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RADIOLOGICAL CHARACTERIZATION OF THE TAN-IET FACILITY

APPLIED PHYSICS BRANCH
PHYSICS DIVISION

L. D. Koeppen, S. V. Podriguez, O. A. Wheeler
E. D. Cadwell and O. D. Simpson

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RADIOLOGICAL CHARACTERIZATION OF THE TAN-IET FACILITY

L. D. Koeppen, S. V. Rodriguez, O. A. Wheeler,
E. D. Cadwell and O. D. Simpson

I. INTRODUCTION

The Initial Engine Test (IET) facility is located on the Idaho National Engineering Laboratory (INEL) site at the north end of Test Area North (TAN), Figures 1, 1A and 2. The IET facility was constructed and used for the Aircraft Nuclear Propulsion Program during the 1950's and was later used for two other programs: the Space Nuclear Auxiliary Power Transient (SNAP-TRAN) and the Hallam Decontamination and Decommissioning Project. The facility is no longer in use, therefore, a complete radiological characterization was conducted at the IET site.

The characterization included measurements of beta-gamma dose rates; beta-gamma and alpha surface contamination; concentrations of selected radionuclides in subsurface storage tanks, surface soil, the exhaust duct, stack and test pad; and a "walk-over" surface survey of the entire facility. The information contained in this report will be of great value as the IET facility goes through the decommissioning and decontamination process.

II. HISTORY[1]

The IET facility was used for three programs.

1. Aircraft Nuclear Propulsion Program

The Aircraft Nuclear Propulsion (ANP) Program, for which the IET was initially constructed, began in 1951 and terminated in 1961. The experiments were called Heat Transfer Reactor Experiments (HTRE).

The HTRE power plants or test assemblies, stored in the TAN/TSF area, consist of the Core Test Facility and the nuclear reactor. The core components are mounted on a structural steel platform called a dolly. The platform units were rolled over a four-rail railroad track so the assembly could be moved between TAN/TSF and TAN/IET, where the tests were conducted.

The HTRE experiments included the following:

- HTRE-1. The HTRE-1 reactor operated a modified J47 turbojet engine exclusively on nuclear power in January 1956. It accumulated a total of 150.8 hours of operation at high nuclear power levels.
- HTRE-2. The HTRE-2 reactor was a modification of HTRE-1. Testing began in July 1957. The reactor accumulated 1299 hours of high-power nuclear operation.
- HTRE-3. The HTRE-3 reactor was built in a full-scale aircraft reactor configuration. Two modified J47 turbojet engines were operated by this reactor. Full nuclear power was achieved in 1959 and the system operated for a total of 126 hours.

Decontamination and decommissioning of the HTRE-2 and -3 test assemblies is scheduled for the near future.

2. Space Nuclear Auxiliary Power Transient Program

The Space Nuclear Auxiliary Power Transient (SNAPTRAN) Program ran from 1961 through 1967. It involved the following tests:

- A series of tests aimed at providing information about beryllium-reflected reactor performance under atmospheric conditions and assessing hazards during reactor assembly and launch,

- Nuclear excursions resulting from immersion of the reactor in water or wet earth,
- Nondestructive tests including static tests and those kinetic tests in which minor damage to the reactor occurred, and
- Destructive tests in which the reactor was destroyed.

3. Hallam Decontamination and Decommissioning Project

The Hallam Decontamination and Decommissioning Project was conducted in 1977 and 1978. It included the following:

- Storing, in the hangar at TAN/LOFT, various components shipped to the INEL in 1968 from the dismantled Hallam Nuclear Power Facility near Lincoln, Nebraska;
- Moving the components to the IET for removal of the sodium from the components;
- Decontaminating the components, when feasible, for use in research and development, and for disposal as surplus materials; and
- Sending materials that could not be decontaminated to the Radioactive Waste Management Complex for disposal.

III. SURVEY PLAN

A detailed radiological investigation was undertaken to establish the existing radiological status of the TAN-IET site. To initially locate and identify the areas of concern, a direct radiation and smear survey was conducted of all buildings, structures, equipment and systems. The initial radiation survey included general area measurements along with detailed scans and smears of all floors, walls, piping, pumps, valves, sumps, drains, ventilation systems, etc.

All systems, tanks, structures and equipment, known to be contaminated, found to be contaminated, or suspected of being contaminated, were sampled and analyzed to determine the kinds of radionuclides involved, their concentrations and their distribution.

A beta-gamma radiation survey of the entire site surface was performed by traversing an established grid system using an Eberline PRS-1 (RASCAL) digital integrated ratemeter with the HP 210 shielded GM detector, Figure 3. The IET site has been assigned coordinates, and a grid system has been established by use of labeled stakes, Figure 4. The entire surface area was beta-gamma surveyed grid square by grid square. The survey was performed by walking back and forth within a selected grid square along parallel east-west paths and then parallel north-south paths with the detector approximately six inches above the surface. The walking speed was such that the entire square could be traversed during a 30-second count. This was then repeated by walking parallel north-south paths. The two 30-second counts were then averaged and recorded on the grid maps, Figures 10A-10D. Soil samples were collected from grid squares found to be contaminated, suspected of being contaminated or having the potential for being contaminated and analyzed for the appropriate radionuclides.

Selected areas were surveyed using an Eberline Stabilized Assay Meter (SAM-II) with the 2" x 1/2" NaI detector (RD-19) for ^{235}Uranium assay, Figure 5. Since concentrations of ^{235}U were discovered in various sample locations, the SAM-II was used experimentally to determine if minimal levels of ^{235}U could be located and quantified in the field with this instrument. The time required to properly examine the instrument's potential and also the relatively high background levels from the IET exhaust duct and stack prevented obtaining any conclusive data with this instrument.

In-situ measurements were also performed using high-resolution gamma-ray spectroscopy (Figure 6). These measurements are discussed in part 8 of section VI of this report.

IV. ANALYSIS METHOD

Gamma-ray analyses were done on samples of liquid, solid, sludge, scrapings, soil, etc., using the latest computer analysis routines. See Figure 7 for typical type samples collected at the IET and analyzed at the RML. Samples indicating the presence of ^{235}U and ^{137}Cs were further analyzed for fissile material content (^{235}U equivalent) by delayed neutron counting[2] at the Coupled Fast Reactivity Measurements Facility (CFRMF) and ^{90}Sr in the RML chemistry laboratories.

Soil samples were oven dried at a temperature of 70°C for a minimum of 24 hrs prior to counting and analysis. The spectrometers were calibrated using National Bureau of Standards (NBS) samples which were distributed uniformly in various soil samples. From these calibrations, quantitative values were obtained. The other samples were counted under similar conditions and are also referencable to NBS standards. Nonuniformity of the radioactive isotopes in the soil samples cause large variations depending on what portion of the sample is analyzed for which species.

Concentrations of fissionable material (^{235}U equivalent) in samples were determined by counting delayed neutrons emitted from fission products produced by neutron activation of the fissionable material in the sample. Neutron activation of the samples was made in the CFRMF located at the Test Reactor Area (TRA). Following exposures to a thermal neutron flux of approximately 5.5×10^{11} n/cm^2-sec, a count of the delayed neutron activity is made using six ^{3}He detectors having a neutron counting efficiency of about 14%. The content of a sample is obtained by comparing its delayed neutron count to that obtained with a comparator sample containing a known quantity of ^{235}U.

The relative sensitivity of this method is very good and the results from the delayed neutron counting are usually considered over the data obtained from gamma-ray analysis. The gamma-ray spectroscopy analysis uses samples in the 500-600 g quantities whereas the delayed neutron technique uses only a few gram sample. If the fissile material (^{235}U or any other fissile material) is not uniformly distributed in the sample then the gamma-ray spectral measurements could be more indicative than the delayed neutron technique.

The errors quoted in all of the tables are due to counting statistics only and represent two std. deviations.

V. NATURAL BACKGROUNDS

The decay of thorium (^{232}Th) and uranium (^{238}U) results in a series of isotopes called the Th-U daughter series. The thorium daughter series is referenced as ^{228}ThD throughout the tables of this report. The uranium daughter series is referenced as ^{226}RaD (Ra is radium). The ^{226}Ra was used because it is the last of the long-lived radioisotopes of the uranium family having a half-life of 1602 y. The ^{228}Th is the last of the long-lived radioisotopes of the thorium series having a half-life of 1.91 y. Potassium (^{40}K) is also a naturally-occurring radioactive isotope. The ^{40}K produces about 85% and the Th-U daughters 15% of the natural gamma-ray background at the INEL. There are also naturally-occurring beta emitters such as tritium (^{3}H), ^{14}C, and ^{87}Rb that add to the natural backgrounds. At the INEL, the natural background radioactivity in the soil is approximately 63 pCi/g (24 pCi/g due to alpha-emitting and 16 pCi/g due to beta-gamma-emitting isotopes in the Th-U chain, 19 pCi/g due to ^{40}K, and about 4 pCi/g due to pure beta-emitting isotopes). The natural background activities are included in this report to give a perspective of the non-natural activities found. There is also a man-made background, mostly ^{137}Cs and ^{90}Sr, that was produced from weapon testing which amounts to about 2-3% of the naturally-occurring background at the INEL,[3] Table 1.

VI. SURVEY AND ANALYSIS RESULTS

1. Buildings

The results of the surveys and analyses of all IET buildings are given in the following tables. The results of the measurements indicate that there was no transferable surface contamination and no direct radiation readings over background in any of the buildings, Tables 2 and 3. However, there is a radioactive waste disposal box reading 2 mR/hr at contact in the equipment room of building 620, Figure 8, and a stack air monitor check source reading 25 mR/hr at contact in Bldg 713.

There were twelve wet-sumps of radiological interest, located in buildings 620, 625 and 627, which were sampled and analyzed. The results of the sumps liquid analyses showed no detectable radionuclei, Table 4.

All horizontal surfaces in building 713 (piping, sample lines and equipment) were covered with a thin layer of rust and dried sludge, and a composite sample of the rust/sludge deposits showed 4.4 pCi/g of ^{137}Cs and 2.7 pCi/g of ^{235}U. There were two air filter samples still mounted in the exhaust stack effluent air monitors. The two filters were removed and analyzed and found to contain 278 pCi/filter #1 of ^{137}Cs and 800 pCi/filter #2 of ^{137}Cs. Table 17 includes all the sample and analysis data for building 713.

Particular attention was given to the ventilation intake and exhaust system in building 620, Figure 8. The system consists of the following: the main ventilation system located in room 8 and the air washer system in room 24. The intake filters of both systems are of the same type, that is, a fiberglass pre-filter or roughing filter and a final filter of dense cellulose type material. Isotopic analysis indicated the presence of small quantities (slightly above detection limits) of ^{137}Cs, ^{60}Co, ^{235}U, and ^{90}Sr, Table 5.

2. Subsurface Storage Tanks

There were eight subsurface storage tanks and one disposal well surveyed and sampled at the IET facility. All tanks were near full except for the gasoline storage tank which was empty.

A unique sampling device was built by the RML, and it allowed retrieving representative liquid samples and also bottom sludge samples from each tank. The liquid samples were taken by lowering the 540-ml sample device from the surface to the bottom in a timed manner so as to collect the sample in a continuous motion from the surface to the bottom. This provided for a very representative sample of the liquid. The sludge could only be collected directly below the tank access covers, therefore, the sludge samples may not be totally representative of the entire bottom.

Septic tank samples A and B are both from the same septic tank, and differ only in sample locations. United States Geological Survey acquired the disposal well sample with a special apparatus for deep well sampling. The sample was taken from the well at a 245' depth.

The hot waste tank and septic tank were the only tanks which revealed measurable concentrations of some radionuclei, Table 6. See Table 7 for a further analysis of the hot waste tank dried sludge sample by Exxon Nuclear Corp.

Direct radiation and smear measurements were taken at several locations, Table 8. No measurable activity above background was observed.

3. Concrete Test Pad

The IET reactor experiments were conducted on a railroad platform assembly which was located on a 50' x 150' concrete test pad. The survey of the test pad, Table 9, revealed three areas of concern: a hot spot on the concrete pad and the north and south drains.

The entire north half of the test pad is covered with a heavy coat of white paint which is believed to "hold down" loose surface contaminants on the pad. Analysis of various paint/concrete chips show that the north end of the test pad had been contaminated at one time and was painted over apparently to hold down or prevent the spread of contamination.

There are two drains which run the entire width of the test pad. The north drain is believed to go to the hot waste tank and/or the hot waste line which runs to TAN/TSF. The south drain runs directly to an adjacent open ditch. Both drains show significant levels of ^{137}Cs and ^{235}U with small amounts of ^{60}Co and ^{90}Sr, Table 10.

A part of the north drain soil sample was sent to Exxon Nuclear Idaho Co., Inc. for a full beta and alpha analysis and the results are listed in Table 7.

4. Coupling Station

The coupling station is a small structure which encloses that part of the exhaust duct where the HTRE power plants were coupled.

The surface contamination and direct radiation surveys in the coupling station were all within EG&G Safety Manual guidelines. The floor of the coupling station had been covered with a heavy coat of white paint apparently to "hold down" loose surface contamination. The paint was severely cracked and chipped with large amounts of loose rust underneath. Samples of the paint chips/rust were collected and analyzed and found to contain mostly ^{137}Cs and ^{235}U. Since no loose surface contamination was detected by standard smear techniques, it is believed that most of the loose activity is "held" in the paint chips. Many samples of paint chips were analyzed by gamma-ray analyses and only a few of them were found to have ^{235}U, therefore it is thought that the ^{235}U activity must be represented as scattered particles.

There are two large fan assemblies, one on the east side and one on the west side of the coupling station. An access cover was removed from the east side fan assembly and samples of loose dirt, debris and scrapings were collected, analyzed and found to have small concentrations of ^{137}Cs, ^{235}U and ^{90}Sr. The fan assembly on the west side was also accessed and its internal radiological status had to be ascertained by standard smear techniques since no loose dirt or debris were present. See Tables 11 and 12 for survey and isotopic results.

5. Exhaust Duct and Exhaust Stack

The exhaust duct is a stainless steel pipe approximately 214' in length and 6' in diameter connected to a concrete stack which is approximately 150' high and 18' in diameter. There was no filtering media used for the exhaust effluents, other than an electrostatic precipitator.

The exhaust duct has an external direct radiation reading of 0.2 mR/hr using a GM meter along its entire length at a 1 meter distance. There were five flanged locations along the bottom of the duct which allowed good accessibility to obtain internal samples. The samples appeared as a black dry powdery substance that contained significant concentrations of ^{60}Co, ^{90}Sr, ^{137}Cs and ^{235}U.

The exhaust stack has an external general area direct radiation field around the base of 0.1 mR/hr. An access cover at the base of the exhaust stack was removed which allowed entrance into the inner stack for surveys and sample collection. A direct radiation survey with a GM meter inside the stack revealed general area fields of 3 mR/hr at waist level over the entire bottom. The samples collected were a black, moist granular substance that contained measurable amounts of ^{60}Co, ^{90}Sr, ^{137}Cs and ^{235}U. The entire bottom of the exhaust stack was covered with 2"-3" of the wet, black granular substance. See Figure 9 for illustration of the actual sample locations. Also see Tables 13 and 14 for survey and isotopic results from the exhaust duct and stack samples.

6. Area PRS-1 ('RASCAL') Survey

The beta-gamma 'walk-over' survey of the IET site was performed using the 'Rascal' survey meter, Figure 3. The averaged counts/30 sec for each 25' grid square were recorded on the grid maps (expanded views) as gross counts/30 sec and are not corrected for background.

Background measurements were made with the 'Rascal' in Idaho Falls, near Big Southern Butte (upwind from INEL) and near Mud Lake (downwind from INEL). The average background count rate was 34 counts/30 seconds (1.14 cts/sec) and was the same for all three locations.

The measured counts/30 sec found at IET were at or very near background levels in most areas, therefore to interpret the results and ascertain the radiological status of the IET surface, a simple statistical analysis of the data was necessary in each quadrant. Statistical analysis of the data indicates that there is low level surface contamination in the following areas: (1) directly below the entire length of the exhaust duct, (2) the concrete test pad, and (3) northwest and northeast of the stack in quadrant IV. The survey data is presented on the survey maps in Figures 10A-10D. These expanded views of the grid plan are referenced to the master grid plan, Figure 4.

7. Soil Sample Locations and Radionuclide Concentrations

Eighty-six soil samples were collected in a pattern which was fairly representative of each quadrant. Many sample locations were chosen because they were found to be contaminated ('Rascal' survey), suspected of being contaminated, or had the potential for being contaminated. The grid plan, Figures 11A-11D, show the actual location where each soil sample was taken. A soil sample is represented by a numbered circle on each of the grid plans. These expanded views of the grid plan are referenced to the master grid plan, Figure 4.

A sampling pattern was used in the grid squares to achieve a reasonably representative sample of the square. A small amount of soil was removed from the surface of the grid square ($\leq$ 2" depth) at ten selected locations within the square. The ten samples were mixed and pulverized in the field, placed in a container, then carefully poured into a final 500 gram plastic container for counting and analysis.

Four soil samples were taken downwind beyond the IET fenced perimeter. Samples were collected in a semicircular pattern at different distances (approximately 1/8 mile, 1/4 mile, 1/2 mile and 1 mile) from the IET site. Each sample was a composite of small amounts of soil removed along a semicircular path. The number on the semicircle represents the number of the soil sample. See illustration of off-site soil sample locations, Figure 12.

The results of the soil analysis show a positive indication (pCi/g amounts) of surface contaminants in the following areas: (1) the north end of the test pad in quadrant II, (2) directly below the full length of the exhaust duct in quadrant IV, (3) near the base of the exhaust stack in quadrant IV, and (4) a few areas in the north half of quadrant IV (downwind from stack). See Table 15 for a summary of the radionuclide concentrations present in the soil samples.

8. In Situ Measurements

In situ gamma-ray spectral measurements were made at several different locations at the IET. The purpose of these measurements was to obtain on-site isotopic spectral data that would show the relative abundance of the gamma-ray emitting radioactive nuclei. A multi-channel portable spectrometer and a high-resolution intrinsic germanium detector were used to collect the data (Figure 6). The data were then stored on magnetic tape and subsequently analyzed at the RML.

Absolute measurements are difficult to obtain using the above equipment but good relative numbers can be obtained for the various radioactive isotopes. The relative efficiency of the detector system was based on a typical detector efficiency curve and the activity of the ^{60}Co and ^{137}Cs was assumed to have the same geometrical distribution as the naturally-occurring radionuclides of ^{40}K and Th-U daughters.

The majority of the gamma-ray activity observed in the water, soil, smears, etc., samples that were collected and analyzed at the RML showed the major radioactive isotope to be ^{137}Cs.

The purpose for these *in situ* measurements was to see if there were any other gamma-ray emitting radioactive nuclei present that might not have been collected in the various samples analyzed at the RML. The *in situ* measurements were performed at four different locations: (1) test pad north drain, (2) test pad hot spot, (3) under stack pipe (exhaust duct), and (4) culvert nothwest of the stack. The spectral data were plotted and are shown in Figures 13, 14, 15, and 16. The data were analyzed and the relative abundances of the various radioactive isotopes are shown in Table 16.

VII. DISCUSSION

The major radioactivity was found to be ^{137}Cs and ^{90}Sr with smaller quantities of ^{60}Co and ^{235}U being observed. Natural and manmade backgrounds were also recorded for comparison purposes (Tables 1 and 15). A discussion of the results from the survey is given. There was a significant difference in the results of samples analyzed by both EG&G Idaho, Inc., and Exxon Nuclear Idaho, Inc. NBS and various other standards have been analyzed on occasion by both EG&G and Exxon, as a quality assurance measure, and the results have been in good agreement; therefore, the variance with the IET samples is known to be due to sample inhomogeneity. Multiple analysis of small portions of the larger initial IET samples by EG&G showed a wide range of results which definitely suggests that the samples had many unevenly dispersed particles throughout that would account for the inhomogeneity.

