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ORNL/RASA-87/111
(AL218)

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**RESULTS OF THE RADIOLOGICAL SURVEY
AT THE NIAGARA-MOHAWK PROPERTY,
RAILROAD AVENUE, COLONIE, NEW YORK
(AL218)**

MASTER

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MARTIN MARIETTA ENERGY SYSTEMS, INC.
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DEPARTMENT OF ENERGY

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Health and Safety Research Division

**Nuclear and Chemical Waste Programs
(Activity No. AH 10 05 00 0; ONLWCOL)**

**RESULTS OF THE RADIOLOGICAL SURVEY AT
THE NIAGARA-MOHAWK PROPERTY,
RAILROAD AVENUE, COLONIE, NEW YORK (AL218)**

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Date of Issue - December 1987

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**Work performed as part of the
RADIOLOGICAL SURVEY ACTIVITIES PROGRAM**

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**RESULTS OF THE RADIOLOGICAL SURVEY AT
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INTRODUCTION

Work with depleted uranium began in Colonie, New York, during 1958 at a plant owned by the National Lead Company.¹ Beginning in 1961, the Atomic Energy Commission (AEC), and other federal agencies engaged the National Lead Company (presently NL Industries, Inc.) in numerous contracts and subcontracts for the fabrication of enriched (3.6%) uranium fuel elements for the Hallam Reactor (Chicago Operations Office) and for the chemical processing of unirradiated, enriched uranium scrap (New York Operations Office).^{2,3} Since the termination of the AEC contracts, the work at the plant was devoted to the fabrication of shielding components, ballast weights, and projectiles from depleted uranium.¹ This plant has operated at a reduced level of activity after February 1980, and ownership of the plant and property was transferred to the Department of Energy (DOE) in February 1984.

A number of properties in the Albany/Colonie area have been identified as being potentially contaminated with uranium originating from the former National Lead Company's uranium forming plant in Colonie, New York.⁴ Radiological surveys were performed at three properties by members of the Radiological Survey Activities (RASA) group at Oak Ridge National Laboratory (ORNL) during the period June 8-August 20, 1987. The Niagara-Mohawk property on Railroad Avenue in Colonie, New York (AL218) was the subject of a radiological investigation initiated June 11, 1987.

This commercial property is an irregularly shaped lot partially occupied by an electric power substation and associated transmission lines. Portions of the property that were swampy and heavily vegetated were inaccessible to the survey team. There are no buildings on the property. A diagram showing the approximate boundaries and the 15-m grid network established for measurements on the property is shown in Fig. 1. The lot included in the radiological survey was ~45 m wide by 246 m deep. Two views of the property are shown in Figs. 2 and 3, respectively.

SURVEY METHODS

The radiological survey methods employed in the survey of this property are described in Ref. 5.

The radiological survey of this property included: (1) gamma exposure rates at 1 m above the ground surface and at the ground surface at outdoor grid locations; (2) a gamma scan of the entire ground surface outdoors; and (3) samples of outdoor soil. A comprehensive description of the survey methods and instrumentation has been presented in another report.⁶

SURVEY RESULTS

Typical background radiation levels for the Albany area are presented in Table 1. The data is provided for purposes of comparison with the survey results presented in this section.

All measurements presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations in soil samples.

Gamma Measurements

Results of grid point/grid block measurements are presented in Table 2. Surface gamma exposure rates measured at grid points over the entire outdoor property are shown on Fig. 4. Note that measurements on grid lines were made at 7.5-m intervals. The increased frequency was used to provide additional assurance that a proper evaluation of the radiological conditions of the property could be reported. The heavy growth of weeds, brush, and bamboo made the surface scan for gamma exposure rates extremely difficult. Gamma exposure rates at 1 m above the ground surface ranged from 7 to 12 $\mu\text{R/h}$ (microroentgens* per hour) and averaged 10 $\mu\text{R/h}$. Gamma exposure rates at the ground surface at grid points also ranged from 7 to 12 $\mu\text{R/h}$ and averaged 10 $\mu\text{R/h}$. The maximum gamma exposure rate measured on the property was 27 $\mu\text{R/h}$. The area inside the fence surrounding the substation was scanned although center point measurements could not be obtained. Gamma exposure rates in that area ranged from 11 to 12 $\mu\text{R/h}$.

