LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : R. Schreiber, Deputy Director DATE: November 28, 1973

THRU: G. L. Voelz, M.D., H-Div. Ldr.

FROM : Eric B. Fowler, Alt. Group Ldr., H-7

SUBJECT : RADIOACTIVE LIQUID WASTES, ENVIRONMENTAL DATA

SYMBOL : EBF-H7-463

1103 General

In reply to the H. Jack Blackwell memo of November 23, 1973 with respect to the TWX from J. F. Burke on the subject data, the following information is submitted.

(Note: Item numbers correspond to numbers in the TWX)

(1) Radioactive liquid wastes with activities in excess of 5×10^{-5} µCi/ml have been discharged to the soil at the Los Alamos Scientific Laboratory.

(2) & (3) Estimated data regarding these discharges is provided in the attached table (TABLE I).

(4) Laboratory tests have shown that plutonium will not move through volcanic tuff which surrounds the absorption beds. This has been largely confirmed by field studies. Ground water aquifers from which drinking water is pumped are over 1,000 ft below the average mesa elevation.

The only containment provided the other nuclides is also by natural phenomenon (e.g. ion exchange).

7 The ^{89}Sr has decayed away as has the ^{140}Ba-^{140}La. Environmental studies have found no strontium in Mortandad Canyon well within the LASL Site Boundary. Ten Site Canyon discharges to Mortandad Canyon at a point about 1.5 miles above the site boundary.

EBF:LAE:gm

Attachment: Table I

XC: L. Johnson, H-8

LJJ: 1) We haven't looked for it - yet! Talked to Stew about it. Capability coming after 1 Jan

2) We expect to begin analyses in 2 weeks and can certainly expect to Audit.

ALH

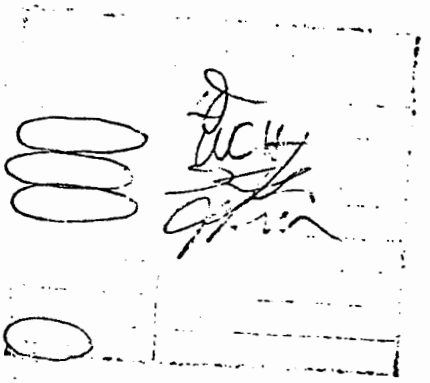

TABLE I

WASTES WITH ACTIVITY LEVELS BETWEEN
5×10^{-5} µCi/ml and 100 µCi/ml DISCHARGED
TO THE SOIL

Dates	Site	Type of Facility	Radio-nuclide	Estimated Amount Ci/y
1945-1951*	TA-21	Area T Absorption Beds	^{239}Pu	1.40
1945-1951*	TA-21	Area T Absorption Beds	^{3}H	2
1945-1961	TA-21	Area V Absorption Beds	^{140}Ba-^{140}La	0.17
∿1953	TA-21	Area U Absorption Beds	^{227}Ac	2.5
1951-1972	TA-21	Treatment Plant, Discharge to DP Canyon	^{3}H	2
1956	TA-35	Treatment Plant to Ten Site Canyon	^{89}Sr	0.94
1956	TA-35	Treatment Plant to Ten Site Canyon	^{90}Sr	0.17
1944-1962*	TA-45	Treatment Plant to Acid Canyon	^{3}H	3
1963-pres.	TA-50	Treatment Plant to Mortandad Canyon	^{3}H	3

*Data for 1945-1951 are estimates based on experience after waste treatment facilities were established.

RADIONUCLIDE INVENTORY

1/15/74

not any longer sealed LA 5614-M

A preliminary survey was made of the radionuclide content and composition of solid wastes disposed of at Los Alamos since the beginning of activity at the laboratory in the early 1940's. Records of solid waste disposal are highly variable in quality. In general, no records were kept until themid-1950's, Detailed records as to content and composition of wastes were not kept until 1959. The quality of records has increased steadily since that time. Information on waste disposal is available in several forms; daily entires in logbooks form the basis of most information, numerous memoranda and other file information is also available. ~~Exxenx xixexnsn~~ Lack of manpower and time has so far prevented direct use of these materials. Extensive use has been made of material accountability records for inferring the amounts of certain nuclides disposed of prior to the initiation of detailed record keeping. Monthly and biannual summaries of the daily logs prepared by waste management personnel ~~xexn~~ provided the bulk of the information presented in this report. The completeness of this inventory is in great part limited ~~xe~~ by that of the summaries.

