REPORTER'S TRANSCRIPT
OF
SIXTH DOSE ASSESSMENT
ADVISORY GROUP MEETING

JANUARY 7, 1983

VOLUME II

UNITED STATES DEPARTMENT OF ENERGY
NEVADA OPERATIONS OFFICE

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Nevada Operations Office

VOLUME II

REPORTERS' TRANSCRIPT

OF

SIXTH DOSE ASSESSMENT ADVISORY GROUP MEETING

Auditorium
2753 South Highland Drive
Las Vegas, Nevada
January 7, 1983

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DOSE ASSESSMENT ADVISORY GROUP

Members Present:

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Members Absent:

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Donner Laboratory
University of California

Mr. William J. Breed
Anthropologist
Museum of Northern Arizona
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6

Others Present:

TASK GROUP PERSONNEL

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UNITED STATES DEPARTMENT OF ENERGY

Nevada Operations Office

OFF-SITE RADIATION EXPOSURE REVIEW PROJECT

Staff Present:

JOHN R. GILPIN, ASSISTANT MANAGER FOR ADMINISTRATION, NV

ROBERT W. NEWMAN, ASSISTANT TO THE MANAGER FOR SCIENCE & TECHNOLOGY, NV

BRUCE W. CHURCH, DIRECTOR, HEALTH PHYSICS DIVISION, NV

MARSHALL PAGE, JR., DEPUTY PROJECT MANAGER

RICHARD V. NUTLEY

DAVID L. WHEELER

Others Present:

BATTELLE PACIFIC NORTHWEST LABORATORY

Ken Kosauke
Mark Rangel
Everett Wingo

COLORADO STATE UNIVERSITY

Thomas B. Kirchner
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DRI

Stanley W. Hutchinson
Carol B. Thompson

HOLMES & NARVER

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Ed Eubanks
Kim D. Lee
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Bernardo Maza
Nancy Rothermich
Stephen Rohrer
Roger C. Thompson

U.S. JOD

Ralph Johnson

WEATHER SERVICE NUCLEAR SUPPORT OFFICE

Charles Steadman

OTHER DOE IN ATTENDANCE

Buford Allen
Rick Betteridge
JoAnne Burrows
Paul B. Dunaway
Roy Maxwell
Chris West

OTHER PUBLIC IN ATTENDANCE

Paul Dawkins
Mary Manning
Darrel W. McIndoe, M.D.
James Murray
Richard Pratt

LAS VEGAS, NEVADA, JANUARY 7, 1983, FRIDAY, 8:30 A.M.

2

3   CHAIRMAN MOSELEY: It's 30 minutes after the hour Coordinated

4 Universal Time, and we will begin with a presentation by Dr. Ng on the

5 Progress on Internal Dose Assessment Models, and he will be followed by

6 Dr. Anspaugh on another aspect of this subject.

7   Dr. Ng.

8   (Exhibit LRA-1)

9   DR. NG: May I have the second viewgraph now, please?

10   Now, this viewgraph (LRA-2) simply emphasizes that the documents by

11 Hicks listed below have been published.

12   Next viewgraph (LRA-3) please.   This viewgraph shows how the dose

13 calculations are carried out, and it summarizes the basic calculations for

14 the dose in somewhat different form than I've previously shown, but it is

15 essentially unchanged.   The DOS is the product of four terms.   ER is the

16 exposure rate 12 hours postdetonation.   It varies with the shot and

17 location.   DEPNO is the deposition normalized to an exposure rate of

18 1 mR/hr at H+12.   It varies with nuclide, event and time of arrival.   INDEP

19 is the integrated intake per unit deposition.   It's specific for the

20 individual and varies with the nuclide and event.   DF is the dose factor

21 which varies with the age group, nuclide and organ.   The dose, therefore,

22 is specific for the individual, event, radionuclide, and organ.

23   The calculations are carried out as shown on the next viewgraph

24 (LRA-4).   The INPUT data consists of the birthdates of the litigants; the

25 dates of the various test events; the intakes per unit deposition for the

26 individuals, nuclides, and events from Colorado State University; the resi-

27 dence locations and dates of residence at these locations, and the exposure

28 rates and times of arrival for the events and locations.

1   The calculations for each litigant are made by selecting the normal-

2 ized depositions and dose factors appropriate for the event, computing the

3 doses, and then summing over the nuclides and events.

4   Our next viewgraph, please (LRA-5). As an example, this viewgraph

5 summarizes the dose estimates for   ,. We list the

6 organ doses for each of the 31 shots and the total dose. For

7   the diagnosis is thyroid cancer, so that the organ of reference is

8 the thyroid. Her residence was St. George, and six of the 31 events

9 transported fallout to St. George: ANNIE, SIMON, HARRY, TESLA, ZUCCHINI,

10 and SMOKY. The total thyroid dose is 40 rads, mostly from event HARRY,

11 36 rads.

12   Our next viewgraph, please (LRA-6). It is useful to know how the

13 individual radionuclides contributed to the dose. We, therefore,

14 calculated the individual contributions of the radionuclides to the dose

15 and the fractional contributions to the total. We made calculations for

16 each litigant and event that contributed to the dose, and for each

17 litigant, and the total dose from all events. As an example, this

18 viewgraph shows the results for   from event HARRY. Thirteen

19 organs are listed across the top; 20 nuclides are listed along the margin.

20 The most important radionuclides and their contributions to the thyroid

21 dose are highlighted. The nuclides that contribute one percent or more of

22 the total thyroid dose are iodine-131, tellurium-132, and iodine-133. Now,

23 the actual contributions are summarized in the next viewgraph.

24   This viewgraph (LRA-7) shows the most important contributions to the

25 thyroid dose to   from HARRY. Again, her residence is

26 St. George; her age group is child; diagnosis, thyroid dose from HARRY, 36

27 rads. Now, iodine-131 contributes some 88 percent of the dose;

28 Tellurium-132, two percent; and iodine-133 essentially the remainder of 10

1 percent. We also note the most important contributions to the lower large

2 intestine, which is of interest because it's the organ that receives the

3 second highest internal doses by ingestion, and the bone marrow dose, which

4 is of interest because of the abundance of leukemia diagnoses. Thus, among

5 the radionuclides that contribute five percent or more of the dose to the

6 lower large intestine, are neptunium-239, strontium-89, yttrium-93,

7 zirconium-97, barium-140, and neodymium-147. We recently added yttrium-93

8 to the list of nuclides because in reexamining our screening calculations

9 we noted that Y-93 did, indeed, contribute some two percent or more of the

10 total lower large intestine dose. For the bone marrow, among the nuclides

11 that contributed the most are strontium-89, strontium-90, collectively

12 contributing over 60 percent to the total dose. Iodine-131, tellurium-132,

13 cesium-137, barium-140 contribute some five percent or more.

14   The next viewgraph (LRA-8) shows a similar distribution. Well, it

15 shows the most important contributors to the thyroid dose to ·

16 from all events. Six of the 31 events contributed doses by virtue of

17 distributing radioactivity over St. George. Fractional contributions are

18 quite similar, as shown on the previous viewgraph (LRA-7), and this is not

19 surprising since HARRY was the major contributor to the total dose from all

20 events.

21   Again, I will go through this quickly, the most important contribu-

22 tions to the thyroid dose are from iodine-131, tellurium-132, and iodine-

23 133; and, serially, the most important contributors to the dose to the

24 lower large intestine are neptunium-239, strontium-89, yttrium-93,

25 zirconium-97, barium-140, and neodymium-147. The most important

26 contributors again to the bone marrow dose are strontium-89, strontium-90,

27 iodine-131, tellurium-132, cesium-137, barium-140.

28   As another example, the next viewgraph (LRA-9) summarizes the dose

1 estimates for   from all events and from the individual

2 events. Residence for   was Washington, Utah. His diagnosis

3 was leukemia, and, therefore, the organ of reference is the bone marrow.

4 We, therefore, highlight the bone marrow and the major contributors to the

5 bone marrow dose, which totals 120 millirads. The events that contributed

6 to this total dosage are again ANNIE, SIMON, HARRY, TESLA, ZUCCHINI, and

7 SMOKY.   The major contributor was HARRY, which contributed some 100

8 millirads to the bone marrow dose.

9   The next viewgraph (LRA-10) shows the contributions of the individual

10 nuclides to the doses for   . This is from all events. The

11 most important contributors to the bone marrow dose are highlighted and

12 examined in the next viewgraph.

13   (LRA-11)   The major contributors to the bone marrow dose are

14 strontium-89, strontium-90, in this case collectively contributing about

15 two-thirds of the total dose, molybdenum-99, iodine-131, tellurium-132,

16 iodine-133, cesium-137, and barium-140.   Each contributed at least two

17 percent. Major contributors to the lower large intestine are the same as

18 fo   and are quite typical. Let me just point out that it is

19 interesting to note that the dose estimate for the thyroid of

20   is 55 rad, which actually exceeds that for   ,; however,

21 his diagnosis was not thyroid cancer but leukemia.

22   Next viewgraph, please (LRA-12).   Three of the litigants who

23 experienced in utero exposures are as summarized in this viewgraph. Here

24 we list the litigants, the birthdates of the litigants, their residences,

25 the events to which they were exposed while in utero, and the dates of the

26 events.   was exposed near the end of the first trimester, and

27 -   and   were exposed near the beginning of the

28 second trimester. Now, we selected _   as the surrogate for

1 estimating maternal doses for   , and   .   Her

2 thyroid dose estimates are the highest among those for adult women who were

3 exposed to fallout from FOX and HARRY at Cedar City, and the second highest

4 among all adults for that matter who were exposed to fallout from these

5 events at Cedar City.   , was selected as the surrogate mother for

6 estimating maternal doses for   .   Her thyroid dose estimate is

7 the highest among the adults who were exposed to fallout from ZUCCHINI at

8 St. George.

9   Since the dose from radioiodines to the fetal thyroid at the beginning

10 of the second trimester is still less than that to the maternal thyroid,

11 the limiting dose to the fetal thyroid is assumed to be the dose estimate

12 for the maternal thyroid. Now, the dose to the fetal total body and other

13 fetal organs is assumed to be that to the maternal total body or uterus.

14 Rapid bone development and accumulation of calcium and strontium do not yet

15 occur at the beginning of the second trimester; so the dose estimates for

16 the in utero exposures are summarized in the next viewgraph.

17   (LRA-13). Now these turn out to be less than one millirad for "Total

18 Body (and other organs)" or one millirad in the case of _   ,; and

19 less than 0.06 of a rad for   , less than 0.5 of a rad for

20   ., and less than 0.2 of a rad for_   . These fetal

21 dose estimates then may be added to the previously calculated totals.

22   Let me simply mention that in the handouts which contain the summaries

23 of the individual dose estimates, we also list two separate sheets for _

24   and   .   had a diagnosis of cancer to the pancreas,

25 and we, therefore, included pancreas as a reference organ and calculated

26 doses to the pancreas. In calculating doses to the brain, which is the

27 organ of reference for _   ., we used pancreas as a reference organ,

28 and making note that the dose to the brain is approximately equal to the

1 dose to the pancreas and certainly less than two times the dose to the

2 pancreas.

3 Now we previously stated that we would evaluate the dose to the

4 salivary glands and the lactating breast from the ingestion of Iodine-131.

5 Both of these tissues can concentrate iodine. Serous salivary glands,

6 stomach, lactating breast, and certain other tissues possess iodine

7 concentrating mechanisms, or an iodine concentrating mechanism that is

8 comparable to that of the thyroid.

9 Next viewgraph, please (LRA-14). We can summarize the readily

10 available data by examining the fluid-to-plasma ratio. We list the average

11 fluid-to-plasma ratio and the range of values for saliva, for gastric

12 juice, and milk; and these are the references from which the data were

13 derived. In the case of the salivary glands, the fluid-to-plasma ratio are

14 to a large extent independent of the plasma concentration and secretion

15 rate. In the case of gastric juice, the fluid-to-plasma ratio varies

16 inversely with the collection rate.

17 May I have the next viewgraph, please (LRA-15). So we made attempts

18 to estimate dose factors to extrathyroidal iodide concentrating tissues for

19 iodine-131 as follows: The half-life of iodine in extracellular fluid is

20 assumed to be the rapidly turning-over component of the iodine retention

21 function with a half-life of 0.35 days; and this is equivalent to an

22 effective turnover rate of about two per day. Now the time integral of the

23 concentration in extracellular fluid is then 0.7, assuming that 0.7 of the

24 ingested iodine goes to the extracellular fluid, and the 2.7×10^4 ml

25 corresponds to the iodide space, and the two per day is the turnover rate

26 that we just examined above.

27 This leads to a time integral then of the concentration in extra-

28 cellular fluid of 1.3×10^{-5} d/l. Now we assume that the equivalence of

1 the time integrals in fluids concentrated from extracellular fluid, and in

2 the tissues from which these fluids are derived, so we have then for the

3 time integral of the concentrations in the concentrated fluids, $1.25 \times$

4 $10^{-5} \times R$, where R is the fluid-to-plasma ratio. Now R is a poor choice

5 inasmuch as it also represents Roentgens, but, nonetheless, R is meant to

6 be the fluid-to-plasma ratio.

7 The dose factor then for extrathyroidal iodide concentrating tissues,

8 is this 1.25×10^{-5} R d/g $\times$ 0.2 MeV, corresponding to the energy from the

9 disintegration of iodine-131 times the conversion factor of 51.2 rad per

10 (μCi-d/g)-MeV, and this is then the resulting expression for the dose

11 factor for extrathyroidal iodide concentrating tissues.

12 Next viewgraph, please (LRA-16). We also made an attempt to estimate

13 a dose factor for iodine-131 to the lactating breast by making note of the

14 recoveries of, well, iodine-131, or of the dietary iodide in milk. Now

15 0.03 - 26.8% of I-131 administered to women at the conclusion of the last

16 breast feeding, resulted in the recovery of this range of values of the

17 isotope in milk. In the case of dietary stable iodide, ten percent or less

18 of the daily ingested iodide is secreted in milk. And this varies

19 inversely with the dietary intake of iodine. So the transfer coefficient

20 and time integral then of the concentration in milk following a single

21 intake of iodide, assuming a milk secretion rate of one liter per day, and

22 this seems to be a reasonable value for nursing mothers, leads to, well, a

23 transfer coefficient, or time integral of 0.1 of a day per liter, and this

24 is equivalent to 10^{-4} d/ml. Now again we assume the equivalence of the

25 time integrals in milk and lactating breast, so we have 10^{-4} d/g for the

26 time integral in the lactating breast. Dose factor then is this number

27 times the 0.2 MeV times the conversion factor, and we get about 1.0×10^{-3}

28 rad/μCi.

1   Next viewgraph, please (LRA-17). This is simply a comparison of those

2 factors for iodine-131 then. This is what is in use, or what we estimate,

3 for the dose factor for iodine-131 and extrathyroidal iodide concentrating

4 tissues. For thyroid, we use a dose factor of 1.9 rad/μCi. For the

5 lactating breast our estimate is -- excuse me. The dose factor for the

6 breast is 4.5 x 10^{-4} rad/μCi. For the lactating breast we have two values,

7 depending on our approach. 1 x 10^{-3} or 3 x 10^{-3}. For salivary glands, 7 x

8 10^{-3}. For stomach, and this is -- I don't want to emphasize stomach

9 here -- assuming the stomach as an extrathyroidal iodide concentrating

10 organ, total body, approximately 1 x 10^{-3}. These are the dose factors from

11 MIRD. This is found in the Journal of Nuclear Medicine, 1975, and from

12 ICRP-30.

13   Now the next slide (LRA-18) summarizes some hypothetical dose esti-

14 mates -- well, this is actually patterned after one of our litigants, and

15 the assumption is that she is a nursing mother. These are the calculated

16 values in our printouts, assuming the adult female. Breast, 0.024. Now if

17 we made a calculation for the dose from iodine-131 to the lactating breast,

18 we would have -- from iodine-131 alone we would have an additional of

19 approximately 50 percent to be added to this calculated value. And in the

20 case of the salivary glands, we estimate, oh, 29 millirads which

21 approximates the dose from all radionuclides to the total body.

22   Now in summary then, the dose to extrathyroidal iodide concentrating

23 organs from iodine-131 is very low relative to that to the thyroid. Lynn

24 now will follow with various other items.

25   CHAIRMAN MOSELEY: Are there questions for Dr. Ng at this point.

26 Thank you very much.

27

28

INDIVIDUAL DOSE ASSESSMENT MODELS AND DOSE TO LITIGANTS

Presentation to
THE DOSE ASSESSMENT ADVISORY GROUP
Las Vegas, NV; January 6 and 7, 1983

Lynn R. Anspaugh and Yook C. Ng
Lawrence Livermore National Laboratory

LRA-1

THE SOURCE-TERM DATA HAVE BEEN PUBLISHED

H.G. Hicks, <u>Results of Calculations of External Gamma Radiation Exposure Rates from Fallout and the Related Radionuclide Compositions</u>, Lawrence Livermore National Laboratory, UCRL-53152, Parts 1 through 8 (1981).

H.G. Hicks, <u>Calculated Concentrations of any Radionuclide Deposited on the Ground by Release from Underground Nuclear Detonations, Tests of Nuclear Rockets, and Tests of Nuclear Ramjet Engines</u>, Lawrence Livermore National Laboratory, UCRL-53228 (1981).

H.G. Hicks, "Calculation of the Concentration of any Radionuclide Deposited on the Ground by Offsite Fallout from a Nuclear Detonation," <u>Health Phys.</u> 42, 585 (1982).

DOSE ESTIMATES FOR LITIGANTS VIA INGESTION

$$DOS = ER \times DEPNO \times INDEP \times DF$$

$$rad \qquad \frac{mR}{h} \qquad \frac{\mu Ci/m^2}{mR/h} \qquad \frac{\mu Ci}{\mu Ci/m^2} \qquad \frac{rad}{\mu Ci}$$

ER	Event, location
DEPNO	Nuclide, event, time of arrival (TOA)
INDEP	Individual, nuclide, event
DF	Nuclide, organ, age group
DOS	Individual, event, nuclide, organ

DOSE ESTIMATES FOR LITIGANTS VIA INGESTION

$$\text{DOS} = \text{ER} \times \text{DEPNO} \times \text{INDEP} \times \text{DF}$$

$$\text{rad} \qquad \frac{mR}{h} \qquad \frac{\mu Ci/m^2}{mR/h} \qquad \frac{\mu Ci}{\mu Ci/m^2} \qquad \frac{rad}{\mu Ci}$$

INPUT:
Birthdates
Event dates
INDEP values for events
Residence locations and dates
ER and TOA for events and locations

CALCULATIONS:
Select DEPNO and DF for each event
Compute doses
Sum over nuclides and events

PRIVACY ACT MATERIAL REMOVED

INTERNAL DOSE ESTIMATES VIA INGESTION FOR LITIGANTS (RADS)

ORGAN	UNCLE	TS-EASY	TS-FOX	ANNIE	NANCY	SIMON	HARRY	GRABLE	TESLA	TURK	HORNET	BEE
BON SURF	0.	0.	0.	7.45E-03	0.	5.19E-04	1.22E-01	0.	1.20E-03	0.	0.	0.
BREAST	0.	0.	0.	1.65E-03	0.	1.06E-04	3.20E-02	0.	4.43E-04	0.	0.	0.
LLI WALL	0.	0.	0.	2.93E-02	0.	1.44E-03	4.64E-01	0.	6.95E-03	0.	0.	0.
KIDNEYS	0.	0.	0.	2.12E-03	0.	1.32E-04	4.15E-02	0.	8.57E-04	0.	0.	0.
LIVER	0.	0.	0.	2.36E-03	0.	1.44E-04	4.69E-02	0.	6.25E-04	0.	0.	0.
LUNGS	0.	0.	0.	1.47E-03	0.	9.69E-05	2.07E-02	0.	3.97E-04	0.	0.	0.
OVARIES	0.	0.	0.	2.06E-03	0.	1.16E-04	3.27E-02	0.	5.37E-04	0.	0.	0.
R MARROW	0.	0.	0.	5.62E-03	0.	3.07E-04	9.20E-02	0.	1.01E-03	0.	0.	0.
THYROID	0.	0.	0.	7.53E-01	0.	7.62E-02	3.60E+01	0.	2.17E-01	0.	0.	0.
TOTAL BODY	0.	0.	0.	3.01E-03	0.	2.13E-04	6.25E-02	0.	7.07E-04	0.	0.	0.
UTERUS	0.	0.	0.	1.52E-03	0.	9.20E-06	2.43E-02	0.	3.91E-04	0.	0.	0.
BLAD WAL	0.	0.	0.	1.41E-03	0.	8.61E-05	2.22E-02	0.	3.63E-04	0.	0.	0.

ORGAN	APPLE I	MET	APPLE II	ZUCCHINI	WILSON	PRISCILLA	HOOD	DIABLO	KEPLER	SHASTA	SMOKY	NEWTON
BON SURF	0.	0.	0.	3.14E-03	0.	0.	0.	0.	0.	0.	3.75E-03	0.
BREAST	0.	0.	0.	7.73E-04	0.	0.	0.	0.	0.	0.	1.27E-03	0.
LLI WALL	0.	0.	0.	9.41E-03	0.	0.	0.	0.	0.	0.	2.17E-03	0.
KIDNEYS	0.	0.	0.	1.01E-03	0.	0.	0.	0.	0.	0.	1.58E-03	0.
LIVER	0.	0.	0.	1.11E-03	0.	0.	0.	0.	0.	0.	1.66E-03	0.
LUNGS	0.	0.	0.	6.95E-04	0.	0.	0.	0.	0.	0.	1.12E-03	0.
OVARIES	0.	0.	0.	7.60E-04	0.	0.	0.	0.	0.	0.	1.00E-03	0.
R MARROW	0.	0.	0.	2.36E-03	0.	0.	0.	0.	0.	0.	2.99E-03	0.
THYROID	0.	0.	0.	8.60E-01	0.	0.	0.	0.	0.	0.	2.13E+00	0.
TOTAL BODY	0.	0.	0.	1.53E-03	0.	0.	0.	0.	0.	0.	2.48E-03	0.
UTERUS	0.	0.	0.	5.79E-04	0.	0.	0.	0.	0.	0.	8.30E-04	0.
BLAD WAL	0.	0.	0.	8.31E-04	0.	0.	0.	0.	0.	0.	7.64E-04	0.

ORGAN	WHITNEY	MORGAN	OTERO	EDDY	SMALL BOY	PIKE	PIN STRIPE	TOTAL
BON SURF	0.	0.	0.	0.	0.	0.	0.	1.30E-01
BREAST	0.	0.	0.	0.	0.	0.	0.	3.62E-02
LLI WALL	0.	0.	0.	0.	0.	0.	0.	6.33E-01
KIDNEYS	0.	0.	0.	0.	0.	0.	0.	4.69E-02
LIVER	0.	0.	0.	0.	0.	0.	0.	5.10E-02
LUNGS	0.	0.	0.	0.	0.	0.	0.	3.25E-02
OVARIES	0.	0.	0.	0.	0.	0.	0.	3.72E-02
R MARROW	0.	0.	0.	0.	0.	0.	0.	1.04E-01
THYROID	0.	0.	0.	0.	0.	0.	0.	4.00E+01
TOTAL BODY	0.	0.	0.	0.	0.	0.	0.	7.04E-02
UTERUS	0.	0.	0.	0.	0.	0.	0.	2.70E-02
BLAD WAL	0.	0.	0.	0.	0.	0.	0.	2.53E-02

Dose via Ingestion

SHOT NAME IS HARRY

DOSE IN RAD

NUCLIDE	BON SURF	BREAST	LLI WALL	KIDNEYS	LIVER	LUNGS	OVARIES	R MARROW	TESTES	THYROID	TOT BODY	UTERUS	BLAD WAL
NP239	2.14E-03	2.37E-04	1.19E-01	2.87E-04	7.64E-04	3.76E-05	2.23E-03	7.90E-04	1.82E-04	3.89E-06	7.80E-04	9.41E-04	6.49E-04
SR 89	5.46E-02	2.62E-03	7.22E-02	3.44E-03	3.44E-03	2.62E-03	3.44E-03	3.73E-02	3.44E-03	3.44E-03	1.04E-02	3.44E-03	3.44E-03
SR 90	2.77E-02	2.52E-04	1.80E-03	3.85E-04	3.88E-04	2.52E-04	3.95E-04	2.01E-02	3.85E-04	3.85E-04	6.37E-03	3.85E-04	3.85E-04
SR 91	4.15E-04	2.61E-04	1.00E-02	3.47E-04	2.12E-04	1.60E-04	5.43E-04	5.65E-04	2.04E-04	1.26E-04	7.54E-04	6.33E-04	1.99E-04
Y 93	0.	0.	2.44E-02	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZR 97	1.22E-04	2.17E-04	4.79E-02	2.94E-04	2.13E-04	4.72E-05	1.66E-03	3.48E-04	1.39E-04	7.12E-06	5.20E-04	7.56E-04	4.72E-04
MO 99	5.80E-03	1.60E-03	9.77E-03	2.05E-02	2.32E-02	1.69E-03	2.50E-03	4.02E-03	1.94E-03	2.20E-03	2.35E-03	2.30E-03	4.72E-04
RU103	3.73E-04	4.67E-04	8.07E-03	5.09E-04	4.71E-04	2.83E-04	7.08E-04	6.43E-04	4.74E-04	2.43E-04	8.30E-04	2.30E-03	2.14E-03
RH105	1.95E-05	7.53E-06	2.21E-03	8.23E-06	6.55E-06	9.44E-07	4.27E-05	1.11E-05	5.65E-06	8.51E-06	8.30E-04	3.29E-04	2.74E-04
RU106	1.31E-03	1.32E-03	1.58E-02	1.04E-03	1.32E-03	1.30E-03	1.50E-03	1.34E-03	1.32E-03	1.29E-03	1.99E-05	1.86E-05	1.02E-05
I131	7.50E-03	1.04E-02	1.23E-03	1.26E-03	1.45E-03	8.77E-03	1.18E-03	8.12E-03	1.09E-03	3.18E+01	2.22E-02	1.39E-03	1.37E-03
TE132	8.64E-03	3.65E-03	6.57E-03	2.90E-03	2.96E-03	3.45E-03	5.65E-03	4.64E-03	3.79E-03	6.21E-01	3.45E-03	1.24E-03	1.18E-03
I133	1.52E-03	1.78E-03	1.45E-03	1.49E-03	1.47E-03	1.73E-03	1.33E-03	1.61E-03	1.36E-03	3.46E+00	3.45E-03	8.00E-04	7.29E-04
I135	2.09E-04	2.39E-04	2.44E-04	2.33E-04	2.37E-04	2.33E-04	2.24E-04	2.27E-04	1.99E-04	8.46E+00	2.83E-03	1.40E-03	1.38E-03
CS136	7.14E-04	6.99E-04	8.94E-04	8.31E-04	8.26E-04	6.89E-04	7.14E-04	7.77E-04	7.99E-04	1.11E-01	3.13E-04	2.39E-04	2.21E-04
CS137	6.63E-03	6.72E-03	7.80E-03	7.42E-03	7.37E-03	6.88E-03	7.00E-03	7.16E-03	7.54E-03	6.93E-03	7.59E-03	1.01E-03	9.10E-04
BA140	3.91E-03	1.47E-03	7.66E-02	4.65E-04	9.94E-04	5.29E-04	2.86E-03	4.16E-03	1.96E-03	1.10E-03	8.50E-04	7.80E-03	7.64E-03
CE143	2.69E-05	3.87E-05	1.96E-02	4.67E-05	3.65E-05	6.38E-06	3.54E-04	8.47E-05	2.56E-05	7.29E-07	4.10E-04	1.39E-03	1.08E-03
CE144	3.00E-05	2.86E-06	1.56E-02	8.79E-06	5.03E-06	1.52E-06	1.64E-05	2.09E-05	2.39E-06	4.07E-06	1.90E-04	1.43E-04	9.31E-05
ND147	2.74E-05	3.13E-05	2.29E-02	3.52E-05	2.76E-05	4.32E-06	3.21E-04	8.77E-05	2.44E-05	4.75E-07	1.30E-04	7.19E-06	5.89E-06
TOTAL	1.22E-01	3.20E-02	4.64E-01	4.15E-02	4.59E-02	2.67E-02	3.27E-02	9.20E-02	2.49E-02	3.80E+01	6.25E-02	2.43E-02	2.22E-02

FRACTION OF TOTAL

NUCLIDE	BON SURF	BREAST	LLI WALL	KIDNEYS	LIVER	LUNGS	OVARIES	R MARROW	TESTES	THYROID	TOT BODY	UTERUS	BLAD WAL
NP239	1.75E-02	7.40E-03	2.57E-01	6.91E-03	1.67E-02	1.31E-03	6.83E-02	8.59E-03	7.32E-03	1.08E-07	1.25E-02	3.87E-02	2.92E-02
SR 89	4.46E-01	8.18E-02	1.56E-01	8.28E-02	7.49E-02	9.13E-02	1.05E-01	4.05E-01	1.38E-01	9.55E-05	1.67E-01	1.41E-01	1.55E-01
SR 90	2.26E-01	7.86E-03	3.87E-03	9.29E-03	8.45E-03	8.77E-03	1.18E-02	2.19E-01	1.55E-02	1.07E-05	1.02E-01	1.58E-02	1.74E-02
SR 91	3.40E-03	8.15E-03	2.16E-02	8.37E-03	4.63E-03	5.97E-03	1.66E-02	6.14E-03	8.19E-03	3.51E-06	1.21E-02	2.60E-02	8.95E-03
Y 93	0.	0.	5.26E-02	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZR 97	9.96E-04	6.78E-03	1.03E-01	7.09E-03	4.64E-03	1.85E-03	5.09E-02	3.78E-03	5.60E-03	1.88E-07	8.32E-03	3.11E-02	2.13E-02
MO 99	4.76E-02	4.98E-02	2.11E-02	4.93E-01	5.06E-01	6.88E-02	7.66E-02	4.38E-02	7.80E-02	6.11E-05	3.76E-02	9.44E-02	9.63E-02
RU103	3.06E-03	1.46E-02	1.74E-02	1.23E-02	1.03E-02	9.86E-03	2.17E-02	6.99E-03	1.91E-02	6.74E-06	1.33E-02	1.35E-02	1.23E-02
RH105	1.60E-04	2.35E-04	4.77E-03	1.98E-04	1.43E-04	3.29E-05	1.31E-03	1.21E-04	2.27E-04	2.37E-07	3.19E-04	7.65E-04	4.60E-04
RU106	1.07E-02	4.12E-02	3.40E-02	2.50E-02	2.87E-02	4.54E-02	4.59E-02	1.45E-02	5.32E-02	3.58E-05	9.84E-02	6.71E-02	6.18E-02
I131	6.15E-02	3.25E-01	2.64E-03	3.04E-02	3.15E-02	3.06E-01	3.61E-02	8.83E-02	4.39E-02	8.83E-01	3.66E-01	6.10E-02	6.32E-02
TE132	7.09E-02	1.14E-01	1.41E-02	7.00E-02	6.45E-02	1.20E-01	1.73E-01	5.04E-02	1.52E-01	1.73E-02	5.53E-02	5.10E-02	5.32E-02
I133	1.25E-02	5.57E-02	3.13E-03	3.59E-02	3.20E-02	6.02E-02	4.08E-02	1.75E-02	5.45E-02	9.61E-02	5.52E-02	3.29E-02	3.29E-02
I135	1.71E-03	7.47E-03	5.25E-04	6.10E-03	5.17E-03	8.12E-03	6.86E-03	2.46E-03	7.98E-03	3.08E-03	5.01E-03	4.82E-03	9.94E-03
CS136	5.86E-03	2.18E-02	1.93E-03	2.00E-02	1.80E-02	2.40E-02	2.19E-02	8.45E-03	3.21E-02	2.00E-05	1.08E-02	4.15E-02	4.10E-02
CS137	5.61E-02	2.10E-01	1.68E-02	1.79E-01	1.61E-01	2.40E-01	2.14E-01	7.79E-02	3.03E-01	1.80E-04	1.21E-01	4.16E-02	4.10E-02
BA140	3.21E-02	4.60E-02	1.65E-01	1.12E-02	2.17E-02	1.84E-02	8.76E-02	4.52E-02	7.87E-02	3.06E-05	1.36E-02	3.20E-01	3.44E-01
CE143	2.21E-04	1.21E-03	4.21E-02	1.13E-03	7.95E-04	2.23E-04	1.08E-02	9.21E-04	1.03E-03	2.03E-08	6.57E-03	5.87E-03	4.89E-02
CE144	2.46E-04	8.93E-05	3.35E-02	2.12E-04	1.10E-04	5.32E-05	5.01E-04	2.27E-04	9.62E-05	1.38E-07	3.04E-03	5.87E-03	4.19E-03
ND147	2.25E-04	9.78E-04	4.93E-02	8.49E-04	6.01E-04	1.51E-04	9.83E-03	9.54E-04	9.82E-04	1.32E-08	2.08E-03	2.96E-04	2.56E-04

LRA-6

LITIGANT:

EVENT: HARRY

RESIDENCE: ST. GEORGE

AGE GROUP: CHILD

DIAGNOSIS: THYROID CANCER

THYROID DOSE: 36 RAD

Percent of total dose

	LLI	Red Marrow	Thyroid
Np-239	25.7		
Sr-89	15.8	40.5	
Sr-90		21.9	
Sr-91	2.2		
Y-93	5.3		
Zr-97	10.3		
Mo-99	2.1	4.4	
Ru-103	1.7		
Ru-106	3.4	1.5	
I-131		8.8	88.3
Te-132	1.4	5.0	1.7
I-133		1.8	9.6
Cs-137	1.7	7.8	
Ba-140	16.5	4.5	
Ce-143	4.2		
Ce-144	3.4		
Nd-147	4.9		

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LRA-7

LITIGANT: AGE GROUP: CHILD
EVENT: ALL (6 OF 31)   DIAGNOSIS: THYROID CANCER
RESIDENCE: ST. GEORGE   THYROID DOSE: 40 RAD

Percent of total dose

	LLI	Red Marrow	Thyroid
Np-239	24.4		
Sr-89	15.8	40.5	
Sr-90		21.8	
Sr-91	2.1		
Y-93	5.1		
Zr-97	10.0		
Mo-99	2.1	4.3	
Ru-103	1.9		
Ru-106	3.5	1.5	
I-131		8.7	88.5
Te-132	1.5	5.0	1.8
I-133		1.7	9.4
Cs-137	1.7	8.0	
Ba-140	17.5	4.7	
Ce-143	4.2		
Ce-144	3.4		
Nd-147	5.2		

LRA-8

PRIVACY ACT MATERIAL REMOVED

INTERNAL DOSE ESTIMATES VIA INGESTION FOR LITIGANTS (RADS)

ORGAN	UNCLE	TS-EASY	TS-FOX	ANNIE	NANCY	SIMON	HARRY	GRABLE	TESLA	TURK	HORNET	BEE
BON SURF	0.	0.	0.	6.61E-03	0.	1.16E-03	1.32E-01	0.	9.41E-04	0.	0.	0.
BREAST	0.	0.	0.	1.43E-03	0.	2.20E-04	3.56E-02	0.	3.20E-04	0.	0.	0.
LLI WALL	0.	0.	0.	1.94E-02	0.	2.16E-03	3.80E-01	0.	4.15E-03	0.	0.	0.
KIDNEYS	0.	0.	0.	1.80E-03	0.	2.54E-04	4.03E-02	0.	4.06E-04	0.	0.	0.
LIVER	0.	0.	0.	1.95E-03	0.	2.72E-04	4.40E-02	0.	4.46E-04	0.	0.	0.
LUNGS	0.	0.	0.	1.33E-03	0.	2.14E-04	3.24E-02	0.	3.03E-04	0.	0.	0.
R MARROW	0.	0.	0.	5.00E-03	0.	8.72E-04	1.01E-01	0.	7.40E-04	0.	0.	0.
TESTES	0.	0.	0.	1.46E-03	0.	2.01E-04	2.50E-02	0.	1.40E-04	0.	0.	0.
THYROID	0.	0.	0.	5.26E-01	0.	1.84E-01	4.07E+01	0.	1.49E-04	0.	0.	0.
TOTAL BODY	0.	0.	0.	2.65E-03	0.	4.01E-04	7.22E-02	0.	5.19E-04	0.	0.	0.
BLAD WAL	0.	0.	0.	1.32E-03	0.	1.91E-04	2.36E-02	0.	2.87E-04	0.	0.	0.

ORGAN	APPLE I	MET	APPLE II	ZUCCHINI	WILSON	PRISCILLA	HOOD	DIABLO	KEPLER	SHASTA	SMOKY	NEWTON
BON SURF	0.	0.	0.	2.06E-03	0.	0.	0.	0.	0.	0.	7.90E-03	0.
BREAST	0.	0.	0.	5.10E-04	0.	0.	0.	0.	0.	0.	2.79E-03	0.
LLI WALL	0.	0.	0.	4.06E-03	0.	0.	0.	0.	0.	0.	3.85E-02	0.
KIDNEYS	0.	0.	0.	5.96E-04	0.	0.	0.	0.	0.	0.	3.20E-03	0.
LIVER	0.	0.	0.	6.46E-04	0.	0.	0.	0.	0.	0.	3.43E-03	0.
LUNGS	0.	0.	0.	4.73E-04	0.	0.	0.	0.	0.	0.	2.48E-03	0.
R MARROW	0.	0.	0.	1.56E-03	0.	0.	0.	0.	0.	0.	6.17E-03	0.
TESTES	0.	0.	0.	3.70E-04	0.	0.	0.	0.	0.	0.	1.43E-03	0.
THYROID	0.	0.	0.	6.97E-01	0.	0.	0.	0.	0.	0.	5.00E+00	0.
TOTAL BODY	0.	0.	0.	1.07E-03	0.	0.	0.	0.	0.	0.	5.49E-03	0.
BLAD WAL	0.	0.	0.	3.47E-04	0.	0.	0.	0.	0.	0.	1.55E-03	0.

ORGAN	WHITNEY	MORGAN	OTERO	EDDY	SMALL BOY	PIKE	PIN STRIPE	TOTAL
BON SURF	0.	0.	0.	0.	0.	0.	0.	1.50E-01
BREAST	0.	0.	0.	0.	0.	0.	0.	4.89E-02
LLI WALL	0.	0.	0.	0.	0.	0.	0.	3.76E-01
KIDNEYS	0.	0.	0.	0.	0.	0.	0.	4.67E-02
LIVER	0.	0.	0.	0.	0.	0.	0.	5.07E-02
LUNGS	0.	0.	0.	0.	0.	0.	0.	3.72E-02
R MARROW	0.	0.	0.	0.	0.	0.	0.	1.15E-01
TESTES	0.	0.	0.	0.	0.	0.	0.	2.80E-02
THYROID	0.	0.	0.	0.	0.	0.	0.	5.53E+01
TOTAL BODY	0.	0.	0.	0.	0.	0.	0.	8.24E-02
BLAD WAL	0.	0.	0.	0.	0.	0.	0.	2.73E-02

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Dose via Ingestion

TOTAL DOSE IN RADS

NUCLIDE	BON SURF	BREAST	LLI WALL	KIDNEYS	LIVER	LUNGS	OVARIES	R MARROW	TESTES	THYROID	TOT BODY	UTERUS	BLAD WAL
NP239	1.21E-03	1.34E-04	8.73E-02	1.62E-04	4.32E-04	2.12E-06	1.26E-03	4.46E-04	1.03E-04	2.20E-06	4.41E-04	5.32E-04	3.67E-04
SR 89	6.83E-02	3.28E-03	9.57E-02	4.23E-03	4.23E-03	3.28E-03	4.23E-03	4.67E-02	4.23E-03	4.23E-03	1.29E-02	4.23E-03	4.23E-03
SR 90	3.86E-02	3.50E-04	2.51E-03	5.25E-04	5.31E-04	3.50E-04	5.25E-04	2.80E-02	5.25E-04	5.25E-04	8.86E-03	5.25E-04	5.25E-04
SR 91	2.20E-04	1.39E-04	5.74E-03	1.64E-04	1.17E-04	8.48E-05	3.11E-04	3.00E-04	1.08E-04	8.70E-05	4.00E-04	3.36E-04	8.25E-04
Y 93	0.	0.	1.38E-02	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.14E-04
ZR 97	7.00E-05	1.25E-04	2.76E-02	1.69E-04	1.23E-04	2.72E-06	9.87E-04	2.00E-04	8.02E-05	4.10E-06	2.99E-04	4.35E-04	2.72E-04
MO 99	6.02E-03	1.64E-03	1.10E-02	2.11E-02	2.36E-02	1.73E-03	2.52E-03	4.17E-03	1.95E-03	2.22E-03	2.41E-03	2.31E-03	2.15E-03
RU103	2.76E-04	3.48E-04	6.35E-03	3.79E-04	3.52E-04	2.11E-04	5.56E-04	4.79E-04	3.53E-04	1.81E-04	6.15E-04	2.59E-04	2.15E-04
RH105	1.55E-05	6.44E-06	1.89E-03	7.03E-06	5.59E-06	8.07E-07	3.65E-05	9.51E-06	4.83E-06	6.66E-06	1.70E-05	1.59E-05	8.72E-06
RU106	1.20E-03	1.21E-03	1.49E-02	9.53E-04	1.21E-03	1.19E-03	1.38E-03	1.22E-03	1.21E-03	1.18E-03	1.68E-03	1.27E-03	1.26E-03
I131	1.10E-02	1.64E-02	1.92E-03	1.98E-03	2.27E-03	1.38E-02	1.84E-03	1.28E-02	1.70E-03	5.00E+01	3.49E-02	1.94E-03	1.84E-03
TE132	5.95E-03	2.53E-03	5.44E-03	2.05E-03	2.09E-03	2.36E-03	3.91E-03	3.21E-03	2.62E-03	4.28E-01	2.39E-03	6.63E-04	6.04E-04
I133	2.07E-03	2.42E-03	1.98E-03	2.03E-03	2.00E-03	2.34E-03	1.82E-03	2.19E-03	1.65E-03	4.69E+00	3.84E-03	1.91E-03	1.88E-03
I135	2.37E-04	2.71E-04	2.77E-04	2.87E-04	2.69E-04	2.64E-04	2.64E-04	2.57E-04	2.25E-04	1.26E-01	3.55E-04	2.71E-04	2.50E-04
CS136	1.00E-03	1.03E-03	1.31E-03	1.22E-03	1.21E-03	1.01E-03	1.05E-03	1.14E-03	1.17E-03	1.06E-03	9.93E-04	1.48E-03	1.33E-03
CS137	1.00E-02	9.88E-03	1.15E-02	1.09E-02	1.08E-02	1.01E-02	1.03E-02	1.05E-02	1.11E-02	1.00E-02	1.12E-02	1.15E-02	1.12E-02
BA140	3.08E-03	1.16E-03	6.59E-02	4.00E-04	7.95E-04	4.16E-04	2.46E-03	3.27E-03	1.55E-03	8.69E-04	7.31E-04	1.19E-03	9.33E-04
CE143	1.09E-05	2.43E-05	1.22E-02	2.93E-05	2.28E-05	4.00E-06	2.22E-04	5.30E-05	1.60E-05	4.56E-07	2.57E-04	8.94E-05	5.63E-05
CE144	2.60E-05	2.47E-06	1.35E-02	7.31E-06	4.17E-04	1.32E-06	1.42E-05	1.81E-05	2.07E-06	4.09E-06	1.64E-04	6.22E-06	4.93E-06
ND147	1.07E-05	2.14E-05	1.56E-02	2.41E-05	1.88E-05	2.95E-06	2.19E-04	5.99E-05	1.67E-05	3.24E-07	8.89E-05	8.36E-05	2.02E-05
TOTAL	1.50E-01	4.09E-02	3.76E-01	4.67E-02	5.07E-02	3.72E-02	3.38E-02	1.15E-01	2.88E-02	5.53E+01	8.24E-02	2.90E-02	2.73E-02

FRACTION OF TOTAL

NUCLIDE	BON SURF	BREAST	LLI WALL	KIDNEYS	LIVER	LUNGS	OVARIES	R MARROW	TESTES	THYROID	TOT BODY	UTERUS	BLAD WAL
NP239	8.04E-03	3.27E-03	1.79E-01	3.47E-03	8.52E-03	5.70E-04	3.73E-02	3.88E-03	3.57E-03	3.97E-08	5.35E-03	1.83E-02	1.34E-02
SR 89	4.55E-01	8.02E-02	2.54E-01	9.00E-02	8.35E-02	8.81E-02	1.25E-01	4.06E-01	1.47E-01	7.66E-05	1.56E-01	1.46E-01	1.55E-01
SR 90	2.57E-01	8.55E-03	6.66E-03	1.12E-02	1.05E-02	9.39E-03	1.55E-02	2.43E-01	1.82E-02	9.50E-06	1.08E-01	1.46E-01	1.55E-01
SR 91	1.46E-03	3.39E-03	1.52E-02	3.96E-03	2.31E-03	2.28E-03	9.18E-03	2.61E-03	3.76E-03	1.21E-06	4.86E-03	1.16E-02	4.16E-03
Y 93	0.	0.	3.68E-02	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ZR 97	4.66E-04	3.06E-03	7.33E-02	3.63E-03	2.42E-03	7.29E-04	2.83E-02	1.74E-03	2.78E-03	7.41E-08	3.63E-03	1.50E-02	9.95E-03
MO 99	4.01E-02	4.00E-02	2.92E-02	4.52E-01	4.69E-01	4.64E-02	7.43E-02	3.63E-02	6.77E-02	4.02E-05	2.92E-02	7.96E-02	7.87E-02
RU103	1.85E-03	8.50E-03	1.69E-02	8.12E-03	6.93E-03	5.67E-03	1.64E-02	4.17E-03	1.23E-02	3.27E-06	7.46E-03	8.92E-03	7.87E-03
RH105	1.02E-04	1.57E-04	5.02E-03	1.61E-04	1.10E-04	2.17E-05	9.65E-04	1.08E-04	1.68E-04	1.21E-07	2.07E-04	5.48E-04	3.20E-04
RU106	7.97E-03	2.95E-02	3.95E-02	2.04E-02	2.38E-02	3.20E-02	4.07E-02	1.07E-02	4.21E-02	2.14E-05	2.04E-02	4.39E-02	4.61E-02
I131	7.85E-02	4.00E-01	5.09E-03	4.25E-02	4.48E-02	3.71E-01	5.43E-02	1.11E-01	5.91E-02	9.05E-01	4.23E-01	6.67E-02	6.76E-02
TE132	3.98E-02	6.18E-02	1.45E-02	4.39E-02	4.11E-02	6.40E-02	1.16E-01	2.79E-02	9.10E-02	7.75E-03	2.90E-02	2.28E-02	2.21E-02
I133	1.38E-02	5.91E-02	5.27E-03	4.36E-02	3.95E-02	6.29E-02	5.38E-02	1.91E-02	5.42E-02	8.49E-02	4.65E-02	6.59E-02	6.86E-02
I135	1.58E-03	6.63E-03	7.35E-04	6.15E-03	5.30E-03	7.09E-03	7.81E-03	2.24E-03	7.82E-03	2.27E-03	4.31E-03	9.35E-03	9.16E-03
CS136	6.97E-03	2.51E-02	3.48E-03	2.61E-02	2.39E-02	2.71E-02	3.10E-02	9.92E-03	4.07E-02	1.91E-05	1.20E-02	5.11E-02	4.89E-02
CS137	6.69E-02	2.41E-01	3.05E-02	2.34E-01	2.14E-01	2.72E-01	3.04E-01	9.16E-02	3.85E-01	1.82E-04	1.36E-01	3.95E-01	4.11E-01
BA140	2.05E-02	2.84E-02	1.75E-01	8.57E-03	1.57E-02	1.12E-02	7.27E-02	2.84E-02	5.37E-02	1.57E-05	8.87E-03	4.11E-02	3.42E-02
CE143	1.12E-04	5.93E-04	3.25E-02	6.27E-04	4.50E-04	1.07E-04	6.56E-03	4.61E-04	5.56E-04	8.26E-09	3.12E-03	3.08E-03	2.13E-03
CE144	1.73E-04	6.05E-05	3.58E-02	1.57E-04	8.22E-03	3.54E-05	4.18E-04	1.57E-04	7.19E-05	7.40E-08	2.00E-03	2.14E-04	1.81E-04
ND147	1.25E-04	5.23E-04	4.15E-02	5.16E-04	3.71E-04	7.93E-05	6.48E-03	5.21E-04	5.79E-04	5.87E-09	1.08E-03	2.88E-03	7.41E-04

LRA-10

LITIGANT: _____ AGE GROUP: CHILD

EVENT: ALL (6 OF 31) DIAGNOSIS: LEUKEMIA

RESIDENCE: WASHINGTON R MARROW DOSE: 120 mrad

Percent of total dose

	LLI	Red Marrow	Thyroid
Np-239	17.9		
Sr-89	25.4	40.6	
Sr-90		24.3	
Sr-91	1.5		
Y-93	3.7		
Zr-97	7.3		
Mo-99	2.9	3.8	
Ru-103	1.7		
Ru-106	4.0	1.1	
I-131		11.1	90.5
Te-132	1.5	2.8	
I-133		1.9	8.5
Cs-137	3.1	9.2	
Ba-140	17.5	2.8	
Ce-143	3.3		
Ce-144	3.6		
Nd-147	4.2		

IN UTERO EXPOSURES

Litigant	Birthdate	Residence	Event	Event date
	'52	Cedar City	TS-FOX	5/25/52
	'53	Cedar City	HARRY	5/17/53
	'55	St. George	ZUCCHINI	5/15/55

30

LRA-12

FETAL DOSES (RAD)

Litigant	Thyroid	Total body (and other organs)
	<0.08	0.0003 - 0.0004
	<0.5	0.002 - 0.003
	<0.2	0.001

31

CONCENTRATION OF IODINE BY HUMAN EXTRATHYROIDAL
IODIDE CONCENTRATING (ETIC) TISSUES

Fluid-to-plasma ratio

	Average	Range	Reference
Saliva	48	12 - 211	Honour (1952)
	63	42 - 101	Jaimet et al. (1956)
	48 (est.)	10 - 85	Schiff et al. (1947)
Gastric juice	33	15 - 84	Honour (1952)
Milk	24	11 - 36	Honour (1952)
	28		Miller & Weetch (1955)

- **Half life in ECF (ICRP-10)**

  T_{B1} = 0.35d

  T_{E1} = 0.335d λ_{E1} = 2.07d^{-1}

- **Time integral of concentrations**

  ECF

  TI   = $0.7/(2.7 \times 10^4 ml \times 2.07 d^{-1})$

      = $1.25 \times 10^{-5} d/ml$

  Fluids concentrated from ECF, and ETIC tissues

  TI   = 1.25×10^{-5} R d/ml or d/g

  R   = fluid-to-plasma ratio

- **Dose factor for ETIC tissues**

  DF   = 1.25×10^{-5} R d/g $\times$ 0.2 MeV

      $\times$ 51.2 rad per (μCi-d/g)-MeV

      = 1.3×10^{-4} R rad/μCi

33

ESTIMATION OF I-131 DOSE TO LACTATING BREAST

- **Recovery in milk**

    0.03 - 26.8% (Weaver and Dobson, 1960)

    ≤10% (Chiba and Ichikawa, 1968)

- **Transfer coefficient and time integral**

    f_M = 0.1 d/l

    TI = 10^{-4} d/ml

- **Assume equivalence of time integrals**

    TI = 10^{-4} d/g

- **Dose factor**

    DF = 10^{-4} d/g × 0.2 MeV × 51.2 rad per (μCi-d/g)-MeV

    = 1.0 × 10^{-3} rad/μCi

LRA-16

COMPARISON OF ADULT DOSE FACTORS FOR I-131

DF, rad/μCi

	LLNL	MIRD	ICRP-30
Thyroid	1.9	1.3	1.8
Breast	4.5(-4)		4.5(-4)
Lactating breast	1(-3)		
	3(-3)		
Salivary	7(-3)		
Stomach	4(-3)	1.4(-3)	1.1(-3)
Thymus			1.1(-3)
Total body	9.6(-4)	7.1(-4)	9.1(-4)

Note: 1(-3) signifies 1×10^{-3}

35

LRA-17

ESTIMATED DOSE TO HYPOTHETICAL ADULT FEMALE FROM I-131 IN ETIC TISSUES

Total dose, rad

	Calculated value	From ETIC tissues
Breast	0.024	0.012
LLI wall	0.54	
Liver	0.035	
R marrow	0.066	
Salivary		0.029
Thyroid	9.9	
Total body	0.041	

1   DR. ANSPAUGH: Could I have the first viewgraph? (LRA-19). This is

2 just to reemphasize what Dr. Ng mentioned about the calculation of the dose

3 from ingestion, which was the subject of his presentation.

4   It's basically the multiplication of these four terms, and the next

5 thing that was to be considered was the estimate of uncertainty; and

6 speaking specifically about the litigants, we were in a position at the

7 time that we made the calculations for the litigants of not having the

8 input from Dr. Whicker's model in terms of his estimate of uncertainty. So

9 we estimated the uncertainty in these estimates based upon a somewhat

10 different approach. That's shown in the next viewgraph.

11   (LRA-20). We made the assumption, which is quite reasonably justified

12 on the basis of other studies reported in the literature, that all of these

13 factors were lognormally distributed; and we estimated their dispersion, or

14 their geometric standard deviation, as shown on this slide. Now the

15 measurements of mR/hr, 1.5 is a reasonable, fairly conservative number of

16 the actual calculated geometric standard deviations that we got from the

17 DRI folks when they looked at locations which had more than one

18 d/measurement of mR/hr at a particular location. This is our source term

19 number. For the purposes of this calculation at the time, we assumed that

20 that number was exactly known. In other words, that we did, in fact, know

21 how to calculate exactly the deposition of a particular radionuclide per

22 unit of external exposure rate. Now that is not quite true. As we go

23 through in a little more sophisticated method, we will examine the actual

24 variations in that term.

25   Now this is the one that really drives the uncertainty, the transport

26 through the food chain. On the basis of some work done by people at Oak

27 Ridge, Hoffman and Baes in particular, they looked at radioiodine transport

28 through a food chain, through the cow milk food chain. Their estimate of

37

1 the geometric standard deviation was essentially 2.0. So that we assume

2 then that all radionuclides behaved in that kind of manner in terms of

3 their dispersion. Now you may recall from the results that the Colorado

4 State group presented yesterday, this turns out to be quite well confirmed

5 by their numbers. As I recall their actual calculations of geometric

6 standard deviations varied from 1.5 to 2.0. The variation in the dose

7 factor -- this again comes from studies at Oak Ridge where they have

8 carefully examined the data available for radioiodine in particular, and

9 also for Cesium-137, and this takes into account variations in uptake

10 factors, biological turnover rates, size of the organ, and so forth. Their

11 data indicate that 1.8 is the geometric standard deviation for that factor.

12 These are all summed up, according to this expression. We take the

13 logarithm of this number, since it is the logarithms that are normally

14 distributed, sum them up in the usual way, take the square root and

15 exponentiate it. So that our overall estimated geometric standard

16 deviation for these calculations of dose from ingestion is 2.7. Then if we

17 want to calculate an arithmetic mean, or look at the relationship between

18 arithmetic and geometric means, we can do so with this calculation. For

19 this particular geometric standard deviation, the arithmetic mean is 1.6

20 times the geometric mean. So that is the process that we used for the

21 calculations for the litigants to estimate the uncertainty in the absence

22 of the dispersion of the results from our own models.

23 Moving on to the next viewgraph (LRA-21), we look at the calculations

24 of the dose from inhalation. We did do this for the litigants in some

25 detail, as I will indicate later on. This is our standard method of the

26 calculation. This is a measured air concentration. All results that we

27 calculated were based upon measured air concentrations, perhaps at a

28 location in the nearest town as opposed to that town; but, nevertheless,

1 they were based upon measured air concentrations. That measurement gives

2 you a total $\mu Ci/m^3$. Then you multiply by the length of the sampling in

3 hours; multiply by a breathing rate which is age specific, of course. Then

4 we want to calculate for a particular radionuclide. We go back to Harry

5 Hicks' source term calculations. For any radionuclide, we can look at the

6 ratio of that radionuclide to the total activity; then that multiplied by

7 this, of course, then gives us the activity of a particular radionuclide;

8 and then, again, our dose factor. Again it depends on human metabolism and

9 is an age specific number.

10 Well, the key thing here is then this measured air concentrations, and

11 the next viewgraph (LRA-22) we've gone through before. Our preference is

12 to use data collected by this device, which is a Casella cascade impactor.

13 It has four stages followed by an after-filter so that we typically were

14 able to recover data as shown in the next viewgraph (LRA-23) where we have

15 the raw log sheets from Los Alamos now where we have the count data for

16 each one of these five stages. We have actually gone back to this original

17 data to make our calculations.

