UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

OFFICE OF THE
CHAIRMAN

FC file 343
SDA Files

July 26, 1978

70-143

The Honorable Jim Sasser
United States Senate
Washington, D. C. 20510

Dear Senator Sasser:

We are pleased to reply to your inquiry of May 12, 1978 which referenced an April 30, 1978 article in the Atlanta Constitution. Your letter requested information concerning a "...possible higher than acceptable discharge of radioactive effluent from the Nuclear Fuel Services facility at Erwin, Tennessee."

As you know, plants which process radioactive materials routinely release small quantities of radioactive material in very dilute form. The NRC approved technical specifications are designed so that the concentration of these releases are as low as is reasonably achievable below the limits established in the Code of Federal Regulations, 10 CFR Part 20, "Standards for Protection Against Radiation."

The NRC evaluation of the results of programs which sample the release of radioactivity into the environment shows the concentration of radioactivity in liquid and airborne effluents from this facility are well within NRC and EPA regulatory limits. Evaluation of radioactive releases is included as a part of the NRC compliance inspection performed several times each year at the Nuclear Fuel Services facility.

Several checks are exercised over the release of radioactivity from this facility into the environment:

- The radioactive liquid effluents from the facility are sampled and analyzed by Nuclear Fuel Services prior to release.
- Samples of air, water, and vegetation taken periodically from the local environment are analyzed for radioactivity independently by Nuclear Fuel Services and the State of Tennessee.
- Additional effluent and environmental samples are analyzed by the NRC as part of its routine inspection.

We share your sentiment about the concerns of residents near the plant--particularly the residents of Jonesboro concerning their water supply. Consequently, on May 25, representatives of the NRC regional office from Atlanta met with the Mayor and Aldermen of the City of Jonesboro to discuss the issues raised in the article and, recently, the State of Tennessee has initiated an epidemiological study of the Unicoi County area with the Atlanta, Georgia HEW Communicable Disease Center.

As an enclosure to this letter, we are providing background information related to the news article and the releases of radioactive effluents from the Nuclear Fuel Services facility.

We hope this information is responsive to your request. We will continue to follow this matter, coordinating efforts with the State of Tennessee. Please let me know if we can be of further assistance.

Sincerely,

Original Signed By
Joseph M. Hendrie

Joseph M. Hendrie
Chairman

Enclosure:
Releases of Radioactivity
into the Environment-NFS

Distribution:
L. V. Gossick, EDO
W. J. Dircks, EDO
T. Rehm, EDO
C. V. Smith, NMSS
E. Volgenau, IE
J. G. Davis, IE
L. Higginbotham, IE
D. Sly, IE
SECY (3) (78-706)
OCA (3)
G. Ertter (EDO-3838)
L. N. Underwood, IE
(H6-1667-H3)
IE Files (3)
EDO Files
IE Reading Files
EDO Reading Files
Chrmn(2)

Cleared with all Cmrs. by SECY C/R.

Retyped in SECY C/R to incorporate Cmr. comments.

OCM	OCM	CHRMN
WmDircks	JEHard	JMHendrie
7/25/78	7/26/78	7/26/78

SECY EDO OCA

AHCombs
7/21/78

7/17/78 7/ /78

WPU:SM 7/13/78 OFFICE	FFMSI	FFMSI	XOOS	DD:IE	DD:IE	ELD
SURNAME	DSly	LHigginbotham	EJordan	JGDavis	EVolgenau	
DATE	7/14/78	7/14/78	7/14/78	7/ /78	7/14/78	7/ /78

Nuclear Fuel Services
Releases of Radioactivity Into the Environment

Basis for Releases

Based on recommendations of international and national scientific groups, limits governing the amount of radioactive materials which may be released by NRC-licensed activities have been established as a part of the Code of Federal Regulations, 10 CFR 20, "Standards for Protection Against Radiation." Generally, these limits are established so that any individual in the general public continuously exposed to the radiation at the quantity of the limit will receive a radiation dose of no more than 500 mrem/year. The 10 CFR 20 dose is further reduced to account for higher sensitivity of certain individuals such as children so that the generally accepted maximum individual dose to a person in the population was 170 mrem/year. In 1977, EPA established a generally applicable environmental standard which limits the individual dose contribution from nuclear fuel facilities to 25 mrem/year.