A large variety of radioactive waste types of been disposed of at Los Alamos. ~~xuxxxexxxxx~~ The bulk of the material is room generated trash, generally contained in boxes or crates. A large variety of special disposal operations have been performed, ranging from the placement of a cylinder contianing a gram of tritium solution to the demolition and burial of entire buildings. During the early years of the laboratory liquid wastes were disposed of to the ground. In later years these liquids, or the sludges resulting from waste treatment were placed in barrels and mixed with cement for disposal. An attempt has been made to delineate the various types of disposal used for the~~x~~ material included in this inventory, eg. ~~dx~~ disposal shaft, pit, absorption bed, etc. Confirmation of this delineation will require completion of a detailed examination of the daily logs presently in process, and

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Location of Waste Disposal Areas

In general two types of disposal operations have been conducted at Los Alamos. In the first several years of operation of the laboratory, expediency dictated rapid, and by present standards, casual disposal of contaminated waste. Since the technical areas generating radioactive waste operated their own burial areas, and no laboratory-wide record keeping or supervision existed. The reduction in research pressure following the war resulted in an increased awarareness and concern for the adequacy of disposal techniques. A waste disposal section was organized, and with it were created various organized burial areas. In additon to areas recieving laboratory-wide generated waste, several areas have been used for special or one time disposal operations. The various burial operations known to contain radioactive material are indicated on Figure 1. The letter designation is one utilized by the Waste Management Section for reference convenience, and does not necessarily convey any information about the chronlogy of use. Each area will be discussed separately in the following sections.

Area A.

This was the first disposal area recieving waste under the supervision of an organized waste disposal section. It was operated from 1945 to 1956. Waste was placed in pits excavated in the volcanic tuff, and the material covered with the crushed material removed from the pit. No records were kept of the types and volumes of waste placed in these pits.

However, it is known that little if any transuanic materail was placed in these pits. Plutonium was an extremely scarce material during the years this area was used, and every effort was made to recover it from waste material. This area undoubtedly contains many of the radionuclides present in fission products and irradiated material that are known to exist in other disposal areas, but it is not presently possible to identify them specifically. The pits in Area C were also used for the disposal of chemical wastes, including HCl, H_2S and HF gas cylinders (Meyer, 1979).

Area B.

This area was opened in 1946, and its use continued through 1949. It was operated in the same manner as Area A, utilizing trenches for burial of all waste, including some chemical materials. No records exist on the types or volume of material placed in this area. The general inferences concerning radionuclides in Area A apply also to Area B. Concern over the proximity of waste disposal operations to residential areas prompted the opening of a new disposal area and the closing of Area B.

Area C.

This area was first opened in 1948. Trench disposal techniques were utilized for room generated trash, with separate pits used for radioactive and chemical wastes. Wastes containing unusual quanities of activity were placed in vertical shafts, varying from 20 to 60 feet deep. A total of 6 pits existed in this area, all of which were filled by 1960. Use of the disposal shafts

in this area continued through 1969.

Records of the types and volumes of waste placed in Area C prior to 1950 are incomplete. Beginning in 1951 data was recorded on the curie content of sludge generated by the liquid treatment facility and buried in this area.[2] The curie content of some isotopes placed in this area can be inferred from material accounability records, which indicate the amount of various materials removed from the inventory, and considered to have been disposed of as waste.[3] Some of this material was released in liquid effluents, and some escaped to the atmosphere. Thus these records only provide an upper limit on the material acutally placed in the disposal area.

The first complete records as to curie content and composition of wastes placed in Area C begin in 1960, and apply only to the material placed in disposal shafts. However, the summary records used for determining the content and composition of the wastes were not specific as to the shaft used for disposal. Beginning in 1965 shafts were in use in both Area C and Area G, and this dual useage continued through 1969. An estimate has been made of the amount of material placed in shafts in to the respective areas during this time. The data on activity and nuclide composition of wastes in shafts in Area C are presented in Table 2, and that on the wastes in pits in Area C are summarized in Table 1 .