18 Now the problem with this data, or one problem with this data, is that

19 what is shown here in terms of the diameters is not an aerodynamic diameter

20 that we want to enter the ICRP lung dynamics model with; so we have gone

21 through and recalculated these diameters.

22 If I could have the next viewgraph (LRA-24). This is again some of

23 the raw data that we find in the files from Los Alamos. This is their

24 original trace of the activity and their attempt to fit. This one was

25 calculated out to have a median diameter of 42 microns. We have found some

26 errors in their calculation. It makes slight corrections. It has a

27 dramatic change on some of these numbers. We get our calculation of 18.

28 But, nevertheless, as I indicated, we have found more accurate calibration

1 data for these cascade impactors in terms of aerodynamic diameter.

2 As shown on the next viewgraph (LRA-25), this represents our current

3 calculations of diameters from the Casella cascade impactor data. Now one

4 of the problems again with this data, is that these three points are the

5 only ones that are valid where this cascade impactor was actually sizing

6 data. If we extrapolate this line 'way up here someplace to get to the 50

7 percent level, we are extrapolating well beyond the range where this

8 cascade impactor was actually sizing. That's because, if we do this

9 extrapolation, we calculate very large aerodynamic diameters, so this

10 presents somewhat of a problem in terms of how do we use this data? These

11 diameters, of course, are way too large to enter the lung dynamics model of

12 the ICRP; so we have chosen to avoid that problem by taking this data

13 apart. We treat it as though it were five individual samples, and then we

14 use the data with an associated particle size for each one of these stages,

15 plus the backup filter in the individual front end of this thing, so that

16 we have broken it apart basically into five different samples.

17 The next viewgraph (LRA-26). We have significantly changed our

18 inhalation calculations from the last time they were presented, in the

19 sense that before we only made these calculations for the lung. As we

20 prepared for this case (litigation), we felt that we must, in

21 order for completeness, do these calculations for the other organs; so we

22 have added all of these other organs. The semicolon represents a

23 difference in sex. We calculate for ovaries and uterus for females and

24 testes for males. So that we have done those calculations for those

25 organs; and in order to make sure that we had the appropriate radionuclides

26 for all of these additional organs, we did add several new radionuclides:

27 Strontium to look at bone marrow dose, and mainly these, to make sure that

28 we had the refractory elements that might be of some interest in terms of

1   the dose to the gastrointestinal tract.

2   Now the next viewgraph (LRA-27) is a list of all of the other radio-

3   nuclides that we had previously considered for the lung only, and these are

4   arranged in order of decreasing dose commitment.   Plutonium-239 is essen-

5   tially a trivial dose to the lung, and we've only done a few calculations

6   for it for completeness.   This gives us a total of 46 radionuclides that we

7   have considered in these calculations, not counting plutonium.

8   The next viewgraph (LRA-28) indicates an ordered procedure that we

9   followed for these calculations in terms of where we get the air concentra-

10 tion data.   We have always used the cascade impactor data where it was

11 available as our first choice, mainly because of the important input that

12 gives us in terms of particle size and thus entry into the lung dynamics

13 model.   Now if we don't have a cascade impactor data, and you may recall

14 that after TEAPOT there were no cascade impactor measurements generally

15 made and reported in the literature, so from PLUMBBOB on all we have is the

16 high volume sampler data.   In that case what we have typically done is to

17 assume that the activity median aerodynamic diameter was 10 micrometers,

18 which is probably quite a conservative assumption, at least in terms of a

19 lung dose; perhaps not in terms of doses to internal organs.

20   Now if we have neither of these kinds of data available, what we have

21 done is to use data from the closest town that did have such data, and

22 we've simply ratioed the activity measured there according to the mR/hr at

23 the two different locations.

24   So the next viewgraph (LRA-29) indicates again what we've done.   Where

25 particle size data are available, this is no longer really proposed, this

26 is what we did particularly for the litigants.   If we ever found a diameter

27 less than 20 micrometers, we would use the ICRP lung model directly in

28 terms of entering it.   This has never been the case where we have an aero-

1 dynamic diameter of less than 20 micrometers as measured by a cascade

2 impactor. So what we have always done is to separate the data by stage and

3 essentially calculate as though we had five separate measurements of air

4 concentration with five different particle size distributions. These are

5 the particle sizing parameters that are actually measured for this cascade

6 impactor and reported by Lippman.

7   Okay, the next viewgraph (LRA-30) is just an indication of the status

8 of our individual dose assessment model. It is not completely general at

9 this time. That's for several reasons, the most notable of which is that

10 we don't have all of the air quality data coded and calculated. This is

11 partly a problem of digging that data out of the Los Alamos original notes

12 and going through the rather laborious hand calculations coming up with

13 those data; so that we are still in the process of doing that. In this

14 picking of a reference location, if we don't have a measured air concentra-

15 tion, we are still doing that by hand at the present time, and probably

16 will continue to do that by hand until we have worked our way through all

17 of the locations for the significant shots.

18   The next viewgraph (LRA-31) indicates the results of these calcula-

19 tions. This is done for ‾‾‾‾‾ ‾ as an example, for shot HARRY. It

20 gives the results of the different organs across the top by radionuclide.

21 Just as an example, looking at the thyroid dose for shot HARRY, this indi-

22 cates 2.5 rads. The important radionuclides, as shown here, are

23 iodine-135, iodine-133, tellurium-132, and iodine-131 as an indication of

24 the somewhat difference in importance of radionuclides as evidenced by the

25 more prominence of the short-lived radionuclides. The lower large

26 intestinal wall is the next most significant dose by inhalation here, as

27 indicated, and the most important radionuclide is the Neptunium-239, and

28 there are several other radionuclides of less significant importance.

1   This is again the dose via inhalation only, and this compares to a

2 calculation of about 40 rads via ingestion.

3   These results I have for all the litigants, if you're interested in

4 them. They have not been handed out. The material gets to be very

5 voluminous considering each individual radionuclide in each event for each

6 individual.

7   The next viewgraph (LRA-32) is the summary of these doses, which has

8 been handed out for each litigant. Again this is our numbers for shot

9 HARRY for   : the numbers that were on the previous

10 viewgraph; and you see it summed up here now for the total events of 2.9

11 rads to the thyroid and 0.41 rads to the lower large intestine.

12   The next viewgraph (LRA-33). The next problem in terms of providing

13 doses for the litigants was to add up all these doses that we've been

14 talking about from the external pathway, the ingestion pathway, the

15 inhalation pathway, and also to deal with the doses from in utero exposure.

16 There were some problems in achieving that summation, because as it turned

17 out, the groups had provided different kinds of data. The Los Alamos

18 calculations provided us with geometric means and doses at the 1%, 10%,

19 90%, and 99% probability levels from which one can, of course, extract a

20 geometric standard deviation.

21   We, on the other hand, have provided an arithmetic mean and have

22 estimated a geometric standard deviation. We have, I should mention,

23 assumed that the geometric standard deviation for the dose from inhalation

24 was the same as it is for the dose from ingestion.

25   So how do we deal with these different kinds of distributions, and so

26 forth? The next viewgraph (LRA-34) shows how we did this. We have summed

27 the arithmetic means, and where we had a geometric mean we can calculate an

28 arithmetic mean. We have assumed that the one thing you can do when you

43

1 are summing distributions reliably, is to sum the arithmetic means, and

2 also, no matter what the distribution is, that you can sum the variances;

3 that the variance of the sum is equal to the sum of the individual

4 variances. Once we have done that, we then have an arithmetic mean and an

5 arithmetic standard deviation. If we know that we can, indeed, calculate

6 back to a geometric mean and a geometric standard deviation to provide a

7 distribution of values.

8 The next viewgraph (LRA-35) shows the relationships between all of

9 these parameters. We've already seen that one. This is how we calculate

10 an arithmetic standard deviation where a variance is shown here, if we know

11 the geometric standard deviation and also the geometric mean. And these

12 two show how, if we know an arithmetic mean, or an arithmetic standard

13 deviation, how we can calculate the geometric mean and the geometric

14 standard deviation. These results, by the way, are taken from a paper by

15 Dunning and Schwarz (published) in Health Physics.

16 Well, the next four viewgraphs (LRA-36, -37, -38, -39) show the

17 results of doing all of these calculations. (LRA-36) ___ was an

18 individual who had melanoma. For his case we are looking now at the beta

19 dose on the skin directly from the Los Alamos calculations. This indicates

20 the probability distribution. The most likely dose is 310 rads. We are 90

21 percent confident that his dose was equal to or less than 590 rads, and so

22 forth.

23 The next viewgraph (LRA-37), the doses for _   , he had

24 Hodgkin's disease. We have assumed that the organ of interest is the whole

25 body. This indicates now that -- in his case we have an in utero exposure,

26 and this is not the one that Yook Ng calculated, but this is largely

27 in utero exposure from external dose. This comes from Los Alamos. We see

28 a fairly typical result that the dose from ingestion is much smaller, say,

1 for total body. The dose from inhalation is much smaller yet. Then we

2 have this summing up.

3 The next viewgraph (LRA-38) is for ___   - from St. George,

4 I believe. Leukemia. Calculations to the bone marrow, again dominated by

5 the external dose followed by ingestion and then inhalation.

6 Then finally the dose to   ; (LRA-39). Thyroid cancer.

7 Dose to the thyroid. In this case we have a dominance of the dose from

8 ingestion; a much smaller dose from inhalation, but the inhalation in this

9 case is about equal to the dose via the external pathway. And our summa-

10 tion then is a most likely dose of 31 rads; a probability of 99% that the

11 dose is equal to or less than 252 rads. Those are four of the 26 that were

12 calculated among the litigants. Those results have also been handed out to

13 you.

14 Let me just conclude with the next viewgraph (LRA-40) which is some-

15 thing that's on quite a little bit different subject, but it is something

16 that we did present to the court as one of the validation studies that we

17 did in looking at the validity of the external dose calculations done by

18 Los Alamos. Now the basic data here is something that I've showed you

19 before in terms of an accumulative probability distribution. The lawyers

20 didn't like that kind of accumulative lognormal plot, so we redid this in

21 terms of a histogram of the measurements of external exposure at

22 St. George, Utah, during PLUMBBOB. There were 33 individuals who

23 essentially wore a badge during the PLUMBBOB series, and this is the

24 distribution of the exposures on those film badges with a geometric mean of

25 150 R, and then an arithmetic mean of 190 R.

26 The Test Manager's Committee -- pardon me?

27 DR. McCLELLAN: mR.

28 DR. ANSPAUGH: mR. I'm sorry. The Test Manager's Committee number

1 was, as I recall, something like 700 mR as estimated here, and you can see

2 that is quite a conservative estimate in general for St. George for

3 PLUMBBOB.   These are the calculations that were actually done for the

4 litigants by Los Alamos.   There were seven individuals who were in

5 St. George and were the litigants.   Now none of the litigants themselves

6 had film badges as it turned out, but the calculations that Los Alamos did,

7 did fit very nicely within this overall distribution of the actual

8 measurements that were recorded by film badges at St. George. So that this

9 was another example of the validation studies that we did do and did

10 present to the court.

11   Any questions?

12   CHAIRMAN MOSELEY: Questions for Dr. Anspaugh?

13   DR. McCLELLAN: I have a couple. Going back into Yook Ng's, it wasn't

14 clear to me why we identified a surrogate mother for the three individuals,

15 and it seems to me you really took pains almost to not identify a typical

16 surrogate mother, but you took an extreme.

17   DR. ANSPAUGH: Well, as I recall -- Yook may want to say that -- the

18 surrogate was taken as a person who was, in fact, there at the same

19 location at the same time. We did not have the data for the actual mother

20 in order to make these calculations in a proper lifestyle manner; so that

21 in the lack of that particular kind of data, the choice was made to look at

22 the individual females who were at that location at that time, and to use

23 essentially in this case the highest one.   That mainly was because we

24 didn't have any better data.   In that particular case it didn't make a

25 whole lot of difference because the in utero doses were quite small from

26 the internal pathway.   They were certainly dominated by the external

27 pathway.

28   DR. McCLELLAN: Was an attempt made to reconstruct the dose to the

46

1   actual mother from the external?

2   DR. ANSPAUGH: Not to the actual mother. Am I wrong on that, Dick?

3   MR. HENDERSON: Richard Henderson from Los Alamos.   As you pointed

4   out, we had no information regarding the actual mother, and we picked --

5   since we are not as closely tied to location, we took a lifestyle that was

6   described by one of the litigants as being typical of a mother at that time

7   and used that kind of information, what her habits were as far as being

8   inside and outside the house. We did use the house that was described by

9   the litigant. We did not go back and say that was the litigant's mother,

10 per se. We also have a surrogate.

11   DR. McCLELLAN: I was wondering in terms of on the cascade impactor

12 data, roughly how many of those data sets do you have that you have worked

13 through already, and how many are potentially available?

14   DR. ANSPAUGH: Well, I really can't give you a hard number, but on the

15 Operations TUMBLER/SNAPPER, UPSHOT/KNOTHOLE, and TEAPOT, there are probably

16 as many of those measurements as there are high volume samplers. I would

17 estimate there is something like 10-12 locations that actually had these

18 cascade impactors per event for those series.

19   DR. McCLELLAN: Were they deployed with a high vol at the same site in

20 each case?

21   DR. ANSPAUGH: I think in almost all cases if there was a cascade

22 impactor, there was a high volume sampler, and I have presented some

23 comparisons between the two data. They track surprisingly well.

24   DR. McCLELLAN: What further have you done on that front in terms

25 of --

26   DR. ANSPAUGH: How well they track?

27   DR. McCLELLAN: Yes, have you done any further --

28   DR. ANSPAUGH: I haven't done anything more than what I have

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1 presented. I think I presented two direct comparisons. One was at Lincoln

2 Mine for shot NANCY from the sheep. Then I also presented the data for

3 shot HARRY at St. George. In those two cases they track amazingly well.

4   CHAIRMAN MOSELEY: Other questions of Dr. Anspaugh?

5   DR. CALDWELL: When you did the thyroid, you took into account the

6 size of the thyroid in the child, right? Difference in size in a child

7 from an adult?

8   DR. ANSPAUGH: We age corrected that in the general manner. Of

9 course, we have no exact data for a particular individual. All of these

10 calculations are done in an age adjusted manner for the ingestion and

11 inhalation, which includes the size of the thyroid.

12   DR. CALDWELL: I thought that's what you did before, but I just

13 couldn't remember.

14   CHAIRMAN MOSELEY: Thanks, sir.

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CALCULATION OF DOSE FROM INGESTION

mR/hr at H+12   Measurement

$\times$

$$\frac{\mu Ci/m^2}{mR/hr \text{ at } H+12}$$ Source-term calculation

$\times$

$$\frac{\mu Ci}{\mu Ci/m^2}$$ Pathway model food → man

$\times$

$$\frac{rad}{\mu Ci}$$ Human-metabolism model
Age-specific adjustment

$$\frac{mR}{h} \quad \times \quad \frac{\mu Ci/m^2}{mR/h} \quad \times \quad \frac{\mu Ci}{\mu Ci/m^2} \quad \times \quad \frac{rad}{\mu Ci}$$

$$\sigma_g = \quad 1.5 \qquad\qquad 1.0 \qquad\qquad 2.0 \qquad\qquad 1.8$$

$$\exp\sqrt{\sum(\ln\sigma_g)^2} = 2.7$$

$$\bar{x} = \bar{x}_g \exp((\ln\sigma_g)^2/2) = \bar{x}_g \cdot 1.6$$

$$\frac{\mu Ci_T}{m^3}$$ Measured air concentration

$$\times$$

$$hr$$ Length of sampling time

$$\times$$

$$\frac{m^3}{hr}$$ Breathing rate

$$\times$$

$$\frac{\mu Ci}{\mu Ci_T}$$ Radionuclide-specific source term

$$\times$$

$$\frac{rad}{\mu Ci}$$ Human-metabolism model

    Age-specific adjustment

SLIP FIT GLUED

FILTER

TO PUMP

REVERSE DIRECTION OF
LAST STAGE HOLDER
ON CASELLA IMPACTOR

52
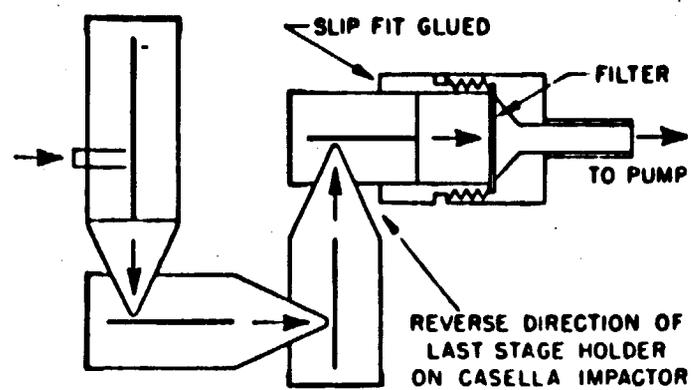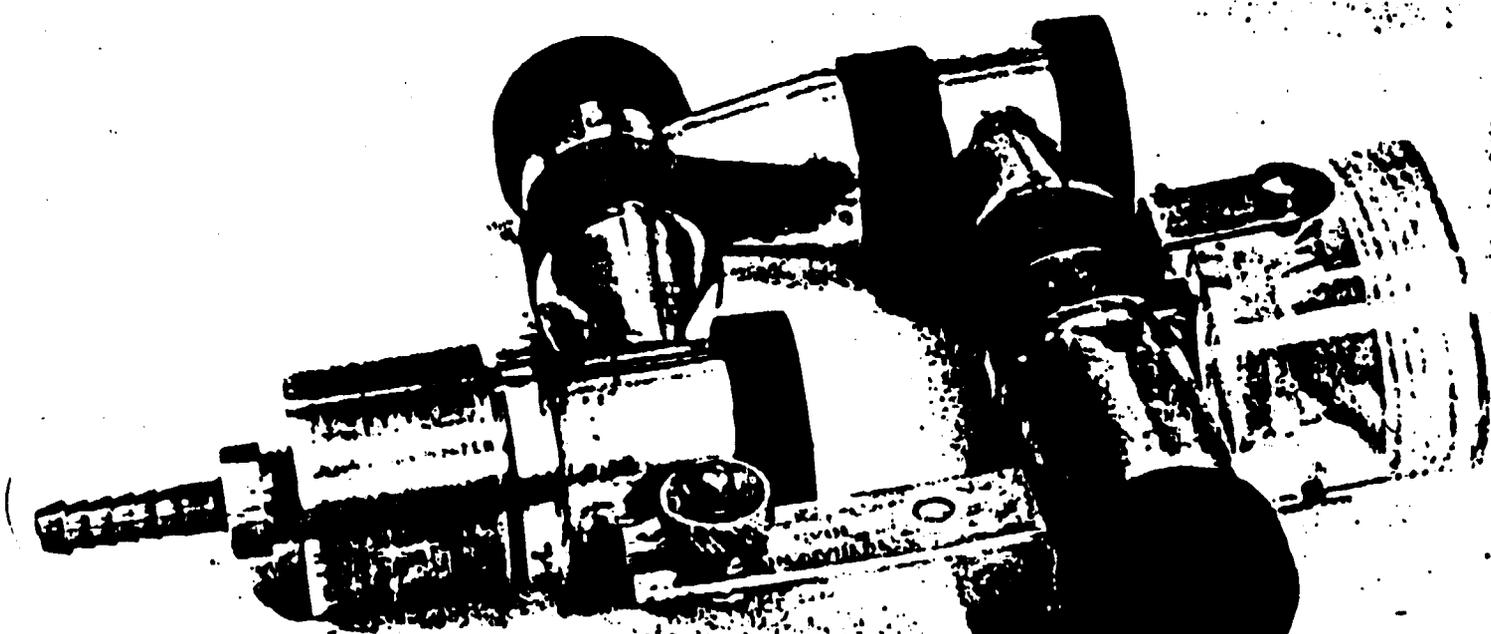
SOURCE: LASL, ENCY. INSTR. INDUST. HYG., U. MICHIGAN, ANN ARBOR (1956) P. 143

LRA-22

Sta.	Grain	Size Class (mm)	Wet Wt. Count	% of Total	Cumulative %	Recovery Median	Particle Size Med. Median	Particle Size Std. Mean	Act. Act.	
IX-C1-SG-1 Collected 06:10-7/11/30 S/11/53	5	605,412	0.1	0.1	0.45					
	4	27,941	4.0	3.7	0.74					
Counted 03.5% 57-01/53	3	36,840	3.2	7.4	1.62					
	2	109,500	13.4	11.4	2.50					
5.16 M3	1	1,118,540	84.0	59.0	6.20	42.3	7.05	16.97	4.5	Particles 30.5
	T	1,965,631,819,641	100.0	100.0						
II-C1-SG-1	5	1,240	0.1	0.1	0.45					
	4	45,190	1.9	1.0	0.74					
Counted 10×4 stylets	3	35,190	7.1	3.7	3.13					
	2	12,390	10.2	4.6	3.65					
516 M3	1	170,000	81.0	51.5	6.30	25.1	4.65	1.17	5.0	Particles 24.0
	T	207,000	100.0	100.0						
	5				0.35					
	4				0.74					
	3									
	2				5.79					

53

LRA-24

II-CS-SG-1
0,157-57m/53

$\rho_0 = 47.3$

$\rho = 47.3$

0,10

IX-CI-SG-1

0357: AMAD = 310 μm
σ_g = 8.6

1024: AMAD = 420 μm
σ_g = 9.8

ACTIVITY MEDIAN AERODYNAMIC DIAMETER (AMAD) -- μm

PERCENTAGE

100

10

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55

- **Added organs:**

    Bladder wall, bone surface, breast, stomach wall, lower large intestinal wall, kidneys, liver, pancreas, red marrow, testes, thyroid, brain; ovaries, uterus

- **Added radionuclides:**

    ^{89}Sr, ^{90}Sr, ^{103}Ru, ^{141}Ce, ^{144}Ce, ^{147}Nd

RADIONUCLIDES CONSIDERED, IN ORDER OF DECREASING DOSE COMMITMENT

Np-239	Sr-92	Ba-140	U-240	Te-133m
Sr-91	La-141	Y-91	Pm-149	Pm-151
I-133	Ce-143	Sb-129	I-131	La-140
Te-132	Ru-106	La-142	Cu-64	Y-91m
Zr-97	Mo-99	Zr-95	Nb-97	Pd-109
Y-93	Ba-139	I-132	Sb-128m	U-237
I-135	I-134	Te-131m	Te-134	Te-131
Y-92	Ru-105	Rh-105	Te-129	Sn-125
				Pu-239

ORDERED PROCEDURE
FOR THESE CALCULATIONS

- Use cascade-impactor data

- Use high-volume sampler data
  Assume AMAD = 10 micrometers

- Use data from neighboring town and ratio
  according to mR/h at H + 12

PROPOSED TREATMENT FOR INHALATION WHERE PARTICLE SIZE DISTRIBUTION DATA ARE AVAILABLE

- If AMAD <20μm, use ICRP lung model

- If AMAD >20μm, separate data by stages, and then use the ICRP lung model

      Filter - Assume 1μm
    Stage 4 -   1.7μm
          3 -   5.8μm
          2 - 19   μm
          1 -   Assume total deposition
                 in N-P

INHALATION METHODS ARE NOT COMPLETELY GENERAL

- Not all air quality data are coded nor calculated

- Still pick reference locations by hand by location for each event

60

PRIVACY ACT MATERIAL REMOVED

Dose via Inhalation

NAME IS

SHOT NAME IS HARRY
LOCATION IS ST. GEORGE
FOUND 20 AIR CONCENTRATIONS
DOSES ARE IN RADS.

NUCLIDE	BLA WAL	BON SUR	BREAST	ST WALL	LLI WAL	KIDNEYS	LIVER	LUNGS	OVARIES	PANCREA	R MARRO	THYROID	UTERUS	BRAIN
CU 64														
U237														
U240														
NP239														
SR 89														
SR 91														
Y 91M														
Y 92														
Y 93														
SR 97														
Y 97														
ZR 97														
NB 97M														
NB 99														
RU103														
RU105														
RU106														
RH105														
PD109														
SN125														
SB126M														
SB129														
TE129														
TE131M														
TE131														
TE132														
I132														
TE133M														
I133														
TE134														
I134														
I135														
BA139														
BA140														
LA140														
LA141														
CE141														
LA143														
CE143														
ND147														
PM149														
PM151														
TOTAL														

61

LRA-31

Dose via Inhalation

NAME IS

FOUND 1 LOCATIONS,   6 SHOTS, AND 48 AIR CONCENTRATIONS.
DOSES ARE IN RADS.

ORGAN	UNCLE	TS-EASY	TS-FOX	ANNIE	SIMON	HARRY	TESLA	TURK	HORNET	APPLE I
BLAD WAL	0.	0.	0.	2.3E-05	1.0E-04	6.4E-03	3.4E-04	0.	0.	0.
BON SURF	0.	0.	0.	1.7E-04	7.6E-04	4.2E-02	3.0E-03	0.	0.	0.
BREAST	0.	0.	0.	2.3E-05	9.9E-06	5.7E-03	3.1E-04	0.	0.	0.
ST WALL	0.	0.	0.	1.9E-04	6.6E-04	5.1E-02	1.7E-03	0.	0.	0.
LLI WALL	0.	0.	0.	1.9E-03	6.6E-03	3.6E-01	2.0E-02	0.	0.	0.
KIDNEYS	0.	0.	0.	2.4E-05	1.0E-04	6.1E-03	3.2E-04	0.	0.	0.
LIVER	0.	0.	0.	6.0E-05	2.5E-04	1.6E-02	9.6E-04	0.	0.	0.
LUNGS	0.	0.	0.	2.7E-04	2.6E-04	1.6E-02	2.9E-03	0.	0.	0.
OVARIES	0.	0.	0.	4.8E-05	2.3E-04	1.3E-02	6.6E-04	0.	0.	0.
PANCREAS	0.	0.	0.	2.4E-05	9.6E-05	6.0E-03	3.1E-04	0.	0.	0.
R MARROW	0.	0.	0.	7.7E-05	3.7E-04	1.6E-02	1.1E-03	0.	0.	0.
THYROID	0.	0.	0.	1.3E-02	6.6E-02	2.5E+00	1.7E-01	0.	0.	0.
UTERUS	0.	0.	0.	3.1E-05	1.4E-04	6.3E-03	4.2E-04	0.	0.	0.
BRAIN	0.	0.	0.	4.6E-06	2.4E-05	1.1E-03	6.9E-05	0.	0.	0.

ORGAN	MET	ZUCCHINI	WILSON	PRISCILLA	DIABLO	SMOKY	NEWTON	MORGAN	SMALL BOY	PIKE
BLAD WAL	0.	3.9E-05	0.	0.	0.	3.0E-04	0.	0.	0.	0.
BON SURF	0.	2.2E-04	0.	0.	0.	2.0E-03	0.	0.	0.	0.
BREAST	0.	3.6E-05	0.	0.	0.	2.9E-04	0.	0.	0.	0.
ST WALL	0.	2.1E-04	0.	0.	0.	1.6E-03	0.	0.	0.	0.
LLI WALL	0.	1.9E-03	0.	0.	0.	1.6E-02	0.	0.	0.	0.
KIDNEYS	0.	3.6E-05	0.	0.	0.	2.9E-04	0.	0.	0.	0.
LIVER	0.	6.7E-05	0.	0.	0.	6.2E-03	0.	0.	0.	0.
LUNGS	0.	3.0E-04	0.	0.	0.	2.3E-03	0.	0.	0.	0.
OVARIES	0.	7.3E-05	0.	0.	0.	5.6E-04	0.	0.	0.	0.
PANCREAS	0.	3.6E-05	0.	0.	0.	2.6E-04	0.	0.	0.	0.
R MARROW	0.	1.3E-04	0.	0.	0.	1.0E-03	0.	0.	0.	0.
THYROID	0.	1.6E-02	0.	0.	0.	1.4E-01	0.	0.	0.	0.
UTERUS	0.	4.9E-05	0.	0.	0.	3.6E-04	0.	0.	0.	0.
BRAIN	0.	9.7E-06	0.	0.	0.	7.4E-05	0.	0.	0.	0.

ORGAN	PIN STRIPE	TOTAL
BLAD WAL	0.	7.2E-03
BON SURF	0.	4.6E-02
BREAST	0.	6.5E-03
ST WALL	0.	5.6E-02
LLI WALL	0.	4.1E-01
KIDNEYS	0.	6.9E-03
LIVER	0.	1.7E-02
LUNGS	0.	2.4E-02
OVARIES	0.	1.5E-02
PANCREAS	0.	6.7E-03
R MARROW	0.	2.1E-02
THYROID	0.	2.9E+00
UTERUS	0.	9.4E-03
BRAIN	0.	1.3E-03

LRA-32

- Want probability distribution

- Input data were different

    LANL: Geometric mean, $\bar{x}_g$, and doses at
    the 1%, 10%, 90%, and 99% levels

    LLNL: Arithmetic mean, $\bar{x}$, and estimated
    geometric standard deviation, σ_g

SUMMATION

- Sum arithmetic means:

$$\bar{x}_T = \sum \bar{x}$$

- Sum variances:

$$\sigma_T^2 = \sum \sigma^2$$

- Calculate geometric mean and standard deviation from the arithmetic mean and standard deviation

RELATIONSHIPS OF PARAMETERS

$$\bar{x} = \bar{x}_g \exp\left[(\ln \sigma_g)^2/2\right]$$

$$\sigma^2 = \exp\left[2 \ln \bar{x}_g + (\ln \sigma_g)^2\right] \times \left[\exp((\ln \sigma)^2) - 1\right]$$

$$A = 1 + (\sigma/\bar{x})^2$$

$$\bar{x}_g = \frac{\bar{x}}{\sqrt{A}}$$

$$(\ln \sigma_g)^2 = \ln A$$

F5

Name:

Organ of Interest: Skin

Calculated dose (rad)

Pathway	Geometric mean	Geometric standard deviation	Arithmetic mean	Arithmetic standard deviation
External:	310.	1.7	350.	190.
Ingestion:		Negligible		
Inhalation:		Negligible		

Total dose:	Probability:	1%	10%	50%	90%	99%
	Dose (rad):	95.	160.	310.	· 590.	1000.

99

LRA-36

Name:

Organ of Interest: Whole body

Calculated dose (rad)

Pathway	Geometric mean	Geometric standard deviation	Arithmetic mean	Arithmetic standard deviation
IN UTERO	0.26	1.4	0.27	0.090
External:	0.24	1.3	0.25	0.059
Ingestion:	0.0049	2.7	0.0080	0.010
Inhalation:	0.00022	2.7	0.00036	0.00047

Total dose:	Probability:	1%	10%	50%	90%	99%
	Dose (rad):	0.32	0.40	0.52	0.67	0.83

LRA-37

Name:

Organ of Interest: Bone marrow

Calculated dose (rad)

Pathway	Geometric mean	Geometric standard deviation	Arithmetic mean	Arithmetic standard deviation
External:	2.6	1.3	2.7	0.67
Ingestion:	0.070	2.7	0.12	0.15
Inhalation:	0.012	2.7	0.019	0.025

Total dose:	Probability:	1%	10%	50%	90%	99%
	Dose (rad):	1.6	2.0	2.8	3.7	4.8

LRA-38

Name:

Organ of Interest: Thyroid

Calculated dose (rad)

Pathway	Geometric mean	Geometric standard deviation	Arithmetic mean	Arithmetic standard deviation
External:	3.0	1.4	3.2	1.0
Ingestion:	24.	2.7	40.	52.
Inhalation:	1.8	2.7	2.9	3.8

Total dose:	Probability:	1%	10%	50%	90%	99%
	Dose (rad):	3.7	9.6	31.	98.	252.

LRA-39

OMPARISON OF MEASUREMENTS AND CALCULATIONS
T. GEORGE — PLUMBBOB

Film badge data; $\bar{x}_g = 150$, $\bar{x} = 190$

⊙ ▪ Litigant exposure

TMC

Number

Exposure, mR
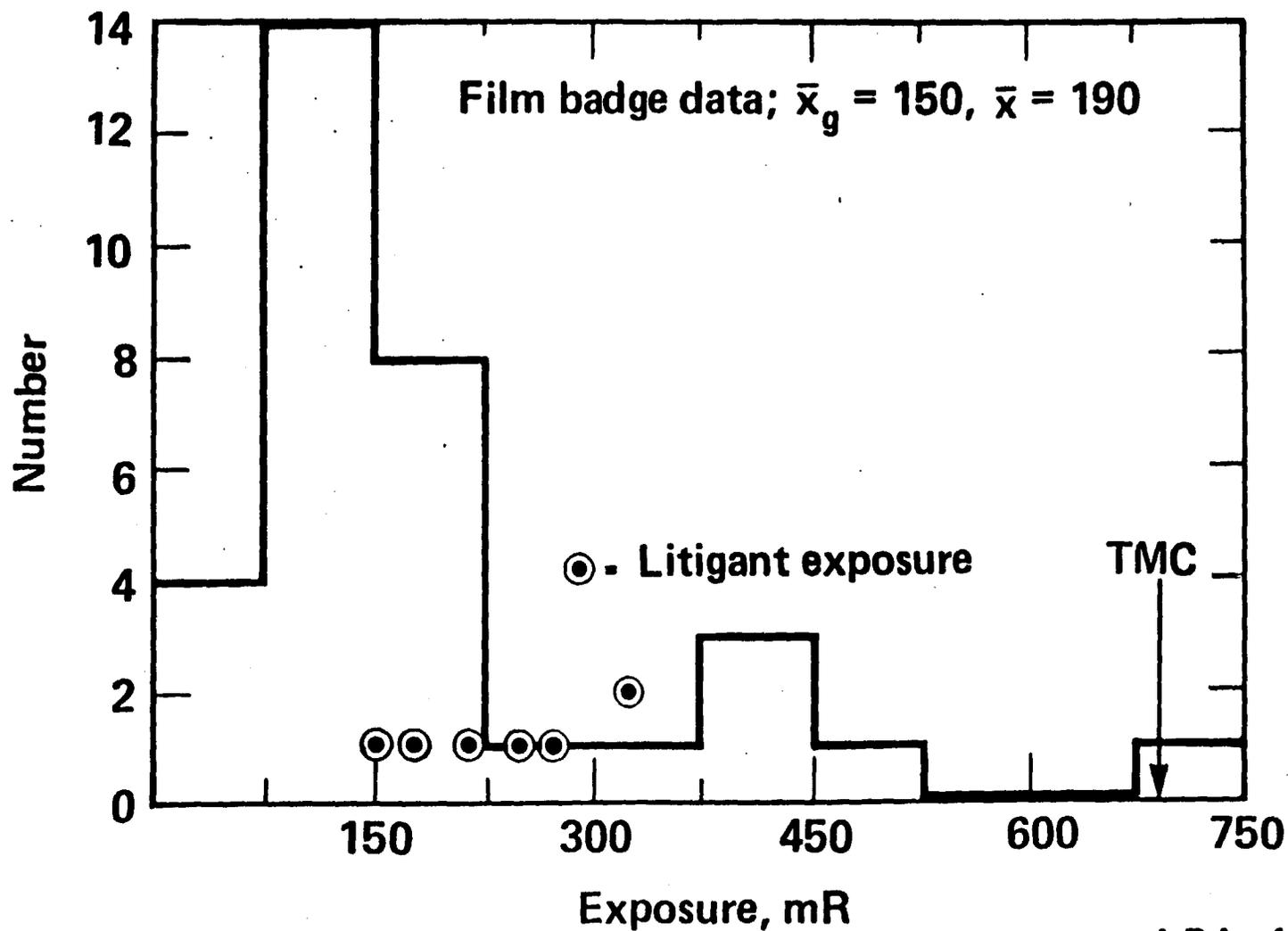
1   CHAIRMAN MOSELEY: We're going to change subjects now. The rest of

2   the morning is essentially going to be spent on discussion of various

3   aspects of soil sampling. We will start with Forest Miller.

4   DR. MCCLELLAN: Excuse me, Bob. Later today in the wrap-up, am I

5   correct to assume that Bruce Church is going to give us a little bit of a

6   feeling where this is going from here in, e.g., the internal dose area?

7   CHAIRMAN MOSELEY: That's what is being scheduled.

8   MR. CHURCH: I'm going to talk somewhat about that.

9   DR. MCCLELLAN: I'm interested in having some time to discuss that.

10   DR. MILLER: This turned out to be one of the more fun things of the

11   project so far; sort of paid vacations. We visited eastern California,

12   Nevada, northern Utah, southeastern Oregon, southern Idaho, southwestern

13   Wyoming, western Colorado, northwestern New Mexico, and northern Arizona,

14   looking for candidate soil sampling sites. We found 306 of them at 132

15   locations. Many locations had multiple candidate sites. The towns with

16   triangles beside them, like Montrose, Rifle and Meeker, had soil samples

17   taken (FM-2). I think there were about 190 soil samples taken from about

18   117 locations. Livermore rejected some of our soil sampling site

19   candidates and substituted others so that the 306 isn't really fixed.

20   We tried to select soil sampling sites which met the EML criteria

21   which you got in Standing Order 4. In brief, the areas EML were interested

22   in were undisturbed, and yet maintained since 1950, at least 40 feet in

23   diameter, relatively flat and open and with ground cover such as grass to

24   minimize wind or water erosion. We also watched for low places in lawns

25   that would serve as collection points due to rain bringing in fallout.

26   We ranked these candidate sites as either "A," "B," or "C." "A"

27   meaning, meets the EML criterion every way we knew; "B" meaning slight

28   deviation from optimality which might mean some trees in the lawn, or the

1 lawn was slightly small, and "C," sort of best available in the areas but

2 not "A" or "B." As you can recognize, (laughter) there are some places

3 where we didn't have lawns, and we just had to sort of pick the best thing

4 we could find. Now if I can just master this technology, I would like to

5 show you a few pictures.

6   This (Site No. BE-23) is a lawn in Bishop, California. All three

7 teams rated it an "A." It's about 50x50 with the estimated age from the

8 owner of 60 years. This (Site No. KS-37) is a field behind the Hiko Post

9 Office in Hiko, Nevada. You're just seeing a part of it. The field was

10 about 1,000' x 1,000' and, according to the postmistress, it had been

11 undisturbed for 40 years -- The order has been changed.-- That (Site

12 No. AS-26) is the Rio Blanco Courthouse in Meeker, Colorado. Also a

13 Triple A. The Courthouse was built in 1935 and several people verified

14 that the lawn was over 30 years old. The Old House in Mancos, Colorado

15 (Site No. AS-08), I believe, yes, 100 x 100 foot lawn. The house was built

16 in 1889. We rated it a "B" because we thought the weeds and lack of care

17 indicated that it might not be an optimal site. The other two people, the

18 other two groups, rated it an "A." That's (Site No. AS-06) a park,

19 Montezuma Park, Cortez, Colorado. The soil sampling site itself was out

20 there where the sprinklers are, an area roughly 200 x 300 with trees around

21 the edges. People verified that that had been undisturbed since 1949.

22 This (Site No. AS-01) is a fairgrounds in New Mexico, Farmington, New

23 Mexico, another Triple A site. I don't know what house this (Site

24 No. FM-51) is, unfortunately.

25   CHAIRMAN MOSELEY: Law offices.

26   DR. MILLER: Oh! Okay, that's Arizona. That is Flagstaff. It's law

27 offices in downtown Flagstaff; a level side yard. People were concerned

28 that there might have been some fill put in here. We were only able to be

1 guaranteed that nothing had happened the past 15 years. Before that, it

2 had been a fraternity house.

3   (Laughter)

4 Nobody thought that they would have been digging holes in it, and we

5 located one of the brothers, and he said, "No, nothing has ever happened,"

6 that he remembered. We called it an "A." Livermore called it a "B"

7 because they thought that there could have been some fill. This picture

8 was taken while standing on a wall at the far end of the lawn and toward

9 the wall was downhill, and people thought it could have been filled

10 recently.

11   This (Site No. FM-54) is the Bureau of Indian Affairs Park in Fort

12 Defiance, Arizona, a large grassy area surrounded by trees; and according

13 to both the Bureau of Indian Affairs in Fort Defiance and the people who

14 run the hospital, which is just down the road, it was undisturbed for at

15 least 35 years. In the trees in the back (Site No. FM-39) is the house of

16 the owner of Garcia's Trading Post in Chinle, Arizona, and the lawn is

17 undisturbed since it was planted in 1926. Unfortunately, my slide of the

18 lawn turned out to be crummy, and this is sort of a substitute. I

19 apologize for it, but it was heavily covered by trees and so that was a

20 potential detriment.

21   This (Site No. FM-12) is an open woodland near Tusayan Ruins in the

22 Grand Canyon National Park; somewhat sparse cover. We rated it a "B" for

23 that purpose. The REECo soil collection team rated it a "C" because they

24 couldn't get below six inches. The large tree you see sort of in the right

25 center, because of the low site index, is probably 125-150 years old. This

26 (Site No. FM-10) is a meadow just off of Grandview Tower Road in the Grand

27 Canyon National Park. Both of these places are on the South Rim, and this

28 a Triple A site. We were able to get deep enough to get a good soil sample

73

1 as well as good cover. I will confess that I don't know what this is.

2 I'll just sort of pass on it. (Site No. AS-32. Bunnings Park, Rock

3 Springs, Wyoming.)

4 An outhouse. (Site No. AS-49. Memorial Park, Pocatello, Idaho.)

5 If I have no complaints from the Projection Room then I have done the

6 technology right, and they can now take the slides off the projector. Any

7 questions?

8 MR. ZIMMERMAN: I have a question. On your map of sites from which

9 you have taken soil, I notice that you didn't take any samples in the areas

10 that were the probable source of milk supply for the Salt Lake City area

11 and the Wasatch front areas. I wonder why that was. Had that been sampled

12 previously by the EML?

13 DR. MILLER: We were only in Utah in the northwestern part, the parts

14 that had not been covered previously by EML.

15 MR. ZIMMERMAN: So this other has adequately been done by the prior

16 work group?

17 DR. MILLER: No. I would let Harold comment on that.

18 MR. BECK: Bruce.

19 MR. CHURCH: I think we're going to do some more soil sampling in

20 Utah.

21 (LRA-52) The colors help highlight a little better where we've been.

22 Dr. Anspaugh will be addressing what the red dots and so forth mean later,

23 but you can see that there is a big hole in the State of Utah, and the

24 reason is that EML had previously sampled throughout the state, and as we

25 discussed last May, the purpose of this sampling is an extension of that

26 work and hoping to look in a contemporary time frame throughout the region,

27 and what we tried to do in that western corner of Utah is to fill in some

28 of the area that EML did not sample, and we were particularly interested

74

1 because of the fallout tracks, if you remember back to some of the patterns

2 that we had previously shown. Now, I will be speaking a little bit later

3 in terms of future plans on some work we plan to do within the state

4 according to the recommendations you gave us last May.

5 CHAIRMAN MOSELEY: There are some reconfirmatory spots that you were

6 going to look at.

7 MR. CHURCH: Yes. I'll go into a little more detail then, later on.

8 DR. MALIK: Was there any attempt to sample in the same places that

9 Kermit Larson's group sampled?

10 MR. CHURCH: No.

11 DR. MALIK: I would sort of like to have a direct comparison in a few

12 places.

13 MR. CHURCH: Early in the project we had Van Romney go back to a

14 number of those stations that they called "Persistent Stations" and had him

15 take a sort of a last sweep of samples through those stations and he -- do

16 you remember the status of that report? It's not a published report, but I

17 guess I failed to recognize it yesterday. Those stations did reach into

18 Utah. I think near Enterprise was the -- or, St. George, Veyo, Enterprise,

19 Montamesa and a couple of other test stations.

20 DR. ANSPAUGH: They were typically not the same kind -- they wouldn't

21 meet the same criteria in terms of lawns and the same thing that we are

22 looking for here, though. They were basically desert areas.

23 MR. CHURCH: That's true, and I was going to add those same kinds of

24 words. They sampled, I believe they sampled soil, natural vegetation in

25 those particular areas and what wildlife was available; such as in the

26 Enterprise area, you could get jack rabbits and stuff like that, but I

27 don't think they are directly comparable to the EML type of effort.

28 DR. MALIK: I was wondering about migration of clides from high

levels to low levels because of rainfall, weathering, and so forth, which would cause them to concentrate in valleys rather than in hills. It would be very difficult to find that out, I presume.

MR. CHURCH: Well, a lot of the Pendleton work was designed to measure just that thing. In the 60s, Bill Wagner's doctoral thesis, which I have a copy of, was published in the early 70s, and that was specifically what he looked at was the migration out of the high Uinta Mountains down into the lowlands. As I recall, his findings were pretty minimal. In fact, he had to look awful hard to try to see anything come down in like 20 miles. He did a lot of ion exchange concentrating out of the streams, just trying to find cesium, as an example. We sampled, in the early 60s, all of the wildlife, vegetation, soil and stuff like that in the high Uintas and found lots of radioactivity in those samples in a comparable sense. I don't think that we ever really saw any evidence of a migrating in a way that would be of much concern. It was hard to find.

CHAIRMAN MOSELEY: Anything further?

MR. BECK: I would just like to remind the Committee that I did report in one of your earlier meetings about our reanalysis of some of the Larson samples from Utah, where we actually got those samples, and we analyzed them for cesium, and, although they were not exactly in the towns, we compared them with the values we got in the nearby towns, and I think you will remember that the values we got were very close to what we would have predicted for that considering the types of samples, and we are still analyzing these samples now for plutonium and isotopic ratios, and we will be reporting on those results in one of your future meetings, comparing the results of those samples with the other results from our own samples.

CHAIRMAN MOSELEY: Thank you very much.
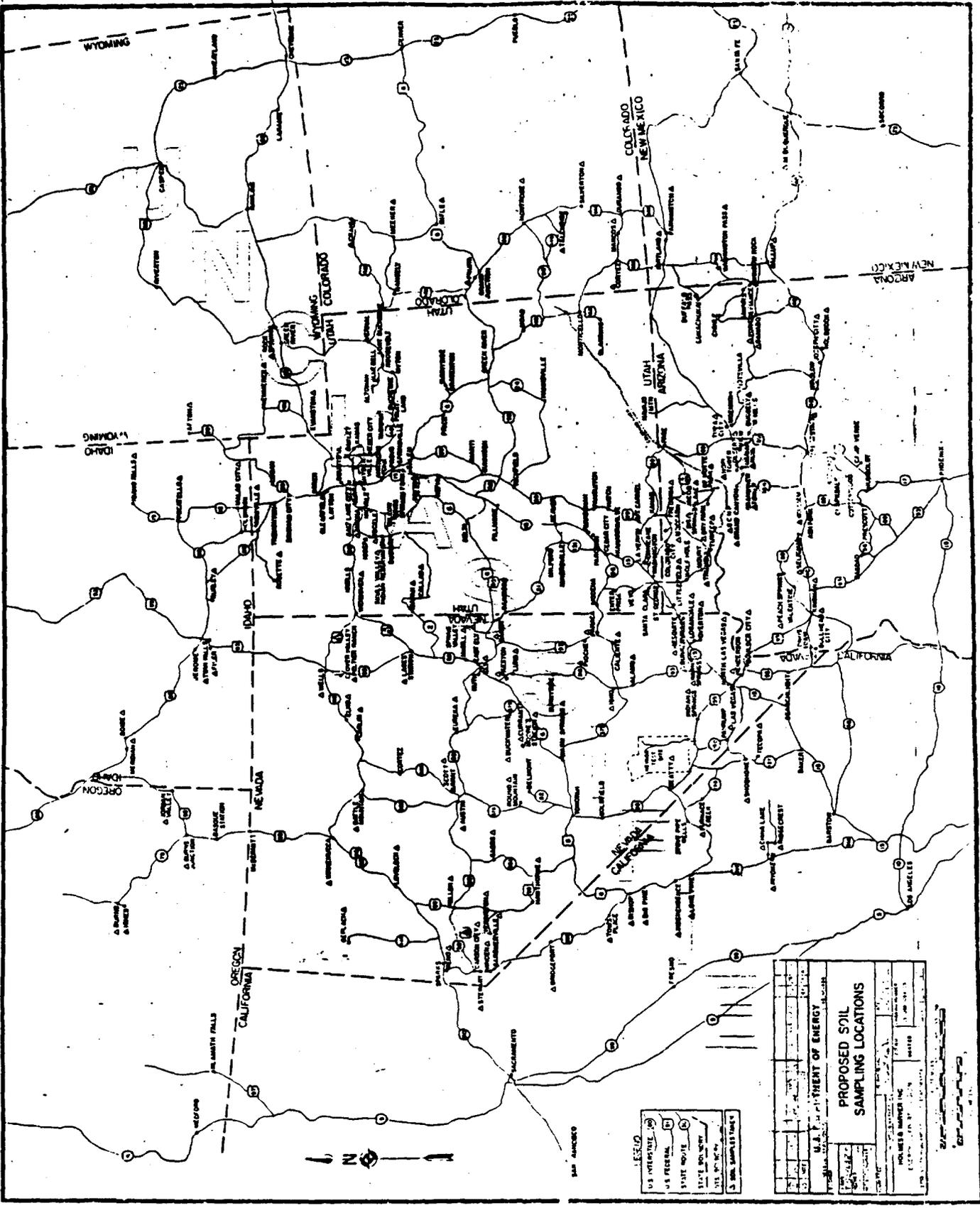
PROPOSED SOIL
SAMPLING LOCATIONS

U.S. DEPARTMENT OF ENERGY

HOLMES & NARVER INC.

Site No. BE-23   Judd Property.   Bishop, California.

KS-37 Field behind Hiko Post Office
in Hiko, Nevada
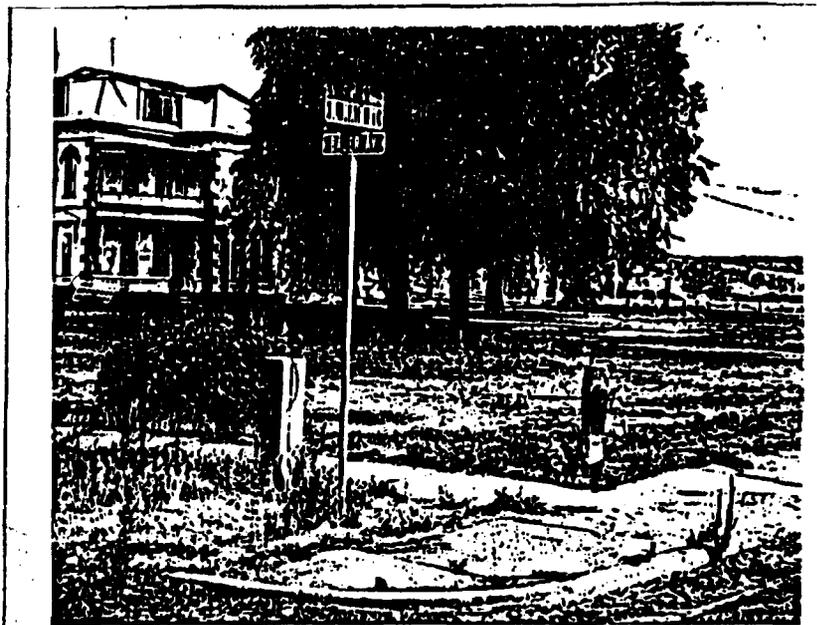
AS-08 - Old House in Mancos, Colorado.
100'x100' lawn.
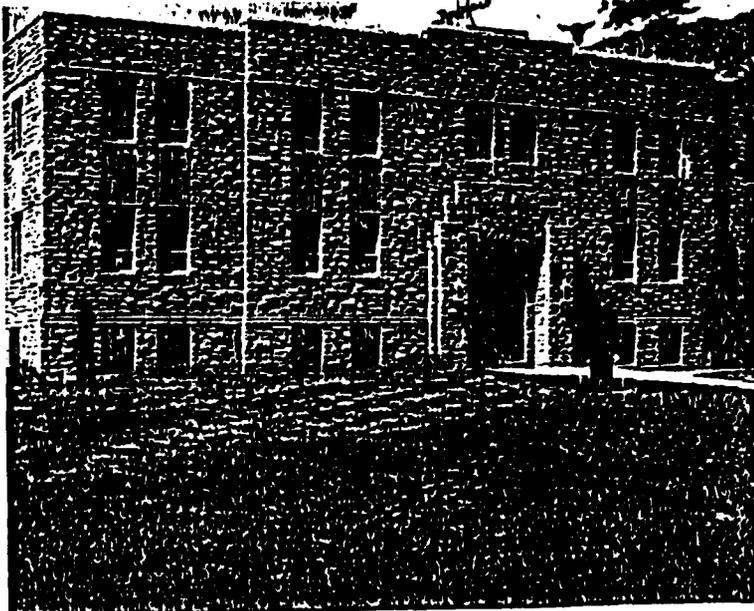
AS-26 Rio Blanco Courthouse in
Meeker, Colorado.

AS-06 Montezuma Park, Cortez, Colorado.
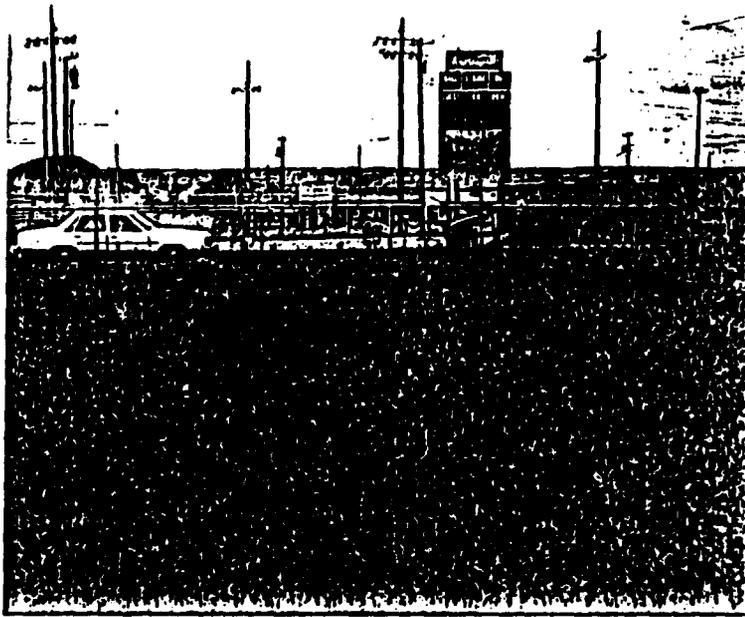
AS-01   Fairgrounds in Farmington, New Mexico.

FM-54   Bureau of Indian Affairs Park in Fort Defiance, Arizona
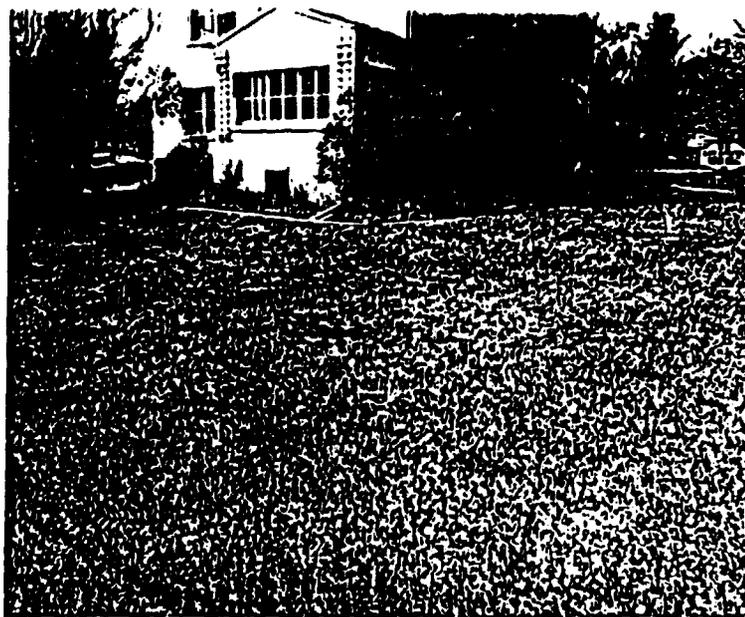
FM-51   Law Offices in Flagstaff, Arizona

FM-39   House of owner of Garcia's Trading Post, Chinle, Arizona.

FM-12   Open woodland near Tusayan   Ruins
         in Grand Canyon National Park

AS-32   Bunnings Park, Rock Springs, Wyoming.

FM-10   Meadow just off of Grandview
         Tower Road in Grand Canyon

AS-49   Memorial Park, Pocatello, Idaho.

1   CHAIRMAN MOSELEY: The next presentation is an expansion on the same

2 subject by John Koranda.

3   DR. KORANDA: May I have the first slide, Dave. (JK-1). Some of the

4 maps I have may clarify some of the questions that you have just been

5 bringing up about the distribution of sites.