Natural Radiation

Man is continually subjected to radiation from sources that occur naturally. This radiation is termed "background radiation." Generally, this background radiation consists of cosmic radiation--from space--and from radioactive materials naturally contained in the human body and the earth's crust. The amount of background radiation varies in different regions on the earth from about 100 mrem/year to greater than 1000 mrem/year. The "background" in the State of Tennessee is about 140 mrem per year. Additional information on dose limits and background is attached as Appendix A.

Environmental Assessment

On January 27, 1978, the NRC Office of Nuclear Material Safety and Safeguards (NMSS) renewed the NFS license (License No. SNM-124) and independently prepared an Environmental Impact Appraisal (EIA) dated January, 1978, on the NFS facility operations. As part of this appraisal, an analysis was performed of the environmental impacts of released radioactive materials from operations. Historical data was used. Radiological liquid effluents were estimated to contribute a total maximum dose to an individual of less than 1 mrem/year from swimming in the Nolichucky River and eating 20 grams of fish and drinking 1.2 liters of water from the river each day. For an individual living at the nearest residence in the direction of prevailing winds, it was estimated that the maximum annual whole body radiation dose from particulates is 0.2 millirem and the maximum organ dose is 3.4 millirems. These dose rates are well below EPA and NRC regulatory limits and

are considered insignificant when compared to the natural background dose rate of 140 millirems per year in the State of Tennessee. (Attached is a copy of the Environmental Impact Appraisal).

Environmental Monitoring Program

The NMSS staff concluded in the EIA that the monitoring program for sampling air, water, soil, and vegetation was adequate to measure the impacts of the radionuclides released from all plant effluents into the environment during routine plant operation, and for measuring impacts of potential accidents. An outline of this monitoring program is included as Appendix B.

Epidemiological Impact

The NRC has not routinely conducted nor sponsored epidemiological studies associated with radiological releases from specific plants. Rather, the NRC has relied on traditional health agencies in this regard.

After reviewing statistical information on the number and frequency of cancer mortalities in Tennessee, the Department of Public Health of the State of Tennessee made the following statement:

> "While the number of deaths from malignant neoplasms in Unicoi County (where the NFS facility is located) and the counties immediately surrounding Unicoi increased significantly ($p < .01$) between the years 1954 and 1974 as did the number for the remainder of the state, the frequency of mortality from cancer in those counties during 1974-1976 was significantly lower ($p < .01$) than the frequency for the remaining counties of the state."

The notation $p < .01$ in the statement is a statistical term that means the probability of the above phenomena occurring by chance is less than 1 in 100.

Because of the interest in this matter the State of Tennessee contacted the HEW Communicable Disease Center in Atlanta, Georgia regarding an epidemiological study of Unicoi County. HEW has agreed to perform such a study in cooperation with the State and NRC.

Soil and "Muck" Samples

NFS does not process radioactive materials which contain significant quantities of radium. Radium, however, occurs naturally in trace amounts in the soil and rocks of the earth. It is a progeny of uranium-238, i.e., is formed from the decay of uranium-238. Because of the

selective leaching, concentration and absorption of natural uranium from its progeny during the varying natural weathering processes, the relative concentrations of the progeny in a stream bed could be significantly higher or lower than that found in undisturbed rock or soil. Soil, rock or "muck" in a stream bed is essentially insoluble and, as such, even if taken into the human body would not be readily absorbed.

The absorption of insoluble materials of such low activities by fish should also be viewed as having an insignificant effect on the fish or one who eats the fish (even the small amount of radium retained from that ingested would concentrate in the fish bones that rarely are eaten).

