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*Environmental Documentation for an
Environmental Impact Statement
on the Pontex Plant
Annual Food Chain Radiological Assessment*

LOS ALAMOS NATIONAL LABORATORY



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Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant

Agricultural Food Chain Radiological Assessment

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SUPPLEMENTARY DOCUMENTATION FOR AN ENVIRONMENTAL IMPACT STATEMENT
REGARDING THE PANTEX PLANT:

AGRICULTURAL FOOD CHAIN RADIOLOGICAL ASSESSMENT

by

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ABSTRACT

This report documents work performed in support of preparation of an Environmental Impact Statement regarding the Department of Energy's (DOE) Pantex Plant near Amarillo, Texas. The introduction describes why soil, water, vegetation, and beef cattle were sampled on the Pantex Plant and the general experimental treatments analyzed for a feedlot experiment. The chemical and radiochemical methods used for analyzing these samples at the Los Alamos National Laboratory are discussed in the methods section for each sample type. The results section presents the statistical differences found between control samples and samples from the Pantex Plant for uranium, tritium, plutonium, and scandium, a nonradioactive rare earth element marker. The significant differences are explained in the conclusions section. The radiation levels found in water, soil, range vegetation, sorghum, and beef cattle from sampling on and near the Pantex Plant are compared to natural background levels. Their significance is interpreted as radiation doses from ingestion of meat. The Appendix contains the uranium, tritium, plutonium, and scandium analysis results for all the samples.

I. INTRODUCTION

This report documents work performed in support of preparation of an Environmental Impact Statement (EIS) regarding the Department of Energy's (DOE) Pantex Plant near Amarillo, Texas. That EIS addresses continuing nuclear weapons operations at Pantex Plant and the construction of additional facilities to house those operations. The EIS was prepared in accordance with current regulations under the National Environmental Policy Act. Regulations of the Council on Environmental Quality (40 CFR 1500) require agencies to

prepare concise EISs with less than 300 pages for complex projects. This report was prepared by Los Alamos National Laboratory to document detail of work performed and supplementary information considered during preparation of the Draft EIS.

Approximately 25% of the United States beef cattle feeding industry is concentrated within a 200-mile radius of Amarillo, Texas. Yearly, over four million cattle are fed for slaughter in this area, which includes the Texas and Oklahoma Panhandles and southwestern Kansas. Cattle raised on native grasses and small-grain pastures are usually sold at public auction. Generally, these cattle will be traded at more than one auction barn before reaching a preconditioning or finishing feedlot. Cattle fed a growing ration in a preconditioning feedlot do not usually go to a finishing feedlot until they weigh 650 to 750 lbs. Pasture cattle may also be sold and transferred to either type of feedlot. After cattle in a finishing feedlot have attained a weight of 1000 to 1100 lbs, they are sold to a slaughter facility where they are butchered and prepared for human consumption.

Cattle feed ingredients are grown in various sections of the country. For economic reasons, feedlots attempt to obtain most ingredients from local sources. Cottonseed hulls, cottonseed meal, and grain sorghum are usually purchased locally. However, soybean meal, minerals, and most of the grain (other than sorghum) must be transported in from other parts of the country.

Upon arrival at the feedlot, cattle are started on a high-roughage ration and rapidly (usually within 28 days) adjust, through a series of rations of increasing energy content, to a high-energy ration. High-energy rations will contain from 80 to 100% grain. Therefore, for most of the feeding period (100 to 140 days), grain is the major dietary component.

Because cattle are pastured on the Pantex Plant site and grain sorghum is the major crop grown on the site, beef cattle ranging on the site were purchased and sampled for radioactive nuclides. Additional cattle purchased at auction were fed grain sorghum grown near the Pantex Plant site to determine whether the feed-to-cattle pathway may be a significant pathway to man. Previous soil and air samples at the Pantex Plant indicated that uranium and tritium are possible onsite contaminants that could enter the food chain (MHSM 1982, Buhl 1982). Because plutonium is handled at the site, it was included along with uranium and tritium in the radiochemical analysis for this study; however, plutonium has never been released by operations at the Pantex Plant. It is available from worldwide fallout from open-air testing of nuclear weapons. Elemental scandium was also analyzed in most samples and is considered a good tracer or "marker" for plutonium and uranium because of its immobility and relatively large natural concentration in soil. In this study, range grass, feeds, and beef cattle produced on and near the Pantex Plant that could be pathways for radiation exposure to the public were sampled and analyzed for tritium, uranium, plutonium, and scandium. Statistical

analyses of the results were performed using standard statistical techniques. Results are reported as mean values ± 1 standard deviation. Means among cattle treatments were tested for significant differences using one-way analysis of variance (ANOVA). Means between onsite and offsite samples were tested using a Student's t-test.

Two major crops, grain sorghum and winter wheat (Triticum sp.), are grown at the Pantex Plant site. Several large pastures on the Pantex Plant site are subleased to local ranchers for beef cattle grazing. These cattle are then placed in a local feedlot or offered for sale at auction. For this study, cattle pastured on Pantex Plant rangeland and cattle purchased at auction were placed in a local feedlot (Texas Tech Feedlot) and fed sorghum grown near the northeast perimeter of the Pantex Plant. A control herd was placed on another feedlot at Bushland, Texas (Bushland Feedlot), and fed a commercial ration. Soil, range grasses, feed, water, blood, selected organs, and meat were sampled and analyzed for tritium, uranium, plutonium, and scandium. Table I lists the sample types, sampling location, and number of samples. A total of 581 samples were analyzed. Uranium and scandium were analyzed in all individual samples except blood; uranium in blood could not be analyzed. Fifty-one composite samples representing all sample types were analyzed for ^{238}Pu and ^{239}Pu .

Other food chain studies have found that cattle, through inhalation and consumption of contaminated particles in soil and vegetation, will accumulate uranium and plutonium in their tissues and hence make them available to man. Uptake studies have been done at the Nevada Test Site and Rocky Flats Plant in areas known to have low-level plutonium and uranium contamination (Smith 1974, Smith 1975). In addition, as part of the radiological assessment after a uranium mill tailings spill near Gallup, New Mexico, the US Public Health Service analyzed goat, sheep, and cattle tissues for uranium and other elements to ascertain the effect on the food chain (Ruttenber 1980). Dairy products and meat ingestion are considered major routes of entry of radionuclides through ingestion for man, and radiation doses calculated from ingestion of radionuclides in these foods are routinely calculated for radiological assessments (USNRC 1977, Garten 1978, and Boone 1981).

II. METHODOLOGY

A. Soils

1. Pantex Plant Sampling Plots. Thirty sample plots were surveyed in a 200-acre pasture (Sections II.A and II.B, Sec. 51, Tract 36 of Carson County, Texas, located 1 mile west of the Pantex Plant site burning ground) on the Pantex Plant site. The plots were sampled on October 27 and 28, 1981, while the cattle were on range. The survey origin was the corner fence post located at the grid origin in Fig. 1. A N-S and E-W 30-m grid system was laid out over the pasture with markers. Figure 1 depicts the grid and sample

TABLE I
SUMMARY OF SAMPLE TYPES

<u>Sample Type</u>	<u>Sampling Location</u>	<u>Number of Samples</u>
Resuspendible range soil	Pantex Plant site pasture	30
25-cm range soil core		30
Live and dead above-ground range grass		30
Water trough		1
<hr/>		
25-cm soil core	NE perimeter near Pantex site	3
Grain Sorghum		
Seed head		3
Shoot		3
Root		3
<hr/>		
Heifer samples	Five beef cattle treatments	
Kidney		30
Lung		30
Bone		30
Liver		30
Muscle		30
Rumen contents		30
Hamburger		30
Steak		30
Blood		180
<hr/>		
Feed and water samples		
Feed mix	Texas Tech Feedlot	23
Alfalfa		11
Feed constituents		4
Tap water		1
Feed mix	Bushland Feedlot	18
Tap water		1

plots by number. Thirty X_1 and Y_1 coordinates were obtained from four-digit random numbers selected by blind entry into a random number table. The first digit represented the positive or negative direction from the fence post origin along a N-S line according to whether it was even or odd, respectively. The second digit represented the distance. Similarly, the third and fourth numbers represented direction and distance along the E-W line. Figure 2 is a photograph of the Pantex Plant range showing the SE

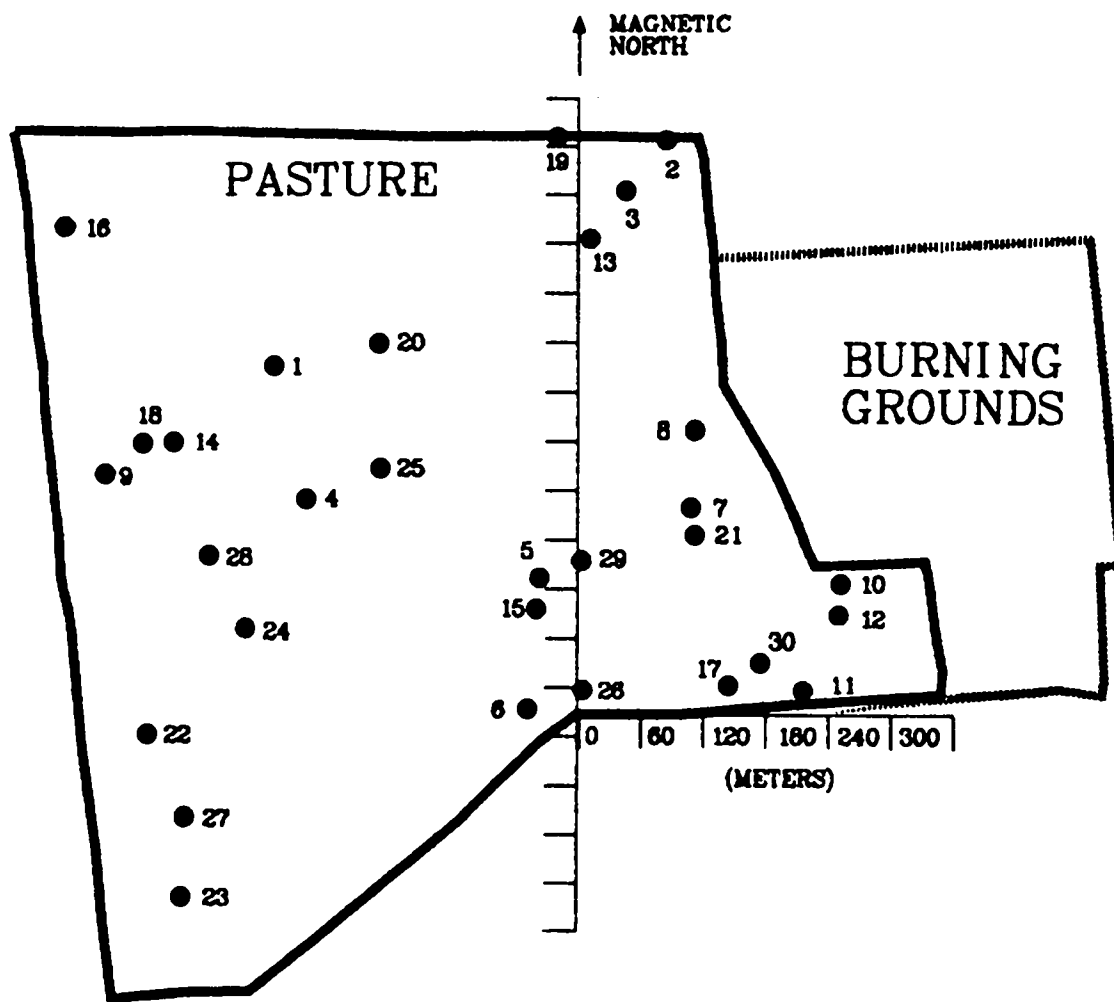


Fig. 1. Random sampling plots on Pantex Plant range.

corner of the pasture. A dry playa lake with approximately 6 ft of elevation change occupies the center portion of the pasture.

Soil samples were taken at each plot by two methods (Hansen 1980). A 1-cm resuspendible soil layer sample was taken, after removal of vegetation, by pounding a 20-cm-diam metal ring into the soil 1 cm until the top edge was flush with the surface. A circular spatula was slid underneath the ring to obtain only the top 1-cm soil layer. The sample was placed in double plastic bags, labeled, and packed for shipping. After removal of the resuspendible layer, a 5-cm-diam plastic pipe was driven 25 cm into the soil and removed to gain a 25-cm soil core. The entire pipe and contents were sealed in double plastic bags, labeled, and packed for shipping. The spatula and 1-cm ring were rinsed with distilled water between plots to avoid cross contamination.



Fig. 2. SE corner looking north toward dry playa of Pantex Plant range bordering the burning grounds.

2. Pantex Plant NE Perimeter Soil Samples. On October 29, 1981, three 25-cm-deep soil core samples were collected beneath sorghum plants on a harvested field edge approximately 2 miles north of the NE corner of the Pantex Plant site. The cores were placed in plastic bags, labeled, and packed for shipping.

3. Laboratory Sample Preparation and Analysis. All samples were brought to the Los Alamos National Laboratory for analysis.

Standard procedures for analytical quality assurance were rigorously followed for all analyses. Details can be found in Gladney 1981A, 1981B, and 1982B. The samples were frozen until ready for analysis. Wet weights were obtained on each sample. Water was distilled from the resuspendible layer soil samples for tritium analysis (Gladney 1982A). When at least 6 ml of distillate had been collected, a 5-ml sample was pipetted into a glass

scintillation vial and 15 ml of PCS II* cocktail was added. Each sample was shaken vigorously and counted for 35 min in a Packard Liquid Scintillator Counter. These data were reduced to pCi/l ^3H using standard computing techniques (Gladney 1982A). Dry weights were obtained after drying at 105°C. The resuspendible soil samples had considerable organic material and were ashed over a period of about 4 days by gradually increasing the oven temperatures to 500°C until a white ash was visible in the soil matrix.

The ashed, resuspendible soil layer and the dried soil core layer samples were ball milled to homogenize the samples. A portion of each sample was analyzed for total uranium using delayed neutron assay (Gladney 1980A and 1980B). Scandium was determined on the same sample by instrumental thermal neutron activation analysis (Gladney 1980B). Plutonium analyses were not done for the soil cores from the NE perimeter. Plutonium was determined for soil composites from the Pantex Site pasture plots. Five plots were composited which gave six analyses for resuspendible and six analyses for 25-cm core samples. The composite plutonium isotopic composition was determined by radiochemical separation and alpha spectroscopy (Gladney 1982A). Plutonium-239,240 are reported together as ^{239}Pu because the analytical method does not distinguish between these two nuclides.

B. Vegetation

1. Pantex Plant Range Sampling Plots. Forage samples were collected at the same time as the soil samples on each plot by clipping all dead and live standing biomass of grasses (mainly Bouteloua gracilis, and Buchloe dactyloides) and forbs to within 1 cm of the ground surface. In some plots, because of sparse vegetation, two or three 1-m² plots adjacent to each other were sampled to obtain sufficient biomass for analyses. Grass clippers were rinsed with distilled water between plots. Plots 3, 6, 11, 12, 13, 14, 15, 18, 24, 25, 26, 28, and 29 were 2 m²; plots 7, 21, 30 were 3-m² plots; and the remainder were 1-m² plots. Biomass was adjusted to 1 m² for data calculations in all cases. Most of the 2- and 3-m² plots were within the dry playa area and were predominantly small forbs instead of established perennial grasses.

2. Pantex Plant NE Perimeter Grain Sorghum Plant Samples. On October 29, 1981, three entire grain sorghum plants were collected from the edge of a harvested field approximately 2 miles north of the NE corner of the Pantex Plant site. The three plants were removed carefully to minimize disturbance of the root system. While in the field each plant was separated into roots, shoots, and seed heads. The samples were placed in double plastic bags, labeled, and packaged for shipment.

*PCS II, Phase Combining System, Amersham Corp., Arlington Heights, Illinois.

3. Laboratory Sample Preparation and Analysis. Wet, dry, and ash weights were taken on all vegetation. During preparation for ^3H analysis, some of the vegetation samples yielded colored distillates causing quenching. They were redistilled over KMnO_4 and realiquoted. Redistillation proved unsatisfactory; therefore, internal ^3H spikes were added and the samples recounted. This procedure allowed for an analysis of the counting efficiency and results were adjusted accordingly.

The uranium, scandium, and plutonium analyses were determined on the plant ash using the same procedures described earlier for soils. Total potassium analysis was performed on the NE perimeter sorghum and soil samples using standard procedures (Gladney 1980B).

C. Water

1. Sampling Stations. Ten 1-gal. plastic containers were used to sample the Pantex Plant pasture trough (October 28, 1981), the Texas Tech Feedlot tap (December 17, 1981), and the Bushland Feedlot tap (December 17, 1981). The samples were labeled and transported to the Los Alamos National Laboratory for analysis.

2. Laboratory Sample Preparation and Analysis. The ten 1-gal. water samples were frozen at Los Alamos until analysis. The 5-ml aliquots were taken for ^3H analysis using the PCS II cocktail. Total uranium was determined directly on the water samples. Scandium determinations in water required an initial chemical separation. Five hundred milliliters of sample water were acidified to 0.5 M HCl, after which a known quantity of ^{144}Ce tracer was added. The sample was passed through a DOWEX* 50 x 8 cation exchange column, which quantitatively retains scandium and other rare earth elements. After washing with 2 M HCl, scandium is eluted with 6 M HCl. The eluant was dried on polycarbonate film, and ^{144}Ce was counted on a NaI well counter to determine chemical rare earth yield. The films were folded and placed into small polyethylene beam vials for scandium measurement by thermal neutron activation.

D. Beef Cattle and Feed

1. Cattle Handling and Feed. Figures 3 and 4 are schematics of the experimental cattle treatments performed for this study at the Texas Tech University Research Feedlot (Texas Tech Feedlot) on the southwest boundary of the Pantex Plant and at the USDA and Texas A&M Experiment Station Feedlot at Bushland (Bushland Feedlot).

*DOWEX cation exchange resin supplied by Bio-Rad Laboratories, 32nd & Griffin, Richmond, Calif. DOWEX is the registered trademark of the Dow Chemical Co.

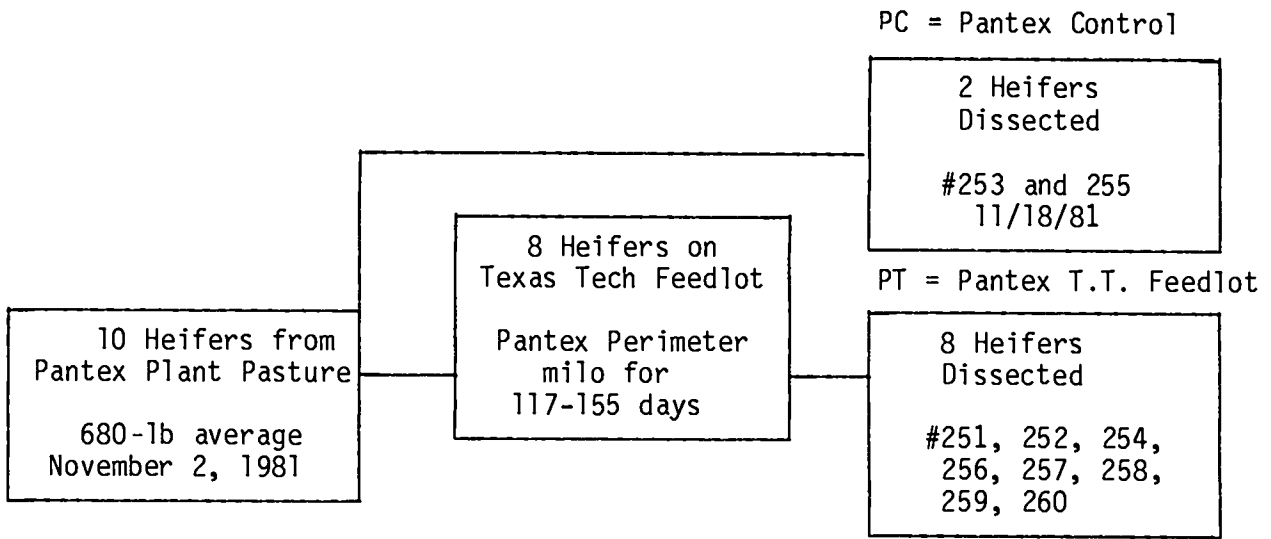


Fig. 3. Experimental cattle treatments PC and PT.