6   We began the field work on Phase II in July and these numbers differ a

7 little bit from those that Frosty may have given a few moments ago, but

8 that's bound to happen in 300 measurements, and I didn't include the Las

9 Vegas measurements in my totals, but we made fifteen trips during the

10 summer with the help of EG&G's field spectrometer and one person, and

11 Livermore personnel were there. As a result of those measurements, we

12 generated this, I guess, tome is the best word for it, mainly the

13 observations and notes on the field measurements, a few spurious remarks

14 about neighborhood dogs, and we have gone into this and I think

15 Dr. Anspaugh will discuss the use of this tome later on in Site Selection.

16   Our next slide (JK-2) will show, when it gets oriented right, the

17 distribution of our measurement sites in the western states. This is from

18 a computer map data base. It doesn't clutter up your mind with cities and

19 towns and just shows the states, and you enter it with the longitude and

20 latitude. That's the scene in the area in which we made our measurements,

21 and you can see that it's around the core of Phase 1 sites, which were

22 measured by the EML people. A couple of sites up in the northwest corner

23 of Utah, at Snowville and Rosette were measured by our group.

24   The next slide (JK-3) shows, I think, just Nevada measurements and

25 over into eastern California, and the next slide (JK-4) will show the New

26 Mexico and Arizona areas.

27   The next slide (JK-5) just is concerned with some of the basic

28 calibrations that we make on the detector. Before we take it into the

1 field, we determine the efficiency for various energies directly beneath

2 the detector and the angular efficiency since most of the energy being seen

3 by the detector comes at an angle -- I can't remember exactly where it is,

4 Harold -- somewhere between 30° and 80°, I guess.

5 The next slide (JK-6) shows the calibration method with the detector

6 hanging on the support there and the sources placed at various angles. We

7 assume that the detector in a hemispheric sense essentially has the same

8 sensitivity.

9 The next slide (JK-7) I think I will show the protocol of the

10 measurements. We take Frosty Miller's site descriptions which he described

11 a little while ago, and we would usually contact the residents or owner --

12 they sometimes got disturbed when they saw all of this claptrap set up in

13 their front yard if you didn't contact them, or they weren't home -- and

14 make the measurements, do the site description and mapping, do a few site

15 photographs, and retrieve the equipment and go on our way.

16 The next slide (JK-8) I think will show some of the -- this is by one

17 of our better ecological artists. These are the kind of measurements we

18 have made to identify the site rather precisely so Howard's people could

19 then come in and locate it. In a few places we placed pegs with a little

20 flag on them so that they could see it. Very often they could see the

21 tripod leg holes in the lawn at the site that we had measured.

22 This is a page right out of the log book. Yes.

23 DR. CALDWELL: How often do you have to have it set up?

24 DR. KORANDA: We are measuring 1,800 seconds, something like that. It

25 takes about 30 minutes.

26 DR. CALDWELL: It's not set up for 24 or 48 hours. That's what I was

27 wanting to know.

28 DR. KORANDA: Oh, no.

1   DR. MCCLELLAN: This one here they had 45 minutes, 16:45 to 17:30.

2   DR. KORANDA: Yes. That includes set up time and all of that sort of

3   thing. We would still be out there if it were that long a measurement.

4   The next slide (JK-9). This is a frequency distribution of the total

5   measurements made. I can't say too much about it because it has an unknown

6   horizontal scale, and the units though are in counts per minute of

7   cesium-137. This is essentially the cesium-137 flux, and the data are

8   skewed by some high values, in this case from natural habitats which were

9   measured, and they represent, according to Harold and our own observations,

10   at least a different situation from the idealized site, namely a lawn.

11   The next slide (JK-10) will show the natural habitat data with the

12   maximum flux here being 85, which I think is what it was on the previous

13   slide for the total data base; and the next slide (JK-11) shows the lawn

14   data which is a little more orderly, but there are a few lawns which we

15   will probably explain with the high concentrations out here when we get the

16   vertical distribution of the radioactivity at that site.

17   The next slide (JK-12) I think shows the Las Vegas site here at

18   Squires Park with the diodes and the P.I.C. or ionization chamber, and this

19   is our system here which is tethered to a truck, and this is the free

20   standing system which EML has used, and we had -- I think that's theirs,

21   isn't it, Harold?   Yeah, that's yours.   We were making parallel

22   measurements at this site.

23   The next slide (JK-13) I think shows the region of interest in that

24   spectrum obtained at that place (Squires Park). People wonder if you can

25   really see it and, of course, with the solid state detector the cesium

26   photopeak is readily discernible even in the presence of high levels of

27   natural radioactivity.

28   The next slide (JK-14) shows one of our measurement sites over in

84

1 California (sic), probably an "A" site with a good, old lawn, relatively

2 well-managed for the area, I guess. You would have to be sensitive to

3 various things like sprinkler systems being put in, which typically have

4 occurred in the last 10-15 years and the trenching that was done to do

5 that.   Sometimes the site was disturbed, and it wasn't hardly evident.

6 Sometimes you would see vegetation differences, and it would suggest to you

7 that the site had been disturbed even though the people said that

8 everything was just peachy there for the last 30-40 years; so you had to

9 use a little bit of ecological intuition and observation to really check

10 out the sites.

11   The next slide (JK-15) I think is over in Nevada where the natural

12 pastures were analyzed with the portable diode system.   This is a pulse

13 height analyzer, and this is an extra battery supply.   The pulse height

14 analyzer and everything (associated circuitry) is right in that small unit,

15 and it records the data on a minicassette.   You get about 10 spectra on the

16 cassette.

17   The next slide (JK-16) -- I think that's up near McGill -- Here are

18 some of the natural habitat types.   This is an open bunch grass underneath

19 a juniper pinion pine woodland on the South Rim of the Grand Canyon.

20 Frosty showed, I think, this same site without the equipment in it.   The

21 vegetation cover is not continuous here and perhaps it doesn't satisfy the

22 criteria that Harold's group have set up, but we measured, perhaps, I don't

23 know, maybe 30-40 of these sites during the process of the summer's work.

24 They were ones that were nominated by Frosty, and in this area there

25 weren't any lawns, and so this is about all you had.

26   The next slide (JK-17) a little more complete vegetated cover in the

27 same region.   This was an area where uranium ore trucks stopped in and did

28 some sort of truck servicing and the Park Service had some suspicions that

1 the area had received some dumping of uranium ore in it. The Orphan Mine

2 is right on the South Rim there, of course, and so we made a series of

3 measurements there in addition to the ones that were nominated by Frosty as

4 being sites for the ORERP program.

5 The next slide (JK-18). Here's a site that Frosty nominated that we

6 would probably give a "C" or and "X," I don't know. It was a salt marsh,

7 and it shows you the other end of the spectrum of sites in an area that

8 receives little or no rainfall. You have a hard time finding a site to

9 measure. This is a few miles away from Death Valley. We did measure the

10 Lodge lawn there and we got a fairly good value for a place that was

11 200 feet below sea level and one inch of rainfall a year. Of course, it

12 gets more than that from the hose but the fallout comes via the rainfall.

13 The next slide (JK-19) is a courthouse in Bridgeport and a somewhat

14 small lawn, but it fell within the criteria. There were some large

15 cottonwood trees here, and, of course, when you look at the trees, as

16 Frosty mentioned a minute ago, 30 years ago their canopies probably did not

17 intercept that large an area, so you have that (time) consideration.

18 The next slide (JK-20) is the quad at the University of Nevada.

19 Previously it had been rather pristine but in the recent past, it had been

20 stomped and trampled by what looked like scrimmages by the football team,

21 and Howard had some remarks about it when he sampled the soil there, but it

22 was a fairly old area, even though the top few centimeters were chewed up

23 by college rituals or something.

24 The next slide (JK-21) is a nice scenic site over in eastern Colorado

25 (sic) and a pasture, sort of a meadow-like pasture. It fell into our

26 natural habitat classification. All three of us recognized this basic

27 difference in the sites which, of course, is quite obvious. Nobody is out

28 here maintaining this, although some of these sites were irrigated by flood

1 irrigation and in some cases, even movable sprinklers, but in many of the

2 cases they were just natural meadows.

3 The next slide (JK-22). Now here is the data base. Here are some of

4 the characteristics of the data base as it resides in the Livermore compu-

5 ter, and we have the identification, the location characteristics and

6 designation, the rainfall as received from Vern and the habitat and site

7 description, and the second value from the bottom there should really be in

8 cpm of cesium because the areal inventory value there is really not valid

9 until we correct the depth distribution function. These are depth

10 distribution. So that's essentially where the data base stands today. I

11 think Howard's going to discuss what followed after our measurements. We

12 were the middle team. The first was Frosty's, and the second team was our

13 group.

14 CHAIRMAN MOSELEY: Are there any questions?

15 DR. AUXIER: John, I was just wondering. That photograph (JK-6) which

16 shows the angular distribution calibration detector in the Lab, that was a

17 setup, I presume, just for the photograph? You didn't really do the

18 calibration in the Lab like that, did you?

19 DR. KORANDA: We sure did.

20 DR. AUXIER: Well, how did you take account of the fact that as you go

21 around the arc, that the $\frac{H}{D}$ ratio for albedo would vary so markedly with

22 angle?

23 DR. KORANDA: I don't use albedo in that context.

24 DR. AUXIER: Well, to say it differently, just say that the room

25 return will vary markedly from -- for instance at the bottom of the arc the

26 source is getting scattering back from the floor much more markedly than it

27 would be over at the 90° angle or 70° angle.

28 DR. KORANDA: I don't think I can deduce that. Do you have any ideas

1 on that, Lynn?

2 DR. ANSPAUGH: We can work some of these calibrations sometimes

3 outside but whether or not that's a particular problem that we ought to

4 worry about some more, I don't know.

5 DR. AUXIER: We can talk about that later.

6 CHAIRMAN MOSELEY: Dr. Beck is very anxious to respond.

7 MR. BECK: What they are doing, doesn't matter. They are looking at

8 the uncollided flux only for this. They are only looking at the uncollided

9 flux.

10 DR. AUXIER: Oh, the resolution is set for --

11 MR. BECK: The resolution is extremely high on these detectors. All

12 they are looking at is the uncollided flux of cesium. What happens is that

13 the continuum changes, as you said, but it doesn't affect anything.

14 CHAIRMAN MOSELEY: Any further questions?

15 We've got another question. Dr. Wrenn.

16 DR. WRENN: Just a quick one.   Do you have a complete pictorial

17 history of every site?

18 DR. KORANDA: It's right in here.   (Indicates looseleaf book

19 approximately eight inches thick.)

20 DR. WRENN: I saw lots of buildings with bricks in them, and so I have

21 an ulterior motive.

22 (Laughter)

23 DR. KORANDA: Do you want to take this home? I'd be glad to get rid

24 of it.

25 MR. CHURCH: I think you ought to let them pass that around the table,

26 or at least leave it there so they can spend some percent of the time we

27 do.

28

ORERP PHASE 2 IN-SITU MEASUREMENTS

BEGUN 19 JULY 1982

COMPLETED   28 OCTOBER 1982

- 267 sites measured
- 34 sites rejected
- 15 field trips

PERSONNEL

L. Anspaugh	J. Koranda
B. Clegg	C. Hall
D. Sawyer	P. Truelsen
M. Stuart	D. Homan
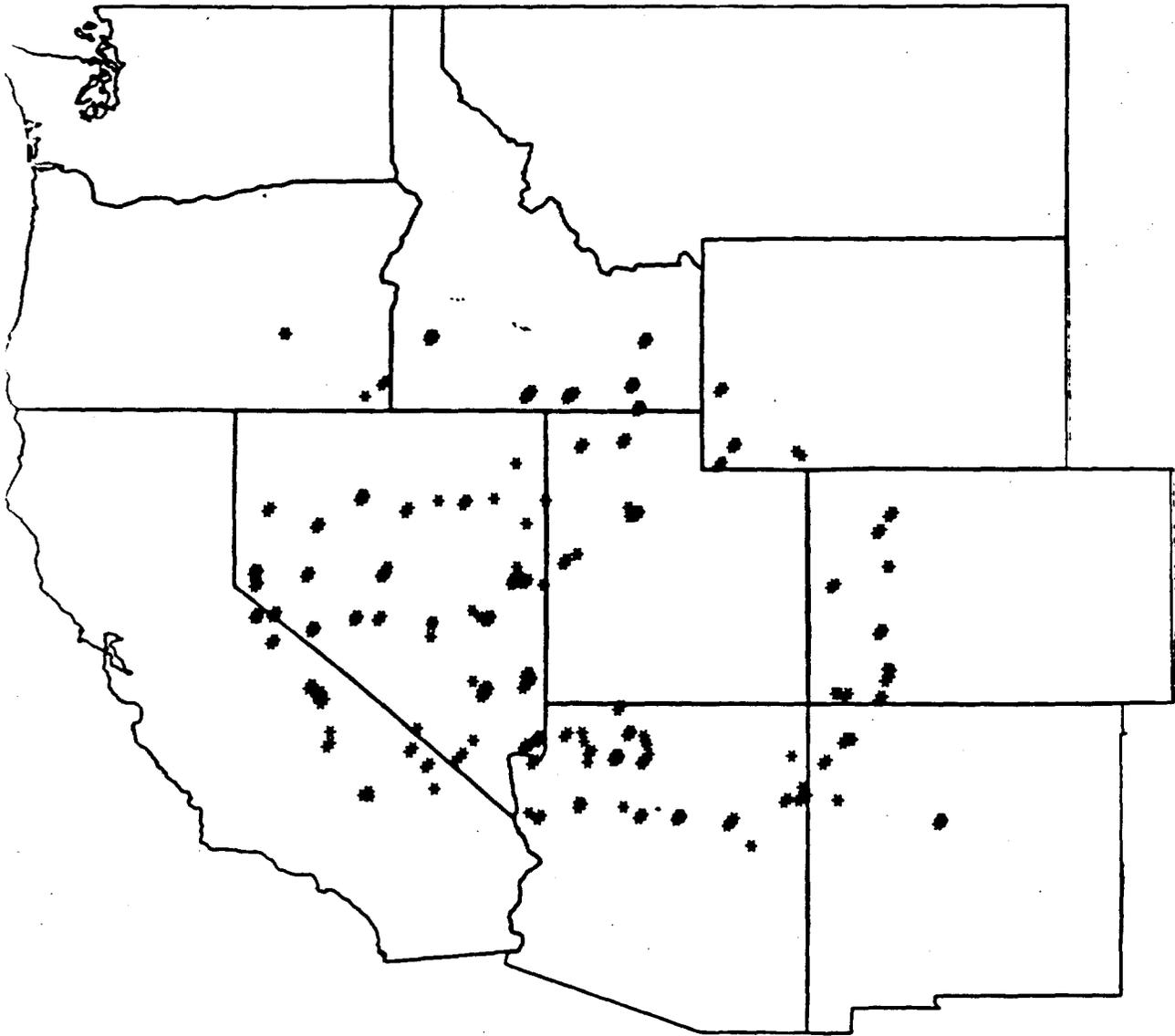
)RERP Phase 2 Collection Sites(1982)

JK2

ORERP Phase 2 Collection Sites(1982)

New Mexico

Albuquerque

Arizona

Flagstaff

ORERP Phase 2 Collection Sites(1982)

Detector

θ
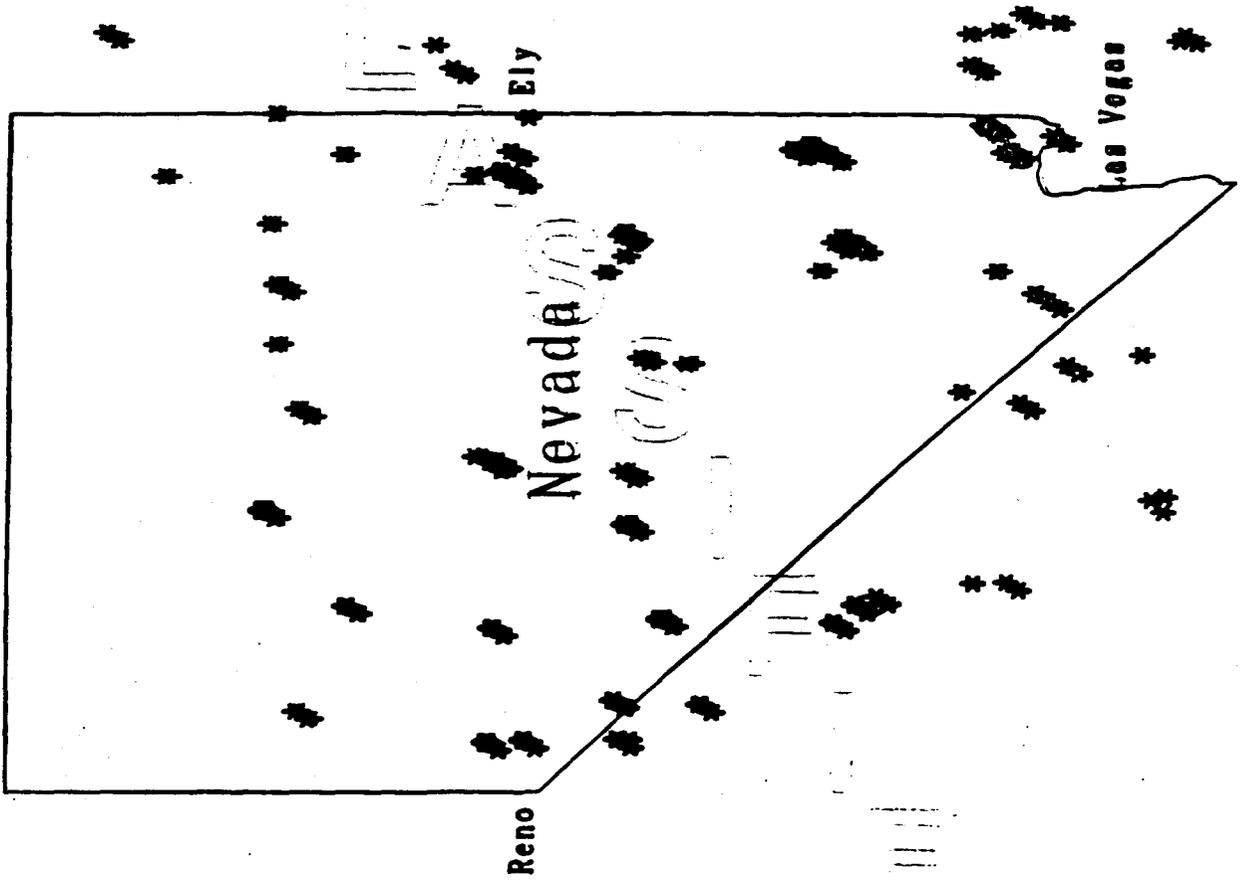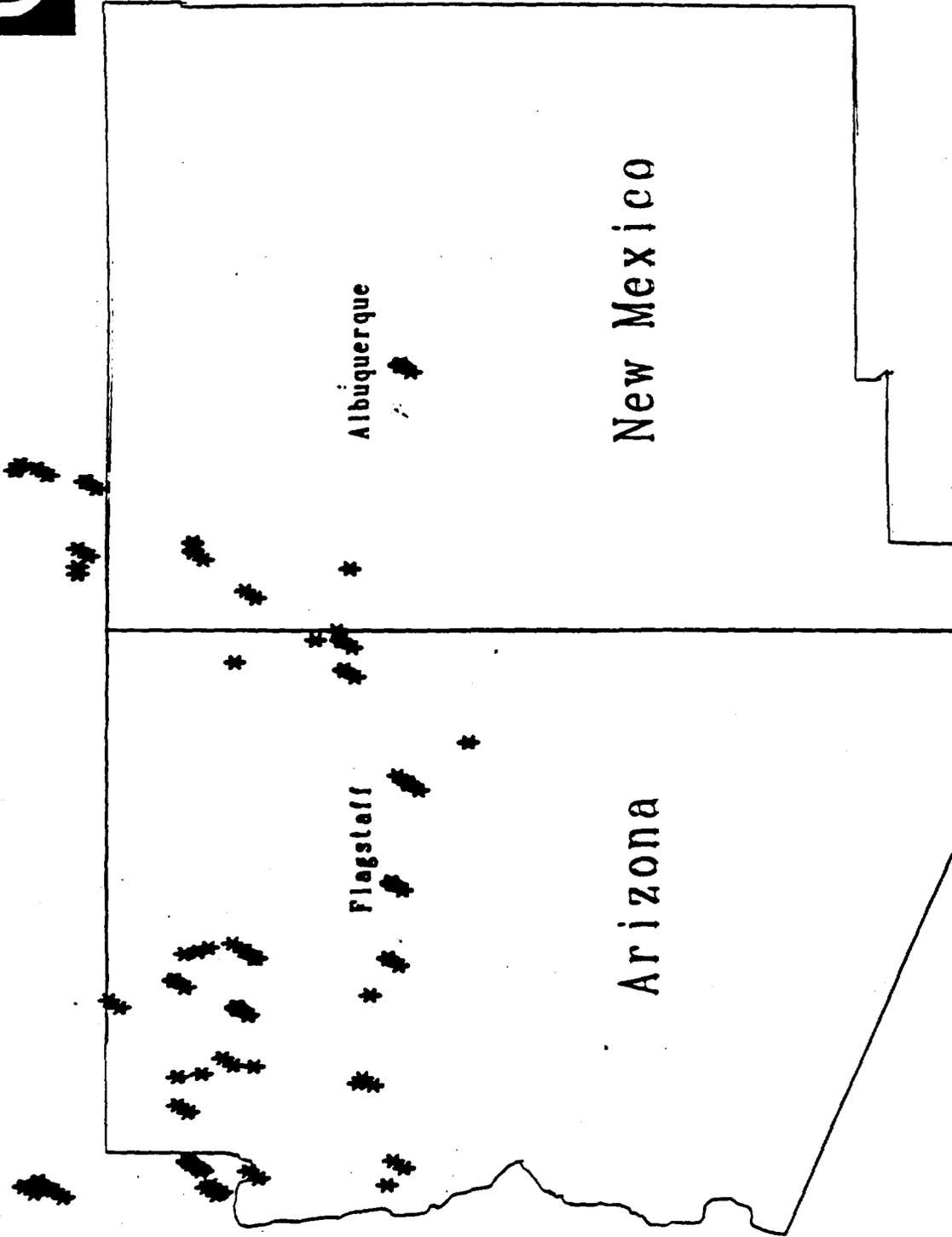
r

H

x

dx

Soil
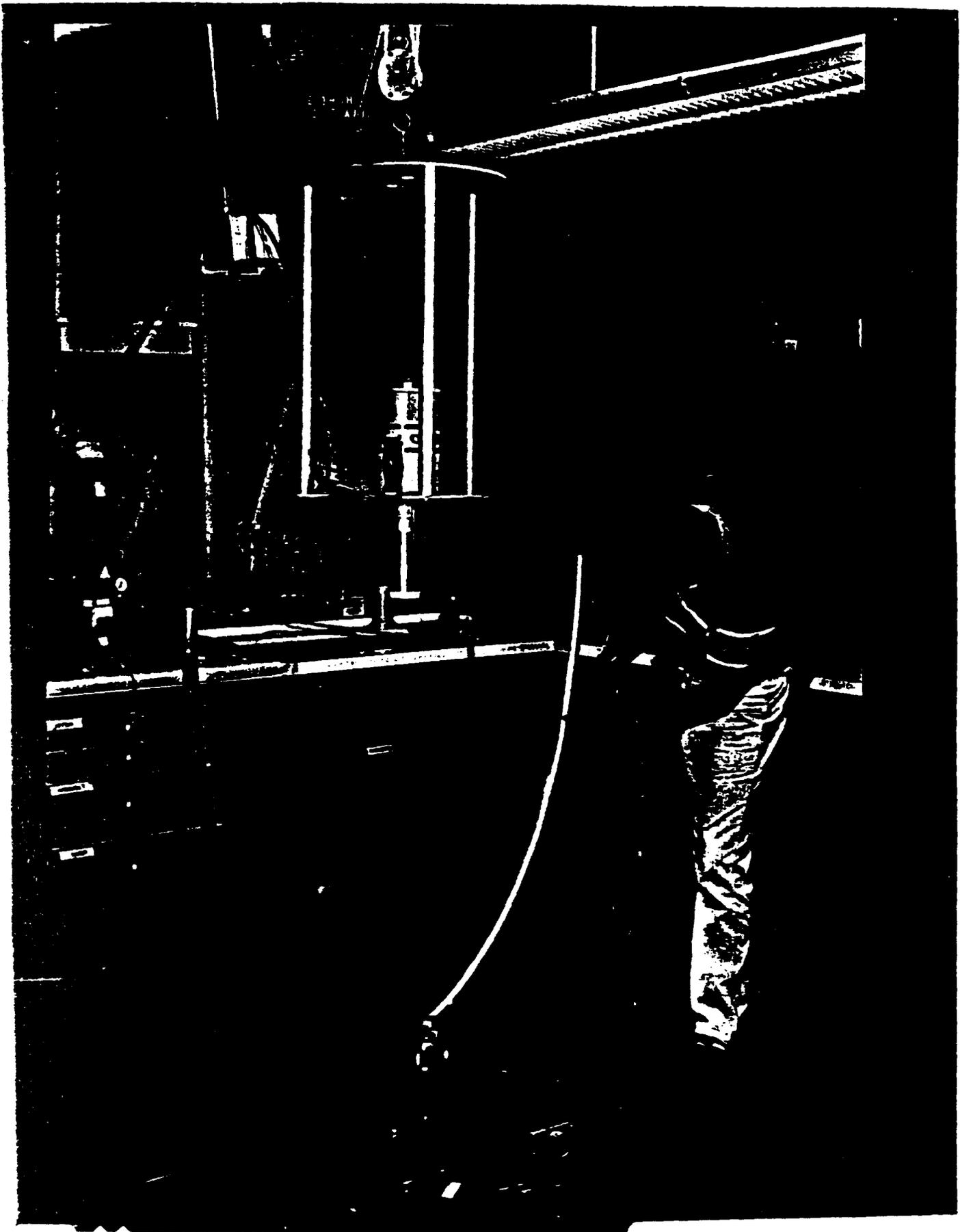
DOUGLAS SAWYER CALIBRATING
DIODE IN LABORATORY, LLNL

JK-6

ORERP PHASE 2 IN-SITU MEASUREMENTS

METHOD

- FIND SITE FROM DRI DESCRIPTION

- CONTACT RESIDENTS OR OWNER

- SET UP DIODE DETECTOR, CALIBRATE
  AND BEGIN MEASUREMENT

- SITE DESCRIPTION AND MAPPING

- SITE PHOTOGRAPHS

- RECORD DATA FROM PHA AND RETRIEVE
  EQUIPMENT

- SEND SITE DESCRIPTION AND DATA TO REECO
  SOIL SAMPLING TEAM

Date: 4 Oct 82   Time: 1645 w/1730 hrs Site # GC-42
Location: Douglas Co. School Dist. Headquarters (old middle school)
8th St,   Minden, Nevada

w-N-E

Mono Ave

Basketball Court Cement

Douglas Co. School
Dist. Headquarters

Playground

Playground
Equipment

Pavement

Pavement

Cyclone Fence
Power Pole

8th Street

7th Street

74'   73'   Lawn

160'   156'

55'

Athletic Field

154'   151'

Lawn

10'   47'   158'

Cyclone Fence

Country Rd.

Hedge

96

JK-8

9
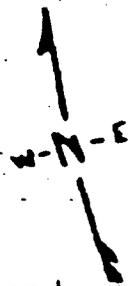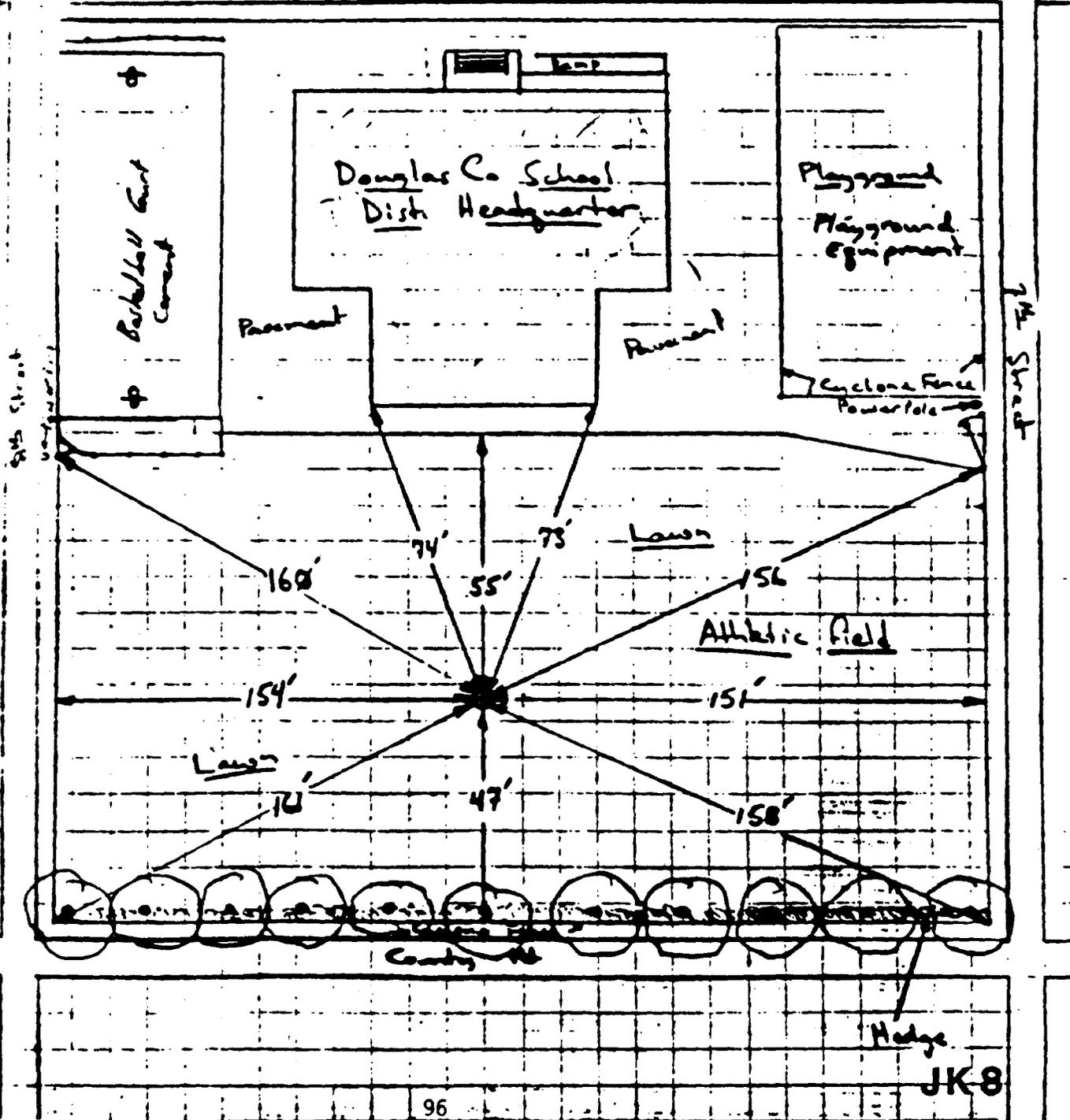
ORERP Phase 2

Number= 272

Median= 1.62e+01

Mean= 2.02e+01   Sigma= 1.35e+01

Geometric Mean= 1.69e+01   Geometric Sigma= 5.85e-01

125   Median   Mean

38

54

26

8   10   6   1   1   3
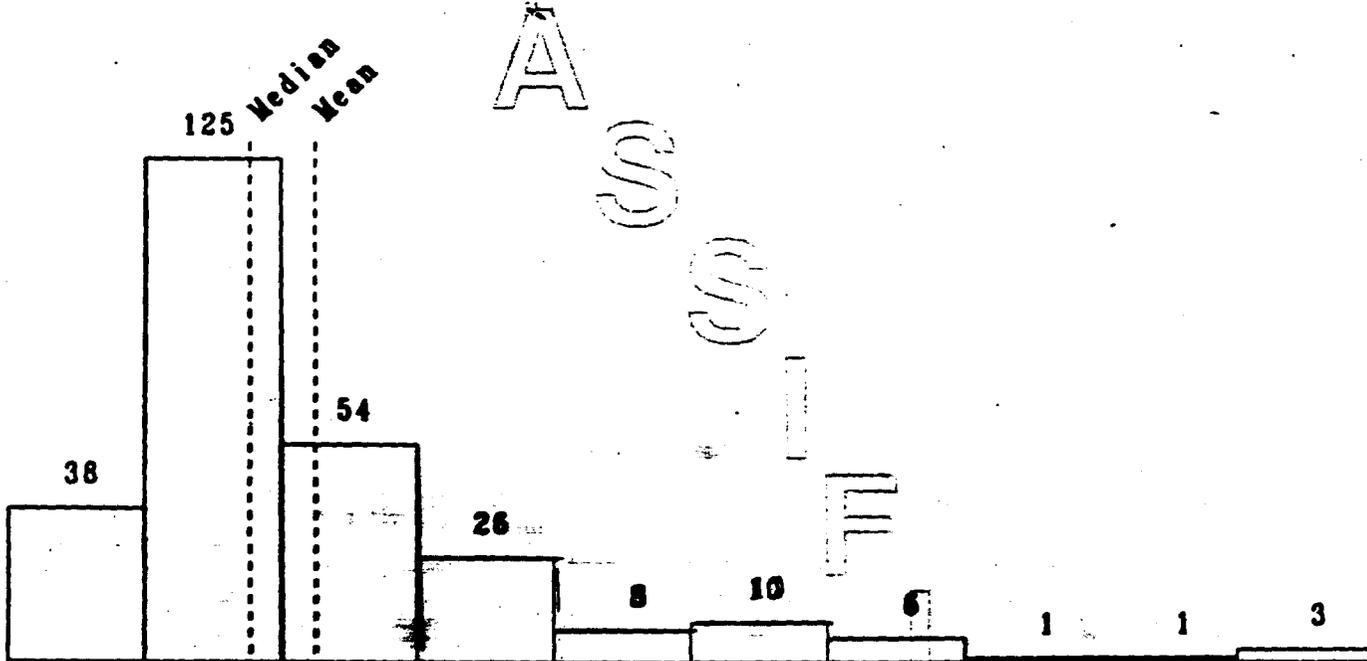
Minimum= 1.40e+00   Maximum= 8.51e+01

JK 9

ORERP Phase 2 Natural Habitat

Number=   63

Median=   1.41e+01

Mean=   3.40e+01   Sigma=   1.87e+01

Geometric Mean=   2.93e+01 Geometric Sigma=   5.67e-01
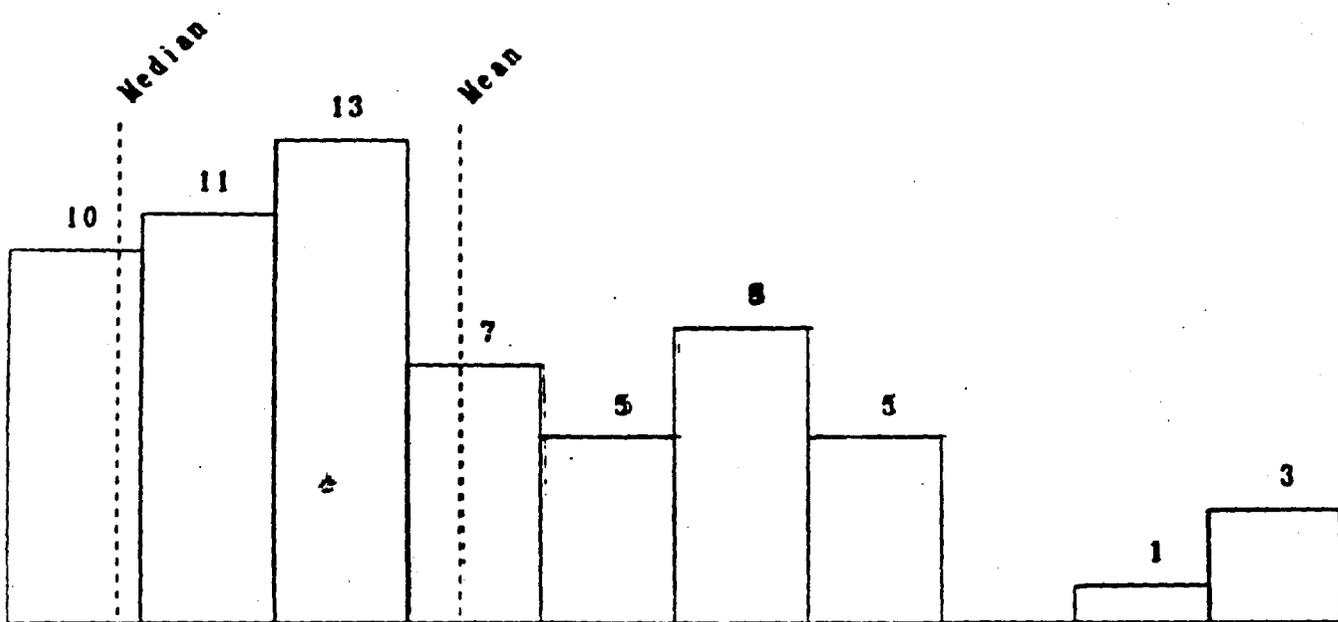
Minimum=   7.80e+00   Maximum=   8.51e+01

ORERP Phase 2 Lawn

Number= 209

Median=   1.39e+01

Mean=   1.60e+01   Sigma=   7.49e+00

Geometric Mean=   1.44e+01   Geometric Sigma=   4.82e-01
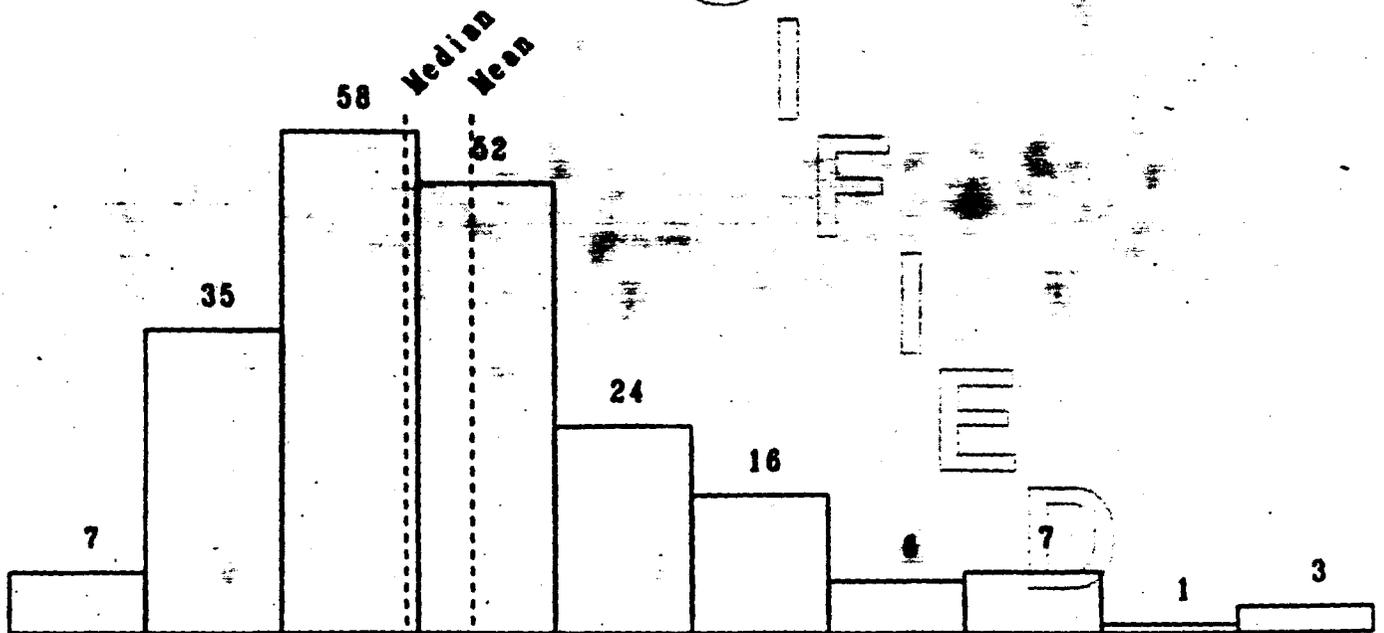
Minimum=   1.40e+00   Maximum=   4.44e+01

JK 11

99

LAS VEGAS, NV.
SQUIRES PARK
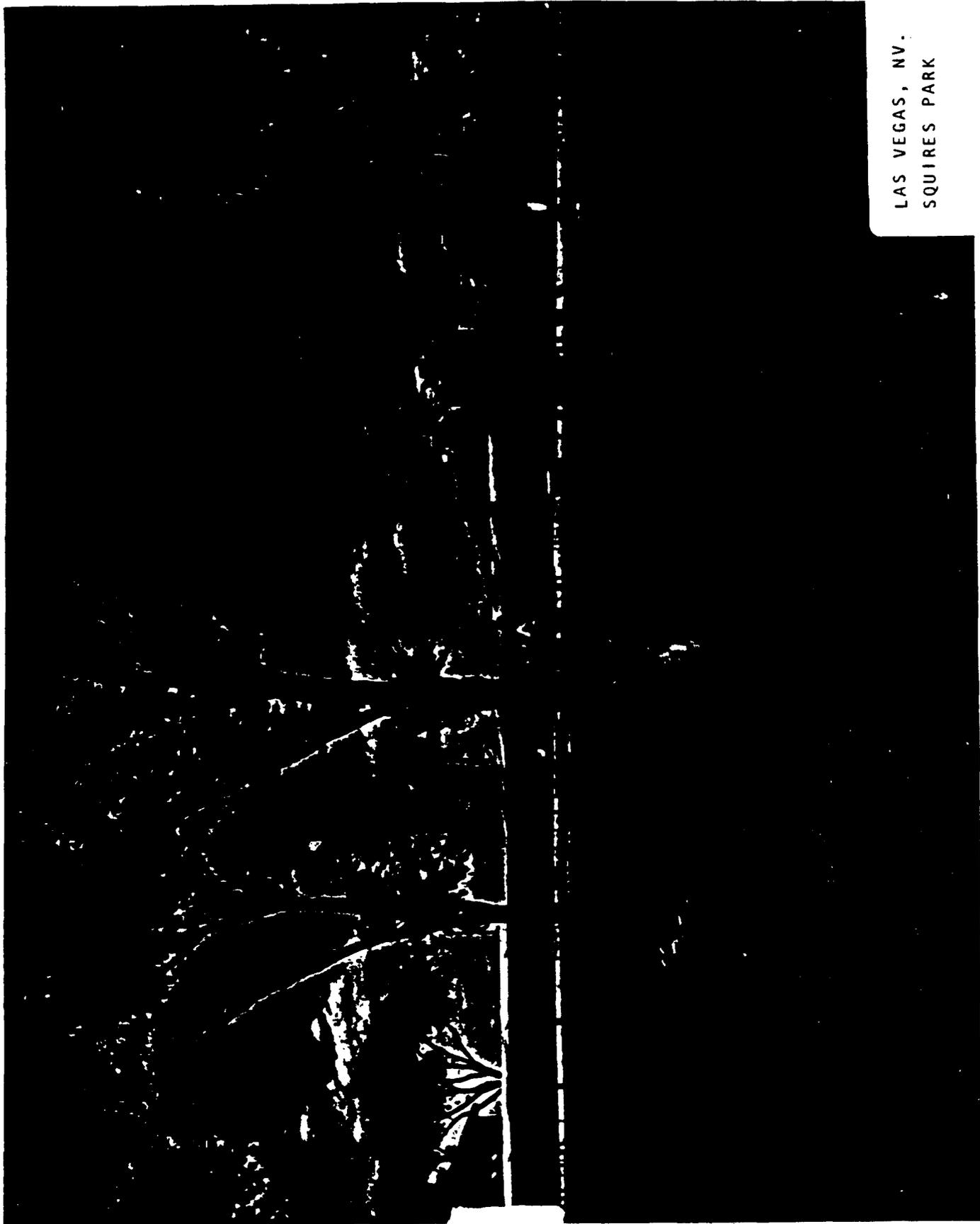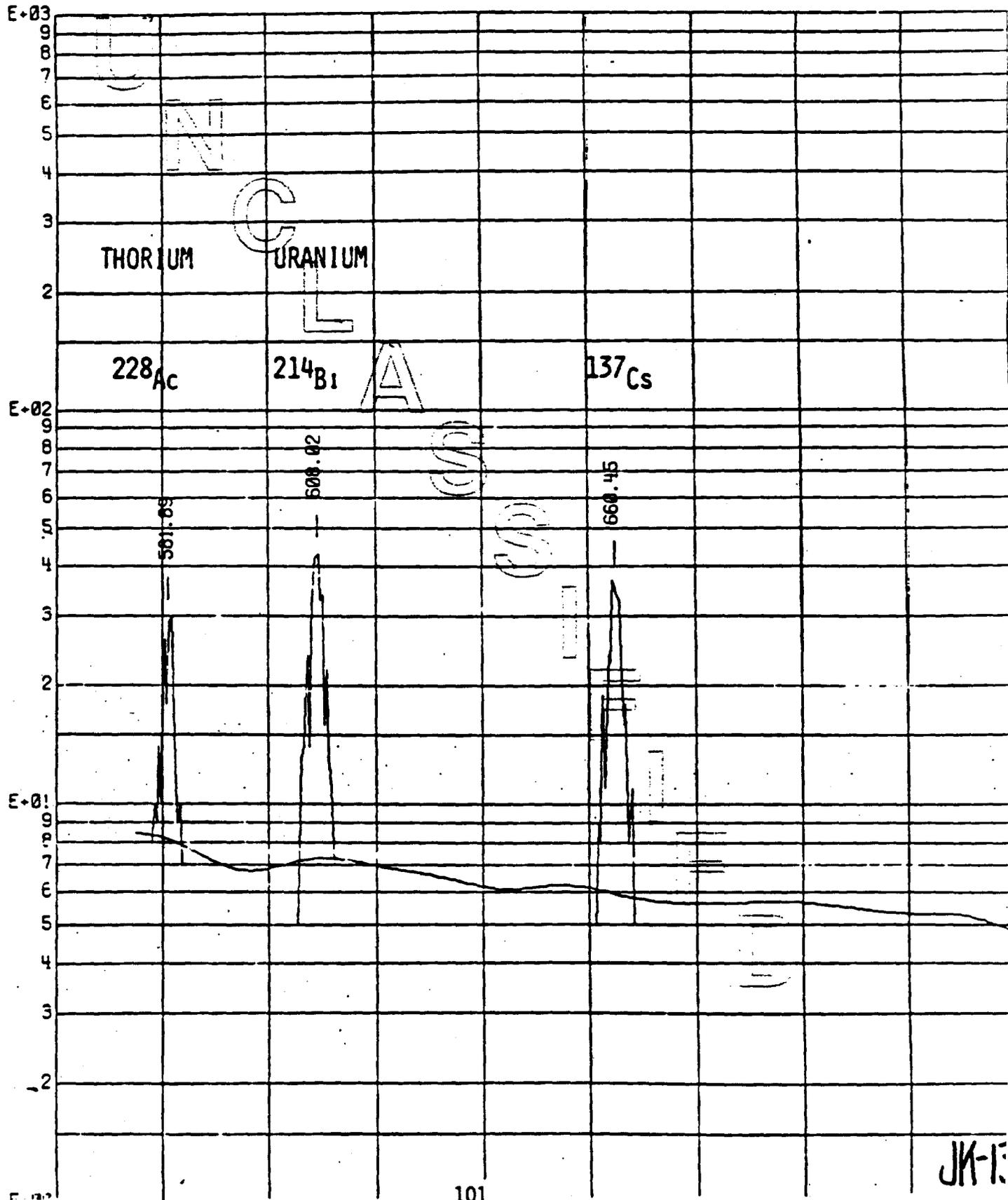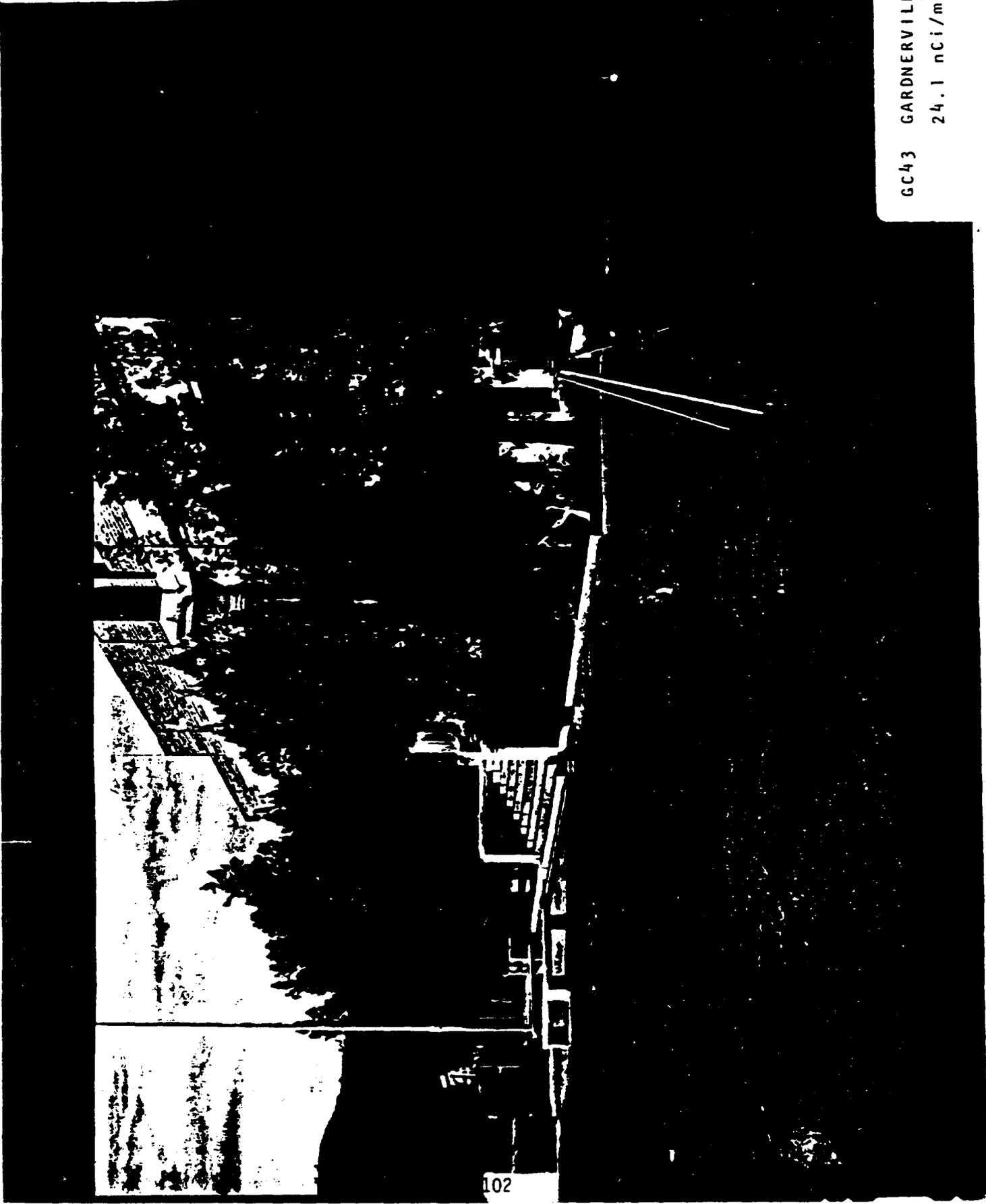
GC43   GARDNERVILLE, NV.
24.1 nCi/m^2

