ENGINEERING DIVISION
U. S. ARMY ENGINEER REACTORS GROUP
Fort Belvoir, Virginia 22060

ENVIRONMENTAL RADIATION MONITORING PLAN

FOR

SM-1A NUCLEAR POWER PLANT

FORT GREELY, ALASKA

20 MAY 1971

This plan was prepared in compliance with the Adjutant General Letter dated 20 October 1965, subject: Guidelines for Environmental Radiological Monitoring at U. S. Army Nuclear Reactor Facilities.

This Environmental Radiation Monitoring Plan supersedes all previous Environmental Radiation Monitoring Plans for SM-1A Nuclear Power Plant, Fort Greely, Alaska.

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An Army-wide nuclear reactor systems health and safety effort was formulated in Army Regulation 385-80 (Ref 1). In this document the Commanding General, Army Materiel Command, is given the task of developing guidelines for environmental radiological monitoring (Ref 2). This SM-1A program is written in compliance with the guidelines furnished by the Army Materiel Command.

PURPOSE:

The purpose of an environmental monitoring program is to assure that the waste control procedures utilized by a reactor plant are effective in preserving the integrity of the surrounding environment.

SCOPE:

The SM-1A Environmental Radiation Monitoring Plan provides a systematic method of sample collection, processing, and counting to assure standardized data in sufficient quantity to permit reliable statistical analysis. Periodic reports are prepared summarizing and interpreting the results.

RESPONSIBILITIES:

The SM-1A Nuclear Power Plant is a unit of the U. S. Army Engineer Reactors Group, a Class II activity of the Chief of Engineers, Fort Belvoir, Virginia. The Officer-In-Charge of the SM-1A Nuclear Power Plant reports directly to the Chief, Operations Division, U. S. Army Engineer Reactors Group, and is responsible for implementation and operation of this program.

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A. FACTORS AFFECTING THE SCOPE OF THE ENVIRONMENTAL RADIATION MONITORING PLAN:

Type and size of the nuclear reactor.

Location.

Terrain.

Climate.

Population and land use.

Hydrology and water use.

Radioactive waste disposal.

Other sources of radioactive contamination.

Background radiation data.

Radiation monitoring within the restricted area.

1. Type and Size of Nuclear Reactor.

The SM-1A is a 20.2 megawatt thermal (MWT) nuclear power plant with a net maximum design capacity of 1,640 kilowatts (kw) of electricity and 37,950 pounds of steam per hour for post heating at Fort Greely. The reactor core consists of 38 parallel plate stationary fuel elements. Fuel is uranium oxide highly enriched in the isotope ^{235}U, and clad in stainless steel. Water under pressure serves as both a moderator and primary coolant. Heat is transferred to the independent secondary system in a steam generator within the containment vessel. Extraction steam is bled from a low pressure stage of the turbine for post heating.

2. Location.

Fort Greely is located in central Alaska, approximately 6 miles south of Delta Junction, which is the junction of the Alaska and Richardson Highways. The main post is separated into two parts by Big Delta Avenue running west to east through the post. South of Big Delta Avenue is the dependent housing area. North of Big Delta Avenue are the buildings housing the administrative services and mission functions, the most important of which are the Arctic Test Center and the Northern Warfare Training Center. The SM-1A is located centrally in the complex of buildings of Big Delta

Avenue on a fenced plot. A radioactive waste storage building is located within the SM-1A restricted area fence east of the plant (figures 1 and 2).

3. Terrain.

The Yukon River, flowing from the east to the Bering Sea in the west, drains the central portion of Alaska between the Brooks Range to the north and the Alaska Range to the south. Fort Greely lies 150 miles below the Arctic Circle on the southern rim of the Central Yukon Valley in the Tanana River tributary system. The terrain is generally flat, with an elevation of 1,000 to 2,000 feet above sea level. Sands, silts, and gravels make up the soil over much of which grow soft spongy tussocks of muskeg. Thin short Arctic Spruces are found abundantly in thickets throughout the area while Aspen cover the low ridges and hills. The perpetually snow covered Alaska Range dominates the view. In the ravines and valleys and on the lower slopes of the mountains are many small glaciers.

4. Climate.

The summers are mild and clear with sunshine from 18 to 24 hours of the day. In June there is only a brief twilight between midnight and 1 o'clock; then the full sun reappears. The winters conversely are long, cold, and dark. The average temperature is 60°F in July and -6°F in January. The region is semi-arid with precipitation averaging less than 12 inches per year. Approximately 75 percent of this appears as rain during the period of June through September. Comparatively little snow falls in the area; the annual average being around 35 inches. Winds are light and variable (up to 24 miles per hour) 75 percent of the time, and 15 percent of the time the winds are moderate to strong (greater than 25 miles per hour). High winds invariably come from the east to the south quadrant.

5. Population and Land Use.

Fairbanks, the only large community in Central Alaska, is 100 miles northwest of Fort Greely. The Upper Yukon Valley, east of Fairbanks, is sparsely inhabited with houses scattered along the main roads at wide intervals. The long cold winter makes living conditions difficult. There is little agriculture and no industry; hunting, fishing and trapping are the main occupations.