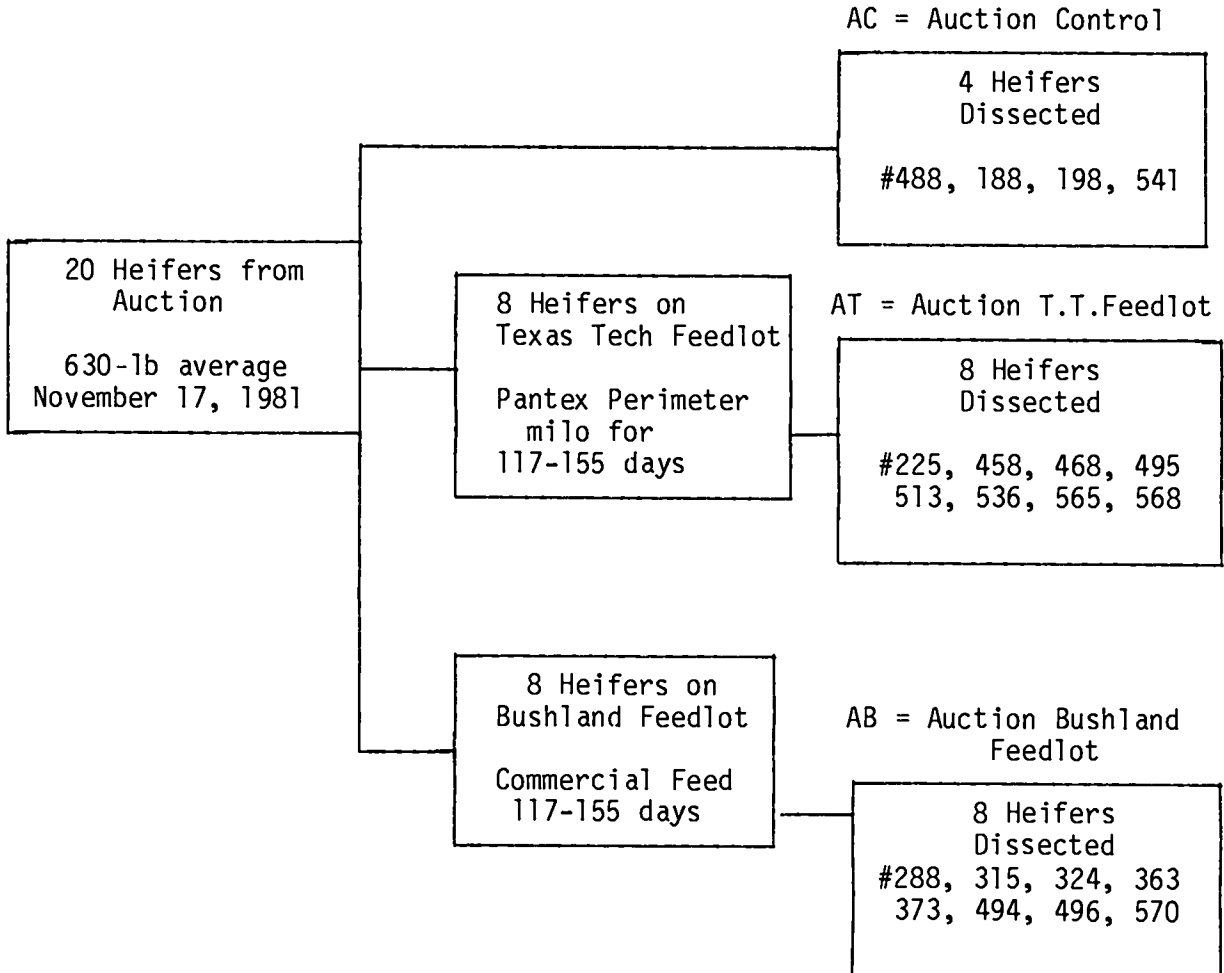


Fig. 4. Experimental cattle treatments AC, AT, and AB.

On November 2, 1981, ten 680-lb (average weight) heifers were purchased from Edwin Kennedy and received at the Texas Tech Feedlot. These heifers had been grazing native grasses from the 200-acre Pantex Plant pasture, which had been sampled earlier for vegetation and soil. Grazing period for these heifers was from approximately June 1, 1981, through November 2, 1981. Two were dissected as controls (PC = Pantex Control), and the remaining eight (PT = Pantex Texas Tech Feedlot) were placed in the Texas Tech Feedlot. This is depicted in Fig. 3.

On November 17, 1981, twenty 630-lb (average weight) heifers were purchased at public auction from the Amarillo Livestock Auction Company. The heifers were randomly allocated to two groups of 10 head. Eight of the ten heifers were retained at the Texas Tech Feedlot as background controls (AT = Auction Texas Tech Feedlot). Eight of the remaining ten heifers were transferred to the Bushland Feedlot to serve as nonexposed controls (AB = Auction Bushland Feedlot). Transfer of the AB heifers to Bushland was delayed until November 24, 1981, because of a quarantine in effect at Bushland. This is depicted in Fig. 4.

Two heifers from each of the three groups (PC = Pantex Control and AC = Auction Control) were randomly chosen and transported on November 18, 1981, to Texas Tech University Meats Laboratory in Lubbock, Texas, to be sacrificed and dissected as controls.

Cattle were housed in open air, dirt floor pens, which provided 20 ft of bunkspace and 300 sq ft of space/heifer at the Texas Tech Feedlot and offered feed ad libitum. Fresh water was available from automatic waterers. Table II shows the feed composition for the PT and AT treatments. Grain sorghum provided to the heifers at the Texas Tech Feedlot was obtained from a field (S 1/2, Sec. 52, Block M-4) located 1 mile west and 1.5 mile north of the Pantex Plant site's northeast corner. This area is considered to be downwind of the Pantex Plant firing site because of the prevailing SW winds. Origin of the chopped alfalfa hay was near McClave, Colorado. Origins of the other commercial feed components are listed in Table II. Weekly feed samples were collected and transported to Los Alamos National Laboratory. Jugular blood samples were collected from both range and auction heifers. Sampling involved collection of 250 cm³ of blood twice weekly for 2 wk followed by once weekly for 2 wk and then once every 2 wk for 2 mo. Initial and final weights were recorded as well as daily feed consumption. Upon reaching finished weight and carcass grade of choice by visual estimation, the three groups of heifers were delivered to the meats laboratory at Texas Tech at Lubbock, Texas, for dissection.

The heifers kept at Bushland were housed in pens similar to those at the Texas Tech Feedlot. The ration described in Table III was provided ad libitum. Table III lists the weight gain and feed consumption for each of the Bushland heifers. Rations were prepared by a commercial feedmill in

TABLE II
FEED COMPOSITION FOR TEXAS TECH FEEDLOT HEIFERS

<u>Ingredient</u>	<u>Per Cent by Weight</u>
Dry rolled sorghum (from NE perimeter of Pantex)	78
Chopped alfalfa hay	12
Cane molasses	5
Protein supplement	
Dehydrated alfalfa meal	2.0
Rice mill feed	0.75
CaCO ₃ (from Waco, Texas)	0.80
NaCl (from Carlsbad, New Mexico)	0.5
KCl (from Carlsbad, New Mexico)	*
Dicalcium phosphate (from Florida)	0.26
Ammonium sulfate	0.31
Urea	0.36
Trace minerals	0.02
Vitamin A	*
Vitamin E	*

*Trace.

TABLE III
FEED COMPOSITION OF BUSHLAND FEEDLOT HEIFERS

<u>Ingredient</u>	<u>Per Cent by Weight</u>
Dry rolled corn	69.0
Cottonseed meal	6.0
Cottonseed hulls	10.0
Alfalfa (dehydrated)	7.5
Cane molasses	5.0
Fat	1.1
NaCl	0.5
Urea 288	0.5
CaCO ₃	0.5
Rumensin 60	*
Vitamin A	*
Trace minerals	*

*Trace.

Friona, Texas. Origin of individual ingredients was not known. Fresh water was provided at all times from automatic waterers. Table IV gives the heifer weight and feed data for both feedlots. Weekly feed samples were collected and transported to Los Alamos National Laboratory for analysis.

2. Organ and Tissue Dissections and Meat Sampling. Heifers were transported to the Texas Tech University Meats Laboratory in Lubbock, Texas, to be sacrificed and dissected. The collection and preparation of tissues was performed by L. C. Hollis, D.V.M., from the Texas A&M Veterinary Diagnostic Laboratory at Amarillo. After dissection of each tissue, scalpels and surgical gloves were discarded to avoid cross contamination. Dissection procedures were the same for all carcasses and progressed as follows.

- a. Following exsanguination, the hide was carefully removed to avoid puncturing pleural and peritoneal cavities.
- b. The carcass was washed completely with hot water.
- c. The peritoneal cavity was carefully incised to avoid puncture of the digestive tract.
- d. Tissue and organ samples were removed in sequence from low to high potential radioactivity concentrations.
- e. Extraneous fat and connective tissues were removed from each sample.
- f. Samples were sealed in freezer containers and frozen for air transport to Los Alamos National Laboratory.

The organ and tissue samples were removed in the following sequence.

- a. Skeletal muscle (The tensor fascia antibrachium muscle was removed from the posterior border of the left front leg and discarded. The muscle bellies from the underlying long and medial heads of the triceps muscle were then collected.)
- b. Kidney (left)
- c. Liver (A portion of dorsal border of the liver including the caudate lobe was collected.)
- d. Bone (The left elbow joint was disarticulated and the upper one-half of both the radius and ulna were collected.)
- e. Lung (The left lung was removed and distal portion was collected.)
- f. Rumen content (A sample from dorsal sac of rumen was collected.)

TABLE IV

HEIFER WEIGHT AND FEED DATA

<u>Ear Tag</u>	<u>Initial Weight (lb)</u>	<u>Final Weight (lb)</u>	<u>Total Gain (lb)</u>	<u>Days on Feed</u>	<u>Average Daily Gain (lb)</u>	<u>Average Consumption/Day (lb)</u>	<u>Feed Efficiency (lb)</u>
<u>Pantex Plant Range Heifers</u>							
259	694	937	243	117	2.08	21.69	10.43
260	682	857	175	117	1.49	21.69	14.56
251	759	1088	329	138	2.38	21.92	9.21
252	710	1036	326	138	2.36	21.92	9.29
257	668	988	320	138	2.32	21.92	9.45
258	738	1124	386	138	2.80	21.92	7.83
254	636	926	290	155	1.87	21.68	11.59
256	620	982	362	155	2.33	21.68	9.30
<u>Pantex Plant Auction Heifers</u>							
225	619	798	179	117	1.53	19.90	13.01
495	618	920	302	117	2.58	19.90	7.71
458	649	1100	451	138	3.27	20.13	6.21
468	526	738	212	138	1.54	20.31	13.19
536	597	987	390	138	2.83	20.31	7.18
565	647	1002	355	138	2.57	20.31	7.90
513	595	917	222	155	2.08	20.25	9.73
568	640	1072	432	155	2.79	20.25	7.26
<u>Bushland</u>							
373	812	1340	528	117	4.51	20.60	4.56
570	715	1050	335	117	2.86	20.60	7.20
288	661	1056	395	138	2.86	20.60	7.20
315	714	1150	436	138	3.16	20.60	6.52
363	639	1084	445	138	3.22	20.60	6.40
494	560	872	312	138	2.26	20.60	9.11
324	546	964	418	155	2.70	20.60	7.63
496	532	920	388	155	2.50	20.60	8.24

The carcasses were chilled and butchered at the meats laboratory. Random 1-kg ground beef and steak samples were collected from each carcass.

Fetuses were recovered from heifers 494, 565, and 570. The fetuses will be dissected for placental transfer studies. Heifer 225 fell immediately before slaughter and inhaled rumen contents, which contaminated the lung sample.

3. Laboratory Sample Preparation for Tissue and Meat. Wet, dry, and ash weights were obtained for each sample. Considerable difficulty was experienced while ashing the large volumes of tissue. Lung and liver were difficult to dry and ash due to bubbling and a tendency to explode in the oven. One liver and two lung samples were lost during ashing because the oven overheated. Therefore, the oven had to be carefully raised over a several day period to avoid loss of sample. Tritium analyses were performed as described earlier on muscle, hamburger, steak, blood, and rumen contents. Analyses on the other tissues were not necessary due to the rapid (about 4 h) equilibrium time for tritium in the body water pool. Uranium, scandium, and plutonium were analyzed on ashed tissue as described previously. Considerable difficulty in the analysis for uranium was encountered for the ashed blood samples because of a large interference by chlorine. Therefore, only the blood scandium data are reported. Total uranium was determined directly on ashed samples.

Samples were composited within sample types and treatments for plutonium analyses.

4. Laboratory Sample Preparation and Analysis for Feed. Feed samples were prepared as described previously for vegetation. Tritium analyses encountered quenching problems and were reanalyzed with interval ^3H spikes in the same fashion as the vegetation samples. Samples were composited for plutonium by collection dates and feedlots.

III. RESULTS

A. Soils

Tables A-I through A-IV give the analysis results for the soil samples for tritium, scandium, uranium, and plutonium. Table V lists the radionuclide and scandium concentration mean value and 1 standard deviation. Tritium mean value for soils is higher than those in northern New Mexico (2600 ± 2400 pCi/g) (ESG 1982), but the standard deviation indicates the means are in the same range. However, Pantex Plant offsite soil and native vegetation samples were not analyzed for tritium to determine the regional tritium concentration. No statistical difference was found between the 2-cm resuspension soil layer uranium concentration and the 25-cm core layer for the 30 Pantex Plant

TABLE V

MEAN VALUES AND 1 STANDARD DEVIATION FOR SOIL, PLANT, AND WATER SAMPLES

<u>Sample Type</u>	<u>n</u>	<u>³H pCi/ℓ</u>	<u>Sc ppm (ash)</u>	<u>U pCi/g (dry)</u>	<u>²³⁸Pu* fCi/g (dry)</u>	<u>^{239,240}Pu* fCi/g (dry)</u>
Resuspendible soil - Pantex	30	3290 ± 2290	8.7 ± 1.5**	2.1 ± 0.14	0.82 ± 1.5	36 ± 7.2
25-cm soil core - Pantex	30	-	9.3 ± 1.7**	2.0 ± 0.13	-0.10 ± 1.2	5.7 ± 8.7
25-cm soil core - perimeter	3	-	8.8 ± 0.25**	2.4 ± 0.058	-	-
Range grass - Pantex	30	7580 ± 4490	0.58 ± 0.5**	0.081 ± 0.088	0.14 ± 0.20	1.0 ± 0.67
Sorghum - perimeter						
Seed head	3	-	0.31 ± 0.012	0.0027 ± 0.00051	-	-
Shoot	3	-	0.44 ± 0.17	0.010 ± 0.0035	-	-
Root	3	-	5.7 ± 2.0	0.34 ± 0.13	-	-
Water samples	3	1500 ± 530	0.000010 ± 0.0000016	6.5 ± 0.40 (pCi/ℓ)	-15 ± 7 (fCi/ℓ)	-17 ± 3 (fCi/ℓ)
Feed mix - Texas Tech Feedlot	23	2780 ± 2350	0.11 ± 0.07**	0.26 ± 0.16	0.3 ± 1.0	1.0 ± 1.0
Feed constituents - Texas Tech Feedlot						
Rolled milo	1	-	0.11 ± 0.02	0.0016 ± 0.0002	-	-
Cotton seed	1	2000 ± 2000	2.1 ± 0.1	0.058 ± 0.006	-	-
Protein pellets	1	-1000 ± 2000	0.96 ± 0.05	3.2 ± 0.3	-	-
Cane molasses	1	8000 ± 2000	0.64 ± 0.04	0.068 ± 0.007	-	-
Alfalfa	11	2760 ± 2670	1.6 ± 1.3	0.11 ± 0.070	-0.4 ± 0.6	4.0 ± 2
Feed mix - Bushland Feedlot	18	2410 ± 1380	0.057 ± 0.02**	0.15 ± 0.074	-0.3 ± 0.5	0.3 ± 0.8

*Plutonium analyses done on composites of n.

**ppm (dry).

range plots sampled. A Student's t-test at 95% confidence level indicated the means were identical. The uranium soil concentrations are in the worldwide background range of 2-3 pCi/g (Russell 1966). Values for ^{238}Pu and $^{239,240}\text{Pu}$ for these soil samples are lower than for the region surrounding Los Alamos (ESG 1982).

B. Range Vegetation and Grain Sorghum

Tables A-IV through A-VII give the analysis results for the plant samples for tritium, scandium, uranium, and plutonium. The vegetation values listed in Table V indicate considerably lower concentrations in plants than are in soils, which show discrimination against uptake as one moves up the food chain from soil to plants for scandium, uranium, and plutonium. This indicates that scandium, uranium, and plutonium are not selectively accumulated in the plants as, for example, is potassium (Table A-VII). Values for potassium were 12 times higher in sorghum shoots than in soil. Tritium values were higher in plant water than in soil water. The ^3H in range grasses was in the same range as for northern New Mexico (4200 ± 3600 pCi/g) (ESG 1982). The mean for range grass was higher statistically than it was for the vegetable samples collected on or near the Pantex Plant and in Claude, Texas (Buhl 1982).

C. Water

Table A-VIII lists the analysis results for the water samples. Table V gives the mean values for these analyses. The tritium levels in the water samples are similar to those in northern New Mexico. Uranium concentrations are higher than they are for northern New Mexico, but plutonium values are lower (ESG 1982).

D. Beef Cattle Tissue and Feed

1. Feed. Tables A-IX through A-XIII list the analysis results for the feed samples for the Texas Tech and Bushland Feedlots. The mean values are given in Table V. Tritium, uranium, plutonium, and scandium values in feed are comparable to the other vegetation samples.

Because the cattle tissues would reflect the feed concentrations for the radionuclides and scandium, the feeds and feed constituents were statistically tested for differences between the two feedlot feeds. The mean scandium value (ppm dry) for the Texas Tech Feedlot weekly feed mix samples was 0.11 ± 0.07 and for the Bushland Feedlot was 0.057 ± 0.02 . These means were tested and found to be statistically different using the Student's t-test ($\alpha = 0.05$).

The mean uranium value (pCi/g dry) for the Texas Tech Feedlot weekly feed mix samples ($n = 23$) was 0.26 ± 0.16 , whereas the Bushland Feedlot feed

(n = 18) was 0.15 ± 0.074 . Means were tested at the 95% confidence level ($\alpha = 0.05$) and found to be statistically different using the Student's t-test. The reason for the higher scandium and uranium content of the Texas Tech Feedlot feed was traced to a protein supplement additive (which was not used at the Bushland Feedlot) that had 0.41 ppm (dry) scandium and 3.2 pCi/g (dry) of natural uranium and represented 5% of the total weight of the normal Texas Tech Feedlot feed used for all cattle at the feedlot. Table VI shows the feed grab sample component and mix analyses. Each component was sampled before mixing and analyzed separately. The feed mix milled at the Texas Tech Feedlot was sampled before distributing to the cattle. Individual uranium analyses on the feed components times the feed component fraction of the final mix gave the same total uranium content as the feed mix grab sample. (Similar analysis for scandium gave the same result.) This finding conclusively shows the protein pellets containing the dicalcium phosphate mineral supplement are the source of uranium for the feed mix. The protein supplement in the feed mix contains 92% of the total uranium in the feed. The specific source of uranium in the Bushland Feedlot feed was not identified because a commercial premixed feed was purchased and fed to the cattle. Two previous studies have identified uranium in cattle feeds (Reid 1977, Chapman 1963). Chapman found about 8 times more uranium in feed concentrates than in alfalfa hay fed to dairy cattle. The average in such concentrate was 0.09 pCi/g of uranium. Reid found uranium to be proportional to the phosphate percentage in the mineral feed supplements and phosphorus ranges from 0 to 20%, which gave uranium values from 0 to 200 ppm.