102
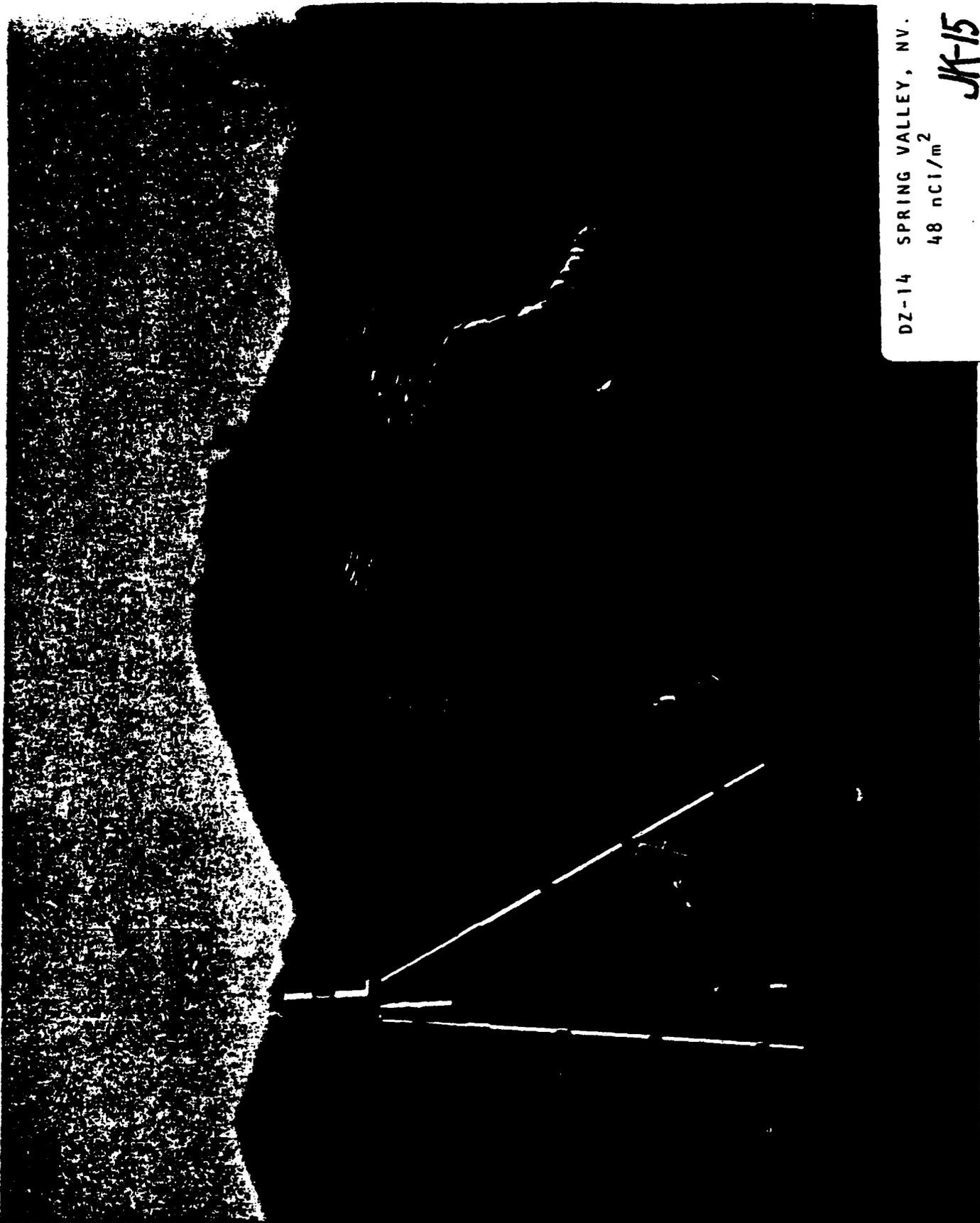
DZ-14 SPRING VALLEY, NV.
48 nCi/m²

JK-15
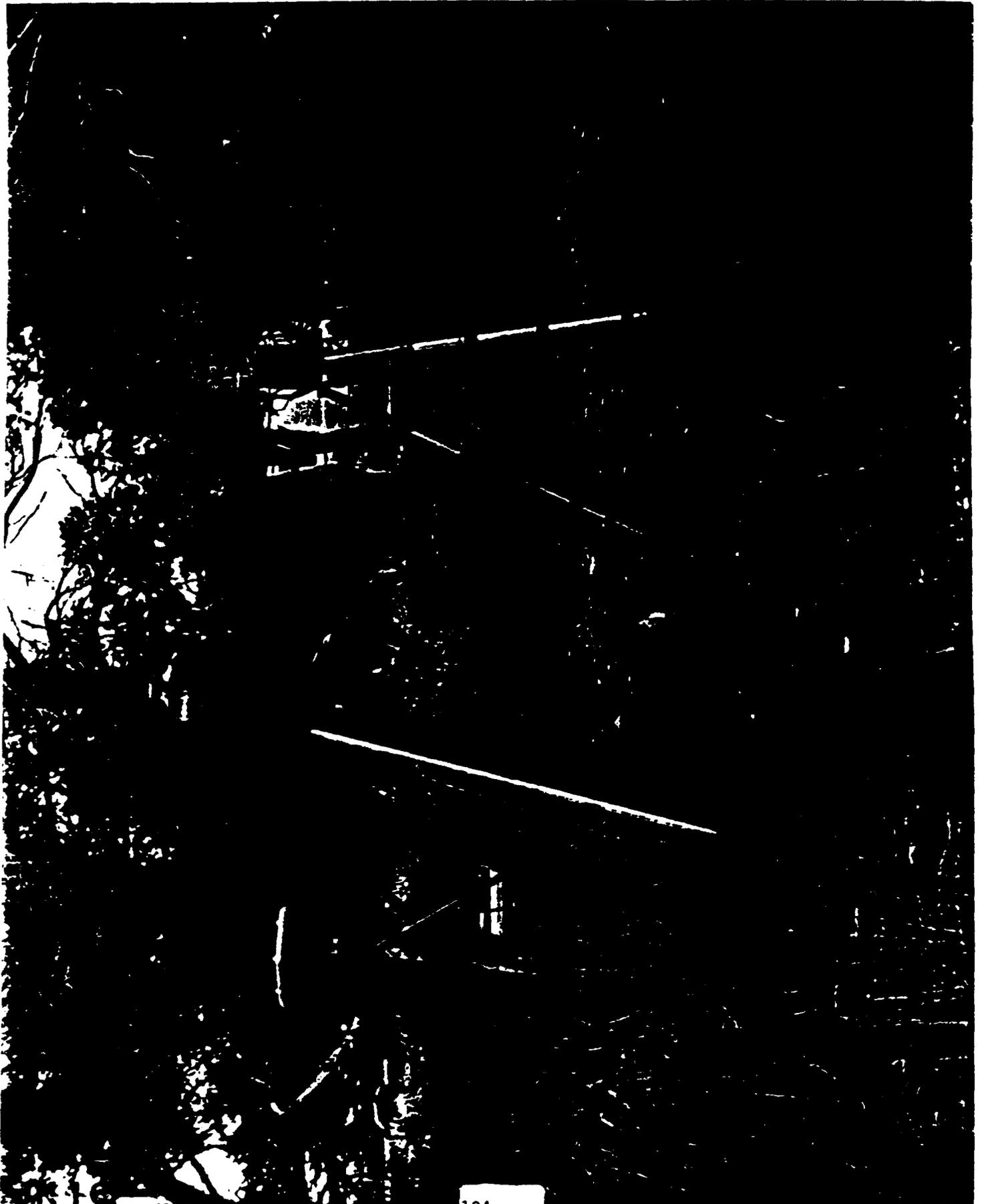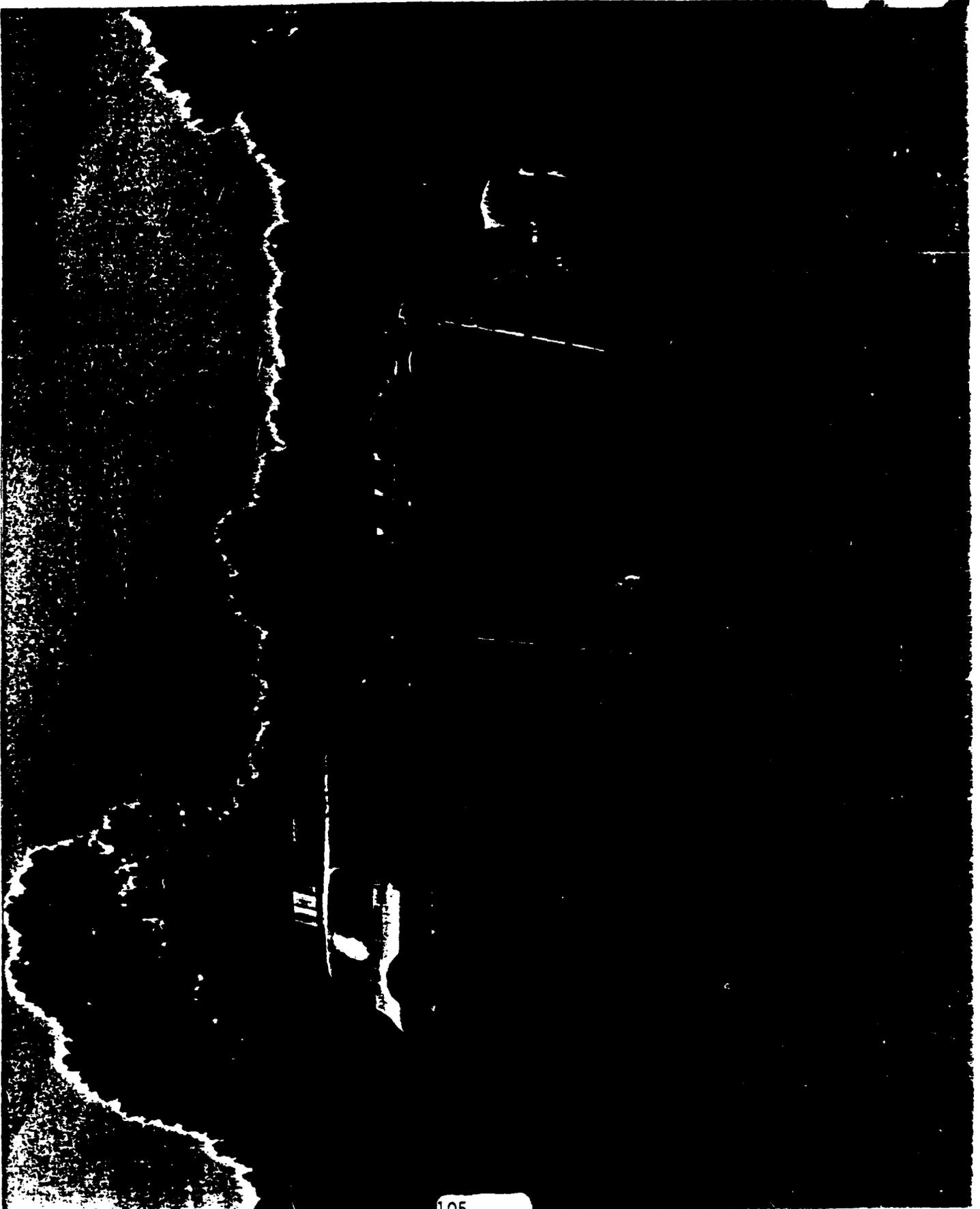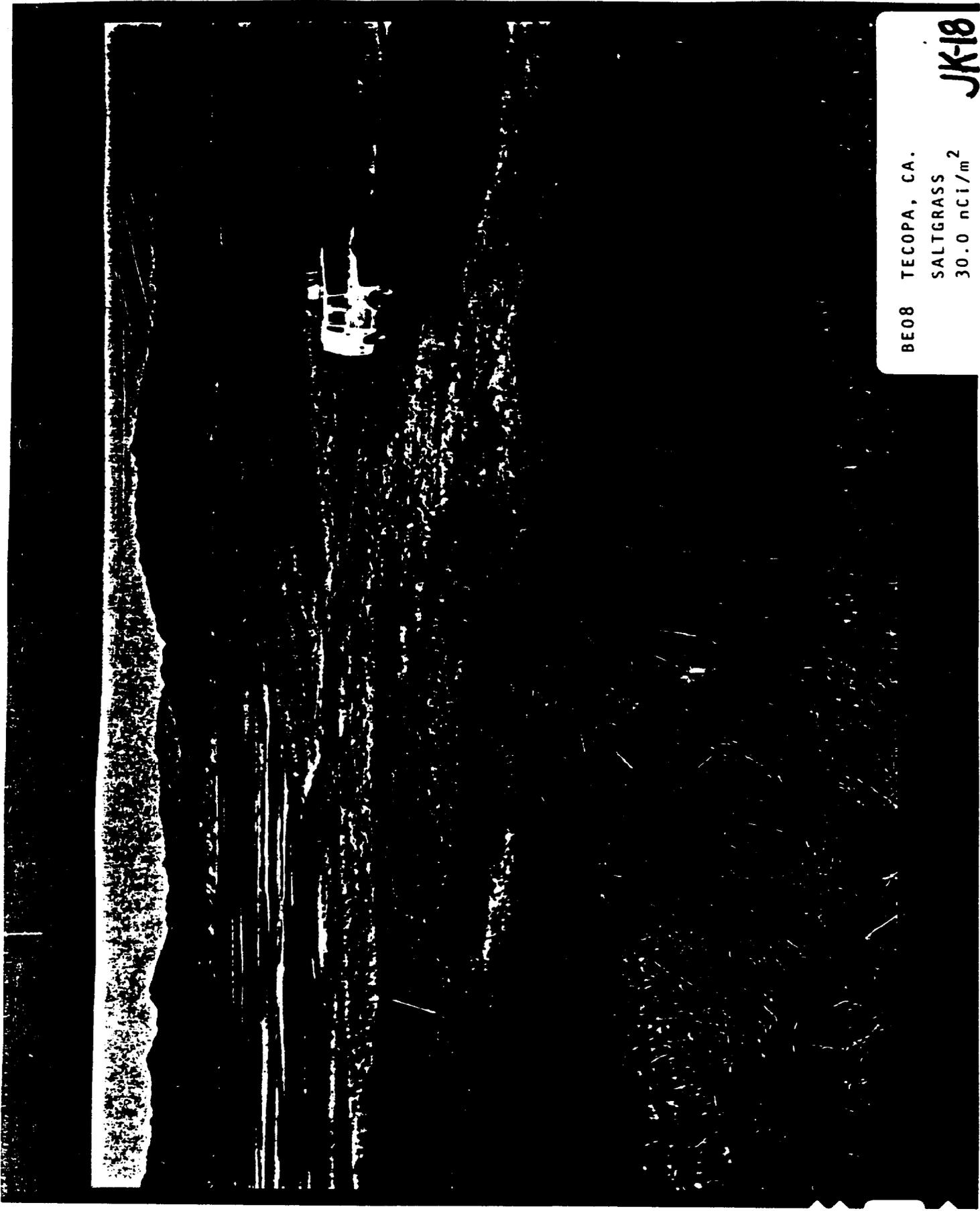
BE08 TECOPA, CA.
SALTGRASS
30.0 nCi/m^2

JK-18
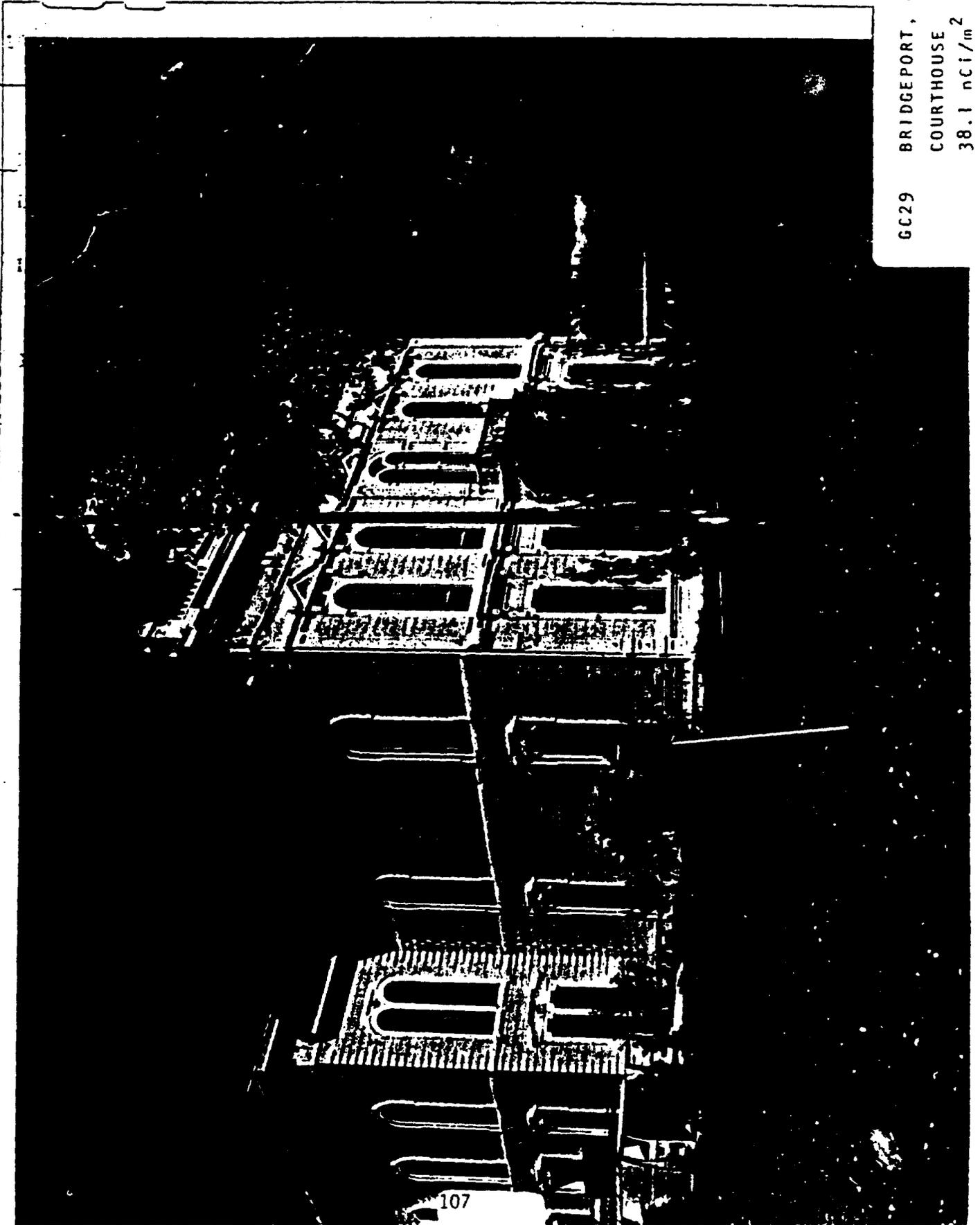
GC29   BRIDGEPORT, CA.
COURTHOUSE
38.1 nCi/m^2

107

JK20

GC01 Reno. NV
Univ. Nev., Quad

JK-20
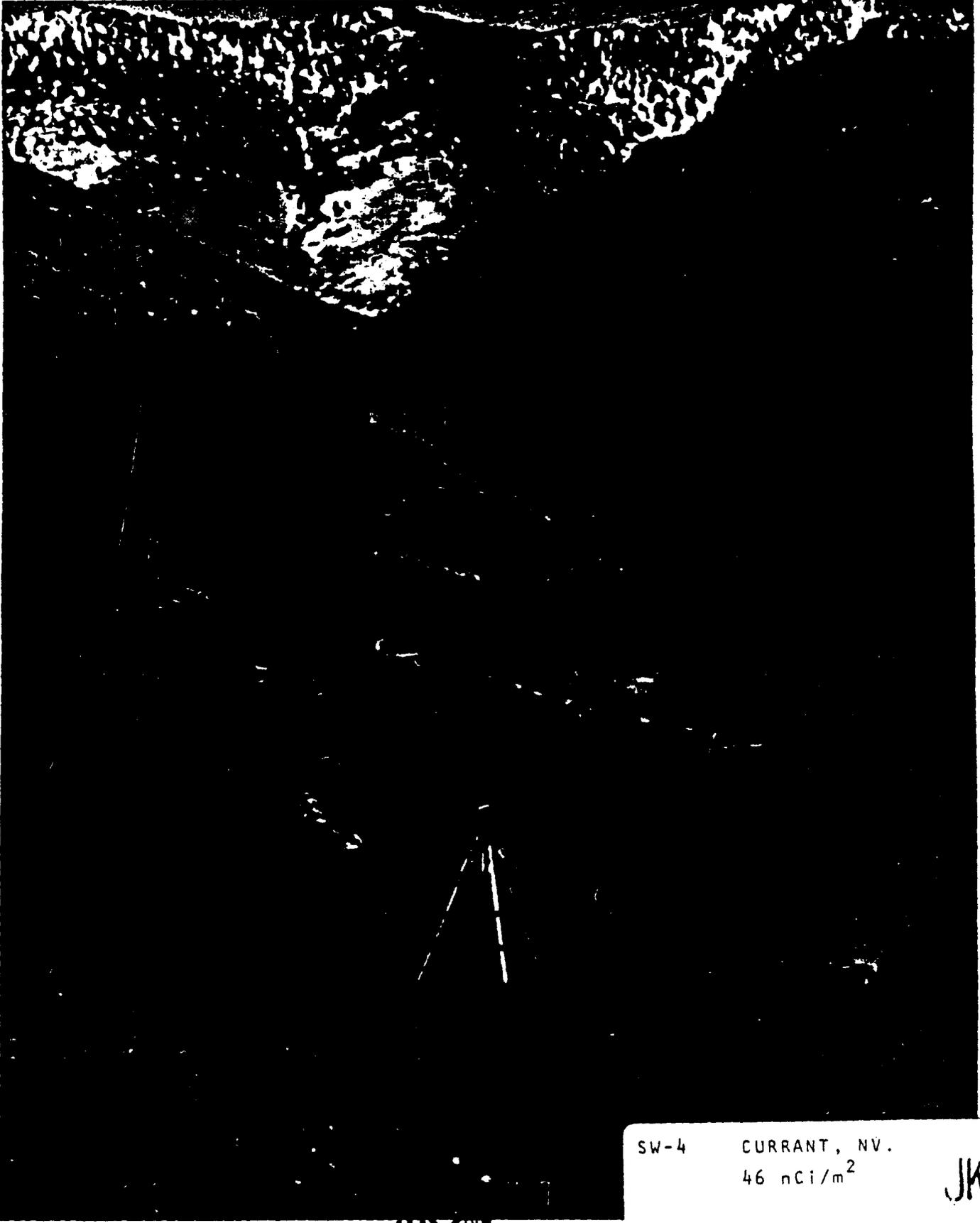
SW-4   CURRANT, NV.
46 nCi/m^2

PRESENT DATA BASE

- IDENTIFICATION   MH22
- LOCATION   BOISE, ID
- LATITUDE   43° 37' N
- LONGITUDE   116° 13' W
- ALTITUDE   2700'
- RAINFALL   12.3"
- HABITAT DESCRIPTION   STATE CAPITOL LAWN
- DATE MEASURED   26 JULY 1982
- PRELIMINARY nCi/m^2 72.8
- SITE CATEGORY   A (SAMPLE SOIL)

110

JK 22

1   CHAIRMAN MOSELEY: Howard Hawthorne is going to regale us next.

2   DR. HAWTHORNE: I'm Howard Hawthorne: I usually sit in the back of

3 the room. I'm accused of sitting back there so I can leave early. Bruce

4 will be relieved today to know that I am going to stay for all of this

5 presentation.

6   Could I have the viewgraphs, please. I'm going to go through the

7 viewgraphs rather rapidly because there are only certain points, and you

8 have copies of them for your later consideration. (REECo 20). We took

9 samples in nine states. We have a little different number of location. We

10 claim 117, and our number of sites remain at 190 as of the end of November.

11 The purpose of collecting the soil cores was twofold: one was to give the

12 validation for the in situ Cesium-137. The second purpose was to derive

13 ratios of Plutonium-239 and -240 from which EML can derive the source of

14 the fallout and the proportions due to NTS.

15   Our instructions were quite simple: Sample or reject. So we did not

16 make conclusions about the suitability of the spot at which the in situ

17 measurements were taken. We might have grumbled a little, but we didn't

18 really do anything serious about it.

19   Mention has been made that occasionally we could relocate the marks of

20 the tripods for the in situ measurement. We took our ten-core sample with-

21 in what Dr. Koranda indicated as the "X" range viewed by the detectors.

22 The difficulty with soil collections is that once you have the specimen in

23 the bag, that's the best that it will ever be. It doesn't matter who does

24 what to it afterwards, it will never get any better than the sample that

25 you took. If the sample you took is not representative, then neither will

26 be the data that you get later; so we go to what may seem to be some

27 extremes in the collection process.

28   I mentioned, we take ten cores. This goes back a long way historic-

1 ally. The core cutters take out 8.9 centimeter diameter cores, and the

2 instructions were: collect from grassy lawns. Sometimes that didn't quite

3 happen, and we had to sample where the stake was drawn. John will be glad

4 to know that he can still find some of the places because we couldn't get

5 the stakes out that he drove to mark the spot so we drove it all of the way

6 down, John.

7   The ten cores represent a fixed area and that area is represented in

8 the collection process by a volume. If the volume is incorrect, i.e., the

9 specimen is too shallow, or is too deep, or is too wide, then the area is

10 misrepresented; and so, as you will see, we provided solutions for all

11 conditions that we came to.

12   For Arizona (REECo 21), we had 21 locations, 44 sites. A location was

13 defined initially and directed for as a place from which for some reason

14 there was a decision to take samples, and Frosty's group went to the

15 locations and designated the sampling sites.

16   In California (REECo 21) we have 12 locations, 15 sites. Those of you

17 who are speed readers have gotten over and found there is no REECo 22.

18 Twenty-three is correct. Twenty-two was of interest mainly to us because

19 it showed that at the start of the program we had a few samples collected

20 and by the end of October, we had a lot. I think that sort of is

21 understood.

22   In western Colorado (REECo 23) there are ten locations, 14 sites. In

23 southern Idaho (REECo 23), eight locations, 11 sites. In New Mexico

24 (REECo 23) five locations, 11 sites. Nevada (REECo 24) obviously got the

25 bulk of the collections, 46 locations, 76 sites. Southeast Oregon

26 (REECo 25), three locations, four sites; Utah, eight locations, 10 sites;

27 and southwest Wyoming, four locations, five sites.

28   Next figure (REECo 26)). This is a figure made from the data supplied

1 to us by Dr. Anspaugh for the sites from which soil collections were

2 actually made. The numbers under the graph are the numbers of specimens.

3 The lefthand side gives you the percentages of the sites that fell into one

4 of these concentration categories. As you can see, our figure is quite

5 similar to that of Dr. Koranda's in which he gave a figure representing all

6 of the measurements taken.

7 Dr. Miller showed the base map. (REECo 27). We have a little yellow

8 dot at each of the sites from which we collected samples. As you can see,

9 Utah has not yet had much attention in this Phase II.

10 Let's go to the next viewgraph (REECo 28), please. I have divided up

11 the soil collection process into five categories of activities, and these

12 will be illustrated by the slides that are next. Initially we thought that

13 we were going to be able to keep that figure on the screen. We will not be

14 able to.

15 Soil sampling equipment came in four sizes. (REECo 31) I may lapse

16 and call the three on the left cookie cutters, occasionally, but they are

17 really core cutters, and the equipment on the righthand side is a standard

18 soil auger which collects to 30 cms. This one has a special order barrel

19 which gives a length of 30 cms from the bottom of the cutter to the top of

20 the barrel.

21 We used color-coded buckets (REECo 32) into which the increments went

22 because sometimes it's a lot easier to see a color than it is to find the

23 number on the back of a container. It also helped us keep the cores that

24 went into a particular increment separate from cores from some other

25 increment.

26 (REECo 33). The first thing that we needed to do after we had gotten

27 to the site was to find where Livermore had taken their readings. There is

28 actually a tape measure lying on the ground between the tree and Nancy

1 Rothermich. Nancy, who is back in the audience, and Bernie Maza took most

2 of the samples that were taken, sometimes together and sometimes with

3 another team member.

4   (REECo 34). We had a horror of losing a specimen or getting one

5 mislabeled. The first thing we did was to make out an ID tag which went

6 into a little ziplock baggy. The baggies went into the bottom of the large

7 plastic bag in which the specimen was collected.

8   (REECo 35). There was a question raised about site identification.

9 We're taking a polaroid picture there, and -- I'm sorry, that's a 35-mm.

10 We took 35 mm from three different positions taken with the idea that the

11 person looking at the picture would be guided in getting back to where the

12 sample site had actually been. We also took a polaroid picture of the site

13 where the holes were actually made for future reference in terms of later

14 assessments of the suitability of the microsite.

15   (REECo 36). We start down in the sampling. This is a 0-5 cm core

16 cutter. You can see its relative size compared to the gloved hand.

17 (REECo 37). We drove the core cutters down with a hammer. At one time

18 these were actually collected by standing with your heels on the edge of

19 the cookie cutter which is a very precarious place to stand. It goes a lot

20 faster if you can drive the cutter into position. You need to be careful

21 that you pound equally on both sides of the handle so that your cutter is

22 driven vertically.

23   (REECo 38). EML sent us a steel driver which was very useful in a

24 number of locations. The gloves become very much appreciated along about

25 .3:30 on the afternoon of the first day of hammering. The midsize cutter

26 (REECo 39) and the long one (REECo 40). This one goes down to 15 cms. The

27 normal procedure would be to take the 0-5 cm core, then the 5-10 cm incre-

28 ment, and finally, with this cutter, the 10-15 cm increment in all of those

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places designated as grassy lawns. For locations which could not be called grassy lawns, we were under instructions to cut the top increment at 2.5 cms, divide it into the first and second increments, collect the 5-10 cm increment as the third sample, and go with the soil auger (REECo 41) from 10-30 cms. The vegetation at this particular site is rather heavy. This makes problems which we will address a little later.

(REECo 42). If the breakoff point for the increment is deeper than it should be, we trimmed, using the base of the core cutter as a guide. The excess material, we dropped into the next lower increment. Cleaning the cutters sometimes gets a little strenuous (REECo 43). Here an eight-inch knife is going in after the core. Another way (REECo 44) was to pound on the outside with a rubber mallet. There is a degree of photographic license in some of our slides. Normally we did not hold the cookie cutter up in the air and thump it. It was down in the bucket when it got pounded on.

This (REECo 45) is the auger we showed earlier. It is a neat fit inside the hole made by the last and longest core cutter. We knew we were at 12 inches or 30 cms when the top of the barrel was even with the surface we had designated as our zero starting point. Sometimes you could pour the soil out; sometimes you had to pound it out.

We come now to some of those special places which were sort of skipped over by Frosty. John Koranda showed a horrible example that looked like it came off the salt beds at Death Valley. Fortunately we didn't have many of those, but we had solutions for all of the kinds-of sampling sites that we came to. These (REECo 46) are some of the tools, knives, spatulas, and, occasionally, (REECo 47) hammer and chisel.

(Laughter)

The chisel has a little extra flourish. You can use it in a very grassy

1 site (REECo 48) to twist out the core cutters. Sometimes (REECo 49) you

2 just have to go to it, and if this happened, then the criteria scheme came

3 into action later. As the cores were taken, each increment was recorded in

4 the bound notebook (REECo 50), and its history was written right there as

5 you did it, not after you had done seven of them, or all 10, and were back

6 in a motel, but as each of the forty core increments was taken, the notes

7 were made in the book.

8   This (REECo 51) wasn't really how we found many places. We probably

9 had two cases out of a thousand increment cores where this arose. The

10 problem is that there is no problem getting the core cutter out. It will

11 just come right out, but nothing comes with it and so the solution there

12 (REECo 52) is to pour some water on it. We would pour a small amount of

13 water around the cookie cutter to maintain the integrity of the hole we

14 were making and some water into the cookie cutter itself, let it infiltrate

15 for a short period of time, and then (REECo 53) go in from the other end of

16 the cookie cutter and take the sample out with a spatula from the top.

17 Fortunately, we didn't have a great many of those, but it is possible.

18   Sometimes you could get the feeling when you started to lift on the

19 core cutter that nothing was coming with it. In those cases we would go

20 back in and tamp the soil (REECo 54) that was supposed to have been coming

21 up. Usually we could get it. If you had a super-reluctant specimen, then

22 we could resort to wetting it (REECo 55) and tamping it.

23   In terms of data recording (REECo 56), I have already shown you the

24 card in the baggy that has a full description of the increment including

25 those persons who are later to be considered either heroes or villains and

26 the date on which they made the collection. The soil is poured right into

27 the large specimen bag on top of that small baggy, and we write another

28 description (REECo 57) with almost the same information that is on the card

1 across the closure label with a flowmaster.

2   We took polaroid pictures (REECo 58) as I mentioned earlier, and those

3 right at the time got stapled to our logbook, as is happening here

4 (REECo 59). The logbook (REECo 48) at the time that you are ready to leave

5 the site had a hand-drawn map, had a polaroid picture of the

6 microenvironment at the sampling site, the pertinent information describing

7 its identification, and the ten core descriptions. This one looks like it

8 probably was an "A" according to our criteria. Please bear in mind that

9 our criteria are connected to the vertical dimension and not to the surface

10 conditions and their suitability or unsuitability.

11   Once you have gotten your sample, the next thing is to clean up and

12 everything got washed. We washed the large cutters (REECo 60), and the

13 small cutters (REECo 61); we washed them on the inside (REECo 62), and we

14 washed them on the outside (REECo 63). Last of all, don't forget to do the

15 buckets (REECo 64). In terms of walking away and leaving a mini-driving or

16 putting range in place, we avoided that by collecting soil (REECo 65) which

17 was tamped into the holes as they were filled (REECo 66) so that when we

18 left the site, the surface had been restored at all of the locations

19 (REECo 67). Unfortunately, we don't know how that worked because we

20 haven't been back to look at them.

21   The happy part comes when you load it all back into the vehicle and

22 this (REECo 68) is what you had better get back to the lab with when you

23 have been out on an expedition.

24   We move now to the criteria. If you would go back to -- as I

25 mentioned, our criteria dealt with the vertical dimension of the soil

26 samples, and our rating scheme started, you might feel, in reverse. We

27 noted all of those conditions which might have impaired the volume

28 representing the area or which could have contributed to

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cross-contamination of the material. There was an automatic "C" rating if the sidewalls of the holes collapsed and fell into the hole, and if after several attempts at other locations to collect samples we were unsuccessful, then we would say that was a "C" site. There is likely to be transfer of material vertically that was not at the lower level when we came to the site. If we were unable to collect a full 30 cms, that also gave an automatic "C" rating.

If extraction of the samples required use of any of the special techniques, that also was considered very seriously. A "B" rating came from those places where some of the holes had stones that had to be extracted manually. There was an automatic presumption that we cross-contaminated the lower sample, or if most of the cores needed to be trimmed indicating that an excess of material had come up the first extraction. If none of these things happened, then we rated it as an "A" site; so, our criteria and our rating do not have the same quality, I might say, as those done by DRI and by Livermore.

That concludes the collection process. You may be wondering what those other two pages are. Those are for my next presentation which deals with soil processing. They are all attached together. It may not have been a good idea, but it seemed like a good idea at the time. Are there any questions?

CHAIRMAN MOSELEY: Are there any questions on this aspect?

DR. WARD: What kind of an array do you have for the ten samples that you take around the centerpoint? I didn't see a plan view of the holes, or is there but one?

DR. HAWTHORNE: Normally it was linear, straight line.

DR. WARD: I see, march along in one direction.

DR. HAWTHORNE: We tried to drive the stake where we thought the

1 centerpoint for Livermore's equipment was. That would be number 5 or

2 number 6 in our line and approximately 14-16 inches apart for the cores.

3   DR. WARD: If one were to repeat your work, you would want to do the

4 same thing.

5   CHAIRMAN MOSELEY: You'd have to have that sample if you repeated it

6 very precisely.

7   DR. WARD: That's one of the hazards of perfection.

8   CHAIRMAN MOSELEY: We will take a 20-minute break and start again at

9 10:40.

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11   (SHORT RECESS)

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REECo Soil Collections through November 1982

STATE	LOCATONS	SOIL SITES COLLECTED
Arizona	21	44
California	12	15
Colorado	10	14
Idaho	8	11
New Mexico	5	11
Nevada	46	76
Oregon	3	4
Utah	8	10
Wyoming	4	5

Totals:

Number of States =	9
Locations =	117
Soil Collection Sites =	190

REECo Soil Collections in Arizona through November 1982

Bullhead City	1
Chinle	1
Flagstaff	6
Fort Defiance	2
Fredonia	1
Ganado	2
Holbrook	1
Jacobs Lake	1
Joseph City	1
Kingman	2
Littlefield	2
Moccasin	1
Mt. Trumbull	1
North Rim Grand Canyon	5
Peach Springs	2
Sawmill	1
Seligman	1
South Rim - Grand Canyon	7
Tuba City	1
Tuweep	2
Williams	3

Totals: 21 Locations   44 Sites

REECo Soil Collections in California through November 1982

Big Pine	1
Bishop	2
Bridgeport	1
China Lake	1
Furnace Creek	1
Independence	1
Inyokern	1
Lone Pine	2
Ridgecrest	1
Shoshone	1
Tecopa Hot Springs	1
Tom's Place	2

Totals: 12 Locations   15 Sites

REECo Soil Collections in Colorado through November 1982

Cortez	1
Craig	2
Durango	2
Fruita	1
Mancos	1
Meeker	1
Montrose	2
Rifle	1
Silverton	2
Telluride	1

Totals: 10 Locations   14 Sites

REECo Soil Collections in Idaho through November 1982

Boise	1
Burley	3
Filer	1
Idaho Falls	1
Malad City	2
Meridian	1
Pocatello	1
Twin Falls	1

Totals: 8 Locations   11 Sites

REECo Soil Collections in New Mexico through November 1982

Albuquerque	5
Crystal	2
Farmington	2
Gallup	1
Kirtland	1

Totals: 5 Locations   11 Sites

REECo Soil Collections in Nevada through November 1982

Alamo	4
Austin	4
Baker	1
Battle Mountain	1
Beatty	1
Big Smokey Valley	1
Boulder City	1
Bunkerville	2
Caliente	1
Carson City	3
Clover Valley	1
Current	1
Duckwater	1
Elko	1
Ely	5
Eureka	1
Fallon	2
Gabbs	2
Gardenerville	2
Gerlach	1
Hawthorne	2
Henderson	2
Hiko	2
Indian Springs	1
Lages Station	1
Las Vegas	1
Logandale	1
Lovelock	2
Lund	1
Mesquite	1
Minden	1
Moores Station	1
North Las Vegas	2
Overton	
Panaca	2
Pioche	2
Preston	1
Reno	6
Spring Valley	1
Stewart	1
Warm Springs	2
Wells	1
Winnemucca	1
Yerington	2

Totals: 46 Locations   76 Sites

REECo Soil Collections in Oregon through November 1982

Burns	1
Hines	1
Jordan Valley	2
Totals: 3 Locations	4 Sites

REECo Soil Collections in Utah through November 1982

Callao	1
Ibapah	2
Iosepa	1
Rosette	1
Skull Valley	1
Snowville	1
Tooele	2
Wendover	1
Totals: 8 Locations	10 Sites

REECo Soil Collections in Wyoming through November 1982

Afton	1
Evenston	1
Kemmerer	2
Rock Springs	1
Totals: 4 Locations	5 Sites

REECo 26

LLNL *in situ* cesium-137 (nCi/m²)

200.00   1
190.00   1
180.00   2
170.00   0
160.00   0
150.00   0
140.00   2
130.00   1
120.00   2
110.00   5
100.00   4
90.00   5
80.00   8
70.00   6
60.00   14
50.00   19
40.00   31
30.00   48
20.00   26
10.00   6
0.   4

PERCENT OF 190 SOIL SITES COLLECTED BY REECo

35 30 25 20 15 10 5 0

PHASE II - SOIL COLLECTING SITES
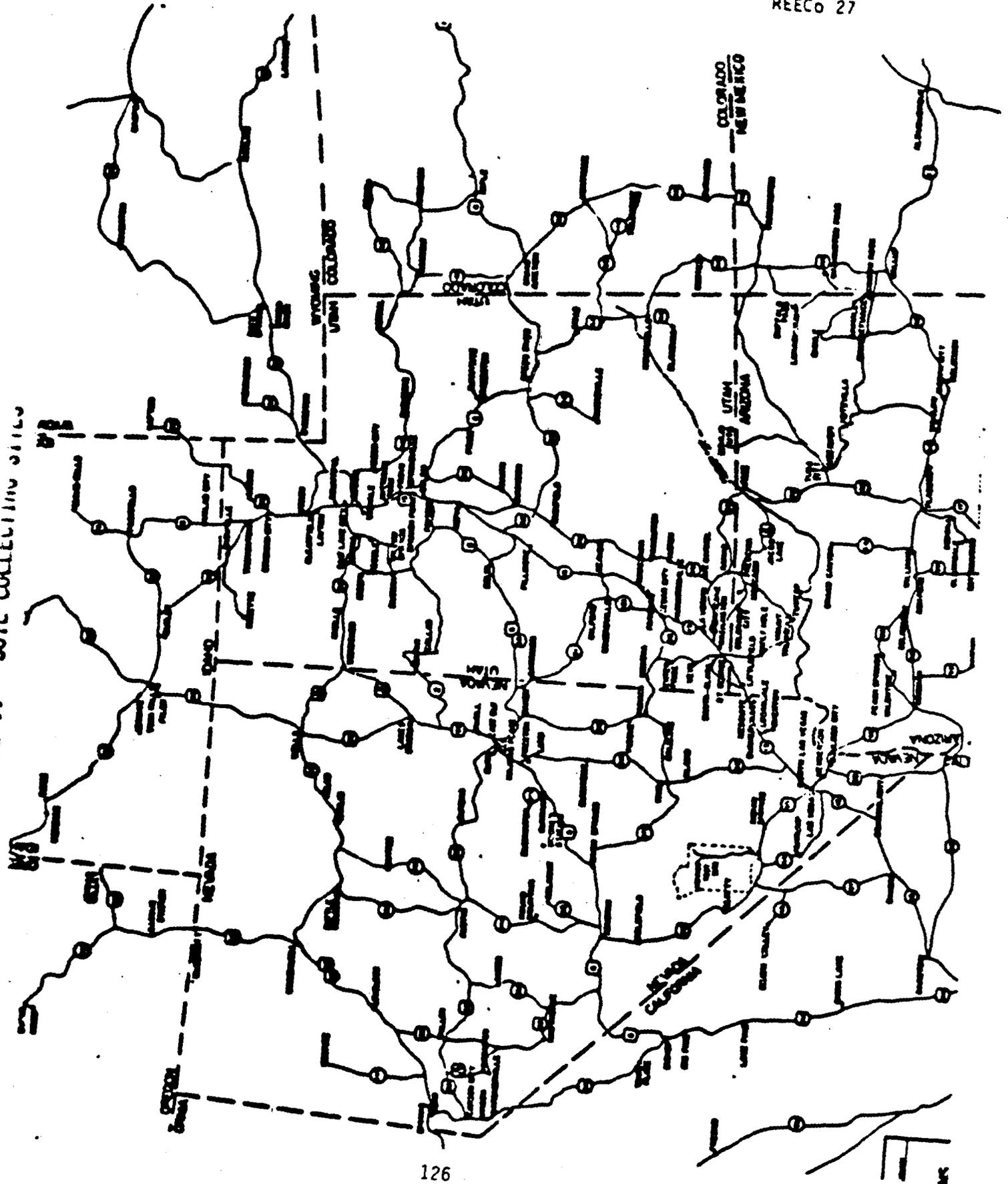
- **Tools at rear of room**
  - 3-cored increments taken
  - Remainder to 30 cm by soil auger
  - Individual buckets for each increment

- In situ TRIPOD SETTING RELOCATION

- Selection of coring devices for site: lawn to 15 cm, pasture to 10 cm

- Preparation of labels for site by increments and photos

COLLECTING SOIL CORES

- Cored increments: Cutting soil and roots
  Core extractions

- Auger use: lawns: 15-30 cm, non-irrigated: 10-30 cm
  - Special techniques
    - Spatula without plant cover 0-2.5 cm
    - Turning and cutting roots
    - Tamping loam
    - Wetting sands around hole and in cutters
    - Chisel and hammer for rocks
    - Removing rock from hole

DATA RECORDING

CLEAN-UP PROCEDURE

SITE RESTITUTION
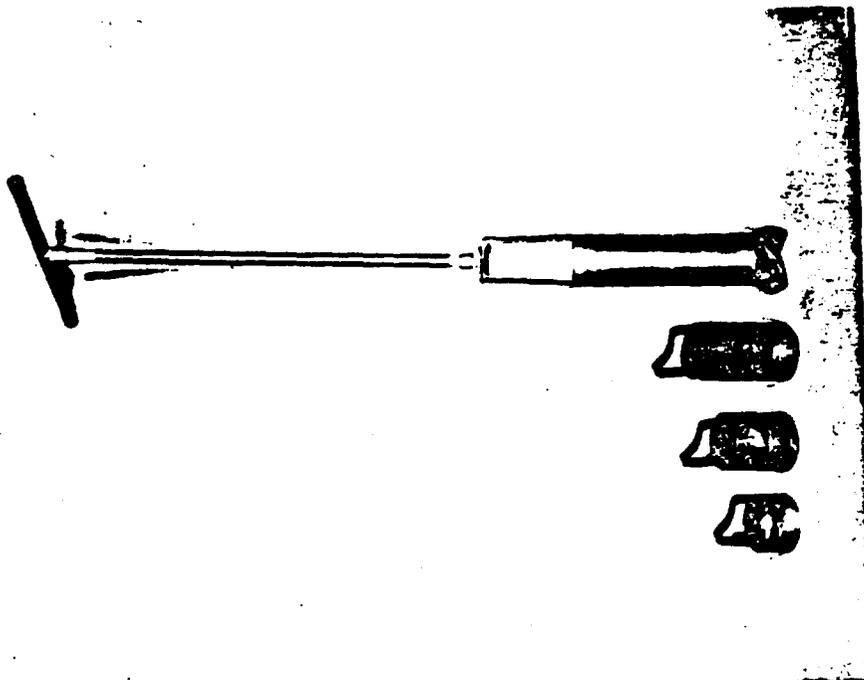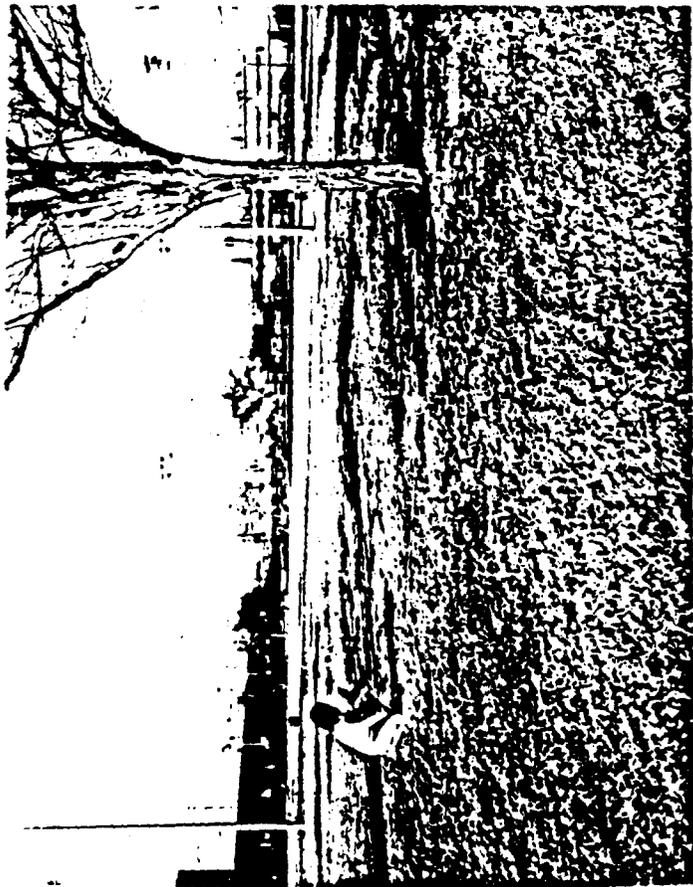
REECo-32 (P-3490)

REECo-31 (P-3473)
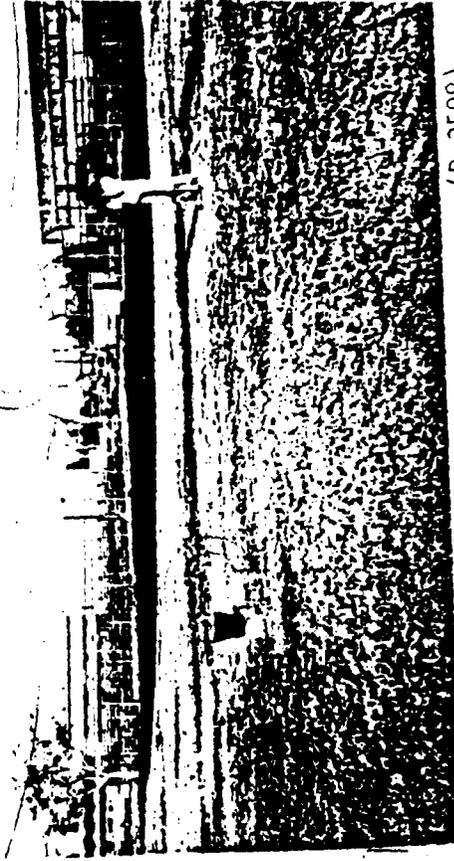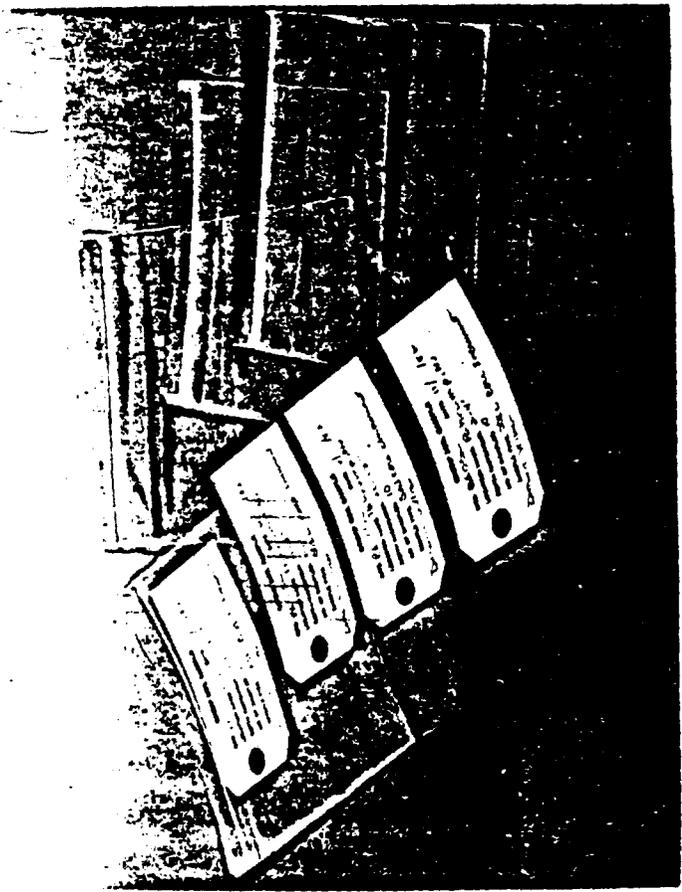
(P-3508)

REECo-35

(P-3534)

REECo-36

(P-3507)

REECo-33

(P-3480)

(P-3524)

REECo-39

(P-35

REECo-40

(P-3533)

REECo-37

(P-3481)

REECo-38

130
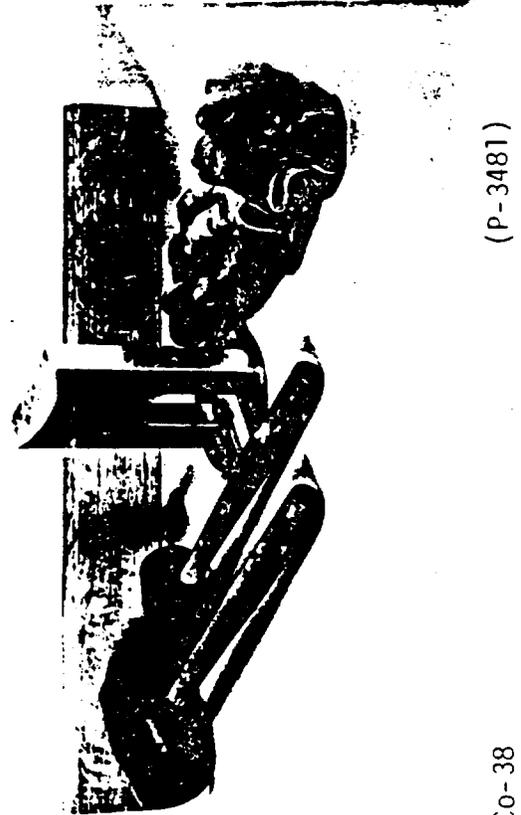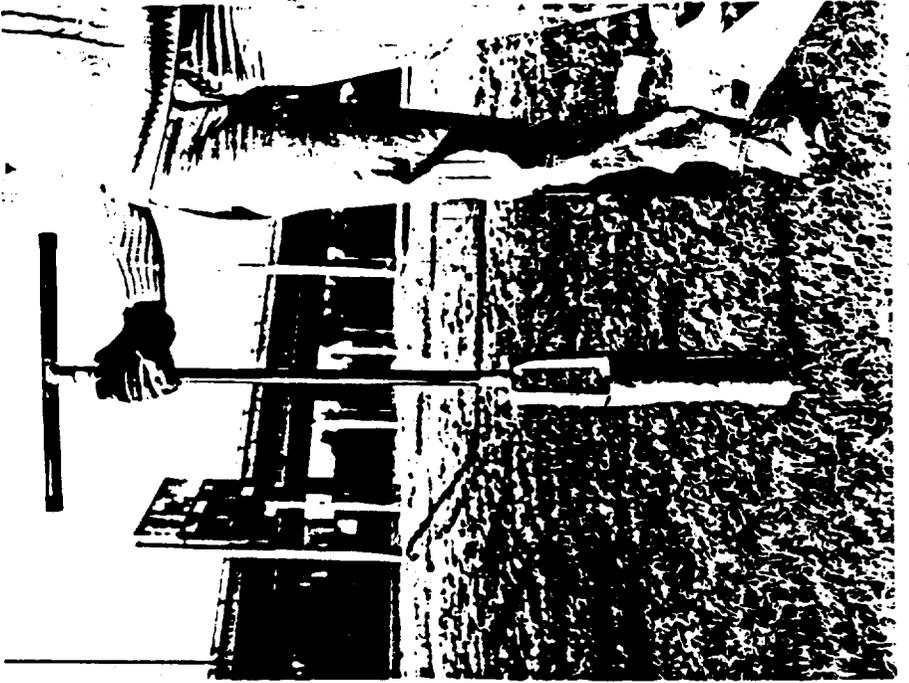
REECo-42 (P-3528)

REECo-41 (P-3517)
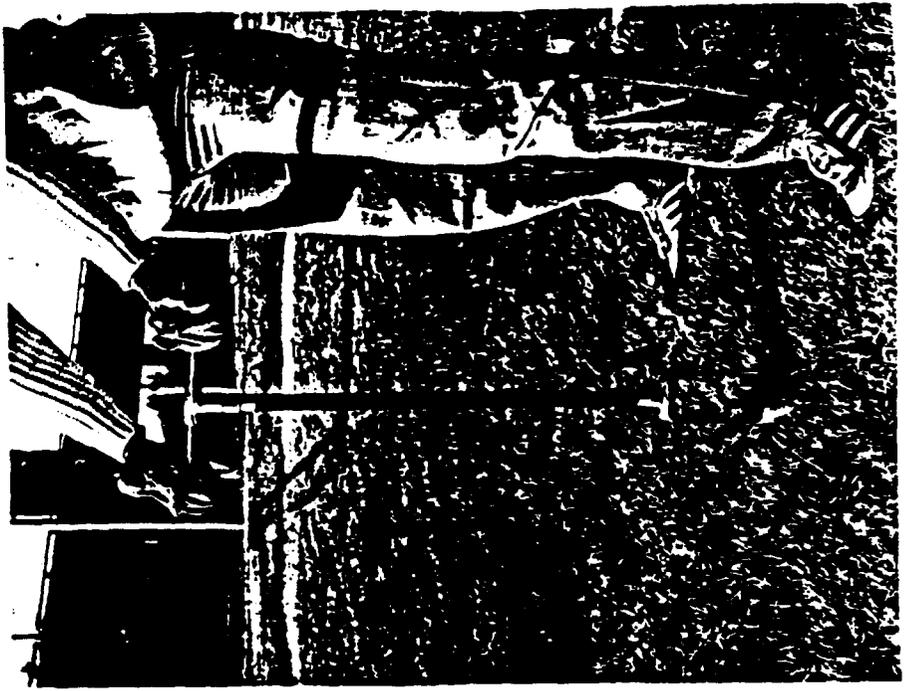
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REECo-45

(P-3425)

REECo-43

(P-3518)

REECo-44

132

(P-3531)

REECo-48

(P-3484)

REECo-46

(P-3493)

REECo-50

(P. 22)
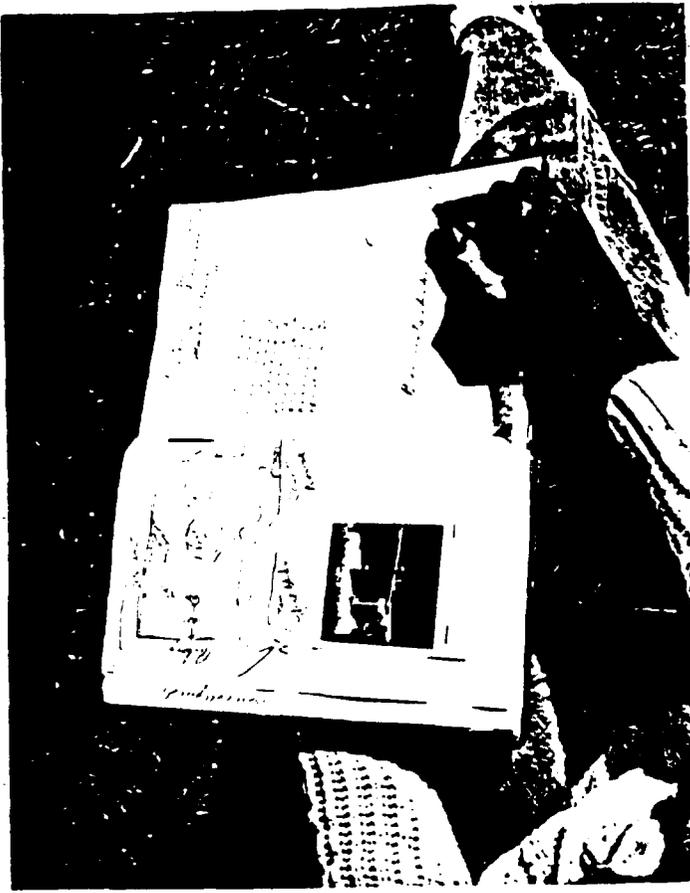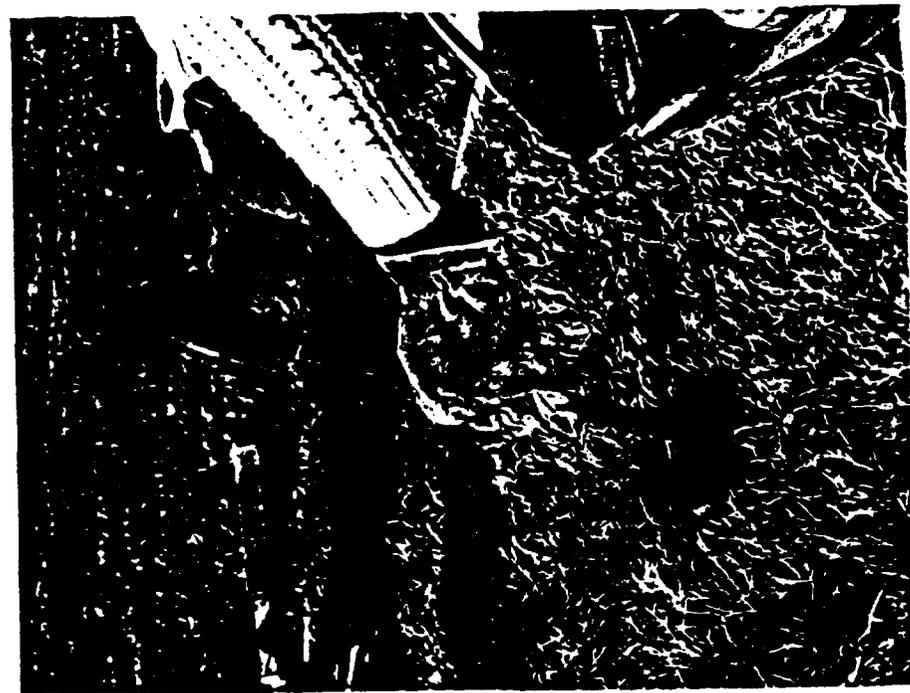
REECo-51

(P-3519)

REECo-49

(P-3520)

REECo-54

(P-3501)

REECo-52

135

(P-3495)

REECo-57

(P-3510)

REECo-56

(P-3504)
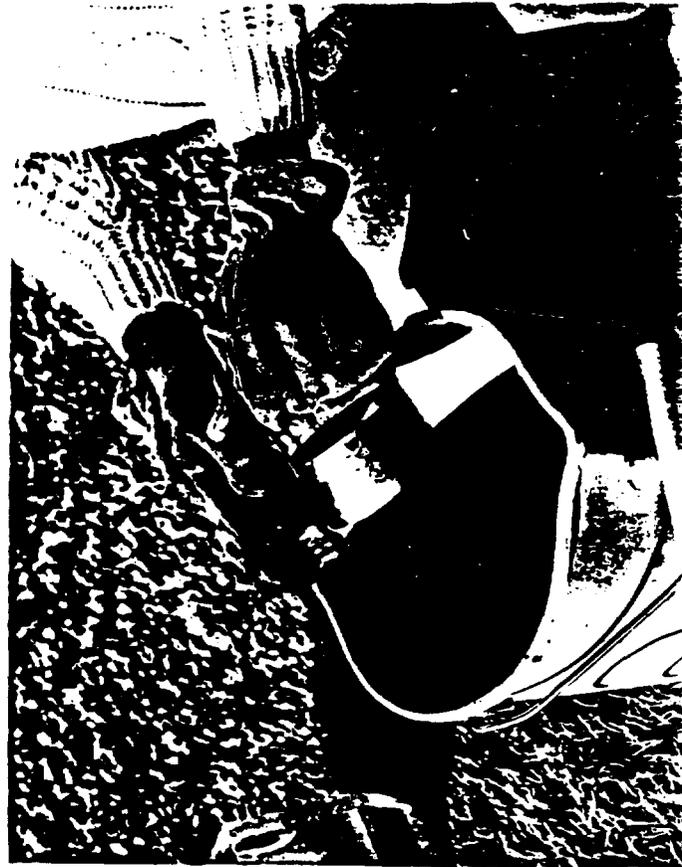
REECo-60

(P-3509)