Area D

This disposal area is located within Technical Area 33. Radioactive wastes generated by weapons testing were disposed of locally due to the sites remoteness from the remainder of the Laboratory. Area D contains several shafts approximately 50 feet deep that were used for subsurface detonation of nuclear explosives. The shafts were last used in 1949, and are known to be contaminated with ^{238}U. They were opened for inspection in 1954, and then backfilled with crushed tuff. In addition to the shafts, this area contains several pits known to contain kilogram quantities of ^{238}U. (Abrahams, 1963). No accurate estimate can be made of the curie content of these wastes.

Area F

This disposal area is located on Two Mile Mesa, and was used intermittently for local disposal of wastes generated in the early 1940's, prior to the organization of a laboratory-wide disposal section. Wastes were placed in shallow pits or trenches, but information on the types and quantities of radionuclides disposed of is generally not available. A memo dated February 13, 1964 reports on the presence of an estimated 30 millicuries of $^{137}Cesium$ within this disposal area.

Area G

This is the primary disposal area used by Los Alamos Scientific Laboratory since 1959. The area contains six large pits (30 x 180 x 8 meters deept), and eight smaller pits of varying dimensions, all of which have been used for routine burial of laboratory generated radioactive wastes. The records describing the material placed in these pits generally do not contain information on the curie content of the material, but the isotopic composition is generally indicated. Uranium and plutonium contaminated wastes are placed in separate pits.[1] ^{241}Americium is known to be present in the pits, occuring in association with plutonium in drums of sludge generated by liquid treatment facilities.[2] A reliable estimate can be made of the curie content of the various isotopes using material accountability data.[3] Other radiosotopes are known to be present in the disposal pits, such as tritium,[6] in unknown quantities. A summary of the available data on activity and nuclide content of wastes in disposal pits in Area G is presented in Table 1.

In additin to the pits, Area G contains over 70 disposal shafts used for burial of intermediate and low level contaminated wastes. Records on the types and activity of these wastes are generally quite good.[7] A summary of the known activities of material in these shafts is presented in Table 2. In addition to the isotopes listed in the table, unspecified but small quantities of the following isotopes are also present in the disposal shafts.[7]

^{24}Na	^{85}Kr	^{147}Pm	^{240}Pu
^{32}P	^{91}Y	^{152}Eu	^{242}Pu
^{51}Cr	^{105}Ag	^{191}Au	^{244}Cm
^{57}Co	^{114}In	^{227}Ac	^{252}Cf
^{59}Fe	^{131}I	^{232}Th	
	^{133}		

The data presented in Tables 1 and 2 were obtained from biannual summaries prepared by the Waste Managaement section. For the sake of completelness, a review of the original logbooks detailing the daily operations of the disposal area is presently underway,. It is expected that this review will result in some modifications to the information presented here. However, the record keeping and summaries thereof have been sufficiently complete that no significant changes are expected.

Area H

This area contains two shafts used for the disposal of contaminated classisfied material. The classified nature of the material has generally restricted the reporting of the composition and activity of radionuclides present. However, the material is reported as being generally low-level.

Area K

This disposal area is located in close proximity to Area D, and was operated similarly for the local disposal of wastes generated at Technical Area 33. Wastes containing an estimated several hundred kilograms of ^{238}U were placed in pits in this area between 1949 and 1955. In addition, a shallow pit in the area was used for disposal of tritium contaminated solutions between 1950 and 1959. Septic tanks in the area have recieved liquid wastes contaminated

with ^{235}U and ^{238}U,. xxxxxxxxxxx One additonal septic tank recieved two emergency releases of plutonium contaminated liquid in 1961. No estimate of the curie content of these various wastes has been made.

Area T

This area has been utilized for waste disposal in two different ways. From 1945 to 1951 covered absorption beds were used for subsurface disposal of liquid wastes resulting from recovery of plutonium. Beginning in 1968 liquid effluents xxx were mixed with cement and placed in vertical shafts. The two disposal operations are discussed separately in the following section.