1. Buildings

- There was no transferable surface contamination and no direct radiation readings over background in any of the buildings; however, there is a radioactive waste disposal box reading 2mR/hr at contact in building 620, and a stack air monitor check source reading 25 mR/hr at contact in building 713.

- Building 713 was previously flooded and just recently pumped down. A flood water sample collected and analyzed before pump-down showed no detectable concentrations of radionuclides. The sludge sample collected and analyzed after pump-down showed approximately 10 pCi/g of ^{137}Cs and approximately 1 pCi/g of ^{60}Co and ^{235}U.

  A detailed survey and sample analysis was completed after the flood water was pumped out and the building was dry. No transferable surface contamination was detected by standard smear techniques, however, the composite rust/sludge sample collected from external surfaces of piping, sample lines and equipment in the building does contain 4.4 pCi/g of ^{137}Cs and 2.7 pCi/g of ^{235}U.

  The ^{235}U concentration in the rust/sludge deposits are of concern because it could possibly cause an airborne radioactivity problem, since a very low Maximum Permissible Concentration of ^{235}U is allowed in air.

- No activity was detected in any of the building sumps.

- Building 620 ventilation system intake filters were found to have small concentrations of ^{60}Co, ^{90}Sr, ^{137}Cs and ^{235}U. The ^{137}Cs and ^{90}Sr concentrations were in the 10-15 pCi/g range making up 99% of the activity.

2. Subsurface Storage Tanks

- The hot waste tank and septic tank were the only tanks having any measurable activity.

- No activity was found in the hot waste or septic tank liquids, however, ^{90}Sr and ^{137}Cs activity was found in the sludge with concentrations ranging from a few hundred to a few thousand pCi/g.

- There is no transferable surface contamination or direct radiation readings from any of these tanks above EG&G Safety Manual guidelines.

3. Concrete Test Pad

- There are three areas on the test pad where measurable concentrations of ^{60}Co, ^{90}Sr, ^{137}C and ^{235}U were observed. The areas of radiological interest are the north and south drains and a "hot spot" on the concrete pad itself. The "hot spot" is apparently from a radioactive spill.

- Both drains have 3"-4" of contaminated soil along their entire length.

- No loose surface contamination above EG&G Safety Manual guidelines was found. The direct radiation dose rates on the "hot spot" is 0.6 mR/hr at contact, 0.2 mR/hr over the north drain and <0.1 mR/hr over the south drain.

- Approximately 99% of the activity on the "hot spot" is due to ^{137}Cs and ^{90}Sr (48% ^{137}Cs and 51% ^{90}Sr).

- Approximately 75% of the activity in the north drain soils is due to ^{137}Cs, approximately 9% is from ^{90}Sr, approximately 5% from ^{235}U, approximately 1% from ^{60}Co and 10% due to the naturally-occurring radioisotopes.

- Approximately 36% of the activity in the south drain soils is due to ^{137}Cs, approximately 15% due to ^{90}Sr, approximately 7% from ^{60}Co, approximately 5% from ^{235}U and 36% from naturally-occurring radioisotopes.

- Both drains have a relatively high percentage of ^{235}U compared to other samples analyzed.

4. Coupling Station

- No loose surface contamination above EG&G guidelines was found using standard smear techniques, however, the loose rust and paint chips on the floor do contain some low-level activity.

- There are no general area direct radiation levels above EG&G guidelines.

5. Exhaust Duct and Exhaust Stack

- No external surface contamination was detected and the highest external direct radiation readings of 12 mR/hr was found on the exhaust duct.

- The internal contents of the duct and stack could present an airborne problem during D&D because of its dry powdery consistency.

- Approximately 94% of the activity in the exhaust duct is due to ^{137}Cs while ^{90}Sr makes up approximately the other 6%. The ^{60}Co and ^{235}U contribute only a small fraction to the total activity.

6. Rascal Surface Survey

- The entire length directly under exhaust duct was found to have beta-gamma count rates of about a factor of two or three above background. It is assumed that the access holes and sampling and measurements penetrations into the duct must have leaked during the tests.

- The north end of the test pad showed count rates about a factor of ten above background due primarily to a "hot spot" and the north drain.

- The north half of quadrant IV (downwind from stack) had a few isolated areas which were approximately twice the background levels.

7. Soil Sample Analyses

- The major source of activity was due to ^{137}Cs and ^{90}Sr.

- Of the 86 soil samples analyzed, most showed activities of only a few pCi/g, a factor of two or three above manmade backgrounds.

- The only significant activities were found under the exhaust duct, on the concrete test pad and directly around the exhaust stack. The hottest sample was found on the concrete pad and its ^{137}Cs activity was 2900 pCi/g.

8. In Situ Measurements

- These measurements confirmed that the major gamma-ray emitting isotope was ^{137}Cs. No radioactive isotopes were observed in the *in situ* measurements that were not found in the "grab samples" measured at the RML.

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TABLE 1. BACKGROUND RADIONUCLIDES FROM IDAHO FALLS SOIL SAMPLES

Nuclide	Gamma Analysis (pCi/g)	Beta Analysis (pCi/g)	Delayed Neutron Analysis (pCi/g)
^{137}Cs	1.0 ± 0.1	----	----
^{90}Sr	----	<1	----
^{235}U	----	----	0.05

Errors (1σ) are due to counting statistics only.

---- not measured

TABLE 2. IET CONTROL AND EQUIPMENT BUILDING 620 - SURFACE CONTAMINATION AND DIRECT RADIATION MEASUREMENTS

Room ID	Sample ID	Smear No.	Beta-Gamma (dpm/100 cm^2)	Alpha (dpm/100 cm^2)	Direct Radiation (mR/hr)
1	Tunnel	1-12	<200(1)	<20(1)	<0.1 (ND)(1)
1	Tunnel Drain	13-16	<200	<20	<0.1 (ND)
2	Turnaround Room	1-25	<200	<20	<0.1 (ND)
3	Entrance	1-10	<200	<20	<0.1 (ND)
4	Diesel Room	1-15	<200	<20	<0.1 (ND)
4	Diesel Room Piping and Ducting (Int. and Ext.)	16-25	<200	<20	<0.1 (ND)
4	Diesel Room Sump	26-30	<200	<20	<0.1 (ND)
5	Elect. Equip. Room	1-15	<200	<20	<0.1 (ND)
5	Elect. Equip. Cable Runs	16-25	<200	<20	<0.1 (ND)
6	Boiler Room	1-15	<200	<20	<0.1 (ND)
6	Boiler Room Piping and Ducting (Int. and Ext.)	16-22	<200	<20	<0.1 (ND)
7	Ventilation Intake/Exh.	1-10	<200	<20	<0.1 (ND)
8	Ventilation System Room	1-18	<200	<20	<0.1 (ND)
9	Readout Room	1-12	<200	<20	<0.1 (ND)
9	Readout Room Piping and Ducting	13-17	<200	<20	<0.1 (ND)
10	Equipment Room	1-34	<200	<20	<0.1 (ND)
10	Equipment Room Piping and Ducting (Int. and Ext.)	35-51	<200	<20	<0.1 (ND)
10	Equipment Room Sump A	52-54	<200	<20	<0.1 (ND)
10	Equipment Room Sump C	55-57	<200	<20	<0.1 (ND)
10	Equipment Room Sump D	58-60	<200	<20	<0.1 (ND)
10	Equipment Room Hot Waste Box	61-65	<200	<20	2.0 contact <0.1 @ 1 meter

TABLE 2. (cont'd)

Room ID	Sample ID	Smear No.	Beta-Gamma (dpm/100 cm^2)	Alpha (dpm/100 cm^2)	Direct Radiation (mR/hr)
11	Tool Crib Room	1-9	<200	<20	<0.1 (ND)
12	Ventilation (Int. and Ext.) Outside	1-10	<200	<20	<0.1 (ND)
13	Mens Room	1-6	<200	<20	<0.1 (ND)
13	Mens Room Sink and Toilet Drains	7-10	<200	<20	<0.1 (ND)
14	Womens Room	1-6	<200	<20	<0.1 (ND)
14	Womens Room Sink and Toilet Drains	7-10	<200	<20	<0.1 (ND)
15	Data and Instrument Room	1-20	<200	<20	<0.1 (ND)
15	Data and Instrument Room Misc. Equipment	21-43	<200	<20	<0.1 (ND)
16	Control Room	1-18	<200	<20	<0.1 (ND)
16	Control Room Cable Runs and Equipment	19-25	<200	<20	<0.1 (ND)
17	Pedestrian Tunnel	1-20	<200	<20	<0.1 (ND)
17	Ped. Tunnel Sump E	21-23	<200	<20	<0.1 (ND)
18	Ped. Tunnel Hatch Entry	24-29	<200	<20	<0.1 (ND)
19	Corridor	1-14	<200	<20	<0.1 (ND)
19	Corridor Cable Runs	15-24	<200	<20	<0.1 (ND)
20	Office	1-8	<200	<20	<0.1 (ND)
21	Monitoring Room	1-13	<200	<20	<0.1 (ND)
22	Office	1-10	<200	<20	<0.1 (ND)
23	Office	1-10	<200	<20	<0.1 (ND)

TABLE 2. (cont'd)

Room ID	Sample ID	Smear No.	Beta-Gamma (dpm/100 cm^2)	Alpha (dpm/100 cm^2)	Direct Radiation (mR/hr)
24	Mechanical Equipment Room	1-12	<200	<20	<0.1 (ND)
24	Mechanical Equipment Room Ventilation System	13-23	<200	<20	<0.1 (ND)
24	Supply Room	1-15	<200	<20	<0.1 (ND)
25	Tunnel	1-20	<200	<20	<0.1 (ND)
25	Tunnel Sump F	21-24	<200	<20	<0.1 (ND)
26	Stairway	1-10	<200	<20	<0.1 (ND)
26	Stairway Piping and Ducting (Int. and Ext.)	11-22	<200	<20	<0.1 (ND)
27	Coupling Station	1-25	<200	<20	<0.1 (ND)
27	Coupling Station Piping (Int. and Ext.)	26-36	<200	<20	<0.1 (ND)
27	Coupling Station Sump J	37-40	<200	<20	<0.1 (ND)
28	Service Room	1-18	<200	<20	<0.1 (ND)
28	Service Room Piping and Ducting (Int. and Ext.)	19-32	<200	<20	<0.1 (ND)
28	Service Room Sumps (3)	33-39	<200	<20	<0.1 (ND)
29	Periscope Tunnel	1-12	<200	<20	<0.1 (ND)
30	Corridor	1-10	<200	<20	<0.1 (ND)
31	Stairway	1-9	<200	<20	<0.1 (ND)
32	Change Room	1-25	<200	<20	<0.1 (ND)
33	Change Room	26-50	<200	<20	<0.1 (ND)
33	Change Room Shower and Drains	51-58	<200	<20	<0.1 (ND)
33	Change Room Sump H & I	59-65	<200	<20	<0.1 (ND)

TABLE 2. (cont'd)

Room ID	Sample ID	Smear No.	Beta-Gamma $(\text{dpm}/100\ \text{cm}^2)$	Alpha $(\text{dpm}/100\ \text{cm}^2)$	Direct Radiation (mR/hr)
34	Stairway	1-12	<200	<20	<0.1 (ND)
35	Entrance	1-15	<200	<20	<0.1 (ND)

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(1) The less-than values are quoted in reference to the EG&G Safety Manual 5040. The ND means not detectable. Direct radiation measurements were taken with a 30 mg/cm^2 GM tube.

Note: The room ID is referencable to the Control and Equipment Building layout in Figure 8.

TABLE 3. IET BUILDINGS (621, 625, 626, 627, 713) - SURFACE CONTAMINATION AND DIRECT RADIATION MEASUREMENTS

Bldg. No.	Bldg. ID	Smear No.	Beta-Gamma (dpm/100 cm^2)	Alpha (dpm/100 cm^2)		Direct Radiation (mR/hr)
621	Guard House	1-12	<200(1)	<20(1)		<0.1(1) (ND)
625	Fuel Bldg.	1-20	<200	<20		<0.1 (ND)
626	Chlorination Bldg.	1-15	<200	<20		<0.1 (ND)
627	Tank Bldg.	1-25	<200	<20		<0.1 (ND)
XXX	Between 712-713	1-10	<200	<20		<0.1 (ND)
713	Monitoring Vault(2)	1-64	<200	<20	gen. area	<0.1 (ND)
					air monitor	25 (contact)
					check source	<0.1 (1 meter)

Smears were taken on floors, walls, sumps, drains, piping (int. and ext.), and equipment.

(1) The less-than values quoted are in reference to the EG&G Safety Manual 5040. The ND means not detectable. Direct radiation measurements were taken with a 30 mg/cm^2 GM tube.

(2) See Table 17 for sample analysis of flood water, sludges, and air filters.

TABLE 4. IET BUILDINGS SUMPS (pCi/ml or pCi/g)

					Gamma Spectroscopy		
Bldg. ID	Room ID	Sample ID	Sump Location/ Description	Sample Volume (ml)	^{60}Co (1173 keV)	^{137}Cs (662 keV)	^{235}U (186 keV)
620	Equip. Room 10	A	N.E. corner	540	<0.1(1)	<0.1	<0.1
	Diesel Room 4	B	S.W. corner	540	<0.1	<0.1	<0.1
	Equip. Room 10	C	Waste #302	540	<0.1	<0.1	<0.1
	Equip. Room 10	D	Sewage #301	540	<0.1	<0.1	<0.1
	Tunnel 17/18	E	W. end	540	<0.1	<0.1	<0.1
	Stairway 26	F	bottom of stairway	540	<0.1	<0.1	<0.1
	Service Rm. 28	G	N.E. corner	540	<0.1	<0.1	<0.1
	Change Rm. 33	H	S.E. corner	540	<0.1	<0.1	<0.1
	Change Rm. 33	I	S.W. corner	540	<0.1	<0.1	<0.1
	Coupling Stn. 27	J	N. side	540	<0.1	<0.1	<0.1
625	Fuel Trans. Bldg.	Sump	N.W. corner	540	<0.1	<0.1	<0.1
627	Tank Bldg.	Sump	S. side	540	<0.1	<0.1	<0.1

TABLE 5. IET CONTROL AND EQUIPMENT BLDG 620 VENTILATION SYSTEM (pCi/cm^2)

		Gamma Spectroscopy		Delayed Neutron	Beta
Sample ID	Filter Area (cm^2)	^{137}Cs (662 keV)	^{60}Co (1173 keV)	^{235}U	^{90}Sr
Main Ventilation Room (8)					
Pre-Filter	900	0.5 ± 0.1	----	0.007 ± 0.001	0.4 ± 0.1
Final Filter	1800	15.8 ± 0.3	----	0.0014 ± 0.0007	6.4 ± 0.6
Ducting (internal)	Smears, scrapings, loose dirt and debris (no measurable activity)				
Air Washer System (Room 24)					
Pre-filter	900	0.6 ± 0.1	----	0.023 ± 0.001	0.3 ± 0.1
Final Filter	1800	10.2 ± 0.3	0.03 ± 0.01	0.020 ± 0.001	11 ± 1
Ducting (internal)	Smears, scrapings, loose dirt and debris (no measurable activity)				

---- Means not detected.

TABLE 6. IET UNDERGROUND STORAGE TANKS ACTIVITIES (pCi/ml or pCi/g)

		Gamma-ray						Delayed Neutron	Beta
Sample ID	Volume (ml)	^{60}Co (1173 keV)	^{137}Cs (662 keV)	^{226}RaD (609 keV)	^{228}ThD (239 keV)	^{40}K (1460 keV)	^{235}U (186 keV)	^{235}U	^{90}Sr
Hot Waste									
Liquid	540	<0.1	<0.1	----	----	----	----	----	----
Wet Sludge	540	2.8 ± 0.4	182 ± 3	<0.1	<0.1	~5	1.4 ± 0.5	----	----
Dried Sludge	1.05 g	43 ± 8	444 ± 22*	----	----	----	~4	2.5 ± 0.1	(A) 5100 ± 400 (B) <1.5
Septic Tank A									
Liquid	540	<0.1	<0.1	----	----	----	----	----	----
Wet Sludge	500	<0.1	<0.1	<0.1	<0.1	~3	~0.1	----	----
Dried Sludge	0.84 g	<2	88 ± 22*	----	----	----	----	0.24 ± 0.03	560 ± 40
Septic Tank B									
Liquid	540	<0.1	<0.1	----	----	----	----	----	----
Wet Sludge	500	<0.1	0.2 ± 0.1	<0.1	<0.1	~2	<0.1	----	----
Dried Sludge	0.77 g	----	31 ± 8*	----	----	----	----	0.30 ± 0.01	560 ± 40
Disposal Well									
@ 245 ft	540	<0.1	<0.1	----	----	----	----	----	<3 E-3
Engine Fuel									
Wet Sludge	540	<0.1	<0.1	----	----	----	----	----	----

TABLE 6. (cont'd)

		Gamma-ray						Delayed Neutron	Beta
Sample ID	Volume (ml)	^{60}Co (1173 keV)	^{137}Cs (662 keV)	^{226}RaD (609 keV)	^{228}ThD (239 keV)	^{40}K (1460 keV)	^{235}U (186 keV)	^{235}U	^{90}Sr
Diesel Fuel									
Liquid	540	<0.3	<0.3	----	----	----	----	----	----
Wet Sludge	400	<0.3	<0.3	----	----	----	----	----	----
Heating Fuel									
Wet Sludge	450	<0.3	<0.3	----	----	----	----	----	----
Foam Stabilizer									
Liquid	540	<0.3	<0.3	----	----	----	----	----	----
Wet Sludge	540	<0.3	<0.3	----	----	----	----	----	----
Gas Storage									
Sludge	45	<0.3	<0.3	----	----	----	----	----	----

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* Dried sludge samples are quoted as pCi/g.

---- Means not measured or detected.

A & B indicates that 2 separate samples out of the larger 540 ml sample were analyzed for ^{90}Sr.

TABLE 7. EXXON NUCLEAR IDAHO COMPANY, INC., ANALYSIS (pCi/g)

				Alpha Spectrometry			
	Gross Beta	Gross Alpha	^{90}Sr	^{235}U	^{238}Pu	$^{239,240}Pu$	^{241}Am
Test Pad North Drain	14 ± 3	5 ± 2	8 ± 1	2.5 ± 0.4	0.07 ± 0.02	0.06 ± 0.02	<0.3
Exh. Stack Bottom	17800 ± 800	1700 ± 100	10400 ± 200	178 ± 7	0.34 ± 0.02	1.36 ± 0.04	0.2 ± 0.1
Hot Waste Tank	360 ± 20	22 ± 3	22 ± 2	<0.1	<0.02	<0.01	<0.2

	Gamma Spectrometry		
	^{60}Co	^{137}Cs	^{235}U
Test Pad North Drain	*	*	*
Exh. Stack Bottom	125 ± 8	8760 ± 80	131 ± 23
Hot Waste Tank	*	563 ± 22	*

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* No values reported.

TABLE 8. IET SUBSURFACE STORAGE TANKS - SURFACE CONTAMINATION AND DIRECT RADIATION MEASUREMENTS

Tank ID	Smear No.	Beta-Gamma ($dpm/100\ cm^2$)	Alpha ($dpm/100\ cm^2$)	Direct Radiation (mR/hr)
Hot Waste	1-10	<200(1)	<20(1)	<0.1(1) (ND)
Septic A	1-5	<200	<20	<0.1 (ND)
Septic B	1-5	<200	<20	<0.1 (ND)
Disposal Well	1-3	<200	<20	<0.1 (ND)
Engine Fuel	1-8	<200	<20	<0.1 (ND)
Diesel Fuel	1-8	<200	<20	<0.1 (ND)
Heating Fuel	1-8	<200	<20	<0.1 (ND)
Foam Stabilizer	1-5	<200	<20	<0.1 (ND)
Gas Storage	1-7	<200	<20	<0.1 (ND)

Smears taken on cover pad, valves, pipes, vents, and all accessible areas.