REECo-58

(P-3537)

REECo-64

3499)

REECo-65

(P-3505)

REECo-62

(P-3486)

REECo

138
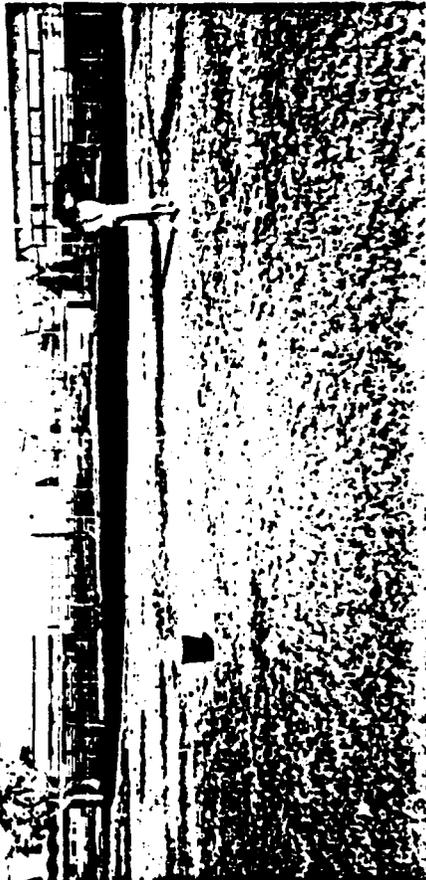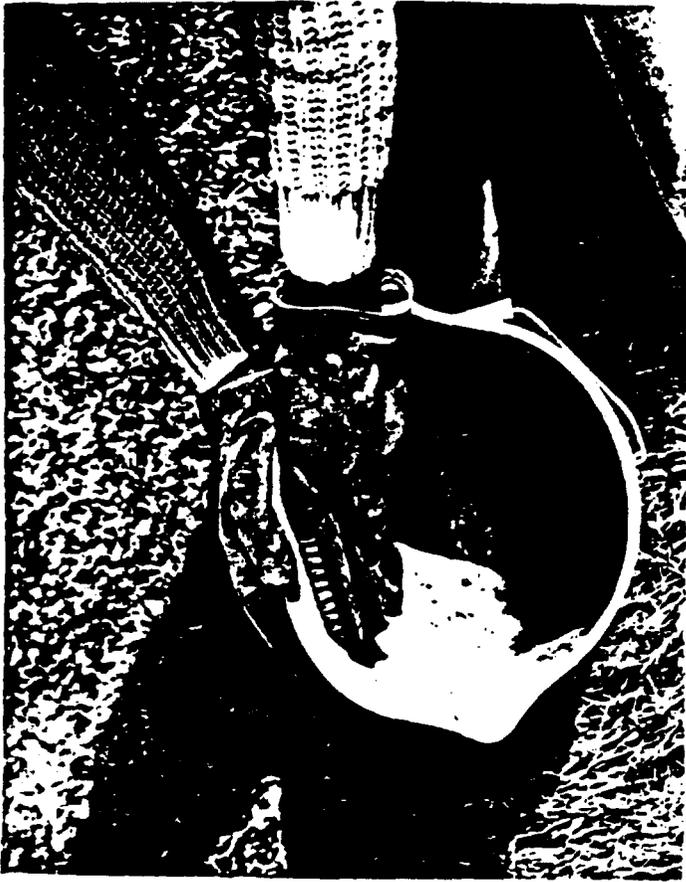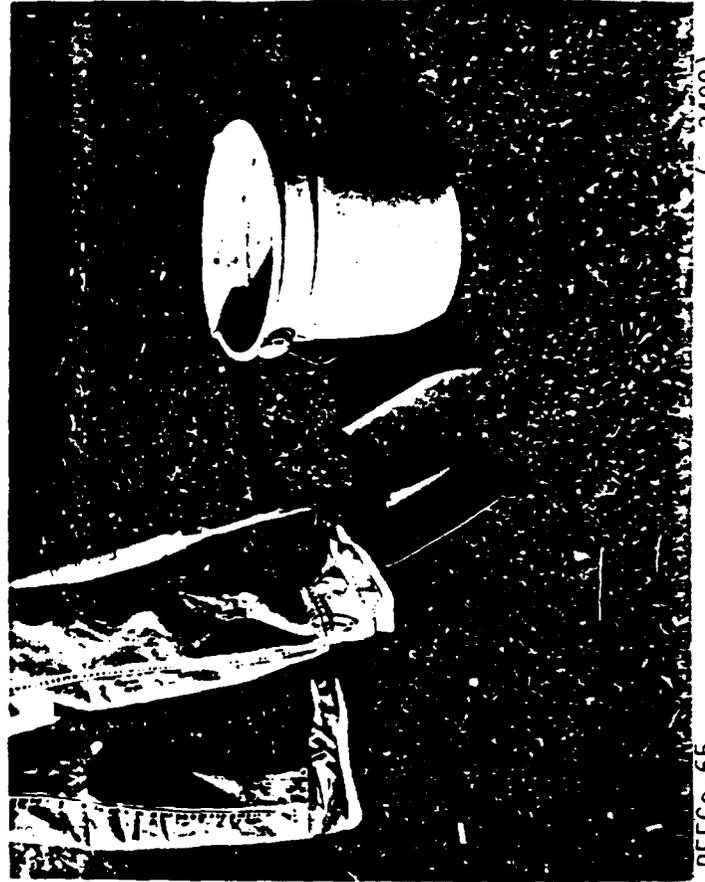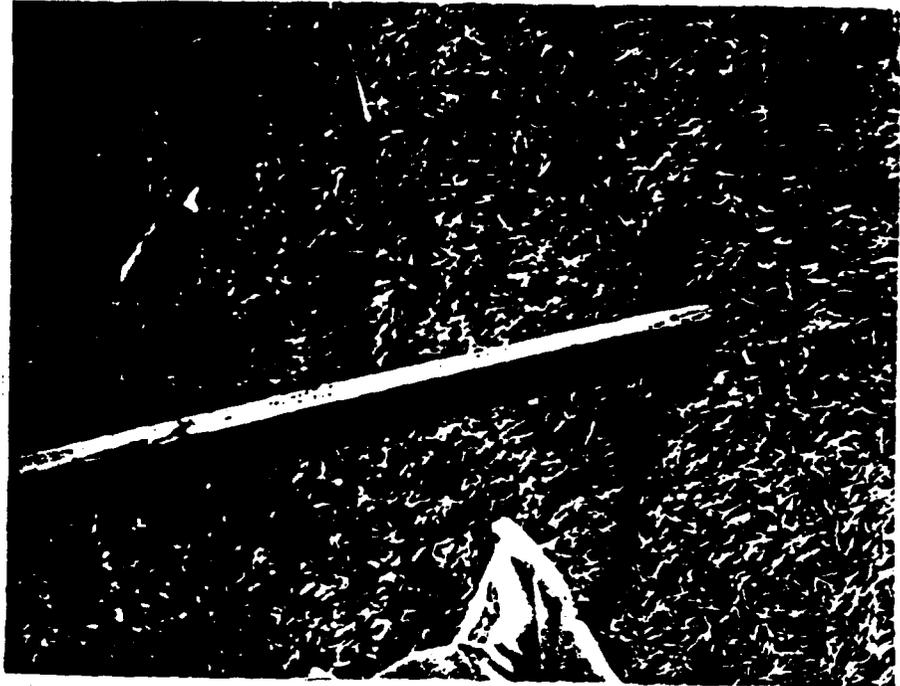
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REECo-67

(P-3498)

REECo-66

REECo-68   (P-3472)

140
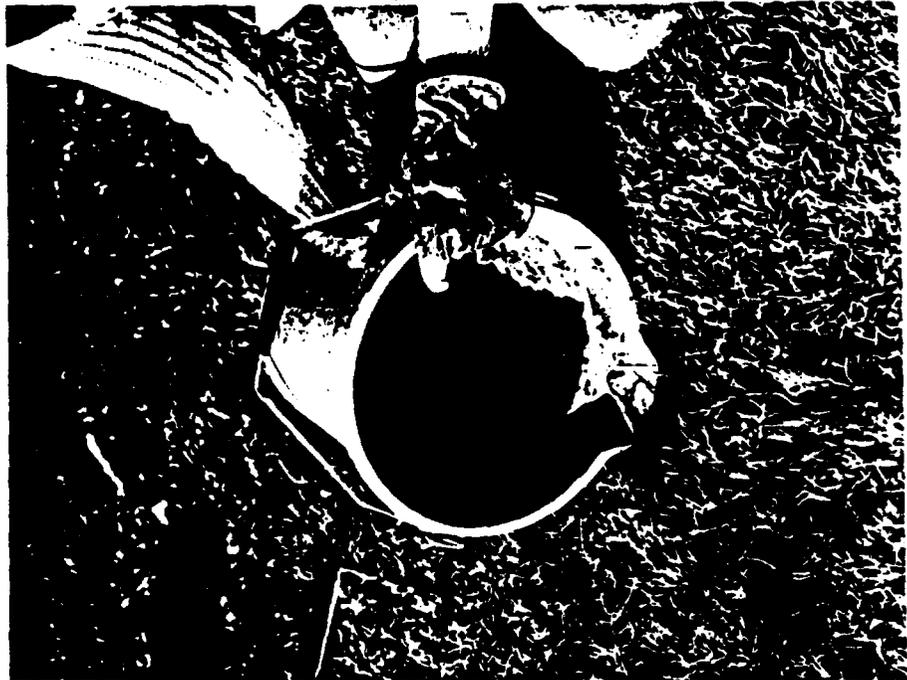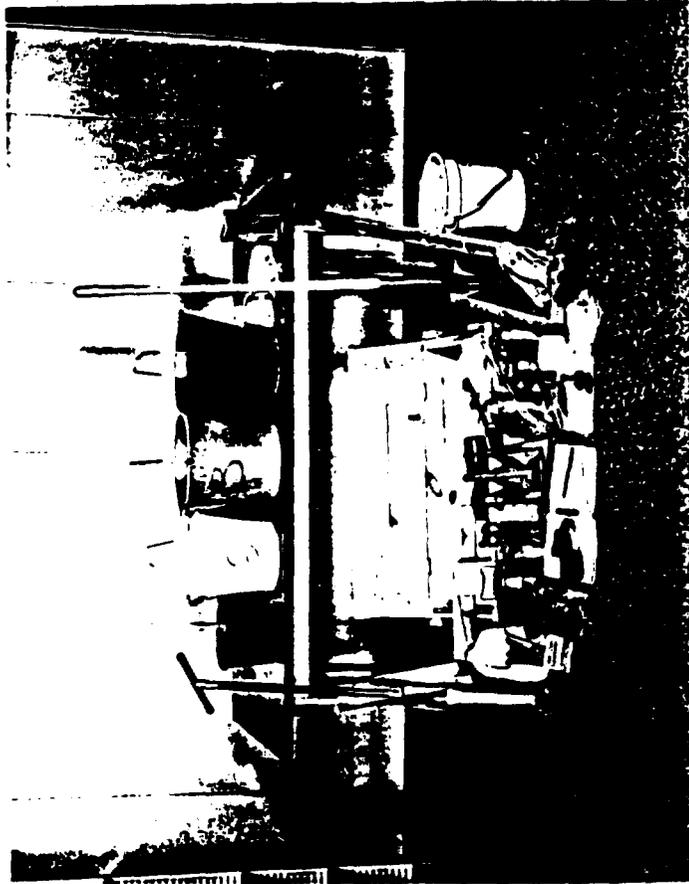
1   CHAIRMAN MOSELEY: Can we come back to order and resume.   Could we

2   continue with the presentation on the soil sampling.

3   DR. HAWTHORNE: This is a schematic (HH-1) of how the sample gets

4   moved through the processing scheme in the laboratory.

5   The scheme is a hybrid.   It is partly how EML recommends doing samples

6   and it is partly how REECo did soil sample preparation for the NAEG

7   program.

8   We wanted to take components of each methodology.   We liked the REECo

9   part where the grinding is carried out in a closed container so that there

10 is no chance of cross contamination of either the laboratory or nearby

11 specimens and there were particle size requirements that came from the way

12 EML does their processing.

13   We were initially anticipating that we would not have to process the

14 entire sample because in the fourth increment at those places where we have

15 a 10-30 centimeter increment, the weight of the specimen can be up as high

16 as 30 kilograms and that is a lot of material to put through a little round

17 screen.

18   We believe we have successfully combined portions of each of the pro-

19 cedures into a system that can be effective both in the processing context

20 and efficient in the manpower requirement.   Could I have the other slide,

21 please.

22   Again I have divided the different steps in the processing into

23 smaller groups (REECo 30).   These are the preparation before you begin

24 doing the processing.   The processing itself is called ball-milling, which

25 will have an obvious derivation of name.   Then we drop down to the exciting

26 part which is removing the aliquots for radiochemistry which is what all of

27 the activity is leading towards and, our final step is again probably the

28 most important one, and that is cleaning up the equipment before you start

1 the next specimen.

2 　　We operate on the single specimen basis. DRI has skillfully removed

3 the specimen identification from all of the samples that we are going to be

4 doing immediately. They have prepared a group of 40. Instead of saying,

5 "Telluride, Colorado; November 20 whatever, Maza and Rothermich, zero to

6 two increments," we have a five-digit number which corresponds to the log

7 number for the radiochemistry group (HH-2).

8 　　When it comes time, and I will be talking about making composites, we

9 have to be notified by DRI which two specimens we put together to make the

10 composite for the plutonium samples. If you would go back to 29 for a

11 another look.

12 　　The sample leaves the field in a canvas bag. There are four incre-

13 ments in the canvas bag, with a shipping tag on the outside. We receive

14 those in the laboratory, open the bag, and take out a specimen and weigh it

15 (REECo 69). Now that will no longer be happening because DRI has already

16 removed the bags for the specimens processed under Phase II of the ORERP

17 program. We have a large plastic bag (REECo 70) which we use as a pseudo

18 glove box. We had lots of experience in cleaning up before we went to the

19 procedure that will be shown. Specimens are wiped off and that will still

20 hold in the future (REECo 71). The moisture in it is kneaded because there

21 is condensation on the plastic. We want the moisture to be in the soil

22 when the bag is emptied. We don't want little globs of wet soil sticking

23 to the inside of the bag.

24 　　The specimen bag is inverted. It will remain inside the larger bag

25 until the gallon cans, which you can see through the bag, have been filled

26 and all of the specimen is transferred into gallon cans for drying

27 (REECo 72). The easiest way to open the bag with the least trauma has

28 turned out to be to cut the bottom off. That leaves the tag attached. We

1 know where the stone and the pieces of root belong when we come back to get

2 a tare weight for the nonspecimen soil.

3   Vegetation is cut into quarter-inch increments (REECo 73). We found

4 it turns out to be much quicker than to leave the grass long because then

5 we don't end up with a sieve covered with grass. The grass does grind and

6 goes through the sieve. There is a mandatory requirement to wear rubber

7 gloves for almost all of the processing steps. We use a steel brush

8 (REECo 74) to dislodge soil from stones that are large enough to pick up.

9 We went to a steel brush because we can clean it effectively in a sonic

10 cleaner. Cleanup is a critical step in the whole procedure.

11   We transfer the soil into the cans (REECo 75) and clean them off as

12 they leave the pseudo glove box (REECo 76). They are dried 24 hours at

13 105°C (REECo 77). While the drying is going on other activities take place

14 in the processing. We go back and we get into the data collection. We

15 took a wet weight of the entire specimen as it came from the shipping bag.

16 We also weigh the bag itself, the tape, the tag that's inside, the stones

17 and the roots to get a tare weight for the wet weight (REECo 78) from the

18 field specimen.

19   After the sample has been dried, we get into the processing proper.

20 Grinding is done by steel balls, rotating inside of a can that is turning

21 at between 130-140 rpm. We use 10 balls for a 2,000-gram specimen

22 (REECo 79) because that works the best or has with us. In passing I might

23 note that all of the information that we have about the specimen goes onto

24 the metal can as well as into the record books.

25   The ball mill is a series of rollers (REECo 80). Each section, if you

26 wish, will grind 10 one-gallon cans. They grind initially as shown on

27 Figure 29 for three hours. We then sieve them, grind the coarse material

28 for an hour, sieve again, regrind the remaining coarse material and sieve

1 off the fine fractions on each of those grindings. We do the sieving

2 because the fine fraction tends to cushion the oversize material that we

3 are trying to abrade.

4   We had an interesting occurrence in that every time we pried up the

5 lid of the can there was a puff of what looked like smoke. We went to all

6 kinds of extremes to avoid that. We cleaned up rather frequently for

7 awhile. We finally avoided that and a related problem ended by simply

8 puncturing the bottom of the can, that vents the air that's been heated up

9 by the ball-milling process, and we continue by cutting out the entire bot-

10 tom of the can (REECo 81). That does away with stone lodging in the rim of

11 the can and it also makes the transfer of the material out of the can a lot

12 easier because you are pouring it across a smooth surface instead of across

13 a rim.

14   The steel balls are retrieved after the grinding session (REECo 82),

15 and we now come to the part which is an absolute art, and that is, turning

16 the can upside down, onto the sieve (REECo 83), without making dust or

17 spilling it or dropping the whole thing. Richard Grisham in the back and

18 Eddie Eubank have developed this talent to a high degree.

19   For those of you who have not seen a soil sieve (REECo 84), the set

20 consists of a metal pan in which the "less-than" fraction is collected, the

21 brass screen, which does the separating, and the metal cover which keeps us

22 from contaminating the rest of the laboratory. The three parts are taped

23 together as shown in the previous slide, and the separating is done on the

24 vibratory shaker (REECo 85). This, also, is an art. The time to reach

25 separation is a function of the characteristics of the soil that is on the

26 screen. You cannot say that you will sieve for ten minutes at a setting of

27 20 or you'll sieve for six hours at a setting of 75. It has been found

28 much more successful if you listen to the vibrator and the screen will tell

1 you, by its sound, when there is no more material leaving on the separation

2 operation.

3   We send the coarse fraction right off to storage (REECo 86) as indi-

4 cated on the flow diagram at the end of the three ball-millings. We con-

5 solidate the less than five hundred micron fraction into as few cans as we

6 can comfortably homogenize. The homogenizing is done by ball-milling the

7 can that has its maximum content a few minutes until we get homogenization.

8   At the present time we are adding five hundred milliliters of soil to

9 the counting bottle. The bottles go to the Test Site and are put on a

10 automatic sample changer (REECo 87). In the rubber glove is a vibratory

11 spatula which has been one of the most useful tools for transferring mate-

12 rials and for cleaning up screens and doing various odd jobs.

13   We make up a 200-gram composite soil specimen for the leaching process

14 in radiochemistry and I have already indicated that we need the collabora-

15 tion of DRI in getting the proper specimens combined. At this point we

16 have accomplished what the collecting and processing set out to do. For

17 us, we still have an important ways to go and that is cleaning up all of

18 the hand tools, the screens, the pans and covers that we have contaminated

19 with dust along the way. If you come into the lab and watch the processing

20 as it goes on, you'll notice that you don't see dust coming from the opera-

21 tions. We have been very concerned about eliminating dust from our

22 operation. When we started out we would wash all of the equipment with

23 detergent in the sink, then dry it, and found that we could draw our

24 initials or pictures of our family on the surface of the pan for the

25 screen. It didn't really matter how much brushing we did or how long we

26 did it, we still ended up with a film (REECo 88). We went to the sonic

27 cleaner and no longer have film on our equipment.

28   The equipment comes from the sonic cleaner, gets a water rinse, goes

1 into the drying oven and is taken out and put into trays. We keep trays

2 marked "clean" and "dirty" so we don't get into the wrong one when we do

3 another operation. The sieves are cleaned with wire brushes and compressed

4 air.

5 If you will go back to the viewgraph flow chart (HH-2), I'll go

6 through it as my summary.

7 We obtain the wet weight of the specimen that has come in from the

8 field. We cut up the vegetation. We remove the rock and the large roots.

9 We transfer the remaining material to drying cans. The specimens are dried

10 24 hours at 105°C. They come out of the ovens, are weighed. I have not

11 shown pictures of weighing on the scales. There are a number of those

12 operations. We add the grinding balls. Put the specimen onto the ball

13 mill for three hours, separate the less than five hundred micron material

14 on the screen. Send the coarse material back into ball-milling for another

15 hour. Sieve again. Ball mill for an hour. Make our final sieving. All

16 of the fine materials have been added together from those three grindings.

17 The coarse material goes off to storage. The fine material is composited,

18 mixed, and we will start weighing out the specimens for radiochemistry. In

19 the procedure, if we have the material, we will weigh out two specimens for

20 cesium-137. One goes to radiochemistry, and one we keep in storage.

21 Sooner or later there are going to be those calls for duplicates and we

22 prefer not to have to go searching for the duplicate in storage.

23 We make up, and I show a dotted line because it's not a procedure that

24 we perform at the time that we do the weighing out for the cesium, and make

25 up a 200-gram composite sample from two specimens which represent incre-

26 ments one and two or increments three and four from the initial profile.

27 The remaining fine material goes to storage. Again, if we have the

28 material, we make up two of the plutonium composites.

1   That concludes my presentation. Are there questions?

2   CHAIRMAN MOSELEY: Questions? Thank you very much.

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PROPOSED SOIL PREP - FLOW CHART

etc. as above - for each layer

Step 1 (5 min): Weigh bag and contents - record

Steps 2,3,4 (30 min): Transfer to empty tared cans working inside a larger bag

Steps 5,6 (15 min): Weigh and record 1/2 full tared cans and place in drying oven

(24 hours)

Step 7 (15 min): Remove dried sample cans - weigh and record

Step 8 (30 min): Add 10 balls/can fasten lids install clips place in ball mill

(3 hours)

Step 9 (60 min): Sieve 32 mesh (500 µ) screen; collect fine and save; put coarse in fresh can and ball mill

(1 hour)

(30 min): Sieve 32 mesh (500 µ) screen; collect fine and save; put coarse in fresh can and ball mill

(1 hour)

(20 min): Sieve 32 mesh (500 µ) screen

Step 10 (15 min): Collect "fine" in a tared can (blend) and coarse in a tared Nalgene ® bottle - weigh and record

Fine →

Coarse → Store

Step 11 (15 min): Make up two 700 gm samples for Cs-137 analysis - save excess

Samples → A B

Remainder →

Step 12 (60 min): Make up one 200 gm composite sample from layers 1 and 2 and one 200 gm composite sample from layers 3 and 4 for Pu-239,240 analysis, save excess

Samples → 1&2 3&4

Remainder → Store

148.

HH-1

Soil samples (REECO) → Samples labelled (DRI) ← QA soil samples (EML)

Samples labelled (DRI) → Soil prep (REECO)

Soil prep (REECO) → γ analysis (REECO)

γ analysis (REECO) → Results decoded (DRI)

Results decoded (DRI) → Precision criterion met?

Precision criterion met? — No → γ analysis (REECO)

Precision criterion met? — Yes → Count at EML?

Count at EML? — Yes → Count at EML

Count at EML? — No → Pu analysis?

Count at EML → Pu analysis?

Pu analysis? — No → Remaining sample to storage

Pu analysis? — Yes → Prep for Pu (REECO)

Prep for Pu (REECO) → Samples labelled (DRI)

QA Pu samples (EML) → Samples labelled (DRI)

Samples labelled (DRI) → Pu analysis (REECO)

Pu analysis (REECO) → Data decoded (DRI)

Data decoded (DRI) → Remaining sample to storage

HH-2

PREPARATION FOR PROCESSING

- Knead condensed water vapor into specimen.
- Weigh and record gross wet weight.
- Wipe bag and discard towel.
- Open specimen bag into pseudo-glove box.

  — cut vegetation into 1/4 inch lengths.

  — remove stones and wire brush rock.

  — remove large plant root fragments and wire brush.

- Transfer 2 kg of soil into each tared, labeled, can.
- Weigh cans and record gross wet weight.
- Dry cans 24 hours in oven at 105°C.
- Weigh cans of dry soil and record dry weights.
- Collect bag, labels, tape, stone, and roots.
- Tare weigh shipping bag and discarded elements.

PROCESSING SOIL

- Ball mill cans 3 hours at 130-140 rpm.
- Prepare hood and assemble hand tools.
- Transfer ground soil to 32 mesh sieves.
- Remove <500 μ fraction by sieving and hold.
- Ball mill >500 μ fraction 60 minutes.
- Remove <500 μ fraction and add to holding cans.
- Ball mill >500 μ fraction 60 minutes then resieve.
- Store >500 μ fraction.
- Ball mill composite <500 μ fraction a few minutes to homogenize.

RADIOCHEMICAL SPECIMENS

- Weigh out 500 ml of homogenized soil, twice.
- Use combined weights of specimens designated by DRI and prepare 200-gram composites, two.

CLEAN UP

- Clean all wire sieves with wire brushes and compressed air.
- Wash all sieves and hand tools in sonic cleaner.
- Rinse sonic-cleaned equipment in clear water and drain.
- Dry all washed equipment at 105°C.
- Discard hood liners and vacuum out the hoods.
- Wipe hoods and other surfaces down with cloth, including vibrating spatula handles.

150

PROPOSED SOIL PREPARATION BY BALL MILLING

Step 1
Weigh bag and contents - record weights.

Steps 2,3,4
Transfer soil to empty tared cans, work inside a larger bag.

Steps 5,6
Weigh, and record, tared cans and place in drying oven. (24 hours)

Step 7
Remove dried sample cans - weigh and record weights.

Step 8
Add 10 balls/can, fasten lids, install clips, place in ball mill.

3 hours

Step 9
Sieve on 500 μ screen; collect fines and save; put coarse in fresh can and ball mill again.

1 hour

Sieve on 500 μ screen; collect fines and save; put coarse in fresh can and ball mill again.

1 hour

Sieve on 500 μ screen; blend all <500 μ on ball mill.

Step 10
Collect fines in tared cans; put coarse in a tared Nalgene ® bottle - weigh and record weights

Fine

Step 11
Make up two 700 gm samples for Cs-137 analysis - save remainder.

Samples

A   B

Coarse   Storage

Remainder

Step 12
Make up one 200 gm composite sample from layers 1 and 2 and one 200 gm composite sample from layers 3 and 4 for Pu-239,240 analysis, save remainder.

Samples

1&2 3&4

Remainder   Storage

P 375

REECo 71

P 3436

REECo 72

P 3452

REECo 69

P 3437

REECo 70

152

REECo 75

P 3432

P (3435)

REECo 73

P 3427

REECo 79

P 3440

REECo 77

P 3430

REECo 78

154

P 3444

REECo 81

P 3429

REECo 80

155

P 3742

REECo 85

P 3447

REECo 83

P 3757

REECo 84

156

P 3460

REECo 88

P 3461

REECo 88

REECo 88

157

1   CHAIRMAN MOSELEY: The next presentation is by Roger Thompson on the

2   Review of the Laboratory Procedures for Soil Analysis.

3   DR. THOMPSON: I would like to talk to you today about the sample

4   pathways in the laboratory with some of the aspects that have an impact at

5   each step.

6   Now, the top box (31) is essentially what Howard has just talked

7   about. The soils lab has received the sample, has ground it, dried it, and

8   they have loaded it into a five hundred milliliter bottle, and DRI comes in

9   and takes away all of the information about the sample location, and he has

10 assigned a five-digit number. We have given them a block of laboratory

11 numbers. DRI will paste labels on the bottles which have only this number

12 on it so that the laboratory has no knowledge of the depth segment that it

13 comes from or the location. Along with the bottle there is some paperwork

14 that's filled out that says what type of analysis is needed whether it's

15 cesium-137 or plutonium.

16 For the cesium-137, the bottles are completely full. Howard mentioned

17 that he fills it with 700 grams. It depends a little bit on the density.

18 He fills it to the shoulder of the bottle and it will be more or less,

19 depending on how much material is in there.

20 Consider the leftmost branch. The bottle comes down and the paper-

21 work, and we log it in the laboratory, and then, depending upon the type of

22 analysis, it goes to the left or right branch. Look at the cesium-137.

23 This is the leftmost branch. In a sense, this is simple in that there's no

24 laboratory preparation that is needed. The samples come in in these bot-

25 -tles and they are calibrated to count the cesium in these bottles on our

26 detectors, so, the sample goes directly to the detector, waiting for count-

27 ing time. We have two intrinsic germanium detectors which are completely

28 dedicated to this project. Nothing but ORERP samples are being counted on

1 them. They are inside shields and it has automatic sample changer built

2 into this so that the bottles can be loaded on a conveyor belt and they

3 will be counted in succession with no intervention by human hands.

4 _ _ The initial count for the cesium will be 300 minutes and we'll talk

5 about this a little bit later. It's a bit more complicated than this. We

6 can get about four 300-minute counts in per day and with two detectors, we

7 can have eight samples counted per day. The spectra from the detectors are

8 dumped from the detector into the computer and the computer does a spectral

9 analysis, peak stripping. It will strip off the cesium-137 peaks and also

10 the peaks from whatever other natural occurring radionuclides that are in

11 the sample. This will give some cross-checks on how well this is being

12 counted. Potassium-40 has a particular value and, if it's a factor of 10

13 off, something may be amiss. It will give something extra to check. The

14 results come to the desk of the laboratory project officer and he reviews

15 these results and an added factor is folded in. We do not normally take

16 into account the density of the soil samples in our gamma analyses. For

17 widely varying densities of soil, which I am led to believe we expect here,

18 this can have an effect on cesium-137 by as much as 10%. Normally it's

19 only a factor of a few percent. At any rate, we have an algorithm which

20 will correct for the density and this will be incorporated at this point.

21 Once the results are finalized for the cesium, a letter is written and

22 sent to DRI with the results. Now, normally this would be all but there is

23 an added complication. The agreement is that we would like less than 5%,

24 twice on accounting statistics error, for the total activity in the core.

25 That folds in the top segment, the middle segments, and the bottom segment.

26 Now, the way the activity is distributed, most of it's in the top segment.

27 Very little, if any, is in the bottom segment. Now when you count the

28 cesium in the top segment, 300 minutes will probably give you 3-4% counting

1 statistics because there's a lot of activity there. Then, that's fine.

2 The bottom segment, you could count it for days and you are not going

3 to get that good accounting statistics, but you are safe because you don't

4 really need it because there is very little activity in that part and when

5 you fold in the total activity, that error is not very important. The

6 problem is, we don't know what segment it comes from. Only DRI knows this,

7 so we have to send the results to DRI and they look at their master log

8 book to see where it comes from, and they fold in all of the errors and

9 say, "Ah ha. This is fine," or "Ah ha, we need more counting on, say, a

10 middle sample somewhere," so they will get back to us and say (that's DRI,

11 it looks like ORI), DRI tells the lab to recount sample such and such, and

12 we'll take that and recount it for a thousand minutes, and then it goes

13 back to computer analysis, and follows through the flow diagram in the same

14 way. Then we send another letter to DRI saying: "This is our new value.

15 Is that ok?" and they will say "yes" or "no." If it's okay, the samples

16 are stored.

17 The cesium analysis is nice in that it's nondestructive. You'll

18 always have that dirt, no matter what. You can count it hundreds of times

19 if you like. The plutonium is different.

20 A word about turnaround time. If we have 100 sites to be analyzed and

21 each site has four segments, that's four hundred samples to be analyzed for

22 cesium. We can do essentially four a day per detector. That's 100 detec-

23 tor days for the cesium and if you add in an extra 50% for QA, duplicate

24 samples, split samples, whatever DRI wants to send in, plus some time for

25 computer down-time, detector down-time, that gives you 150 detector days.

26 Now you also have 1,000-minute counts. A 1,000-minute count takes up an

27 entire detector day effectively, and it's hard to know how many of these we

28 will need. An initial estimate might be 20% of the samples may need to be

1 recounted. Note that you don't really lose the 300-minute count. The

2 total count time would be 1,300 minutes because you can fold the two num-

3 bers together. At any rate, this would be 20% of 400 is 80 samples, as an

4 estimate; another 80 detector days, so as an estimate 80 samples per day

5 for 150 days equals 230 days of testing and with two detectors, 115 days,

6 so that's four months, approximately, depending on how many samples you

7 want to send out.

8   Now let's consider the plutonium branch (32). The plutonium, of

9 course, is a destructive analysis. Once we analyze this dirt, the dirt's

10 gone forever. The plutonium we still have but it's in a form that's --

11 it's electroplated on platinum disks. The problem is that with the alpha

12 spectroscopy, the alphas are absorbed into dirt so readily you have to have

13 a very thin coating of the sample, so the sample -- the plutonium from the

14 sample is electroplated on platinum disks and these are counted. The plu-

15 tonium on that is saved and will go to mass spectroscopy which will deter-

16 mine the plutonium 240-239 ratios. As it stands, the plutonium will come

17 in and we only need 200 grams for this rather than the 700 for the cesium

18 and, in a sense, the procedure is simpler than for the cesium. We have

19 this simple linear block diagram it goes down and in a sense, it's much

20 more complicated because that first block is a big one. That's where the

21 chemistry is done. It comes in, the EML chemical procedure is followed,

22 which is a leach that we will talk about in a little bit, and at this point

23 the sample is electroplated on a platinum disk. They are taken in to the

24 counting room and counted on surface barrier detectors. These are 450

25 square millimeter detectors and they will be counted routinely for 1,000

26 minutes and we will get an energy spectrum of the alphas which will identi-

27 fy the plutonium-239 and we'll show you a spectrum in a few minutes. This

28 data is dumped into the computer and is analyzed and the results are

1 reviewed by the lab project officer to make sure that it looks reasonable,

2 there are no screw-ups in it. When the data has been certified, then a

3 letter is written to DRI, and they receive the results of the plutonium.

4 Bernie, let me have the next one. We'll go over these boxes one by one

5 (32). This is breaking down the chemistry box. As soon as the sample comes

6 in, it goes directly to chemistry and this is roughly what happens to it in

7 chemistry.

8   (Figure 33). The initial box is the leach. What happens is that you

9 dissolve most of the metals in the soil with acid. It comes off in the

10 acid leach. You discard the rest of the soil. The second two boxes,

11 essentially, do the same thing. They separate out the plutonium from all

12 of the other draughts that came out with the acid. By the time that you

13 get to the bottom of the third box, you have only plutonium. The bottom

14 box is where you electroplated, and I'll show you our electroplating appa-

15 ratus. This is where the plutonium is put on as a thin film on top of the

16 platinum disk. Now, platinum is used because you want to do mass spec-

17 troscopy on the plutonium, and we normally use stainless steel, because

18 it's much cheaper, but that interferes with the spectroscopy, so we do it

19 on platinum and, of course, the platinum can be reused. It's not really

20 lost.

21   I have some slides here. This is the initial step in the leach. We

22 have the soil in the beaker and the chemist is pouring the acid in it. It

23 gives you an idea of how much soil we start to analyze and this is normally

24 done on a hot plate and it is done overnight. This is what happens to the

25 soil once the acid goes in there. It starts foaming and working. It does

26 this for quite a while. The way this is done, it's done in four steps.

27 You put the acid in and you put it on a hot plate and heat it and leave it

28 overnight, pour off the liquid which contains most of the plutonium and for

1 the residual stuff, you do the same thing again. Pour the acid in, heat

2 it, let it sit overnight, and work. You do this four times. At the end of

3 the fourth time, you have a white, I don't know what to call it, residual

4 _soil, a white mess here. Supposedly this has nothing else of interest in

5 it and it's discarded. In the middle steps that I told you about, you need

6 to separate the plutonium from the other material that was leached out with

7 the acid. This is a key step. This is the resin columns. These columns,

8 glass tubes in the background, are loaded with a resin which has an

9 affinity for plutonium so that you pour your liquid through there, and the

10 plutonium is absorbed on the resin, and nothing else, and then you can pour

11 some material in it which will release the plutonium and you will have a

12 solution which has, effectively, only plutonium in it.

13 We come to the last step and this is the electroplating apparatus.

14 The plutonium liquid is poured into these little glass vials, here's one,

15 here's one, here's one. The platinum disk is at the bottom of the vial.

16 It's sort of held on with a rubber cover so that the platinum is effective-

17 ly part of the vial. There is a platinum electrode that comes down from

18 here, from here, goes down into the liquid and an electric current is kept

19 between the two electrodes so that the platinum ions are electroplated on

20 the bottom surface. This takes on the order of 5-6 hours, and we can do a

21 number of samples at once. The little platinum disks are these shiny

22 things that look like they are surrounded by the gold here. One here,

23 here, here and here. That is what the sample itself looks like after the

24 chemistry is done, and this gadget is the counter which does the alpha

25 spectroscopy. The detectors themselves are the gold gadgets, here and

26 here, that look up and the planchets are put face down over the detector

27 and the detector can rotate under them so that we can count. This is an

28 automatic sample changer. We can count a number of them without human

1 intervention although, since you are counting them at 1,000 minutes, that's

2 of little help, although you can count over the weekend. We have four

3 detectors in each one and, depending upon the sample load, we will more or

4 less dedicate these four detectors to this operation. The chemistry is

5 really the hang-up in the sample on plutonium and the hang-up in the chem-

6 istry is the leaching process because it takes a fair amount of space in

7 hot plates and you need to do this in a hood because, obviously, you have

8 intense acid fumes coming off and there's just so much hood space. We can

9 do eight samples per month, or per week which probably is not going to be a

10 hang-up; probably the cesium will take longer because you are going to do

11 more of the cesium samples I understand.

12 I believe this is the last slide. Yes, it is. This is my last figure

13 (33) and I wanted to show you what the data looks like, the plutonium data,

14 which comes off the alpha spectroscopy. Now what we have plotted here, the

15 vertical scale is the number of alpha counts in a particular energy bin,

16 the horizontal scale are the energy bins. There are two peaks that are of

17 primary interest here. This is the plutonium-239 and the plutonium-236.

18 Now (Figure 33) these are truncated. The real peaks go quite a bit higher,

19 but the upper parts are not of much interest. The way we do this, whenever

20 you do the chemistry and the counting, you always lose some plutonium. You

21 don't really know how much and this is a problem. You've got a recovery

22 problem, so what you do is, at the beginning of the chemistry, you put in a

23 known amount of something that's not going to interfere. We put in

24 plutonium-236 because this follows the chemistry of the plutonium-239, it's

25 counted with the same efficiency, so, we can compare the known amount of

26 material that was put in here with the height of this peak, the number of

27 counts in it, and that will give you an accurate measure of your total

28 recovery, so, what we are really doing is looking at the ratio of this peak

1 to this peak and we can get an accurate number in disintegrations per

2 minute of plutonium-239, which effectively gives you picocuries per gram.

3 A couple of things you should look at in this figure is the resolution

4 of the spectra. If you have plating problems or detector problems, these

5 peaks will get much wider and you will get overlaps and it's difficult to

6 extract the information from them. The resolution here is on the order of

7 50-60 keV, if I remember correctly. There are other peaks in the spectra,

8 obviously coming from thorium. I wanted you to see that they don't really

9 interfere significantly with the plutonium-239 and -236. There is one

10 small interference. This thorium-228 has a daughter which is radium-224.

11 Radium-224 has a three-day half-life and it ingrows because it's eliminated

12 in the chemistry, but as soon as you plate it, it starts ingrowing from the

13 thorium. Its peak lies right here and can create a shoulder in the

14 plutonium-236, so we have to account for the length of time between the

15 plating and the counting and the ingrowth of the radium-224 and subtract

16 that from the plutonium-236. If you do it within a few hours, it's essen-

17 tially zero. If you wait several weeks, it can go into the same height as

18 the thorium-228 peak which gives you an estimate of what kind of error

19 you're looking at, but we can correct this.

20 One last point. The reason that you can't do plutonium-240 this way,

21 and you have to go with the mass spectroscopy is that the energy of the

22 plutonium-240 is the same as the plutonium-239. I should have written this

23 239 and 240. The 236 has a different energy but we are just unlucky in

24 that 239 and 240 have the same alpha energy and you just can't discriminate

25 between them.

26 That concludes my presentation. Are there any questions?

27 CHAIRMAN MOSELEY: Dr. Wrenn.

28 DR. WRENN: If you do radiochemical separation, why do you have so

165

much thorium showing up?

DR. THOMPSON: Well, the thorium, I believe, should be taken out, as I understand it, in the washing of the resin columns with hydrochloric acid. We can probably get rid of that by increasing that wash. For the details of the procedure you should probably ask Phil Krey. It's his procedure. At any rate, it only moderately interferes with what we are doing.

DR. WRENN: We do the same sorts of analyses in my lab and we use solvent extraction as opposed to ion exchange and our impression is that we don't have thorium interference.

DR. THOMPSON: I think we could get rid of the thorium by increasing the HCl wash. At least this is what my chemist tells me.

CHAIRMAN MOSELEY: Other questions?

MR. KREY: Phil Krey from EML. To answer Ed's question, Roger is correct in that the hydrochloric acid wash of the second column is the exact step which remains thorium. We have looked into the problem, as Roger has explained it, and have in our laboratory completely eliminated any thorium contribution so there is some little communication gap we have here. The other point is you saw a polonium peak on the spectrum which doesn't interfere with that and shouldn't really be there either and after you electroplate, if the platinum disk is heated correctly, you will vaporize any of the polonium and that will be removed also so you should, as you indicate, come up with a clean spectrum. Roger is also correct that if there is some slight contamination by thorium or polonium, it may not interfere with the analysis but from a purist's sense, it would be neater and should be completely clean.

CHAIRMAN MOSELEY: Any further questions? Thank you very much.

This brings us to an early lunch according to my schedule. We will reconvene at 1:15 p.m. back here.

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│   Ge Detector   │                   │       EML       │
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│  Letter to DRI  │           │      │   Review by     │
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EML

Pu CHEMICAL PROCEDURE

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┌─────────────────────┐
│       LEACH         │
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│    SCAVENGE WITH     │
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│  Pu WITH RESIN COLUMN    │
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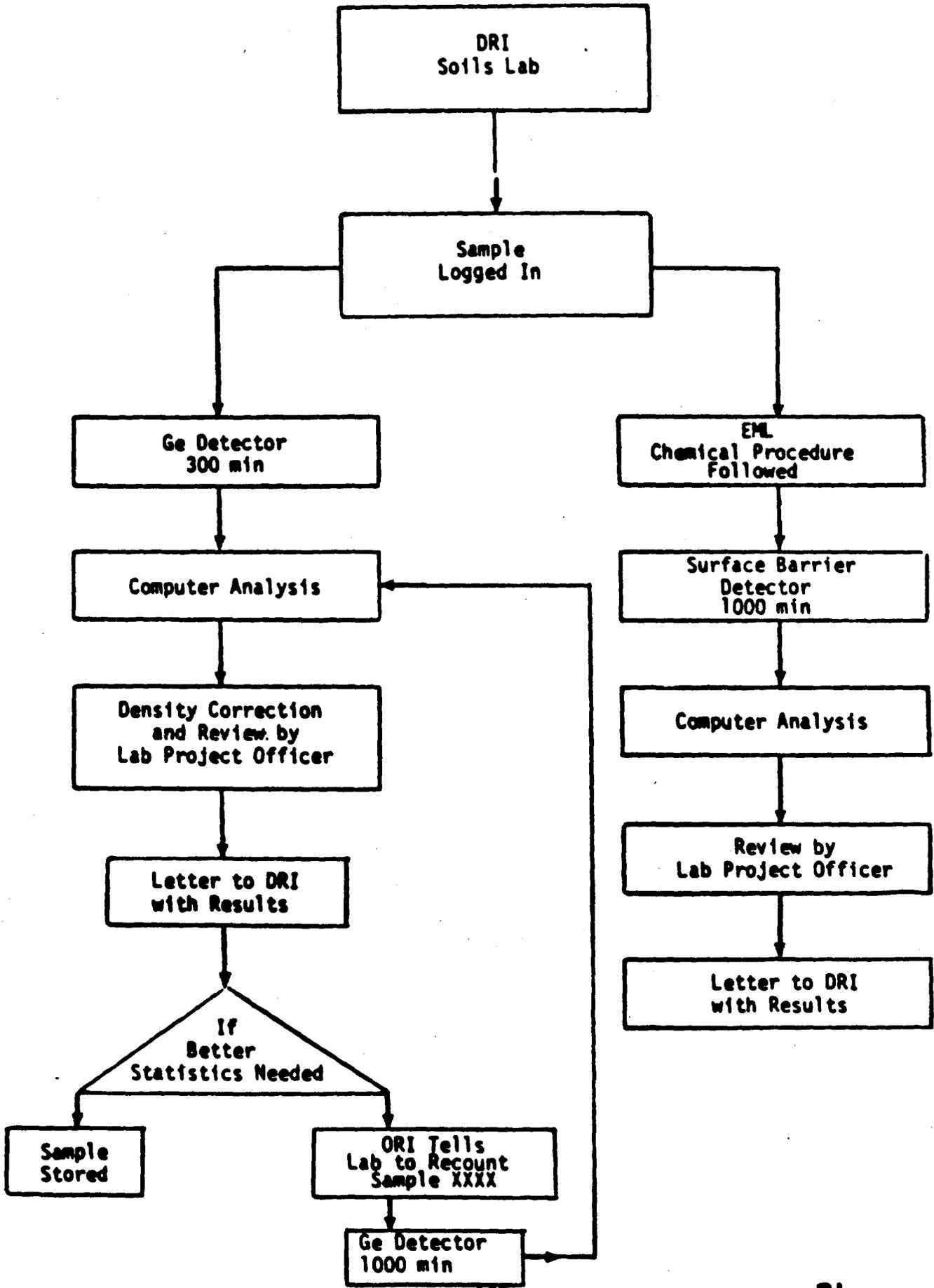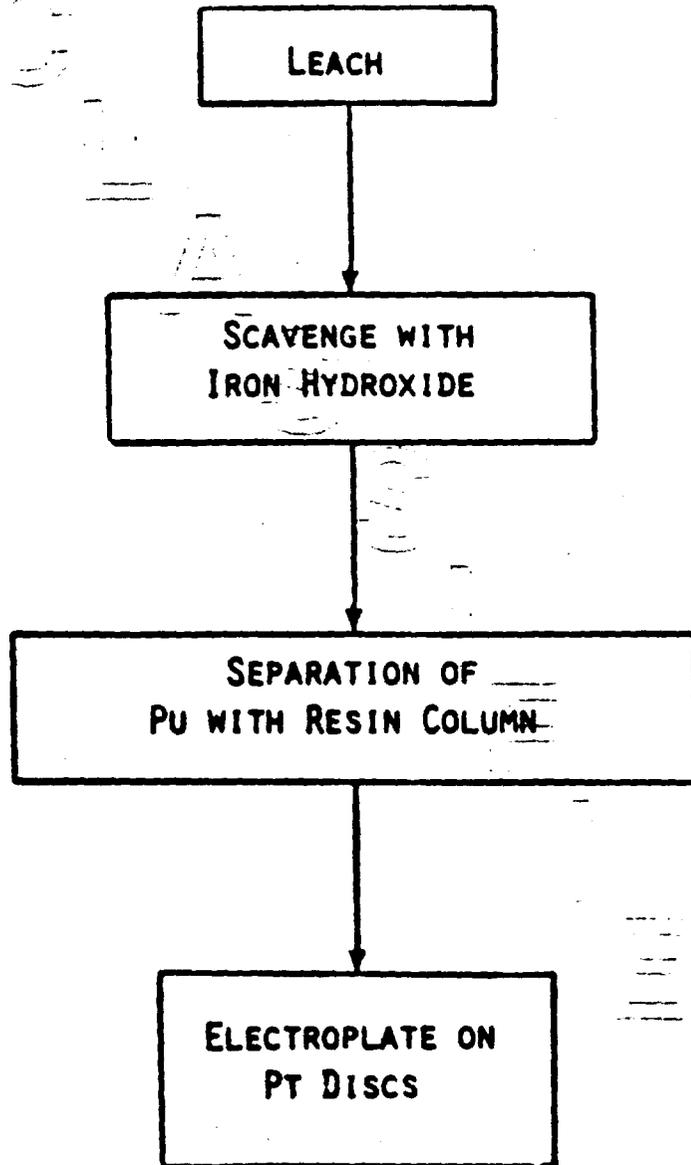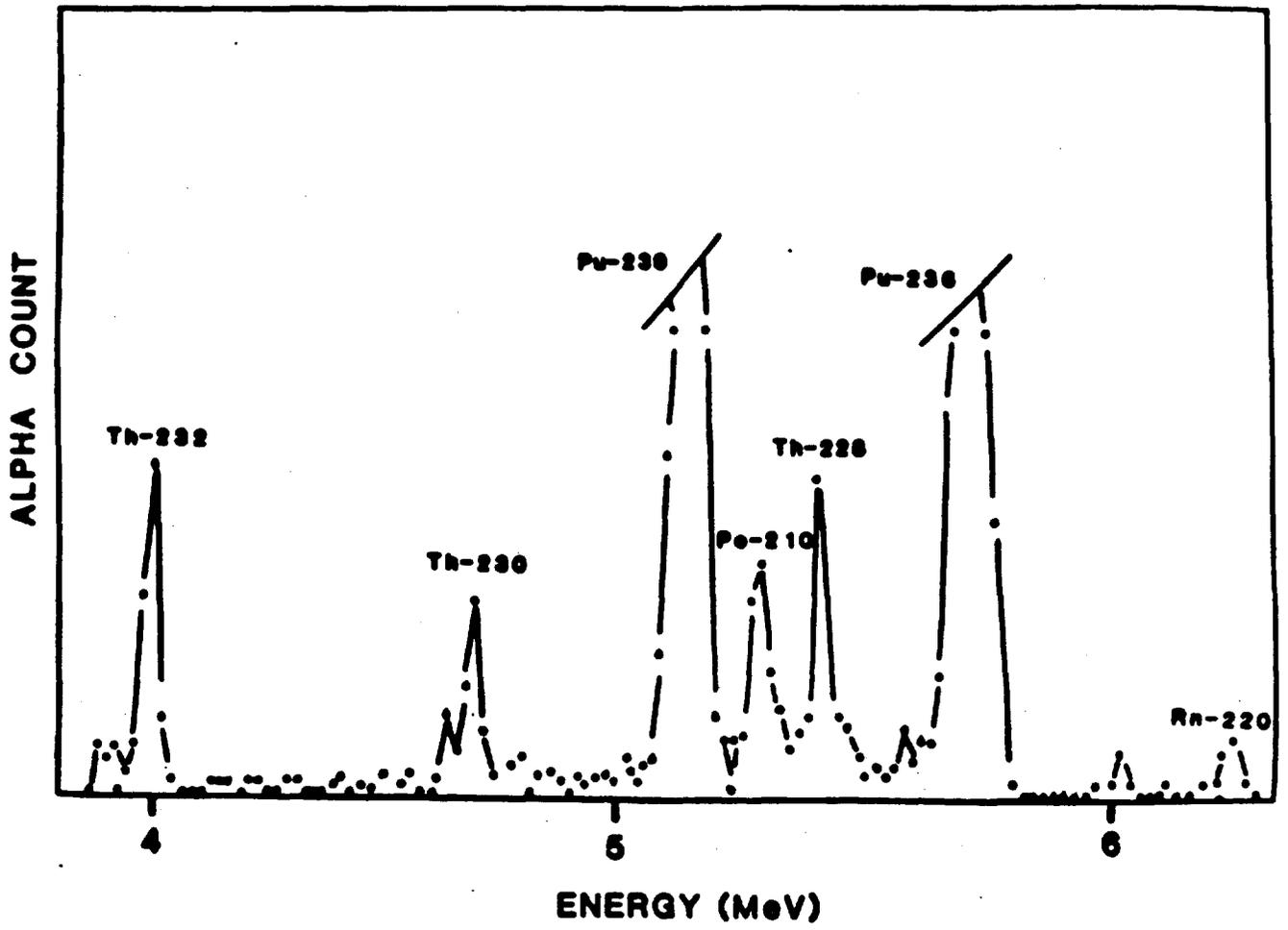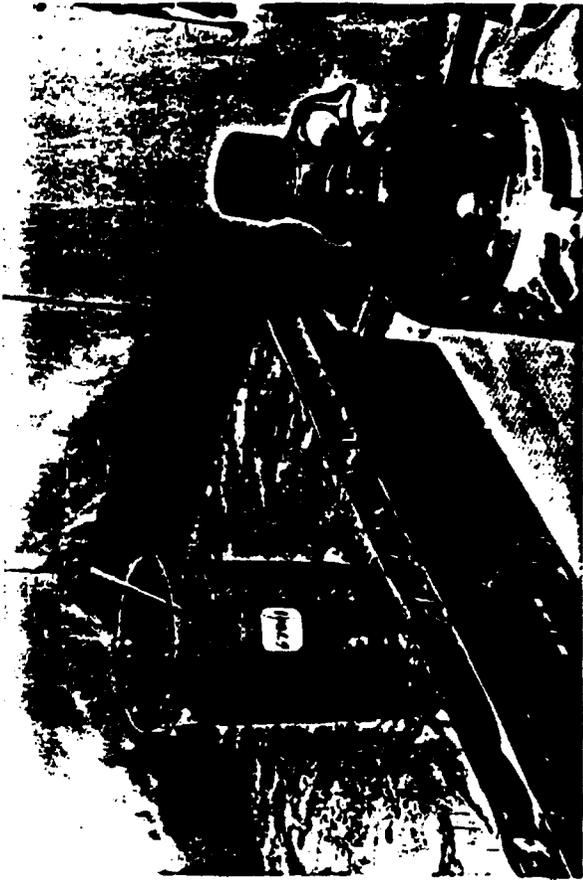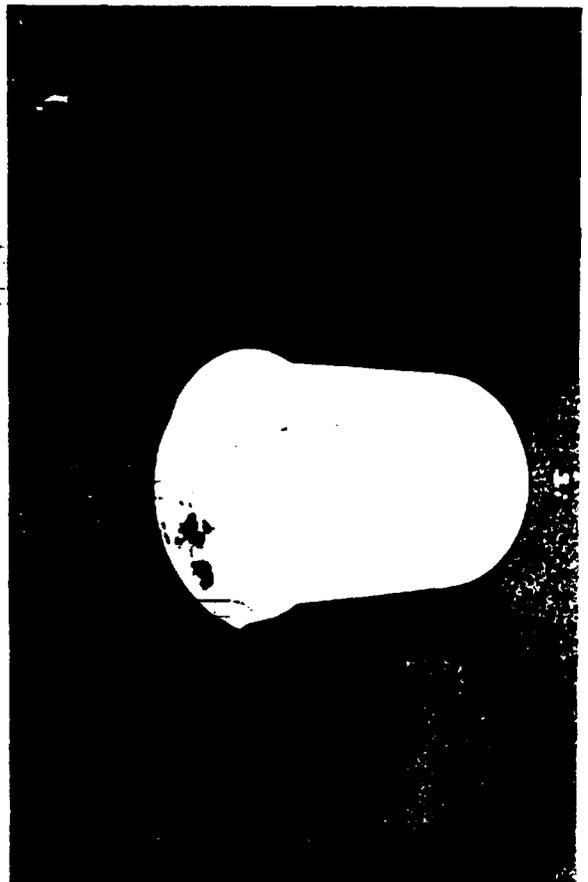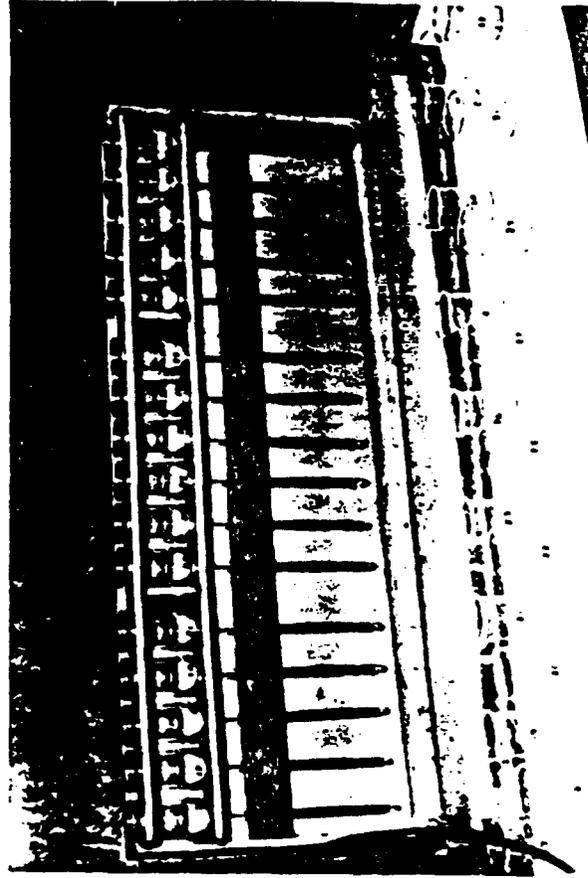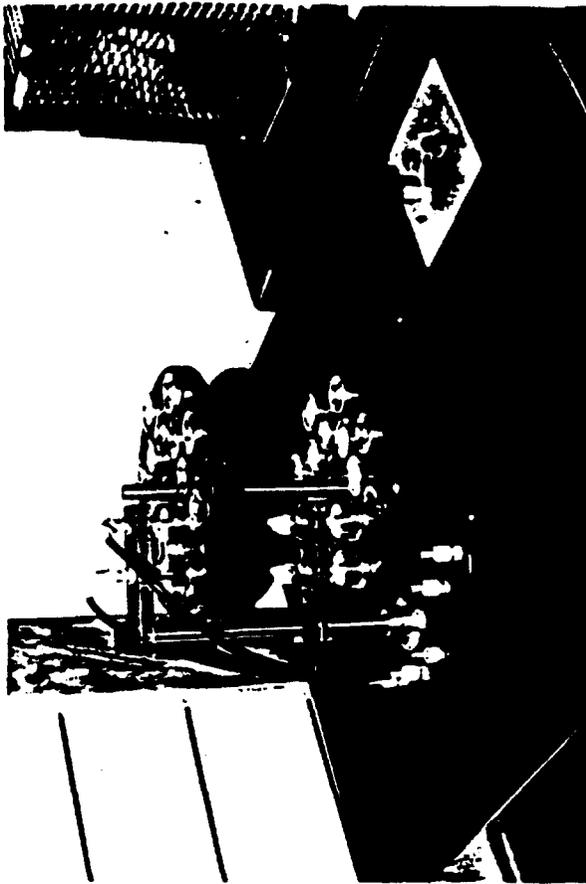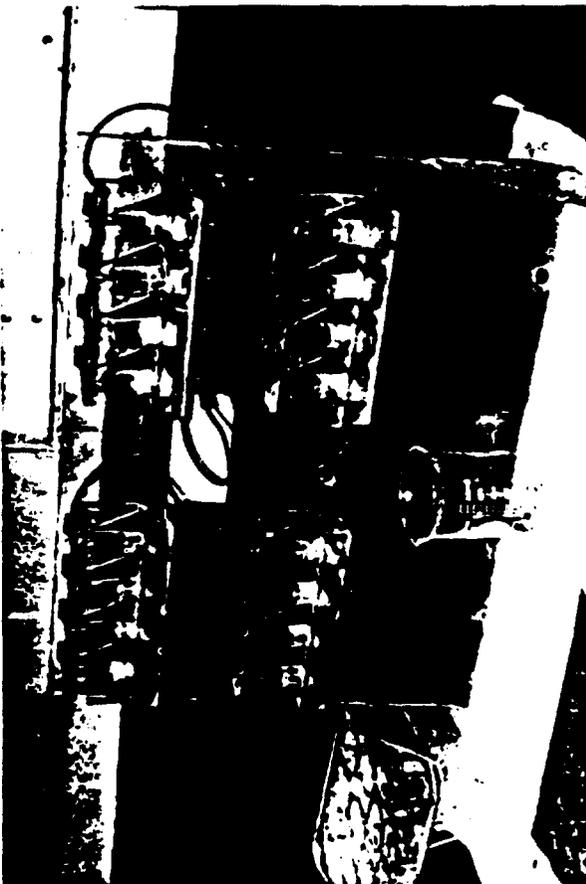
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3   CHAIRMAN MOSELEY: My apologies to all of you. Most of the members of

4   the Dose Assessment Advisory Group made the mistake of having lunch

5   together today at one table and that slowed things down considerably. I

6   will have to say that by fiat in this case, I denied dessert to the entire

7   group so that they are going to be maybe more disgruntled and less coopera-

8   tive this afternoon than they might have been had I been more generous with

9   their time.