Radium in Ground Water

Radium is present naturally in the rocks, soil and waters of the earth. It is more or less evenly distributed but in some geographical areas, e.g., around underground deposits of natural uranium, the radium concentrations may be elevated one to two orders of magnitude. The NRC does not regulate naturally occurring radioactivity in the environment. The Environmental Protection Agency (EPA), however, has established a standard for radioactivity in drinking water. The EPA drinking water standard is:

Gross Alpha - 15 picocuries/liter (1.5 x E-08 uCi/ml)

Radium - 5 picocuries/liter (5 x E-09 uCi/ml)

Three ground water (well) samples taken recently in Erwin, Tennessee had gross alpha activities as follows:

Well 1 - 8 x E-10 uCi/ml

Well 2 - 4 x E-10 uCi/ml

Well 3 - 7 x E-10 uCi/ml

Water taken from a well in the waste burial area on the NFS site not used for drinking water had a gross alpha activity of 7 x E-09 uCi/ml.

All these samples meet the EPA drinking water standard of 1.5 x E-08 uCi/ml. (NFS was required by condition 46 of its renewed license, dated January 27, 1978, to establish a ground water monitoring program to include analysis of ammonia, nitrate, fluoride, mercury, uranium, thorium and plutonium.)

Samples Taken by Cox Newspaper Reporter

The following are HSL laboratory results of samples submitted to the NRC by a Cox newspaper reporter. Measured radioactivity of these samples was below NRC and EPA applicable limits and comparable to activities found by NFS, NRC and the State of Tennessee in their routine programs.

EPA Drinking water limit - 1.5 x E-08 uCi/ml gross alpha

NRC Natural Uranium limit - 3 x E-05 uCi/ml

Water Samples

*Water from little green bottom stream emptying into Martins Creek:

Alpha 7.7 ± 0.3 E-07 uCi/ml

Beta 1.9 ± 0.1 E-07 uCi/ml

*Nolichucky River, 150 yards downstream

Alpha 2 ± 2 E-10 uCi/ml

Beta 4 ± 5 E-09 uCi/ml

*Water under RR Bridge, Martins Creek

Alpha 9.8 ± 0.7 E-09 uCi/ml

Beta 4 ± 6 E-09 uCi/ml

*Water from spigot, RR parking lot

Alpha 4 ± 3 E-10 uCi/ml

Beta 1 ± 6 E-09 uCi/ml

*Nolichucky River above plant

Alpha 1.3 ± 0.2 E-09 uCi/ml

Beta 2 ± 5 E-09 uCi/ml

*Nolichucky River approximately 3 miles downstream

Alpha 1.4 ± 0.3 E-09 uCi/ml

Beta 7 ± 6 E-09 uCi/ml

Notes: (1) HSL remarked that this appears to be natural uranium. *Appeared to be no transuranics, i.e., no Alpha above 5 Mev. Beta components are in the range to be expected from natural uranium.

Soil Samples

*Gamma scan of three soil samples showed:

- soil from "pipe in sand on side of road" 150 yards downstream:

  naturally occurring; Pb^{212}, Pb^{214}, $B2^{214}$, Ra^{226}, K^{40}

- soil from "pipe in sand" 150 yards downstream:

  same as above

- soil from Tenn. Wildlife Fish Hatchery:

  same as above, plus traces of Ce^{144}, Ru^{106}, Cs^{137}, La^{140} - (kind of thing and levels expected from fallout, e.g., recent Chinese Test)

Attachments:
1. Appendix A - NRC Radiation Standards Fact Sheet
2. Appendix B - NFS Erwin - Radiological Monitoring
3. Environmental Impact Appraisal - NFS Erwin January 1978

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

RADIATION STANDARDS FACT SHEET

Atomic radiation is not new to the world; it is part of our natural "background" environment. This background of natural radiation comes from two sources. One is radiation in the form of high-energy particles that come from outer space and are known collectively as cosmic rays. The other natural source is radioactive substances present in commonplace materials found in the earth (such as granite), in living matter (such as our bodies), in air, and in water. Part of the hydrogen, potassium, and carbon in the human body, for example, is radioactive.