Fort Greely is a modern, well-constructed military post with structures that are maintained in excellent condition. The two major mission functions are the Arctic Test Center and the Northern Warfare

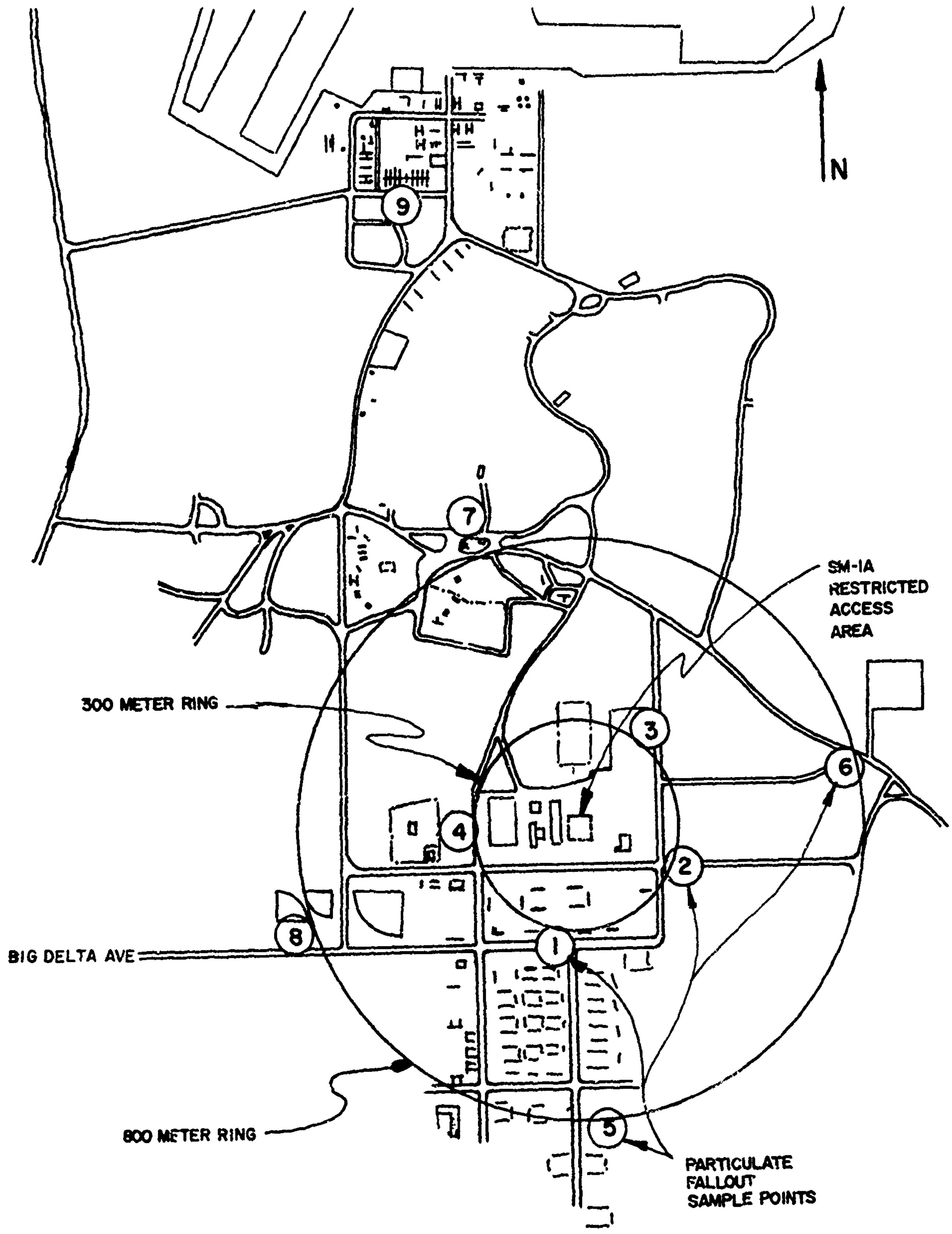

FIGURE I
FORT GREELY, ALASKA

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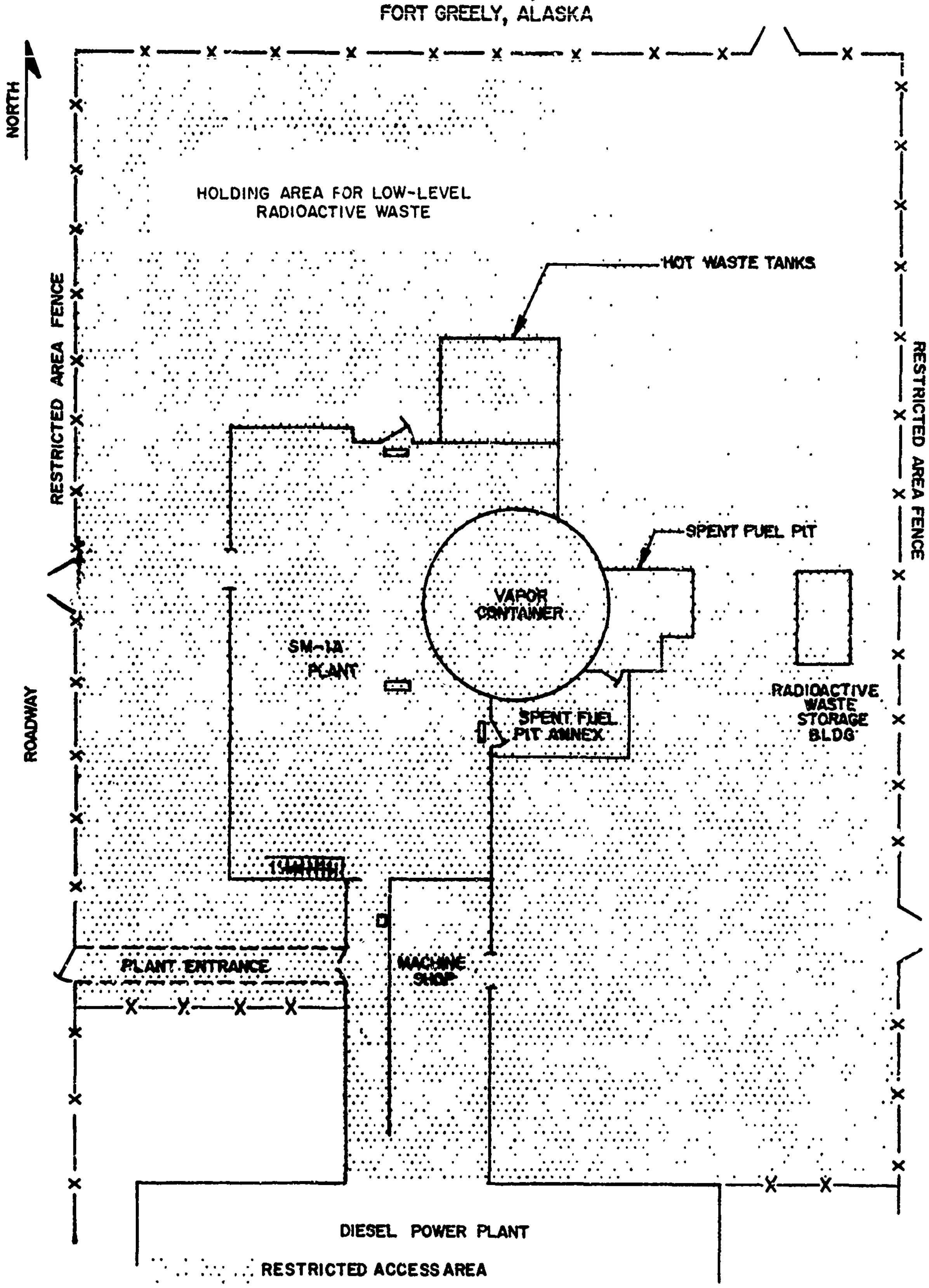
FIGURE 2.
LAYOUT SKETCH, SM-1A
FORT GREELY, ALASKA



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Training Center. The usual military support facilities are present including quartermaster, engineer, and signal services; recreation facilities, dependent housing, schools, and a chapel. The total population is approximately 2,500.

There are two civilian communities in the area. Delta Junction is 6 miles north of the post at the junction of the Alaska Highway going eastward into Canada and the Richardson Highway going to the southern coast. Adjoining Delta Junction to the north is the community of Big Delta at the junction of the Delta and Tanana Rivers. The economy of the area is based on the services to the military installation and tourists. Several trailer courts (primarily occupied by families who cannot get quarters on the post) along with a few bars, service stations, and stores comprise the business portion of the villages. The total population is approximately 1,800 for Delta Junction and 200 for Big Delta.

6. Hydrology and Water Use.