10   We will continue with the Soil Analysis Program and Forest Miller will

11   talk about a Description of the QA Program for the Soil Analysis.

12   DR. WRENN: Mr. Chairman.

13   CHAIRMAN MOSELEY: Dr. Wrenn.

14   DR. WRENN: May I make a quick comment that dealt with the last

15   presentation?

16   CHAIRMAN MOSELEY: Please do so.

17   DR. WRENN: I have an observation which is intended to be helpful to

18   the effort. I have spent a considerable number of years measuring radio-

19   cesium in soils by gamma spectrometry myself when at New York University,

20   and we developed a technique, and I will furnish a published paper to the

21   ORERP if they would like it, which dealt with measuring radiocesium at

22   these levels, fallout, in small soil samples, 20 grams, using sodium iodide

23   as opposed to lithium drip to germanium crystal and the advantage is

24   greater sensitivity and greater speed of analysis. The equipment and tech-

25   nique still exist at New York University and I will be happy to furnish a

26   contact there. I know Mr. Krey knows the group very well and it might be

27   useful for screening purposes with respect to a large number of samples

28   like this and as a cross check on some of the results, but, conceptually,

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1   one could go through a hundred samples in a period of a week or two as

2   opposed to a longer time period, and I'll furnish the reference later.

3   CHAIRMAN MOSELEY: Thank you, sir.

4   DR. MILLER: I want to talk for a very few minutes on what you might

5   call the flow of information through the soil analysis procedure and to

6   indicate where the QA samples will come in.

7   Beginning at the top of the page (FM-3) DRI as sort of a broker will

8   combine the QA soil samples from EML with the prepared samples from REECo,

9   renumber them, and send them through the soil preparation phase. After the

10 soil preparation, drying, ball-milling and sieving is completed, then the

11 700- gram aliquot will be drawn for gamma analysis and the numbers that are

12 put on the samples by the initial brokering will be laboratory analysis

13 numbers and they will carry straight through the gamma analysis and the

14 results will come back to DRI where we will decode and decide whether the

15 precision criterion was met. A certain percentage of the samples will be

16 recounted at EML to check for bias. After that decision is made, we will

17 decide whether that particular soil sample is going to be submitted for

18 plutonium analysis and that's not a DRI responsibility, but it's going to

19 be a group responsibility. If not, the remaining sample will be sent to

20 storage. If so, we'll do the preparation for plutonium analysis which,

21 essentially, means drawing another 200-gram aliquot from the remaining

22 sample. That sample will be relabeled with a different chemistry labora-

23 tory number and those samples will be blended with QA Pu samples from EML

24 and sent for plutonium analysis. Again the data will be decoded and the

25 remaining samples will be sent to storage. This is basically the external

26 quality assurance procedure using EML and it will check for both bias and

27 precision and also for contamination, the cross-contamination of the sam-

28 ples because blanks will be sent through.

1   In addition there is a REECo internal quality control procedure. For

2   instance, the analytical balance in the soil preparation area has a quality

3   control program going on it. There will be resampling of a large batch of

4   soil recently taken at Hurricane and both plutonium and gamma analysis sam-

5   ples will be sent through on a periodic basis. Given that the plutonium

6   analysis can handle eight per week, eight samples per week, one of those

7   will be an external quality control sample, and one of them will be an

8   internal quality control sample.

9   We have designed an experiment to address a problem in precision of

10   analysis in the REECo laboratory. The experiment, essentially, is a basic

11   analysis of a random components design and should allow us to determine at

12   what part in the REECo plutonium analysis procedure, the uncertainty is

13   creeping in. Perhaps I could stick this up here (FM-4), probably not too

14   many people care too much about this, but for the statisticians in the

15   crowd, this is what R. L. Anderson calls a staggered experimental design.

16   We will take eight 200-gram aliquots, four of this kind, two of this kind,

17   one of each of those kinds. Everytime there is a fork in there we split

18   the sample. You notice that we split one of the samples 16 times and the

19   two analyses here will give us an estimate of the variability due to the

20   plating step. The split here will give us a column-extraction variability

21   estimate. The split here will give us a scavenging-variability estimate,

22   and this will give us, directly, an aliquoting estimate, or have I skipped

23   one, leaching. I have laid out here, given that this is Type 1, where the

24   degrees of freedom with respect to the experimental design go and for

25   Type 2, Type 3 and Type 4, and what we have at the end of the experiment is

26   an almost equal number of degrees of freedom for estimating each of the

27   variance components. An additional nice property of this experimental

28   design is that the estimates of variance components are not correlated,

1 given that our model is correct, namely, that we have additive effects.

2 Any questions?

3   DR. KORANDA: How are you going to split those samples, Frosty?

4   DR. MILLER: Well, I'm not going to do it physically. That's going to

5 be part of the laboratory procedure, and they've assured me that at each

6 step they can split them.

7   DR. KORANDA: Do they have a riffler to do that?

8   DR. MILLER: Well --

9   DR. KORANDA: It's pretty hard to get representative subaliquots when

10 you have that many splits.

11   MR. KREY: These are solutions, at this point.

12   DR. KORANDA: Well, it's not hard to split a solution. There are

13 solutions and solutions.

14   DR. MILLER: Right. The aliquoting -- the initial aliquoting of the

15 eight samples, that will be done in a standard manner, is going to be done

16 for the ORERP samples, and that will provide us with an estimate of the

17 variability induced by that; and given that soil homogeneity, or the lack

18 thereof, is a standard problem in these sorts of analyses, I think it's

19 desirable to have an estimate of the variability that occurs when that hap-

20 pens and, in particular since we are drawing 200-gram aliquots, the vari-

21 ability that we estimate from here will be directly applicable to the

22 uncertainty in the plutonium analyses of our standard samples.

23   CHAIRMAN MOSELEY: Thank you. Questions?

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FM-3
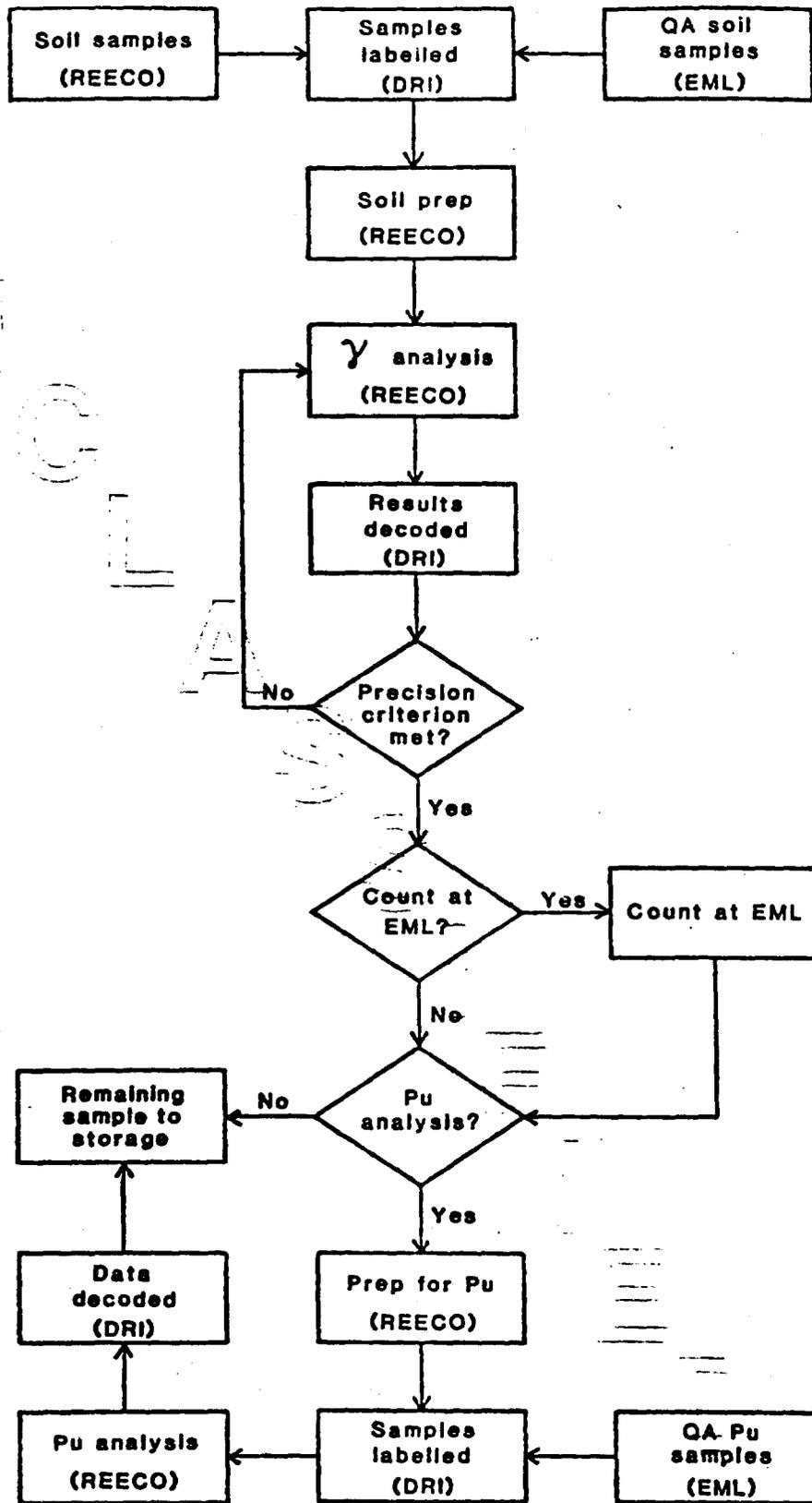
A IS ALIQUOTING

L IS LEACHING

S IS SCAVENGING

C IS COLUMN EXTRACTION

P IS PLATING
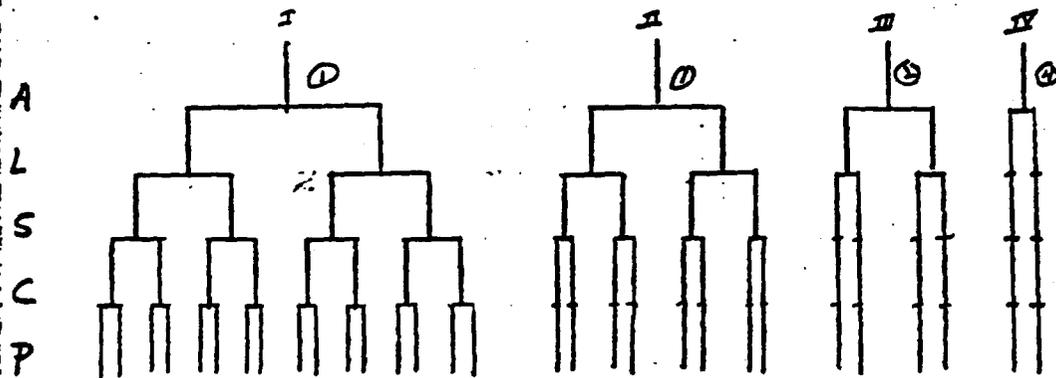
D F	I	II	III	IV	TOTAL
A	0	0	1	3	7
L	1	1	2	4	8
S	2	2	4	0	8
C	4	4	0	0	8
P	8	0	0	0	8

(INCLUDES 3 DF FROM COMPARISONS BETWEEN I TO I

$$Y_{ijklm} = \mu + A_i + L_{j(i)} + S_{k(ij)} + C_{l(ijk)} + P_{m(ijkl)}$$

FM-4

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1   CHAIRMAN MOSELEY: The next presentation is a rebuttal by EML.

2   MR. KREY: At the request of the DAAG and the ORERP, EML has agreed to

3   assist and participate in the quality assurance plan for Phase II.

4   _ _As Frosty indicated, DRI is indeed responsible for the conduct of the

5   quality assurance plan, but we have been, and we will continue to be active

6   in the design and logistics of that plan.

7   The first viewgraph, if you will (A). This identifies the various

8   subtasks in the experimental approach to Phase II. These are the site

9   selection, the in situ gamma spectrometry, soil sampling and sample

10   preparation, cesium-137 analysis, and plutonium 239-240 analysis. I have

11   left off in that viewgraph one other task which will be coming down the

12   road much later. That is the mass isotopic analysis of the plutonium 239

13   and 240 nuclides. That's far down the road, and we'll address that when

14   the time comes, but it will be part of this subtask.

15   EML has been involved in each of these tasks in one of three ways:

16   instruction, reference samples, and duplication. As part of this plan, EML

17   has provided written instructions to each of the appropriate ORERP groups

18   for each of these subtasks, as far as the EML standard methods are

19   concerned. In reference samples: at the present time to allow REECo to

20   test its analytical methods prior to proceeding with the actual Phase II

21   samples, we have provided them with typical samples which have been

22   analyzed under previous EML programs. In the future we will provide refer-

23   ence samples and blank samples to DRI who will then insert them blind into

24   the normal sample flow to the analytical contractor. As far as duplication

25   is concerned, EML has intercalibrated its in situ gamma spectrometry system

26   with the system from Livermore at a number of sites. In October, we have

27   collected or retrieved soil samples from 13 sites where REECo had sampled

28   earlier.   These particular samples will be processed and analyzed at

1 EML for comparison of the final results with the values provided by the

2 ORERP teams. From some of the discussion that we heard this morning and

3 our observations, I think that the site selection subtask has been done

4 quite well. In the in situ spectrometry, we have had no observable

5 problems. The soil sampling I think has been done very well. I've seen

6 the people collect soil samples and I hope we can do as well in the future.

7 The sample preparation is different from the kind of preparation that EML

8 has done in the past; however, I believe that the REECo method is quite

9 adequate. We've set certain criteria that this method should satisfy and

10 from some of the data that I have seen today and yesterday, it appears that

11 it is adequately satisfying these criteria. A few more analyses will be

12 helpful, but I am quite optimistic that that is quite adequate.

13 The next viewgraph (B) summarizes the test results for the REECo

14 cesium-137 analysis. We submitted one blank sample which indeed reflected

15 no detectable activity. However, one sample does not make a case

16 obviously. I should also point out that this particular sample was simply

17 counted on a gamma spectrometer and was not subjected to the possible

18 contaminating rigors of sample preparation. From the analysis of two sets

19 of duplicate aliquots, the precision of the analysis was within the

20 counting statistics which is on the order of 2-3%. From the analysis of

21 six samples, there appears to be a slight positive bias of REECo over EML,

22 about 5%. We intend in the future to continue making comparisons to firm

23 up that bias if it exists, which it looks like it does, and if it does

24 exist, to make the appropriate correction in the future. We don't feel

25 that this is a serious problem, however.

26 The next viewgraph (C) summarizes the test results from the REECo plu-

27 tonium analysis. From the analysis of three blank samples, they reported

28 no detectable activity. However, on the analysis of one blind Utah sample,

1 they reflected a contamination level of about ten times the value that you

2 would normally expect from these kinds of samples. The actual source of

3 that contamination has never been identified. After this incident, REECo

4 thoroughly cleaned their laboratory and that situation has not since

5 recurred. Hopefully it was a freak occurrence and the quality assurance

6 plan that we intend to follow, that DRI intends to follow, will address

7 this question very carefully.

8 The analysis of three sets of replicate samples indicated that the

9 precision of plutonium was an unacceptable 20% and this must be improved

10 before routine analyses of Phase II samples can begin and, as Dr. Miller

11 indicated, DRI and REECo have a plan to address this question.

12 From the analysis of twelve samples, there does not appear to be a

13 demonstrable bias between REECo and EML. The weighted average of 1.05 $\pm$

14 .03 seems pretty adequate and is certainly not demonstrable to be a bias at

15 all.

16 The next viewgraph (D) identifies the 13 sites at which EML has

17 recently recovered the soil samples where REECo had sampled earlier. We

18 will process and analyze these samples at EML for ultimate comparison with

19 the results from the ORERP teams. The sites with the blue circles repre-

20 sent locations where EML collected a duplicate sample. I know that REECo

21 has also collected a sample at Touelle -- and I'm not sure that I can see

22 Touelle but somewhere up around here, I can't see but somewhere up around

23 here -- I know that next year they are planning to revisit a number,

24 perhaps six or seven additional EML sites that were sampled in Utah in

25 1979. So by the time that Phase II is over, we should have something on

26 the order of 20 or so sites where EML and REECo have sampled identical

27 locations. These particular sites were selected for several reasons: one

28 on a geograpical basis such that two EML teams could adequately reach these

1 sites within one week's sampling time. The other was that we hoped to

2 collect samples at sites that reflect relatively high, intermediate and low

3 level NTS fallout. The sites at Alamo, Caliente, Ely, Eureka, and Austin

4 probably reflect sites with a relatively high level of NTS debris. At

5 Wendover, Wells, and Elko, there are probably sites with an intermediate

6 level, and here at Boise, Twin Falls, Malad City, Idaho Falls, and possibly

7 Fredonia, Arizona, might reflect sites with relatively little NTS fallout.

8   That's all for the viewgraphs.

9   As the analytical work proceeds on the actual Phase II samples, EML

10 will supply DRI with reference material, reference soil samples and blanks

11 for the blind insertion of samples to the analytical contractor.

12   The reference sample is a 20-kilogram composite of a sample retrieved

13 in northeastern United States which has been processed and analyzed at EML.

14 Approximately 200-gram samples of this composite, a large sample, will be

15 supplied. The physical appearance of this sample should not be readily

16 distinguishable from the appearance of the normal Phase II samples.

17   The appropriate quantities of a blank sample will be submitted to DRI,

18 appropriate quantities in the sense of the various depth profiles, 0-5 cm,

19 5-10, 10-15 and 15-30. These samples will be in a different fashion from

20 the reference samples. These blank samples will be processed throughout

21 the entire soil handling and analysis procedure to monitor every possible

22 aspect of contamination. The reference samples will simply go directly to

23 measurement -- cesium measurement and plutonium analysis. The blank sam-

24 ples will be processed through the soil-handling techniques from the out-

25 set. This soil was recovered several feet underground at an excavated pit

26 in Chester, New Jersey where EML maintains an environmental research sta-

27 tion. Under the radioassay criteria for this project, these samples should

28 reflect no detectable cesium-137 activity.

1   Finally, to better quantify that slight bias in the cesium-137

2 measurement, we will analyze another 20 or so samples for cesium-137 and

3 these samples will be the exact samples that REECo will have analyzed for

4 their estimate of the cesium-137 content. Using the exact same sample will

5 eliminate any complication with regard to aliquoting. It will be the same

6 sample analyzed by both labs. Are there any questions?

7   CHAIRMAN MOSELEY: Bruce.

8   MR. CHURCH: They are going to mail you that same sample. Is that

9 what I understood?

10   MR. KREY: That is correct. Frosty Miller will identify what samples

11 will be shipped to EML. I must admit at this very moment that I'm not sure

12 whether REECo will submit that sample to us directly or whether he will get

13 it back to DRI for renumbering and then sent to us. The detail I'm not

14 exactly sure of at this moment. That might be a better approach in that we

15 would be completely blind, also, but, in either event, it will be the exact

16 same sample.

17   CHAIRMAN MOSELEY: Any other questions? Thank you very much.

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QUALITY ASSURANCE PLAN

TASK

SITE SELECTION

IN-SITU SPECTROMETRY

SOIL SAMPLING

SAMPLE PREPARATION

^{137}CS ANALYSIS

$^{239+240}$PU ANALYSIS

1. INSTRUCTION

2. REFERENCE SAMPLES

3. DUPLICATION

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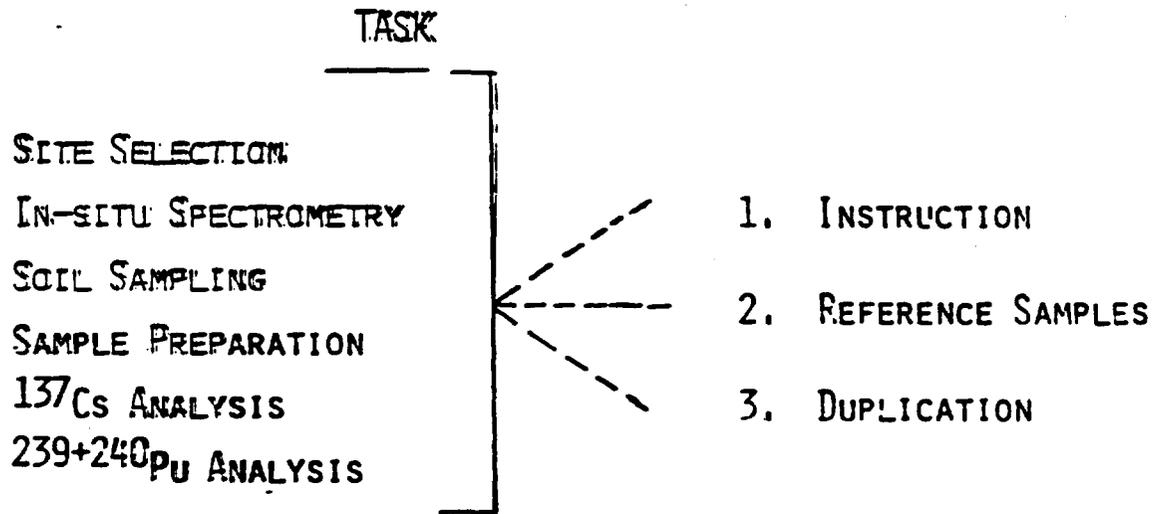
^{137}Cs QUALITY ASSURANCE

		No. of Analyses	Assessment
Blanks		1	M. D.
Precision	Duplicates	2	2 - 3%
Bias	REECO/EML	6	1.05 ± .01

Pu QUALITY ASSURANCE

		No. of Analyses	Assessment
Blanks:		3	N. D.*
Precision	Replicate	3	-20%
Bias	REECO/EML-400	12	1.05 ± .03

*ONE UTAH SOIL REFLECTED A CONTAMINATION OF 10X AVERAGE
 Pu CONTENT.

C

PRELIMINARY

U S DEPARTMENT OF ENERGY

PROPOSED SOIL
SAMPLING LOCATIONS

1   CHAIRMAN MOSELEY: Dr. Anspaugh is going to speak regarding the

2 Selection of Approximately 100 Soil Sampling Sites.

3   DR. ANSPAUGH: Before I go into my primary topic, I would like to

4 briefly go back, if I might, to another topic. Being handed out to you is

5 a second draft of our Historical Estimates of Exposure to the Offsite

6 Population (UCRL-87380-Draft Rev 1). This was originally handed out at the

7 meeting last May, and primarily in response to some rather lengthy, and

8 very well-taken comments from Dr. Auxier, we have extensively modified that

9 paper. The primary table as it was originally handed out had only the

10 estimates of population exposure. We've gone back and included not only

11 the total population exposure, but also the cumulative estimated exposure.

12 These are the tabulations of the original Vay Shelton or Test Manager's

13 Committee to Estimate Fallout Exposure recast so that we can look at them

14 in terms of population exposure as well, so we would like to submit this

15 paper to Health Physics and if we could ask the Committee to review that

16 and make any comments, if they would, we would certainly like to proceed

17 with submitting that paper.

18   Back to the topic of interest, the selection of the 100 locations for

19 further analysis. With your indulgence, Mr. Chairman, I would like to

20 spend a few minutes perhaps reviewing exactly what we intend to get out of

21 this whole soil sampling and analysis program and why it was really

22 undertaken, if you think that's appropriate.

23   CHAIRMAN MOSELEY: I can't give you that permission unless I ask you a

24 question.

25 · DR. ANSPAUGH: Okay.

26   CHAIRMAN MOSELEY: This is external exposure?

27   DR. ANSPAUGH: Yes, it is. Only external exposure.

28   CHAIRMAN MOSELEY: Then you may go ahead with it.

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1   DR. ANSPAUGH: Okay.   If I may have the first viewgraph, David.

2 (LRA-41).

3   From our original discussions, I think at the very first meeting of

4 this Committee and even its predecessor committee, we wrestled with the

5 problem of what do we do about areas that are really beyond the original

6 estimates of exposure, external exposure, and how do we deal with it and

7 how far do we go.   I think we always agreed that additional measurements

8 would be useful.   This is actually an old viewgraph, from many meetings

9 ago, and we generally concluded that it would be useful to have con-

10 temporary measurements of the deposition of radionuclides in a broader geo-

11 graphical area and I don't think that we have ever come to a reasonable way

12 of saying where we will draw that line, but, nevertheless, I think that

13 everybody felt that the original fallout patterns were not extended far

14 enough to answer all of the questions that we had.

15   Some of the methods that we proposed were aircraft measurements, field

16 spectrometry and soil sampling.   As it turns out, we are actually pursuing

17 all of these methods.   Harold Beck discussed the analysis that he is doing

18 of the NURE aircraft data and the Phase II that we initiated following the

19 May meeting has extensively used the techniques of field spectrometry to

20 measure the cesium flux and also soil sampling so that's just to emphasize,

21 again, that this whole process is being undertaken to extend the region

22 where we can calculate doses.

23   The   next   viewgraph   (LRA-42)   indicates   the   dose   determination

24 methodology that's based upon these techniques and this, I would like to

25 emphasize, is based upon the work that EML has done primarily, and their

26 demonstration of this technique throughout Utah, but, basically, the key to

27 this whole business is to calculate the amount of cesium-137 that arrived

28 at a site at some estimated time of arrival.   Now, if we can in fact cal-

1 culate the estimated cesium that came from the Nevada Test Site, we can go

2 back to our standard source term calculations and we can, indeed, calculate

3 in a reasonable way the short-lived radionuclides that came with the cesium

4 that were responsible for the dose, and, again, just to emphasize, it's the

5 short-lived radionuclides that are responsible for the dose and not the

6 cesium. The cesium is our track of what's still there and we can measure

7 with contemporary measurements. Once we know Number 2, we can then cal-

8 culate Numbers 3 and 4 with our standard methodologies.

9 The next viewgraph (LRA-43) indicates the two methods that EML has

10 come up with and successfully demonstrated in Utah. If we know, on the

11 basis of the current measurements, the total cesium that's in the soil now;

12 and if we have a reasonable idea of when it got there, we can, of course,

13 calculate backward how much was there originally. The first method assumes

14 that global cesium primarily comes down with rainfall and that if we do

15 know the rainfall at a particular location, we can use a regression

16 equation that EML has developed to estimate the global; and then the cesium

17 that came from Nevada is simply the difference between the total and

18 global. The other method is based upon current measurements of plutonium

19 deposition as well as the cesium-137 and the ratio of plutonium-240 to

20 -239.

21 The next viewgraph (LRA-44) is an indication of why that ratio should

22 be different for global fallout as opposed to that that came from the

23 Nevada Test Site, and, basically, plutonium-239 is made in reactors with

24 the bombardment on uranium-238. The longer you leave it in the reactor,

25 the more plutonium-239 is created from uranium; and at the same time if you

26 have created plutonium-239, you leave it in the reactor, and you eventually

27 build up levels of plutonium-240 by two different methodologies. The level

28 of plutonium-240 is a reflection of the neutron flux that the plutonium has

1 seen and the uranium, in this case, as well, as if we talk about global

2 fallout, it's mainly due to thermonuclear explosions which produce a very

3 large neutron flux and substantially change the ratio of plutonium-240 to

4 -239. Now, from the Test Site, we essentially have all fission devices

5 that did not produce such large neutron fluxes, so that's the basic reason

6 why the ratio of plutonium-240 to -239 is different for the Nevada material

7 as opposed to global fallout.

8 The next viewgraph (LRA-45) are some material from EML that I won't go

9 through in any great detail. It's been presented a couple of different

10 times, but, just to emphasize that this technique has been worked out by

11 EML that you can calculate the ratio of (total) plutonium from Nevada to

12 that of global if you measure several different things and that includes

13 the ratio of plutonium-240 to -239 in your sample and then you know what it

14 should be for global fallout, and what it should be for Nevada fallout.

15 Going through this arithmetic, you can calculate on the basis of these

16 measurements and those knowns, the ratio of plutonium from Nevada and

17 global fallout in that sample, and these are the values that EML has

18 provided us as the constants for the Nevada fallout and for the global

19 fallout. You see that the ratio from the two sources differs by about a

20 factor of 6.

21 The next viewgraph (LRA-46) is simply an extension of that. The other

22 equation is that the total plutonium in the sample has to represent the sum

23 of the two sources; combine that equation with the other one, and then you

24 can come up with the amount of global fallout in that sample and then, what

25 we really want is now this number, whereas if we know the global plutonium

26 in that sample, and also the total cesium, we know the ratio of cesium-

27 plutonium in global fallout, shown there, and then we can, indeed, calcu-

28 late this number, which is the number we need to drive our dose

1 calculations and we can also compare that number with the number that came

2 from the rainfall method.

3 And the next viewgraph (LRA-47) shows the steps in this measurement

4 strategy of what we now call Phase II. We select the desired communities.

5 Those were selected on the basis of geographical coverage where we had a

6 feeling that the fallout might have gone. Areas were selected essentially

7 to provide a circle around the areas that we have been measuring so that we

8 did select about 100 communities where we felt it was desirable to look for

9 a soil sampling site. Frosty's group then went out, selected these candi-

10 date sites. They were followed by the Livermore people, and EG&G also

11 assisted in this operation, to measure cesium-137 by field spectrometry.

12 That's mainly a confirmatory technique to make sure that that sample does

13 have a representative amount of cesium in there because if it has been

14 seriously disturbed then we essentially get very little values of cesium,

15 and we would not take soil samples at that site. On the basis of that, we

16 then select sites for soil collection, collect the soil samples, we select

17 sites for following analysis by laboratory methods. We have just finished

18 Step 6. Last May we essentially had just done this part (Step 1), and so

19 we've been very busy since the May meeting doing all of this measurement by

20 field spectrometry and collection of soil samples. We now have picked

21 these sites (for Step 6), and I'll get to them in a moment, which ones they

22 are, and then we'll follow that with our cesium measurements. In the soil

23 samples we'll look at the distribution (of cesium) with depth. We can go

24 back then and calibrate our field spectrometry measurements, and once we

25 know the distribution with depth to get a semi-independent measurement of

26 the total cesium deposition. Now on the basis of this measurement

27 (Step 7), if the distribution with depth continues to look reasonable and

28 provides us with confidence that that site has not been further disturbed,

1   then we will proceed with these other analyses, the more expensive analyses

2   of plutonium and plutonium isotopic composition.

3   The next viewgraph (LRA-48). On Wednesday our Site Selection

4   Committee met to select the sites for the laboratory analysis of

5   cesium-137, and those were the members of the Committee. I think Harold

6   Beck and Phil Krey with their experience from doing this already in Utah

7   probably provided the most valuable input at this meeting. Howard

8   Hawthorne was involved in the soil sampling and was responsible for that

9   program; also a very important input. Frosty, in the inital selection of

10 the site and questions about verifications of age, and so forth. We

11 provided the in situ measurements, the field spectrometry of the

12 cesium-137, and then the folks from NV. That was the Committee. We met

13 all day, and we did run through several hundred prospective sites and

14 reached agreement in a rather amazing fashion, as it turned out.

15   The next viewgraph (LRA-49) basically looks at the soil -- the site

16 selection criteria. Now the first four here were the criteria that we had

17 before we even went into the field. In essence we are looking for large

18 areas of open, which have a consistent ground cover of lawn as our first

19 priority and away from obstructions, such as buildings and trees, and so

20 forth. An absolute requirement, as much as it can be positively verified,

21 is that the sample has been undisturbed since the testing began. We

22 certainly have a fundamental reason for wanting to look at the total cesium

23 that has been deposited on that site. So that that is a very strong

24 criterion. Other criteria, three and four, are that the site is not

25 subject to erosion, and it's not subject to accumulation. We want

26 definitely a site that retained the fallout that fell on it and did not

27 lose it by erosion and did not accumulate it by sedimentation, from

28 waterborne material, or by windborne.

1   Now after we have a preliminary site selection then the fifth

2 criterion is that the field measurement confirms at a reasonable level that

3 cesium is, indeed, present at that site. And finally, a sixth criterion

4 that is very important is that the soil sample is collected successfully.

5 Howard talked about several different kinds of problems. I think the worst

6 problem is that there might be a serious problem of crosscontamination of

7 samples; that the hole sloughs off, and you get relatively high activity

8 material that falls down and contaminates the lower levels. So that if the

9 soil sample is not collected successfully, that's reason for rejection of

10 that site.

11   The next viewgraph, please. (LRA-50). This shows our current results

12 in terms of numbers. We started out with 105 desired communities, target

13 communities, if you will, that we felt it was desirable to include.

14 Frosty's people went out, and according to my tabulations, selected 316

15 candidate sites attempting to look at more than one site within each

16 community, so that we had more than one choice if we encountered other

17 kinds of problems. Actually measured by field spectrometry were 276. On

18 the basis of those numbers, if we had three sites in a small community, and

19 they all had the same flux, then we only chose to, say, sample one of those

20 sites for soil; so that there was a considerable reduction in the total

21 number of sites that were actually selected for soil sampling.

22   In our present process now we've gone through, we had a target of 100

23 sites, and we actually selected 102 sites for lab cesium analysis. Four of

24 those are questionable in terms that they need further verification; so

25 that we may have 98-102 sites depending on how those verifications turn

26 out. That's mainly verification from somebody who will say that in their

27 memory that site has, in fact, been undisturbed since 1950.

28   The next viewgraph, please. (LRA-51). Now this is a summary of these

1 selected soil sampling sites by state and type. Now, I haven't really

2 referred to the types before. A type-A site is one that we feel meets the

3 criteria that I showed before. Now a type-B site meets most of the

4 criteria, but it becomes a little bit questionable for one reason or

5 another, but because the type-A site was not available, or in some cases

6 because we wanted to compare the two types of sites, we have chosen some

7 type-B sites. One of the handouts you have is a list of these 102 sites

8 and just some reasons here for why something might be a type-B site. You

9 can read down through there. Some sites had tree cover, which might have

10 affected the deposition of cesium. That was sufficient reason to be a

11 type-B site. If gravel was encountered at the bottom of a sample, we felt

12 that that was a less desirable site and became a type-B. Where it might be

13 questionable that there might be areas of runoff, that made it a type-B

14 site. Any site, even though it looked like it had a nice consistent

15 vegetation, if it was not a lawn, that became automatically a type-B site.

16 Some areas are indicated here as small. The small by itself was not a

17 sufficient criterion to make it a type-B site; but small usually meant that

18 it was not very far away from obstructions like buildings or trees. We

19 have in this list indicated the reason why each site was designated as

20 type-B as opposed to type-A.

21 As I mentioned, we had four sites that are questionable mainly because

22 we feel uncomfortable with our present level of verification of the age.

23 Could I have the next viewgraph (LRA-52). Now this shows where all

24 these sites are. This is kind of a complicated viewgraph. The code is up

25 here (on upper right). The black indicates the DRI site selection as a

26 preliminary candidate site. The blue is where Livermore actually made, or

27 EG&G actually made in situ measurements. The green is where REECo made a

28 soil sample collection. These dots are sites that have been selected for

1 laboratory analysis for cesium-137. Now you see we have some pretty good

2 geographical coverage here. We do have some holes over in the area here in

3 the region of some interesting areas in Nevada that we simply have not been

4 able to locate sites which we feel comfortable with even on a B-level. So

5 we are looking for some additional sites over in areas in Nevada. But, as

6 you can see, we have extended our coverage now to a fairly good coverage of

7 Arizona, northern Arizona, and we have extended our coverage in several

8 areas here which were not originally tabulated by the Test Manager's

9 Committee. We have some areas in Idaho where we believe there probably was

10 some fairly substantial fallout deposition that are now included; and we

11 have some areas here in Utah which we hope might help give us some

12 additional information on how material got to Salt Lake City.

13   Now one of the tools we used that has been referred to before in this

14 process was this book. Every member of the group had this book. Included

15 in here is a photograph of the site, Frosty's site description, the results

16 of the Livermore measurement, and also notes and maps; and I would hope

17 that you might pick out your favorite site and actually come and look at

18 this book--we will leave it up here--and perhaps get a feel for the type of

19 information that was available to us when we made the site selection.

20   There is also shown up here a larger map, so that you can look at it

21 without looking at the viewgraphs. We have several materials available, if

22 you'd care to study this.

23   The next viewgraph (LRA-53). One of the recommendations of this

24 Committee was that we provide a sufficient number of sites that we could

25 make a comparison between our normal method of calculation of doses which

26 is based upon external exposure rate measurements. This other method is

27 based upon contemporary measurements of cesium in soil. So that these 10

28 sites are included in Phase II in order to make that comparison.

1   The next viewgraph (LRA-54) indicates that we have several communities

2 with multiple sites. Now there's several different reasons why we have

3 communities with multiple sites. In some cases, like Albuquerque is a good

4 example, we do have some information that leads us to believe that there

5 could be significant deposition from Nevada material in Albuquerque. So

6 that we have included three sites, because it is a large town, so we can

7 examine that question. Flagstaff, I think we have less reason to believe

8 there is significant deposition there, but it is a large town which has

9 three good sites. The other reason for doing this is to have a sufficient

10 number of locations with two samples such that we can look at sample

11 variability within the same location.

12   Now at some other sites, Boise is a good example, we had many areas

13 which had the same cesium flux as measured with our field spectrometer, and

14 one site which had essentially twice as much flux as any of the others.

15 Unfortunately, that happened to be the State Capitol, so we thought we'd

16 better make sure that we included that, measured both of the areas. Las

17 Vegas is included, e.g., primarily because, again, it is a relatively large

18 town. We want to look at two sites that are geographically separated

19 within the same area.

20   That concludes my presentation, Mr. Chairman. Any questions?

21   DR. CAROTHERS: Lynn, have you, or has EML -- I'm sure they must

22 have -- selected sites and taken a sample or two where you would expect to

23 find no NTS fallout at all?

24   DR. ANSPAUGH: We have not done that yet ourselves. I think EML has

25 done quite a bit of work on that. We do intend to take some additional

26 samples along the west coast of California to look at that.

27   DR. CAROTHERS: I was just wondering, because then if you did that

28 when you got done certain assumptions ought to be checked in a way. Phil,

1 you wanted to say something?

2 MR. KREY: Yes. I'd just like to say that I think you have to be a
3 little careful when you use those words. I don't think there's a site in
4 the United States that received no NTS fallout at all.

5 DR. CAROTHERS: Oh, I understand that. I've been on the witness stand
6 and been questioned about, how much is any.

7 MR. KREY: So we certainly have made collections all over the United
8 States. I think Lynn is planning to take a collection on the west coast.
9 We've just retrieved a sample in 1982, the end of 1982, on the east coast.
10 Yes, there will be other samples around. I'm a little sensitive to that,
11 Jim, and I didn't mean to be legalistic in that sense, but it becomes hard
12 to define when you say a site that has no NTS fallout at all. I think,
13 I'll just throw it out as a suggestion that might be worthy of some con-
14 sideration, and it was the same question that the Steering Committee
15 addressed many years ago, as to what area you go to before you say, "I'm no
16 longer interested in the impact of NTS."

17 DR. CAROTHERS: Phil, I'll bet you Hawaii has very little NTS fallout,
18 but I'll bet it's got global.

19 MR. KREY: I said the United States. Of course, Hawaii is part of the
20 United States.

21 DR. CAROTHERS: It's part of the United States.

22 MR. KREY: But I happen to know that the University of Texas -- Martha
23 Scott is an oceanographer, and she is befuddled with an enormous amount of
24 what appears to be NTS fallout in the sediments in the middle of the
25 .Carribean Sea; so it gets around an awful lot. I think you just have to
26 be -- you know, it's something to consider. I, personally, have some
27 difficulties looking at the dose from NTS fallout in Albany, or in
28 Birmingham, or somewhere like that. Certainly if you wanted to be careful

1 and scientifically precise you probably could, indeed, find fallout that

2 occurred in practically every town in the United States.

3   DR. CAROTHERS: Well, no, I'm not trying to be legalistic either. I

4 was only thinking. Certainly you would agree that there are some sites

5 which have less NTS fallout than others, and that if you picked a likely

6 one that had probably very little fallout, like Hawaii, and ran your proce-

7 dures on it, and so forth; then you would be surprised if you found a lot

8 of NTS fallout.

9   MR. KREY: Well, in 1969 and 1970, we did a global soil sampling for

10 plutonium and plutonium isotopics, and that has been published. I can't

11 remember whether we got a sample from Hawaii or not. We might have, but we

12 certainly got them in Europe, Asia, Africa, and South America. You

13 certainly can see different isotopic compositions based on the geographical

14 and longitudinal characteristics. But for the DAAG and ORERP to consider

15 their Charter, I think you have to consider just the NTS.

16   DR. CAROTHERS: Well, I was thinking only of it as giving me

17 confidence in your method. In a sense it's a blank, if you like, of a

18 particular kind.

19   MR. KREY: Well, I hope I answered your question. We will have

20 samples of that nature.

21   DR. CAROTHERS: Thank you.

22   CHAIRMAN MOSELEY: Other questions? Thank you very much, Lynn.

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HISTORICAL ESTIMATES OF EXPOSURE AND
POPULATION EXPOSURE FROM TESTING AT THE
NEVADA TEST SITE
I.   TEST SERIES THROUGH HARDTACK II, 1958

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ABSTRACT

Based upon estimates of population and calculations of estimated exposure made by the Test Manager's Committee to Establish Fallout Doses, we have tabulated the population estimated exposures for communities within established fallout patterns. The total population estimated exposure is 85,000 person-R. The greatest population exposures occurred in three general areas: Saint George, Utah; Ely, and Las Vegas, Nevada. Three events, HARRY (May 19, 1953), BEE (March 22, 1955), and SMOKY (August 31, 1957), accounted for over half of the total population estimated exposure. The bases of the calculational models for "infinite exposure," "estimated exposure," and "one year effective biological exposure" are explained.

INTRODUCTION

We and individuals from several other organizations are engaged in a major, 4-yr project that has the goal of determining the radiation doses received by residents in the region of the Nevada Test Site (NTS). This complete evaluation will include doses received from external gamma and beta exposure due to the fallout field, from external gamma and beta exposure from immersion in the debris clouds, from beta exposure of the skin from direct deposition of fallout, and from internal exposure due to the intake of radionuclides via inhalation and ingestion. All activities conducted at the NTS will be included. It is not generally appreciated that tests of nuclear engines and ramjets were conducted at the NTS during the 1959 to 1969 period, and that these reactor tests released radionuclides to offsite locations.

One of the important goals of this project is to understand the measurements that were made in the field at the times immediately following the detonations, and the methods of calculation that were used to translate these measurements into estimates of exposure and/or dose. Unfortunately, there was no major effort to calculate the dose that people received from internal emitters and this is a major part of our study. Some radionuclides, such as ^{90}Sr, ^{131}I, and ^{137}Cs, did receive major attention as time went on (JCAE63), but the available measurement techniques and assessment methods did not permit a complete evaluation.

In contrast, a great deal of effort was devoted to calculating the external gamma exposure received by the off-site residents. The most substantial of these efforts was undertaken by the Test Manager's Committee to Establish Fallout Doses (TMCEFD). This committee was chaired by A. Vay Shelton of the University of California Radiation Laboratory (now Lawrence Livermore National Laboratory) and included Roscoe H. Goeke, US Public Health Service (PHS), William R. Kennedy, Los Alamos Scientific Laboratory, Kermit H. Larson, UCLA, Kenneth M. Nagler, US Weather Bureau, and Oliver R. Placak, USPHS. This Committee's major report was completed in 1959 (Sh59) and covered testing conducted up through 1958, but the report was not widely distributed nor formally published. The results, however, were summarized in a paper by Dunning (Du59) published in the 1959 Hearings on Fallout from Nuclear Weapons Tests conducted by the Joint Committee on Atomic Energy (JCAE). These documents provided estimates of exposure for 300 localities that were judged to be "within the fallout region."

A controversy has arisen over these exposure estimates (Sh59 and Du59 refer to estimates of "dose," but they clearly are estimates of exposure as we use the terms today); much of this controversy (e.g., Hu79) results from an alleged discrepancy between results reported by the Atomic Energy Commission (AEC), a predecessor agency of the Department of Energy, and the PHS. It is our opinion that this controversy is due entirely to a misunderstanding of the terms and methods used by the TMCEFD (Sh59) and the PHS (e.g., PHS55).

There are several purposes for this paper. First, we will explain the methods used by the TMCEFD in deriving their estimates; we believe these are the best estimates available at present because they were

made by people who had intimate and current knowledge of the original measurements. Second, we will use these estimates to calculate population exposure by communities; we hope such data may be useful to epidemiologists. A third purpose is to identify those locations that received the largest population exposures and those weapons tests that produced the largest population exposures. A subsequent paper will address the population exposures that have resulted from NTS-related activities after the Hardtack II test series ended in 1958.

Shleien (Shl81) recently published his estimates of population exposure for activities at the NTS between 1951 and 1970. His results are based upon a different calculational model and he did not include several exposed communities that were included in the TMCEFD tabulation.

METHODS

About half of the population exposure during the 1951 to 1958 period was due to the UPSHOT-KNOTHOLE series in 1953. It is important to note that during this series only very few measurements of <u>exposure</u> were made by the use of film badges or other integrating devices. Rather, measurements of open-field external exposure <u>rate</u> were made and a calculational model was necessary to convert to estimates of human exposure. External exposure rates were typically measured with the AN/PDR-T1B ionization-chamber instrument when the rates were >10 mR/hr or the MX-5 Geiger-Mueller tube instrument when rates were <10 mR/hr. Because readings were made at many times post detonation when the external exposure rate was changing rapidly with time, it was desirable to normalize to a common time in order to construct isopleths. The

convention was adopted frequently that the exposure rate from material deposited at a given location varies with time according to the relationship

$$R(t) = R(1) t^{-1.2}$$ [1]

where $R(t)$ = Exposure rate at time t in hr, and

$R(1)$ = Exposure rate at 1 hr.

This has become known as the $t^{-1.2}$ "law," but the relationship was originally derived as an __approximation__ (Wa48) of the rate of decay of fission-product __beta activity__. It is instructive to note that Way and Wigner (Wa48) actually calculated two quantities: the rate of beta-particle emission as a function of time, $\beta(t)$, and the rate of total energy emission as a function of time, $3B(t) + \Gamma(t)$; where $B(t)$ is the rate of total beta-energy emission and $\Gamma(t)$ is the rate of total gamma-energy emission. Neither of these quantities is an appropriate analog of the external gamma-exposure rate for the resulting fallout field, but presumably the rate of total _energy_ emission would be the better analog. The results of Way and Wigner's calculations for t < 1 sec are

$$\beta(t) = \sim (0.38 - 2.6t) \text{ /sec}$$ [2]

$$\text{and } 3B(t) + \Gamma(t) = \sim (3.8 - 0.61t) \text{ MeV/sec}$$ [3]

For times longer than one day, the results are

$$\beta(t) = \sim 5.2 \times 10^{-6} \, d^{-1.2} \, /\text{sec} \qquad [4]$$

$$\text{and } 3B(t) + \Gamma(t) = \sim (3.9 \, d^{-1.2} + 11.7 \, d^{-1.4})$$
$$\times 10^{-6} \, \text{MeV/sec.} \qquad [5]$$

These results, which apparently are the source of the $t^{-1.2}$ "law," suggest that there should not be a simple power-law dependence of the external gamma-exposure rate as a function of time and that $t^{-1.4}$ might have been a better "law" over longer times. Nevertheless, the $t^{-1.2}$ approximation was frequently used to describe the decrease with time of the external gamma-exposure rate. As an approximation, it was then a natural extension to calculate an infinite exposure (IE) as

$$IE = R(1) \int_a^\infty t^{-1.2} dt = \frac{R(1)}{-0.2} \left[t^{-0.2} \right]_a^\infty = 5R(1)a^{-0.2} \qquad [6]$$

where a is the time of arrival. In such a calculation, the validity of the $t^{-1.2}$ approximation is of major importance. If, for example, a more appropriate model were $t^{-1.4}$, the infinite exposure would be $R(1)a^{-0.4}/0.4$. For an arrival time of 3 hr, the two models differ by a factor of 4.0/1.6 or 2.5.

Recent analysis of the original data taken following the weapons test HARRY (May 19, 1953) indicates that a more appropriate model of the rate of decrease of the external gamma exposure rate is $t^{-1.35}$ over periods of about 100 hr (Qu81). Hicks (Hi82) has also performed detailed calculations of the expected rate of decay of the HARRY and

SMOKY external gamma-exposure fields based upon the individual radionuclides and their gamma emissions, and has shown that $t^{-1.35}$ is a better approximation over longer time periods.

Also, the use of this infinite exposure model does not represent realistically the exposure received by <u>people</u> because no provision is made for the shielding provided by residences, workplaces, schools, or automobiles.

These two problems were recognized and addressed by Dunning (Du57a,b). Based upon measurements of the external gamma-exposure field on the Island of Rongelap over a two-yr period (reproduced in Fig. 1), Dunning developed the following model as a more realistic expression of the external exposure rate in a real open-field situation where fallout is weathering into soil:

$$R(t) = \begin{cases} R(1) \ t^{-1.2} \text{ for } & t < 168 \text{ hr} \\ bR(1) \ t^{-1.3} \text{ for } 168 \text{ hr} < t < 336 \text{ hr} \\ cR(1) \ t^{-1.4} \text{ for } 336 \text{ hr} < t \end{cases}$$ [7]

where b and c are constants required for continuity.

The estimated exposure (EE) experienced by people over a one-yr period is then calculated as

$$EE = S \int_a^{8760} R(t) \ dt$$ [8]

where S is a building shielding factor of 0.75. This was based upon the experimental observation that buildings reduce exposure by an average factor of two (Du57a) and the assumption that people are in buildings half the time. The solution of the above is

$$EE = 0.75 \, R(1) \left[\frac{1}{0.2} \, (a^{-0.2} - 168^{-0.2}) \right.$$

$$+ \frac{168^{0.1}}{0.3} \, (168^{-0.3} - 336^{-0.3})$$

$$\left. + \frac{2^{0.1} \, 168^{0.2}}{0.4} \, (336^{-0.4} - 8760^{-0.4}) \right] \qquad [9]$$

Dunning (Du56, AEC57) also developed the concept of the one-year effective biological exposure (EBE). (Both estimated exposure and effective biological exposure were referred to as "doses," but were calculated in units of R. For consistency, we will refer to both as "exposure.") This was done in order to account for the concept of biological repair and was intended only for application where acute somatic effects were of concern. The defining differential equation for EBE is

$$\frac{d(EBE)}{dt} = S \cdot R(t) - \lambda(EBE) \qquad [10]$$

where $R(t)$ is given by Eq. [7] and λ is a repair constant equal to $\ell n2/672$ hr. There is no easy solution of Eq. 10, but a graphical solution has been provided (AEC57).

A comparison of the three calculational models is shown in Table 1 for several different times of arrival of fallout. For most arrival times of interest, the EE is shown to be roughly half of the IE.

For its estimates of exposure, the TMCEFD used the calculational model of estimated exposure for the BUSTER-JANGLE (1951), TUMBLER-SNAPPER (1952), UPSHOT-KNOTHOLE (1953), and TEAPOT (1955) series. The

TMCEFD said and thought they were using the effective biological exposure model (Sh59). However, one of their input papers prepared by Nagler and Telegadas (Na56) contains a table of conversions from infinite exposure; this is reproduced in Table 2. A comparison of Tables 1 and 2 demonstrates that they were indeed using the estimated exposure model. Further, Nagler and Telegadas stated that the data reproduced in Table 2 were supplied by Dunning and he (Du81) has confirmed that the relevant model was indeed that of estimated exposure.

For the PLUMBBOB (1957) series, an alternate approach was used by the TMCEFD. Larson et al. (La59) collected many samples of PLUMBBOB fallout, returned them to the laboratory, and measured the rate of decay of gamma emissions. From these data, they constructed a composite PLUMBBOB gamma-decay curve and the TMCEFD used these data in place of Eq. [7]. They did not appreciate that the rate of gamma emission is not adequate directly as a model for external exposure rate, as the energy per gamma emitted changes with time, and there is no indication that their data were corrected for the efficiency of the detector as a function of energy. The TMCEFD, Sh59, state that the PLUMBBOB data so calculated were about 50% higher than would have been calculated with the infinite exposure model. In terms of the estimated exposure model, we conclude that the PLUMBBOB estimates are too high by about 100%. For PLUMBBOB, the TMCEFD also used film badge data to estimate exposure for some communities. As the film badges were not in the field for a full year, they used a rough model of multiplying the film badge reading by 1.3 to approximate infinite exposure and then dividing by 2 to approximate estimated exposure.

For the HARDTACK II (1958) series, the exposures to communities were all small and much less effort was devoted to estimating exposures. In general, most of the estimates of exposure to communities were based upon film badge data with no corrections applied.