Direct radiation readings were taken directly over open access cover plates with a 30 mg/cm^2 GM tube.

(1) The less-than values are quoted in reference to the EG&G Safety Manual 5040.

ND means not detected.

TABLE 9. IET FACILITY CONCRETE TEST PAD - SURFACE CONTAMINATION AND DIRECT RADIATION MEASUREMENTS

Location	Smear No.	Beta-Gamma (dpm/100 cm^2)	Alpha (dpm/100 cm^2)		Direct Radiation (mR/hr)
Concrete Pad	1-25	<200	<20	General Area	0.1
				Hot Spot (contact)	0.6
				Hot Spot (1 meter)	0.1
Concrete Wall	26-40	<200	<20		<0.1 (ND)
Misc. Equipment	41-54	<200	<20		<0.1 (ND)
Drains	55-62	<200	<20	N. Drain (contact)	0.2
				N. Drain (1 meter)	0.1
				S. Drain (contact)	<0.1 (ND)
				S. Drain (1 meter)	<0.1 (ND)
Hallum Na Tanks	1-30 (external)	<200	<20	Contact 1 meter	<0.1 (ND) <0.1 (ND)

Direct radiation readings were taken with a 30 mg/cm^2 GM tube.

Less-than values are quoted in reference to the EG&G Safety Manual 5040.

ND means not detectable.

TABLE 10. INITIAL ENGINE TEST (IET) FACILITY CONCRETE TEST PAD (pCi/g)

		Gamma-ray						Delayed Neutron	Beta
	Weight (g)	^{60}Co (1173 keV)	^{137}Cs (662 keV)	^{226}RaD (609 keV)	^{228}ThD (239 keV)	^{40}K (1460 keV)	^{235}U (186 keV)	^{235}U	^{90}Sr
Concrete Chips*									
#22	250	14 ± 1	2900 ± 11	2.3 ± 1.8	2.0 ± 1.3	15 ± 3	11 ± 2	2.7 ± 0.1	3100 ± 600
#23	531	<0.1	<0.1	1.3 ± 0.3	0.9 ± 0.2	11 ± 2	~0.1	----	----
#24	471	<0.1	0.4 ± 0.1	1.2 ± 0.3	1.1 ± 0.2	13 ± 2	0.3 ± 0.1	----	----
#25	431	<0.1	<0.1	1.0 ± 0.2	0.4 ± 0.1	4 ± 1	~0.1	----	----
#26	335	<0.1	15.5 ± 0.7	1.3 ± 0.3	1.2 ± 0.2	13 ± 2	~0.2	.049 ± .002	128 ± 9
Drain, North End									
Soil	489	2.2 ± 0.4	130 ± 3	0.8 ± 0.4	1.2 ± 0.4	14 ± 3	9.1 ± 0.5	0.39 ± 0.02	15 ± 8
Concrete	408	6.4 ± 0.5	250 ± 3	1.3 ± 0.4	1.1 ± 0.4	11 ± 2	1.4 ± 0.4	----	850 ±
Drain, South End									
Soil	520	3.5 ± 0.4	17.0 ± 0.6	1.1 ± 0.3	0.9 ± 0.2	15 ± 2	2.2 ± 0.2	0.28 ± 0.02	7 ± 7
Concrete	471	<0.1	<0.1	0.9 ± 0.3	0.5 ± 0.2	5 ± 2	<0.1	----	----

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* See grid plan (quadrant II) for actual sample location.

---- Means not measured.

TABLE 11. COUPLING STATION - SURFACE CONTAMINATION AND DIRECT RADIATION MEASUREMENTS

Location	Smear No.	Beta-Gamma (dpm/100 cm^2)	Alpha (dpm/100 cm^2)	Direct Radiation (mR/hr)
Inside				
Floor	1-10	<200	<20	<0.1 (ND)
Walls	11-21	<200	<20	<0.1 (ND)
Ceiling	22-24	<200	<20	<0.1 (ND)
Ducting and Fan Housing (int. & ext.) (west side)	25-35	<200	<20	<0.1 (ND)
Outside				
Floor	1-12	<200	<20	<0.1 (ND)
Walls	13-22	<200	<20	<0.1 (ND)
Top	23-30	<200	<20	<0.1 (ND)

Direct radiation readings were taken with a 30 mg/cm^2 GM tube.

Less-than values are quoted in reference to the EG&G Safety Manual 5040.

ND means not detectable.

TABLE 12. INITIAL ENGINE TEST (IET) FACILITY COUPLING STATION (pCi/g)

		Gamma Activity			Delayed Neutron	Beta
	Weight (g)	^{60}Co (1173 keV)	^{137}Cs (662 keV)	^{235}U (186 keV)	^{235}U	^{90}Sr
Floor						
Paint Chips west side	0.43	<26	1538 ± 147	<11	0.32 ± 0.02	----
Paint Chips Envelope west side	6.16	<1	313 ± 15	<0.4	----	----
Paint Chips east side	0.56	<47	355 ± 31	<8	2.72 ± 0.04	----
Paint Chips Envelope east side	9.53	<1	266 ± 14	167 ± 7	----	----
Fan and Ducting Internal East Side						
Debris and Scrapings	0.56	<25	14 ± 10	<6	0.49 ± 0.19	204 ± 10
Debris and Scrapings	31	2.2 ± 0.9	24 ± 3	<0.5	----	----

---- means not measured.

TABLE 13. IET EXHAUST DUCT AND STACK - SURFACE CONTAMINATION AND DIRECT RADIATION MEASUREMENTS

Location	Smear No.	Beta-Gamma (dpm/100 cm^2)	Alpha (dpm/100 cm^2)		Direct Radiation (mR/hr)
Duct (external)	1-15	<200	<20	highest contact	12
		<200	<20	1 meter	0.2
Stack (external)	16-24	<200	<20	contact	0.1
		<200	<20	1 meter	0.1
				internal (gen. area)	3

Direct radiation readings were taken with a 30 mg/cm^2 GM tube.

Less-than values are quoted in reference to the EG&G Safety Manual 5040.

TABLE 14. IET EXHAUST DUCT AND STACK ACTIVITY (pCi/g)

		Gamma Activity			Delayed Neutron	Beta
Sample ID	Weight (g)	^{60}Co (1173 keV)	^{137}Cs (662 keV)	^{235}U (186 keV)	^{235}U	^{90}Sr
Exhaust Duct						
#1	0.1032	126 ± 75	376,000 ± 4000	1550 ± 250	1194 ± 12	----
#2	0.1539	253 ± 126	946,000 ± 9000	1910 ± 440	1119 ± 11	----
#3	0.2094	338 ± 85	466,000 ± 2000	840 ± 170	479 ± 5	28,000 ± 1000
#4	0.1848	510 ± 100	277,000 ± 2000	484 ± 145	43 ± 1	----
#5	0.1888	420 ± 92	211,000 ± 1700	378 ± 125	92 ± 1	----
Stack						
Bottom #6	0.4158	67 ± 26	4490 ± 160	26 ± 11	19.2 ± 0.2	----
Bottom #7	0.4307	113 ± 41	6280 ± 190	45 ± 15	33.0 ± 0.3	----
Bottom #8 all over	0.1667	100 ± 40	7490 ± 260	72 ± 20	39.8 ± 0.4	
Wall #9 Scrapings	0.3014	<26	584 ± 50	17 ± 6	11.7 ± 0.1	----
Bottom all over	1.2473	----	----	----	----	1610 ± 80

---- Means not measured.

Note: Measurements of ^{226}RaD, ^{228}ThD and ^{40}K were not possible because of the smallness of the samples.

TABLE 15. INITIAL ENGINE TEST (IET) FACILITY SOIL ANALYSIS (pCi/g)

		Gamma-ray						Delayed Neutron	Beta
Sample ID	Weight (g)	^{60}Co (1173 keV)	^{137}Cs (662 keV)	^{226}RaD (609 keV)	^{228}ThD (239 keV)	^{40}K (1460 keV)	^{235}U (186 keV)	^{235}U	^{90}Sr
Bkg #1	545	ND	1.0 ± 0.1	1.0 ± 0.2	1.0 ± 0.1	12 ± 2	~0.1	----	----
Bkg #2	476	ND	0.7 ± 0.1	1.2 ± 0.3	1.0 ± 0.2	13 ± 2	~0.2	----	----
Quadrant I*									
1	550	<0.1	1.1 ± 0.2	1.4 ± 0.4	1.2 ± 0.2	16 ± 3	<0.1	----	----
2	580	<0.1	0.6 ± 0.1	1.4 ± 0.3	1.1 ± 0.2	12 ± 2	~0.1	----	----
3	567	<0.1	1.1 ± 0.2	0.9 ± 0.2	0.8 ± 0.1	10 ± 2	~0.1	----	----
4	565	<0.1	1.3 ± 0.2	1.1 ± 0.2	0.8 ± 0.1	16 ± 2	~0.1	----	----
5	483	<0.1	0.4 ± 0.2	1.2 ± 0.4	1.4 ± 0.3	20 ± 4	<0.1	----	----
6	521	<0.1	0.7 ± 0.1	1.6 ± 0.3	1.2 ± 0.2	16 ± 2	0.3 ± 0.1	----	----
7	548	<0.1	1.2 ± 0.2	1.1 ± 0.2	0.7 ± 0.1	12 ± 2	<0.1	----	----
8	687	<0.1	<0.1	0.9 ± 0.2	0.5 ± 0.1	8 ± 1	~0.1	----	----
9	554	<0.1	0.8 ± 0.1	1.1 ± 0.2	1.0 ± 0.1	14 ± 1	~0.1	----	----
Quadrant II*									
10	500	0.6 ± 0.1	0.7 ± 0.1	1.7 ± 0.4	1.3 ± 0.2	13 ± 2	<0.1	----	----
11	498	<0.1	1.1 ± 0.2	1.0 ± 0.2	1.1 ± 0.2	16 ± 2	~0.2	----	----
12	577	<0.1	0.2 ± 0.1	0.8 ± 0.2	0.9 ± 0.1	13 ± 2	~0.1	----	----
13	611	<0.1	0.4 ± 0.1	1.4 ± 0.3	0.9 ± 0.2	9 ± 2	~0.1	----	----
14	569	<0.1	0.7 ± 0.2	1.3 ± 0.3	1.0 ± 0.2	17 ± 3	<0.1	----	----
15	545	<0.1	0.3 ± 0.1	1.8 ± 0.4	1.1 ± 0.2	15 ± 2	~0.1	----	----
16	506	<0.1	0.4 ± 0.1	1.1 ± 0.2	0.7 ± 0.1	10 ± 2	~0.1	----	----

TABLE 15. (cont'd)

		Gamma-ray						Delayed Neutron	Beta
Sample ID	Weight (g)	^{60}Co (1173 keV)	^{137}Cs (662 keV)	^{226}RaD (609 keV)	^{228}ThD (239 keV)	^{40}K (1460 keV)	^{235}U (186 keV)	^{235}U	^{90}Sr
17	772	<0.1	0.2 ± 0.1	0.8 ± 0.2	0.2 ± 0.1	2 ± 0.5	<0.1	----	----
18	562	<0.1	1.3 ± 0.2	1.2 ± 0.3	1.2 ± 0.2	15 ± 2	<0.1	----	----
19	556	<0.1	0.4 ± 0.1	1.1 ± 0.2	1.0 ± 0.1	15 ± 2	<0.1	----	----
20	530	<0.1	0.2 ± 0.1	1.4 ± 0.2	1.2 ± 0.2	17 ± 2	<0.1	----	----
21	740	<0.1	0.3 ± 0.1	0.5 ± 0.1	0.2 ± 0.1	2 ± 0.5	<0.1	----	----
22	250	14 ± 1	2901 ± 11	2.3 ± 1.8	2.0 ± 1.3	15 ± 3	11 ± 2	2.7 ± 0.1	3100 ± 600
23	531	<0.1	<0.1	1.3 ± 0.3	0.9 ± 0.2	11 ± 2	~0.1	----	----
24	471	<0.1	0.4 ± 0.1	1.2 ± 0.3	1.1 ± 0.2	13 ± 2	0.3 ± 0.1	----	----
25	431	<0.1	<0.1	1.0 ± 0.2	0.4 ± 0.1	4 ± 1	~0.1	----	----
26	335	<0.1	15.5 ± 0.7	1.3 ± 0.3	1.2 ± 0.2	13 ± 2	~0.2	0.05 ± 0.01	128 ± 9
Quadrant III*									
27	523	<0.1	0.6 ± 0.1	1.6 ± 0.4	1.2 ± 0.2	16 ± 2	~0.2	----	----
28	499	<0.1	0.5 ± 0.1	1.1 ± 0.2	1.1 ± 0.2	12 ± 2	~0.1	----	----
29	500	<0.1	1.5 ± 0.2	1.0 ± 0.2	0.9 ± 0.2	13 ± 2	<0.1	----	----
30	404	<0.1	0.7 ± 0.2	0.6 ± 0.2	0.6 ± 0.1	5 ± 1	~0.2	----	----
31	448	<0.1	0.4 ± 0.1	1.3 ± 0.3	1.1 ± 0.2	14 ± 2	~0.1	----	----
32	514	0.2 ± 0.1	0.8 ± 0.2	0.9 ± 0.2	1.0 ± 0.2	13 ± 2	~0.1	----	----
33	462	<0.1	0.7 ± 0.1	1.1 ± 0.2	1.0 ± 0.2	12 ± 2	~0.1	----	----
34	529	<0.1	0.5 ± 0.1	1.2 ± 0.3	1.1 ± 0.2	15 ± 2	~0.1	----	----
35	445	<0.1	0.7 ± 0.1	1.7 ± 0.4	1.0 ± 0.2	14 ± 2	0.3 ± 0.1	----	----

TABLE 15. (cont'd)

		Gamma-ray						Delayed Neutron	Beta
Sample ID	Weight (g)	^{60}Co (1173 keV)	^{137}Cs (662 keV)	^{226}RaD (609 keV)	^{228}ThD (239 keV)	^{40}K (1460 keV)	^{235}U (186 keV)	^{235}U	^{90}Sr
36	408	<0.1	0.7 ± 0.2	1.5 ± 0.3	1.4 ± 0.2	16 ± 3	0.3 ± 0.1	----	----
58	458	<0.1	0.6 ± 0.1	1.4 ± 0.3	1.0 ± 0.1	14 ± 2	~0.2	----	----
Quadrant IV*									
37	473	0.2 ± 0.1	0.6 ± 0.1	1.2 ± 0.3	1.2 ± 0.2	14 ± 2	<0.1	----	----
38	538	0.3 ± 0.1	303.1 ± 3.1	1.7 ± 0.6	1.5 ± 0.5	11 ± 2	1.4 ± 0.5	0.20 ± 0.01	2 ± 5
39	529	0.1 ± 0.1	0.4 ± 0.1	1.2 ± 0.2	1.0 ± 0.1	13 ± 2	<0.1	----	----
40	580	<0.1	0.6 ± 0.1	1.2 ± 0.2	0.9 ± 0.1	14 ± 2	~0.1	----	----
41	546	0.2 ± 0.1	6.0 ± 0.4	1.4 ± 0.3	1.0 ± 0.2	11 ± 2	~0.2	0.07 ± 0.01	<1
42	594	<0.1	1.0 ± 0.2	1.7 ± 0.3	1.4 ± 0.2	22 ± 3	<0.1	----	----
43	542	<0.1	2.6 ± 0.3	1.2 ± 0.3	3.4 ± 0.3	15 ± 2	0.3 ± 0.1	----	----
44	515	0.1 ± 0.1	1.1 ± 0.2	1.3 ± 0.3	1.1 ± 0.2	15 ± 2	~0.2	----	----
45	571	0.4 ± 0.1	3.2 ± 0.3	1.1 ± 0.2	1.0 ± 0.1	13 ± 2	~0.1	0.05 ± 0.01	10 ± 1
46	518	0.6 ± 0.1	2.6 ± 0.2	1.2 ± 0.2	1.1 ± 0.2	14 ± 2	~0.2	----	----
47	551	0.2 ± 0.1	1.9 ± 0.2	1.2 ± 0.2	1.0 ± 0.1	17 ± 2	~0.1	----	----
48	507	<0.1	1.2 ± 0.2	2.2 ± 0.4	2.1 ± 0.3	29 ± 4	~0.2	----	----
49	563	<0.1	1.5 ± 0.2	1.1 ± 0.2	0.9 ± 0.1	15 ± 2	<0.1	----	----
50	513	<0.1	1.3 ± 0.2	1.6 ± 0.4	1.1 ± 0.2	14 ± 2	~0.2	----	----
51	510	<0.1	0.7 ± 0.1	1.3 ± 0.3	1.3 ± 0.2	17 ± 3	~0.1	----	----
52	443	<0.1	0.4 ± 0.1	1.6 ± 0.3	1.2 ± 0.2	19 ± 3	~0.1	----	----
53	503	<0.1	1.2 ± 0.2	1.0 ± 0.3	1.2 ± 0.2	16 ± 2	~0.1	----	----
54	427	<0.1	1.1 ± 0.2	1.9 ± 0.4	1.4 ± 0.3	16 ± 3	~0.1	----	----

TABLE 15. (cont'd)

		Gamma-ray						Delayed Neutron	Beta
Sample ID	Weight (g)	^{60}Co (1173 keV)	^{137}Cs (662 keV)	^{226}RaD (609 keV)	^{228}ThD (239 keV)	^{40}K (1460 keV)	^{235}U (186 keV)	^{235}U	^{90}Sr
55	434	<0.1	2.3 ± 0.2	0.9 ± 0.2	0.8 ± 0.1	8 ± 2	0.3 ± 0.1	----	----
56	610	<0.1	0.8 ± 0.1	1.2 ± 0.3	0.5 ± 0.2	5 ± 1	ND	----	----
57	514	<0.1	<0.1	1.0 ± 0.2	0.6 ± 0.1	10 ± 2	~0.1	----	----
62	427	<0.1	0.4 ± 0.1	1.2 ± 0.3	1.1 ± 0.2	12 ± 2	~0.1	----	----
63	513	0.2 ± 0.1	1.6 ± 0.2	0.9 ± 0.3	1.0 ± 0.2	11 ± 2	~0.2	----	----
64	466	<0.1	1.0 ± 0.2	1.3 ± 0.3	1.0 ± 0.2	16 ± 2	~0.1	----	----
65	442	<0.1	0.8 ± 0.2	1.7 ± 0.4	1.2 ± 0.3	19 ± 3	<0.1	----	----
66	504	0.2 ± 0.1	1.0 ± 0.2	1.2 ± 0.2	0.9 ± 0.1	12 ± 2	<0.1	----	----
67	432	<0.1	1.1 ± 0.2	1.4 ± 0.3	1.1 ± 0.2	18 ± 3	<0.1	----	----
68	459	<0.1	0.8 ± 0.2	1.4 ± 0.3	1.3 ± 0.2	17 ± 3	~0.2	----	----
69	478	0.2 ± 0.1	153.5 ± 2.0	0.8 ± 0.3	1.0 ± 0.3	10 ± 2	<0.1	0.13 ± 0.01	<1
70	476	<0.1	10.6 ± 0.5	1.4 ± 0.3	1.1 ± 0.2	15 ± 2	0.9 ± 0.1	0.77 ± 0.02	2.5 ± 3.0
71	519	<0.1	4.0 ± 0.3	1.1 ± 0.2	1.0 ± 0.2	10 ± 2	0.7 ± 0.1	0.37 ± 0.02	<1
72	499	<0.1	1.6 ± 0.2	1.5 ± 0.4	1.1 ± 0.2	14 ± 2	0.3 ± 0.1	----	----
73	472	<0.1	2.5 ± 0.2	1.3 ± 0.3	1.1 ± 0.2	16 ± 2	~0.2	----	----
74	559	<0.1	0.4 ± 0.1	0.9 ± 0.2	0.5 ± 0.1	10 ± 2	~0.2	----	----
75	552	<0.1	1.6 ± 0.2	1.5 ± 0.3	1.2 ± 0.2	14 ± 2	0.3 ± 0.1	----	----
76	531	<0.1	1.0 ± 0.1	1.2 ± 0.2	0.9 ± 0.1	12 ± 2	~0.2	----	----
77	516	<0.1	1.2 ± 0.2	1.2 ± 0.2	0.8 ± 0.1	13 ± 2	~0.2	----	----
78	563	<0.1	4.1 ± 0.4	1.4 ± 0.3	0.8 ± 0.2	12 ± 2	0.3 ± 0.1	----	----
79	537	<0.1	3.5 ± 0.3	1.3 ± 0.2	0.9 ± 0.1	16 ± 2	~0.2	----	----
80	523	<0.1	14.6 ± 0.6	1.3 ± 0.3	1.4 ± 0.2	13 ± 2	~0.2	0.06 ± 0.01	6.0 ± 3.0