NATURAL RADIATION

The amount of radiation an individual receives is called the "dose" and is measured in units called "rems." The average individual in the United States accumulates a dose of one rem from natural sources about every 10 years. The following table shows a breakdown of the estimated radiation dose typically received by an individual in the United States from natural sources. The doses indoors would be somewhat lower due to shielding by housing.

Source	Annual Radiation Dose Received (in rems)
Cosmic radiation	0.04
Terrestrial radiation	
Radionuclides in the body	0.02
External radiation	0.04
Total	0.10

The exact amount of natural background radiation varies from place to place -- mainly because of differences in the amounts of natural radioactive materials present in the environment and differences in elevation. The dose from radiation is higher in certain states, for example, primarily because of cosmic radiation. Since cosmic rays lose strength as they pass through the earth's atmosphere, cosmic radiation doses are higher at high altitudes than at low altitudes. The annual dose from cosmic radiation varies among the states from about 0.03 rem in Hawaii to 0.13 rem in Wyoming.

The annual dose from materials existing naturally in the ground also varies among the states, ranging from about 0.03 rem in Texas to about 0.115 rem in South Dakota.

Background radiation levels also are higher in certain local areas because some common materials are radioactive. For example, the potential annual dose from working 8 hours a day near a granite wall at the Redcap Stand in Grand Central Station, New York City, is 0.2 rem. A dose of 1 rem may be received in some areas on the beach at Guarapari, Brazil, in only about 9 days because the sand in that region is naturally radioactive.

MAN-MADE RADIATION

Individuals also receive radiation doses as a result of the use of man-made radiation and radioactive materials for various purposes. Such doses result from additional exposures to exactly the same kinds of radiation found in nature. Many people are exposed to radiation for medical reasons, for example. In 1970, an estimated 212 million x-ray examinations were performed in the United States. The dose to the skin from one chest x-ray is usually in the range of 0.03 to 0.05 rem, and the average dose to the skin from an abdominal x-ray is about 0.6 rem. X-rays are also used extensively, of course, for dental examinations. The radiation dose to the skin from one dental x-ray is about 1 rem. In all, radiation used for the purpose of medical diagnosis accounts for about 90 percent of the total man-made annual radiation dose received by the population of the United States.

Much of the man-made radioactive material is subject to the control of the U.S. Nuclear Regulatory Commission (NRC), which licenses individuals to use radioactive materials for purposes such as producing electrical power, controlling the rate of heart beat (pacemakers), and other medical and industrial uses. Other sources of man-made radiation, such as nuclear weapons testing, radar, x-ray, and TV sets, are not subject to NRC's control.

To protect the public health, the Commission requires that its individual licensees meet certain standards for the control of radiation. The reason for these requirements is that radiation, like many things, can be harmful. A large dose to the whole body received in a short period of

time (such as about 400 rems in one day) would probably cause death within several weeks to about half of the persons so exposed, but such large doses can result only from rare accidents.

Control of exposure to radiation is based on the assumption that any exposure, no matter how small, involves some risk. The exposure limits are set so low, however, that medical evidence gathered over the past 50 years indicates that the actual health effects due to exposure to radiation when the doses are within the established limits will usually be so low that they will not be distinguishable from natural occurrences of ill health in the population. The risk to individuals at the current exposure levels is considered to be very low. However, it is impossible to say that the risk is zero. To decrease the risk still further, NRC licensees are expected to keep actual doses as far below the limits as is reasonably achievable.

HISTORY OF CURRENT STANDARDS

In the past, radiation dose limits were based on recommendations of two groups, the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP). Both include in their memberships recognized experts in science and medicine.