2. Beef Cattle Tissue and Meat. Tables A-XIV through A-XXI list the analysis results for the tissues and meat samples for tritium, scandium, uranium, and plutonium. Two statistical analyses were performed for each radionuclide and scandium: one-way analysis of variance and the two-tailed t-test (Nie 1975). The tissue data in Table A-XIV were input to a file and SPSS was used to do the statistical analyses.

Comparison of treatments PT, AT, and AB for tritium showed no significant difference between these treatments for muscle, hamburger, steak, and rumen contents. Table VII gives the tritium ANOVA results. Significance is given for α . When $1 - \alpha$ was greater than 0.90, results were considered significant. Tritium t-test results are shown in Table VIII for PC vs AC, AC vs AB, and AC vs AT. The reason for significance for hamburger and steak in AC vs AB is not clear. Analyses were done several months apart, and interference from ambient tritium levels may be the cause for the difference. The major result of no difference between treatments for tritium is apparent in Table VII.

Table IX gives the ANOVA and Table X the t-test results for scandium among the same treatments as tested for tritium. Two sets of data were tested: analysis results in ppm (ash) and a converted set ppm (wet). Rumen contents were treated differently. Because rumen contents are vegetative

TABLE VI
SCANDIUM AND URANIUM CONTENT OF THE TEXAS TECH FEEDLOT FEED CONSTITUENTS

Grab Samples of Constituent and Feed Mix (12/17/81)	Composition Fraction	Scandium Dry (ppm)	Uranium Dry (pCi/g)	Dry Weight	Ash Weight	Composition Fraction x Uranium Dry (pCi/g)	Composition Fraction x Scandium Dry (ppm)
Dry roll milo	0.78	0.014 ± 0.003	0.0016 ± 0.0002	1149	147	0.0012	0.011
Alfalfa	0.12	0.098 ± 0.006	0.073 ± 0.007	232	26.7	0.0088	0.012
Cane molasses	0.05	0.15 ± 0.01	0.068 ± 0.008	363	86.5	0.0034	0.0075
Protein supplement	0.05	0.41 ± 0.02	3.2 ± 0.3	1180	507	0.16	0.021
Mixed feed	1.00	0.061 ± 0.003	0.17 ± 0.02	572	39.2	Σ 0.17	Σ 0.052

TABLE VII
TRITIUM ANOVA RESULTS

Sample Type	n	F Value	Significance α	pCi/ξ		
				Treatment PT X ± 1 s.d.*	Treatment AT X ± 1 s.d.	Treatment AB X ± 1 s.d.
Muscle	24	0.7247	0.4962	730 ± 1300	810 ± 2000	38 ± 530
Rumen contents	24	0.7422	0.4882	300 ± 1100	1700 ± 4200	700 ± 520
Hamburger	24	0.2564	0.7762	1000 ± 1300	1000 ± 1000	2400 ± 4100
Steak	24	0.0829	0.9208	700 ± 790	850 ± 920	860 ± 950

*Uncertainties are one standard deviation.

TABLE VIII
TRITIUM T-TEST RESULTS

Sample Type	DF	T Value	2-Tail Prob., α	pCi/l	
				Treatment $\bar{X} \pm 1 \text{ s.d.}^*$	Treatment $\bar{X} \pm 1 \text{ s.d.}^*$
				PC	AC
Muscle	4	-0.26	0.805	350 \pm 70	430 \pm 380
Rumen contents	4	0.19	0.857	300 \pm 140	230 \pm 510
Hamburger	4	-0.71	0.517	2100 \pm 850	4200 \pm 3900
Steak	4	0.48	0.654	4000 \pm 3000	3200 \pm 1100
				AC	AB
Muscle	10	1.28	0.228	430 \pm 380	38 \pm 530
Rumen contents	10	-1.01	0.338	230 \pm 510	2400 \pm 4100
Hamburger	10	2.63	0.025**	4200 \pm 3900	700 \pm 520
Steak	10	3.84	0.003**	3200 \pm 1100	860 \pm 950
				AC	AT
Muscle	10	-0.37	0.716	430 \pm 380	810 \pm 2000
Rumen contents	10	-0.68	0.510	230 \pm 510	1700 \pm 4200
Hamburger	10	2.26	0.047**	4200 \pm 3900	1000 \pm 1000
Steak	10	3.93	0.003**	3200 \pm 1100	850 \pm 920

*Uncertainties are ± 1 standard deviation.

**Means are significantly different at the $1-\alpha$ level of 0.90 or higher.

matrices, they were converted to ppm (dry) for analysis. (This conversion from ash to dry weights for rumen contents was also done for uranium). The scandium in rumen contents of PT and AT heifers was significantly higher than AB. This is reasonable because the scandium concentration was higher in the Texas Tech Feedlot feed than the Bushland Feedlot feed. The reason for the difference in the hamburger samples is not clear. Because both steak and muscle do not show a similar trend, probably differences in detection levels (which change for each batch of samples run) could account for the difference. In Table X significant differences between means of scandium in muscle are probably attributable to changes in detection limits for PC vs AC. Because these heifers are close in age and weight, the test indicates similar scandium concentrations in tissue at the beginning of the feedlot experiments. Testing the AC vs AB and AT indicates differences due to age and feed, resulting in significant changes of scandium concentration in kidney, liver, bone, muscle, and rumen contents.

TABLE IX
SCANDIUM ANOVA RESULTS

Sample Type	n	ppb (wet)		ppb (ash)		ppb (wet)		
		F Value	Significance α	F Value	Significance α	Treatment PT $X \pm 1 \text{ s.d.}$	Treatment AT $X \pm 1 \text{ s.d.}$	Treatment AB $X \pm 1 \text{ s.d.}$
Kidney	24	0.0648	0.9375	0.2174	0.8064	0.18 \pm 0.2	0.16 \pm 0.06	0.16 \pm 0.06
Lung	24	0.3525	0.7070	0.6391	0.5377	1.1 \pm 2	0.67 \pm 0.2	0.79 \pm 0.5
Bone	24	0.5997	0.5581	0.5739	0.5719	1.8 \pm 0.7	2.4 \pm 2	2.9 \pm 3
Liver	24	1.5797	0.2296	1.1717	0.3293	0.29 \pm 0.1	0.43 \pm 0.3	0.24 \pm 0.06
Muscle	24	0.1851	0.8323	0.9147	0.4160	0.31 \pm 0.2	0.36 \pm 0.2	0.40 \pm 0.4
Rumen content (dry)	24	3.0032	0.0713*	3.1337	0.0644*	150 \pm 60	150 \pm 70	82 \pm 60
Hamburger	24	3.0588	0.0693*	2.5967	0.0994*	0.81 \pm 0.6	0.33 \pm 0.3	0.37 \pm 0.2
Steak	24	0.5795	0.5693	0.6117	0.5523	0.64 \pm 0.6	0.45 \pm 0.3	0.46 \pm 0.2

*Means are significantly different at the 1- α level of 0.90 or higher.

TABLE X
SCANDIUM T-TEST RESULTS

Sample Type	ppb (wet)			ppb (ash)			ppb (wet)	
	DF	T Value	2 Tail Prob., α	DF	T Value	2 Tail Prob., α	Treatment $\bar{X} \pm 1$ s.d.	Treatment $\bar{X} \pm 1$ s.d.
<u>PC vs AC</u>								
Kidney	4	1.08	0.341	4	0.89	0.425	PC 0.43 \pm 0.2	AC 0.30 \pm 0.1
Lung	3	-0.22	0.842	3	-0.26	0.810	0.73 \pm 0.5	0.85 \pm 0.7
Bone	4	-1.30	0.264	4	-1.53	0.201	3.0 \pm 1	5.6 \pm 3
Liver	4	-0.63	0.560	4	-1.28	0.270	0.31 \pm 0.02	0.37 \pm 0.1
Muscle	4	-2.62	0.059*	4	-2.50	0.067*	0.56 \pm 0.6	1.6 \pm 0.4
Rumen contents (dry)	4	1.95	0.122	4	4.32	0.012*	120 \pm 10	59 \pm 40
Hamburger	4	0.37	0.730	4	-0.57	0.598	0.42 \pm 0.3	0.35 \pm 0.2
Steak	4	-0.35	0.743	4	-0.33	0.757	0.19 \pm 0.08	0.22 \pm 0.09
<u>AC vs AB</u>								
Kidney	10	2.76	0.020*	10	2.64	0.025*	AC 0.30 \pm 0.1	AB 0.16 \pm 0.06
Lung	9	0.17	0.868	9	1.04	0.324	0.85 \pm 0.7	0.79 \pm 0.5
Bone	10	1.68	0.123	10	2.03	0.069*	5.6 \pm 3	2.9 \pm 3
Liver	10	2.42	0.036*	10	2.77	0.020*	0.37 \pm 0.1	0.24 \pm 0.06
Muscle	10	5.07	0.000*	10	8.68	0.000*	1.6 \pm 0.4	0.40 \pm 0.4
Rumen contents (dry)	10	-0.69	0.506	10	-0.88	0.400	59 \pm 40	82 \pm 60
Hamburger	10	-0.21	0.836	10	1.26	0.236	0.35 \pm 0.2	0.37 \pm 0.2
Steak	10	-2.37	0.039*	10	-0.90	0.390	0.22 \pm 0.09	0.46 \pm 0.2
<u>AC vs AT</u>								
Kidney	10	2.98	0.014*	10	2.46	0.034*	AC 0.30 \pm 0.1	AT 0.16 \pm 0.06
Lung	9	0.72	0.491	9	1.11	0.296	0.85 \pm 0.7	0.67 \pm 0.2
Bone	10	2.12	0.060*	10	2.48	0.032*	5.6 \pm 3	2.4 \pm 2
Liver	10	-0.31	0.764	10	0.11	0.914	0.37 \pm 0.1	0.43 \pm 0.3
Muscle	10	6.61	0.000*	10	9.32	0.000*	1.6 \pm 0.4	0.36 \pm 0.2
Rumen contents (dry)	10	-2.31	0.043*	10	-2.22	0.050*	59 \pm 40	150 \pm 70
Hamburger	10	0.10	0.922	10	2.97	0.014*	0.35 \pm 0.2	0.33 \pm 0.3
Steak	10	-1.50	0.164	10	-1.13	0.284	0.22 \pm 0.09	0.45 \pm 0.3

*Means are significantly different at the 1- α level of 0.90 or higher.

The uranium ANOVA and t-tests are given in Tables XI and XII. Uranium in bone was significantly different in the ANOVA. One large outlier (heifer 565) forced treatment AT to be higher than PT and AB. This is more noticeable in the larger standard deviation for uranium in bone in treatment AT than for PT and AB. T-test results indicate differences for rumen contents when AC vs AB and AC vs AT means were tested. Apparent differences found scattered in muscle, hamburger, and steak means can probably be attributed to differences in detection limits. Data resolution appears somewhat lower for uranium than for scandium. Even though higher uranium content was found in Texas Tech Feedlot feeds compared to Bushland feeds, ANOVA identified a significant difference only for bone [although kidney $1-\alpha$ significance was 0.83 for ppb (ash)].

Inspection of the ^{238}Pu and $^{239-240}\text{Pu}$ analysis results for the tissues and meat did not indicate expected metabolic dynamics typical of plutonium. Bone and liver values should be higher than muscle and kidney for plutonium. However, because the tissue plutonium concentrations were so low, these metabolic dynamics were apparently masked by the uncertainty of analytical detection limits. Statistical analyses were not done on the plutonium composites because the values were at or below the detection limits.

IV. CONCLUSIONS

A. Concentration Ratios Among Sample Types

The extent of discrimination in the food chain for uranium is apparent when the concentration ratios are examined. Uranium concentrations in the soil exceed those in vegetation; concentrations in vegetation are greater than those in cattle tissues. This decrease in concentration as one traverses up the food chain can be expressed as a concentration ratio (CR) between the soil, vegetation, and tissue compartment of the food chain. The uranium CR for grass/soil is 0.039. Thus, soil has about 26 times more uranium on a per dry gram basis than does the range grass growing on it.

The two cattle that had grazed on the Pantex Plant range from June through October (treatment PC, heifers 253 and 255) gave the estimated CRs in Tables XIII and XIV. CRs for treatments PT, AT, and AB are also listed in Tables XIII and XIV. The CRs are lower for the tissue/feed than the tissue/range grass CRs. Perhaps this is caused by the chemical form of ingested uranium or by feed effects on uranium absorption in the ruminant gut. This difference is not apparent for the scandium CRs.

B. Radiation Doses

Calculated radiation doses based on the levels of uranium, tritium, and plutonium found in meat were in the fraction of a mrem/yr per person.

TABLE XI
URANIUM ANOVA RESULTS

Sample Type	n	fCi/g (wet)		ppb (ash)		fCi/g (wet)		
		F Value	Significance α	F Value	Significance α	Treatment PT $\bar{X} \pm 1$ s.d.	Treatment AT $\bar{X} \pm 1$ s.d.	Treatment AB $\bar{X} \pm 1$ s.d.
Kidney	24	1.3731	0.2751	1.9047	0.1737	0.90 \pm 0.5	1.5 \pm 1.3	0.78 \pm 0.7
Lung	24	1.5580	0.2339	1.3145	0.2898	0.082 \pm 0.04	0.14 \pm 0.07	0.36 \pm 0.6
Bone	24	3.5720	0.0462*	3.4845	0.0493*	5.3 \pm 2	19 \pm 19	7.4 \pm 4.2
Liver	24	0.7058	0.5051	0.3746	0.6921	0.11 \pm 0.08	0.23 \pm 0.4	0.11 \pm 0.04
Muscle	24	0.3919	0.6806	1.7195	0.2034	0.071 \pm 0.03	0.090 \pm 0.07	0.096 \pm 0.07
Rumen content (dry)	24	0.7019	0.5069	1.8730	0.1784	160 \pm 60	190 \pm 100	230 \pm 160
Hamburger	24	0.7856	0.4688	0.0003	0.9997	0.21 \pm 0.1	0.20 \pm 0.09	0.16 \pm 0.07
Steak	24	0.9311	0.4098	0.5709	0.5736	0.091 \pm 0.05	0.083 \pm 0.04	0.11 \pm 0.05

*Values for bone show strong differences between treatments.

Uranium occurs naturally in soils at an average of 3 to 4 ppm. Levels in soil, grass, and meat samples were in the background range. Natural uranium usually has 99.3% ^{238}U , 0.72% ^{235}U , and 0.006% ^{234}U (Los Alamos Scientific Laboratory 1979). Dose factors for natural uranium can be calculated using the INREM Ingestion model (Dunning 1977). These values are given in Table A-XXI as rem/ μCi of natural uranium ingested. If a beef consumption rate of 79 kg/yr is assumed, then the 50-yr dose commitment to an adult from ingestion of ground beef at 1.6×10^{-4} pCi/g wet weight would be 0.2 mrem to bone, 0.01 mrem to kidney, and 0.01 mrem to liver. These values are far below the 500 mrem/yr accepted for an individual and over 500 times below the radiation dose each person receives each year from natural background. Uranium, ^3H , and plutonium values for samples collected at the Pantex Plant and Bushland indicate background levels for soil, range grass, sorghum, cattle tissues, and meat. Ingestion of meat grown on or near the Pantex Plant does not represent a radiological hazard to the public because levels of these radionuclides are far below the accepted Concentration Guides.

Cattle slaughtered after ranging on a Pantex pasture west of the burning ground did not have levels of these nuclides above the background levels observed for cattle purchased at auction. Cattle fed milo grown near the northeast perimeter of the Pantex Plant showed no significant differences in nuclide concentrations in their tissues from those purchased at auction and fed a commercial ration.

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TABLE XII
URANIUM T-TEST RESULTS

Sample Type	DF	ppb (ash)		DF	fCi/g (wet)		fCi/g (wet)		
		T Value	2-Tail Prob., α		T Value	2-Tail Prob., α	Treatment AT $\bar{X} \pm 1$ s.d.	Treatment AB $\bar{X} \pm 1$ s.d.	
<u>PC vs AC</u>									
Kidney	4	1.92	0.127	4	1.52	0.204	PC 1.4 \pm 0.07	AC 0.83 \pm 0.5	
Lung	2	-0.49	0.671	2	-0.49	0.675	0.11	0.30 \pm 0.3	
Bone	4	-0.82	0.460	4	-0.77	0.483	2.4 \pm 0.3	6.0 \pm 6	
Liver	3	0.72	0.524	3	0.61	0.586	0.18 \pm 0.03	0.12 \pm 0.2	
Muscle	4	3.00	0.040*	4	2.76	0.051*	0.10 \pm 0.03	0.045 \pm 0.02	
Rumen con- tents (dry)	4	-0.22	0.837	4	-0.69	0.526	51 \pm 40	66 \pm 20	
Hamburger	4	1.35	0.248	4	2.85	0.046*	0.31 \pm 0.01	0.11 \pm 0.09	
Steak	4	0.0	1.00	4	-0.34	0.749	0.029 \pm 0.001	0.030 \pm 0.004	
<u>Ac vs AB</u>									
Kidney	10	0.16	0.876	10	0.15	0.883	AC 0.83 \pm 0.5	AB 0.78 \pm 0.7	
Lung	9	-0.08	0.937	9	-0.17	0.871	0.30 \pm 0.03	0.36 \pm 0.6	
Bone	10	-0.15	0.881	10	-0.42	0.683	6.0 \pm 6	7.4 \pm 4.2	
Liver	9	0.43	0.676	9	0.18	0.864	0.12 \pm 0.2	0.11 \pm 0.04	
Muscle	10	-1.37	0.201	10	-1.35	0.208	0.045 \pm 0.02	0.096 \pm 0.07	
Rumen con- tents (dry)	10	-1.54	0.154	10	-1.88	0.089*	66 \pm 20	230 \pm 160	
Hamburger	10	0.37	0.718	10	-0.96	0.358	0.11 \pm 0.09	0.16 \pm 0.07	
Steak	10	-1.72	0.116	10	-3.48	0.006*	0.030 \pm 0.004	0.11 \pm 0.05	
<u>AC vs AT</u>									
Kidney	10	-1.16	0.272	10	-0.92	0.379	AC 0.83 \pm 0.5	AT 1.5 \pm 1.3	
Lung	9	1.47	0.176	9	1.39	0.198	0.30 \pm 0.3	0.14 \pm 0.07	
Bone	10	-1.24	0.245	10	-1.33	0.214	6.0 \pm 6	19 \pm 19	
Liver	9	-0.20	0.848	9	-0.47	0.651	0.12 \pm 0.2	0.23 \pm 0.4	
Muscle	10	-0.98	0.351	10	-1.27	0.231	0.045 \pm 0.02	0.090 \pm 0.007	
Rumen con- tents (dry)	10	-3.01	0.013*	10	-2.50	0.031*	66 \pm 20	190 \pm 100	
Hamburger	10	0.34	0.739	10	-1.57	0.148	0.11 \pm 0.07	0.20 \pm 0.09	
Steak	10	-1.43	0.183	10	-2.32	0.043*	0.030 \pm 0.004	0.083 \pm 0.04	

*Means are significantly different at the $1-\alpha$ level of 0.90 or higher.

