at least six feet (36 sq. ft. of area).

The area required for burial would be 12 x 36 = 432 sq. ft. If one-sixth (17%) of the material is Sr^{90}, the permissible yearly burial would be 0.1 x 6 x 12 x 2/3 = 4.8 mc of mixed fission products. (The 2/3 factor arises from the summation rule of th N isotopes in combination.)

The permissible average activity at four foot depth would be

$$\frac{4800}{432} = 11\ \mu c/ft^2.$$

3. Average Radioactivity per Basin Area.

The total area of the back-filled basins is 35,200 sq. ft. The total activity from Appendix A is 280,000 μc as of June, 1964.

$$\text{Average radioactivity} = \frac{280 \times 10^3}{35.2 \times 10^3} = 8\ \mu c/ft^2$$

APPENDIX D

1. Time Radioactivity is Below 10CFR20 Limits.

Several assumptions have been made to calculate the required decay time of the fission products. They are:

a. The "1.2 decay rule" is valid for a period of ten (10) years. After this time the isotopes decay according to their individual half-lives.

b. After ten years the fission products will consist of Sr^{90} in equilibrium with its daughter Y^{90} and Cs^{137} in equilibrium with its daughter Ba^{137}. Each isotope will provide 25% of the activity.

This assumption is not unreasonable in as much as both Sr^{90} - Y^{90} and Cs^{137} - Ba^{137} in equilibrium have almost precise half-lives of approximately 28 years which is much longer than the other fission products. At ten years there will be approximately 16% Pm^{147}, buts its half-life is 2.6 years, and from Appendix C it can be seen that it gives a negligible contribution to the burial limits.

The calculations indicate:

a. Basin No.1

$$(132)\ (2.5)^{1.2} = A_2\ (10)^{1.2}$$

$$A_2 = \frac{(132)\ (3.00)}{15.85} = 25 \text{ mc at 10 years}$$

Sr^{90} present = 1/4 x 25 = 6.3 mc

To satisfy the 10CFR20 requirements with the four isotopes in combination, the material can contain no more than 0.077 mc of Sr^{90}.

$A = A_2 e^{-\lambda t}$, where λ is the decay constant for Sr^{90} = 0.0247 $years^{-1}$, and A is the 0.077 mc.

$$0.077 = 6.3\ e^{-0.0247t}$$

$$t = 178 \text{ years}$$

Total Time = 10 + 178 = 188 years

APPENDIX D (Continued)