The ICRP's recommendations on radiation protection have been widely adopted and form the basis for radiation protection practices throughout the world. In the United States, the NCRP, which is federally chartered, provides recommendations for interested industries and federal and state agencies.

The first recommended radiation exposure limits were offered in 1925, when scientists suggested limiting exposures of radiation workers to 0.5 roentgen per week from x-rays. (A "roentgen" is a unit of measure similar to a rem but used only for x- or gamma radiation.) In 1934 the ICRP recommended a maximum of 1 roentgen per week and the NCRP 0.5 per week, in 1949-50 the two groups recommended 0.3 rem per week, and in 1956-57 they recommended 5 rems per year. This latter recommendation still stands as the basis of today's occupational limit. All of these recommended dose limits were in addition to radiation doses from natural background and medical sources.

In 1959, with atmospheric weapons testing underway and with the growing use of nuclear energy under the Atoms for Peace program, President Eisenhower established the Federal Radiation Council (FRC) to provide guidance with respect to all radiation matters directly or indirectly affecting health; including guidance for all Federal agencies in the formulation of radiation standards for protection of humans from radiation. When the Environmental Protection Agency (EPA) was formed in 1970, this responsibility was transferred to that agency. In addition, the responsibility for establishing generally applicable environmental radiation standards for uses of man-made radioactive materials regulated under the Atomic Energy Act also was transferred to EPA. The NRC has responsibility for implementing and enforcing these standards.

A principal feature of the FRC guidance was the definition of Radiation Protection Guides and Radiation Concentration Guides which are similar to the previously discussed radiation limits. These guides establish maximum values for annual radiation doses and concentrations of radioactive material in the environment, and the FRC, with the approval of the President, has stated that these limits should not be exceeded without careful consideration of the reasons for doing so. The FRC also provided guidance concerning the surveillance and control actions that should be undertaken if radiation levels in the environment became such that individuals could receive more than a certain fraction of the Radiation Protection Guides.

In addition, the FRC, as well as the NCRP and ICRP, recommended several further limitations, including: (1) that no single source of man-made radiation should be allowed to consume the total dose limits and (2) that all exposures to radiation should be kept as far below the recommended limits as is reasonably achievable.

Federal agencies such as the Nuclear Regulatory Commission are responsible for ensuring that licensees under their regulatory control keep radiation levels as low as is reasonably achievable and within the limits recommended by FRC and any generally applicable environmental standards established by EPA.

CURRENT STANDARDS

The following Federal standards currently apply to all sources of man-made radiation except those used for medical purposes:

Category	Dose Limit
Workers in nuclear industry--	
Any 13-week period	3 rems
Lifetime	5 rems times number of years beyond age 18
Individuals who are not radiation workers--in 1 year	0.5 rem
Average population exposure-- in 30 years	5 rems

As a practical matter, the annual dose limit for radiation workers is 5 rems and the annual dose limit for the population is 0.17 rem.

Note that the limit set for an individual in the general population is only one-tenth of that allowed for an individual radiation worker. Moreover, the limit for the general population as a whole is only about one-third of that for individual members of the population. Thus, the standards for the population as a whole are some 30 times more strict than the standards for workers in the nuclear industry.

The above standards were recommended by the FRC and approved by the President and are reflected in NRC's regulations. The current standards also include recommended limits for radiation exposures to individual parts of the body, such as hands and feet, skin, bone, and the lung. In general, these limits are higher than those for the body as a whole.

The NCRP and ICRP also have recommended derived limits related to the dose standards for concentrations of specific radioactive materials in air and water. These limits reflect the physical and chemical nature of the materials and are included in the NRC's regulations.

NFS ERWIN - RADIOLOGICAL MONITORING

Air monitoring--NFS

Onsite the gaseous effluent of each release point that may contain radionuclides is sampled with a particulate filter and sample pump that operate continuously during facility use. Filters are changed and analyzed daily, or five to seven days per week, according to potential significance of release. The effluent and building air samples are routinely counted for alpha activity.