TABLE XIII

SCANDIUM CONCENTRATION RATIOS

Sample Description	Concentration Ratio		
1. Pantex Plant pasture			
<u>Resuspendible soil</u>			
25-cm core soil	0.94		
<u>Range grass</u>			
Resuspendible soil	0.067		
Kidney/range grass	0.0074		
Lung/range grass	0.013		
Bone/range grass	0.052		
Liver/range grass	0.0053		
Muscle/range grass	0.0097		
Rumen contents/range grass	2.07		
Hamburger/range grass	0.0072		
Steak/range grass	0.0033		
2. Feedlots			
	PT	AT	AB
Kidney/feed	0.0016	0.0015	0.0028
Lung/feed	0.010	0.0061	0.014
Bone/feed	0.016	0.022	0.051
Liver/feed	0.0026	0.0039	0.0042
Muscle/feed	0.0028	0.0032	0.0070
Rumen contents/feed	1.36	1.36	1.44
Hamburger/feed	0.0074	0.0030	0.0065
Steak/feed	0.0058	0.0041	0.0081

TABLE XIV
URANIUM CONCENTRATION RATIOS

<u>Sample Description</u>	<u>Concentration Ratio</u>		
1. Pantex Plant pasture			
<u>Resuspendible soil</u>			
25-cm core soil	1.0		
<u>Range Grass</u>			
Resuspendible soil	0.039		
Kidney/range grass	0.017		
Lung/range grass	0.0014		
Bone/range grass	0.030		
Liver/range grass	0.0022		
Muscle/range grass	0.0012		
Rumen contents/range grass	0.63		
Hamburger/range grass	0.0038		
Steak/range grass	0.00036		
2. Feedlots			
	<u>PT</u>	<u>AT</u>	<u>AB</u>
Kidney/feed	0.0035	0.0058	0.0052
Lung/feed	0.00032	0.00054	0.0024
Bone/feed	0.020	0.073	0.049
Liver/feed	0.00042	0.00088	0.00073
Muscle/feed	0.00027	0.00035	0.00064
Rumen contents/feed	0.62	0.73	1.5
Hamburger/feed	0.00081	0.00077	0.0011
Steak/feed	0.00035	0.00032	0.00073

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APPENDIX

RESULTS FOR URANIUM, SCANDIUM, TRITIUM, AND PLUTONIUM

Tables A-I through A-XXI give the vegetation, soil, water, feed, and tissue analysis results for uranium, scandium, tritium, and plutonium. Wet, dry, and ash weights are also included for conversions. Natural uranium (pCi/g) is calculated from the total uranium analysis results in ash.

The uncertainty following each analytical result is estimated counting error plus analytic error. Analytic error is based on radiochemical recovery and standardization with National Bureau of Standards (NBS) standard matrix samples.

TABLE A-I
RESUSPENSION SOIL LAYER RESULTS

Plot	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	^3H (pCi/l)	Scandium Ash (ppm)	Scandium Dry (ppm)	Uranium Ash (ppm)	Uranium Dry (pCi/g)
1	1014	911	867	2300 ± 400	10.0 ± 0.6	9.5 ± 0.6	3.3 ± 0.3	2.1 ± 0.2
2	704	657	619	3200 ± 400	7.3 ± 0.4	6.9 ± 0.4	3.7 ± 0.4	2.3 ± 0.3
3	580	522	492	1800 ± 300	7.8 ± 0.4	7.4 ± 0.4	3.4 ± 0.3	2.1 ± 0.2
4	586	493	449	1000 ± 300	11.0 ± 0.6	10.0 ± 0.5	3.6 ± 0.4	2.2 ± 0.2
5	614	528	503	4100 ± 400	9.5 ± 0.5	9.1 ± 0.5	3.0 ± 0.3	1.9 ± 0.2
6	960	856	812	8500 ± 400	8.1 ± 0.4	7.7 ± 0.4	3.3 ± 0.3	2.1 ± 0.2
7	581	537	508	3000 ± 400	10.0 ± 0.5	9.5 ± 0.5	3.4 ± 0.3	2.2 ± 0.2
8	615	534	501	900 ± 300	13.0 ± 0.7	12.0 ± 0.7	3.2 ± 0.3	2.0 ± 0.2
9	562	514	475	5400 ± 500	8.9 ± 0.5	8.2 ± 0.5	3.4 ± 0.3	2.1 ± 0.2
10	450	386	354	3400 ± 400	8.7 ± 0.5	8.0 ± 0.5	3.4 ± 0.3	2.1 ± 0.2
11	739	690	642	9800 ± 1800	7.4 ± 0.4	6.9 ± 0.4	3.6 ± 0.4	2.2 ± 0.3
12	520	467	436	2700 ± 400	8.3 ± 0.5	7.7 ± 0.5	3.4 ± 0.3	2.2 ± 0.2
13	851	778	744	2300 ± 400	10.0 ± 0.5	9.6 ± 0.5	3.7 ± 0.4	2.4 ± 0.3
14	1098	1023	969	5600 ± 400	8.2 ± 0.4	7.8 ± 0.4	3.6 ± 0.4	2.3 ± 0.3
15	1158	1004	929	6000 ± 400	9.7 ± 0.5	9.0 ± 0.5	3.7 ± 0.4	2.3 ± 0.3
16	714	624	556	2400 ± 400	7.9 ± 0.4	7.0 ± 0.4	3.0 ± 0.3	1.8 ± 0.2
17	853	744	684	5100 ± 400	8.6 ± 0.5	7.9 ± 0.5	3.5 ± 0.4	2.2 ± 0.3
18	851	773	635	2500 ± 400	9.3 ± 0.5	7.6 ± 0.4	3.4 ± 0.3	1.9 ± 0.2
19	492	421	366	1100 ± 300	8.4 ± 0.5	7.3 ± 0.4	3.5 ± 0.4	2.0 ± 0.2
20	381	320	285	2500 ± 400	12.0 ± 0.7	11.0 ± 0.6	3.3 ± 0.3	2.0 ± 0.2
21	1227	1065	1027	3500 ± 400	10.0 ± 0.6	9.6 ± 0.6	3.2 ± 0.3	2.1 ± 0.2
22	625	508	470	1100 ± 300	11.0 ± 0.6	10.0 ± 0.6	3.1 ± 0.3	1.9 ± 0.2
23	420	360	330	3800 ± 400	9.9 ± 0.5	9.1 ± 0.5	3.4 ± 0.3	2.1 ± 0.2
24	367	302	282	1300 ± 300	9.3 ± 0.5	8.7 ± 0.5	3.2 ± 0.3	2.0 ± 0.2
25	598	515	484	800 ± 300	12.0 ± 0.6	11.0 ± 0.6	3.3 ± 0.3	2.1 ± 0.2
26	767	704	642	1700 ± 300	7.3 ± 0.4	6.7 ± 0.4	3.5 ± 0.4	2.1 ± 0.2
27	535	442	370	1200 ± 300	13.0 ± 0.7	11.0 ± 0.6	3.5 ± 0.4	2.0 ± 0.2
28	670	616	582	7100 ± 600	8.1 ± 0.4	7.7 ± 0.4	3.5 ± 0.4	2.2 ± 0.3
29	614	526	490	1700 ± 300	11.0 ± 0.6	10.0 ± 0.6	3.1 ± 0.3	1.9 ± 0.2
30	595	560	537	2900 ± 400	6.9 ± 0.4	6.6 ± 0.4	3.4 ± 0.3	2.2 ± 0.2

TABLE A-II
RESUSPENSION SOIL LAYER COMPOSITE RESULTS

<u>Plot</u>	<u>Ash Weight (g)</u>	<u>²³⁸Pu Ash (pCi/g)</u>	<u>²³⁸Pu Dry (pCi/g)</u>	<u>²³⁹Pu Ash (pCi/g)</u>	<u>²³⁹Pu Dry (pCi/g)</u>
6,22,23,24,26	10.01	0.0020 ± 0.001	0.0015 ± 0.001	0.043 ± 0.004	0.040 ± 0.004
10,11,12,17,21	10.00	0.0033 ± 0.001	0.0031 ± 0.001	0.045 ± 0.004	0.041 ± 0.004
5,7,8,15,25	10.02	0.0005 ± 0.0007	-0.0005 ± 0.001	0.030 ± 0.004	0.028 ± 0.004
1,4,14,20,27	10.04	0.0011 ± 0.001	-0.0010 ± 0.001	0.004 ± 0.002	0.038 ± 0.002
9,16,18,19,28	10.05	0.0014 ± 0.001	0.0012 ± 0.001	0.049 ± 0.004	0.043 ± 0.004
2,3,13,29,30	10.09	0.001 ± 0.001	0.0006 ± 0.001	0.028 ± 0.004	0.026 ± 0.004

TABLE A-III

SOIL CORE LAYER (25 cm) RESULTS

Plot	Wet Weight (g)	Dry Weight (g)	Scandium Dry (ppm)	Uranium Dry (ppm)	Uranium Dry (pCi/g)
1	848	726	9.7 ± 0.5	3.1 ± 0.3	2.1 ± 0.2
2	546	487	8.4 ± 0.5	3.3 ± 0.3	2.2 ± 0.2
3	746	650	6.8 ± 0.4	2.7 ± 0.3	1.8 ± 0.2
4	1094	945	6.6 ± 0.4	2.5 ± 0.3	1.7 ± 0.2
5	916	751	8.8 ± 0.5	2.8 ± 0.3	1.9 ± 0.2
6	717	603	9.7 ± 0.5	3.2 ± 0.3	2.1 ± 0.2
7	1032	874	6.8 ± 0.4	2.9 ± 0.3	1.9 ± 0.2
8	873	700	12.0 ± 0.6	2.9 ± 0.3	1.9 ± 0.2
9	543	489	9.5 ± 0.5	3.2 ± 0.3	2.1 ± 0.2
10	1023	851	8.3 ± 0.4	2.9 ± 0.3	1.9 ± 0.2
11	834	741	8.3 ± 0.5	3.2 ± 0.3	2.1 ± 0.2
12	999	832	9.2 ± 0.5	3.2 ± 0.3	2.1 ± 0.2
13	839	701	8.6 ± 0.5	2.9 ± 0.3	1.9 ± 0.2
14	607	542	15.0 ± 0.8	3.1 ± 0.3	2.1 ± 0.2
15	1101	926	8.5 ± 0.5	2.8 ± 0.3	1.9 ± 0.2
16	719	611	8.5 ± 0.5	3.2 ± 0.3	2.1 ± 0.2
17	919	791	9.5 ± 0.5	2.9 ± 0.3	1.9 ± 0.2
18	624	529	9.0 ± 0.5	3.3 ± 0.3	2.2 ± 0.2
19	707	597	8.0 ± 0.4	3.1 ± 0.3	2.1 ± 0.2
20	755	618	11.0 ± 0.6	2.9 ± 0.3	1.9 ± 0.2
21	730	592	11.0 ± 0.6	2.9 ± 0.3	1.9 ± 0.2
22	836	704	9.6 ± 0.5	3.2 ± 0.3	2.1 ± 0.2
23	977	823	11.0 ± 0.6	3.3 ± 0.3	2.2 ± 0.2
24	857	750	8.3 ± 0.4	3.2 ± 0.3	2.1 ± 0.2
25	991	713	10.0 ± 0.6	2.8 ± 0.3	1.9 ± 0.2
26	886	763	8.9 ± 0.5	3.2 ± 0.3	2.1 ± 0.2
27	726	591	10.0 ± 0.5	3.1 ± 0.3	2.1 ± 0.2
28	622	549	9.2 ± 0.5	3.2 ± 0.3	2.1 ± 0.2
29	820	666	11.0 ± 0.6	2.8 ± 0.3	1.9 ± 0.2
30	631	529	8.7 ± 0.5	3.0 ± 0.3	2.0 ± 0.2

Plot	Dry Weight (g)	²³⁸ Pu Dry (pCi/g)	²³⁹ Pu Dry (pCi/g)
6; 22, 23, 24, 26	10.00	0.0011 ± 0.0011	0.0022 ± 0.0040
10, 11, 12, 17, 21	10.00	0.0005 ± 0.0008	0.0005 ± 0.0009
5, 7, 8, 15, 25	10.00	-0.0014 ± 0.0004	0.0028 ± 0.0011
1, 4, 14, 20, 27	10.00	-0.0017 ± 0.0005	0.0030 ± 0.0021
9, 16, 18, 19, 28	10.00	0.0004 ± 0.0007	0.0080 ± 0.0021
2, 3, 13, 29, 30	10.01	0.0005 ± 0.0009	0.0022 ± 0.0005
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TABLE A-IV

SOIL CORE LAYER-(25 cm) RESULTS FOR COMPOSITES

WASTE ASSAY REPORT

TABLE A-4

TABLE A-V
RANGE VEGETATION RESULTS

Plot	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	³ H (pCi/l)	Scandium Ash (ppm)	Scandium Dry (ppm)	Uranium Ash (ppm)	Uranium Dry (pCi/g)
1	98.70	39.46	13.31	6200 ± 400	5.2 ± 0.3	1.8 ± 0.1	1.69 ± 0.2	0.38 ± 0.04
2	75.71	46.95	5.40	9400 ± 500	1.0 ± 0.07	0.12 ± 0.008	0.35 ± 0.03	0.027 ± 0.002
3	87.56	54.00	8.40	7300 ± 400	0.98 ± 0.07	0.15 ± 0.01	0.33 ± 0.03	0.034 ± 0.003
4	276.14	163.22	16.41	9800 ± 500	1.1 ± 0.08	0.11 ± 0.008	0.29 ± 0.03	0.019 ± 0.002
5	63.57	37.94	5.98	7900 ± 400	3.2 ± 0.2	0.50 ± 0.03	0.79 ± 0.08	0.083 ± 0.008
6	67.55	38.79	4.94	2600 ± 400	1.2 ± 0.08	0.15 ± 0.01	0.29 ± 0.03	0.025 ± 0.003
7	47.97	25.06	5.62	3400 ± 400	6.8 ± 0.4	1.5 ± 0.09	1.45 ± 0.1	0.22 ± 0.02
8	168.98	61.78	19.38	14300 ± 500	5.4 ± 0.3	1.7 ± 0.09	1.28 ± 0.1	0.27 ± 0.03
9	72.84	47.25	5.86	1500 ± 400	1.9 ± 0.1	0.24 ± 0.01	0.49 ± 0.05	0.040 ± 0.004
10	62.78	38.51	5.47	9400 ± 500	0.44 ± 0.04	0.062 ± 0.006	0.16 ± 0.02	0.015 ± 0.002
11	64.96	37.58	5.81	6000 ± 400	1.2 ± 0.08	0.19 ± 0.01	0.33 ± 0.03	0.034 ± 0.003
12	91.30	51.47	8.66	5300 ± 400	2.2 ± 0.1	0.37 ± 0.02	0.26 ± 0.03	0.029 ± 0.003
13	77.59	44.00	11.21	4800 ± 400	4.8 ± 0.3	1.2 ± 0.08	0.97 ± 0.1	0.17 ± 0.02
14	127.32	68.67	10.17	1700 ± 400	0.97 ± 0.07	0.14 ± 0.01	0.26 ± 0.03	0.026 ± 0.003
15	76.67	47.96	6.89	12000 ± 500	2.3 ± 0.1	0.33 ± 0.01	0.57 ± 0.06	0.055 ± 0.006
16	70.30	44.47	6.59	8200 ± 400	0.37 ± 0.04	0.55 ± 0.006	0.12 ± 0.01	0.012 ± 0.001
17	75.71	50.00	6.75	1600 ± 1400	0.86 ± 0.06	0.12 ± 0.008	0.21 ± 0.02	0.019 ± 0.002
18	121.73	75.61	10.16	7500 ± 400	0.63 ± 0.05	0.85 ± 0.007	0.22 ± 0.02	0.020 ± 0.002
19	169.93	107.95	14.18	8000 ± 500	2.2 ± 0.1	0.29 ± 0.01	0.71 ± 0.07	0.062 ± 0.006
20	90.48	37.01	9.69	1800 ± 400	4.0 ± 0.2	1.0 ± 0.05	0.86 ± 0.09	0.15 ± 0.02
21	89.47	49.70	10.36	12100 ± 500	5.0 ± 0.3	1.0 ± 0.06	1.21 ± 0.1	0.17 ± 0.02
22	151.64	89.55	11.44	17000 ± 800	1.5 ± 0.09	0.19 ± 0.01	0.37 ± 0.04	0.031 ± 0.003
23	94.44	54.84	10.97	11100 ± 500	5.5 ± 0.3	1.1 ± 0.06	0.76 ± 0.08	0.10 ± 0.002
24	89.63	50.27	7.93	6300 ± 400	3.4 ± 0.2	0.54 ± 0.03	0.50 ± 0.05	0.053 ± 0.005
25	87.86	47.75	10.52	2100 ± 400	5.4 ± 0.3	1.2 ± 0.07	0.81 ± 0.08	0.12 ± 0.01
26	57.51	32.10	4.83	9900 ± 600	0.83 ± 0.06	0.12 ± 0.009	0.23 ± 0.02	0.023 ± 0.002
27	100.48	62.70	8.71	12500 ± 500	3.3 ± 0.2	0.46 ± 0.03	0.44 ± 0.04	0.041 ± 0.004
28	54.41	28.28	4.16	5300 ± 400	1.3 ± 0.08	0.19 ± 0.01	0.29 ± 0.03	0.028 ± 0.003
29	74.60	32.49	7.13	1500 ± 400	4.2 ± 0.2	0.92 ± 0.04	0.95 ± 0.09	0.14 ± 0.01
30	75.91	48.13	7.50	4800 ± 400	1.1 ± 0.07	0.17 ± 0.01	0.26 ± 0.03	0.027 ± 0.003

TABLE A-VI
RANGE VEGETATION RESULTS

Plot	Ash Weight (g)	^{238}Pu Ash (pCi/g)	^{238}Pu Dry (pCi/g)	^{239}Pu Ash (pCi/g)	^{239}Pu Dry (pCi/g)
6,22,23,24,26	10.00	0.0003 ± 0.0005	0.00026 ± 0.0002	0.0053 ± 0.001	0.0008 ± 0.0002
10,11,12,17,21	9.99	-0.0010 ± 0.00003	-0.0002 ± 0.0002	0.0010 ± 0.001	0.0002 ± 0.0002
5,7,8,15,25	10.02	0.0018 ± 0.001	0.0004 ± 0.0002	0.0080 ± 0.003	0.0017 ± 0.0006
1,4,14,20,27	10.00	0.0009 ± 0.002	0.00018 ± 0.0002	0.0009 ± 0.002	0.0018 ± 0.0002
9,16,18,19,28	10.00	0.0012 ± 0.0006	0.00016 ± 0.0002	0.0029 ± 0.001	0.0004 ± 0.0001
2,3,13,29,30	10.02	0.0003 ± 0.0004	0.00005 ± 0.0002	0.0072 ± 0.001	0.0013 ± 0.0002