b. Basin No.2

$A_2 = \frac{(4)\ (3.00)}{15.85}$ = 0.76 mc at 10 years

Sr^{90} present = 1/4 x 0.76 = 0.19 mc

$0.077 = 0.19e^{-0.0247t}$

t = 36 years

Total Time = 10 + 36 = 46 years

c. Basin No.3

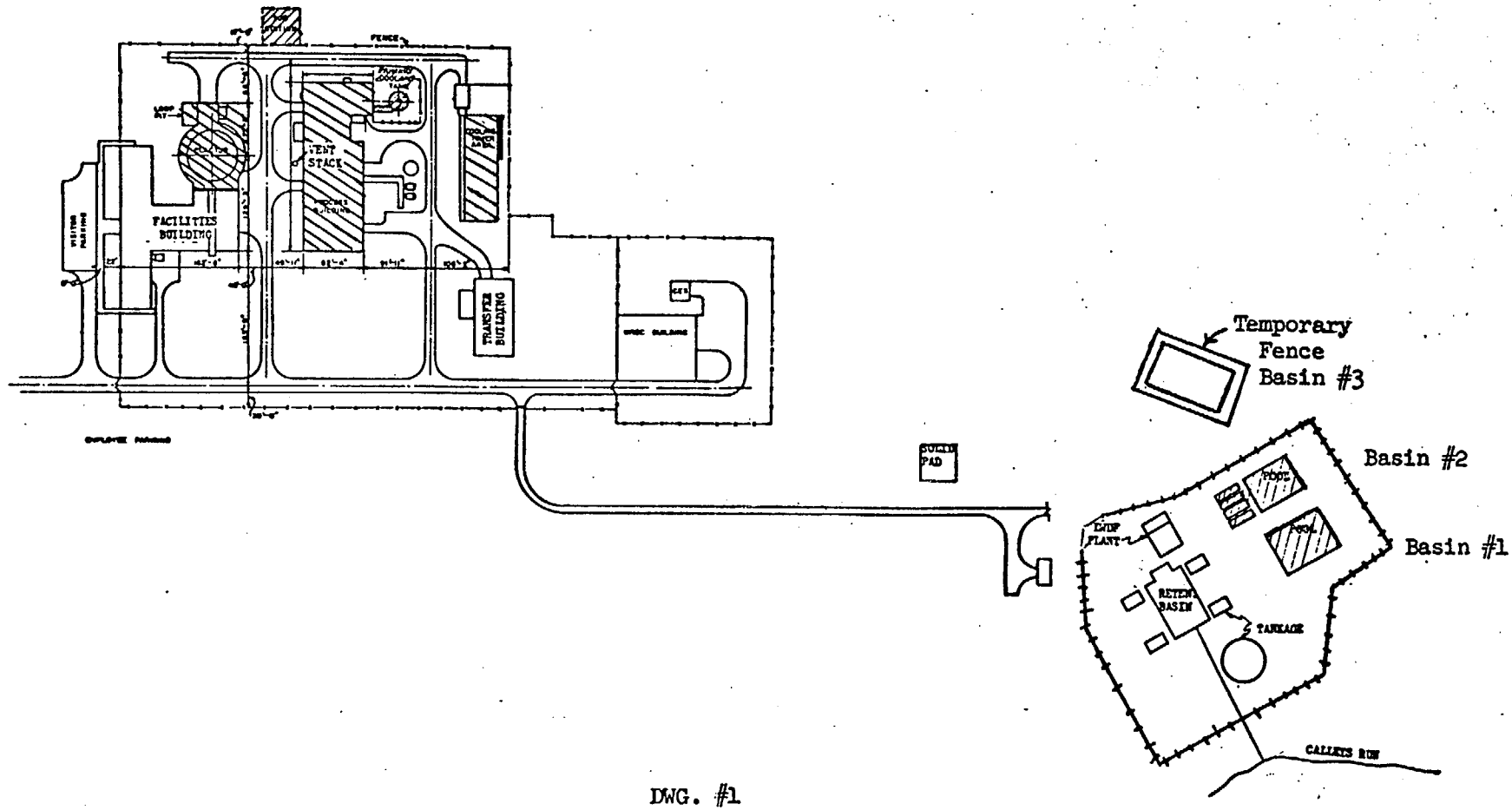
$A_2 = \frac{(400)\ (3.00)}{15.85}$ = 76 mc. at 10 years