Soil Sampling

Twenty-seven soil samples were taken at this property from 25 locations. Twenty of these samples, taken without strict regard to gamma exposure rates at the sampling points, are denoted as systematic samples (AL218S). Seven samples, designated as biased samples (AL218B), were

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*The roentgen (R) is a unit which was defined for radiation protection purposes for people exposed to penetrating x-rays or gamma radiation. A microroentgen (μR) is one millionth of a roentgen. A milliroentgen (mR) is one thousandth of a roentgen or one thousand microroentgens.

collected from areas having elevated gamma exposure rates. The locations of the samples are shown in Fig. 5, and the results of analysis are presented in Table 3.

Twenty-six of the samples were taken at 0 to 5 cm; one sample was collected from 5 to 15 cm. Concentrations of ^{238}U in the systematic soil samples ranged from 1.3 to 72 pCi/g (picocuries* per gram) and averaged 16 pCi/g. The concentrations of ^{238}U in the biased samples ranged from 2.5 to 2,100 pCi/g and averaged 610 pCi/g.

A yellowish material resembling uranium oxide in the surface soil at grid location 0+57, 9L was sampled at depths of 0 to 5 cm to determine its composition (sample AL218B2B). The soil was also sampled at that location at two depths, 0 to 5 cm and 5 to 15 cm (samples AL218B2A and AL218B2C, respectively). Sample AL218B2B contained 2,100 pCi/g ^{238}U , the maximum concentration collected on the property. The soil at that spot (sample AL218B2A) contained 430 pCi/g ^{238}U . The sampled area of approximately 1 m² exceeds the DOE guidelines for ^{238}U content in the soil (Fig. 6). The concentration of ^{238}U in sample AL218B2C collected from a depth of 5 to 15 cm (1,700 pCi/g) indicates that the contamination extends to the subsurface soil at that spot.

Radium-226 was measured in each sample. The concentrations of ^{226}Ra in systematic samples ranged from 0.40 to 0.90 pCi/g, and averaged 0.63 pCi/g. The concentrations of ^{226}Ra in biased samples ranged from 0.67 to 1.3 pCi/g, averaging 0.88 pCi/g.

A summary of the outdoor measurement results is provided in Table 4.

SIGNIFICANCE OF FINDINGS

The background gamma radiation exposure rate for the State of New York averages 9.5 $\mu\text{R}/\text{h}$ ^{8,9} and averages 9 $\mu\text{R}/\text{h}$ for the Albany area (Table 1). The gamma exposure rates measured on this property at 1 m above the ground surface range from 7 to 12 $\mu\text{R}/\text{h}$ and average 10 $\mu\text{R}/\text{h}$ (within the range of background for the Albany area). The DOE guidelines¹⁰ state that gamma exposure rates inside occupied or habitable structures shall not exceed 20 $\mu\text{R}/\text{h}$ above background. Gamma exposure rates outside of structures shall be such that these exposure rates, due to residual radioactivity, will not result in potential doses (assuming a conservative but plausible use scenario) in excess of 100 mrem/y for long term exposure. These guidelines are not exceeded at this property.

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*The curie is a unit used to define the radioactivity in a substance and equals that quantity of any radioactive isotope undergoing 2.2×10^{12} disintegrations per minute. The picocurie is one million-millionth of a curie or that amount yielding 2.2 disintegrations per minute.