TABLE 15. (cont'd)

		Gamma-ray						Delayed Neutron	Beta
Sample ID	Weight (g)	^{60}Co (1173 keV)	^{137}Cs (662 keV)	^{226}RaD (609 keV)	^{228}ThD (239 keV)	^{40}K (1460 keV)	^{235}U (186 keV)	^{235}U	^{90}Sr
81	506	<0.1	2.5 ± 0.3	1.5 ± 0.3	1.2 ± 0.2	14 ± 2	<0.1	----	----
82	490	<0.1	13.5 ± 0.6	1.2 ± 0.3	0.7 ± 0.1	11 ± 2	0.1	0.08 ± 0.01	4.0 ± 3.0
83	526	<0.1	1.7 ± 0.2	1.2 ± 0.2	1.1 ± 0.2	15 ± 2	0.1	----	----
84	492	<0.1	0.8 ± 0.1	1.2 ± 0.3	1.2 ± 0.2	14 ± 2	0.1	----	----
85	503	<0.1	1.3 ± 0.2	1.3 ± 0.3	1.1 ± 0.2	13 ± 2	0.1	----	----
86	501	<0.1	0.8 ± 0.1	1.0 ± 0.2	1.1 ± 0.2	15 ± 2	0.2	----	----
Outside IET Facility Boundary*									
59A	410	<0.1	1.2 ± 0.2	1.3 ± 0.3	1.0 ± 0.2	10 ± 2	0.2	----	----
59B	509	<0.1	1.1 ± 0.2	1.3 ± 0.3	1.2 ± 0.2	18 ± 2	0.1	----	----
60	473	<0.1	1.4 ± 0.2	1.7 ± 0.4	1.3 ± 0.2	15 ± 2	0.3 ± 0.1	----	----
61	357	<0.1	1.4 ± 0.2	1.4 ± 0.3	0.8 ± 0.2	14 ± 2	0.3 ± 0.1	----	----

---

* See grid plan (Figure 12) for actual sample location.

Bkg #1 - southwest end of INEL site (upwind) near Big Southern Butte

Bkg #2 - northeast end of INEL site (downwind) near Mud Lake

Background data from off site including ^{90}Sr and ^{235}U by delayed is found on Table 1.

TABLE 16. RELATIVE ACTIVITY FOR VARIOUS RADIONUCLIDES AT THE IET (percent of activity)

Isotope	Test Pad North Drain (above grate)	Test Pad North Drain (below grate)	Test Pad Hot Spot	Under Stack Pipe*	Culvert North West Stack**
^{60}Co	5	2	1	~1	4
^{137}Cs	26	25	90	90	10
^{235}U	~0.5	41	~1	--	--
^{226}RaD	3	0	1	--	--
^{228}ThD	8	0	1	--	8
^{40}K	57	32	6	9	78

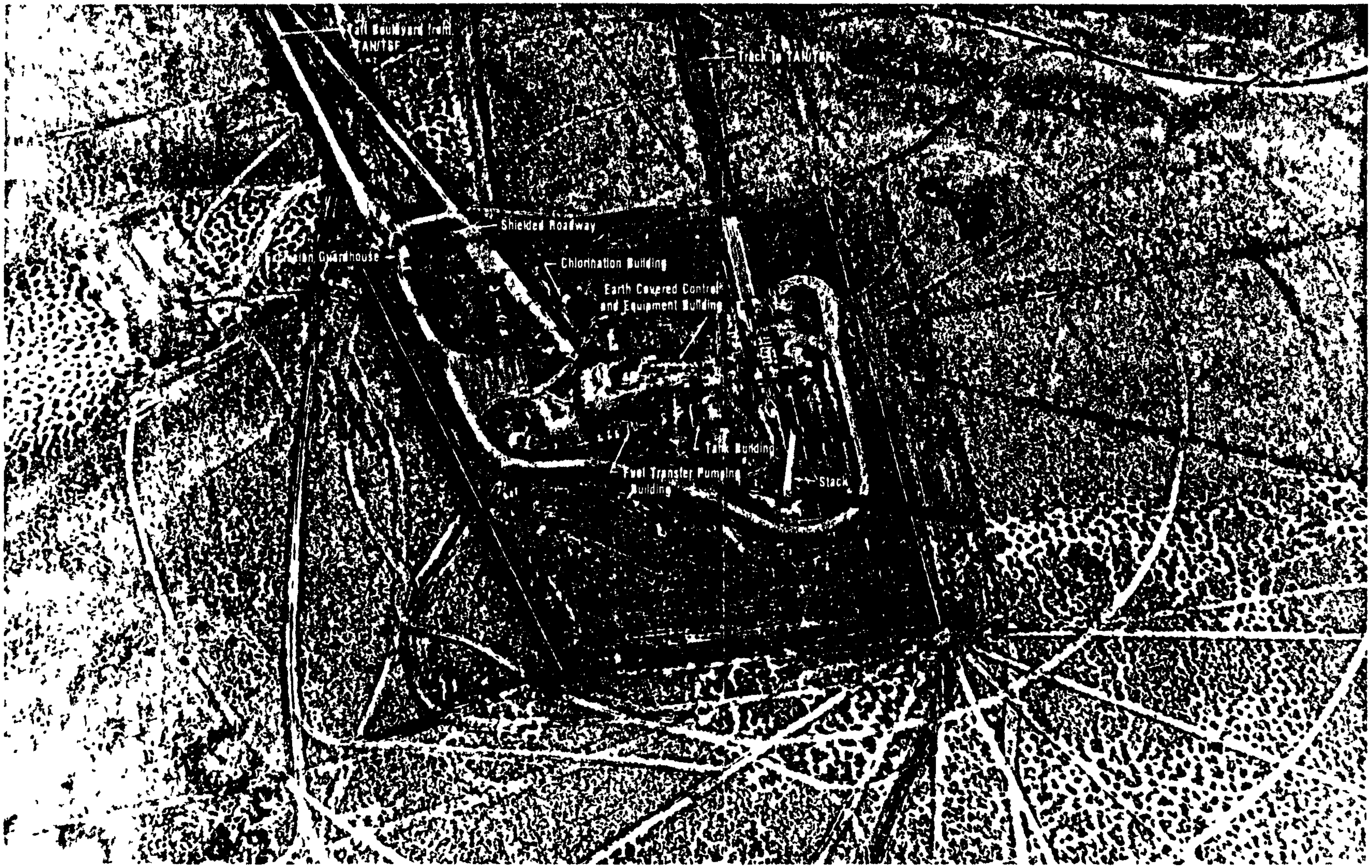
* Soil grid area #69

** Soil grid area #63

TABLE 17. IET MONITORING VAULT (BLDG. 713)
(pCi/g, pCi/ml, pCi/filter)

Sample ID	Sample Volume or Weight	Gamma Spectroscopy		
		^{60}Co (1173 keV)	^{137}Cs (662 keV)	^{235}U (186 keV)
Flood Water	540 ml	<0.1	<0.1	<0.1
Sludge [floor] (after pump-down)	142 g	0.9 ± 0.3	11.0 ± 0.9	0.9 ± 0.2
Rust/sludge [piping, sample lines, and equipment external surfaces]	207 g	<0.2	4.4 ± 0.5	2.7 ± 0.3
Air Filter #1	filter	<29	278 ± 65	<7
Air Filter #2	filter	<29	800 ± 108	<7

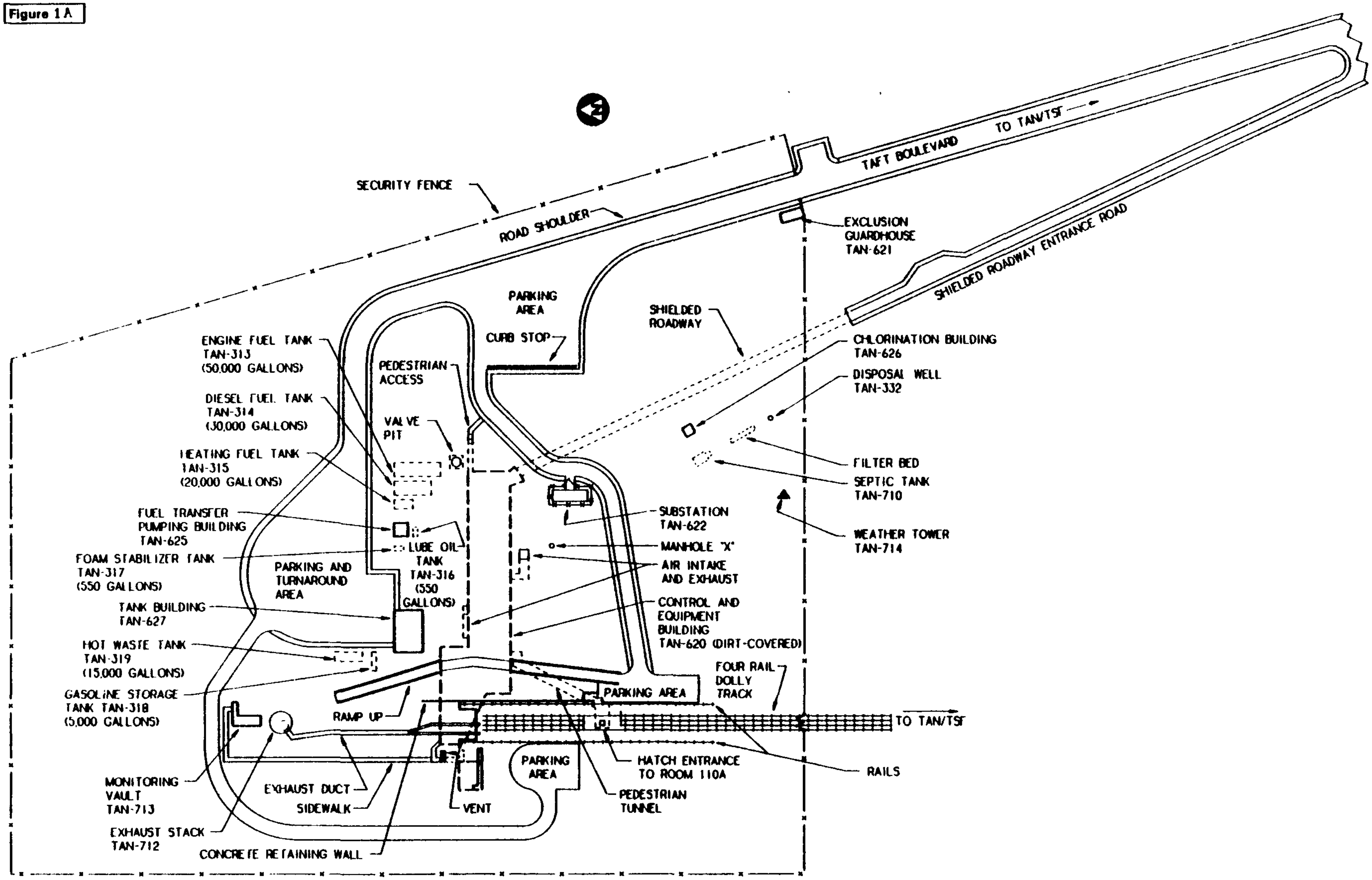
Figure 1 An aerial view of the TAN/IET Facility and surrounding area (76-7647)



Test Area North - IET

Plot Plan

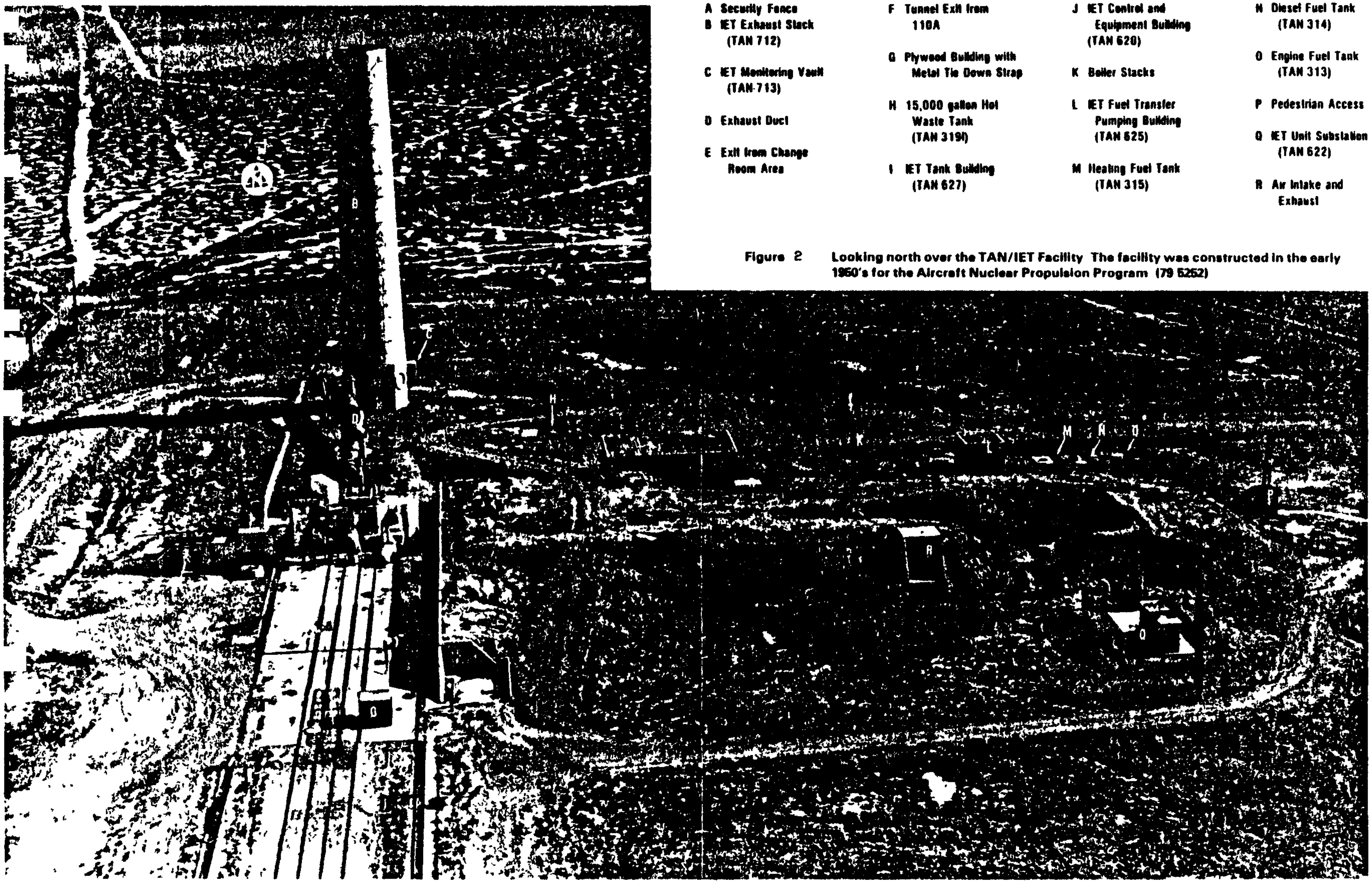
Figure 1A



Test Area North - IET

Facilities

Plot Plan



A	Security Fence
B	IET Exhaust Stack (TAN 712)
C	IET Monitoring Vault (TAN-713)
D	Exhaust Duct
E	Exit from Change Room Area
F	Tunnel Exit from 110A
G	Plywood Building with Metal Tie Down Strap
H	15,000 gallon Hot Waste Tank (TAN 319I)
I	IET Tank Building (TAN 627)
J	IET Control and Equipment Building (TAN 620)
K	Boiler Stacks
L	IET Fuel Transfer Pumping Building (TAN 625)
M	Heating Fuel Tank (TAN 315)
N	Diesel Fuel Tank (TAN 314)
O	Engine Fuel Tank (TAN 313)
P	Pedestrian Access
Q	IET Unit Substation (TAN 622)
R	Air Intake and Exhaust

Figure 2 Looking north over the TAN/IET Facility The facility was constructed in the early 1950's for the Aircraft Nuclear Propulsion Program (79 5252)

Test Area North - IET

← Power

Figure 3. Eberline PRS-1 (RASCAL) Ratemeter with HP 210 GM Detector.

This instrument was used for the beta-gamma radiation survey of the entire site surface.

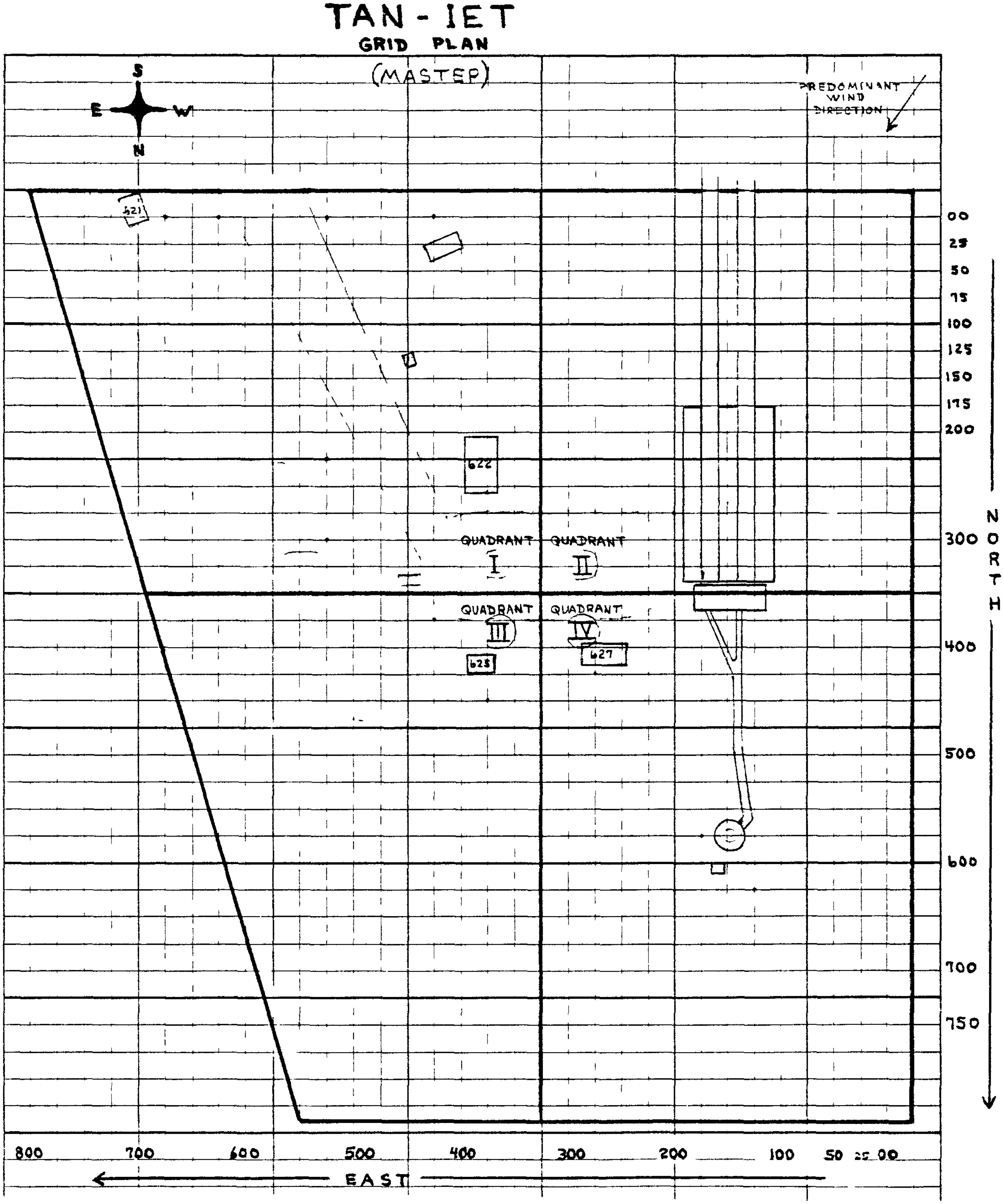


Figure 4. Master Grid Plan

The squares are 25 feet on each side. All sampling and radiation surveying was done according to this grid structure.