Sr^{90} present = 1/4 x 76 = 19 mc

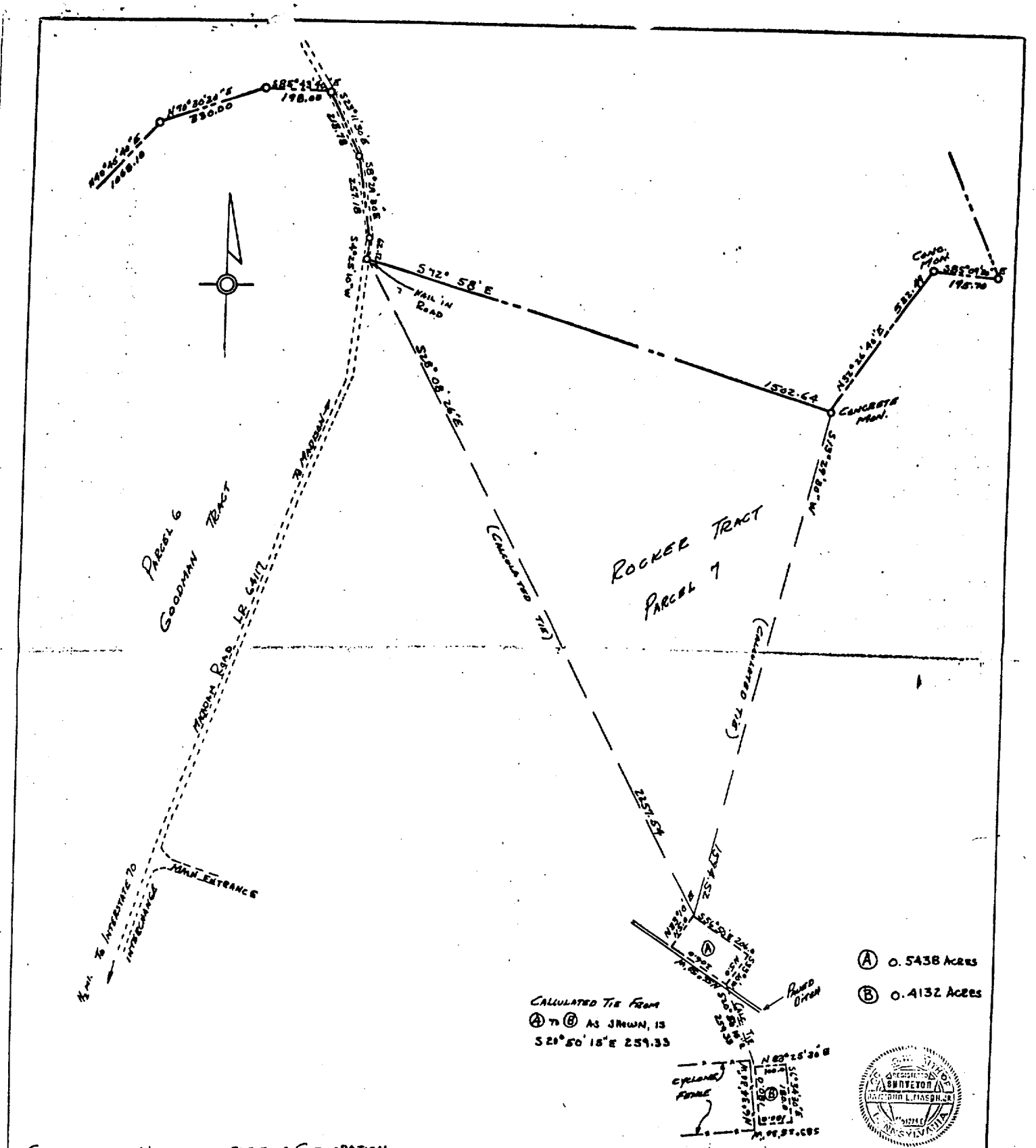
$0.077 = 19e^{-.0247t}$

t = 221 years

Total Time = 10 + 221 = 231 years



DWG. #1
WALTZ MILL SITE LAYOUT



SURVEY FOR: WESTINGHOUSE ELECTRIC CORPORATION
ATOMIC POWER DIVISION
WALTZ MILL PENNA.

SEWICKLEY TOWNSHIP WMD. CO. PENNA.

SHOWING AREAS (A) & (B) FORMERLY RETENTION BASINS FOR CONTAMINATED WATER NOW COVERED & BACKFILLED TO ORIGINAL CONTOUR.

DATE: JUNE 15 1964
SCALE 1" = 200'
P.L. MASON JR.
REG. SURV. # 1274-E

DRAWING #2

☆U. S. GOVERNMENT PRINTING OFFICE: 1964 — 725-839

FROM: Westinghouse Electric Corporation
Law Department
Pittsburgh, Pa. 15230 (Vincent Campbell)

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LTR. X MEMO: REPORT: OTHER: w/attachment

TO: DIRL (F. Karas)

ORIG.: X CC: OTHER: of ltr. & 1 reproc cy of attach (10 complete cys

ACTION NECESSARY X
NO ACTION NECESSARY ☐
CONCURRENCE ☐
COMMENT ☐
DATE ANSWERED: xeroxed
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DESCRIPTION: (Must Be Unclassified)
Ltr. transmitting the following in accordance w/telephone conversation w/Farbstein:

ENCLOSURES:
Report on Residual Activity in Retired WIR Basins.

(NOT MARKED)

REFERRED TO	DATE	RECEIVED BY	DATE
F. Karas w/5 Extra cys FOR ACTION	2-2		
Dr. Boan w/1 cy for info	2-2		

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