Environmental air sampling is conducted continuously at seven boundary site locations. The filters are exchanged weekly and analyzed for alpha radioactivity. In addition to the boundary locations, three offsite locations are sampled--about 2000 ft northeast, 500 ft southeast, 5 miles southwest of the plant site.

Air monitoring--State

The State samples air particulate radioactivity at two locations--1 background location and 1 sample at the point of calculated maximum ground level concentration (maximum X/Q).

Water monitoring--NFS

Water samples are taken daily from Banner Spring Branch and Martin Creek. Samples are analyzed for gross alpha and gross beta radioactivity. An aliquot of each sample is composited monthly and sent to an offsite laboratory for analysis of plutonium, uranium and thorium as well as gross alpha and gross beta.

Water from the Nolichucky River is sampled both upstream and downstream of the facility once each month. Samples are analyzed for gross alpha and gross beta radioactivity.

Water samples are taken from a well in the waste burial area once each month and analyzed for gross alpha and gross beta. Water from a sewage line from the plant is sampled by a flow proportional sampler; an aliquot is taken from this sample each day and a monthly composite is analyzed for gross alpha and gross beta radioactivity. A weekly grab sample of water from a storm drain (runoff) is analyzed for gross alpha and beta.

Water monitoring--State

The State samples water at four locations--in the Nolichucky River both upstream and downstream of the NFS facility, from the end of the pipe discharging NFS liquid effluent into the Nolichucky River, and from the sewage pipeline on the NFS site. These samples are collected monthly and analyzed for gross alpha and gross beta.

Sediment sampling--NFS

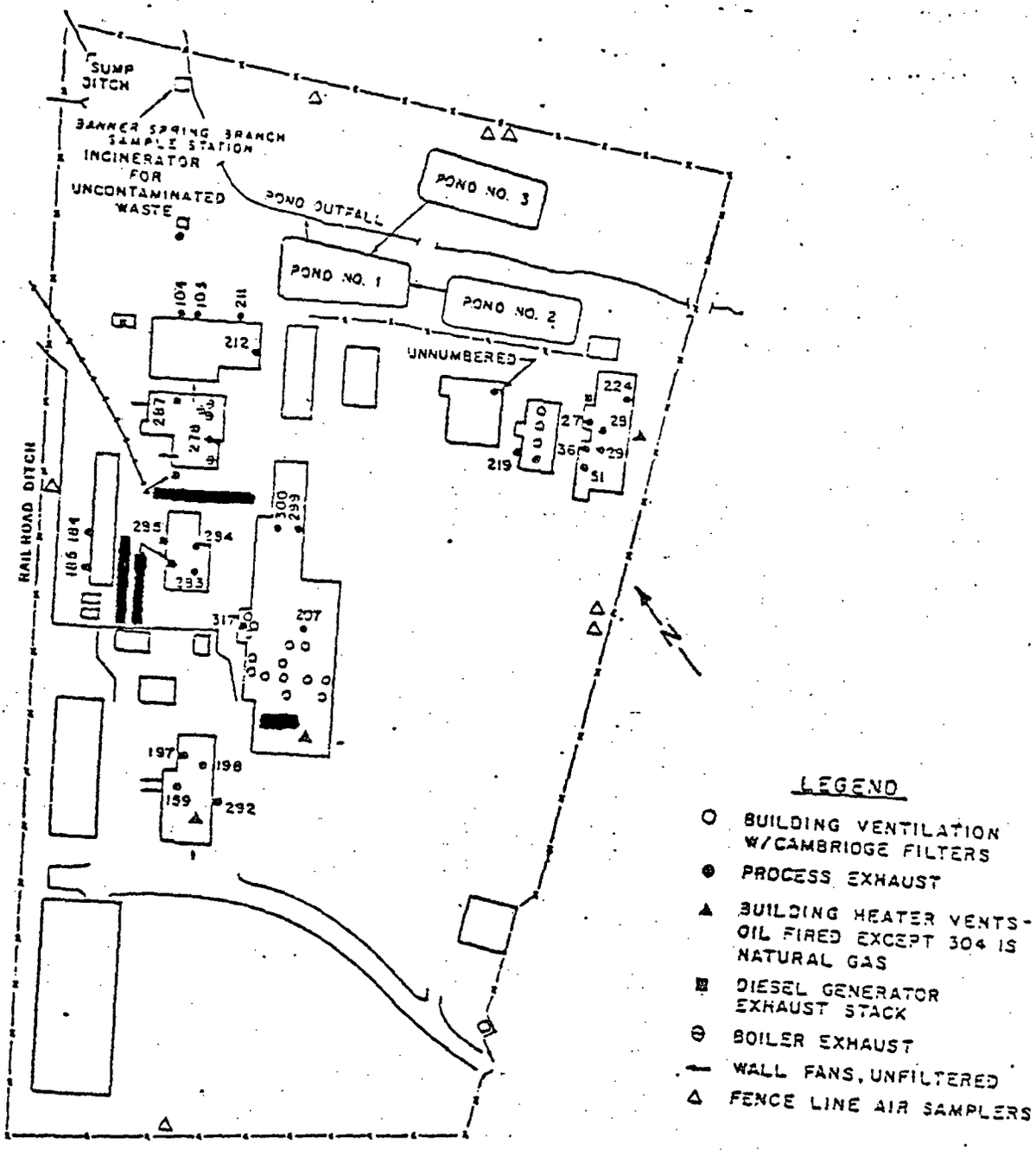
Sediment samples are taken once per month from Banner Spring Branch, Martin Creek, and from the Nolichucky River both upstream and downstream of the location were plant effluents are released. Sediment from the top 1/4-inch of a square foot of stream bed is analyzed for gross alpha and gross beta.