It is also important to note that during the earlier test series (prior to PLUMBBOB), no radiation surveys were made in some communities. In order to assess exposures for such communities, the TMCEFD constructed exposure isopleths and interpolated between these isopleths.

The TMCEFD report (Sh59) itself contains data for the 300 communities aggregated by "Pre-PLUMBBOB," "PLUMBBOB," "HARDTACK II," and "Cumulative." Through the courtesy of the late Mr. Kosta Telegadas, we have access to the original compilations for the TMCEFD of estimated exposures by individual weapons tests. We have used these data to calculate population, or collective, estimated exposure. The population data were also taken from Sh59, wherein many population figures were listed as ranges over the total time period or were listed as "not available," "transient," or "variable." Where ranges were provided, we used the higher number in our calculations of population exposure. Where the population was listed as "not available" or "transient," we have not included these locations in population exposure tabulations, but list them separately with the cumulative estimated exposures. Where the population was listed as "variable," footnotes were frequently provided that contained sufficient information to calculate population exposures; if not, they were treated as locations of unknown population.

The calculated values of cumulative population estimated exposure by communities within the States of Arizona, California, Nevada, and Utah are listed in Table 3. The cumulative estimated exposures for locations where no population figures were listed are also provided in Table 3. This Table, including the footnotes, lists all of the locations for which the TMCEFD estimated exposures. Of these many communities, only 19 received cumulative population estimated exposures in excess of 1,000 person-R, and they account for 76% of the total cumulative population estimated exposure. Details for these 19 communities are provided in Table 4.

The total cumulative population estimated exposure by test series is shown in Table 5.

Table 6 presents the population estimated exposure for the 17 individual events that contributed more than 1,000 person-R. (The HARDTACK II series is listed as a single event because the series was analyzed in entirety by use of film badge data.) These 17 events contributed more than 90% of the total population estimated exposure.

Tables 3 through 6 all contain data calculated with the use of the original materials of the TMCEFD. Where we believe their results are in error, this has been noted in footnotes to these Tables.

DISCUSSION

Table 5 indicates that the population estimated exposure from all of the tests through the end of 1958 totaled 85,000 person-R. This can

be converted to a bone-marrow population dose of 59,000 person-rad by use of an absorbed dose/exposure factor of 0.7 rad/R (As79).

The TMCEFD inexplicably did not include Reno, Nevada, in its tabulation. Apparently, the only exposure in Reno was from event BOLTZMANN of the PLUMBBOB series. According to the PHS report (P157), the estimated exposure at Reno was 45 mR and the population was 35,000 people. This population estimated exposure of 1600 person-R would rank tenth in terms of total community exposure.

As noted above, we believe that the TMCEFD overestimated the estimated exposures for the PLUMBBOB series by a factor of two. By making this correction and including the exposure at Reno from event BOLTZMANN, we calculate a corrected population estimated exposure of 19,000/2 person-R + 35,000 persons x 0.045 R = 11,000 person-R for the PLUMBBOB series.

For the HARDTACK II series, the calculated population exposures are small and all of the community estimated exposures were less than or equal to 150 mR with the exception of Adam's Ranch, Nevada, which received 800 mR. As these values were evidently not corrected for background radiation, the TMCEFD values are perhaps too high by a factor of about 2.

Saint George, Utah, received the largest community population estimated exposure of 18,000 person-R and also had a relatively high cumulative estimated exposure of 3.7 R. Other communities in the same area were Hurricane, Washington, La Verkin, and Santa Clara and these also received relatively high exposures as shown in Table 4. The communities of Ely, McGill, East Ely, and Ruth, Nevada, are similarly located close together and represent another area of relatively large

population estimated exposure. Las Vegas, Nevada, had the second highest·population estimated exposure but the estimated exposure was quite low at 0.21 R. Most of this estimated exposure, 0.17 R, was due to event BEE.

Only a few events accounted for most of the population estimated exposure. The data in Table 6 show that event HARRY resulted in 30,000 person-R; this is 35% of the total cumulative population estimated exposure. The three events, HARRY, BEE, and SMOKY, accounted for 57% of the total cumulative population estimated exposure.

The TMCEFD (Sh59) also attempted to estimate the uncertainties associated with their calculations. They considered these sources of uncertainty: 1) Fission-product decay rate, 2) Instrument response to the mixed fission-product-field as compared to calibration source, 3) Inaccuracy of instrument readings at lower exposure rates, 4) The use of film badge data in the calculations as opposed to exposure-rate measurements, 5) Analysis or interpolation to derive results for communities where no exposure-rate measurements were made, and 6) Uneven deposition of fallout. Their estimates of the cumulative uncertainty factors were

$\pm$ 80% for < 0.1 R,

$\pm$ 60% for 0.1 to 1.0 R, and

$\pm$ 40% for > 1.0 R.

Recently, Krey and Beck (Kr81) have measured the total areal deposition of ^{137}Cs and ^{239,240}Pu for soils in Utah, and have also determined the ratio ^{240}Pu/^{239}Pu. Because this ratio is different

for NTS and global fallout, they have been able to determine the amounts of NTS-derived ^{137}Cs in soil. They (Be82) then calculated the short-lived fission products that would have accompanied the ^{137}Cs from NTS and the resulting infinite exposure. A comparison of their results and the TMCEFD results is shown in Table 7 for all communities where data from both sources are available. The two sets of results, based upon independent methods, agree well.

The TMCEFD did not calculate estimated exposures at distances as far away as Salt Lake City, Utah, and fallout patterns were not plotted to such distances, in general. Data in Be82 indicate that the cumulative infinite exposure at Salt Lake City might have been 1.2 R and the cumulative population infinite exposure might have been 220,000 person-R; the cumulative estimated exposure and the cumulative population estimated exposure would be approximately half of these amounts. The latter is larger than the total population estimated exposure shown in Table 5 for all of the closer in communities that are considered to be in the "high fallout" region.

Because the raw data that served as input to calculations in this paper have not been generally available to the scientific community, we have prepared a companion report (An82) that contains these data and a reproduction of the TMCEFD report.

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Fig. 1. The measured external exposure rate over long time periods compared to that predicted by $t^{-1.2}$, and an early attempt to calculate the rate based upon nuclide composition. Redrawn from Du57b.

Table 1. A comparison of the three calculational models: infinite exposure (IE), estimated exposure (EE), and effective biological exposure (EBE). Results are expressed as reduction factors compared to an infinite exposure of 1.0 at all times of arrival.

Table 2. Calculational model used by Nagler and Telegadas (Na56) to calculate estimated exposure. The original reference mistakenly referred to the calculation as effective biological exposure.

Table 3. Cumulative estimated exposure in R and cumulative population estimated exposure in person-R by community from weapons tests at the Nevada Test Site, 1951 to 1958. A dash indicates that the population was unknown, transient, or variable.

Table 4. Population, cumulative estimated exposure, and cumulative population estimated exposure, for the 19 communities receiving a cumulative population estimated exposure in excess of 1,000 person-R during 1951-1958.

Table 5. Cumulative population estimated exposure by test series.

Table 6. Cumulative population estimated exposure for the 17 events that contributed more than 1000 person-R, 1951-1958.

Table 7. Comparison of the recent results of Beck and Krey (Be82) based on contemporary measurements of ^{137}Cs with those of the TMCEFD.

Gamma exposure rate (mR/h)

Time after detonation (days)

Legend:
— Gamma dose rates three feet above ground on island of Rongelap.

— — Theoretical decay according to (time)$^{-1.2}$ (starting D + 1 days).

········ Estimated from relative theoretical gamma dose rates, decay rates of fission products, energy of the gammas, and the number of gamma photons per disintegration.
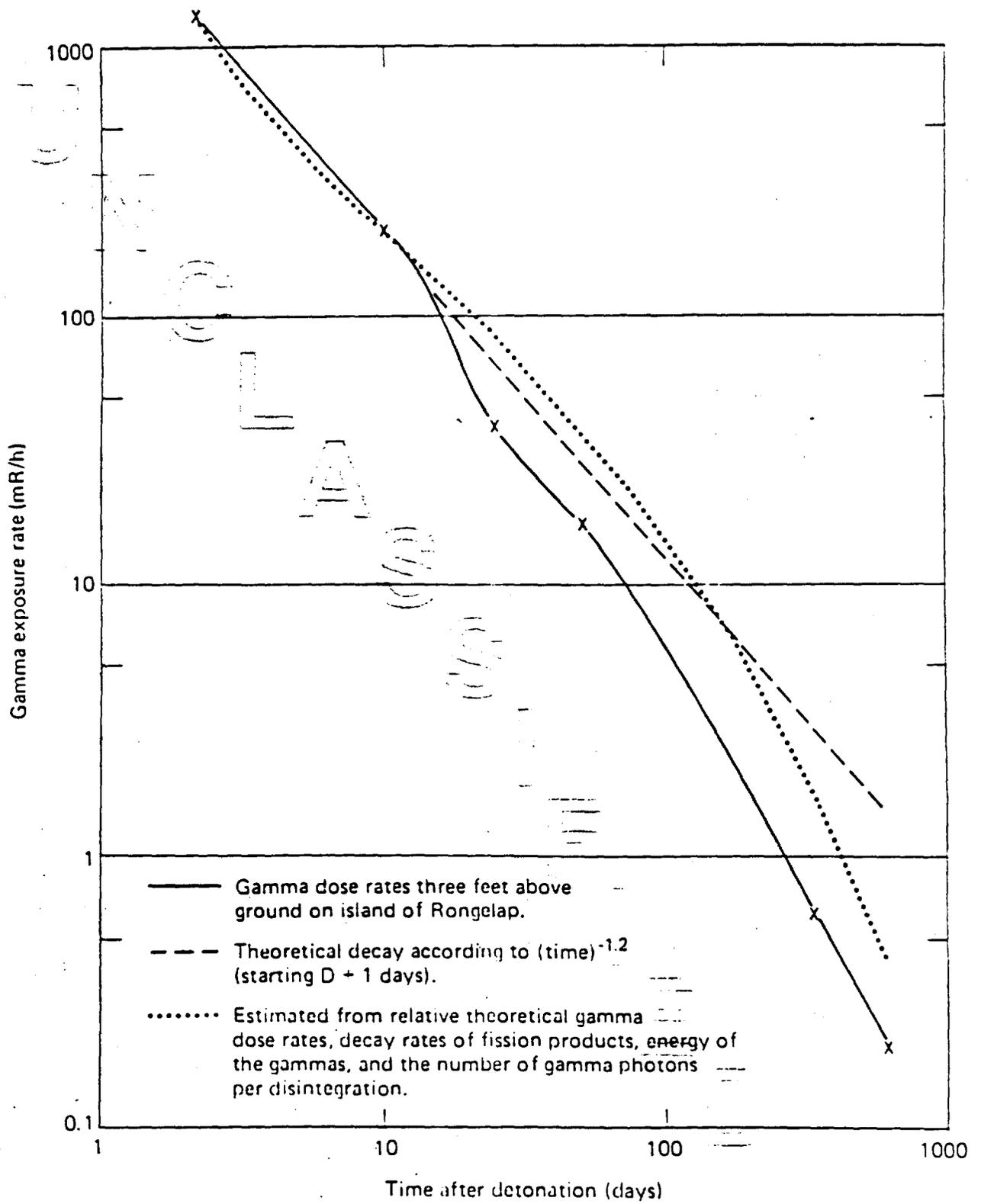
Table 1. A comparison of the three calculational models: infinite exposure (IE), estimated exposure (EE), and effective biological exposure (EBE). Results are expressed as reduction factors compared to an infinite exposure of 1.0 at all times of arrival.

Time of arrival, hr	Shielding	x Weathering[a]	x Time[b]	= EE	x Repair	= EBE
1	0.75	0.83	0.95	0.59	0.84	0.50
2	0.75	0.81	0.94	0.57	0.81	0.46
3	0.75	0.79	0.94	0.56	0.79	0.44
4	0.75	0.78	0.93	0.54	0.79	0.43
6	0.75	0.76	0.93	0.53	0.78	0.41
8	0.75	0.75	0.92	0.51	0.76	0.39
10	0.75	0.73	0.91	0.50	0.76	0.38
12	0.75	0.72	0.91	0.49	0.75	0.37
14	0.75	0.71	0.91	0.49	0.74	0.36
16	0.75	0.71	0.90	0.48	0.73	0.35
18	0.75	0.70	0.90	0.47	0.73	0.35
20	0.75	0.69	0.90	0.47	0.73	0.34

[a]"Weathering" includes the effects of variation from $t^{-1.2}$ in decay rate of the external exposure rate and the variation in shielding or "ground roughness" effects as fallout weathers into the soil. The calculations are based upon an empirical model.

[b]The effect of integrating for one yr instead of infinite time.

Table 2. Calculational model used by Nagler and Telegadas (Na56) to calculate estimated exposure. The original reference mistakenly referred to the calculation as effective biological exposure.

Time of arrival, hr	Percent of infinite exposure
0.5 - 0.8	60
0.9 - 1.2	59
1.3 - 1.7	58
1.8 - 2.3	57
2.4 - 2.9	56
3.0 - 3.6	55
3.7 - 4.3	54
4.4 - 5.3	53
5.4 - 6.4	52
6.5 - 7.7	51
7.8 - 9.4	50
9.5 - 11.5	49
11.6 - 14.0	48
14.1 - 17.2	47
17.3 - 20.6	46
20.7 - 24.3	45
24.4 - 30.	44

Table 3. Cumulative estimated exposure in R and cumulative population estimated exposure in person-R by community from weapons tests at the Nevada Test Site, 1951 to 1958. A dash indicates that the population was unknown, transient, or variable.

Community	Cumulative exposure	Cumulative population exposure	Community	Cumulative exposure	Cumulative population exposure
		Arizona[a]			
Beaver Dam	2.3	12.	Kingman	0.04	220
Big Bend Ranch	2.2	11.	Lake Mohave	0.02	0.04
Bullhead	0.02	10.	Littlefield	1.9	84.
Chloride	0.02	3.2	Mount Trumbull	0.16	16.
Grasshopper Junction	0.03	0.06	Short Creek	1.6	140.
Hackberry	0.01	1.0	Valentine	0.01	0.50
Hughes Ranch	2.3	--	Wolf Hole	1.3	6.5
		California[b]			
Baker	0.03	22.	Johannesburg	0.03	9.0
Barstow	0.01	100.	Kelso	0.03	8.1
Benton Station	0.07	21.	Laws	0.07	5.0
Big Pine	0.03	17.	Lenwood	0.01	26.
Bishop	0.06	170.	Lone Pine	0.08	110.
Cartago	0.03	3.8	Oasis	0.10	1.2
Chalfant	0.10	2.5	Olancha	0.03	8.2
Death Valley Junction	0.15	3.0	Red Mountain	0.03	9.6
Deep Spings	0.03	3.0	Ridgecrest	0.02	80.
Emigrant Springs Ranger Station	0.09	0.18	Ryan Mine	0.21	0.21
			Silver Lake	0.05	0.50
Essex	0.02	1.5	Stovepipe Wells	0.06	0.12
Furnace Creek	0.15	7.5	Tom's Place	0.02	--
Independence	0.02	18.	Yermo	0.01	7.0

Table 3. (continued)

Community	Cumulative exposure	Cumulative population exposure	Community	Cumulative exposure	Cumulative population exposure
		Nevada[c,d,e]			
A & B Mine	3.4	41.	Cactus Springs	0.08	1.4
Acoma	3.0	30	Caliente	0.76	740.
Adam's Ranch	2.2	--	Carp	3.9	98.
Alamo	1.4	350.	Caselton Mine	0.72	110.
Apex	0.13	6.5	Charleston Lodge	0.01	0.60
Ash Meadows	0.21	1.7	Cherry Creek	0.50	56.
Ash Springs	0.66	3.3	Clark's Station	1.6	8.0
Atlanta	0.56	1.1	Cloud	3.6	--
Austin	0.20	100.	Coaldale	0.98	24.
Babbitt	0.28	690.	Cole & Dolan Ranch	0.81	2.4
Baker	1.0	63.	Corn Creek	0.40	4.4
Barclay	2.0	20.	Cove	0.85	17.
Bardoli Ranch	2.0	7.9	Crestline	0.70	15.
Basalt	0.20	1.6	Crystal	4.1	20.
Beatty	0.21	110.	Currant	0.83	62.
Belew Ranch	1.7	5.2	Deimue	0.65	4.6
Belmont	1.2	7.5	Desert Rock	0.19	--
Blue Diamond	0.05	20.	Dodge Const. Camp	11.	470
Blue Eagle School	1.6	17.	Donahue Ranch	0.35	1.4
Bonanza Boy Scout Camp	0.12	--	Dry Lake	1.0	21.
Bond Ranch	0.75	--	Duckwater	1.0	50.
Boulder City	0.08	320.	D-X Ranch	1.0	--
Boyd	1.5	--	Dyer	0.18	6.3
Bristol Silver Mine	0.78	39.	East Ely	1.2	1200.
Buckhorn Ranch	0.98	12.	El Dorado	1.0	3.2
Bunkerville	4.5	1100.	Eldridge Ranch		
Butler Ranch	15.	30.	(Mt. Wheeler Inn)	0.98	--

Table 3. (continued)

Community	Cumulative exposure	Cumulative population exposure	Community	Cumulative exposure	Cumulative population exposure
		Nevada (continued)			
Eldridge Ranch	0.54	2.2	Kimberly	0.92	110.
Elgin	3.6	110.	Kyle	3.5	--
Ely	1.2	4300.	Laboard Ranch	0.45	--
Etna	0.82	--	Lake Mead Base	0.09	0.45
Eureka	0.85	420.	Lane City	0.98	39.
Fallini Ranch	2.0	30.	Las Vegas	0.21	9900
Fallon	0.14	340.	Lathrop Wells	0.16	2.4
Fish Creek Ranch	1.2	--	Lehman Caves	1.2	--
Gabbs	0.38	240.	Leith	3.3	--
Galt	11.	--	Lida	0.87	22.
Garnet	0.90	--	Lida Junction	1.3	3.8
Geyser Maint. Station	1.4	14.	Lincoln Mine	6.0	3000.
Geyser Ranch	1.6	7.8	Lockes	1.6	6.4
Glendale	0.85	64.	Logandale	0.56	170.
Goldfield	1.2	260.	Lund	1.3	320.
Goldpoint	1.3	13.	Luning	0.49	24.
Groom Mine	4.9	20.	M & M Mine	3.4	6.8
Gubler Ranch	1.4	--	Manhattan	0.39	16.
Hawthorne	0.28	520.	McGill	0.77	1800
Henderson	0.02	280.	Mercury	0.22	770.
Hiko	1.1	59.	Mesquite	2.1	1200.
Hollinger's Ranch	0.37	0.37	Millett	0.44	2.2
Hoover Dam	0.05	--	Mina	0.58	260.
Hoya	5.9	--	Moapa	0.77	40.
Indian Creek Ranch	0.98	--	Moapa Indian Res.	0.79	120.
Indian Springs	0.15	280.	Moon River Ranch	2.1	6.2
Ione	0.24	9.6	Mounts Ranch	1.1	--

Table 3. (continued)

Community	Cumulative exposure	Cumulative population exposure	Community	Cumulative exposure	Cumulative population exposure
		Nevada (continued)			
Nellis AFB	0.05	400.	Schurz	0.22	22.
Nivloc	0.43	110.	Searchlight	0.08	12.
North Las Vegas	0.20	2600.	Searls Ranch	0.98	16.
Nyala	2.1	12.	Seven L Ranch	0.42	0.42
Overton	0.43	320.	Sharps (Adaven)	1.7	42.
Pahrump	0.20	18.	Shoshone	0.94	240.
Pahrump Mining Co.	0.10	--	Silver Peak	0.75	5.2
Panaca	0.66	330.	South Paw Mine	1.8	5.5
Parmon's Ranch	0.45	3.6	Springdale	0.11	1.6
Pioche	0.74	1000.	Steward, R. Ranch	1.3	7.8
Pittman	0.10	--	Stine	1.2	--
Pony Springs	1.2	--	Stone Cabin Ranch	1.0	8.2
Potts	0.39	6.6	Sunnyside	1.7	45.
Preston	1.2	74.	Swallow Ranch	1.0	--
Rattlesnake Maint.			Tonopah	1.1	1500.
Station	1.6	6.6	Tonopah Airport	0.80	3.2
Reed	6.7	11.	Uhalde Ranch	1.9	15.
Reville Mill	5.5	29.	Urrettas Ranch	1.8	--
Phyolite	0.11	0.77	Ursine	0.61	15.
Riverside	8.0	110.	Vigo	3.5	--
Rogers Ranch	0.31	3.1	Walch Pine Creek		
Rose Valley	0.65	6.5	Ranch	2.8	17.
Round Mountain	0.49	98.	Warm Springs	0.93	51.
Rox	3.3	--	Warm Springs Ranch	1.2	580.
Ruby Hill Mine	0.88	44.	Watertown	3.8	15.
Ruth	0.95	1200	Whipple Ranch	1.1	11.
Sarcobatus	0.23	0.69			

Table 3. (continued)

Community	Cumulative exposure	Cumulative population exposure	Community	Cumulative exposure	Cumulative population exposure
			Utah		
Adamsville	0.23	22.	Kanab	1.6	3100.
Alton	0.83	130.	Kanarraville	1.9	510.
Anderson Junction	1.9	32.	Kanosh	0.05	24.
Bear Valley Junction	0.95	9.5	La Verkin	3.7	1400.
Beaver	0.25	420.	Leeds	3.7	800.
Beryl	0.53	8.0	Long Valley Junction	0.87	8.7
Bery Junction	1.0	8.4	Lund	0.50	38.
Black Rock	0.05	0.45	Manderfield	0.23	14.
Bryce Canyon	0.56	--	Milford	0.10	170.
Cedar City	0.64	3900.	Minersville	0.20	120.
Central	1.9	94.	Modena	0.54	54.
Cove Fort	0.07	0.56	Mount Carmel	0.94	120.
Desert Range Exp. Sta.	0.10	0.50	Mount Carmel Junction	0.85	8.5
Duck Creek Forest Camp	1.1	--	Newcastle	0.65	75.
Enoch	0.54	140.	New Harmony	1.9	240.
Enterprise	0.79	630.	Orderville	1.6	590.
Garrison	0.88	110.	Paiute Indian Res.	0.30	28.
Glendale	1.4	380.	Panguitch	0.70	1000.
Greenville	0.24	42.	Paragonah	0.42	170.
Gunlock	3.1	400.	Parowan	0.42	610.
Hamilton Fort	0.80	21.	Pintura	2.2	110.
Hamlin Valley	0.51	--	Rockville	3.1	390.
Hatch	0.54	13.	Saint George	3.7	18,000
Hilldale	0.44	4.4	Santa Clara	4.3	1,400.
Hurricane	3.5	4800.	Shivwits	3.6	340.

Table 3. (continued)

Community	Cumulative exposure	Cumulative population exposure	Community	Cumulative exposure	Cumulative population exposure
		Utah (continued)			
Springdale	2.7	560.	Vic's Service Station	3.9	7.8
Summit	0.52	76.	Virgin	1.6	240.
Toquerville	2.3	510.	Washington	3.3	1,400.
Uvada	0.70	10.	Zane	0.30	7.5
Veyo	2.8	280.	Zion Lodge	1.2	--
Vic's Place	1.9	5.6			

[a]Fallout was not distinguished from background radiation at these Arizona communities: Catherine Ranger Station, Davis Dam, Oatman, Peach Spring, Topock, Truxton, Walapai, Warm Springs, Willow Beach, and Yucca.

[b]Fallout was not distinguished from background radiation at these California communities: Amboy, Boron, Camp Irwin, Cantil, China Lake, Crest View, Daggett, Hinkley, Inyokern, Littlelake, Ludlow, Manix, Mojave, Mountain Pass, Needles, Newberry, Randsburg, Shoshone, South Haiwee, Tecopa, Trona, Wheaten Springs, and ZZXYZ Springs.

[c]Fallout was not distinguished from background radiation at these Nevada communities: Goodsprings, Johnnie, Nelson, Pop's Oasis, State Line, and Whitney.

[d]Reno was not included in the TMCEFD tabulations. We calculated a population estimated exposure of 1600 person-R from event BOLTZMANN.

[e]Boyd, Cloud, Etna, Galt, Garnet, Hoya, Kyle, Leith, Rox, Stine, and Vigo were railroad maintenance stations. Apparently a crew of 15 people moved from station to station.

Table 4. Population, cumulative estimated exposure, and cumulative population estimated exposure, for the 19 communities receiving a cumulative population estimated exposure in excess of 1,000 person-R during 1951-1958.

Location[a]	Population	Cumulative estimated exposure, R	Cumulative population estimated exposure, person-R
Saint George, UT	5,000	3.7	18,000
Las Vegas, NV	47,000	0.21	9,900
Hurricane, UT	1,375	3.5	4,800
Ely, NV	3,558	1.2	4,300
Cedar City, UT	6,106	0.64	3,900
Kanab, UT	1,900	1.6	3,100
Lincoln Mine, NV	100 to 500	6.0	3,000[b]
North Las Vegas, NV	13,000	0.20	2,600
McGill, NV	2,297	0.77	1,800
Tonopah, NV	1,375	1.1	1,500
Washington, UT	435	3.3	1,400
La Verkin, UT	387	3.7	1,400
Santa Clara, UT	319	4.3	1,400
Mesquite, NV	590	2.1	1,200
East Ely, NV	1,000	1.2	1,200
Ruth, NV	1,244	0.95	1,200
Bunkerville, NV	250	4.5	1,100
Panguitch, UT	1,500	0.70	1,000
Pioche, NV	1,392	0.74	1,000
Total	89,228[b]		64,000[b]

[a]Reno, NV, according to our calculation, received a population estimated exposure of 1600 person-R and would therefore rank tenth in population estimated exposure.

[b]Calculated by using a population of 500 at Lincoln Mine.

Table 5. Cumulative population estimated exposure by test series.

Series	Year	Person-R
BUSTER-JANGLE	1951	610
TUMBLER-SNAPPER	1952	4,700
UPSHOT-KNOTHOLE	1953	40,000
TEAPOT	1955	19,000
PLUMBBOB	1957	19,000[a]
HARDTACK II	1958	1,500
Total		85,000

[a]Because of the use of what we now believe to be an inappropriate model for the rate of decay of the external exposure field and the neglect of the exposure at Reno, NV, we believe that this value is incorrect. Our estimate is 11,000 person-R.

Table 6. Cumulative population estimated exposure for the 17 events that contributed more than 1000 person-R, 1951-1958.

Event[a]	Date	Population estimated exposure, person-R
HARRY	530519	30,000
BEE	550322	11,000
SMOKY	570831	7,500
ANNIE	530317	3,700
EASY	520507	2,700
DIABLO	570715	2,700
SHASTA	570818	2,600
ZUCCHINI	550515	2,300
SIMON	530425	2,200
BADGER	530418	2,100
NANCY	530324	1,800
FOX	520525	1,800
APPLE II	550505	1,700
HARDTACK II Series	1958	1,500
KEPLER	570724	1,500
WHITNEY	570923	1,300
MET	550415	1,200
Total		77,000

[a]If we include 1600 person-R at Reno, NV, the total for event BOLTZMANN would be 2200 person-R. This event would then rank tenth in the above tabulation.

Table 7. Comparison of the recent results of Beck and Krey (Be82) based on contemporary measurements of ^{137}Cs with those of the TMCEFD.

| Utah location | Estimated exposure, R | | Ratio |
	Be82[a]	TMCEFD	
Beaver	≤ 0.42	0.25	≤ 1.7
Cedar City	0.42	0.64	0.65
Enterprise	1.2	0.79	1.5
Hatch	≤ 0.42	0.54	≤ 0.78
Hurricane	2.9	3.5	0.84
Kanab	0.49	1.6	0.31
Kanarraville	0.49	1.9	0.26
La Verkin	2.9	3.7	0.79
Milford	≤ 0.42	0.10	≤ 4.2
Minersville	0.69	0.20	3.5
Modena	≤ 0.42	0.54	≤ 0.78
Mt. Carmel	≤ 0.42	0.94	≤ 0.43
Panguitch	0.28	0.70	0.40
Paragonah	0.77	0.42	1.8
Parowan	0.77	0.42	1.8
St. George	2.6	3.7	0.70
Santa Clara	1.7	4.3	0.39
Veyo	4.1	2.8	1.5
Washington	1.7	3.3	0.52
Average, geometric			$0.88 \times 2.2^{+1}_{-1}$

[a]The original numbers resulted from an integration of Hicks' (Hi82) calculations for exposure rate. We converted to a number as comparable as possible to those of the TMCEFD by multiplying by the shielding and time correction factors from Table 1.

LOCATIONS OF SOIL SAMPLES SELECTED FOR FURTHER ANALYSIS

Presented to

THE DOSE ASSESSMENT ADVISORY GROUP

LAS VEGAS, NV; JANUARY 7, 1983

ARIZONA

BE 09	Bullhead City	A	
FM 39	Chinle	B	Tree cover
FM 45	Flagstaff	A	
FM 46	Flagstaff	B	Gravel and rock at bottom
FM 50	Flagstaff	B	Tree cover
FM 54	Ft. Defiance	A	
KS 01	Fredonia	B	Possible area of ranoff
FM 29	Ganado	A	
KS 05	Grand Canyon, North	A	
KS 10	Grand Canyon, North	B	Native area
FM 08	Grand Canyon, South	B	Native area
FM 10	Grand Canyon, South	B	Native area
FM 17	Holbrook	A	
FM 01	Kingman	A	
KS 21	Littlefield	B	Silt present
KS 07	Moccasin	A	
FM 14	Tuba City	A	
FM 43	Williams	A	

CALIFORNIA

BE 22	Bishop	A	
GC 29	Bridgeport	A	
BE 29	China Lake	B	Tree cover
BE 01	Furnace Creek	A	
BE 25	Independence	A	
BE 06	Shoshone	B	Native area

COLORADO

AS 06	Cortez	B	Some disturbance
AS 27	Craig	A	
AS 28	Craig	A	
AS 10	Durango	A	
AS 21	Fruita	A	
AS 08	Mancos	A	
AS 26	Meeker	A	
AS 20	Montrose	A?	Need verification of age
AS 13	Silverton	B	Rock ledge at 11"

IDAHO

MH 22	Boise	A	
MH 19	Boise - Meridian	A	
MH 11	Burley	A	
MH 12A	Burley	B	Native area
AS 43	Idaho Falls	A	
MH 07	Malad City	A	
AS 50	Pocatello	A	
MH 14	Twin Falls	A	
MH 17	Twin Falls - Filer	A	

NEVADA

KS 33	Alamo	A	
GC 20	Austin	B	Small
DZ 01	Baker	A	
RM 06	Battle Mountain	B	Has been flooded
SH 11	Boulder City	A	
KS 25	Bunkerville	A	
KS 26	Bunkerville	A	
RM 21	Caliente	A	
RM 08	Carlin	A	
GC 48	Carson City	A	
SW 06	Duckwater	B	Pasture
RM 10	Elko	A	
DZ 04	Ely	A	
DZ 04A	Ely	B	Oats
DZ 05A	Ely	B	Questioned age
SW 05	Eureka	A	
GC 15	Fallon	A	
GC 19	Gabbs	A	
GC 43	Gardnerville	A	
GC 08	Gerlach	B	Small
GC 33	Hawthorne	A	
SH 10	Henderson	A	
KS 36	Hiko	A	
BE 10	Indian Springs	A	
SH 05	Las Vegas	A	
SH 07	Las Vegas	A	
KS 27	Logandale	A	
GC 10	Lovelock	A	
GC 12	Lovelock	A	

NEVADA (Cont'd)

SW 02	Lund	A	
DZ 09A	McGill	A	
KS 24	Mesquite	A	
GC 50	Moore's Station	B	Pasture
KS 30	Overton	A	
RM 19	Panaca	B	Tree cover
RM 14	Pioche	B	Small
SW 03A	Preston	B	Tree cover
GC 05	Reno	A	
GC 06	Reno	A	
RM 12	Wells	A	
RM 02	Winnemucca	?	Need verification of age
GC 39	Yerington	A	

<u>NEW MEXICO</u>

FM 31	Albuquerque	A	
FM 33	Albuquerque	A	
FM 35	Albuquerque	A	
AS 01	Farmington	A	
FM 16	Gallup	B?	Question of disturbance

OREGON

MH 29	Basque Station	A
MH 28	Hines	A
MH 25	Jordan Valley	A

UTAH

DZ 10	Ibapah	B	Pasture
DZ 21	Iosepa	A	
MH 02	Rosette	B	Meadow
MH 03	Snowville	B	Field (non-lawn) area
DZ 18	Tooele	A	
DZ 16	Wendover	B	Small

WYOMING

AS 41	Afton		A
AS 35	Evanston		A
AS 36	Kemmerer		A
AS 32	Rock Springs		A

SUMMARY

ARIZONA	13
CALIFORNIA	6
COLORADO	9 (1?)
IDAHO	9
NEVADA	42 (2?)
NEW MEXICO	5 (1?)
OREGON	3
UTAH	6
WYOMING	4
	101 (4?)

ADDITIONAL MEASUREMENTS WOULD BE USEFUL

- **Deposition of radionuclides in broader geographical area**

- **Method?**
    - **Aircraft**
    - **Field spectrometry**
    - **Soil sampling**

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LRA-41

DOSE DETERMINATION

1. Calculate $(^{137}Cs)_N$ at time of arrival

2. Use our standard source-term data to calculate the deposition of other radionuclides

3. Calculate external dose

4. Calculate intake of radionuclides by man, and the internal dose

(LRA-42)

EML HAS DEVELOPED TWO METHODS OF APPORTIONING ^{137}Cs FROM GLOBAL AND NTS SOURCES

1. Based on current measurements of $(^{137}Cs)_T$ and rainfall records:

$$(^{137}Cs)_G = A + B \cdot Rainfall$$

$$(^{137}Cs)_N = (^{137}Cs)_T - (^{137}Cs)_G$$

2. Based on current measurements of $(Pu)_T$ $(^{137}Cs)_T$ and the ratio $^{240}Pu / ^{239}Pu$

THE ATOM RATIO OF $^{240}Pu/^{239}Pu$ IS DIFFERENT FOR GLOBAL AND NTS FALLOUT

^{239}Pu is made in reactors:

$$^{238}U + n \rightarrow ^{239}U \rightarrow ^{239}Np \rightarrow ^{239}Pu$$

^{240}Pu is a contaminant:

$$^{239}Pu + n \rightarrow ^{240}Pu$$

$$^{238}U + 2n \rightarrow ^{240}U \rightarrow ^{240m}Np \rightarrow ^{240}Pu$$
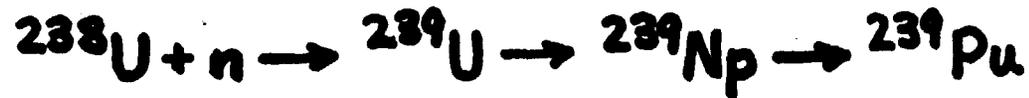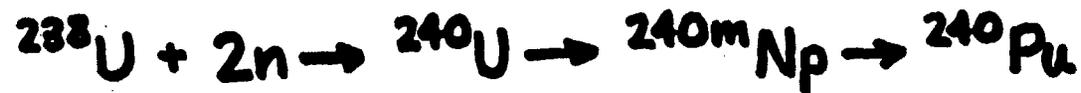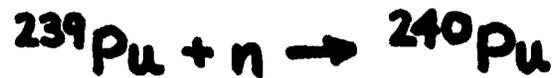
Thermonuclear explosions produce a high neutron flux and also make ^{240}Pu from ^{239}Pu and ^{238}U, and thereby alter the ratio of ^{240}Pu to ^{239}Pu.

(Pu) FROM A MIXTURE OF TWO SOURCES CAN BE RESOLVED BY SAMPLE ANALYSIS

$$\frac{(Pu)_N}{(Pu)_G} = Y = \frac{(R_G - R_s)(1 + 3.73 R_N)}{(R_s - R_N)(1 + 3.73 R_G)}$$

(Pu) = Pu activity per unit area

$R = {}^{240}Pu / {}^{239}Pu$ atom ratio

$R_N = 0.0321 \pm 0.003$

$R_G = 0.180 \pm 0.006$

From EML-400

THIS ALLOWS THE CALCULATION OF $(^{137}Cs)_N$

$$(Pu)_G + (Pu)_N = (Pu)_S$$

$$(Pu)_G = \frac{1}{1+Y} \ (Pu)_S$$

$$(^{137}Cs)_N = (^{137}Cs)_S - (^{137}Cs/Pu)_G \ (Pu)_G$$

$$(^{137}Cs/Pu)_G = 53 \pm 1\%$$

FROM EML-400

(LRS-46)

MEASUREMENT STRATEGY

1. Select desired communities.
2. Select candidate sites.
3. Measure ^{137}Cs by field spectrometry.
4. Select sites for soil collection.
5. Collect soil samples.
6. Select sites for laboratory analysis.
7. Measure $(^{137}Cs)_T$ and distribution with depth.
8. Select sites for further laboratory analysis.
9. Measure $(^{239+240}Pu)_T$.
10. Measure $^{240}Pu / ^{239}Pu$.
11. Calculate $(^{137}Cs)_N$

THE SITE SELECTION COMMITTEE MET ON
JANUARY 5, 1983, TO SELECT SITES FOR
LABORATORY ANALYSIS OF ^{137}Cs

EML: H. Beck
P. Krey

DRI: F. Miller

LLNL: L. Anspaugh
J. Koranda

NVO: B. Church
M. Page
D. Wheeler

REECo: H. Hawthorne

LRA-48

SITE SELECTION CRITERIA

1. Prefer large (> 40 ft dia.) open, flat areas of grass away from obstructions

2. Must be undisturbed since 1950

3. Not subject to erosion

4. Not subject to accumulation of sediments

5. Field measurement confirms that a reasonable level of ^{137}Cs is present

6. Soil sample is collected successfully

LRA-49

CURRENT RESULTS OF THE SELECTION PROCESS

Desired communities	105
Candidate sites	316
Sites measured by field spectrometry	276
Sites sampled for soil	190
Sites selected for lab ^{137}Cs analysis	102

LRA-50

SUMMARY OF SELECTED SOIL SAMPLE SITES BY STATE AND TYPE

State	A	B	?	Sum
Arizona	10	8		18
California	4	2		6
Colorado	6	2	1	9
Idaho	8	1		9
Nevada	31	9	2	42
New Mexico	4		1	5
Oregon	3			3
Utah	2	4		6
Wyoming	4			4
Sums	72	26	4	102

LRA-51

DRI SITE SELECTION FOR SOIL SAMPLING - 1982
LLNL IN SUTU MEASUREMENTS - 1982
RECo SOIL SAMPLE LOCATIONS - 1982
SAMPLES FOR LAB ANALYSIS
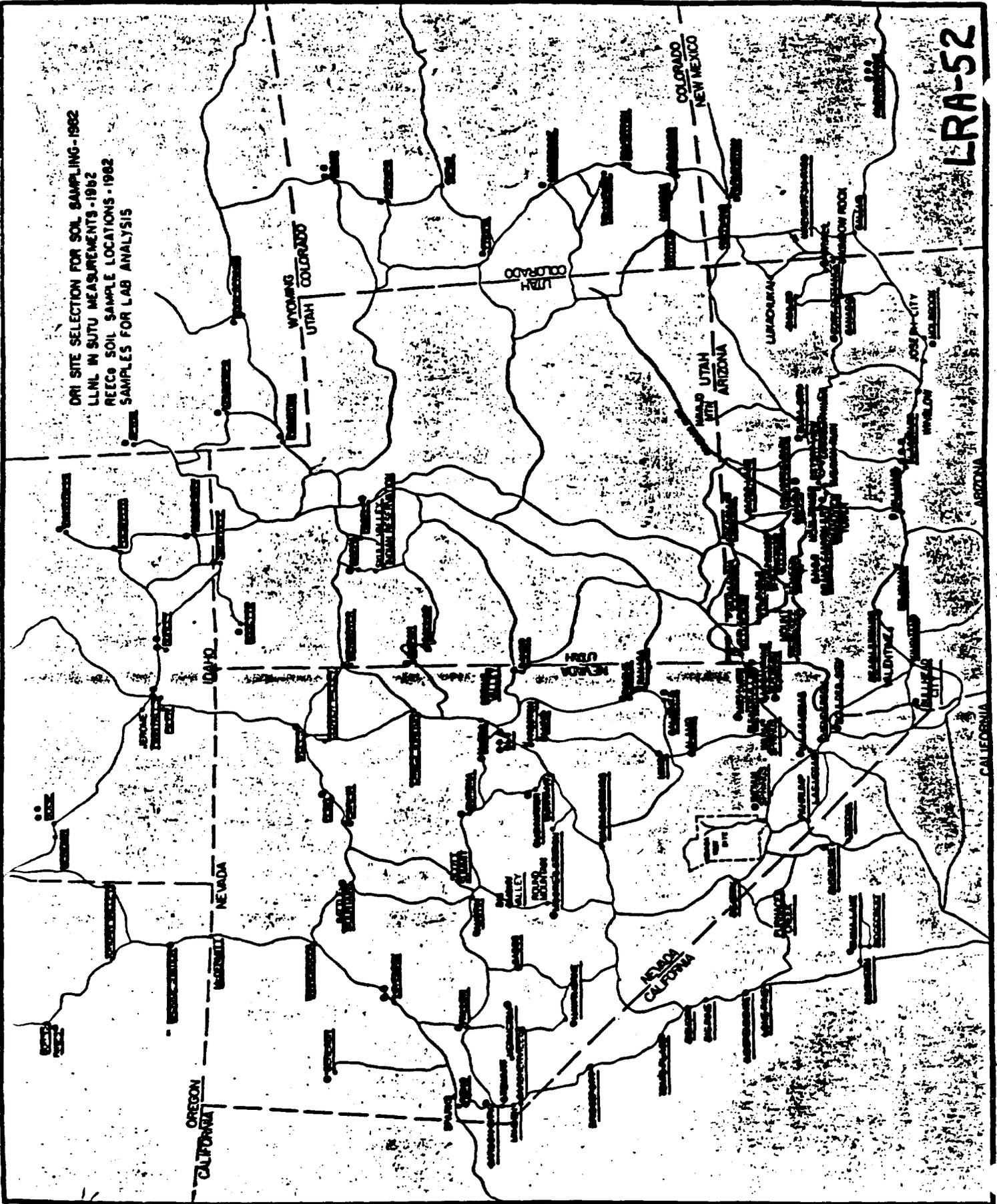
COMMUNITIES SELECTED FOR CORRELATION
WITH ESTIMATES OF DOSE FROM OTHER MEANS

Alamo   Indian Springs

Bunkerville   Logandale

Caliente   Mesquite

Duckwater   Overton

Hiko   Pioche

LRA-53

COMMUNITIES WITH MULTIPLE SITES

Flagstaff, AZ	3	Bunkerville, NV	2
Grand Canyon, N., AZ	2	Ely, NV	3
Grand Canyon, S., AZ	2	Las Vegas, NV	2
		Lovelock, NV	2
Craig, CO	2	Reno, NV	2
Boise, ID	2	Albuquerque, NM	3
Burley, ID	2		
Twin Falls, ID	2•		

LRA-54

1	CHAIRMAN MOSELEY:	And now the discussion of future activities and

2	time scales. Bruce Church.

3	MR. CHURCH:	This first viewgraph (BC-4) is one you have seen, and I

4	only want to put it up to show that we're now operating out on this end of

5	our time scale. These are some of the things I will be talking about in

6	the next few minutes. We will be endeavoring to make a more detailed

7	time-frame map. We have not accomplished that yet, and it will tend to

8	spread out that region, and we will probably have that ready for presenta-

9	tion at our next meeting.

10	If I could have that next one. (BC-5). These are basically the major

11	tasks that we've got to accomplish. We've made, I believe, great progress

12	in many of them. I'm going to address each one of these now in some

13	detail.

14	With respect to the population dose assessment, we have completed the

15	external exposure rate data base. We have yet to complete the distribution

16	data, and you have received some progress report on that. We are discuss-

17	ing and entertaining some considerations with respect to perhaps truck

18	farms and the distribution of vegetables, concerning ourselves with the GI

19	tract dose. We don't know yet what will become of that, but we think that

20	we've got to be a little bit concerned about leafy vegetables and perhaps

21	any other truck gardening that went on within at least the near regions,

22	and what the distribution of that might give rise to in terms of population

23	dose. We need to finish the Pathway Model yet. You are being kept abreast

24	of the progress there. We need to finish the Internal Dose Assessment

25	Model and the External Dose Assessment Model.

26	With respect to Item 2, we need to complete the External Exposure Rate

27	Data Base, the Individual Dose Assessment Model, and the Pathway Model.

28	With respect to the fallout patterns, we think we have made good progress

1 in this area. We pretty much believe it is on track. With respect to

2 extending beyond the current fallout patterns, we are pretty well up to

3 speed on our intentions there with respect to the soil sampling, and meteo-

4 rological modeling. We certainly believe that we will be dealing with some

5 dose assessment because of litigation on an ad hoc basis. The extent of

6 that, I think, we've yet to find out what that will be.

7   In terms of Phase III, I hope you've gotten a pretty good feel this

8 afternoon, or today, on where we stand in that area. We've got to complete

9 the measurement of cesium. We're in the process of starting the pipeline

10 into the laboratory. The critical thing that remains to be done is to

11 complete the laboratory analysis for both the cesium, then the plutonium

12 isotope, chemistry, and mass spectroscopy. After that we need to go

13 through the arithmetic of apportioning the Cesium-137 from global and NTS,

14 and then using that apportionment to calculate through the mathematics that

15 Dr. Anspaugh just illustrated for you. Beyond that we have to complete our

16 reporting, and I think we're somewhat on track in our planning there. As

17 you are well aware, our intent is to encourage the investigators to publish

18 in peer reviewed journals as much as is feasibly possible. We are

19 entertaining some ideas with respect to wrapping up the project perhaps

20 with a symposium-type of presentation with the conclusion of the tenure of

21 the DAAG. If we are able to develop concrete ideas in that, as soon as

22 something firms up we will be talking to you. Some of the timing has been

23 difficult because of the schedule of the DAAG in its lifetime, and when we

24 might get everything completed.

25   Of course, the last item is to become operational in a routine manner

26 with the models resident at a single location so we can basically be of

27 service to people who request information concerning their dose. We do

28 have requests from single individuals concerning their exposure and the

1 result of dose as they resided in the NTS region, and that's totally

2 outside of litigation, but people who are concerned. That's one of the

3 things that this project was to satisfy, is a data base and a mechanism

4 whereby people, when inquiring of their test exposure, could be given a

5 good sound technical answer.

6 To be specific for the next five or six months, you heard the Weather

7 Service mention that they will be finished with BOLTZMANN in the time frame

8 that was mentioned; you also heard them say that they need some directions

9 on which fallout pattern to do after that. We will be directing them to

10 work on the SMALL BOY pattern probably ahead of NANCY.

11 If we could have the NURE viewgraph for a moment. (BC-6). The Bendix

12 Corporation has been funded at a level whereby we expect to see ten to

13 fifteen quadrangles in this general area completed this year.

14 As Dr. Beck mentioned the other day, the area contained within that

15 green has basically been done, or, it is in the process of being done. We

16 have discussed several times today the fact our plans include going back

17 into Utah and resampling what appears on this map (BC-7) as six locations

18 that were sampled by EML with earlier activity, and that ties into about 20

19 sites that Phil Krey mentioned a few moments ago. In addition to that we

20 plan to sample these other locations indicated by the black dots -- and if

21 you can drop that a little bit so I can see. These are proposed locations

22 at the moment to help us define a little better from a resolution

23 standpoint what the deposition might have been in the region indicated.

24 As I mentioned earlier, an important element in Phase II is the

25 laboratory pipeline. You've seen the progress and status of that discussed

26 today. REECo is basically set to launch that. They have some additional

27 qualifying to do in the plutonium area. I think they feel our pressure in

28 terms of getting on with that work. We see these things being well

1 underway in the next six months. Most of these locations that we've

2 indicated in terms of additional sampling, won't take place until the

3 spring thaw, and so the teams won't be in the field probably until the time

4 frame we meet again.

5   I've got one more viewgraph in terms of soil sampling.

6   This (BC-8) is the recommendation you made concerning Phase III.

7 These are proposed sites coincidental with the sticky film paper. We

8 propose to look at sites probably west of the Mississippi, probably around

9 a dozen. These do include some sites on the west coast. We intend also to

10 look at the sampling data that EML has previously done in the eastern part

11 of the United States. Perhaps it will be worthy of reviewing the data that

12 they've already collected as we start seeing some of these results to help

13 get a total perspective of what we've commonly referred to as the Phase III

14 area.

15   I have, to wrap up my remarks, a request of the DAAG. We have handed

16 to you four draft reports, yesterday and today, reports by Messrs. Burson,

17 Steadman, Rohrer, and Anspaugh, and we would certainly solicit and request

18 your comments and critique on those reports very soon, so that we might

19 move towards publication.

20   I'd be happy to entertain any questions.

21   CHAIRMAN MOSELEY: Questions?

22   Thank you, Bruce.

23

24

25

26

27

28

O.R.E.R.P. FLOW CHART
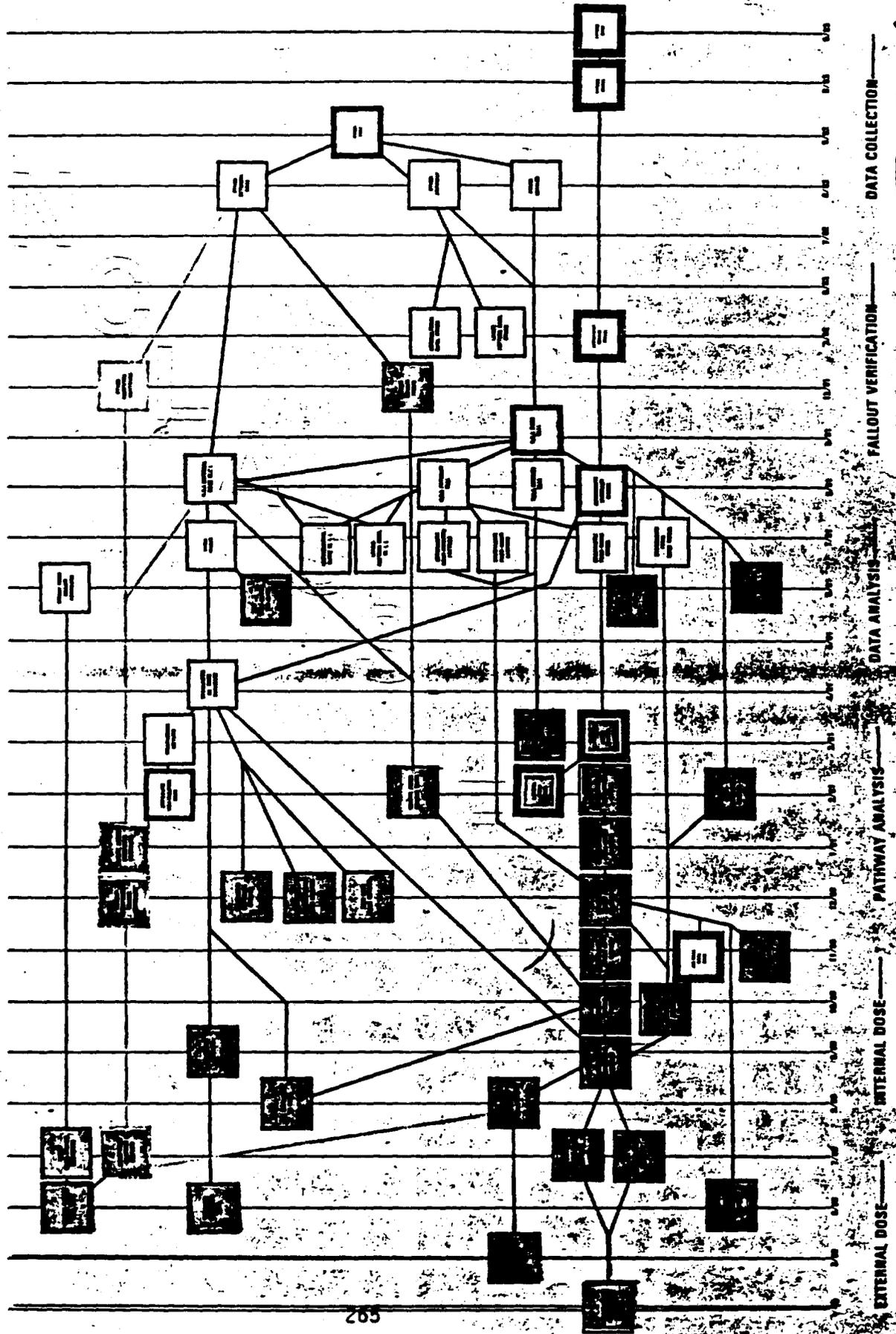
ORERP MAJOR TASKS TO BE FINISHED

1. POPULATION DOSE ASSESSMENT
2. INDIVIDUAL DOSE ASSESSMENT
   A. INSIDE FALLOUT PATTERNS
   B. BEYOND FALLOUT PATTERNS
3. PHASE II
4. FINAL REPORTS AND PUBLICATIONS
5. OPERATIONAL MODE

BC-5

STATUS OF NURE DATA ANALYSIS
QUADRANGLE NAMES
OF POTENTIAL INTEREST IN 137 Cs MAPPING
NEVADA AND UTAH

EML (BECK)

BC-6

VYA	MC DERMITT	WELLS	BRIGHAM CITY	OGDEN	
LOVELOCK	WINNEMUCCA	ELKO A	TOOELE A	SALT LAKE CITY	VERNAL
RENO	D MILLETT	ELY	DELTA NOT COMPLETED	PRICE	GRAND JUNCTION
WALKER LANE	TONOPAH NO DATA?	LUND B	RICHFIELD B	SALINA	MOAB
MARIPOSA	GOLDFIELD NO DATA?	CALIENTE C	CEDAR CITY B	ESCALANTE B	CORTEZ
DEATH VALLEY		LAS VEGAS B	GRAND CANYON C	MARBLE CANYON	
	KINGMAN	WILLIAMS	FLAGSTAFF		

N E V A D A C   U T A H

A-No significant
  problems in inferring
  Cs-137 flux

B-Minor problems, i.e. pressure, etc.

C-significant problems, i.e. snow
  cover, altimeter, etc.