TABLE A-VII
GRAIN SORGHUM PLANT RESULTS

Grain Sorghum Sample	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	Scandium Ash (ppm)	Scandium Dry (ppm)	Uranium Ash (dry for soil, ppm)	Uranium Dry (pCi/g)	Potassium Ash (%)
<u>Seed Head</u>								
Plant 1	101	89.0	2.84	0.32 ± 0.03		0.10 ± 0.01	0.0021 ± 0.0002	18.2 ± 0.9
Plant 2	79.0	70.0	2.53	0.30 ± 0.02		0.13 ± 0.01	0.0031 ± 0.0005	14.0 ± 0.7
Plant 3	60.0	55.0	1.90	0.32 ± 0.03		0.12 ± 0.01	0.0028 ± 0.0003	14.1 ± 0.7
<u>Shoot</u>								
Plant 1	133	50.0	5.76	0.32 ± 0.03		0.16 ± 0.02	0.012 ± 0.001	20.4 ± 0.9
Plant 2	128	45.5	5.57	0.63 ± 0.04		0.15 ± 0.02	0.012 ± 0.001	14.2 ± 0.7
Plant 3	97.0	33.0	3.66	0.37 ± 0.03		0.08 ± 0.01	0.0059 ± 0.0006	29.5 ± 1.4
<u>Root</u>								
Plant 1	18.3	13.0	2.96	8.0 ± 0.4		2.3 ± 0.2	0.35 ± 0.04	5.97 ± 0.60
Plant 2	18.5	17.3	3.64	4.3 ± 0.2		2.5 ± 0.3	0.47 ± 0.05	19.0 ± 0.9
Plant 3	31.5	22.5	3.11	4.7 ± 0.3		2.3 ± 0.2	0.21 ± 0.02	16.9 ± 0.8
<u>Soil</u>								
Below plant 1	--	23.0	--		8.6 ± 0.5	3.4 ± 0.3	2.3 ± 0.02	1.71 ± 0.17
Below plant 2	--	30.0	--		9.1 ± 0.5	3.6 ± 0.4	2.4 ± 0.03	1.70 ± 0.17
Below plant 3	--	23.5	--		8.8 ± 0.5	3.6 ± 0.4	2.4 ± 0.03	1.80 ± 0.18

TABLE A-VIII

WATER SAMPLES

Location Sampled	Volume Collected (ℓ)	³ H (pCi/ℓ)	Scandium (ppb)	Uranium (ppb)	Uranium (pCi/ℓ)	²³⁸ Pu (pCi/ℓ)	²³⁹ Pu (pCi/ℓ)
Pantex range trough	35.4	2100 ± 300	0.0091 ± 0.001	10.0 ± 1.0	6.9	-0.017 ± 0.0003	-0.017 ± 0.004
Pantex Feedlot tap	35.4	1100 ± 300	0.012 ± 0.001	9.0 ± 0.9	6.1	-0.020 ± 0.0004	-0.020 ± 0.01
Bushland Feedlot tap	35.4	1300 ± 300	0.0094 ± 0.001	9.6 ± 1.0	6.5	-0.0076 ± 0.0002	-0.015 ± 0.0003

TABLE A-IX

WEEKLY FEED MIX RESULTS FOR TEXAS TECH FEEDLOT

Date Collected	Day	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	³ H (pCi/ℓ)	Scandium Ash (ppm)	Scandium Dry (ppm)	Uranium Ash (ppm)	Uranium Dry (pCi/g)
11/06/81	5	542	395	36.7	0 ± 2000	1.1 ± 0.06	0.10 ± 0.006	1.6 ± 0.2	0.10 ± 0.01
11/13/81	12	402	191	22.0	2000 ± 2000	0.58 ± 0.04	0.067 ± 0.005	1.2 ± 0.1	0.097 ± 0.01
11/20/81	19	292	207	18.8	--	1.2 ± 0.07	0.11 ± 0.006	1.1 ± 0.1	0.065 ± 0.01
11/27/81	26	478	354	52.8	4000 ± 2000	1.0 ± 0.06	0.15 ± 0.009	3.3 ± 0.3	0.33 ± 0.03
12/04/81	33	448	346	24.1	3000 ± 2000	0.78 ± 0.04	0.054 ± 0.003	3.8 ± 0.4	0.17 ± 0.02
12/11/81	40	529	419	40.8	1000 ± 2000	1.3 ± 0.07	0.13 ± 0.007	5.0 ± 0.5	0.32 ± 0.03
12/17/81	46	713	572	39.2	2000 ± 2000	0.89 ± 0.05	0.061 ± 0.003	3.8 ± 0.4	0.17 ± 0.02
12/25/81	54	499	419	32.0	400 ± 300	1.3 ± 0.07	0.099 ± 0.005	5.0 ± 0.5	0.26 ± 0.03
01/01/82	61	605	541	42.5	900 ± 300	1.1 ± 0.06	0.086 ± 0.005	5.4 ± 0.5	0.28 ± 0.03
01/08/82	68	791	664	46.5	100 ± 300	0.81 ± 0.05	0.057 ± 0.004	5.0 ± 0.5	0.24 ± 0.02
01/15/82	75	652	545	51.7	1400 ± 300	0.75 ± 0.05	0.071 ± 0.005	2.2 ± 0.2	0.14 ± 0.01
01/22/82	82	717	627	49.6	600 ± 300	0.90 ± 0.05	0.071 ± 0.004	3.9 ± 0.4	0.21 ± 0.03
01/29/82	89	531	440	42.3	700 ± 300	1.2 ± 0.07	0.12 ± 0.007	5.4 ± 0.5	0.35 ± 0.04
02/05/82	96	682	538	49.9	100 ± 300	0.89 ± 0.06	0.083 ± 0.006	6.2 ± 0.6	0.38 ± 0.04
02/12/82	103	959	821	50.8	3000 ± 2000	1.2 ± 0.07	0.074 ± 0.004	6.5 ± 0.7	0.27 ± 0.03
02/19/82	110	949	823	76.0	3000 ± 2000	1.2 ± 0.06	0.11 ± 0.006	8.7 ± 0.9	0.54 ± 0.05
02/26/82	117	914	749	55.0	6000 ± 2000	0.73 ± 0.04	0.54 ± 0.003	7.7 ± 0.8	0.38 ± 0.04
03/05/82	124	829	716	46.9	4000 ± 300	1.8 ± 0.2	0.12 ± 0.01	1.9 ± 0.2	0.082 ± 0.01
03/12/82	131	950	819	78.7	8200 ± 500	1.5 ± 0.2	0.14 ± 0.02	5.5 ± 0.6	0.35 ± 0.04
03/19/82	138	738	641	44.6	5800 ± 400	0.98 ± 0.05	0.068 ± 0.003	1.4 ± 0.1	0.066 ± 0.01
03/26/82	145	712	609	61.7	5000 ± 400	3.2 ± 0.2	0.32 ± 0.02	4.2 ± 0.4	0.29 ± 0.03
04/02/82	152	840	730	97.6	3900 ± 300	2.0 ± 0.1	0.27 ± 0.01	8.5 ± 0.9	0.76 ± 0.08
04/09/82	159	776	639	47.2	6100 ± 400	2.0 ± 0.1	0.15 ± 0.01	4.6 ± 0.5	0.22 ± 0.02

TABLE A-X

FEED COMPONENT SAMPLES FROM TEXAS TECH FEEDLOT

<u>Samples</u>	<u>Day</u>	<u>Wet Weight (g)</u>	<u>Dry Weight (g)</u>	<u>Ash Weight (g)</u>	<u>³H (pCi/l)</u>	<u>Scandium Ash (ppm)</u>	<u>Scandium Dry (ppm)</u>	<u>Uranium Ash (ppm)</u>	<u>Uranium Dry (pCi/g)</u>
Rolled milo	46	1252	1149	147	--	0.11 ± 0.02	0.014 ± 0.003	0.019 ± 0.002	0.0016 ± 0.0002
Cotton seed	46	344	273	25.7	2000 ± 2000	2.1 ± 0.1	0.20 ± 0.009	0.92 ± 0.09	0.058 ± 0.006
Protein pellets	46	1322	1180	507	-1000 ± 2000	0.96 ± 0.05	0.41 ± 0.02	11.0 ± 1.0	3.2 ± 0.3
Cane molasses	46	580	363	86.5	8000 ± 2000	0.64 ± 0.04	0.15 ± 0.01	0.43 ± 0.04	0.068 ± 0.007

TABLE A-XI

ALFALFA SAMPLES FROM TEXAS TECH FEEDLOT

<u>Date Collected</u>	<u>Day</u>	<u>Wet Weight (g)</u>	<u>Dry Weight (g)</u>	<u>Ash Weight (g)</u>	<u>³H (pCi/l)</u>	<u>Scandium Ash (ppm)</u>	<u>Scandium Dry (ppm)</u>	<u>Uranium Ash (ppm)</u>	<u>Uranium Dry (pCi/g)</u>
12/17/81	46	307	285	31.1	--	0.88 ± 0.05	0.096 ± 0.005	1.4 ± 0.1	0.10 ± 0.007
12/17/81	46	277	232	26.7	2000 ± 2000	0.85 ± 0.05	0.098 ± 0.006	0.95 ± 0.09	0.074 ± 0.007
12/23/81	52	292	258	29.7	300 ± 400	1.6 ± 0.09	0.18 ± 0.01	1.4 ± 0.1	0.11 ± 0.008
01/07/82	67	284	244	28.5	1300 ± 300	0.80 ± 0.05	0.093 ± 0.006	1.5 ± 0.2	0.12 ± 0.02
01/18/82	78	251	220	22.0	600 ± 300	0.51 ± 0.03	0.051 ± 0.003	0.61 ± 0.06	0.041 ± 0.004
01/31/82	91	144	122	13.9	300 ± 300	1.1 ± 0.07	0.13 ± 0.008	1.1 ± 0.1	0.085 ± 0.008
02/14/82	105	238	221	28.1	1800 ± 400	1.7 ± 0.1	0.22 ± 0.01	1.1 ± 0.1	0.095 ± 0.009
02/24/82	115	343	301	36.0	2000 ± 300	1.6 ± 0.09	0.19 ± 0.01	1.8 ± 0.2	0.15 ± 0.02
03/10/82	129	282	255	31.1	7700 ± 500	1.4 ± 0.2	0.12 ± 0.02	0.80 ± 0.08	0.066 ± 0.007
03/17/82	136	366	297	66.1	5500 ± 400	5.4 ± 0.3	1.2 ± 0.07	2.0 ± 0.2	0.30 ± 0.03
04/05/82	155	287	258	28.6	6100 ± 400	1.5 ± 0.08	0.17 ± 0.009	0.81 ± 0.08	0.061 ± 0.006

TABLE A-XII
WEEKLY FEED RESULTS FOR BUSHLAND FEEDLOT

Date Collected	Day	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	³ H (pCi/£)	Scandium Ash (ppm)	Scandium Dry (ppm)	Uranium Ash (ppm)	Uranium Dry (pCi/g)
12/03/81	9	301	255	17.1	1500 ± 300	0.68 ± 0.04	0.046 ± 0.003	2.2 ± 0.2	0.099 ± 0.009
12/14/81	20	153	133	11.0	3500 ± 300	1.5 ± 0.08	0.12 ± 0.007	3.4 ± 0.3	0.19 ± 0.02
12/23/81	29	348	270	18.6	1800 ± 300	0.87 ± 0.06	0.060 ± 0.004	2.5 ± 0.3	0.11 ± 0.01
12/30/81	36	286	227	14.7	700 ± 300	0.61 ± 0.04	0.040 ± 0.003	1.8 ± 0.2	0.079 ± 0.008
01/06/82	43	259	200	13.9	1500 ± 300	0.82 ± 0.05	0.057 ± 0.003	3.3 ± 0.3	0.15 ± 0.02
01/13/82	50	229	189	9.4	1000 ± 300	0.84 ± 0.05	0.042 ± 0.002	2.3 ± 0.2	0.075 ± 0.007
01/22/82	61	400	323	16.1	1700 ± 300	0.76 ± 0.05	0.038 ± 0.002	2.0 ± 0.2	0.067 ± 0.007
01/28/82	67	401	327	22.1	1700 ± 300	0.82 ± 0.06	0.055 ± 0.004	3.6 ± 0.4	0.16 ± 0.02
02/01/82	71	228	189	12.1	1300 ± 300	0.81 ± 0.06	0.052 ± 0.004	3.5 ± 0.4	0.15 ± 0.02
02/09/82	79	273	219	13.4	1400 ± 300	0.81 ± 0.06	0.050 ± 0.004	1.9 ± 0.2	0.076 ± 0.008
02/18/82	88	193	149	10.1	1400 ± 300	0.63 ± 0.04	0.043 ± 0.003	2.4 ± 0.2	0.11 ± 0.01
02/24/82	94	387	339	22.2	2100 ± 300	0.58 ± 0.03	0.038 ± 0.002	3.0 ± 0.3	0.13 ± 0.01
03/10/82	118	202	172	14.2	3800 ± 300	0.89 ± 0.05	0.073 ± 0.004	6.6 ± 0.7	0.36 ± 0.04
03/17/82	125	240	203	17.5	2700 ± 300	0.67 ± 0.07	0.058 ± 0.006	4.4 ± 0.4	0.25 ± 0.03
03/24/82	132	228	199	19.2	5900 ± 400	0.76 ± 0.08	0.073 ± 0.008	3.2 ± 0.3	0.20 ± 0.02
03/31/82	139	230	201	20.9	3800 ± 300	0.72 ± 0.07	0.075 ± 0.007	3.1 ± 0.3	0.21 ± 0.02
04/01/82	140	246	216	22.0	3800 ± 300	0.52 ± 0.05	0.053 ± 0.005	2.9 ± 0.3	0.19 ± 0.02
04/07/82	146	204	179	16.7	3700 ± 300	0.47 ± 0.05	0.044 ± 0.005	2.3 ± 0.2	0.15 ± 0.01

TABLE A-XIII

FEED COMPOSITE RESULTS FOR TEXAS TECH AND BUSHLAND FEEDLOTS

<u>Feedlot</u>	<u>Dates</u>	<u>^{238}Pu (pCi/g)</u>	<u>^{239}Pu (pCi/g)</u>
Texas Tech (feed mix)	11/06/81 - 11/27/81	-0.0012 \pm 0.0009	0.0012 \pm 0.001
	12/04/81 - 12/25/81	-0.0010 \pm 0.001	0.0007 \pm 0.001
	01/01/82 - 01/22/82	-0.0028 \pm 0.002	-0.0006 \pm 0.001
	01/29/82 - 02/19/82	0.0003 \pm 0.0006	0.0019 \pm 0.0009
	02/26/82 - 03/19/82	0.0005 \pm 0.002	0.0015 \pm 0.002
	03/26/82 - 04/09/82	0.0004 \pm 0.001	0.0026 \pm 0.002
Texas Tech (alfalfa)	12/17/81 - 01/07/82	-0.0010 \pm 0.0009	0.006 \pm 0.002
	01/18/82 - 02/24/82	0.0002 \pm 0.001	0.003 \pm 0.002
	03/02/82 - 04/05/82	-0.0003 \pm 0.0006	0.0041 \pm 0.001
Bushland	10/07/81 - 11/25/81	0.0002 \pm 0.0007	0.0002 \pm 0.0007
	12/03/81 - 12/14/81	0.0004 \pm 0.0007	0.0004 \pm 0.0008
	12/16/81 - 01/06/82	0.0003 \pm 0.0007	0.0003 \pm 0.0006
	01/13/82 - 02/01/82	-0.0006 \pm 0.0003	0.0003 \pm 0.0008
	02/09/82 - 03/10/82	0.0003 \pm 0.0007	0.0016 \pm 0.0009
	03/17/82 - 04/07/82	0.0009 \pm 0.0007	-0.0009 \pm 0.0007

TABLE A-XIV

HEIFER TISSUE AND ORGAN RESULTS

Treatment	Tissue	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	³ H (pCi/£)	Scandium Ash (ppm)	Uranium Ash (ppb)	
PC	Heifer 253							
	Kidney	330	83.4	3.40	--	0.056 ± 0.01	200 ± 10	
	Lung	427	103	4.79	--	0.096 ± 0.02	15 ± 3	
	Bone	353	290	146.1	--	0.0090 ± 0.007	8 ± 4	
	Liver	695	261	9.35	--	0.022 ± 0.01	22 ± 2	
	Muscle	931	310	11.2	400 ± 300	0.081 ± 0.02	15 ± 3	
	Rumen	617	137	11.3	200 ± 300	1.3 ± 0.08	1400 ± 70	
	Hamburger	836	273	8.6	1500 ± 400	0.022 ± 0.01	47 ± 5	
	Steak	816	176	9.1	6100 ± 400	0.022 ± 0.01	< 4	
	Blood							
	11/05/81	363	60.6	3.34	1800 ± 300	0.067 ± 0.02	--	
	11/12/81	422	67.4	1.95	2600 ± 300	0.030 ± 0.01	--	
	11/17/81	517	96.8	4.71	500 ± 300	0.043 ± 0.02	--	
PC	Heifer 255							
	Kidney	265	82.8	3.06	--	0.024 ± 0.008	170 ± 9	
	Lung	324	73.9	3.66	--	0.033 ± 0.009	NS	
	Bone	370	300	144.0	--	< 0.006	10 ± 2	
	Liver	628	252	6.88	--	0.029 ± 0.009	22 ± 2	
	Muscle	511	130	6.20	300 ± 300	0.012 ± 0.01	10 ± 2	
	Rumen	810	181	14.3	400 ± 300	1.6 ± 0.09	480 ± 20	
	Hamburger	985	307	17.5	2700 ± 400	0.034 ± 0.01	25 ± 3	
	Steak	829	247	8.8	1800 ± 400	0.013 ± 0.01	< 4	
	Blood							
	11/05/81	372	54.1	5.46	800 ± 300	0.014 ± 0.013	--	
	11/12/81	575	88.7	--	2200 ± 300	--	--	
	11/17/81	441	69.5	4.80	1100 ± 300	0.68 ± 0.044	--	
AC	Heifer 188							
	Kidney	233	65.2	2.89	--	0.021 ± 0.009	170 ± 9	
	Lung	547	120	5.65	--	NS	NS	
	Bone	337	272	124	--	0.022 ± 0.007	61 ± 6	
	Liver	724	251	5.14	--	0.024 ± 0.01	NS	
	Muscle	503	124	6.49	400 ± 300	0.12 ± 0.02	< 4	
	Rumen	791	155	10.4	700 ± 300	0.32 ± 0.02	1300 ± 60	
	Hamburger	883	313	8.10	2700 ± 400	0.026 ± 0.01	40 ± 4	
	Steak	813	264	9.00	3400 ± 400	0.015 ± 0.01	< 4	
	Blood							
	11/17/81	289	50.0	2.67	4200 ± 300	0.031 ± 0.008	--	
	AC	Heifer 198						
		Kidney	183	47.7	2.27	--	0.032 ± 0.01	43 ± 4
Lung		373	77.2	3.69	--	0.029 ± 0.009	< 4	
Bone		328	264	110	--	0.013 ± 0.007	9 ± 3	
Liver		396	150	5.39	--	0.032 ± 0.01	< 4	
Muscle		559	140	7.19	700 ± 300	0.17 ± 0.02	9 ± 3	
Rumen		943	117	13.9	300 ± 300	0.32 ± 0.02	950 ± 50	
Hamburger		873	315	7.6	9900 ± 500	0.032 ± 0.01	16 ± 3	
Steak		699	191	6.8	2800 ± 400	0.024 ± 0.01	< 4	
Blood								
11/17/81		285	48.4	2.48	1100 ± 300	0.026 ± 0.02	--	

NS = no sample.