Soil and vegetation sampling--NFS

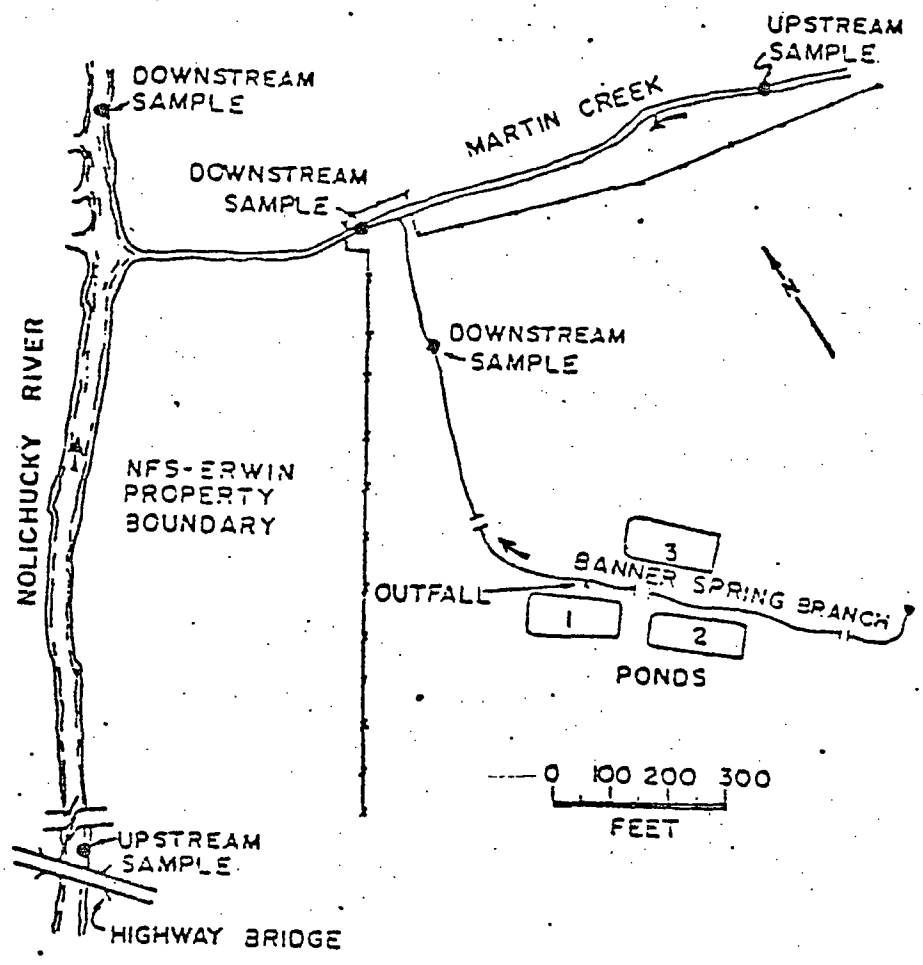
Soil and vegetation samples are taken at five locations near the plant perimeter. Because the prevailing wind is out of the south, most of the sample locations are north of the release point. An additional sampling site is located 5 miles south of Erwin and is considered to represent the background for the area. Samples are analyzed for uranium-238, 234, and 235; plutonium-239; and thorium-228, 230, and 232.