Absorption beds. Four pits ~~100 feet long~~, ~~20 ft~~ wide and approximately ~~6 feet~~ deep were dug in the tuff, and partially backfilled with large gravel. Liquid wastes containing plutonium were discharged to these pits beginning in 1945. The use of the pits was discontinued in 1952 with the completeion of a liquid waste treatment facility. Hydroflouric acid used in the plutonium recovery operation is known to have been present in the waste discharge. Some trituium is also known to have been present. A summary of the radioactivity discharged to the pits is presented in Table 1. When the use of the pits was discontinued they were completely backfilled with earth and crushed tuff.

Disposal Shafts. The opeartion of the liquid treatement facility at TA-21, near area T, resulted in the production of a xx sludge residue contaminated with plutonium and ammricium. For many years this material was mixed with concrete and placed in

steel drums for disposal at Area C and Area G. In 1968 the operation of a pug mill was insituted, which mixed the waste material with cement. This cement was then pumped directly into unlined vertical shafts approximately 60 feet deep and 8 feet in diameter. The shafts were augered into the tuff using a large diameter bucket auger. This practice continued through 1973, when techniques were developed for the disposal of the contaminated cement slurry in a fashion that would permit retrieval on a 20 year basis. Numerous radionuclides are known to be present in the contaminated slurry, amongst them ^{90}Sr, ^{238}Pu, ^{239}Pu and ^{241}Am.[1] A complete summary of the activity placed in the shafts through 1972 is presented in Table .2.

Area U

This area contains several absorption beds similar to those in Area T, The beds were used for subsurface disposal of contaminated liquid wastes between 1945 and 1968. The primary radionuclide present in these wastes was $^{210}Polonium$. No records were kept of the amount discharged. However the short half-life of the material (60 days) will have produced a decay of the material to innocuous levels by 1972. During 1953 approximately 2.5 curies of $^{227}Actinium$ were discharged to the pits.[8] As indicated in Table 1, a portion of this activity remained undecayed as of the end of 1973.

Area V

This area was used for the disposal of contaminated liquid wastes resulting from laundry operations during the years 1945 to 1961, using absorption beds similar to those in Area T. An estimated total of three curies of ^{89}Sr, ^{140}Ba and ^{140}La were present in the liquid discharged to the beds.[8] This activity had decayed to a very low level by the end of 1972. In addition, small quantities of ^{90}Sr and ^{239}Pu were contained in the waste.[8] The remaining non-decayed activity of thesetwo contaminants is given in Table 1.

Area W

This area is used for the subsufrace storage of two coolant tanks assocaated with the LAMPRE reactor dismantled in 1963. Two stainless steel tanks, each containing 30-40 gallons of irradiated sodium, are encased in carbon steel sleeves, and located in separate vertical shafts about 100 feet deep. The sodium is known to be contaminated with ^{58}Cobalt, ^{137}Cesium, ^{182}Tantalum and ^{239}Plutonium. The total activity present in the tanks is not known,

Area X

This site, in close proximity to Area W, is being used for the subsurface storage of the LAMPRE reactor vessel. The vessel was buried in1964, containg an unspecified amount of ^{239}Plutonium. Other activation products are also expected to be present.

Summary

Records on the subsurface storage and disposal of radioactive waste are of varying quality. No complete records of waste volume, curie content and composition were kept until 1960. After that date the records contain information on the curie content of material placed in disposal shafts, and on specialized material placed in disposal pits. Quanties of certain materials present in various disposal areas can be estimated from material acountability records.

The various disposal areas at Los Alamos conatain a recorded decayed total of 107,046 curies, of which nearly 99,000 curies is tritium. ^{90}Sr and ^{241}Am are the second and third largest contributors to the activity, ^{239}Pu comprises a relatively small fraction of the activity (428 curies) However, all of the isotopes present in the pits, shafts and absorption beds are of concern when considering the ultimate dispositon of the disposal areas. Many of the isotopes are short-lived, and may be of concern only in the event of a decision to exhume the waste for transferral to a more permanent depository. Many of the wastes, such as ^{238}Pu are of concern principally because of their biological toxicity and long half lives.

References

1. Dean Meyer, Los Alamos Scient Lab, Personal Communication, 1963. ? 1973

2. [redacted] Emiley, L. Data on contamination in sludge from H-7 sent to Areas C & G

3. Bond, V. Data on material removed from inventory, during years 1952-1972.

4 Abrahams, J. H., 1963. Geologic and hydrologic environment of radioactive waste disposal sites at Los Alamos, New Mexico. U.S.G.S. Albuquerque, N.M.