The DOE guideline for ^{238}U concentration in soil at the Colonie, New York site is: (a) the ^{238}U concentration shall not exceed the limits of 35 pCi/g averaged over an area of 10 m x 10 m (33 ft x 33 ft), and over 5 cm (2 in.) depth; and (b) the concentration shall not exceed the additional restriction of 100 pCi/g maximum at a spot (1 m²) averaged over 5 cm (2 in.) depth.^{11,12} No 10 m x 10 m area was found that averages more than 35 pCi/g of ^{238}U in the soil. The average concentration was 16 pCi/g of ^{238}U in the systematic samples, approximately one-half the limit of 35 pCi/g; therefore, the average concentration is well below the DOE guideline. However, one isolated spot of approximately 1 m² exceeded DOE guidelines. The maximum concentration of ^{238}U measured was 2,100 pCi/g, considerably above the surface soil limit of 100 pCi/g averaged over a 1 m² area. The contamination was also found to extend to subsurface depths. The 0.88 pCi/g of ^{226}Ra found in the biased soil samples is essentially the same as the Albany area background of 0.85 pCi/g of radium-226.

In summary, while some radiological measurements at this property are in excess of background levels normally encountered in this area of New York, under current conditions there is no reasonable probability that individuals using the property will receive radiation exposure in excess of limits established for protection of the general public. However, some areas of soil contain concentrations of uranium-238 in excess of guidelines used by the Department of Energy to determine if remedial action is warranted.

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Fig. 1. Diagram showing grid point and grid block locations outdoors on the Niagara-Mohawk property on Railroad Avenue, Colonie, New York (AL218).

Fig. 2. View of the Niagara-Mohawk property on Railroad Avenue, Colonie, New York (AL218) looking northeast from the Conrail tracks.

Fig. 3. View of the Niagara-Mohawk substation, Railroad Avenue, Colonie, New York (AL218) looking southwest.

Fig. 4. Surface gamma exposure rates measured at grid points on the Niagara-Mohawk property on Railroad Avenue, Colonie, New York (AL218).

Fig. 5. Locations of soil samples on the Niagara-Mohawk property on Railroad Avenue, Colonie, New York (AL218).

Fig. 6. Area estimated to contain uranium-238 concentrations exceeding guidelines in the soil of the Niagara-Mohawk property, Railroad Avenue, Colonie, New York (AL218).

Table 1. Background radiation levels in the Albany area

Type of radiation measurement or sample	Radiation level or radionuclide concentration	
	Range	Average
Gamma exposure rate at 1 m above floor or ground surface ($\mu\text{R/h}$) ^a	8-10	9
Concentration of radionuclides in soil (pCi/g) ^b		
²³⁸ U	0.76-1.2	0.96
²²⁶ Ra	0.48-1.2	0.85

^aValues obtained from four locations in the Albany area.

^bSoil samples (NY1-NY6) obtained from six locations around the Albany area.⁷

Table 2. Results of the gamma exposure rate measurements outdoors on the Niagara-Mohawk property, Railroad Avenue, Colonie, New York (AL218)

Grid location ^a	Grid point measurements ^b ($\mu\text{R/h}$)		Range of gamma exposure rate during scan of grid block ^d ($\mu\text{R/h}$)
	Gamma exposure rate at 1 m	Gamma exposure rate at the surface ^c	
0+00, BL	8	8	7-11
0+7.5, BL	7	8	-
0+15, BL	8	7	7-12
0+22.5, BL	7	8	-
0+30, BL	8	7	7-11
0+37.5, BL	8	8	-
0+45, BL	8	7	6-30
0+52.5, BL	8	8	-
0+60, BL	8	8	8-12
0+67.5, BL	8	7	-
0+75, BL	8	9	6-11
0+82.5, BL	8	8	-
0+90, BL	8	9	9-13
0+97.5, BL	9	9	-
1+05, BL	9	10	8-14
1+12.5, BL	10	9	-
1+20, BL	8	9	6-12
1+27.5, BL	9	8	-
1+35, BL	9	8	8-17
1+42.5, BL	8	9	-
1+50, BL	8	9	9-14
1+58, BL	9	9	-
1+65, BL	9	7	7-12
1+80, BL	8	7	8-12
1+87.5, BL	8	9	-
1+95, BL	10	10	9-15
2+02.5, BL	10	11	-
2+10, BL	10	11	9-13
2+14.7, BL	10	11	-
2+17, BL	10	10	-
2+25, BL	10	12	-
2+32.5, BL	9	11	-
2+40, BL	e	e	-
2+46.4, BL	7	8	-
0+00, 7.5L	8	8	-
0+15, 7.5L	8	8	-
0+30, 7.5L	7	8	-
0+45, 7.5L	8	8	-
0+60, 7.5L	8	7	-
0+75, 7.5L	8	9	-