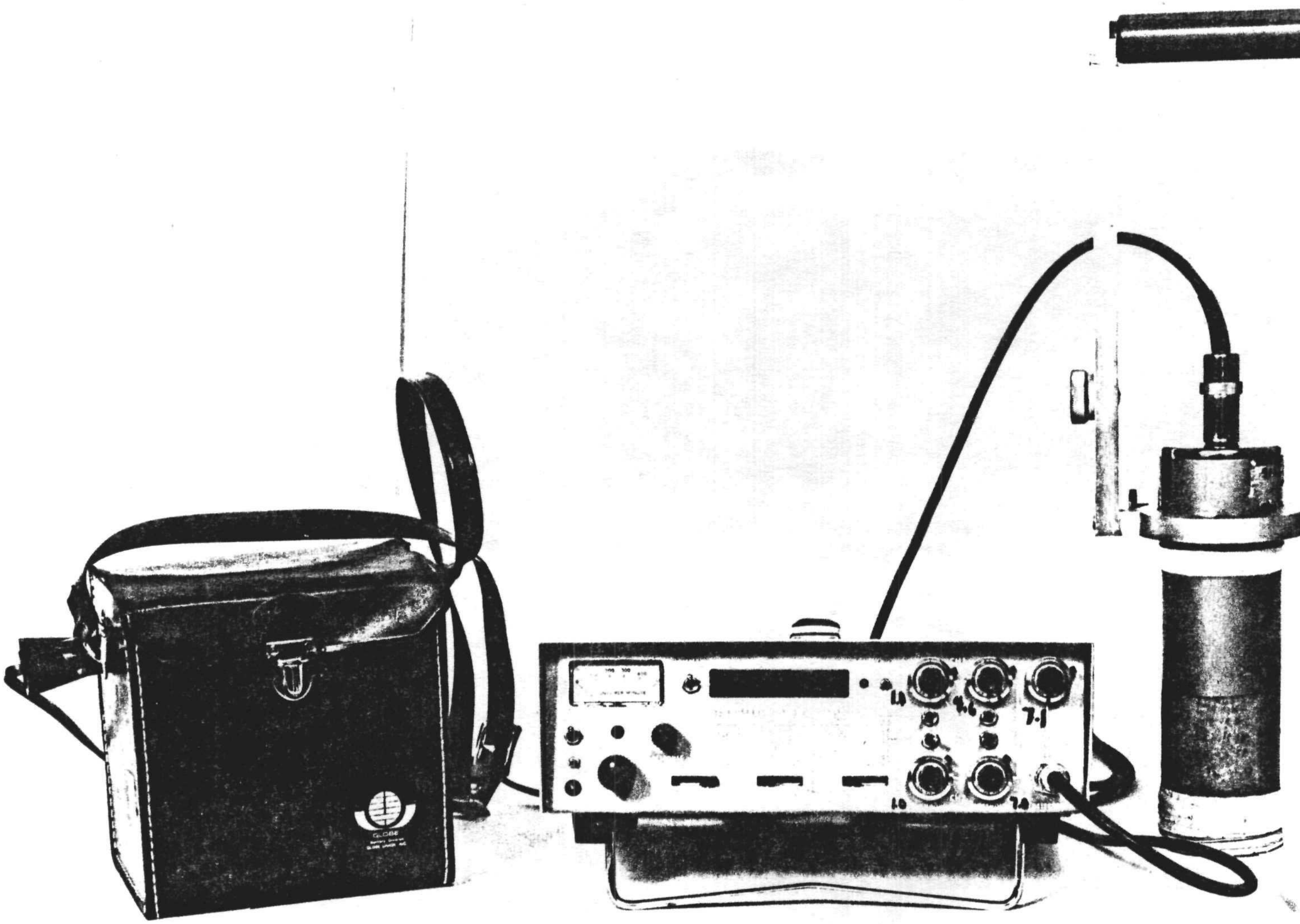


Figure 5. Eberline Stabilized Assay Meter (SAM II) with RD-19 NaI Detector. This system was used in an attempt to measure the ^{235}U concentrations.

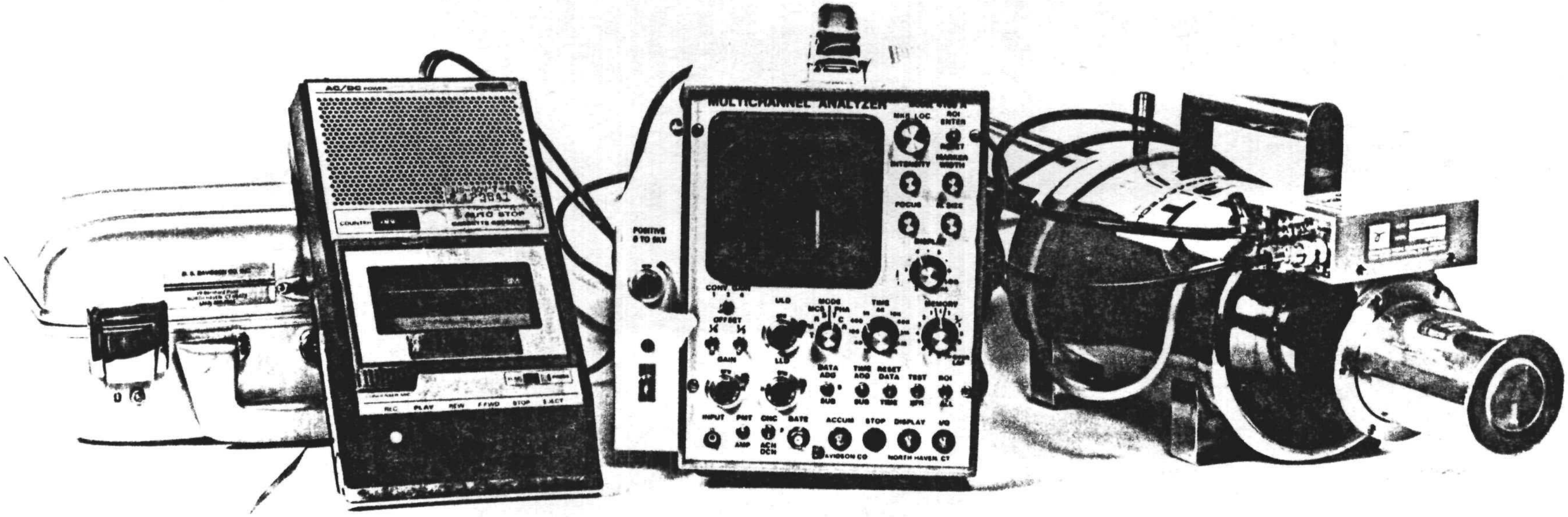


Figure 6. Portable Gamma Spectrometer for <u>In-Situ</u> Measurements

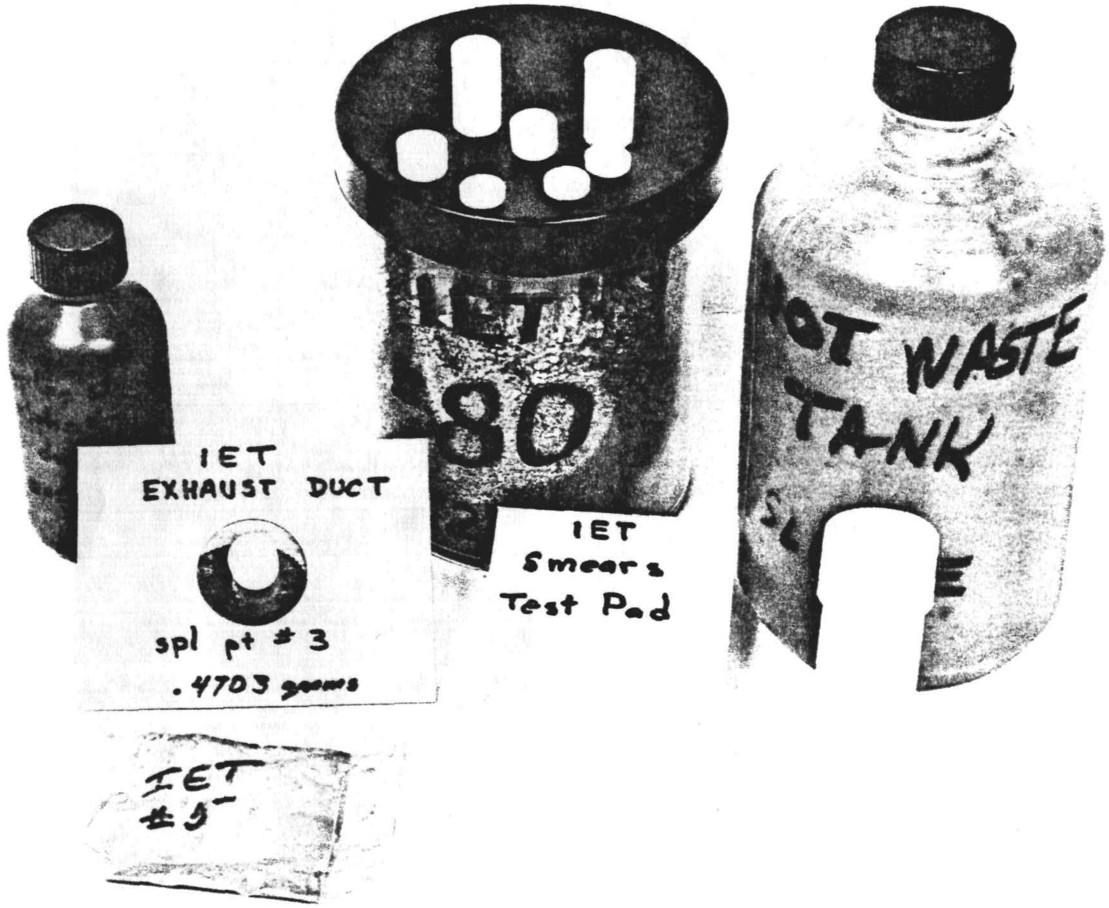
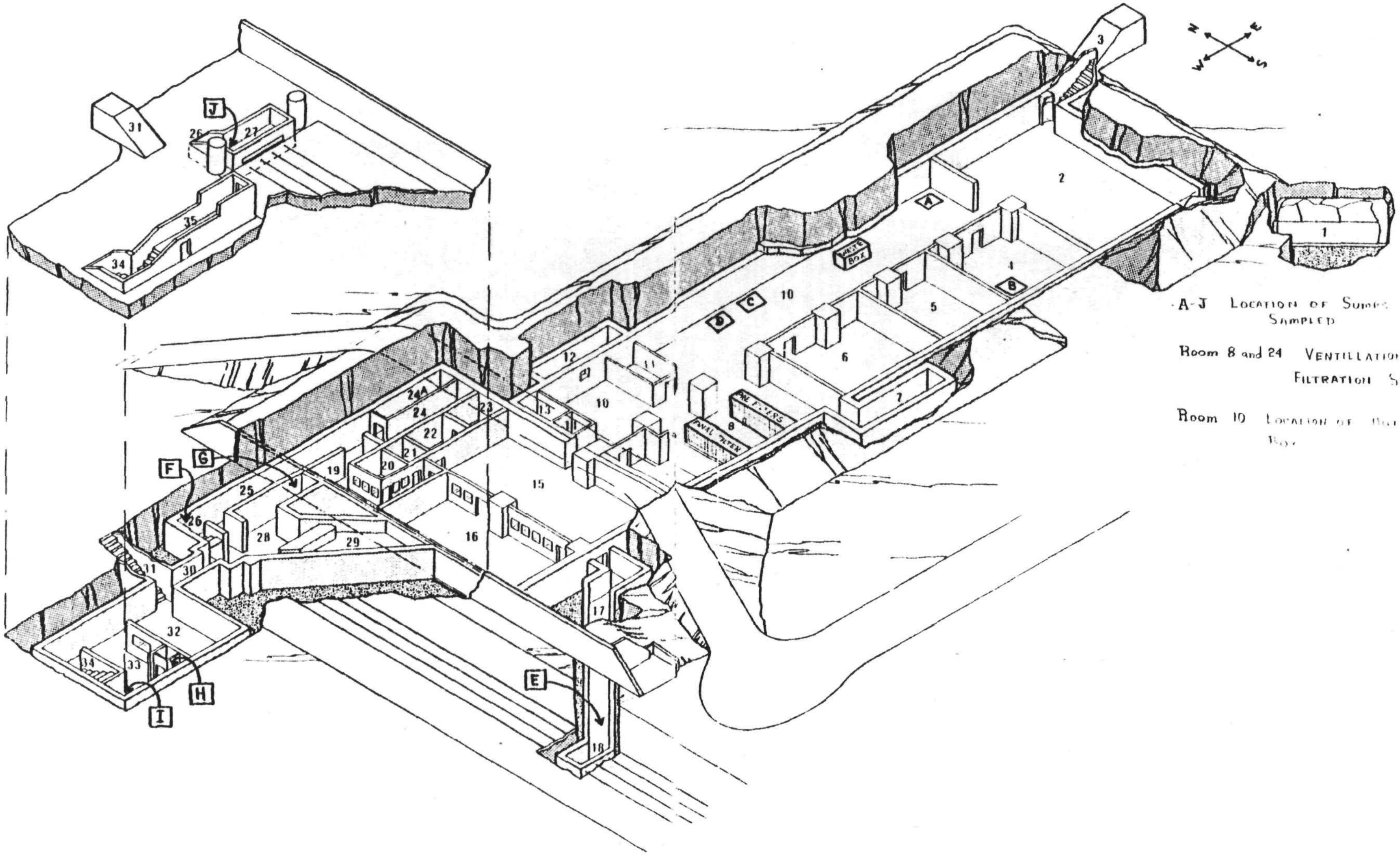


Figure 7. Typical Type Samples Collected and Analyzed by the Radiation Measurements Laboratory (RML) for TAN-IET.

Figure 8



·A-J LOCATION OF SUMPS SAMPLED

Room 8 and 24 VENTILLATION FILTRATION SYSTEMS

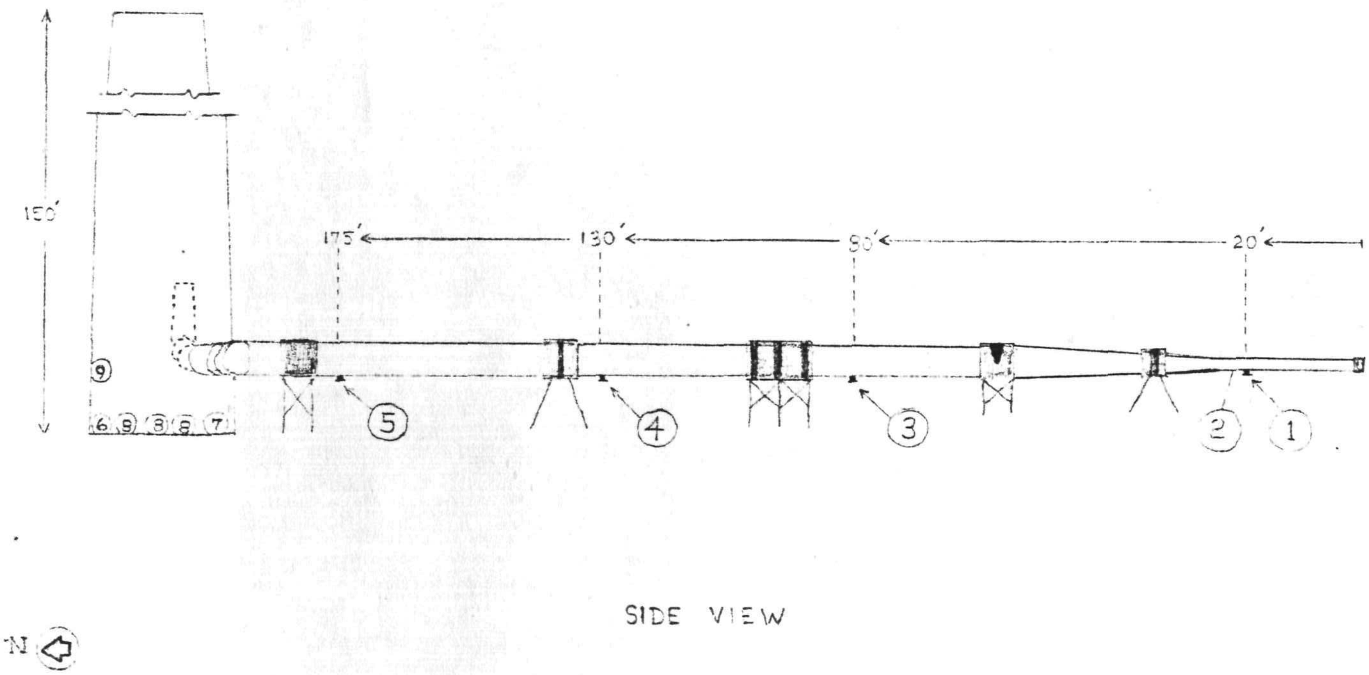
Room 10 LOCATION OF HOT WASTE BOX

Test Area North - IET

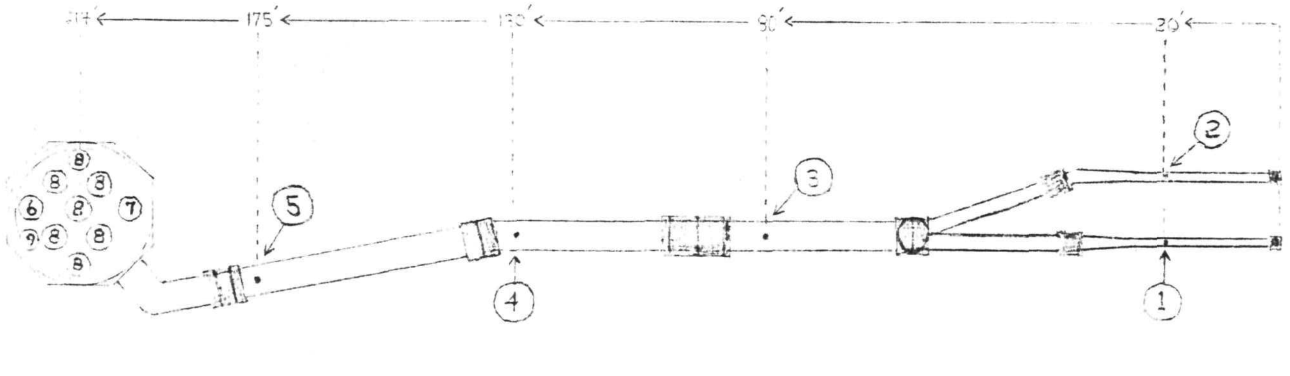
TAN-620 Control and Equipment Building Layout

Figure 9.