TABLE A-XIV (cont)

Treatment	Tissue	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	³ H (pCi/g)	Scandium Ash (ppm)	Uranium Ash (ppb)
AC	Heifer 448						
	Kidney	286	87.5	2.36	--	0.044 ± 0.01	110 ± 11
	Lung	610	143	6.83	--	0.056 ± 0.009	27 ± 3
	Bone	437	359	162	--	< 0.007	6 ± 4
	Liver	563	192	7.70	--	0.033 ± 0.01	4 ± 4
	Muscle	560	147	7.07	-100 ± 300	0.12 ± 0.01	< 4
	Rumen	791	139	18.8	-500 ± 300	0.82 ± 0.05	480 ± 25
	Hamburger	801	260	8.60	1400 ± 400	0.059 ± 0.02	5 ± 5
	Steak	745	201	8.10	4600 ± 400	0.031 ± 0.01	< 4
	Blood (none)						
AC	Heifer 541						
	Kidney	234	63.6	2.97	--	0.013 ± 0.009	110 ± 11
	Lung	472	99.3	5.17	--	0.15 ± 0.2	91 ± 9
	Bone	322	262	123	--	0.019 ± 0.008	22 ± 3
	Liver	455	155	5.87	--	0.033 ± 0.01	32 ± 3
	Muscle	657	162	8.35	700 ± 300	0.094 ± 0.02	< 4
	Rumen	783	126	11.8	400 ± 300	0.68 ± 0.04	1400 ± 70
	Hamburger	790	301	7.80	2700 ± 400	0.024 ± 0.02	11 ± 3
	Steak	769	187	10.4	2000 ± 400	< 0.01	< 4
	Blood 11/17/81	291	48.7	2.52	3900 ± 300	0.012 ± 0.01	--
PT	Heifer 251						
	Kidney	353	83.1	2.90	--	0.011 ± 0.007	160 ± 14
	Lung	457	99.8	5.20	--	0.070 ± 0.01	< 5
	Bone	329	248	77.0	--	0.006 ± 0.002	29 ± 5
	Liver	573	162	7.00	--	0.024 ± 0.006	7 ± 5
	Muscle	779	193	25.1	100 ± 300	0.027 ± 0.008	< 5
	Rumen	447	65.2	7.80	0.0 ± 300	1.7 ± 0.09	2600 ± 130
	Hamburger	1030	331	27.6	100 ± 300	0.046 ± 0.01	13 ± 3
	Steak	981	270	6.20	400 ± 300	0.065 ± 0.02	12 ± 4
	Blood						
	11/05/81	294	41.8	2.75	300 ± 300	0.020 ± 0.01	--
	11/12/81	520	98.2	1.54	2700 ± 300	0.031 ± 0.009	--
	11/17/81	446	70.6	3.68	800 ± 300	0.026 ± 0.01	--
	11/19/81	292	47.5	2.60	4800 ± 400	0.060 ± 0.01	--
	11/24/81	289	45.2	2.55	900 ± 300	0.028 ± 0.01	--
	12/01/81	282	49.1	2.52	3400 ± 300	0.028 ± 0.02	--
	12/15/81	267	47.2	2.37	300 ± 300	0.046 ± 0.01	--
12/29/81	284	48.9	2.41	-100 ± 300	0.013 ± 0.02	--	
01/13/82	300	56.7	2.52	300 ± 300	0.052 ± 0.02	--	
02/10/82	288	51.8	3.68	600 ± 300	0.022 ± 0.009	--	
03/11/82	297	49.0	2.60	1300 ± 300	0.038 ± 0.01	--	
PT	Heifer 252						
	Kidney	351	81.0	2.80	--	0.008 ± 0.008	66 ± 7
	Lung	441	107	4.70	--	0.035 ± 0.005	7 ± 5
	Bone	441	359	194	--	0.004 ± 0.001	18 ± 4
	Liver	800	252	11.1	--	0.019 ± 0.004	< 5
	Muscle	789	231	21.7	300 ± 300	0.003 ± 0.006	< 5
	Rumen	719	119	10.9	-1100 ± 300	1.5 ± 0.080	2000 ± 100
	Hamburger	1043	349	12.9	600 ± 300	0.032 ± 0.01	21 ± 3
	Steak	852	286	8.50	700 ± 300	0.080 ± 0.01	8 ± 5

TABLE A-XIV (cont)

Treatment	Tissue	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	³ H (pCi/£)	Scandium Ash (ppm)	Uranium Ash (ppb)
	Heifer 252 (cont)						
	Blood						
	11/05/81	340	52.8	3.49	1100 ± 300	0.049 ± 0.02	--
	11/12/81	522	89.9	2.10	1700 ± 300	0.030 ± 0.02	--
	11/17/81	279	48.7	2.50	4200 ± 300	0.083 ± 0.02	--
	11/19/81	283	52.8	2.46	600 ± 300	0.021 ± 0.01	--
	11/24/81	302	64.9	2.60	1300 ± 300	0.026 ± 0.01	--
	12/01/81	240	42.7	2.35	700 ± 300	0.021 ± 0.01	--
	12/15/81	293	55.7	2.75	1100 ± 300	0.030 ± 0.02	--
	12/29/81	184	33.2	1.58	200 ± 300	0.033 ± 0.01	--
	01/13/82	293	58.4	2.60	2100 ± 300	< 0.02	--
	02/10/82	292	59.7	4.75	1600 ± 300	0.019 ± 0.01	--
	03/11/82	275	50.2	2.40	1500 ± 300	0.048 ± 0.01	--
PT	Heifer 254						
	Kidney	415	104	6.00	--	0.045 ± 0.01	170 ± 17
	Lung	431	104	4.90	--	0.066 ± 0.009	16 ± 3
	Bone	432	356	191	--	0.007 ± 0.003	13 ± 3
	Liver	598	172	8.80	--	0.039 ± 0.01	12 ± 4
	Muscle	606	154	7.10	2900 ± 300	0.026 ± 0.008	< 5
	Rumen	819	89.7	17.8	2600 ± 300	1.2 ± 0.06	1700 ± 80
	Hamburger	963	269	48.0	3400 ± 300	0.012 ± 0.006	< 5
	Steak	864	220	38.7	700 ± 300	0.041 ± 0.009	< 5
	Blood						
	11/05/81	356	57.9	3.23	400 ± 300	0.038 ± 0.02	--
	11/12/81	577	108	6.41	2300 ± 300	0.061 ± 0.02	--
	11/17/81	436	73.9	3.87	-100 ± 300	0.023 ± 0.02	--
	11/19/81	292	59.1	2.57	800 ± 300	0.017 ± 0.01	--
	11/24/81	294	56.1	2.53	4500 ± 300	0.045 ± 0.02	--
	12/01/81	271	50.9	2.32	1000 ± 300	0.039 ± 0.01	--
	12/15/81	245	42.1	2.27	1400 ± 300	0.031 ± 0.01	--
	12/29/81	222	39.6	1.83	400 ± 300	0.033 ± 0.02	--
	01/13/82	297	60.8	4.16	2300 ± 300	0.046 ± 0.02	--
	02/10/82	220	40.4	1.84	0.0 ± 300	0.027 ± 0.01	--
	03/11/82	258	50.7	2.10	--	0.061 ± 0.02	--
PT	Heifer 256						
	Kidney	303	69	3.6	--	< 0.004	120 ± 12
	Lung	461	98	5.7	--	0.39 ± 0.003	18 ± 3
	Bone	397	310	180	--	0.002 ± 0.002	7 ± 5
	Liver	901	215	8.3	--	0.013 ± 0.008	< 5
	Muscle	841	231	13.2	2700 ± 300	0.010 ± 0.004	< 5
	Rumen	899	185	21.8	900 ± 300	1.1 ± 0.06	2700 ± 130
	Hamburger	924	315	35.2	2400 ± 300	0.014 ± 0.006	< 5
	Steak	907	313	43.2	2500 ± 300	< 0.006	< 5
	Blood						
	11/05/81	379	72.1	3.39	400 ± 300	0.034 ± 0.01	--
	11/12/81	578	92.5	2.83	200 ± 300	0.027 ± 0.01	--
	11/17/81	288	48.4	2.46	2400 ± 300	0.021 ± 0.01	--
	11/19/81	293	48.8	2.58	10900 ± 400	< 0.01	--
	11/24/81	284	46.4	2.52	500 ± 300	0.052 ± 0.02	--
	12/01/81	290	50.4	2.65	4800 ± 400	0.019 ± 0.01	--
	12/15/81	292	55.8	2.70	3200 ± 300	0.038 ± 0.02	--
	12/29/81	299	56.6	5.74	1000 ± 300	0.023 ± 0.01	--

TABLE A-XIV (cont)

Treatment	Tissue	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	³ H (pCi/£)	Scandium Ash (ppm)	Uranium Ash (ppb)
	Heifer 256 (cont)						
	Blood						
	01/03/82	299	58.1	2.60	-300 ± 300	0.037 ± 0.02	--
	01/10/82	291	56.9	2.56	100 ± 300	0.033 ± 0.02	--
	03/11/82	290	54.5	3.00	1800 ± 300	0.040 ± 0.006	--
PT	Heifer 257						
	Kidney	308	68.3	1.8	--	0.019 ± 0.008	194 ± 19.0
	Lung	398	81.9	4.3	--	0.055 ± 0.007	14 ± 3
	Bone	428	247	187	--	0.005 ± 0.002	33 ± 6
	Liver	923	292	12.7	--	0.030 ± 0.009	27 ± 5
	Muscle	679	205	19.1	0.0 ± 300	0.014 ± 0.006	< 5
	Rumen	670	88.2	11.0	200 ± 300	1.2 ± 0.1	2100 ± 100
	Hamburger	922	291	9.3	-200 ± 300	0.033 ± 0.009	20 ± 4
	Steak	1020	322	9.4	700 ± 300	0.051 ± 0.01	16 ± 4
	Blood						
	11/05/81	338	44.9	2.87	400 ± 300	0.043 ± 0.008	--
	11/12/81	579	89.8	4.56	800 ± 300	0.033 ± 0.02	--
	11/17/81	419	58.1	4.18	0 ± 300	0.041 ± 0.02	--
	11/19/81	299	43.1	2.84	7900 ± 400	< 0.0	--
	11/24/81	274	47.4	2.39	700 ± 300	0.026 ± 0.01	--
	12/01/81	287	43.6	3.25	600 ± 300	0.014 ± 0.01	--
	12/15/81	298	51.1	2.69	600 ± 300	0.022 ± 0.01	--
	12/29/81	281	44.7	2.43	200 ± 300	0.026 ± 0.01	--
	01/13/82	296	52.9	2.51	900 ± 300	0.018 ± 0.02	--
	02/10/82	283	50.0	2.38	500 ± 300	< 0.02	--
	03/11/82	289	49.6	2.70	--	0.013 ± 0.007	--
PT	Heifer 258						
	Kidney	353	91.1	2.3	--	0.013 ± 0.01	140 ± 14.
	Lung	310	73.8	3.6	--	0.024 ± 0.006	< 5
	Bone	431	352	180	--	0.003 ± 0.002	20 ± 4
	Liver	625	208	8.6	--	0.020 ± 0.004	24 ± 4
	Muscle	985	276	10.6	100 ± 300	0.031 ± 0.01	< 5
	Rumen	609	85.5	10.0	100 ± 300	1.3 ± 0.06	1400 ± 70
	Hamburger	992	316	22.4	1200 ± 300	0.090 ± 0.01	26 ± 4
	Steak	912	261	30.8	500 ± 300	0.006 ± 0.005	< 5
	Blood						
	11/05/81	567	83.9	4.92	700 ± 300	0.045 ± 0.02	--
	11/12/81	584	88.5	4.92	1800 ± 300	0.038 ± 0.02	--
	11/17/81	409	58.4	3.65	2300 ± 300	0.040 ± 0.01	--
	11/19/81	301	44.1	2.65	1000 ± 300	0.038 ± 0.01	--
	12/01/81	267	42.4	2.57	600 ± 300	0.017 ± 0.01	--
	12/15/81	294	47.0	2.78	1800 ± 300	0.057 ± 0.02	--
	12/29/81	298	54.3	2.54	1900 ± 300	0.037 ± 0.02	--
	01/13/82	299	51.0	2.51	1100 ± 300	0.020 ± 0.02	--
	02/10/82	299	51.6	2.54	3000 ± 300	0.042 ± 0.02	--
	03/11/82	292	51.7	2.90	8700 ± 400	0.061 ± 0.01	--
PT	Heifer 259						
	Kidney	307	74.3	3.66	--	0.019 ± 0.01	180 ± 18
	Lung	491	115	5.44	--	0.043 ± 0.02	< 10
	Bone	519	428	222	--	< 0.005	16 ± 4
	Liver	373	102	2.94	--	0.019 ± 0.01	10 ± 4

TABLE A-XIV (cont)

Treatment	Tissue	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	³ H (pCi/£)	Scandium Ash (ppm)	Uranium Ash (ppb)
	Heifer 259 (cont)						
	Muscle	508	129	2.96	-300 ± 300	0.021 ± 0.01	< 10
	Rumen	642	115	10.4	0.0 ± 300	0.55 ± 0.06	1400 ± 70
	Hamburger	898	296	27.5	100 ± 300	0.017 ± 0.008	< 5
	Steak	686	171	12.3	-200 ± 300	0.025 ± 0.02	< 5
	Blood						
	11/05/81	353	49.7	3.35	200 ± 300	0.030 ± 0.01	--
	11/12/81	541	86.7	2.83	100 ± 300	0.068 ± 0.02	--
	11/17/81	458	85.2	4.04	-300 ± 300	0.059 ± 0.02	--
	11/19/81	320	47.2	2.54	400 ± 300	< 0.02	--
	11/24/81	284	49.8	2.49	1700 ± 300	0.048 ± 0.02	--
	12/15/81	277	47.3	2.42	1800 ± 300	0.033 ± 0.02	--
	12/29/81	293	56.7	2.49	300 ± 300	< 0.02	--
	01/13/82	283	53.1	2.38	1600 ± 340	0.028 ± 0.02	--
	02/10/82	296	55.2	2.49	1200 ± 300	0.039 ± 0.02	--
	03/11/82	290	53.7	2.70	--	0.044 ± 0.01	--
PT	Heifer 260						
	Kidney	310	78.9	3.34	--	0.015 ± 0.01	66 ± 7
	Lung	462	103	5.16	--	0.028 ± 0.02	< 10
	Bone	391	310	181	--	< 0.004	21 ± 4
	Liver	677	221	9.30	--	0.019 ± 0.01	< 10
	Muscle	567	155	8.40	0.0 ± 300	0.016 ± 0.009	< 10
	Rumen	303	40.0	5.40	-300 ± 300	0.89 ± 0.1	1200 ± 60
	Hamburger	931	330	15.9	400 ± 300	--	26 ± 4
	Steak	909	259	9.50	300 ± 300	--	< 5
	Blood						
	11/05/81	514	91.6	4.64	100 ± 300	0.060 ± 0.02	--
	11/12/81	519	78.5	4.58	900 ± 300	0.067 ± 0.02	--
	11/17/81	410	62.6	3.02	3300 ± 300	0.039 ± 0.02	--
	11/19/81	293	46.9	2.61	6800 ± 400	0.036 ± 0.01	--
	11/24/81	294	48.2	2.58	1000 ± 300	0.045 ± 0.02	--
	12/01/81	269	48.4	2.69	500 ± 300	0.035 ± 0.01	--
	12/15/81	297	52.1	2.57	800 ± 300	0.018 ± 0.02	--
	12/29/81	293	51.8	3.46	400 ± 300	0.047 ± 0.02	--
	01/13/82	299	55.0	2.70	1000 ± 300	0.036 ± 0.02	--
	02/10/82	286	53.2	2.68	1000 ± 300	0.029 ± 0.01	--
	03/11/82	290	51.3	2.80	12300 ± 400	0.038 ± 0.01	--
AT	Heifer 225						
	Kidney	307	84.0	3.74	--	0.012 ± 0.01	540 ± 30
	Lung	303	68.6	3.43	--	0.046 ± 0.02	31 ± 4
	Bone	442	348	178	--	0.020 ± 0.009	61 ± 6
	Liver	554	167	7.20	--	0.027 ± 0.02	< 10.
	Muscle	772	189	23.3	-200 ± 300	0.027 ± 0.02	< 10.
	Rumen	687	57.1	11.1	-400 ± 300	0.790 ± 0.08	1100 ± 60
	Hamburger	585	159	6.2	-100 ± 300	0.022 ± 0.02	21 ± 4
	Steak	719	179	8.1	100 ± 300	0.028 ± 0.01	21 ± 4
	Blood						
	11/17/81	289	52.7	2.62	1300 ± 300	0.029 ± 0.02	--
	11/19/81	261	45.4	2.22	400 ± 300	0.094 ± 0.01	--
	11/24/81	293	52.0	2.48	2300 ± 300	0.046 ± 0.02	--
	11/26/81	266	71.1	1.28	700 ± 300	< 0.01	--
	12/08/81	267	40.7	2.92	3400 ± 300	0.010 ± 0.008	--

TABLE A-XIV (cont)

Treatment	Tissue	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	³ H (pCi/£)	Scandium Ash (ppm)	Uranium Ash (ppb)
	Heifer 225 (cont)						
	12/15/81	286	48.7	2.38	600 ± 300	0.053 ± 0.02	--
	12/29/81	280	50.3	2.73	500 ± 300	0.043 ± 0.02	--
	01/13/82	283	52.0	2.54	0.0 ± 300	0.042 ± 0.02	--
	03/11/82	284	54.5	2.70	--	0.071 ± 0.02	--
AT	Heifer 458						
	Kidney	364	60.9	4.10	--	0.019 ± 0.006	97 ± 10
	Lung	337	78.8	4.10	--	0.032 ± 0.006	< 5
	Bone	478	369	206	--	0.002 ± 0.001	17 ± 4
	Liver	756	258	11.0	--	0.019 ± 0.007	< 5
	Muscle	813	203	20.1	200 ± 300	0.026 ± 0.008	< 5
	Rumen	873	147	15.0	-1800 ± 300	1.2 ± 0.06	2800 ± 140
	Hamburger	996	304	32.7	200 ± 300	0.033 ± 0.007	17 ± 4
	Steak	894	229	9.20	400 ± 300	0.029 ± 0.009	< 5
	Blood						
	11/17/81	292	53.9	2.58	-200 ± 300	< 0.01	--
	11/19/81	289	51.4	2.60	9600 ± 400	0.054 ± 0.02	--
	11/24/81	244	37.8	2.23	1200 ± 300	0.045 ± 0.02	--
	11/26/81	294	53.6	2.64	300 ± 300	0.013 ± 0.01	--
	12/01/81	291	50	2.62	-100 ± 300	0.049 ± 0.02	--
	12/08/81	249	46.5	2.25	1500 ± 300	0.054 ± 0.02	--
	12/15/81	294	50.0	2.94	700 ± 300	0.018 ± 0.01	--
	12/29/81	285	53.1	2.38	-100 ± 300	0.041 ± 0.02	--
	01/13/82	297	51.5	2.60	500 ± 300	0.015 ± 0.01	--
	02/10/82	282	52.3	2.33	600 ± 300	0.019 ± 0.02	--
	03/11/82	295	53.9	2.50	900 ± 300	0.071 ± 0.02	--
AT	Heifer 468						
	Kidney	313	72.4	2.00	--	0.012 ± 0.006	150 ± 15
	Lung	271	50.9	2.90	--	0.043 ± 0.01	16 ± 4
	Bone	359	277	150	--	0.007 ± 0.003	47 ± 5
	Liver	624	182	22.9	--	0.026 ± 0.008	49 ± 5
	Muscle	562	141	6.10	-200 ± 300	0.004 ± 0.009	< 5
	Rumen	246	31	3.80	-200 ± 300	2.0 ± 0.2	2400 ± 120
	Hamburger	994	271	49.5	1000 ± 300	0.008 ± 0.004	7 ± 5
	Steak	1017	262	10.3	600 ± 300	0.033 ± 0.02	< 5
	Blood						
	11/17/81	279	51.7	2.51	-100 ± 300	0.034 ± 0.02	--
	11/19/81	274	47.4	2.54	600 ± 300	0.013 ± 0.008	--
	11/24/81	252	36.9	2.50	800 ± 300	0.030 ± 0.01	--
	11/26/81	278	41.5	2.39	1300 ± 300	0.019 ± 0.007	--
	12/01/81	270	38.4	2.51	600 ± 300	0.023 ± 0.009	--
	12/08/81	216	30.8	2.01	2200 ± 300	0.017 ± 0.01	--
	12/15/81	299	46.3	2.58	1000 ± 300	0.019 ± 0.01	--
	12/29/81	264	41.2	2.31	700 ± 300	0.011 ± 0.02	--
	01/13/82	283	48.6	2.66	700 ± 300	0.042 ± 0.02	--
	02/10/82	229	37.2	2.05	600 ± 300	< 0.01	--
	03/11/82	194	32.9	1.90	--	0.039 ± 0.006	--