5 Dunniger, J. E., Feb 13, 1964. [redacted] Memo from [redacted] to Dean Meyer, H-1 Group Leader

6. Log books of burial operations at Area G.

7. Log books of burial shaft operations at Area C & Area G.

8. Emily, L. 1973. Data on isotopes and activity discharged to absorption beds in Areas T, U, V.

9. Emily, L. 1973. Data on isotopes and activity discharged to Area T wells.

10. Meyer, Dean, 1972. Memo to E.E. Wingfield, Chief Operations branch LAO, Sept 11, 1972.

11. Schulk, J.W., 1973. Memo to C.W. Christenson, Group H-7, on strontium contamination in shipments of ^{140}La - ^{140}Ba processed at Los Alamos. Nov 15, 1973.

Table 1. Activity of materials placed in Disposal Pits and Absorption Beds, as of January, 1973.[a]

Area / Use Dates / Isotope	C 1948-1959 Pits	G 1959-1972 Pits	T 1945-51 Absorption beds	U 1945-68 Ab. Beds	V 1945-61 Ab. Beds	
^{3}H			3.6[g]			
^{22}Na						
^{60}Co						
$^{90}Sr - ^{90}Y$		~~4000~~			~~4000~~ .02[g,1]	
^{137}Cs						
$^{140}Ba-La$						
^{144}Ce						
^{182}Ta						
^{210}Po						
^{226}Ra						
^{227}Ac				1.36[b]		
^{233}U						
$^{(b)}U$ [3]	25	48				
^{238}Pu		14.6[2]				
^{239}Pu	22[2]	326.8[3]	9.8[g]		.06[3]	
^{24}Am [1]	149[2]	2074				total
Total	196	2463.4	13.4	1.36	.08	2604.2

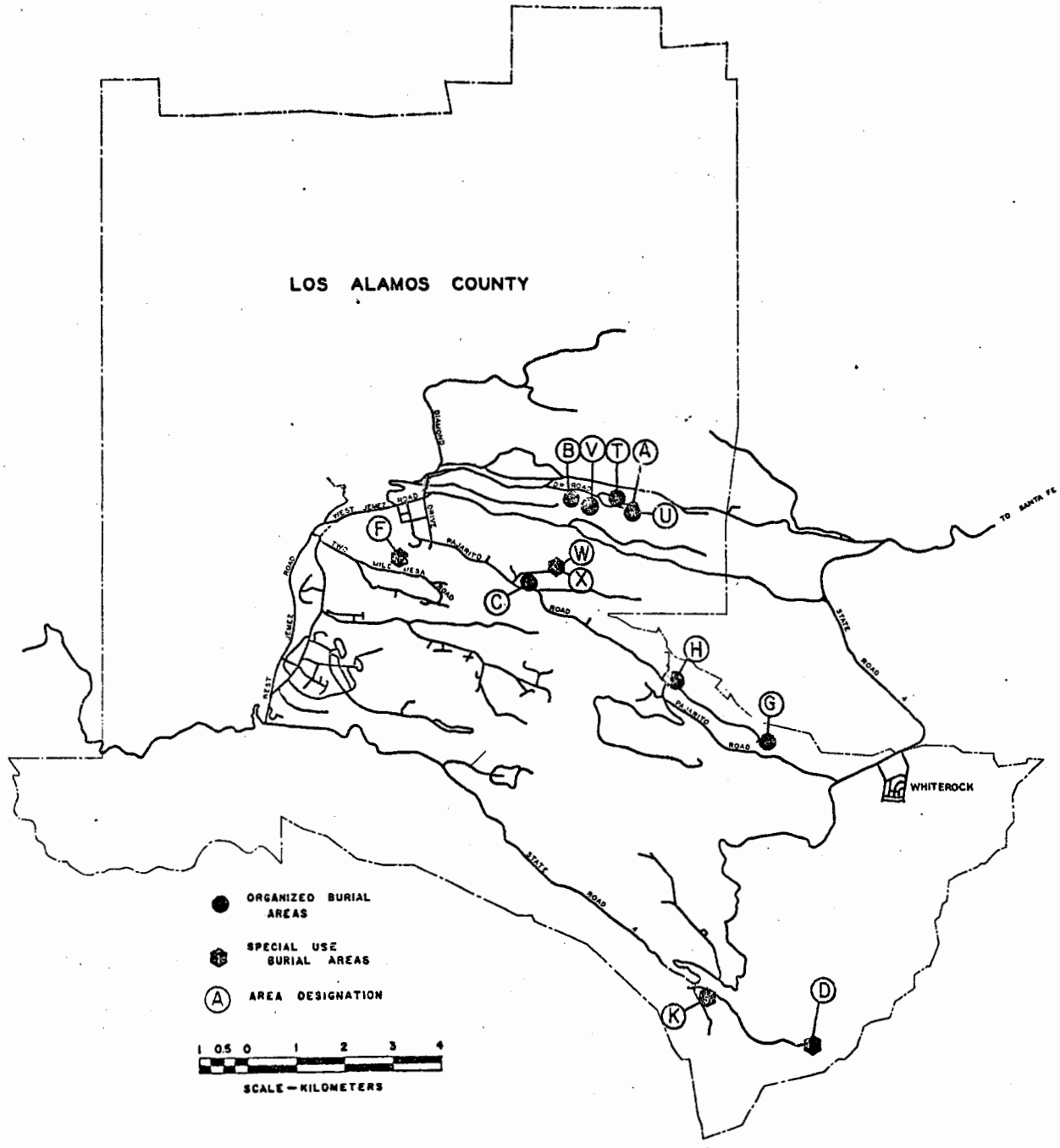
(a) All values in curies, decay corrected from original magnitude to that as of December 31, 1972.