Table 2 (continued)

Grid location ^a	Grid point measurements ^b ($\mu\text{R/h}$)		Range of gamma exposure rate during scan of grid block ^d ($\mu\text{R/h}$)
	Gamma exposure rate at 1 m	Gamma exposure rate at the surface ^c	
0+90, 7.5L	8	7	-
1+05, 7.5L	9	9	-
1+20, 7.5L	8	9	-
1+35, 7.5L	8	10	-
1+50, 7.5L	10	9	-
1+65, 7.5L	e	e	-
1+80, 7.5L	e	e	-
1+87.5, 7.5L	9	11	-
1+95, 7.5L	9	11	-
2+02.5, 7.5L	10	11	-
2+10, 7.5L	10	12	-
2+14.7, 7.5L	9	12	-
2+46.4, 7.5L	8	9	-
0-02.9, 15L	8	8	8-9
0+00, 15L	9	9	7-11
0+7.5, 15L	8	9	-
0+15, 15L	8	9	7-11
0+22.5, 15L	8	10	-
0+30, 15L	9	9	6-10
0+37.5, 15L	9	9	-
0+45, 15L	8	10	8-11
0+52.5, 15L	9	10	-
0+60, 15L	10	10	7-11
0+67.5, 15L	9	9	-
0+75, 15L	8	10	8-11
0+82.5, 15L	8	9	-
0+90, 15L	8	9	6-12
0+97.5, 15L	8	8	-
1+05, 15L	9	10	8-11
1+12.5, 15L	10	10	-
1+20, 15L	10	10	8-11
1+27.5, 15L	10	10	-
1+35, 15L	10	11	11-15
1+42.5 15L	11	14	-
1+50, 15L	11	11	8-19
1+57.5, 15L	11	11	-
1+61.7, 15L	11	11	-
1+65, 15L	10	11	8-27
1+72.5 15L	e	e	-

Table 2 (continued)

Grid location ^a	Grid point measurements ^b ($\mu\text{R/h}$)		Range of gamma exposure rate during scan of grid block ^d ($\mu\text{R/h}$)
	Gamma exposure rate at 1 m	Gamma exposure rate at the surface ^c	
1+80, 15L	11	9	8-15
1+87.5, 15L	9	10	-
1+95, 15L	9	10	9-13
2+02.5, 15L	12	11	-
2+10, 15L	12	12	9-16
2+14.7, 15L	9	12	-
2+46.4, 15L	9	10	-
0-04.2, 22.5L	9	9	-
0+00, 22.5L	8	8	-
0+15, 22.5L	8	8	-
0+30, 22.5L	10	10	-
0+45, 22.5L	8	8	-
0+60, 22.5L	9	9	-
0+75, 22.5L	9	10	-
0+90, 22.5L	9	10	-
1+05, 22.5L	8	10	-
1+20, 22.5L	10	10	-
1+35, 22.5L	11	11	-
1+50, 22.5L	11	13	-
1+63.4, 22.5L	11	11	-
1+65, 22.5L	10	11	-
1+72.5, 22.5L	-	e	-
1+80, 22.5L	9	10	-
1+87.5, 22.5L	10	9	-
1+95, 22.5L	9	10	-
2+02.5, 22.5L	11	12	-
2+10, 22.5L	11	11	-
2+14, 22.5L	9	11	-
2+46.4, 22.5L	9	11	-
0-5.5, 30L	9	9	-
0+00, 30L	8	8	7-9
0+7.5, 30L	8	9	-
0+15, 30L	8	8	8-11
0+22.5, 30L	9	9	-
0+30, 30L	8	9	8-11
0+45, 30L	9	10	6-10
0+52.5, 30L	8	9	-
0+60, 30L	9	9	8-11
0+67.5, 30L	10	10	-

Table 2 (continued)