Vegetation sampling--State

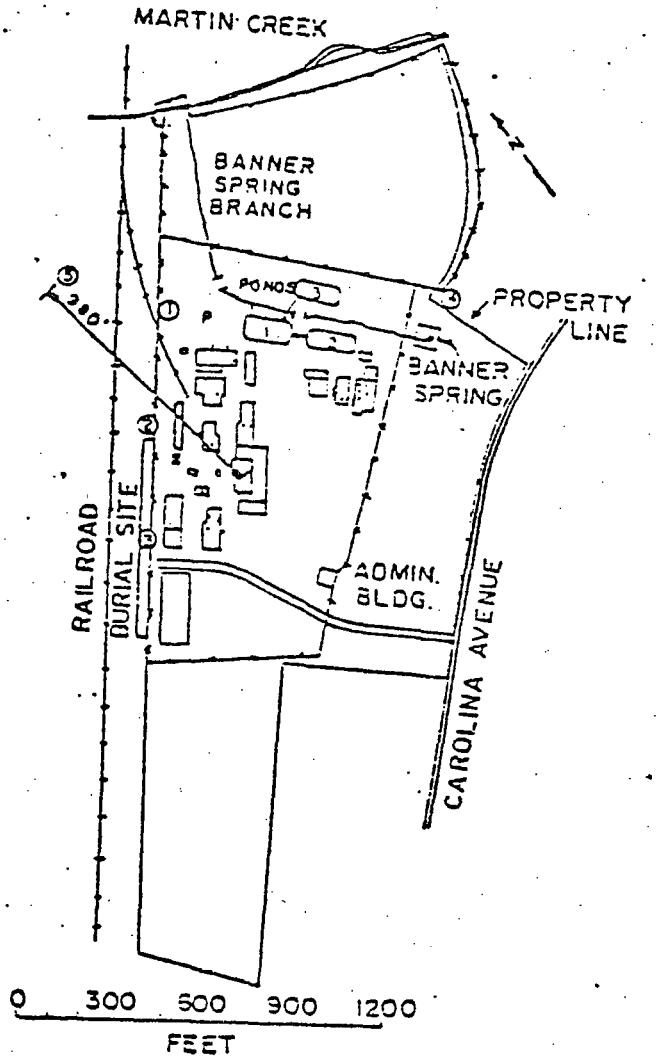
The State collects and analyzes vegetation samples once per year during the growing season.



Air sampling stations.



Water sampling stations.



Soil and vegetation sampling locations.

ENVIRONMENTAL IMPACT APPRAISAL

of the

NUCLEAR FUEL SERVICES, INC. ERWIN PLANT

ERWIN, TENNESSEE

JANUARY 1978

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY
WASHINGTON, D.C.