TAN-IET
EXHAUST DUCT and STACK
SAMPLE LOCATIONS



SIDE VIEW

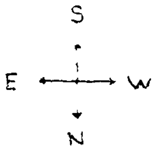


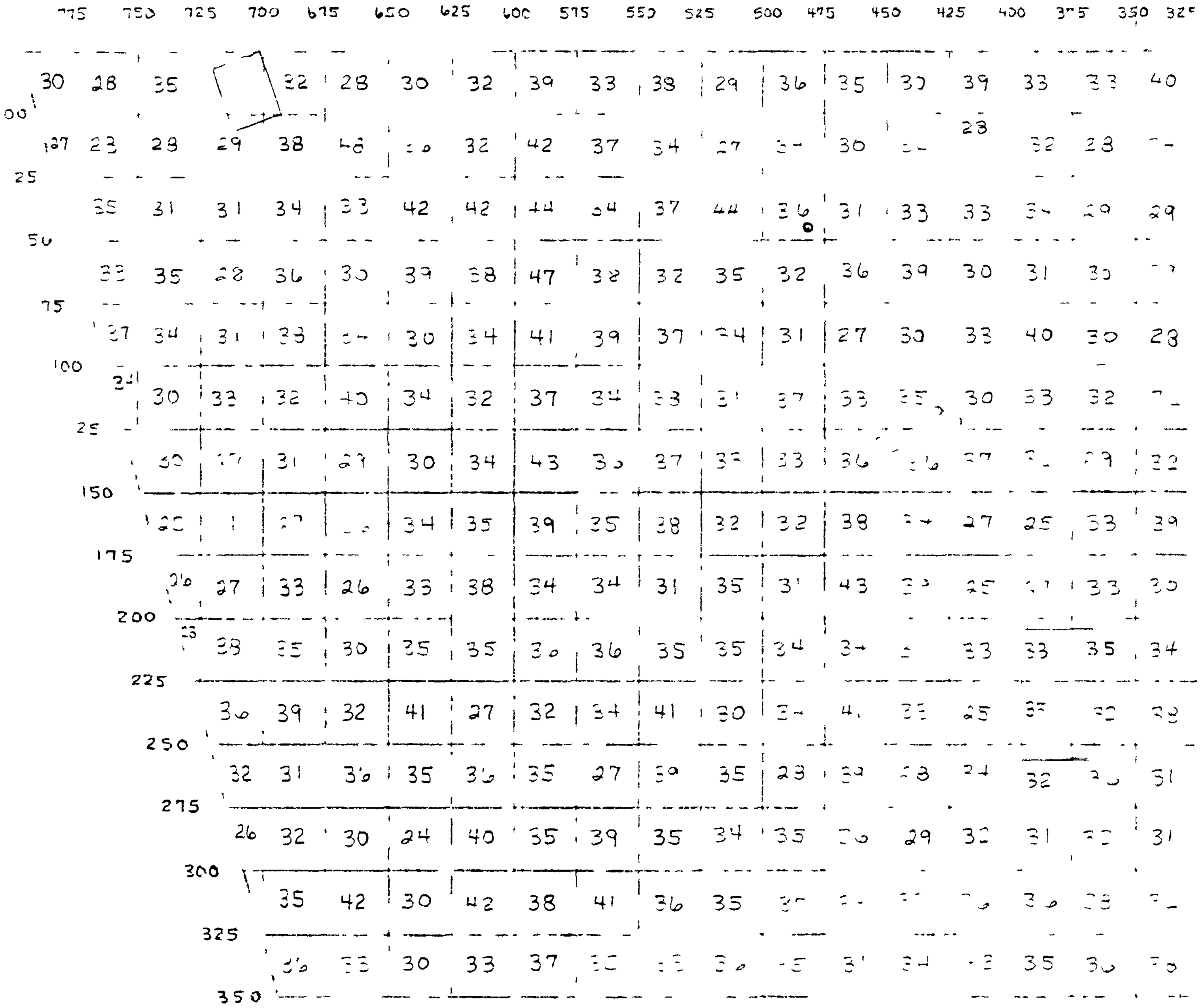
TOP VIEW

Figure 10A.

TAN-IET

EXPANDED VIEW
OF
GRID PLAN
QUADRANT I





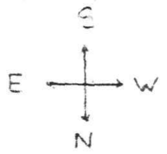
	775	750	725	700	675	650	625	600	575	550	525	500	475	450	425	400	375	350	325
00	30	28	35		32	28	30	32	39	33	38	29	36	35	30	39	33	33	40
25	37	23	28	29	38	48	[illegible]	32	42	37	34	27	[illegible]	30	[illegible]	28	32	28	[illegible]
50		35	31	31	34	33	42	42	44	34	37	44	36	31	33	33	[illegible]	29	29
75		33	35	28	36	30	39	38	47	38	32	35	32	36	39	30	31	30	[illegible]
100		37	34	31	33	[illegible]	30	34	41	39	37	34	31	27	30	33	40	30	28
125		[illegible]	30	33	32	40	34	32	37	34	33	31	37	33	35	30	33	32	[illegible]
150			30	[illegible]	31	29	30	34	43	30	37	33	33	36	36	37	[illegible]	29	32
175			20	[illegible]	27	[illegible]	34	35	39	35	38	32	32	38	[illegible]	27	25	33	39
200			26	27	33	26	33	38	34	34	31	35	31	43	33	25	[illegible]	33	30
225			23	38	35	30	35	35	30	36	35	35	34	[illegible]	[illegible]	33	33	35	34
250				36	39	32	41	27	32	34	41	30	[illegible]	[illegible]	33	25	35	32	38
275				32	31	36	35	36	35	27	39	35	23	39	28	24	32	[illegible]	31
300				26	32	30	24	40	35	39	35	34	35	36	29	32	31	32	31
325					35	42	30	42	38	41	36	35	[illegible]	[illegible]	[illegible]	[illegible]	36	38	[illegible]
350					36	33	30	33	37	33	33	36	[illegible]	31	34	[illegible]	35	36	[illegible]

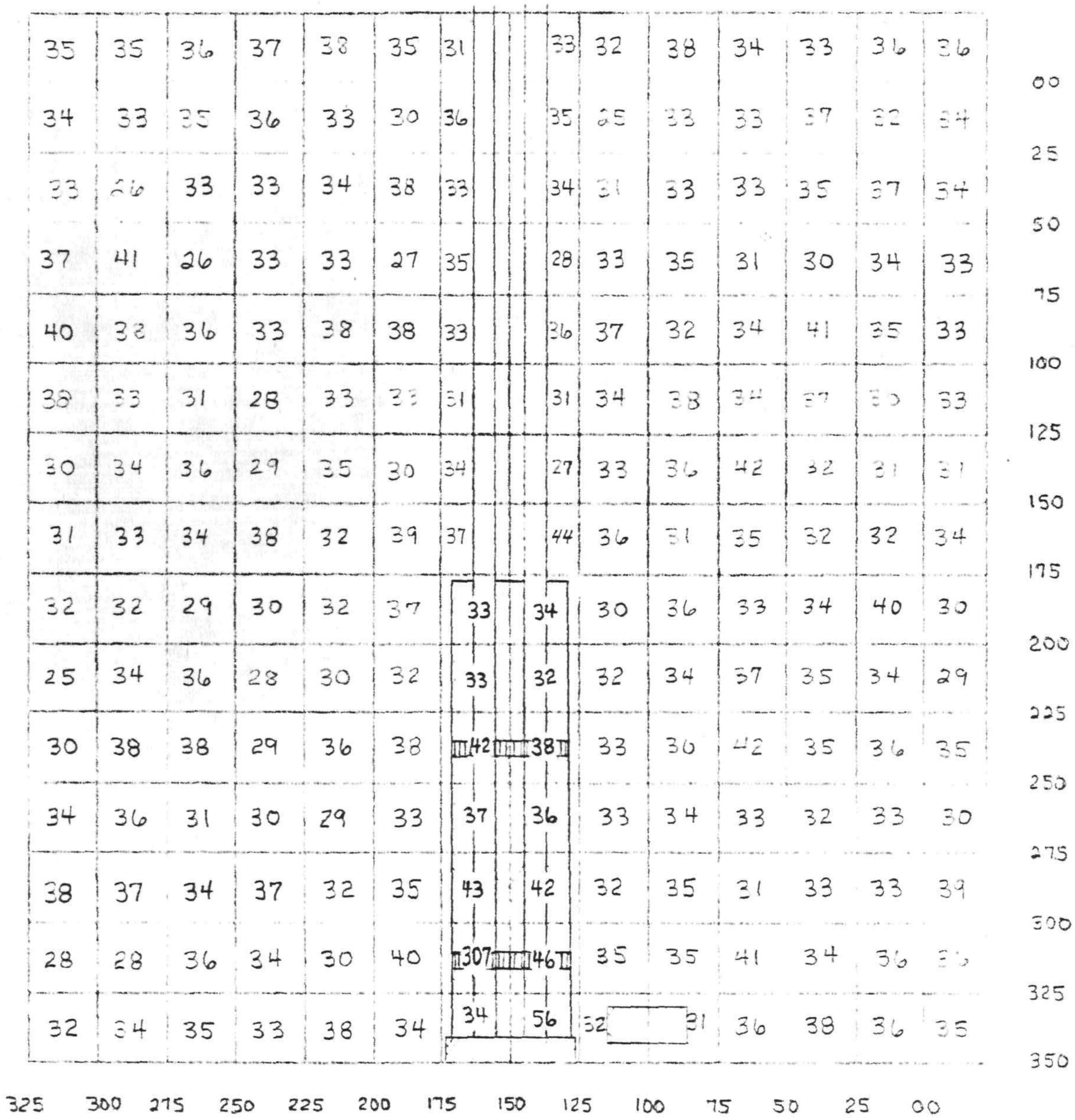
EBERLINE PRS-1 ('RASCAL') SURVEY
counts/30 seconds

Figure 10B.

TAN-IET

EXPANDED VIEW
OF
GRID PLAN
QUADRANT II



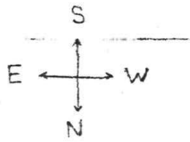


35	35	36	37	38	35	31	33	32	38	34	33	36	36
34	33	35	36	33	30	36	35	25	33	33	37	32	34
33	26	33	33	34	38	33	34	31	33	33	35	37	34
37	41	26	33	33	27	35	28	33	35	31	30	34	33
40	38	36	33	38	38	33	36	37	32	34	41	35	33
38	33	31	28	33	33	31	31	34	38	34	37	30	33
30	34	36	29	35	30	34	27	33	36	42	32	31	31
31	33	34	38	32	39	37	44	36	31	35	32	32	34
32	32	29	30	32	37	33	34	30	36	33	34	40	30
25	34	36	28	30	32	33	32	32	34	37	35	34	29
30	38	38	29	36	38	42	38	33	30	42	35	36	35
34	36	31	30	29	33	37	36	33	34	33	32	33	30
38	37	34	37	32	35	43	42	32	35	31	33	33	39
28	28	36	34	30	40	307	46	35	35	41	34	36	36
32	34	35	33	38	34	34	56	32	31	36	38	36	35

EBERLINE PRS-1 ('RASCAL') SURVEY
counts/30 seconds

Figure 10C. TAN-IET

EXPANDED VIEW
OF
GRID PLAN
QUADRANT III

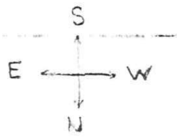


	675	650	625	600	575	550	525	500	475	450	425	400	375	350	325
350	43	38	43	22	23	32	32	35	33	28	35	37	35	31	38
375	48	42	28	26	30	33	32	31	33	29	33	36	33	35	33
400	40	56	41	37	37	34	32	33	38	33	40	33	32	35	37
425		31	35	35	36	26	33	38	34	41	37	33	31	35	29
450		39	39	42	39	32	31	29	25	55	39	29	33	32	36
475		32	38	35	29	32	34	38	34	44	34	30	33	27	37
500			40	36	34	35	34	35	33	46	36	37	36	26	27
525			35	42	31	36	38	35	34	44	25	32	37	35	33
550			30	29	31	35	36	35	46	35	46	30	30	30	33
575				34	32	32	33	35	36	52	33	35	36	30	33
600				33	34	30	37	36	39	41	35	39	35	33	36
625				33	32	35	34	42	36	49	43	34	41	30	33
650				30	32	39	35	39	39	39	36	34	42	36	34
675					38	37	44	32	38	39	40	33	29	43	34
700					34	36	40	37	34	34	38	35	36	32	37
725					33	43	42	36	35	32	35	40	33	38	34
750						38	41	38	35	54	34	33	35	34	32
775						38	43	32	34	47	33	42	43	35	36
800						34	42	34	29	38	37	45	39	32	42
825							44	35	33	33	41	45	40	36	34

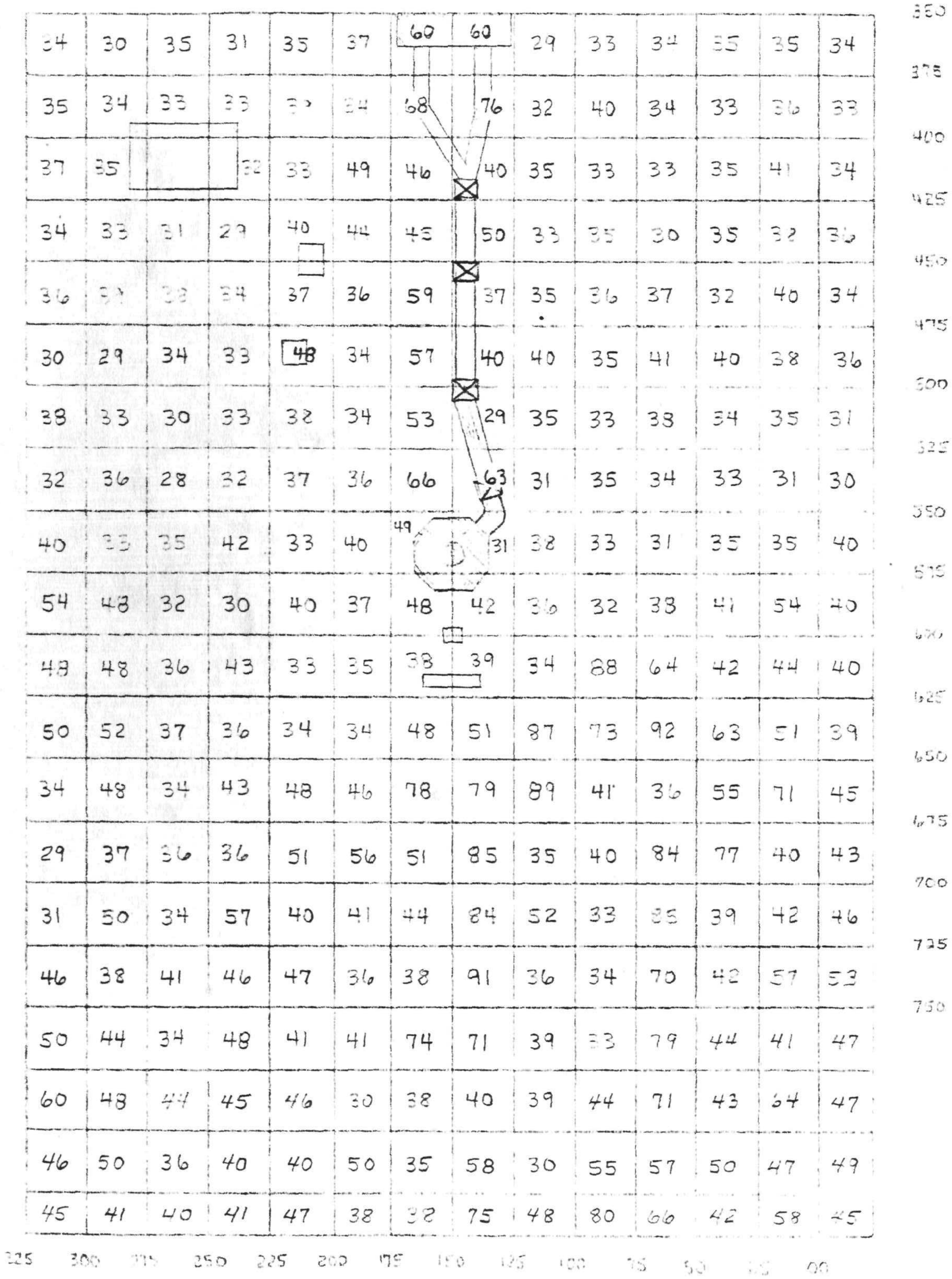
EBERLINE PRS-1 ("RASCAL") SURVEY

Counts / 30 seconds

Figure 10D. TAN-IET



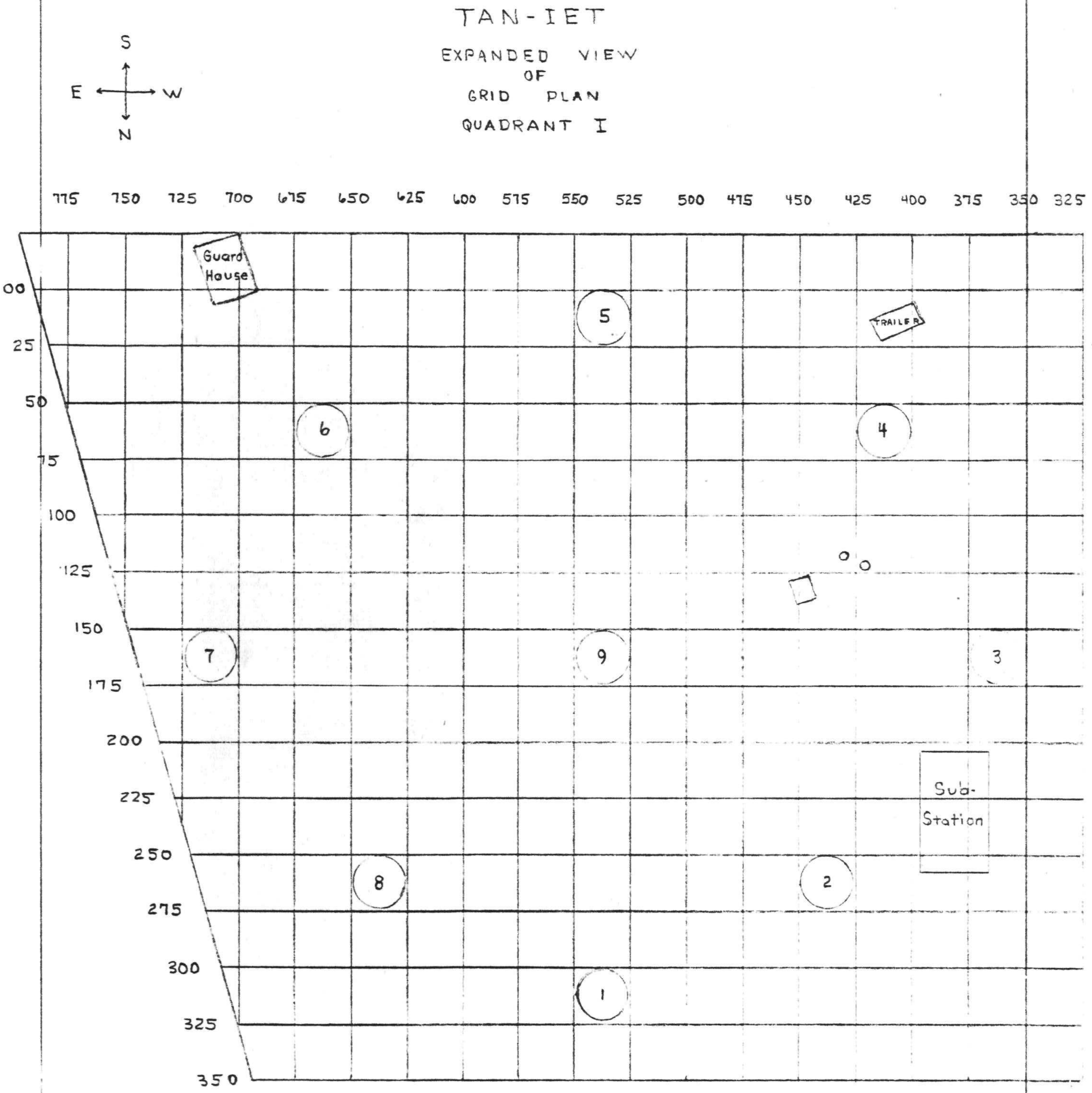
EXPANDED VIEW
OF
GRID PLAN
QUADRANT IV



34	30	35	31	35	37	60	60	29	33	34	35	35	34
35	34	33	33	32	34	68	76	32	40	34	33	36	33
37	35		32	33	49	46	40	35	33	33	35	41	34
34	33	31	29	40	44	45	50	33	35	30	35	32	36
36	37	38	34	37	36	59	37	35	36	37	32	40	34
30	29	34	33	48	34	57	40	40	35	41	40	38	36
38	33	30	33	32	34	53	29	35	33	38	34	35	31
32	36	28	32	37	36	66	63	31	35	34	33	31	30
40	33	35	42	33	40	49	31	38	33	31	35	35	40
54	48	32	30	40	37	48	42	36	32	33	41	54	40
48	48	36	43	33	35	38	39	34	88	64	42	44	40
50	52	37	36	34	34	48	51	87	73	92	63	51	39
34	48	34	43	48	46	78	79	89	41	36	55	71	45
29	37	36	36	51	56	51	85	35	40	84	77	40	43
31	50	34	57	40	41	44	84	52	33	85	39	42	46
46	38	41	46	47	36	38	91	36	34	70	42	57	53
50	44	34	48	41	41	74	71	39	33	79	44	41	47
60	48	44	45	46	30	38	40	39	44	71	43	64	47
46	50	36	40	40	50	35	58	30	55	57	50	47	49
45	41	40	41	47	38	38	75	48	80	66	42	58	45

EBERLINE PRS-1 ('RASCAL') SURVEY
counts/30 seconds

Figure 11A.