TABLE A-XIV (cont)

Treatment	Tissue	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	³ H (pCi/£)	Scandium Ash (ppm)	Uranium Ash (ppb)
AT	Heifer 495						
	Kidney	385	88.6	4.46	--	0.015 ± 0.01	150 ± 15
	Lung	352	75.8	3.82	--	0.066 ± 0.02	9 ± 4
	Bone	474	385	198	--	< 0.005	61 ± 6
	Liver	721	237	8.60	--	0.057 ± 0.02	12 ± 4
	Muscle	690	169	10.8	100 ± 300	0.021 ± 0.01	5 ± 4
	Rumen	676	96.7	9.70	-400 ± 300	0.63 ± 0.07	1800 ± 90
	Hamburger	923	272	41.4	500 ± 300	< 0.007	< 5
	Steak	627	162	13.5	-500 ± 300	0.048 ± 0.01	< 5
	Blood						
	11/17/81	276	42.9	2.84	2100 ± 300	0.050 ± 0.02	--
	11/19/81	255	39.9	2.42	2800 ± 300	< 0.02	--
	11/24/81	290	50.9	2.55	500 ± 300	0.049 ± 0.01	--
	11/26/81	285	45.1	2.51	2000 ± 300	0.023 ± 0.01	--
	12/01/81	267	39.1	2.59	5900 ± 400	0.044 ± 0.01	--
	12/08/81	279	45.0	2.48	900 ± 300	0.024 ± 0.01	--
	12/15/81	292	46.1	2.64	400 ± 300	0.076 ± 0.02	--
	12/29/81	292	51.2	2.44	100 ± 300	0.047 ± 0.02	--
	01/13/82	289	50.3	2.45	600 ± 300	0.023 ± 0.02	--
	02/10/82	285	51.7	2.42	1000 ± 300	0.048 ± 0.02	--
	03/11/82	307	44.6	2.80	400 ± 300	0.025 ± 0.009	--
AT	Heifer 513						
	Kidney	304	69.7	4.00	--	0.007 ± 0.004	73 ± 7
	Lung	498	109	5.50	--	0.083 ± 0.01	23 ± 4
	Bone	398	315	169	--	0.003 ± 0.002	51 ± 6
	Liver	668	182	5.20	--	0.008 ± 0.006	< 5
	Muscle	666	168	7.90	5600 ± 300	0.027 ± 0.01	8 ± 5
	Rumen	934	76.8	16.9	11300 ± 400	0.96 ± 0.05	2800 ± 140
	Hamburger	830	254	18.2	3100 ± 300	0.013 ± 0.01	12 ± 4
	Steak	812	272	8.30	1900 ± 300	0.031 ± 0.009	7 ± 5
	Blood						
	11/17/81	242	44.7	2.10	700 ± 300	0.039 ± 0.01	--
	11/19/81	288	54.5	2.50	3400 ± 300	0.040 ± 0.02	--
	11/24/81	289	49.6	2.82	1400 ± 300	0.064 ± 0.02	--
	11/26/81	278	46.4	2.51	11800 ± 400	0.045 ± 0.02	--
	12/01/81	267	43.9	2.56	1300 ± 300	0.065 ± 0.02	--
	12/08/81	275	51.6	2.36	1100 ± 300	0.020 ± 0.009	--
	12/15/81	298	59.2	1.91	1400 ± 300	0.053 ± 0.02	--
	12/29/81	256	47.4	2.17	600 ± 300	< 0.02	--
	01/13/82	283	51.1	2.45	200 ± 300	0.042 ± 0.01	--
	02/10/82	295	59.3	2.43	1300 ± 300	0.043 ± 0.02	--
	03/11/82	293	53.4	2.50	1500 ± 300	0.064 ± 0.02	--
AT	Heifer 536						
	Kidney	300	71.4	2.80	--	0.017 ± 0.006	120 ± 12
	Lung	337	71.3	7.10	--	0.049 ± 0.008	7 ± 5
	Bone	404	321	168	--	0.001 ± 0.001	29 ± 4
	Liver	862	239	11.7	--	0.007 ± 0.007	6 ± 5
	Muscle	998	238	23.0	100 ± 300	0.011 ± 0.006	12 ± 4
	Rumen	770	106	11.1	800 ± 300	0.61 ± 0.03	1700 ± 80
	Hamburger	1007	298	10.7	1700 ± 300	0.012 ± 0.007	10 ± 4
Steak	1016	318	11.8	600 ± 300	0.011 ± 0.009	14 ± 4	

TABLE A-XIV (cont)

Treatment	Tissue	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	³ H (pCi/£)	Scandium Ash (ppm)	Uranium Ash (ppb)
	Heifer 536 (cont)						
	Blood						
	11/17/81	268	48.3	2.40	1300 ± 300	0.018 ± 0.01	--
	11/19/81	273	49.0	2.45	600 ± 300	0.015 ± 0.01	--
	11/24/81	294	48.7	2.54	9000 ± 400	0.058 ± 0.02	--
	11/26/81	299	55.1	2.62	1400 ± 300	0.026 ± 0.02	--
	12/01/81	288	44.3	2.70	600 ± 300	0.033 ± 0.01	--
	12/08/81	299	47.3	2.65	4500 ± 400	0.021 ± 0.02	--
	12/15/81	283	48.0	2.69	1900 ± 300	0.031 ± 0.02	--
	12/29/81	283	50.8	5.30	1900 ± 300	0.042 ± 0.02	--
	01/13/82	288	53.3	2.56	500 ± 300	0.045 ± 0.02	--
	02/10/82	282	51.8	2.29	-600 ± 300	< 0.01	--
	03/11/82	282	48.8	2.60	500 ± 300	0.013 ± 0.02	--
AT	Heifer 565						
	Kidney	330	79.2	2.80	--	0.017 ± 0.005	270 ± 20
	Lung	418	87.2	4.80	--	0.055 ± 0.01	30 ± 5
	Bone	438	341	184	--	0.003 ± 0.002	230 ± 20
	Liver	750	226	10.3	--	0.015 ± 0.005	32 ± 5
	Muscle	707	214	11.3	-400 ± 300	0.020 ± 0.007	< 5
	Rumen	633	108	9.20	500 ± 300	1.3 ± 0.1	2300 ± 120
	Hamburger	874	275	8.50	500 ± 300	< 0.009	44 ± 5
	Steak	955	306	26.1	2100 ± 300	0.028 ± 0.007	< 5
	Blood						
	11/17/81	286	52.7	2.57	2900 ± 300	0.028 ± 0.02	--
	11/19/81	288	51.7	2.64	500 ± 300	0.030 ± 0.01	--
	11/24/81	280	47.2	2.46	1600 ± 300	0.060 ± 0.02	--
	11/26/81	290	47.6	2.45	400 ± 300	0.033 ± 0.02	--
	12/01/81	253	41.2	2.30	2300 ± 300	0.021 ± 0.01	--
	12/08/81	282	52.5	3.16	5200 ± 400	0.019 ± 0.01	--
	12/15/81	286	47.4	2.75	500 ± 300	0.065 ± 0.02	--
	12/29/81	297	52.6	2.45	500 ± 300	0.034 ± 0.02	--
	01/13/81	292	56.7	2.59	1000 ± 300	0.024 ± 0.01	--
	02/10/81	272	51.7	2.27	600 ± 300	< 0.02	--
	03/11/82	297	58.2	2.30	900 ± 300	0.039 ± 0.01	--
AT	Heifer 568						
	Kidney	360	78.6	4.40	--	0.021 ± 0.007	202 ± 15
	Lung	345	75.1	4.10	--	0.055 ± 0.009	21 ± 4
	Bone	424	361	183	--	0.005 ± 0.003	50 ± 5
	Liver	846	202	8.90	--	0.074 ± 0.02	< 5
	Muscle	779	197	8.80	1300 ± 300	0.017 ± 0.01	< 5
	Rumen	840	79.4	16.1	3800 ± 300	1.2 ± 0.06	1600 ± 80
	Hamburger	865	289	44.8	1200 ± 300	0.002 ± 0.003	< 5
	Steak	909	258	29.0	1600 ± 300	0.013 ± 0.007	< 5
	Blood						
	11/17/81	274	57.8	2.36	300 ± 300	0.022 ± 0.02	--
	11/19/81	105	15.6	1.84	1600 ± 300	0.041 ± 0.02	--
	11/24/81	292	52.9	2.52	300 ± 300	0.060 ± 0.02	--
	11/26/81	300	56.1	2.57	900 ± 300	0.040 ± 0.02	--
	12/01/81	282	48.4	2.38	2000 ± 300	0.019 ± 0.02	--
	12/08/81	259	40.5	2.29	2300 ± 300	0.044 ± 0.01	--
	12/15/81	192	30.7	1.74	2000 ± 300	0.030 ± 0.01	--

TABLE A-XIV (cont)

Treatment	Tissue	Wet Weight (g)	Dry Weight (g)	Ash Weight (g)	³ H (pCi/£)	Scandium Ash (ppm)	Uranium Ash (ppb)
	Heifer 568 (cont)						
	Blood						
	12/29/81	302	53.5	2.61	500 ± 300	0.027 ± 0.02	--
	02/10/82	294	55.8	4.14	2900 ± 300	0.026 ± 0.02	--
	03/11/82	286	50.5	2.70	1300 ± 300	0.044 ± 0.01	--
AB	Heifer 288						
	Kidney	327	95.0	2.40	--	0.020 ± 0.006	200 ± 20
	Lung	410	93.3	4.50	--	0.099 ± 0.007	35 ± 4
	Bone	398	332	156.	--	0.007 ± 0.002	46 ± 6
	Liver	727	231	9.90	--	0.015 ± 0.005	11 ± 4
	Muscle	809	233	8.70	0.00 ± 300	0.019 ± 0.009	21 ± 4
	Rumen	774	94.0	12.5	-100 ± 300	1.2 ± 0.06	4600 ± 250
	Hamburger	852	313	8.10	900 ± 300	0.016 ± 0.006	36 ± 5
	Steak	784	281	7.50	400 ± 300	0.048 ± 0.012	12.4 ± 4
AB	Heifer 315						
	Kidney	412	108	5.60	--	0.013 ± 0.004	220 ± 20
	Lung	572	130	28.9	--	0.035 ± 0.007	< 5
	Bone	523	418	214.	--	0.004 ± 0.002	< 5
	Liver	878	293	14.8	--	0.016 ± 0.007	14 ± 4
	Muscle	729	202	8.00	0.0 ± 300	0.017 ± 0.008	< 5
	Rumen	685	86.0	12.2	700 ± 300	1.1 ± 0.1	3600 ± 200
	Hamburger	961	331	9.20	900 ± 300	0.035 ± 0.008	18 ± 4
	Steak	912	278	9.90	1500 ± 300	0.070 ± 0.01	21 ± 4
AB	Heifer 324						
	Kidney	321	78.2	4.20	--	0.018 ± 0.007	79 ± 8
	Lung	457	104	7.20	--	0.057 ± 0.01	18 ± 4
	Bone	421	349	183.	--	0.009 ± 0.003	33 ± 5
	Liver	867	242	20.1	--	0.013 ± 0.006	< 5
	Muscle	749	214	8.70	1000 ± 300	0.025 ± 0.01	< 5
	Rumen	665	84.7	10.8	5900 ± 400	0.860 ± 0.05	1500 ± 80
	Hamburger	931	291	39.2	1400 ± 300	0.007 ± 0.006	< 5
	Steak	839	270	36.8	1900 ± 300	0.012 ± 0.005	< 5
AB	Heifer 363						
	Kidney	416	118	1.60	--	0.010 ± 0.004	31 ± 4
	Lung	515	115	5.90	--	0.068 ± 0.008	12 ± 4
	Bone	393	328	167.	--	< 0.002	23 ± 4
	Liver	658	181	9.20	--	0.012 ± 0.006	18 ± 4
	Muscle	660	179	9.10	100 ± 300	0.015 ± 0.004	19 ± 4
	Rumen	723	151	9.00	300 ± 300	0.1 ± 0.02	670 ± 40
	Hamburger	1020	340	22.9	600 ± 300	0.034 ± 0.01	11 ± 4
	Steak	712	260	13.9	1300 ± 300	0.034 ± 0.01	7 ± 5
AB	Heifer 373						
	Kidney	419	101	7.52	--	< 0.01	30 ± 4
	Lung	412	96	4.42	--	0.034 ± 0.02	23 ± 4
	Bone	558	444	236	--	< 0.005	27 ± 4
	Liver	766	202	10.4	--	< 0.02	< 10
	Muscle	671	179	20.4	-900 ± 300	0.031 ± 0.01	< 10
	Rumen	605	143	9.0	-200 ± 300	0.76 ± 0.08	10000 ± 500
	Hamburger	881	336	10.1	-200 ± 300	0.048 ± 0.02	18 ± 4
	Steak	824	242	35.2	-800 ± 300	< 0.01	< 5

TABLE A-XIV (cont)

<u>Treatment</u>	<u>Tissue</u>	<u>Wet Weight (g)</u>	<u>Dry Weight (g)</u>	<u>Ash Weight (g)</u>	<u>³H (pCi/£)</u>	<u>Scandium Ash (ppm)</u>	<u>Uranium Ash (ppb)</u>
AB	Heifer 494						
	Kidney	273.0	67.6	3.70	--	0.010 ± 0.004	32 ± 5
	Lung	206.1	50.2	2.20	--	0.037 ± 0.006	13 ± 4
	Bone	444.4	350	161	--	0.005 ± 0.002	9 ± 4
	Liver	475	120	6.90	--	0.014 ± 0.005	7 ± 5
	Muscle	538	144	5.80	-300 ± 300	0.018 ± 0.006	< 5
	Rumen	1300	275	17.2	900 ± 300	0.36 ± 0.04	1200 ± 60
	Hamburger Steak	918 887	301 251	8.80 8.30	1000 ± 300 1000 ± 300	0.014 ± 0.01 0.033 ± 0.01	21 ± 4 7 ± 5
AB	Heifer 496						
	Kidney	330	77.6	4.00	--	0.020 ± 0.008	170 ± 20
	Lung	413	91.9	4.70	--	0.038 ± 0.07	230 ± 20
	Bone	425	350	185	--	0.004 ± 0.004	44 ± 5
	Liver	935	262	7.90	--	0.038 ± 0.01	12 ± 4
	Muscle	722	226	17.6	300 ± 300	0.044 ± 0.02	< 5
	Rumen	716	84.8	11.5	11300 ± 400	0.84 ± 0.05	1200 ± 70
	Hamburger Steak	944 899	303 368	46.2 9.30	900 ± 300 1700 ± 300	0.006 ± 0.002 0.017 ± 0.01	8 ± 5 24 ± 4
AB	Heifer 570						
	Kidney	370	102	4.70	--	0.012 ± 0.01	46 ± 5
	Lung	317	71.2	3.40	--	0.056 ± 0.02	20 ± 4
	Bone	451	380	181	--	0.022 ± 0.007	23 ± 4
	Liver	706	194	13.7	--	0.010 ± 0.01	< 10
	Muscle	418	101	2.20	100 ± 300	0.024 ± 0.02	< 10
	Rumen	721	127	10.0	100 ± 300	0.42 ± 0.05	5700 ± 300
	Hamburger Steak	800 720	234 153	13.8 15.8	100 ± 300 -100 ± 300	0.027 ± 0.01 0.016 ± 0.01	< 5 < 5

TABLE A-XV

CATTLE TREATMENT PT (PANTECH RANGE PLUS TEXAS TECH FEEDLOT)
URANIUM RESULTS pCi/g WET

	Heifers			
	251	252	254	256
Muscle	< 1.07 x 10 ⁻⁴	< 9.17 x 10 ⁻⁵	< 3.91 x 10 ⁻⁵	< 5.24 x 10 ⁻⁵
Kidney	8.77 x 10 ⁻⁴ ± 8.77 x 10 ⁻⁵	3.50 x 10 ⁻⁴ ± 3.72 x 10 ⁻⁵	1.60 x 10 ⁻³ ± 1.64 x 10 ⁻⁴	9.58 x 10 ⁻⁴ ± 9.51 x 10 ⁻⁵
Liver	5.38 x 10 ⁻⁵ ± 4.08 x 10 ⁻⁵	< 4.63 x 10 ⁻⁵	1.16 x 10 ⁻⁴ ± 4.91 x 10 ⁻⁵	1.84 x 10 ⁻⁵ ± 3.07 x 10 ⁻⁵
Bone	4.53 x 10 ⁻³ ± 7.08 x 10 ⁻⁴	5.27 x 10 ⁻³ ± 1.47 x 10 ⁻³	3.68 x 10 ⁻³ ± 1.47 x 10 ⁻³	2.05 x 10 ⁻³ ± 1.51 x 10 ⁻³
Lung	< 3.79 x 10 ⁻⁵	4.69 x 10 ⁻⁵ ± 3.55 x 10 ⁻⁵	1.18 x 10 ⁻⁴ ± 3.79 x 10 ⁻⁵	1.47 x 10 ⁻⁴ ± 4.12 x 10 ⁻⁵
Rumen	3.02 x 10 ⁻² ± 3.02 x 10 ⁻³	2.03 x 10 ⁻² ± 2.02 x 10 ⁻³	2.39 x 10 ⁻² ± 2.46 x 10 ⁻³	4.42 x 10 ⁻² ± 4.37 x 10 ⁻³
Steak	5.19 x 10 ⁻⁵ ± 8.90 x 10 ⁻⁵	5.12 x 10 ⁻⁵ ± 3.32 x 10 ⁻⁵	< 1.49 x 10 ⁻⁴	< 1.59 x 10 ⁻⁴
Hamburger	2.26 x 10 ⁻⁴ ± 8.90 x 10 ⁻⁵	1.71 x 10 ⁻⁴ ± 4.12 x 10 ⁻⁵	< 1.66 x 10 ⁻⁴	< 1.27 x 10 ⁻⁴

	Heifers			
	257	258	259	260
Muscle	< 9.38 x 10 ⁻⁵	< 3.59 x 10 ⁻⁵	< 3.88 x 10 ⁻⁵	< 9.88 x 10 ⁻⁵
Kidney	7.57 x 10 ⁻⁴ ± 7.41 x 10 ⁻⁵	6.09 x 10 ⁻⁴ ± 6.09 x 10 ⁻⁵	1.41 x 10 ⁻³ ± 1.41 x 10 ⁻⁴	4.70 x 10 ⁻⁴ ± 4.74 x 10 ⁻⁵
Liver	2.46 x 10 ⁻⁴ ± 4.59 x 10 ⁻⁵	2.21 x 10 ⁻⁴ ± 4.59 x 10 ⁻⁵	5.21 x 10 ⁻⁵ ± 5.26 x 10 ⁻⁶	< 9.17 x 10 ⁻⁵
Bone	9.60 x 10 ⁻³ ± 1.46 x 10 ⁻³	5.57 x 10 ⁻³ ± 1.39 x 10 ⁻³	4.61 x 10 ⁻³ ± 4.55 x 10 ⁻⁴	8.02 x 10 ⁻³ ± 6.48 x 10 ⁻⁴
Lung	1.03 x 10 ⁻⁴ ± 3.60 x 10 ⁻⁵	< 3.87 x 10 ⁻⁵	< 7.39 x 10 ⁻⁵	< 7.44 x 10 ⁻⁵
Rumen	2.27 x 10 ⁻² ± 2.30 x 10 ⁻³	1.51 x 10 ⁻² ± 1.51 x 10 ⁻³	1.49 x 10 ⁻² ± 1.49 x 10 ⁻³	1.43 x 10 ⁻² ± 1.43 x 10 ⁻³
Steak	9.74 x 10 ⁻⁵ ± 3.08 x 10 ⁻⁵	< 1.13 x 10 ⁻⁴	< 5.98 x 10 ⁻⁵	< 3.48 x 10 ⁻⁵
Hamburger	1.39 x 10 ⁻⁴ ± 3.36 x 10 ⁻⁵	3.95 x 10 ⁻⁴ ± 7.53 x 10 ⁻⁵	< 1.02 x 10 ⁻³	2.93 x 10 ⁻⁴ ± 5.70 x 10 ⁻⁵

< Less than detection limits.