Grid location ^a	Grid point measurements ^b ($\mu\text{R/h}$)		Range of gamma exposure rate during scan of grid block ^d ($\mu\text{R/h}$)
	Gamma exposure rate at 1 m	Gamma exposure rate at the surface ^c	
0+75, 30L	10	11	6-11
0+82.5, 30L	9	9	-
0+87.5, 30L	8	9	-
0+90, 30L	8	9	8-14
0+97.5, 30L	8	9	-
1+05, 30L	9	10	7-11
1+12.5, 30L	9	9	-
1+20, 30L	9	9	9-14
1+27.5, 30L	11	11	-
1+35, 30L	11	11	-
1+42.5, 30L	10	11	-
1+57.5, 30L	12	12	-
1+50, 30L	11	12	-
1+65, 30L	10	11	-
1+72.5, 30L	9	11	-
1+80, 30L	9	12	-
1+87.5, 30L	9	11	-
1+95, 30L	9	12	-
2+02.5, 30L	9	9	-
2+10, 30L	10	9	-
2+14, 30L	9	9	-
2+17.5, 30L	9	11	-
2+25, 30L	10	10	-
2+32.5, 30L	9	10	-
2+40, 30L	10	10	-
2+46.4, 30L	9	9	-
0-07.7, 37.5L	8	8	-
0+00, 37.5L	8	8	-
0+15, 37.5L	8	10	-
0+30, 37.5L	8	9	-
0+45, 37.5L	9	10	-
0+60, 37.5L	10	10	-
0+75, 37.5L	9	9	-
0+90, 37.5L	8	10	-
1+05, 37.5L	8	10	-
1+20, 37.5L	11	11	-
1+33.1, 37.5L	10	10	-
0-08, 45L	7	8	7-11
0+00, 45L	6	7	7-11

Table 2 (continued)

Grid location ^a	Grid point measurements ^b ($\mu\text{R/h}$)		Range of gamma exposure rate during scan of grid block ^d ($\mu\text{R/h}$)
	Gamma exposure rate at 1 m	Gamma exposure rate at the surface ^c	
0+7.5, 45L	6	7	-
0+15, 45L	7	8	7-11
0+22.5, 45L	7	7	-
0+30, 45L	8	8	6-11
0+37.5, 45L	8	9	-
0+45, 45L	8	8	8-11
0+52.5, 45L	8	8	-
0+60, 45L	7	8	6-11
0+67.5, 45L	8	8	-
0+75, 45L	7	7	7-12
0+82.5, 45L	8	7	-
0+90, 45L	8	8	6-30
0+97.5, 45L	9	9	-
1+05, 45L	8	8	8-30
1+12.5, 45L	9	8	-
1+20, 45L	8	8	8-12
1+27.5, 45L	8	8	-
1+31.2, 45L	8	10	-
0-09.9, 48.6L	9	9	-
0+00, 49.8L	8	8	-
0+07.5, 51L	8	8	-
0+15, 52.2L	8	8	-
0+30, 52.5L	8	7	-
0+45, 52.5L	8	8	-
0+60, 52.5L	8	9	-
0+75, 52.5L	8	8	-
0+90, 52.5L	8	8	-
1+05, 52.5L	8	8	-
1+20, 52.5L	8	10	-
0+22.5, 53.4L	8	9	-
0+30, 54.5L	8	9	-
0+37.5, 55.7L	10	10	-
0+45, 57L	8	9	-
0+52.5, 58.3L	8	10	-
0+60, 59.6L	8	8	-
0+90, 60L	8	9	-
0+97.5, 60L	8	9	-
1+05, 60L	8	8	-
1+12.5, 60L	8	8	-

Table 2 (continued)

Grid location ^a	Grid point measurements ^b ($\mu\text{R/h}$)		Range of gamma exposure rate during scan of grid block ^d ($\mu\text{R/h}$)
	Gamma exposure rate at 1 m	Gamma exposure rate at the surface ^c	
1+20, 60L	9	8	-
1+27.4, 60L	9	9	-
0+67.5, 61.4L	8	10	-
0+75, 62.7L	10	10	-
0+82.5, 63.6L	8	10	-
0+90, 64.5L	8	8	-
0+97.5, 66L	8	10	-
1+05, 67.5L	9	10	-
1+12.5, 68.8L	10	10	-
1+20, 70L	10	11	-
1+23.2, 70L	9	11	-

^aGrid location shown on Fig. 1.