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BC-7

PROPOSED SOIL SAMPLING
LOCATIONS FOR UTAH
O EML Resample
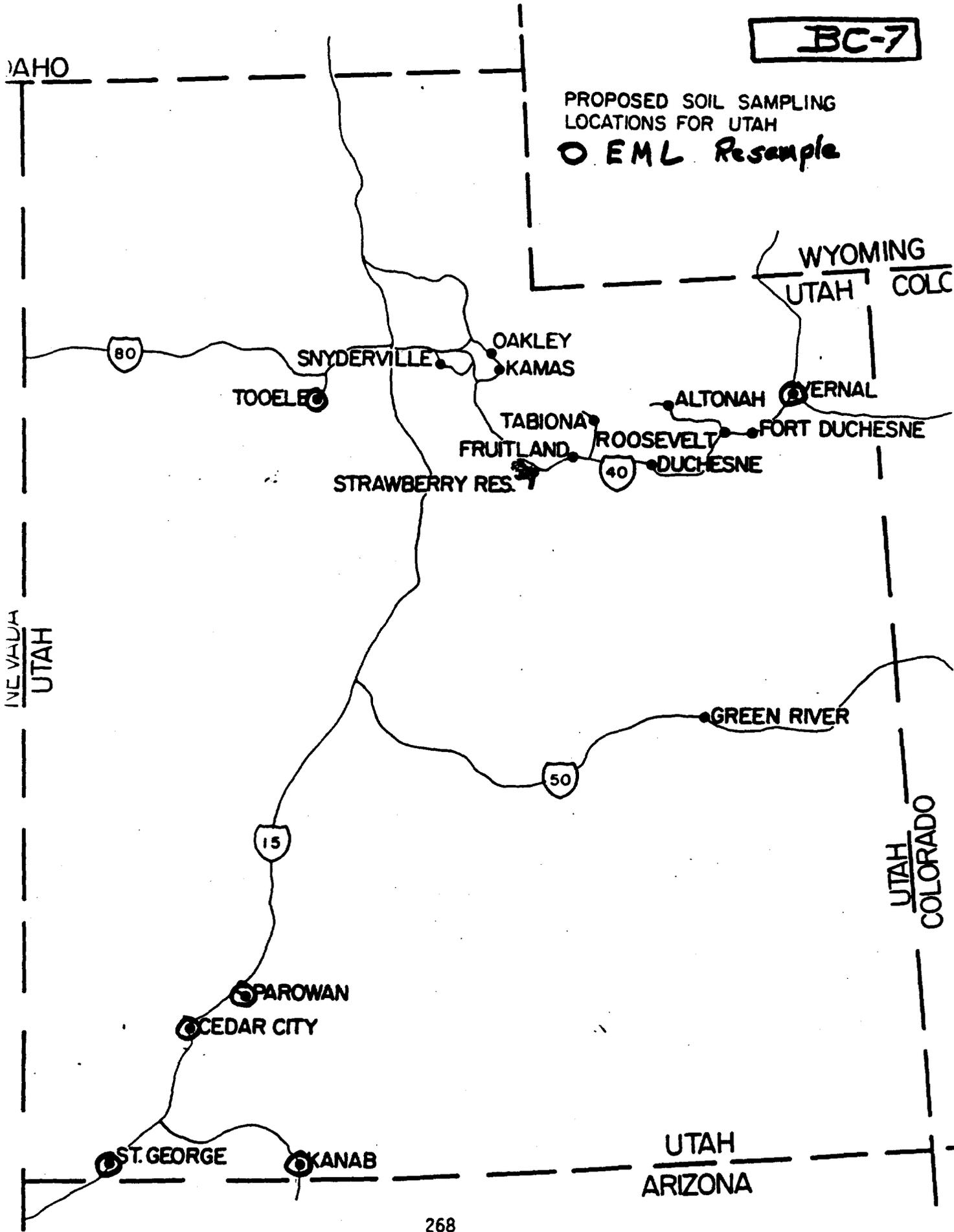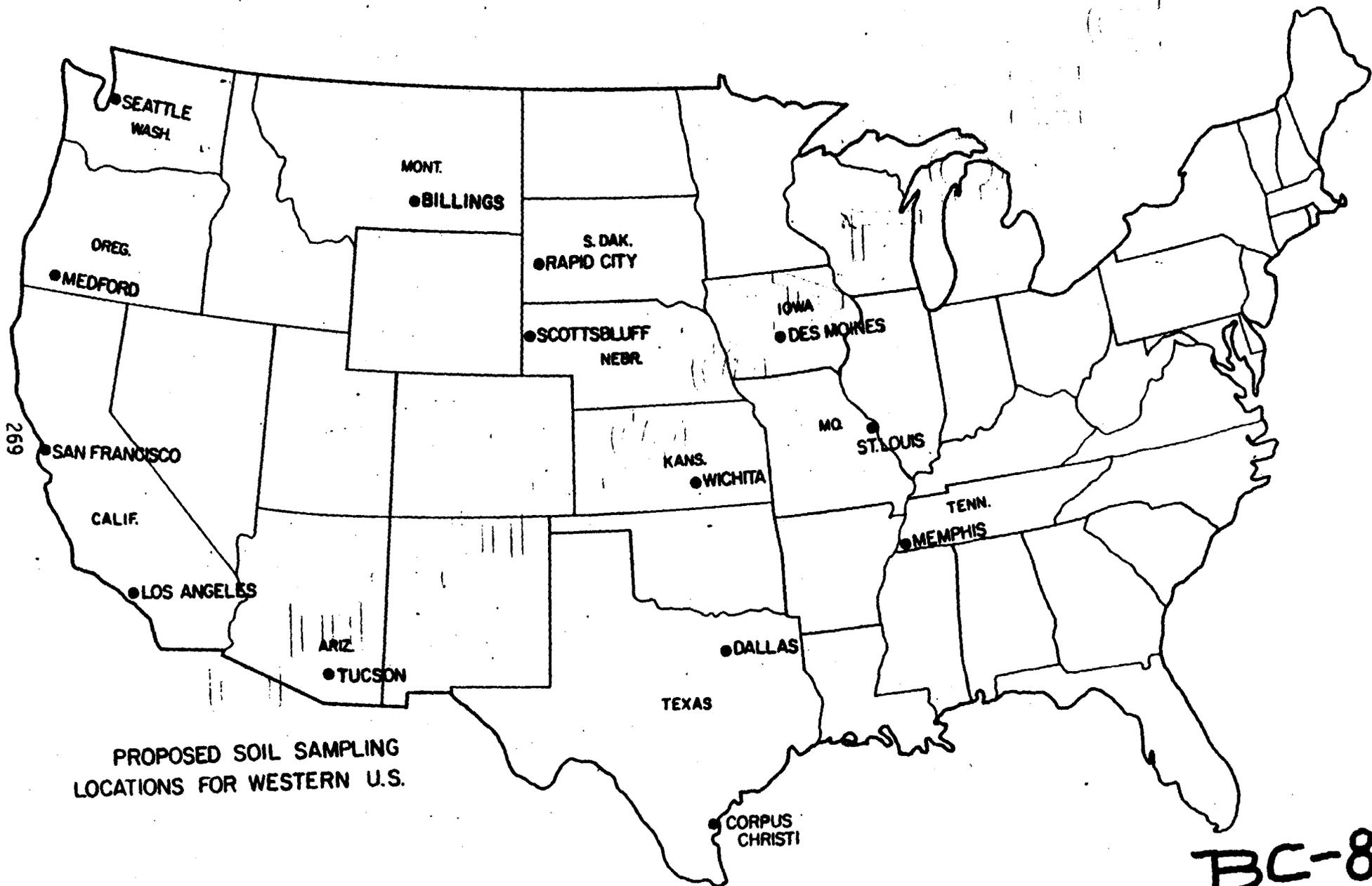
PROPOSED SOIL SAMPLING
LOCATIONS FOR WESTERN U.S.

BC-8

1   CHAIRMAN MOSELEY: As you all know from your reappointment letters,

2 the Secretary of Energy has reappointed the Dose Assessment Advisory Group

3 for another two year period ending in 1984 based on Bruce's Flow Chart,

4 and, I guess, our own projections of things. We believe the task of ORERP

5 groups and of DAAG will be completed by that time.

6   I felt jealous of all of the Task Groups having viewgraphs, so I

7 thought the Chairman of the Committee ought to have a viewgraph, too.

8 (RDM-1). This is for a dual purpose, to remind you of the Charter of our

9 group, which we discussed in substantial extent at our first meeting in

10 December a couple of years ago. The Charter is unchanged except in one

11 facet. The initial Charter called for us to meet quarterly; and as our

12 task progressed, it seemed reasonable to allow longer periods of time

13 between the meetings to allow the Task Groups to accomplish more of the

14 scientific effort without being interferred with by having to prepare for

15 another Dose Assessment Advisory Group meeting. This Charter differs from

16 the first one in that it removes the requirement, which we had to petition

17 to have removed initially, that we meet quarterly, and now it says that we

18 meet at least semiannually. We can meet more frequently than that, but we

19 need to meet semiannually, which is probably an adequate schedule for us.

20   Maybe I'm a little more exorcised about this than I should be. The

21 Media in Las Vegas last night, or this morning, characterized me as a DOE

22 official. I'm neither an official of the Department of Energy, nor an

23 employee of the Department of Energy, nor have I ever been in my entire

24 career in either of those capacities. I've served on two committees of the

25 Department of Energy and its predecessor agency, the Atomic Energy

26 Commission, this one, the Dose Assessment Advisory Group, and the Advisory

27 Committee on Biology and Medicine of the Atomic Energy Commission in the

28 mid-sixties to the early 1970s. I, and all of the other members of this

1   Committee, serve without stipend, honorarium, or even complete

2   reimbursement of their expenses, in attending these sessions. I think that

3   it is a little calumny to imply that the public spirited members of this

4   Committee, who give from their own time and their own direct professional

5   interests to serve their country in this capacity, would be considered to

6   have anything except the motivation for seeing that the United States and

7   that the people of the United States be properly served by their advisory

8   efforts.

9   You can see that our Charter requires that we have three real

10 functions about the middle of the Committee's objectives, scope, activi-

11 ties, and duties. As a multi-disciplinary group of experts, this group

12 provides effective and objective working level advice and recommendations

13 to the Manager of the Nevada Operations Office in the planning, organiza-

14 tion, and technical direction of the Dose Assessment Project. And,

15 secondly, what we have been doing at this meeting and at previous meetings,

16 we review the activities of the project and ask occasionally a name but not

17 infrequently searching questions about the direction that the project is

18 going. In reviewing the impact that the Dose Assessment Advisory Group has

19 had on the Task Groups, I think it has been both a definite one, hopefully,

20 and, I really believe, a useful one, as we have commented on the directions

21 that the research effort should take in order to establish the credibility

22 of this effort. And, thirdly, we report on the progress of this project

23 after each of these meetings with a full transcript of our activities in

24 addition to a summary with identification of problems and recommendations

25 that we have both to the Secretary of the Department of Energy and to the

26 manager of this office as well as individuals involved in the supervision

27 of the project.

28   I don't know how one establishes credibility in this regard. The

1 Federal Advisory Committee Act attempts to assure that Federal Advisory

2 Committees are established in a way that should insure their credibility

3 with the public in that it requires that the Committee have representatives

4 from the public sector, as this Committee does, with one representative

5 from California, representing both the governor and the people of

6 California, and two representatives from Utah, representing the people and

7 the government of Utah individually. The two from Arizona and the two from

8 Nevada having exactly those same relationships. In addition, while there

9 are three or four members of the Committee whose present occupations, or

10 past occupations, have to do with operations of national laboratories or

11 contractors of national laboratories, many of the members, I guess the

12 majority of the members, including those who represent the public, are

13 individuals who are not "government scientists" at all but who come from

14 various universities and other research groups around the country. The

15 individuals on the Committee, who have some direct relationship with the

16 Department of Energy operations, in my opinion, are obligatory to the

17 proper functioning of the Advisory Group, because we need their expert

18 knowledge in some areas in which we deliberate.

19 In essense, I believe that our Charter is a reasonable one. I believe

20 that we decided it was a reasonable one two or three years ago when we

21 started working on this; and it is my opinion that the Advisory Group is

22 discharging their efforts in relation to this Charter in an appropriate, if

23 not exemplary, fashion.

24 I thank you all for being willing to serve on the Advisory Group given

25 the financial and other restraints that I mentioned earlier.

26

27

28

1. Committee's Official Designation:

   Dose Assessment Advisory Group (DAAG).

2. Committee's Objectives and Scope of Activities and Duties:

   The DAAG provides the Secretary of Energy and the Manager, Nevada Operations
   Office (NV), with advice and recommendations pertaining to the Offsite
   Radiation Exposure Review Project. This project concerns the evaluation
   and assessment of the potential amount of radiation received by members of
   the offsite population surrounding the Nevada Test Site (NTS) as a result
   of atmospheric nuclear test operations conducted at the NTS. The function
   and role of this advisory group are threefold. First, as a multidisciplinary
   group of experts, the group provides effective and objective working-level
   advice and recommendations to the Manager, NV, in the planning, organization,
   and technical direction of the project. Second, the group reviews the
   activities of the project. Third, the group forwards copies of all reports
   on the progress of the project including the identification of problem areas,
   if any, to both the Secretary of Energy and to the Manager, NV. The Manager,
   NV, will maintain management and administrative supervision of the project.
   The group will act in an advisory and review capacity to the project. The
   Secretary will receive and review reports of the group and, where appropriate,
   resolve problems which might arise.

3. Time Period Necessary for the Committee to Carry Out Its Purpose:

   The advisory group is expected to complete its purpose in another two years
   (July 1984) at current funding levels. Appropriate actions will be taken to
   obtain an extension at the required two-year interval, if found necessary.

4. Official to Whom This Committee Reports:

   The advisory group will report to the Secretary of Energy and to the Manager,
   NV.

5. Agency Responsible for Providing Necessary Support for this Committee:

   The Department of Energy (DOE). Within DOE, primary support shall be
   provided by NV.

6. A Description of Duties for Which the Committee is Responsible:

   The duties of the advisory group are solely advisory and are stated in
   paragraph 2 above.

7. Estimated Annual Operating Costs in Dollars and Man-Years:

   The estimated annual operating cost of the DAAG is $130,200 including
   two man-years of part-time staff support.

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8. **Estimated Number and Frequency of Committee Meetings:**

The advisory group is expected to meet approximately three times a year, but at least semiannually, and may meet more often if necessary.

9. **Committee's Termination Date (if less than two years from the date of establishment or renewal:**

Not applicable.

10. **Subcommittees:**

To facilitate functioning of the advisory group, subcommittees may be formed. The objectives of the subcommittees are to make recommendations to the parent committee with respect to matters concerning DOE plans and programs which are related to the responsibilities of the parent committee.

11. **Members:**

a. Advisory group members shall be appointed by the Secretary of Energy. Membership terms shall be subject to review every two years, unless terminated earlier. Members, whose initial terms have expired, may be reappointed to additional terms following review.

b. Approximate number of members: 20.

12. **Chairperson:**

The Chairperson shall be appointed by the Secretary of Energy.

This charter for the advisory group named above is hereby approved on:

July 15, 1982
—————————————————————————————
Date
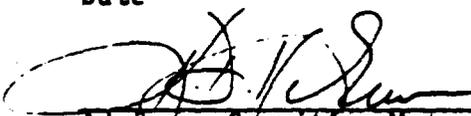
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Advisory Committee Management Officer

July 15, 1982
—————————————————————————————
Date filed

1   DR. MOSELEY: I'd like to bring up another temporal factor for us.

2 We've got to decide when we are going to meet again. I have two suggested

3 dates. If you will look at your calendars, the first dates are May 12 and

4 13th. Anybody have impossible conflicts for that period that they know

5 about at this time? May 12th and 13th. That's a Thursday and Friday.

6   DR. SARN: I have a Cabinet meeting.

7   CHAIRMAN MOSELEY: A Cabinet meeting. That probably takes precedence.

8 Dr. Miercort is unavailable the first week in May. Would the first part of

9 that week be all right with you, Dr. Sarn, or would that be impossible,

10 too?

11   DR. SARN: I also have trouble with the first week in May.

12   CHAIRMAN MOSELEY: Why don't you tell me what is available for you in

13 May?

14   DR. SARN: How about the 19th and 20th, or the 26th and 27th?

15   CHAIRMAN MOSELEY: What about the 19th and 20th? Everybody say okay?

16 We will shoot for that. There are members who are not here. We will try

17 to correlate the situation so that we can have the maximum attendance at

18 the meeting.

19   The next one is a little further off, and I would propose October 13th

20 and 14th. That again is a Thursday and Friday.

21   DR. AUXIER: I have a conflict, Bob.

22   CHAIRMAN MOSELEY: What dates are available for you in October?

23   DR. AUXIER: The 20th and the 21st of October.

24   DR. SARN: Good. Mr. Chairman.

25   CHAIRMAN MOSELEY: Yes, sir.

26   DR. SARN: We have thought in the past about having meetings in other

27 places beside Las Vegas. I think that prior to this date we've always felt

28 that just the sheer number of people who had to be in attendance made it

1 less expensive to have it any place else but here. I am wondering whether,

2 in fact, it might be time to think about having it in another location.

3   CHAIRMAN MOSELEY: I agree that we even said the Committee wished to

4 do that. It wasn't just that we were going to explore the issue. We run

5 into climate problems for one thing. We had planned to go to Ely, but it

6 coincided with our winter meeting which didn't work out very well. May or

7 October would probably not represent transportation problems here, and I

8 think we ought to ask Marshall to see if we can't arrange such a meeting

9 for either one of those dates at some non-Las Vegas site. St. George or

10 Ely have been the two that have been discussed in the past. I think it

11 probably still does impact financially, as a matter of fact. It will be

12 more expensive to have the meeting somewhere else, but the Committee has

13 asked that we look into that, and I wish we would.

14   DR. SARN: How far is St. George?

15   MR. PAGE: 135 miles from here. Ely is 284 from here.

16   DR. SARN: Can we get an expression of which place we'd like to meet

17 in May, Ely or St. George?

18   CHAIRMAN MOSELEY: Where would you like to meet in May, gentlemen?

19   DR. SARN: St. George.

20   DR. CAROTHERS: Las Vegas.

21   DR. CALDWELL: Las Vegas.

22   (Laughter)

23   DR. SARN: Can we let Marshall look into that?

24   CHAIRMAN MOSELEY: We will let Marshall look into that. I'm getting a

25 diversity of opinion on the Committee now, Dr. Sarn. It doesn't make any

26 difference to you?

27   DR. SARN: I don't care which place.

28   CHARIMAN MOSELEY: And Roger, you said Las Vegas, or were you just

1 mumbling?

2 DR. CALDWELL: I mumbled. I can float either way.

3 CHAIRMAN MOSELEY: We have one positive vote on the Committee for Las

4 Vegas, and -- three votes for Las Vegas.

5 MR. ZIMMERMAN: I vote for one of the two spots, St. George or Ely.

6 DR. AUXIER: Which one of them has the best airport?

7 CHAIRMAN MOSELEY: Well, neither are prepared for 747s.

8 MR. ZIMMERMANN: Actually, as I recall, St. George used to have some

9 short jets that went in there.

10 CHAIRMAN MOSELEY: St. George has commercial service from Las Vegas as

11 well as from locations in Arizona.

12 MR. PAGE: So does Ely.

13 DR. AUXIER: Okay, no problem.

14 MR. ZIMMERMAN: I would say at some point it would seem to me that

15 St. George would be an appropriate place at some juncture simply because

16 there seems to be at least a significant amount of interest in that area

17 apparently.

18 DR. CASARETT: What do you have to do to get in and out? Do you have

19 to go to them from Las Vegas and then come back to Las Vegas to get out?

20 MR. ZIMMERMAN: No. You can go to Salt Lake and go to St. George. I

21 know you can do that.

22 CHAIRMAN MOSELEY: Or you can come to Las Vegas and go to St. George.

23 DR. CALDWELL: Would it be better to come here and then get ground

24 transportation from here?

25 CHAIRMAN MOSELEY: I think that we can't solve that issue. We will

26 let Marshall work out the logistics of what we are going to do.

27 Any other discussion about the meeting dates? Or place?

28 I need to have our normal recital then. I guess I will start with

1 Dr. Malik who is closest to me here.

2 DR. MALIK: Three areas. One on hotspots. The work reported on at
3 this meeting by EG&G for the Surface Nuclear Report Office and REECo has
4 done much to clarify the so-called hotspot designation in the observed
5 fallout patterns. In particular, the famous BOLTZMANN hotspot, which had
6 no plausible explanation, now appears to be nonexistent. Many others in
7 the environs of the NTS have also little credibility. If a quantitative
8 definition could be established, more might disappear from the patterns.
9 Such might be established in consideration of the variability of exposures
10 established along the hotline. The variables might include terrain
11 effects, variability of the particle size distribution, wind shears, and so
12 forth. A limited effort on this description might be useful. One should
13 note the hotspots are, indeed, real. Examples are: TRINITY, HOROSHIMA,
14 SIMON and SMALL BOY. The NURE data seemed to say that the historical
15 fallout patterns are probably complete with high level hotspots unlikely.
16 Analysis, however, was not completed. On pathways, the work to date seems
17 to agree with the limited data base but with large error voids. They have
18 a long way to go. On soil sampling, this is a very essential study area in
19 the effort. Work seems to be proceeding well but is only started. My
20 concern about mechanical concentration of fallout does not seem to be
21 warranted. This from a comparison of the recent versus the Larson samples.
22 These data will be of great interest. We have seen some impressive
23 progress.

24 CHAIRMAN MOSELEY: Dr. Caldwell.

25. DR. CALDWELL: He has already hit one of mine. One of the things that
26 I'd thought about when we were looking at some of the reports and at the
27 same time talking about the CIC was I think that DAAG needs to consider
28 whether or not the funds shortfall for the CIC, particularly for keyword

1 insertion and some of those things, whether we ought not to urge that they

2 replace some of that shortfall and maybe try to get the Adjustments Depart-

3 ment, who chewed up a fair amount of those funds, to provide some to us.

4   (Laughter)

5   The other thing was one that had occurred to me before I got out here.

6 We had scheduled Harold Knapp to talk to us once before. I wondered more

7 whether or not that was still appropriate and whether it would be useful.

8 I don't know, and I think that needs to be decided by Lynn and Bruce Church

9 as to whether or not that would be useful. It was something we did not do

10 and had planned to do.

11   My last comment is related to the facts and assumptions. We have com-

12 plained about that in the past. I think there was a great effort made to

13 provide those things to us this trip, and I think we ought to compliment

14 the Task Groups. There were a couple of places where I wasn't sure which

15 was fact and which was assumption, but I think that will work out as time

16 goes on. I think they have made considerable effort to do that; so they

17 should be complimented.

18   I think those were the only things I had written down.

19 CHAIRMAN MOSELEY: Roger.

20 DR. MC CLELLAN: I only had a couple of items. One related to the

21 CIC. I think there's a need for them to really critically examine, this is

22 something that could be done very easily, the litigation process to deter-

23 mine if it is likely to provide opportunities in terms of documentation,

24 development of documentation that should be included in the Center, and if

25 those opportunities are identified then to establish the vehicle by which

26 those appropriate documents can be entered into the collection.

27   The second item is really one of -- I guess I'd have to say, I cannot

28 really support Glyn's recommendation with regard to the funding shortfall

1 for the CIC, because I continue to be perplexed as to the level of produc-

2 tivity relative to the level of funding and really what I view as

3 relatively meager information that has been provided to us with regard to

4 the time lines and the establishments of the priorities for work within

5 that Center. That leads really to my second recommendation which is for a

6 critical examination of the material that is now on hand for entry, or

7 likely to be provided for entry, and to the establishment of priorities to

8 enter that material into the collection and continuation of the work in

9 terms of key words.

10   I guess I can best sum it up by saying, I suspect that there are docu-

11 ments that await handling by the Center that would be categorized in the

12 ten cent range; there are probably some that are worth a dollar; there are

13 some of the $10 variety; there are probably some that are of the $100

14 variety; there may even be some, oh, $10,000 pieces of information there.

15 When the information has been presented to us here, I sometimes have the

16 impression that the ten cent items are handled with about the same priority

17 as the $10,000 or vice versa.

18   The other item is one, and I may have frought my attention or recall-

19 ing in thumbing through the article here by Anspaugh and Church, and this

20 goes to the question of the extent to which there is in one place

21 information in terms of natural background exposure levels across the

22 region of interest, and I think that just as a general matter of practice

23 it would be useful to take the opportunity to call those background

24 exposure levels to the attention of the interested individual anytime the

25 exposure and dose information is provided from the program here. I'm

26 struck by the extent to which in many cases the levels of exposure

27 attributable to the fallout are disappearing into the background that is

28 naturally there.

1   And the other area is one which I do not know that anything realistic-

2 ally can be done as a part of this, but it seems to me that it is appro-

3 priate to keep in mind, although admittedly provided for a specific

4 purpose, i.e., the use of medical diagnostic radiation exposure. It seems

5 to me that somehow that has to -- we have to keep in mind that as a factor

6 here. - My overall concern is one that -- As I look at many of these

7 numbers, I am concerned that we tend to become, well, mesmerized, or give

8 them undue weight, and we do that in terms of reporting of the values to

9 two, occasionally to three significant figures when perhaps an order of

10 magnitude would be more appropriate, or even more appropriate in other

11 cases as the recording has de minimis values.

12   CHAIRMAN MOSELEY: May I say that the Chair was planning to comment

13 that this was the first-time he had heard from you the admonition to expand

14 the activities of the CIC, and I'm delighted that in your second

15 recommendation you quickly kept me from being disillusioned with your

16 watchdog-type activities in this regard.

17   DR. MC CLELLAN: I appreciate the commendation from my colleague from

18 New Mexico.

19   (Laughter)

20   DR. WARD: Mr. Chairman, I think there are two issues that might be of

21 priority to those of us who seem to be outside of the blackest of the cloud

·22 that has been predicted here. That would be to have Dr. Whicker do a

23 little bit more work on the consequences, if any, to those of us who may be

24 recipients of food and fodder grown here, sort of secondary inheritors, if

25 you will, of the problem that may be local. And the other thing, of

26 course, is the correlation between the soil sampling that's being done now

27 and the extended modeling of the fallout to make sure that we are not too

28 comfortable by seeming to be outside the centerline of most of the things

1 that have happened here over the years. That would be my two priorities.

2   CHAIRMAN MOSELEY: Thank you. Mr. Zimmerman.

3   MR. ZIMMERMAN: The hotspot issue, I was impressed with the resolution

4 of the BOLTZMANN hotspot. I wondered about whether any attempt is being

5 done to do any soil sampling in the same area to get any further verifica-

6 tion of its nonexistence. At least it's always seemed to me that the

7 possibility of hotspots which at least heretofore has always been accepted

8 was always a question mark in any analysis, no matter how exact it appeared

9 to be. I would just suggest that maybe some more could be done to nail

10 down some of the other hotspots, whether it be by the sort of thing

11 Dr. Malik suggested, topographical justifications for them; whether they're

12 really cool contours in a continuous hot contour, something like that.

13   The REECo CIC work, my first impression was at the rate they're going

14 it's going to take them about 15 more years to do what they are supposed to

15 do. That either calls for more money, or it calls for what Roger is

16 suggesting, a little more selectivity. Maybe it calls for both. But it

17 did strike me that the selectivity might be more useful in terms of getting

18 the most out of the money at the present time, because there does not seem

19 to be any attempt to sort out the important from the unimportant.

20   Also, with respect to the litigation data, it seems to me that it is

21 quite possible that information is very pertinent to the ORERP effort that

22 will be turned up during the course of the litigation either by way of

23 deposition or possibly even conceivably by studies paid for and done by

24 plaintiffs, and that at present there does not seem to be a mechanism for

25 bringing that into CIC. That might be some at least $10 or $100 informa-

26 tion, and a mechansim ought to be set up to do that one way or another, and

27 I would not suggest that the government attornies pick and choose among

28 things. Perhaps they ought to just send all the depositions down, or some-

1 thing like that. I don't know how you are going to do the screening.

2 Being an attorney, I frankly don't always trust the attornies to do the

3 picking and choosing about what gets into the library, but some mechanism

4 needs to be established.

5   I thought, a comment I made before, that it's important that the Utah

6 milk studies, whatever they are going to be, be very closely coordinated

7 with the CSU work, so that it is very congruent. I noticed when we heard

8 about REECo's cesium work and plutonium work, and then EML's which have

9 been going supposedly hand-in-hand, they are using different chemistries.

10 One had already developed a chemistry, and the other, at least it appeared

11 to me as a layman, to have reinvented the wheel. I would hope that we

12 could avoid that kind of problem with the milk work.

13   And the soil sampling, it may be because I missed a meaning, but I'm

14 somewhat concerned about what appears to me to be an absence of sampling in

15 the Utah County, Heber City areas, which are the milk sources for Salt Lake

16 and the Wasatch front where the bulk of the Utah population is. It may be

17 that that was done in the first EML survey that we saw about a year and-a-

18 half ago; but I don't particularly recall it as being related to the milk

19 producing areas.

20   That's all I have.

21 CHAIRMAN MOSELEY: Can we clarify that issue right now without carry-

22 ing it to our summary? It's my recollection that there was a fairly

23 extensive EML sampling in Utah, and that this committee's recommendation

24 was that some of those be resurveyed in this process in order to cross-

25 validate the two efforts and be certain that the methodology gave similar

26 results; but that not all of those areas be resampled again. That does not

27 speak to the question about the specific areas that you talked about, and

28 maybe Bruce or some of the folks from EML can respond to that.

1   Do you know, Phil, what your Utah --

2   MR. KREY: I'll be very truthful with you.   I don't think I know geo-

3   graphically where the milk area is for Salt Lake City.   Is it around Heber

4   City?

5   MR. ZIMMERMAN: Actually, I think, was it Ward's data that talked

6   about Utah County, Provo, and some of the mountain valleys which would

7   include Heber City.   Around Oakley and Kamas there's some grazing.   But

8   Utah County, as I recall, he indicated was the primary -- Utah County and

9   Cache Valley were the primary milk producing areas.

10   MR. BECK: Our measurements, we had extensive measurements in the

11   cities in that region.   We did not have any measurements outside the

12   cities.   Now Bruce told you he was going to have some additional sampling

13   made in Roosevelt and Duchene County.   The purpose of that, I understand,

14   was just to address this question, to fill in those areas.   This may be

15   where we want to move those additional sites to satisfy your requirements

16   here, but we had extensive measurements throughout that whole area; but

17   only in the cities --

18   CHAIRMAN MOSELEY: Based on your methodology, the cities with the

19   established lawns were the best spots from your standpoint; so that a

20   meadow, or a grazing area, might not fit your criteria as an optimum site

21   to sample.

22   MR. BECK: I think one thing that our data showed was that essentially

23   that entire area was fairly uniform in its NTS cesium deposition, so I felt

24   we had established pretty much what the deposition of NTS cesium was, and

25   that it was fairly uniform over that area.   I think that there are going to

26   be enough additional samples taken in this Phase II effort to corroborate

27   that, and if they come up with the same results, I think we can go with

28   that assumption.

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1   CHAIRMAN MOSELEY: Was that clarified to a certain extent?

2   MR. ZIMMERMAN: Yes.

3   MR. CHURCH: Mr. Chairman, I think it is probably also appropriate to

4   clarify the chemistry techniques. We either didn't make it clear, or we

5   made it confusing, that the REECo chemistry procedures is an identical

6   procedure to the EML one. If I'm wrong, somebody correct me.

7   MR. BECK: That's correct.

8   MR. KREY: No, that's correct.

9   MR. ZIMMERMAN: That impression I got was that it was something

10   different because you were talking about eliminating the thorium, as I

11   recall.

12   MR. KREY: They are using the exact procedure. There is a little bit

13   of uncertainty as to why the thorium and the polonium is showing up in the

14   final product. There are some chemical reasons that we can propose that

15   might explain it, but the procedure is identical, and the confusion part

16   is, why did they get that when we don't. But the chemistry is exactly the

17   same, at least as I understand it.

18   CHAIRMAN MOSELEY: Dr. Sarn.

19   DR. SARN: I don't think I can resist saying something about the CIC;

20   but I would say with the limited funds of CIC, we'll need to be selective

21   with regard to what kind of information it's going to gather and store, but

22   at the same time it must also be concerned with information which has been

23   shown to have a high public interest in addition to information that is

24   purely technical or scientific in nature. I think that, without being

25   dramatic and being mindful of other momentous events in the history of the

26   world, I think the creation of nuclear weapons and its testing is certainly

27   one of the key historical occurrences in the history of man, and I think

28   people who operate very close to it sometimes fail to realize the

1 importance of it to the general public. These records, I think, should be

2 viewed as exceedingly useful to not only scientists but to public

3 officials, individual citizens, and their legal representatives. I would

4 suggest that we are on the side of gathering more rather than less

5 information within reasonable limits, and, specifically speaking to the

6 issue of the trial information, that I find that -- or, I believe we will

7 find that to be very useful, and so will people in the future, and it

8 appears to be important enough for CIC purposes.

9 On the dose reconstruction and soil sampling, I was just very pleased

10 to see the intensity of the work in that area and the output of the staff.

11 Since the very beginning, I think that has been a key issue with represen-

12 tatives from Utah, Arizona, and Nevada, and I believe that the lack of

13 accuracy of the airborne readings just begins to bring that out further,

14 the importance of having this reconstruction especially in areas that did

15 not have ground monitoring during the fallout. I think that the staff

16 should be commended in this area, and that we should continue to emphasize

17 work in this area with both our own interest and resources for these under-

18 takings.

19 I think of one other issue and that is a final report. I saw Bruce

20 putting up his concern for some of the committees, publications, and

21 presentations, and I think it is appropriate for us at the next meeting as

22 an advisory group to begin to outline what we believe should be our

23 analysis of the effort and begin to assign people on this advisory group

24 with some responsibilities for final publication information, because I

25 think that will roll around very quickly in a year and-a-half. With the

26 kind of intensity of effort that's being shown in all of these areas, it

27 will be just around the corner.

28 CHAIRMAN MOSELEY: May I make a comment in connection with that last

1 one. I would remind you of Bruce's request that documents that you have

2 there in the preprint state be reviewed in relation to your areas of expert

3 knowledge and that the authors be communicated with about any comments that

4 you might have about it, so that it gets some additional peer review before

5 it goes for publication.

6   John.— Dr. Auxier.

7   DR. AUXIER: I have no substantive technical comments or suggestions

8 now. It still appears to me, as we have observed before, that the ORERP

9 has been positively responsive to the DAAG suggestions, and I think the

10 work is progressing in a very professional manner. The things we've heard

11 at this meeting that we've received have helped clarify several long-term

12 problems including that old bug-a-boo of the hotspots; but I would be sur-

13 prised if when all is said and done if there are not areas found wherein

14 the exposures are somewhat higher than in surrounding areas, than the

15 immediately adjacent areas, and I still have a slight nagging concern con-

16 cerning soil sampling in areas that are subject to extensive use of

17 sprinkling and soaking. I think it is perhaps just a problem I have in not

18 having looked at it that long in how I would interpret the data. We know

19 in a general sense how nuclides progress through soil, depending on their

20 solubility and other factors, but I worry about this. Like we picture a

21 lawn with sprinklers going. I wouldn't personally know how to handle that

22 right now.

23   CHAIRMAN MOSELEY: Dr. Carothers.

24   DR. CAROTHERS: With regard to the items presented on Thursday, I have

25 no recommendations. As an observation, I am pleased to see the analysis

26 being done on the NURE data. This ties in with comments with respect to

27 Friday. I have no recommendations for the items on Friday either; however,

28 as an observation, I believe the Phase II soil sampling program is

1 providing a very important base line data set, not only for the present,

2 perhaps temporal, purpose of assessment of dose from NTS fallout but for

3 possible future events which might occur. It appears to be being carried

4 out in a careful and excellent fashion. Since I think it is so important,

5 I believe all possible checks should be made to ensure that this data set

6 is as soundly based and documented as is reasonably possible, and any

7 possible ties to the NURE analysis should also be made for much the same

8 reasons as above.

9   CHAIRMAN MOSELEY: Thank you. George.

10   DR. CASARETT: In general the ORERP investigators continue to be

11 highly responsive to recommendations and suggestions from DAAG to the

12 extent that is reasonably feasible, and I feel that Bruce Church and Lynn

13 Anspaugh have made it clear to us those suggestions that don't seem

14 reasonable and feasible and those which are. In general, the progress

15 toward achievement of the overall research objectives and completion of

16 specific tasks appears to have been excellent, especially in view of the

17 substantial time and effort that has been devoted recently to provide

18 information in litigation processes.

19   The ORERP investigators, therefore, should be congratulated on their

20 high levels of competence and conscientiousness in this work.

21   In view of the progress made toward assessment of the extent or

22 validity of so-called hotspots, it does seem advisable to define this

23 jargon term more formally; if not replace it. Presumably, by implication,

24 there may also be cold spots. Definitions could be made in terms of some

25 minimal factor or factors of difference distinguishing extraordinarily high

26 or low radiation exposure in demarcated subareas relative to the exposure

27 in surrounding larger areas characterized more generally or uniformly by

28 elevated exposure; something of that sort, and whether you call it hot-

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1 spots, or cold spots, or whatever, it doesn't make much difference.

2   In regard to tables or text dealing with doses in rads, or with dose

3 equivalents in rems, it would be useful to accelerate the implementation of

4 previous suggestions to establish and consistently practice expressions of

5 types of radiation involved, and where involved, quality factors used, or

6 assumed, to know that we're getting penultimate drafts for review by DAAG.

7 Perhaps we should take a hard look at factors of this sort.

8   I'm simply advising that you not take for granted that everyone who

9 reads these documents, especially with the public attention now being

10 given, is going to understand what you mean without expressing these

11 factors we all take for granted.

12   The CIC archival effort seems still to be indiscriminately

13 encyclopedic in character and for imminent purposes needs a practical set

14 of guidelines for relative effort in relation to relative importance of

15 various categories of information for early processing.

16   Those are the only thoughts I have at this time, Mr. Chairman.

17   CHAIRMAN MOSELEY: Thank you.

18   I will open the meeting now for public comments and questions.

19   Hearing none, I will adjourn this meeting of the Dose Assessment

20 Advisory Group.

21   MR. CHURCH: Mr. Chairman.

22   CHAIRMAN MOSELEY: Yes, sir.

23   MR. CHURCH: Could I make a request before you adjourn?

24   CHAIRMAN MOSELEY: You were almost not in time. (Laughter)

25   MR. CHURCH: I'm perplexed by the comments with regard to the CIC.

26 There apparently is an area where we have had a hard time striking harmony

27 with respect to level of effort. We have tried to balance, in terms of

28 responding to DAAG recommendations, a level of effort somewhat below what

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1 the initial design of their budget was. It was largely upon DAAG recom-

2 mendations that their budget was diminished in favor of resources going to

3 other aspects of ORERP activity. Our early intention had not been to do

4 that but to obtain funding perhaps from other sources as we dealt with the

5 technical requirements of the project.

6 It would help me considerably if we could consummate a firm set of

7 recommendations from the DAAG with respect to what they saw the utility of

8 the CIC to be; what you see an appropriate level of effort to be. It's

9 clear, I believe, that the current level of effort cannot satisfy the

10 archival activities for potential document sources that are out there, and

11 I think that is now clear to you. In the way of information, there are

12 other types of needs, primarily litigatory, where we are now meeting to

13 perhaps create additional tasks for the CIC to supplement and support

14 litigatory efforts. In fact, week after next I will be attending the Task

15 Group meeting at the Headquarters where we will be looking at that type of

16 thing.

17 From our perspective, the CIC has provided an immensely important

18 role. I think it has provided also an important role for the public and

19 their attornies. I think -- this is strictly an opinion on my part -- they

20 would have had a difficult time presenting a case without the resources of

21 the CIC for the Allen trial. One of the primary objectives of the CIC was

22 to make government documents available to the public. I think we need to

23 endeavor to complete that. We need, I believe, to hear from the DAAG with

24 respect to what your recommendations are. I feel I am a little bit on a

25 yo-yo. Our time is not long enough to go up and down that loop more than

26 one more time.

27 CHAIRMAN MOSELELY: I appreciate your problem, and I'm certain that

28 the ambiguity that you are receiving is based on the fact that there really

1 isn't a consensus among the members of the Dose Assessment Advisory Group,

2 as you can detect from listening to the recommendations made at this

3 meeting. Whether we can provide a precise outline of what we believe the

4 CIC's obligations can do, since we don't seem to have very much agreement

5 about it among ourselves, is not something that is patent to meet at this

6 point, but I will ask the members of the Committee to provide me by mail,

7 in addition to the documents that you will give me now for the preparation

8 of the summary, your individual assessments of the CIC's mission and recom-

9 mendations for our accomplishing it in the most expeditious and cost

10 effective way.

11   MR. WHEELER: I think there is a misunderstanding in the report that

12 was given by the CIC on the type of work that still needs to be done. As

13 far as identifying government records that were not available to the

14 public, I think all of those records are currently, the $10,000 records are

15 currently on the system and available. The records still that need to be

16 done are those that are in collections or in archives in other locations

17 which have not been entered into the computer system, which are accessible,

18 which are researchable, which are available other places, are your records

19 of less quality. I think we have done the type of prioritizing of which

20 records get into the system first. Those are the ones we have requested,

21 and I don't understand what the requests are for this prioritizing of

22 records. It seems to me like we've done it. Maybe we haven't communi-

23 cated.

24   CHAIRMAN MOSELEY: If your statement is correct, I would interpret

25 many of the members' opinions as, if you've gotten all of the $10,000

26 records and some of other values, stop accessions. Am I correct in

27 interpreting some of the members?

28   DR. CASARETT: You say there are about 40,000 already in hand of all

1   types, $10,000 in others, I presume, and you have about up to 200,000 to

2   go, and so you're --

3   CHAIRMAN MOSELEY: Yes.

4   MR. WHEELER: Well, of the 40,000 that we have left to go, there are

5   archives of the Public Health Service, e.g., that are --

6   CHAIRMAN MOSELEY: They are available.

7   MR. WHEELER: -- that are accessible; they are available, many of

8   which are duplicated within what we have collected. The 200,000 that he is

9   talking about is a lot of specific records, and so forth that we don't

10   really know where they are right now.

11   DR. WARRINER: I guess I never cease to be amazed at the controversy

12   that the CIC engenders, seeing this with the other controversial topics

13   that have been presented to the DAAG that have received minimal comment,

14   but somehow the issue of document collection seems to be one that is rather

15   exciting which, from the standpoint of an archivist, is fascinating to say

16   the least. (Laughter)

17   I suppose though, the one thing I keep hearing of the comments that

18   have been made so far is the issue of selectivity and specificity in

19   prioritizing what it is that we collect, and what it is that we process.

20   Documents that come to us come to us in one of two ways, and this might

21   help answer some of this. Some of them have already been selectively

22   reviewed. Those that are coming to us, one particular example, are those

23   that came to us from the Department of Energy Headquarters Archives. Those

24   documents were the result of a two year research process in the archives in

25   the Department of Energy Headquarters. They have received extensive

26   review. Some of them required extensive declassification review. When

27   those came to us, we assumed that those had already been assigned a

28   priority. There are other documents that the CIC Research Teams have

1 reviewed in other repositories. When we identify those documents, we only

2 retrieve those that we feel are pertinent and that have a priority. There

3 are others that come to us in bulk; what I presented to you yesterday,

4 e.g., the Public Health Service Archives microfilm. Now that's 76 reels of

5 microfilm. That, to identify of those 12,000 documents what it is that is

6 most pertinent to us, will take some time. There is some prioritizing done

7 within that study. The Research Team that put that collection together did

8 review those documents and selected some 500 that they thought were the

9 most pertinent documents for the records. Those would be the ones that we

10 would put on our file initially. There are other documents in those

11 12,000, however, that we have used that have been requested, that we have

12 provided, that are not among those 500. I suppose the problem that we all

13 face is to set in a couple of criteria to distinguish between the ten cent,

14 the one dollar, the $100, and the $10,000 document. What may appear to be

15 a one dollar document today may be a $10,000 document tomorrow. I don't

16 have a clear enough crystal ball to be able to predict which of those

17 documents are going to fall in which category.

18   The other thing I want to say is that the CIC serves two functions,

19 and I think that is often confused here. We serve as an information

20 resource for the Task Groups of the ORERP. We serve also as an information

21 resource both to the Department of Energy and any other agencies or members

22 of the public that wish to use our resources; so that we are, in a sense,

23 wearing two hats. It is perhaps the perspective of the DAAG to be most

24 concerned with the dose assessment, and that is proper for you to be most

25 concerned with that; but those of us who work in the CIC also have a

26 broader conception of the function of the CIC in that we also want to

27 provide services to a much broader public to be able to resolve the issues

28 with which we are dealing. Obviously, the issue of the health effects of

ionizing radiation, the question of fallout, are controversial public

issues, and we would like to resolve that controversy and provide public

access to that information so at least there would be some public under-

standing of the issue.

MR. ZIMMERMAN: Maybe the question that might help us a little is what

proportion of your budget do you think is being spent on servicing the

litigation on the DOJ? What proportion is being spent on providing data to

people other than the public and ORERP.

DR. WARRINER: I don't have those figures at my fingertips, Mike, but

we could give you them --

MR. ZIMMERMAN: Just as a ballpark figure, would you say 5 percent,

20 percent, 50 percent?

DR. WARRINER: Well, obviously within the last seven months since the

DAAG met last, because of the preponderance of the support by request

relative to the legal effort -- and, Tom, you can correct me -- I would say

probably 50 percent of our effort has been put to that for both plaintiffs

and DOE at government lawyers' requests. That is doing research for

people. That's not processing documents.

MR. ZIMMERMAN: So that comes out of your budget. You aren't reim-

bursed for that by any other planning source?

DR. WARRINER: That's right, it comes right out.

MR. ZIMMERMAN: The figure that we see, four hundred and some thousand

dollars, really a large proportion of that is going for other then ORERP

work?

DR. WARRINER: Correct.

CHAIRMAN MOSELEY: Did you want to say something?

DR. CAROTHERS: Yes, I want to say something. I have spoken from time

to time in the past. I suppose I'm in the pro-CIC faction. I want to make

1 just one observation which may provide some perspective to this, although

2 it's not necessarily relevant to the DAAG, and so on. The University of

3 California, the Regents of the University of California, are currently

4 named in some eight legal suits having to do with radiation health

5 practices in the fifties. It is entirely conceivable that the discovery

6 process involved in those legal suits will cost the University several

7 million dollars.

8 I think that you have gotten a tremendous bargain out of the CIC in

9 terms of overall monies that would have been spent in finding these

10 documents in all of the places that they formerly resided.

11 CHAIRMAN MOSELEY: I don't know whether this comment has been made or

12 not, but in actuality the genesis of the CIC had nothing to do with the

13 Dose Assessment Advisory Group. It was required by other federal legisla-

14 tion that a communication and information center be established. It was

15 established here in Las Vegas, and the Dose Assessment Advisory Group was

16 given some relation to it for reasons that I don't totally understand at

17 this point in terms of their advisory function, but there is specific

18 separate legislation that establishes the CIC. Maybe our advice is

19 gratuitous. In any case --

20 MR. FRADKIN: May I?

21 CHAIRMAN MOSELEY: Yes.

22 MR. FRADKIN: Again, my name is Philip Fradkin. If I could just say a

23 few words as one who has to use the CIC extensively in doing research for

24 my projects, I would hate to see anybody, whether they are the most

25 knowledgeable person in the world, or the most menial clerk, deciding what

26 I could see, because I don't know what I need until I see it myself. I

27 think, to set somebody up within that system to select things out, you are

28 putting one person's or two or three persons' biases in place where perhaps

1 there should be no bias, simply because, it strikes me, that not only this

2 question you are discussing but the documentation that exists in the CIC,

3 is the most extensive documentation that probably exists in this world on

4 the effects of nuclear warfare, which is the most preeminent question of

5 our time, and my project is only within the next couple of years. Well,

6 I'm sure there will be historians, physicists, biologists, and so forth,

7 who will be looking for the answers to these questions in any number of

8 years, if we survive down the road, and I hope that this facility is given

9 all the money and all the manpower it legitimately needs.

10 CHAIRMAN MOSELEY: Dr. McClellan.

11 DR. MC CLELLAN: Well, I think I've perhaps been one of the, I would

12 hope, constructive critics of the Center. My concern is that today I can't

13 tell you what it would cost to fulfill the objectives that have just been

14 laid out, if those were adopted as the appropriate objectives for the

15 Center.

16 My plea is for us to be provided information and some insight into the

17 operations of the Center; some assurance that the limited resources that

18 are available are being used to tackle the highest priority projects.

19 Perhaps the information that might be provided might well lead us to

20 endorse the request that would say the Center should receive $8 million to

21 accomplish the total tasks at hand during the next year. Today we just

22 don't have that kind of information.

23 In response to questions yesterday, we received extremely glib com-

24 ments in terms of how many documents are potentially going to be entered,

25 the status of key wording. We are simply not provided adequate information

26 with regard to CIC to really render informed judgments on it. I think your

27 problem, Bruce, is that you simply have not given us the information; and

28 until you provide us the information, I think you will be on the yo-yo from

the Committee; because there are many things that we see in the CIC that we
think are very laudatory. I think there are also impressions at times of
some things that have to be accorded very low priority compared to other
activities that we are reviewing; and we are reviewing some of these
recognizing that they are operating under relatively severe budget
contraints in getting important tasks done now.

MR. ZIMMERMAN: Mr. Chairman.

CHAIRMAN MOSELEY: Dr. Sarn, first.

DR. SARN: I, in the past, have favored the funding of the dose recon-
struction of soil samples over the CIC, and I will admit to that. Of
course, now that that problem seems solved with our really excellent work
of the last couple of months, I would like to turn our attention to the
CIC. In trying to be very practical and pragmatic, I think, number one,
for Bruce's sake, I would favor continuing, obviously, the same level of
effort that we are now expending. I think the second thing we really need
out of the CIC is literally a list of those documents which they plan to
register to put into the information bank with the amount of the resources
they have at their disposal. I would also like to see a second category of
information of what they would like to incorporate, or what they feel that
they should incorporate. And, obviously, we need another contingency area
in which there is going to be information developed that no one can foresee
the need for such entry at this particular time. I think if that kind of
information is presented to the DAAG group and also to Bruce that the
decisions will be made much easier as to how much we are going to request
in addition to make this CIC an appropriate one, because I think we must
not lose sight of the fact that billions of dollars have been put into the
development of nuclear weapons testing and millions of dollars into this
effort to this point, and I would hate to see us somehow not

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1 include that vital information into a repository someplace; but I don't

2 think we can do it without having an idea of what we can do with the

3 present resources, and what is left literally to be done.

4 CHAIRMAN MOSELEY: Mr. Zimmerman, can you educate this for me?

5 MR. ZIMMERMAN: Not likely. But I think it would be helpful along the

6 lines that you mentioned, if we could get a budgetary breakdown of what

7 your money is going for. I mean, you have only so much money, and people

8 are saying, as I said, it is going to take you 15 years at the rate you are

9 going. Now if you are spending half your money to support the

10 lawsuits -- we don't look at, I think in terms of the ORERP, the comparison

11 of a dollar spent on soil sampling versus a buck spent to help in the liti-

12 gation. In other words, the money that funds that litigation is not really

13 something we, I think we've been thinking we've been dealing with

14 particularly, although it is recognized that you are spending time doing

15 litigant assessments and that sort of stuff. Maybe it would be helpful if

16 we got a projection of how much? It's going to cost you $3 million to

17 support litigation for the next ten years? If so, are you going to have

18 any money left to do the functions that at least some of us understood were

19 the primary functions of CIC, which were to gather them so they wouldn't be

20 lost or destroyed and make them available to the public and the ORERP.

21 Maybe we should have some projections on that.

22 CHAIRMAN MOSELEY: Bruce, comments?

23 MR. CHURCH: Let me make a comment about what you just said, Mike,

24 with respect to litigation. I fully anticipate restoration of that type of

25 resource this year, and I fully anticipate that the litigation requirements

26 are going to be dealt with on an agency-need basis and really not a problem

27 for the DAAG to consider. I think the problem that DAAG needs to consider

28 and be vitally interested in is the fact the resources and the mission of

1 the CIC satisfy the public needs; and I think that's what you need to focus

2 on. We laid off six people this year, primarily at your suggestion, in

3 that we interpreted your recommendation that we were doing too much in that

4 arena for the sake of the public.

5 DR. MC CLELLAN: Hold it just a second. That, I think, is a gross

6 misstatement, Bruce. Our recommendations come within the context of total

7 dollars available. You could not make the statement you made without

8 offering the qualification that the recommendation was made to provide

9 dollars in terms of other activities. It's grossly inappropriate to make

10 the statement in other context.

11 MR. CHURCH: And I'll back off to that degree, but the point is we're

12 trying to operate in the context of providing enough resources into putting

13 documents available to the public in harmony with the kind of recommenda-

14 tion that you guys have given us.

15 CHAIRMAN MOSELEY: I had made the assumption that we might be able to

16 do this by correspondence between now and the next meeting, and as the

17 discussion has gone on it is apparent to me that's not a feasible mechanism

18 for responding to this.

19 Can you stand to ride up and down the yo-yo until May, Bruce, so that

20 we might at the next meeting of this committee bring joy to the archivist's

21 heart and devote substantial time yet again to investigating our feelings

22 about the CIC and our recommendations.

23 MR. CHURCH: We will do the best we can. One thing you might consider

24 is maybe a subcommittee of three can meet with us in a month or two and

25 look at it in excruciating detail.

26 CHAIRMAN MOSELEY: I will be glad to form such a subcommittee, and I

27 think that is probably a good idea because I don't think the whole

28 committee can look at it in the detail that is required, but there is a

1   substantial amount of disagreement on this Advisory Group. I don't know

2   exactly how to get you a representative committee. Maybe you would choose

3   the people from the assessment group that you would like to serve on that

4   committee. (Laughter)

5   MR. CHURCH: I would prefer not to.

6   DR. CAROTHERS: This raised hand is not to volunteer --

7   CHAIRMAN MOSELEY: Oh, thank you very much.

8   DR. CAROTHERS: -- but I would like, if I may, to have a couple of

9   minutes?

10 CHAIRMAN MOSELEY: Yes.

11 DR. CAROTHERS: I would like to address a question to Mr. Warriner.

12 At one time, sir, you typified your collection as a manuscript collection

13 rather than as an archives. Would you consider that to be true today?

14 DR. WARRINER: Yes.

15 DR. CAROTHERS: Now my understanding is that in a manuscript

16 collection, basically every document or manuscript is indexed individually

17 and separately. Is that your practice in your operation?

18 DR. WARRINER: Yes.

19 DR. CAROTHERS: I will point out to the committee that that is an

20 enormously costly way to do business in terms of time, effort, and money.

21 It provides you with the finest possible index because every single piece

22 of paper is indexed onto your data base, and you can find it, hopefully,

23 relatively easily by one method or another. There are other ways of

24 indexing which are not so laborious and costly, all-be-it-not so, that

25 don't provide the same facility for retrieval to people, such as

26 Mr. Fradkin, who wish to do research.

27 Have you investigated that possibility and rejected it?

28 MR. NUTLEY: Yes.

1   DR. CAROTHERS: Is there a reason for that?

2   MR. NUTLEY: The decision was made before Mr. Warriner came on board

3   that we had to be able to recover each individual document on its own merit

4   rather than a group of documents of similar subject matter.

5   DR. CAROTHERS: Is that directive or decision arguable?

6   MR. NUTLEY: Certainly.

7   DR. CAROTHERS: Because if it is not, then I submit that there is no

8   point in further discussion.

9   MR. NUTLEY: We can discuss anything that needs to be discussed.

10   DR. CAROTHERS: I know, but I do not wish to discuss something which

11   leads to no possible action, however. I do that at home a lot. I don't

12   wish to do it here. (Laughter)

13   MR. NUTLEY: Is your wife related to mine?

14   DR. CAROTHERS: No, but the point I'm making is that if it is in some

15   form of an order from somebody that we must follow regardless, why then so

16   be it. It's just a point that might be investigated by this subcommittee,

17   sir.

18   CHAIRMAN MOSELEY: Yes.

19   DR. MC CLELLAN: Let me try to be as succinct as I can. What I would

20   like to see -- my concern is that we don't have enough information at hand

21   to really grapple with the CIC. I would like to see laid out before us

22   what are the absolute norms in terms of documents that are in hand today be

23   it perhaps categorized by three value ranges. I think even the member of

24   the public who spoke would agree that it would be appropriate to input

25   certain resources. If you can't do them all tomorrow, instantaneously, you

26   have to have some decision basis to which you will do first. But if we had

27   that as a given there, we had the information in hand in terms of how many

28   have been keyworded, how many have not; what is the average amount of time

1   required to just index a document, enter it in; what is the amount of time

2   projected to keyword it, and a management plan -- to carry out other

3   functions of the Center, and then a management plan laid out for the next

4   one, two, three, five years; so that we are not based on essentially a kind

5   of a level of effort. What we keep hearing is, we don't have enough money

6   to do the task. Well, we will never get it solved unless we can have a

7   certain number of givens put on the table and some assumptions. You've got

8   to make them, i.e., we assume we will get another 10,000 documents of this

9   kind. But a plan. We've got to see a plan if we are going to grapple with

10 this, then we can react to the plan.

11   CHAIRMAN MOSELEY: I don't believe that we are going to solve this

12 this afternoon, and the committee is peeling off to the airport at an

13 accelerating rate; so the Chair will appoint a subcommittee of this commit-

14 tee to grapple with this problem before the next meeting of the Dose

15 Assessment Advisory Group in May. I think we will have to have that sub-

16 committee report to the full committee in May, so the yo-yo will have to go

17 up and down or maybe spin at the bottom for awhile.

18   Now aren't you sorry you brought that up and interrupted me, Bruce,

19 when I was adjourning the meeting which I do so at this time.

20

21   (Whereupon, the meeting was adjourned at 3:40 p.m. to reconvene

22   at 8:30 a.m. on May 19, 1983.)

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STATE OF NEVADA)
)   SS: CERTIFICATE OF REPORTERS
COUNTY OF CLARK)

I, FRANCES ANSON, Verbatim Reporter, hereby certify that I took down in shorthand, and I, BROOKEE ALLEN, C.S.R. #5, do hereby certify that I took down in shorthand (stenotypy), the proceedings had in the above-entitled matter; and

I, FRANCES ANSON, do further certify that my shorthand notes, in conjunction with voice tapes, were transcribed into typewriting: Volume I, pages 1 through 110; 311 through 351; and Volume II, pages 141 through 193, line 14; and

I, BROOKEE ALLEN, do further certify that my shorthand notes, in conjunction with voice tapes, were transcribed into typewriting: Volume I, pages 111 through 310; 352 through 416; and Volume II, pages 1 through 140; and 193, line 15 through 302; the above pages inclusive of viewgraphs associated therewith.

We, FRANCES ANSON and BROOKEE ALLEN, do further certify that the foregoing pages contain a full, true and correct transcription of all of the proceedings had at the said time and place and that the foregoing transcript is a true record of said proceedings to the best of our skill and ability.

Dated at Las Vegas, Nevada, this 25th day of February, 1983.

Francie Anson
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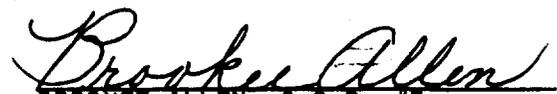
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