TAN-IET

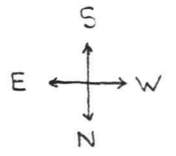
EXPANDED VIEW
OF
GRID PLAN
QUADRANT I

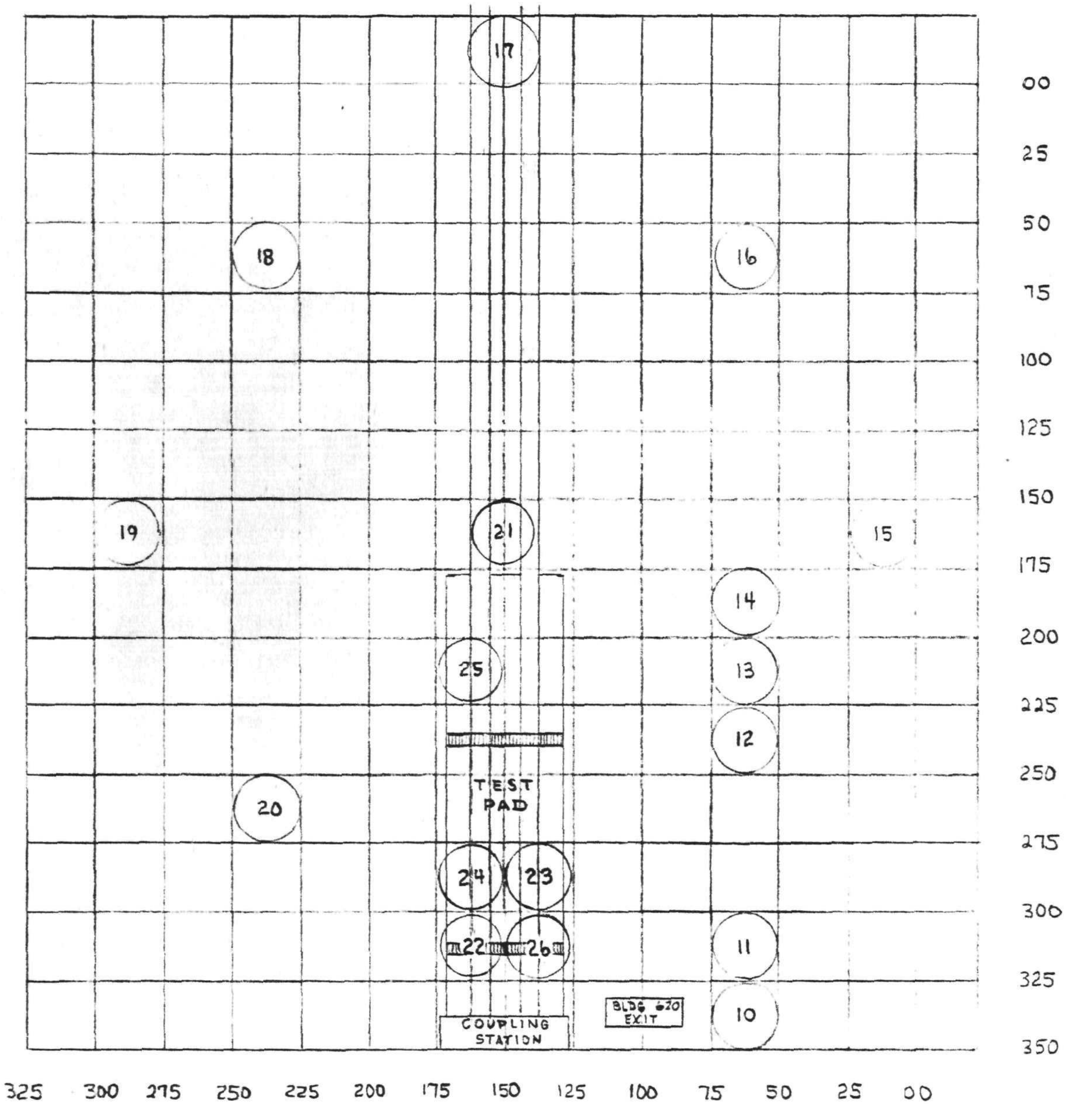
SOIL SAMPLE
LOCATIONS

AMPAD 22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS

Figure 11B.

TAN-IET
EXPANDED VIEW
OF
GRID PLAN
QUADRANT II

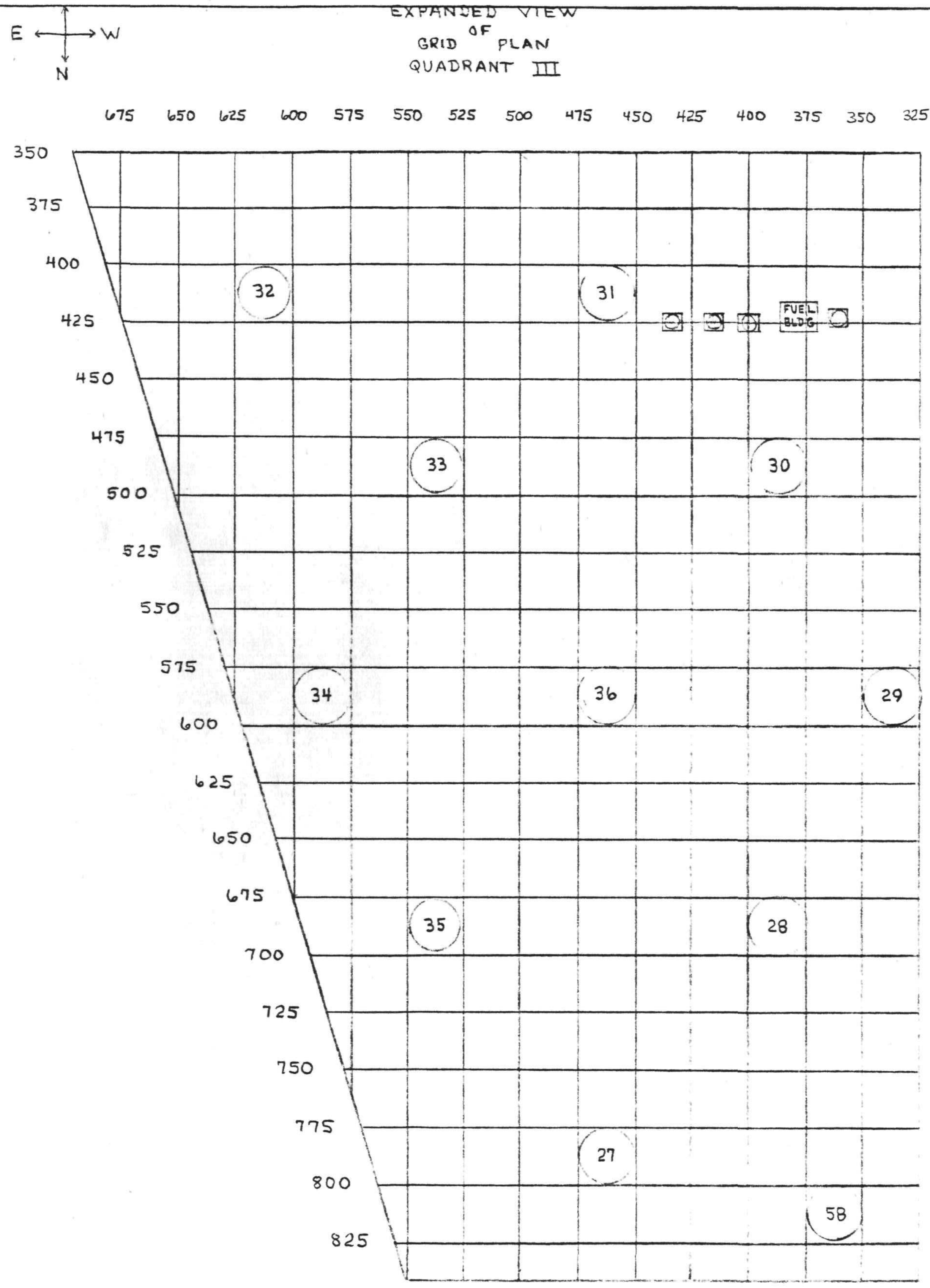




SOIL and CONCRETE
SAMPLE LOCATIONS

Figure 11C.

TAN-IET
EXPANDED VIEW
OF
GRID PLAN
QUADRANT III

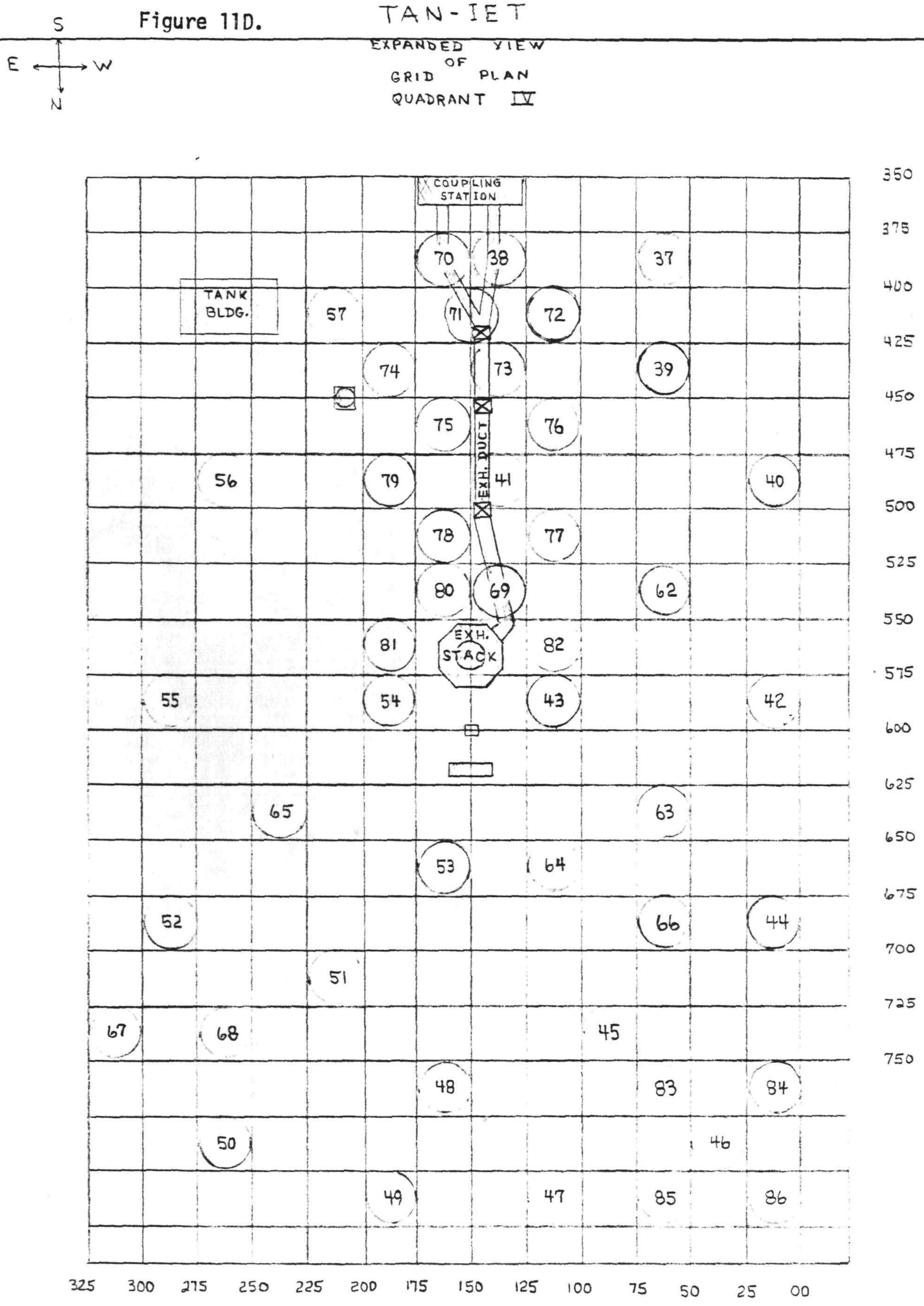


SOIL SAMPLE
LOCATIONS

AMPAD 22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS

Figure 11D.

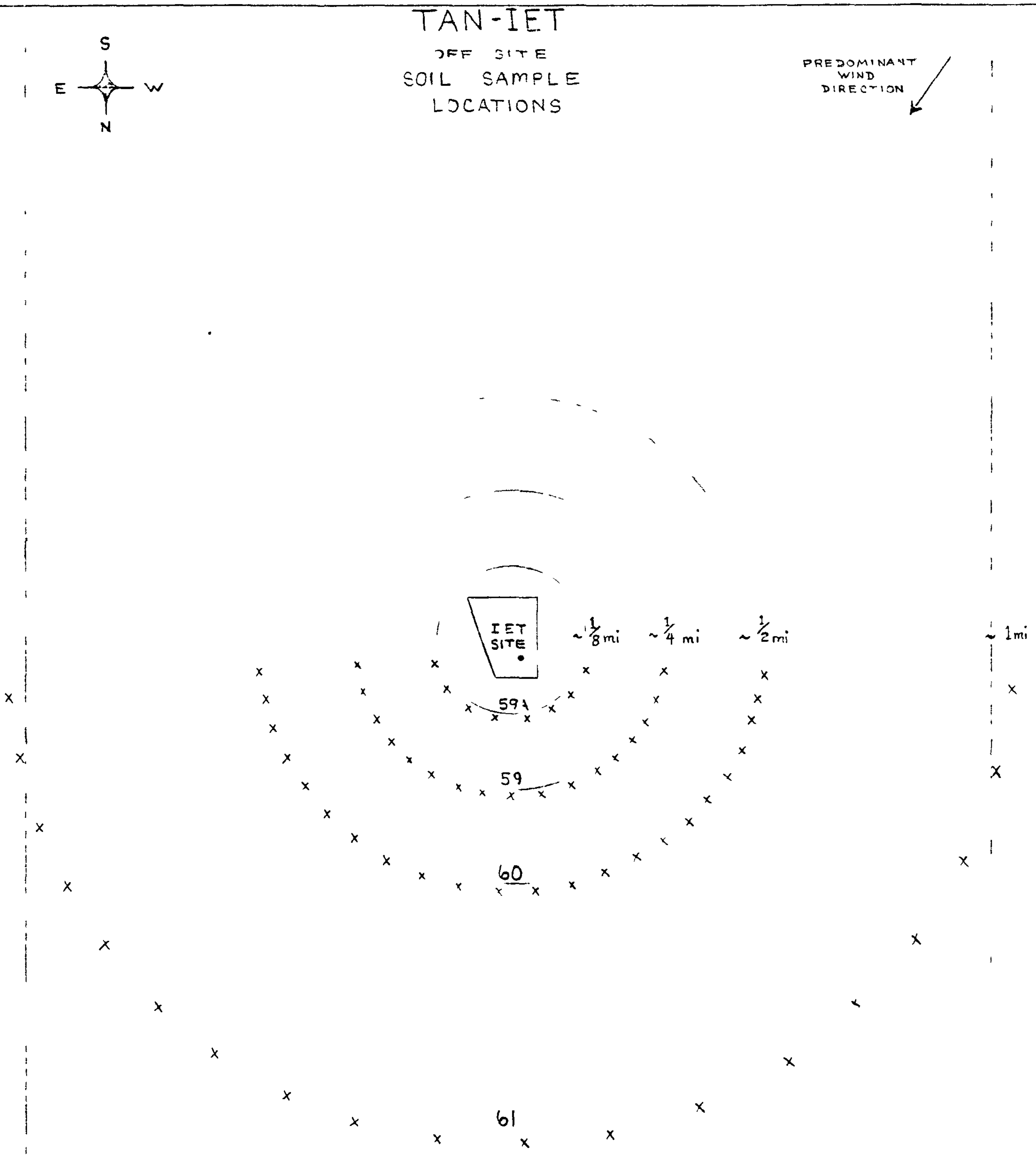
TAN-IET
EXPANDED VIEW
OF
GRID PLAN
QUADRANT IV



SOIL SAMPLE
LOCATIONS

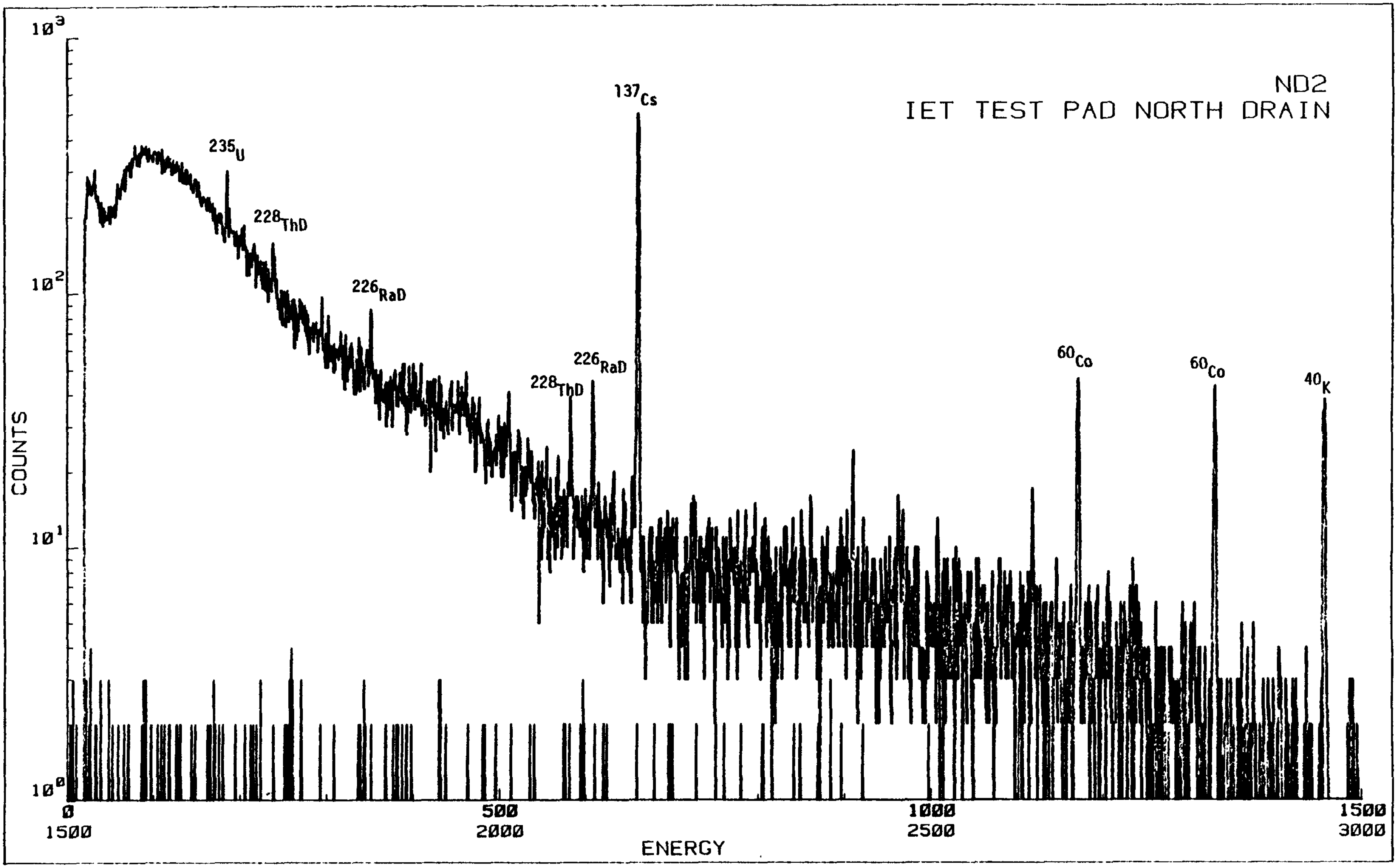
AMPAD 22-141 50 SHEETS
22-142 100 SHEETS
22-144 200 SHEETS

Figure 12.