^bGrid point measurements are discrete measurements at each grid point.

^cThese values are shown on Fig. 4.

^dGrid block measurements are obtained by a gamma scan of the entire block.

^eInaccessible.

Table 3. Results of soil sample analysis on the Niagara-Mohawk property, Railroad Avenue, Colonie, New York (AL218)

Sample	Location ^a	Depth (cm)	Radionuclide concentration (pCi/g)	
			²²⁶ Ra ^b	²³⁸ Uc
Systematic samples ^d				
AL218S1	0+00, 15L	0-5	0.68	2.5
AL218S2	0+00, 30L	0-5	0.40	5.0
AL218S3	0+30, BL	0-5	0.60	3.0
AL218S4	0+30, 54.5L	0-5	0.60	4.0
AL218S5	0+60, BL	0-5	0.50	9.0
AL218S6	0+60, 30L	0-5	0.60	8.0
AL218S7	0+90, BL	0-5	0.50	10
AL218S8	0+90, 30L	0-5	0.50	5.0
AL218S9	1+20, BL	0-5	0.90	21
AL218S10	1+20, 30L	0-5	0.60	11
AL218S11	1+20, 70L	0-5	0.90	3.0
AL218S12	1+35, 15L	0-5	0.90	5.0
AL218S13	1+61, 15L	0-5	0.90	16
AL218S14	1+65, BL	0-5	0.55	1.3
AL218S15	1+65, 30L	0-5	0.74	18
AL218S16	1+80, 15L	0-5	0.49	7.2
AL218S17	1+80, BL	0-5	0.53	8.7
AL218S18	2+10, 15L	0-5	0.61	44
AL218S19	2+10, 30L	0-5	0.59	72
AL218S20	2+14, 15L	0-5	0.54	70
Biased samples ^e				
AL218B1	0+98, 46L	0-5	1.1	2.5
AL218B2A	0+57, 9L	0-5	0.67	430
AL218B2B	0+57, 9L	0-5	<0.87	2100
AL218B2C	0+57, 9L	5-15	0.71	1700
AL218B3	1+43, 13L	0-5	1.3	<2.9
AL218B4	1+65, 22.6L	0-5	0.77	15
AL218B5	1+66, 25L	0-5	0.76	16

^aLocations of soil samples are shown on Fig. 4.

^bCounting error is $\pm 8\%$ (2σ).

^cError of measurement results is $\pm 15\%$ (2σ) at the 35 pCi/g level.

^dSystematic samples are taken at grid locations irrespective of gamma exposure.

^eBiased samples are taken from areas having elevated gamma exposure rates.

Table 4. Summary of outdoor measurements and sample results on the Niagara-Mohawk property, Railroad Avenue, Colonie, New York (AL218)

Measurement or sample type	Number of measurements/ samples	Range	Mean
Gamma exposure rate at 1 m ($\mu\text{R/h}$) ^a	207	7-12	10
Gamma exposure rate at surface ($\mu\text{R/h}$) ^a	207	7-12	10
Scan, gamma exposure rate near surface ($\mu\text{R/h}$) ^b	-	7-27	-
Concentration of ²³⁸ U in surface soil (pCi/g), systematic locations ^c	20	1.3-72	16
Concentration of ²³⁸ U in surface soil (pCi/g), biased locations ^c	7	2.5-2,100	610
Area estimated to contain ²³⁸ U concentrations exceeding guidelines (m ²)	-	-	1
Concentration of ²²⁶ Ra in surface soil (pCi/g), systematic locations ^c	20	0.40-0.90	0.62
Concentration of ²²⁶ Ra in surface soil (pCi/g), biased locations ^c	7	0.67-1.3	0.88

^aAt grid points, Table 2.

^bScan of entire property, Table 2.

^cSoil samples, Table 3.

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