(b) Includes isotopes 234, 235, 236, 238

Table 2. Activity of materials placed in subsurface Disposal sites, as of January 1, 1973.

Area / use Dates / Isotope	Disp wells (a) 1968-1972	Area C Disp. shafts 1960-1969	Area G Disp. shafts 1965-1972	Total subsurface disposal from Table 1	Total all Disposal Areas 1952-1972
^{3}H		1400	98,449	3.6	99,853
^{22}Na		40	46		86
^{60}Co		20	229		249
^{90}Sr-^{90}Y	2.3	31	~~410~~ 750	~~4000~~ 4000.02	~~4783.32~~ ~~41.02~~
^{137}Cs	2.1		6		6
^{226}Ra		1			1
^{227}Ac				1.36	1.36
^{233}U	6.9	5	5		16.9
^{235}U		.05			.05
U				73	73.05
^{236}Pu	12.6			14.6	27.2
^{239}Pu	69.4			358.66	428.06
^{241}Am	1256			2223	3479
Fission Prod.		50	77		127
Induced Activ.		250	2458		2658
Total	1349.3	1797.05	101,280	2674.2	107,046

All values in curies, already corrected from original magnitude to that as of December 31, 1972.



NO.	DATE	REVISIONS	BY
15	10-2-72	REVISED TO STATUS OF 10-2-72	ORA
14	8-2-72	ADDED MESON TA-53 ACCESS ROAD	JRM
13	11-8-66	REMOVED PORTION WEST ROAD, RENAMED TA-[illegible] TO BE WEST ROAD, ADDED CAMP KAY ROAD	DAC
12	1-10-63	REVISED TO STATUS OF 1-1-63	CDF
11	8-15-61	REDRAWN TO STATUS OF 8-1-61 (WAS ENG-R 110)	GDS

AUTHORIZED FOR: HEALTH, SAFETY, FIRE PROT., SEC.

LOS ALAMOS SCIENTIFIC LABOR.
ENGINEERING DEPARTMENT
UNIVERSITY OF CALIFORNIA — LOS ALAMOS, NEW

TECHNICAL AREA ROA

CHECKED [illegible] ENG.	RECOMMENDED GROUP LEADER	APPROVED ENG. DEPT. OFF.	
DESIGNER	DATE 8-15-61	DRAWING NO. ENG-R	
DRAWN SIMES	SHEET		
SCALE AS NOTED	1 OF 1		