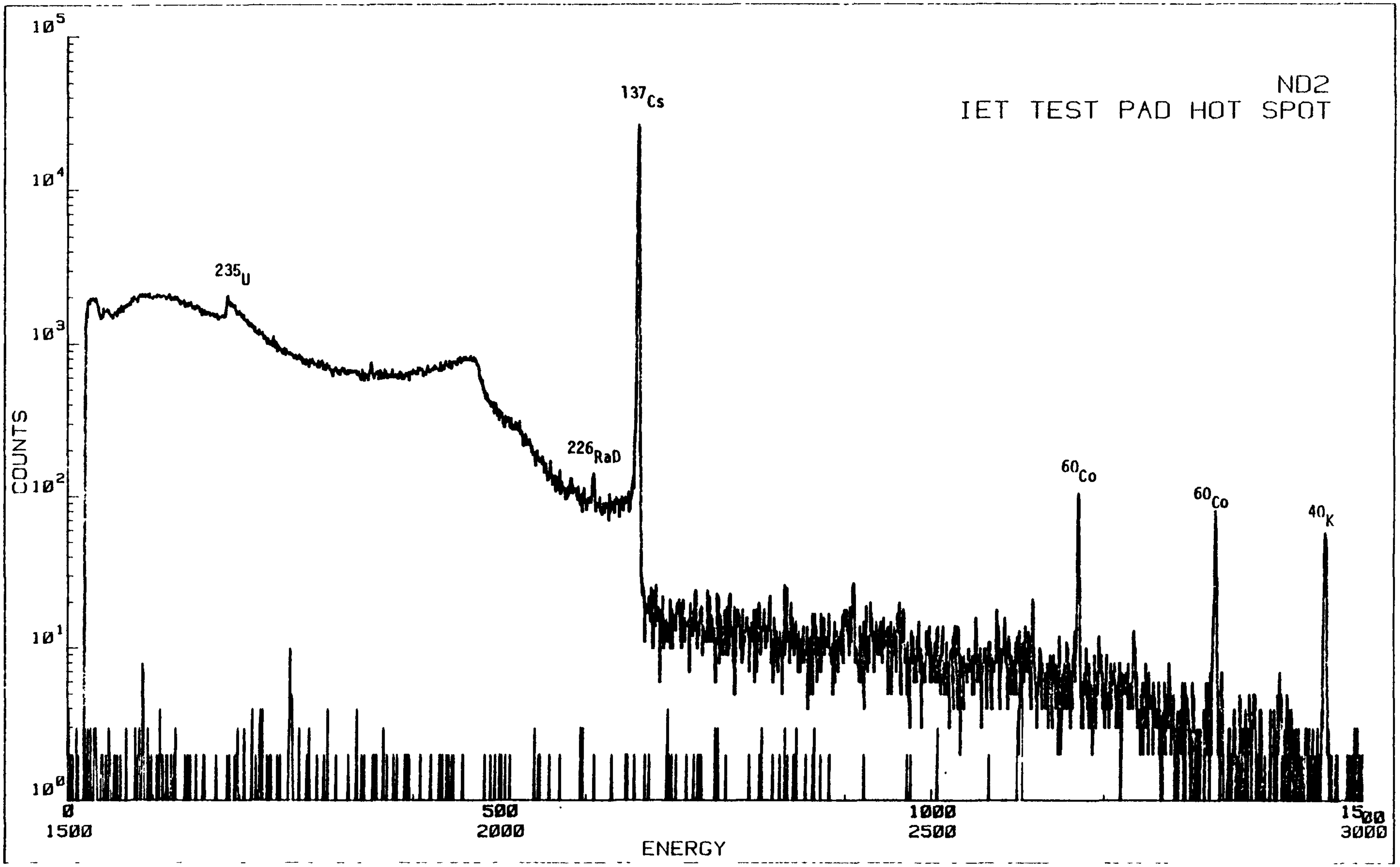
A single composite sample was collected by taking small amounts of soil at the locations represented by X's along a semicircular path.

Figure 13.



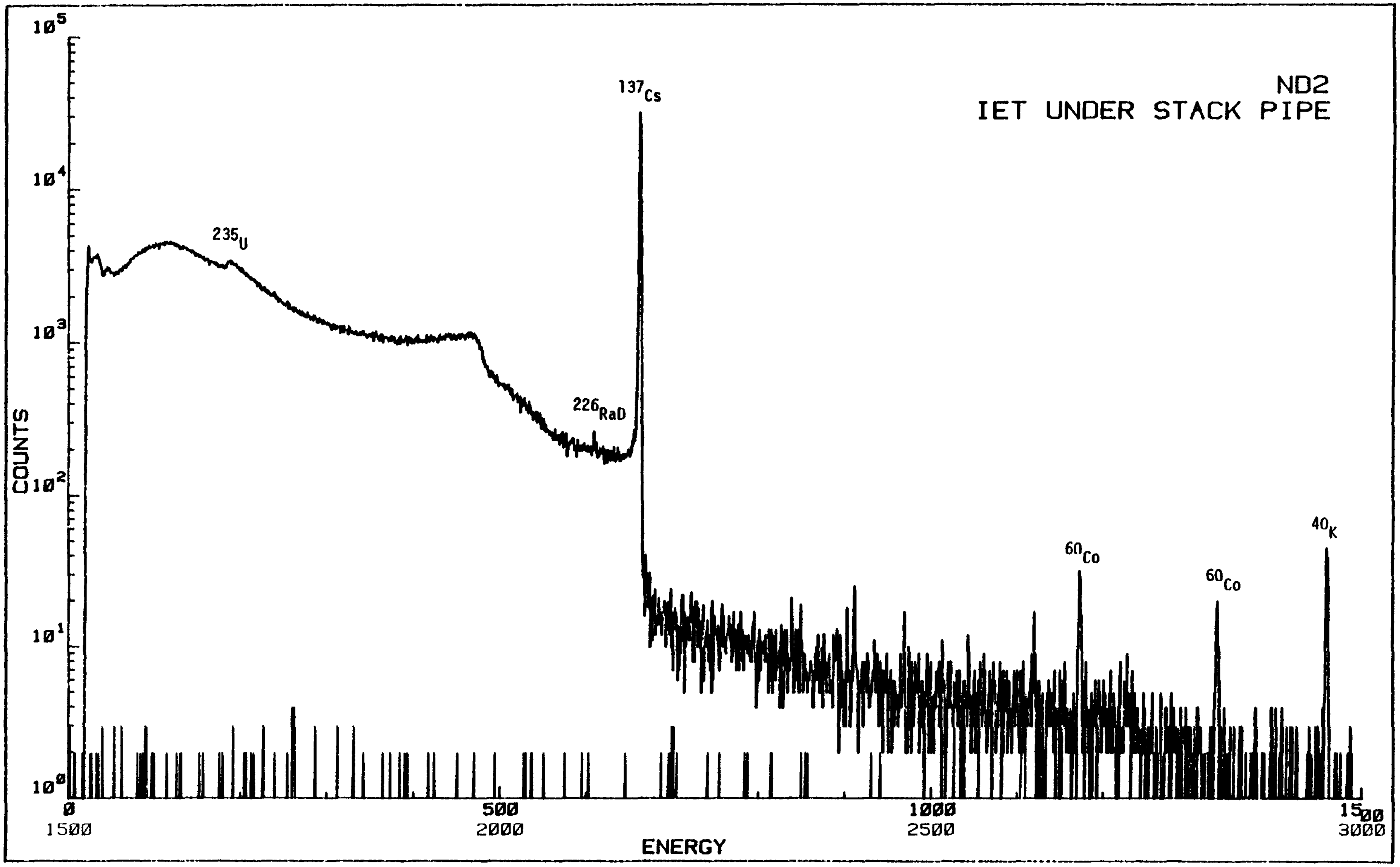
ND2
IET TEST PAD NORTH DRAIN
^{137}Cs
^{235}U
^{228}ThD
^{226}RaD
^{228}ThD
^{226}RaD
^{60}Co
^{60}Co
^{40}K
COUNTS
10^3
10^2
10^1
10^0
0
500
1000
1500
1500
2000
2500
3000
ENERGY

Figure 14.



ND2
IET TEST PAD HOT SPOT
137Cs
235U
226RaD
60Co
60Co
40K
COUNTS
10^5
10^4
10^3
10^2
10^1
10^0
0
500
1000
1500
1500
2000
2500
3000
ENERGY

Figure 15.



ND2
IET UNDER STACK PIPE
^{137}Cs
^{235}U
^{226}RaD
^{60}Co
^{60}Co
^{40}K
10^5
10^4
10^3
10^2
10^1
10^0
COUNTS
0
500
1000
1500
1500
2000
2500
3000
ENERGY

Figure 16.

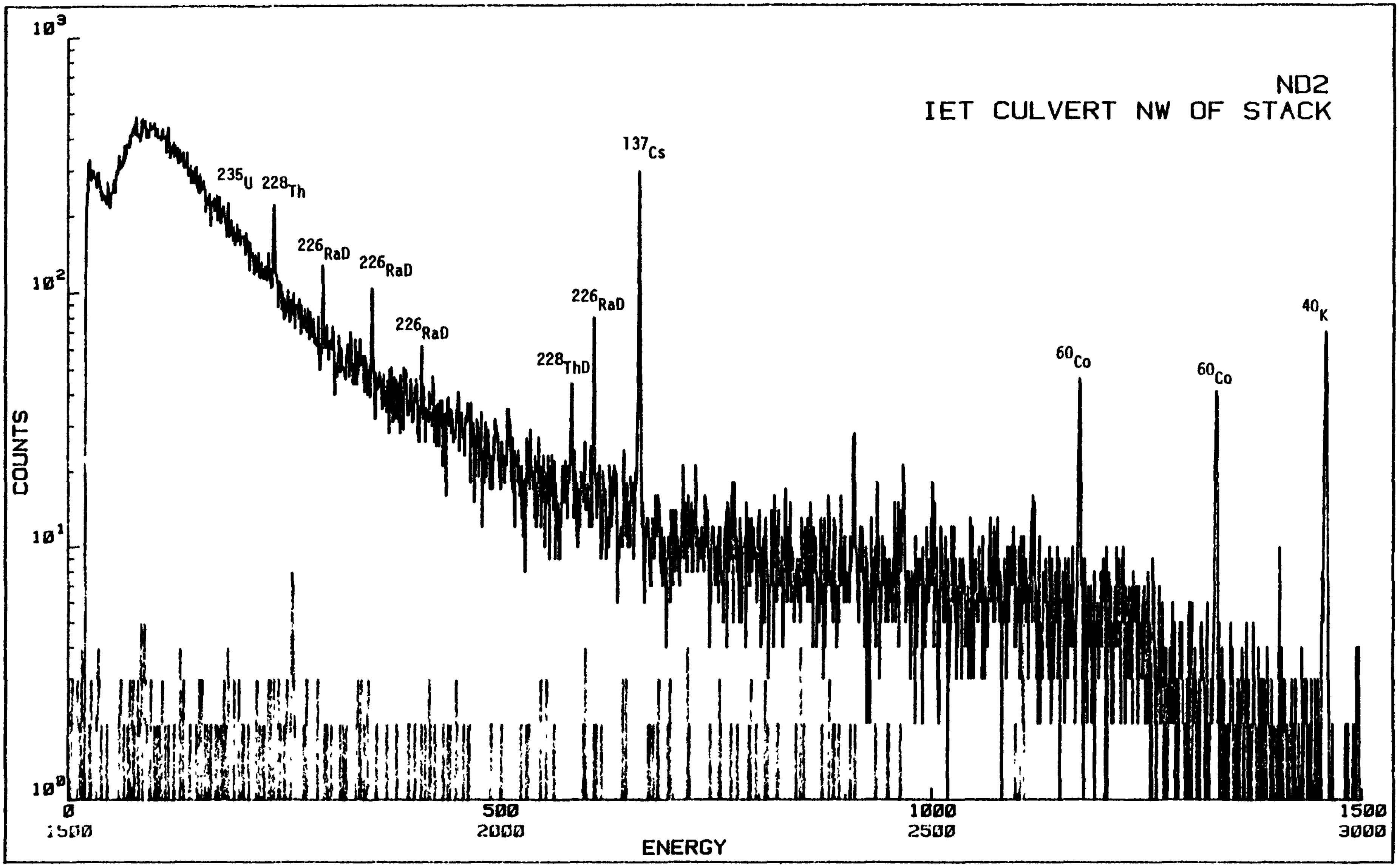
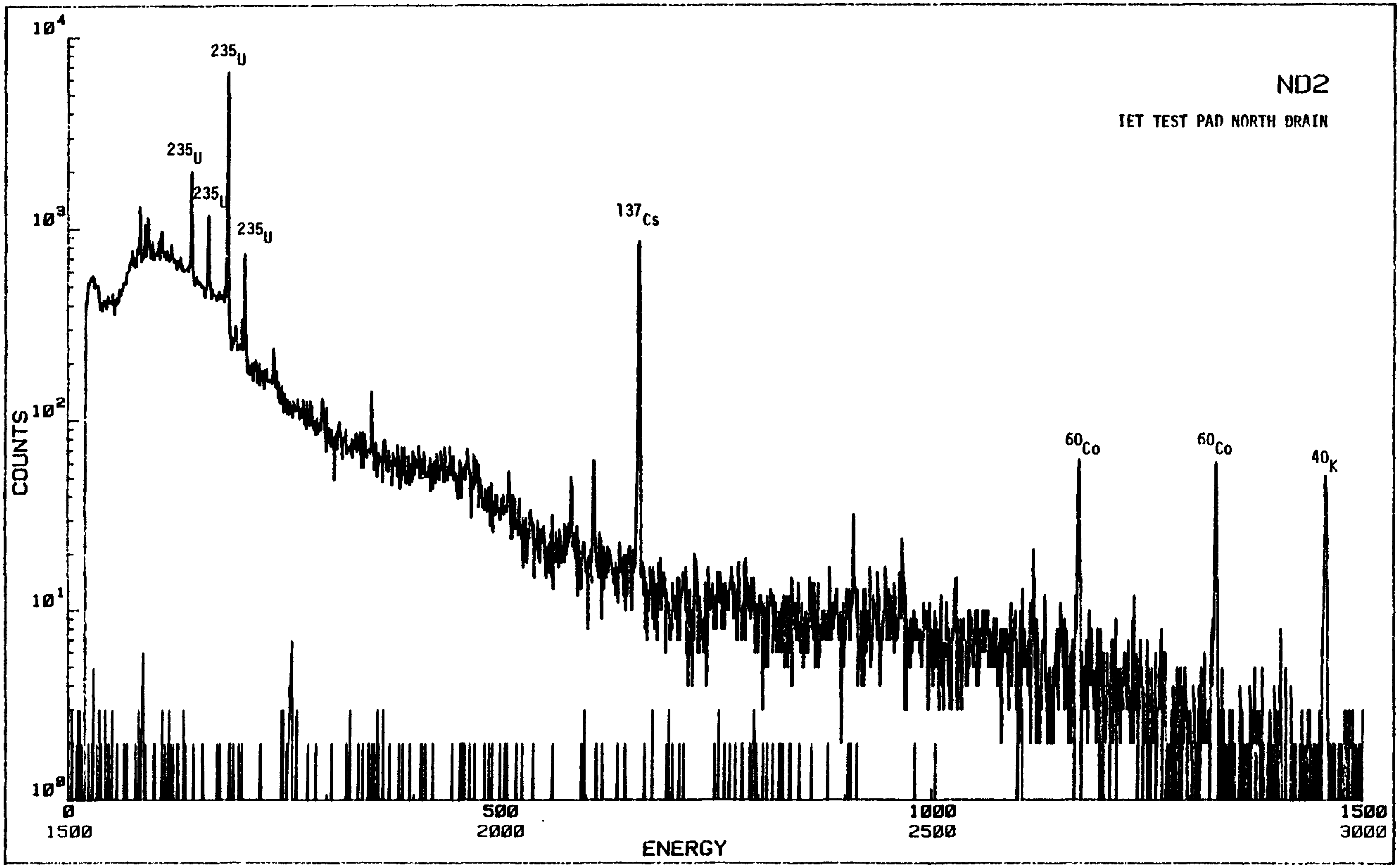

ND2
IET CULVERT NW OF STACK
^{137}Cs
^{235}U
^{228}Th
^{226}RaD
^{226}RaD
^{226}RaD
^{226}RaD
^{228}ThD
^{60}Co
^{60}Co
^{40}K
10^3
10^2
10^1
10^0
COUNTS
0
500
1000
1500
1500
2000
2500
3000
ENERGY

Figure 17.


ND2
IET TEST PAD NORTH DRAIN
COUNTS
10^4
10^3
10^2
10^1
10^0
^{235}U
^{235}U
^{235}U
^{235}U
^{137}Cs
^{60}Co
^{60}Co
^{40}K
0
1500
500
2000
1000
2500
1500
3000
ENERGY