TABLE A-XV (cont)

CATTLE TREATMENT AT (AUCTION CATTLE ON TEXAS TECH FEEDLOT)
URANIUM RESULTS pCi/g WET

	Heifers			
	225	458	468	495
Muscle	< 2.01 x 10 ⁻⁴	< 8.25 x 10 ⁻⁴	< 3.62 x 10 ⁻⁵	5.22 x 10 ⁻⁵ ± 5.22 x 10 ⁻⁶
Kidney	4.37 x 10 ⁻³ ± 4.37 x 10 ⁻⁴	7.31 x 10 ⁻⁴ ± 7.51 x 10 ⁻⁵	6.52 x 10 ⁻⁴ ± 6.39 x 10 ⁻⁵	1.13 x 10 ⁻³ ± 1.13 x 10 ⁻⁴
Liver	< 8.67 x 10 ⁻⁵	< 4.85 x 10 ⁻⁵	1.21 x 10 ⁻³ ± 1.22 x 10 ⁻⁴	9.54 x 10 ⁻⁵ ± 9.54 x 10 ⁻⁶
Bone	1.63 x 10 ⁻² ± 1.64 x 10 ⁻⁴	4.83 x 10 ⁻³ ± 1.44 x 10 ⁻³	1.32 x 10 ⁻² ± 1.39 x 10 ⁻³	1.70 x 10 ⁻² ± 1.70 x 10 ⁻³
Lung	2.34 x 10 ⁻⁴ ± 2.34 x 10 ⁻⁵	< 4.06 x 10 ⁻⁵	1.16 x 10 ⁻⁴ ± 3.57 x 10 ⁻⁵	6.29 x 10 ⁻⁵ ± 6.50 x 10 ⁻⁶
Rumen	1.23 x 10 ⁻² ± 1.23 x 10 ⁻³	3.23 x 10 ⁻² ± 3.23 x 10 ⁻³	2.51 x 10 ⁻² ± 2.47 x 10 ⁻³	1.73 x 10 ⁻² ± 1.73 x 10 ⁻³
Steak	1.55 x 10 ⁻⁴ ± 3.76 x 10 ⁻⁵	< 3.43 x 10 ⁻⁵	< 3.38 x 10 ⁻⁵	< 7.18 x 10 ⁻⁵
Hamburger	1.49 x 10 ⁻⁴ ± 3.53 x 10 ⁻⁵	3.70 x 10 ⁻⁴ ± 1.10 x 10 ⁻⁴	2.26 x 10 ⁻⁴ ± 1.66 x 10 ⁻⁴	< 1.50 x 10 ⁻⁴

	Heifers			
	513	536	565	568
Muscle	6.48 x 10 ⁻⁵ ± 3.95 x 10 ⁻⁵	1.89 x 10 ⁻⁴ ± 7.69 x 10 ⁻⁵	< 5.33 x 10 ⁻⁵	< 3.77 x 10 ⁻⁵
Kidney	6.39 x 10 ⁻⁴ ± 6.15 x 10 ⁻⁵	7.59 x 10 ⁻⁴ ± 7.47 x 10 ⁻⁵	1.52 x 10 ⁻³ ± 1.53 x 10 ⁻⁴	1.65 x 10 ⁻³ ± 1.63 x 10 ⁻⁴
Liver	< 2.60 x 10 ⁻⁵	5.61 x 10 ⁻⁵ ± 4.52 x 10 ⁻⁵	2.88 x 10 ⁻⁴ ± 4.58 x 10 ⁻⁵	< 3.51 x 10 ⁻⁵
Bone	1.43 x 10 ⁻² ± 1.42 x 10 ⁻³	7.94 x 10 ⁻³ ± 1.39 x 10 ⁻³	6.47 x 10 ⁻² ± 6.44 x 10 ⁻³	1.44 x 10 ⁻² ± 1.44 x 10 ⁻³
Lung	1.70 x 10 ⁻⁴ ± 3.69 x 10 ⁻⁵	1.01 x 10 ⁻⁴ ± 7.03 x 10 ⁻⁴	2.30 x 10 ⁻⁴ ± 3.83 x 10 ⁻⁵	1.69 x 10 ⁻⁴ ± 3.96 x 10 ⁻⁵
Rumen	3.39 x 10 ⁻² ± 3.38 x 10 ⁻³	1.60 x 10 ⁻² ± 1.63 x 10 ⁻³	2.18 x 10 ⁻² ± 2.18 x 10 ⁻³	2.06 x 10 ⁻² ± 2.05 x 10 ⁻³
Steak	4.77 x 10 ⁻⁵ ± 3.40 x 10 ⁻⁵	1.06 x 10 ⁻⁴ ± 3.87 x 10 ⁻⁵	< 9.12 x 10 ⁻⁵	< 1.06 x 10 ⁻⁴
Hamburger	1.68 x 10 ⁻⁴ ± 7.31 x 10 ⁻⁵	6.81 x 10 ⁻⁵ ± 3.54 x 10 ⁻⁵	2.84 x 10 ⁻⁴ ± 3.25 x 10 ⁻⁵	< 1.73 x 10 ⁻⁴

< Less than detection limits.

TABLE A-XVI
 CATTLE TREATMENT AB (BUSHLAND FEEDLOT)
 URANIUM RESULTS pCi/g WET

	Heifers			
	288	315	324	363
Muscle	$1.52 \times 10^{-4} \pm 3.59 \times 10^{-5}$	$< 3.66 \times 10^{-5}$	$< 3.87 \times 10^{-5}$	$1.71 \times 10^{-4} \pm 4.60 \times 10^{-5}$
Kidney	$7.69 \times 10^{-4} \pm 9.78 \times 10^{-5}$	$1.99 \times 10^{-3} \pm 1.99 \times 10^{-4}$	$6.91 \times 10^{-4} \pm 6.98 \times 10^{-5}$	$8.00 \times 10^{-5} \pm 1.28 \times 10^{-5}$
Liver	$1.03 \times 10^{-4} \pm 4.54 \times 10^{-5}$	$1.54 \times 10^{-4} \pm 5.62 \times 10^{-5}$	$< 7.73 \times 10^{-5}$	$1.70 \times 10^{-4} \pm 4.66 \times 10^{-5}$
Bone	$1.21 \times 10^{-2} \pm 1.31 \times 10^{-3}$	$< 1.36 \times 10^{-3}$	$9.56 \times 10^{-3} \pm 1.45 \times 10^{-3}$	$6.58 \times 10^{-3} \pm 1.42 \times 10^{-3}$
Lung	$2.55 \times 10^{-4} \pm 3.66 \times 10^{-5}$	$< 1.69 \times 10^{-4}$	$1.90 \times 10^{-4} \pm 5.25 \times 10^{-5}$	$8.95 \times 10^{-5} \pm 3.82 \times 10^{-5}$
Rumen	$4.97 \times 10^{-2} \pm 4.97 \times 10^{-3}$	$4.31 \times 10^{-2} \pm 4.28 \times 10^{-3}$	$1.59 \times 10^{-2} \pm 1.62 \times 10^{-3}$	$5.56 \times 10^{-3} \pm 5.57 \times 10^{-4}$
Steak	$7.78 \times 10^{-5} \pm 3.19 \times 10^{-5}$	$1.53 \times 10^{-4} \pm 3.62 \times 10^{-5}$	$< 1.46 \times 10^{-4}$	$9.51 \times 10^{-5} \pm 6.51 \times 10^{-5}$
Hamburger	$2.26 \times 10^{-4} \pm 3.17 \times 10^{-5}$	$1.17 \times 10^{-4} \pm 3.19 \times 10^{-5}$	$< 1.40 \times 10^{-4}$	$1.67 \times 10^{-4} \pm 7.50 \times 10^{-5}$
	Heifers			
	373	494	496	570
Muscle	$< 2.03 \times 10^{-4}$	$< 3.60 \times 10^{-5}$	$< 8.12 \times 10^{-5}$	$< 3.58 \times 10^{-5}$
Kidney	$3.59 \times 10^{-4} \pm 3.59 \times 10^{-5}$	$2.89 \times 10^{-4} \pm 4.52 \times 10^{-5}$	$1.34 \times 10^{-3} \pm 1.38 \times 10^{-4}$	$3.95 \times 10^{-4} \pm 3.93 \times 10^{-5}$
Liver	$< 9.06 \times 10^{-5}$	$6.40 \times 10^{-5} \pm 4.85 \times 10^{-5}$	$6.93 \times 10^{-5} \pm 2.82 \times 10^{-5}$	$< 1.29 \times 10^{-4}$
Bone	$7.51 \times 10^{-3} \pm 7.62 \times 10^{-4}$	$2.13 \times 10^{-3} \pm 1.21 \times 10^{-3}$	$1.29 \times 10^{-2} \pm 1.45 \times 10^{-3}$	$6.03 \times 10^{-3} \pm 6.14 \times 10^{-4}$
Lung	$1.65 \times 10^{-4} \pm 1.65 \times 10^{-5}$	$8.97 \times 10^{-5} \pm 3.56 \times 10^{-5}$	$1.75 \times 10^{-4} \pm 3.80 \times 10^{-5}$	$1.44 \times 10^{-4} \pm 1.45 \times 10^{-5}$
Rumen	$1.01 \times 10^{-1} \pm 1.01 \times 10^{-2}$	$1.04 \times 10^{-2} \pm 1.06 \times 10^{-3}$	$1.33 \times 10^{-3} \pm 1.29 \times 10^{-4}$	$5.31 \times 10^{-2} \pm 5.31 \times 10^{-3}$
Steak	$< 1.42 \times 10^{-4}$	$4.37 \times 10^{-5} \pm 3.12 \times 10^{-5}$	$1.67 \times 10^{-4} \pm 3.45 \times 10^{-5}$	$< 7.31 \times 10^{-5}$
Hamburger	$1.37 \times 10^{-4} \pm 3.82 \times 10^{-5}$	$1.35 \times 10^{-4} \pm 3.20 \times 10^{-5}$	$2.71 \times 10^{-4} \pm 1.63 \times 10^{-4}$	$< 5.75 \times 10^{-5}$

< Less than detection limits.

TABLE A-XVII

CATTLE TREATMENT PC (PANTEX RANGE CONTROLS)
URANIUM RESULTS pCi/g WET

	Heifers	
	253	255
Muscle	$1.17 \times 10^{-4} \pm 1.20 \times 10^{-5}$	$7.96 \times 10^{-5} \pm 8.09 \times 10^{-6}$
Kidney	$1.36 \times 10^{-3} \pm 1.37 \times 10^{-4}$	$1.32 \times 10^{-3} \pm 1.32 \times 10^{-4}$
Liver	$1.95 \times 10^{-4} \pm 1.98 \times 10^{-5}$	$1.60 \times 10^{-4} \pm 1.61 \times 10^{-5}$
Bone	$2.27 \times 10^{-3} \pm 2.21 \times 10^{-4}$	$2.58 \times 10^{-3} \pm 2.60 \times 10^{-4}$
Lung	$1.09 \times 10^{-4} \pm 1.12 \times 10^{-5}$	NS
Rumen	$1.68 \times 10^{-2} \pm 1.68 \times 10^{-3}$	$5.66 \times 10^{-3} \pm 5.66 \times 10^{-4}$
Steak	$< 2.98 \times 10^{-5}$	$< 2.83 \times 10^{-5}$
Hamburger	$3.24 \times 10^{-4} \pm 2.74 \times 10^{-4}$	$2.98 \times 10^{-4} \pm 2.96 \times 10^{-5}$

TABLE A-XVIII

CATTLE TREATMENT AC (AUCTION CONTROLS)
URANIUM RESULTS pCi/g WET

	Heifers			
	188	198	448	541
Muscle	$< 3.44 \times 10^{-5}$	$7.58 \times 10^{-5} \pm 7.72 \times 10^{-6}$	$< 5.24 \times 10^{-5}$	$< 3.39 \times 10^{-5}$
Kidney	$1.39 \times 10^{-3} \pm 1.38 \times 10^{-4}$	$3.56 \times 10^{-4} \pm 3.56 \times 10^{-5}$	$5.94 \times 10^{-4} \pm 5.95 \times 10^{-5}$	$9.33 \times 10^{-4} \pm 9.33 \times 10^{-5}$
Liver	NS	$< 3.64 \times 10^{-5}$	$2.99 \times 10^{-5} \pm 2.74 \times 10^{-6}$	$2.75 \times 10^{-4} \pm 2.75 \times 10^{-5}$
Bone	$1.50 \times 10^{-2} \pm 1.50 \times 10^{-3}$	$1.93 \times 10^{-3} \pm 2.01 \times 10^{-4}$	$1.35 \times 10^{-3} \pm 1.24 \times 10^{-4}$	$5.60 \times 10^{-3} \pm 5.60 \times 10^{-4}$
Lung	NS	$< 2.64 \times 10^{-5}$	$1.99 \times 10^{-4} \pm 2.02 \times 10^{-5}$	$6.61 \times 10^{-4} \pm 6.65 \times 10^{-5}$
Rumen	$1.10 \times 10^{-2} \pm 1.09 \times 10^{-3}$	$9.38 \times 10^{-3} \pm 9.38 \times 10^{-4}$	$7.53 \times 10^{-3} \pm 7.53 \times 10^{-4}$	$2.12 \times 10^{-3} \pm 2.12 \times 10^{-4}$
Steak	$< 2.95 \times 10^{-5}$	$< 2.60 \times 10^{-5}$	$7.54 \times 10^{-6} \pm 7.25 \times 10^{-7}$	$< 3.61 \times 10^{-5}$
Hamburger	$2.45 \times 10^{-4} \pm 2.45 \times 10^{-5}$	$9.00 \times 10^{-5} \pm 9.28 \times 10^{-6}$	$3.71 \times 10^{-5} \pm 3.71 \times 10^{-6}$	$7.11 \times 10^{-5} \pm 7.25 \times 10^{-6}$

NS = no sample.

< = less than detection limit.

TABLE A-XIX

 TISSUE COMPOSITE RESULTS FOR PLUTONIUM
 pCi/g WET

<u>Treatment</u>	<u>Tissue</u>	<u>^{238}Pu Ash (pCi/g)</u>	<u>^{239}Pu Ash (pCi/g)</u>
PT	Muscle	0.0005 ± 0.002	-0.0040 ± 0.003
	Kidney	0.0005 ± 0.001	0.0005 ± 0.001
	Liver	-0.0020 ± 0.005	-0.0020 ± 0.005
	Bone	-0.0004 ± 0.0005	0.0004 ± 0.0008
	Lung	0.0007 ± 0.002	0.0007 ± 0.002
	Rumen	0.0002 ± 0.0003	0.0020 ± 0.0007
	Steak	0.0002 ± 0.0003	-0.0002 ± 0.0003
	Hamburger	-0.0015 ± 0.0007	-0.0010 ± 0.001
AT	Muscle	0.0011 ± 0.001	-0.0004 ± 0.001
	Kidney	0.0010 ± 0.001	0.0024 ± 0.002
	Liver	-0.0050 ± 0.005	-0.0030 ± 0.004
	Bone	-0.0003 ± 0.001	< 0.001
	Lung	0.0003 ± 0.0006	0.0003 ± 0.0007
	Rumen	0.0002 ± 0.0006	0.0015 ± 0.0008
	Steak	-0.0012 ± 0.002	0.0030 ± 0.002
	Hamburger	0.0007 ± 0.001	0.0013 ± 0.001
AB	Muscle	-0.0005 ± 0.0009	0.0016 ± 0.002
	Kidney	< 0.001	-0.0011 ± 0.001
	Liver	-0.0004 ± 0.003	0.0040 ± 0.004
	Bone	-0.0016 ± 0.0008	-0.0003 ± 0.0008
	Lung	-0.0005 ± 0.001	0.0005 ± 0.0009
	Rumen	-0.0003 ± 0.0001	0.0013 ± 0.0005
	Steak	-0.001 ± 0.001	0.0003 ± 0.001
	Hamburger	-0.0003 ± 0.0009	0.0006 ± 0.0008

 < less than detection limits.

TABLE A-XX

BLOOD COMPOSITE RESULTS FOR PLUTONIUM
pCi/g WET

<u>Treatment</u>	<u>Date</u>	<u>²³⁸Pu Ash (pCi/g)</u>	<u>²³⁹Pu Ash (pCi/g)</u>
PT	11/05/81	--	0.0004 ± 0.0004
	11/12/81	--	0.0004 ± 0.0004
	11/17/81	--	-0.0015 ± 0.0001
	11/19/81	--	-0.0008 ± 0.0008
	11/24/81	--	-0.0004 ± 0.0004
	12/01/81	--	-0.0009 ± 0.0009
	12/15/81	--	-0.0009 ± 0.0009
	12/29/81	0.0002 ± 0.0009	0.0002 ± 0.0008
	01/13/82	0.0004 ± 0.0004	0.0004 ± 0.0004
	02/10/82	-0.0005 ± 0.0004	-0.0006 ± 0.0004
	03/11/82	-0.0005 ± 0.0005	0.0003 ± 0.0005
AT	11/17/81	--	-0.0011 ± 0.0001
	11/19/81	--	0.0004 ± 0.0004
	11/24/81	--	-0.0009 ± 0.0009
	11/26/81	--	0.0003 ± 0.0003
	12/01/81	--	-0.0010 ± 0.0001
	12/08/81	--	0.0003 ± 0.0003
	12/15/81	--	0.0013 ± 0.0001
	12/29/81	-0.0001 ± 0.0002	0.0001 ± 0.0003
	11/13/82	0.0002 ± 0.0006	0.0002 ± 0.0006
	02/10/82	0.0007 ± 0.0006	0.0002 ± 0.001
03/11/82	-0.0007 ± 0.0004	-0.0006 ± 0.0002	
PC	11/05/81	--	-0.0023 ± 0.0002
	11/12/81	--	-0.013 ± 0.001
	11/17/81	--	-0.0005 ± 0.001
AC	11/17/81	--	0.0010 ± 0.0001
AC (before transfer to Bushland)	11/17/81	--	-0.0004 ± 0.0004

TABLE A-XXI

DOSE FACTORS FOR NATURAL URANIUM INGESTION WHEN GUT TO BLOOD
IS 0.05 AND 50-YR DOSE COMMITMENT

<u>Nuclide</u>	<u>Organ</u>	<u>Ingested*</u> <u>(rem/μCi)</u> <u>per model</u>	<u>Natural**</u> <u>Uranium</u> <u>(wt%)</u>	<u>Ingested</u> <u>(rem/μCi</u> <u>for natural</u> <u>uranium)</u>
235U	Bone	18.0	0.72	0.13
	Kidney	0.770		0.0055
	Liver	0.526		0.0038
234U	Bone	19.9	0.0057	0.0011
	Kidney	0.851		0.000049
	Liver	0.583		0.000033
238U	Bone	17.6	99.27	17.5
	Kidney	0.765		0.75
	Liver	0.522		0.52
U-nat	Bone			Σ 17.6
	Kidney			0.77
	Liver			0.52

*D. E. Dunning, Jr., S. R. Bernard, P. J. Walsh, G. G. Killough, and J. C. Pleasant, "Estimates of Internal Dose Equivalent to 22 Target Organs for Radionuclides Occurring in Routine Releases from Nuclear Fuel-Cycle Facilities, Vol. II," Oak Ridge National Laboratory report ORNL/NUREG TM-190/V2 (October 1977).

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