The Tanana River is the largest river in the district. It is a silt-laden stream with a mean discharge in January of 5,000 cubic feet per second (cfs) and a mean July discharge of 40,000 cfs. The Delta River, which drains into the Tanana from the south, has its source in the Tangle Lakes on the southern side of the Alaska Range. The river flows north through a pass in the range, and empties into the Tanana River at Big Delta Village. The Upper Delta River is a small, clear stream, but its lower branches are silt-laden due to the discharge from several major glaciers. Its mean discharge is 450 cfs in January and 9,000 cfs in July.

Jarvis Creek originates at Jarvis Glacier and discharges into the Delta River halfway between Fort Greely and Big Delta. Its mean discharge is 30 cfs in January and 650 cfs in July. This is the stream which flows through the military reservation and into which diluted radioactive liquid waste may be discharged. The broad flood plain of the creek is covered with silt banks and a few gravel bars. Shallow channels carrying swift flowing water are braided through the silt layer in a constantly changing pattern. It has a great diurnal change in discharge because of variations in rate of melting of the glacier. The water stage is highest in the late afternoon and early evening, especially on clear hot days. Streams like this freeze to the bottom in winter; the constricted water then breaks through to the surface, flooding over and freezing. Successive overflow forms thick sheets of ice.

There is no known use of surface water in the Delta District for domestic or industrial water supplies. Deep wells are used at Fort Greely as a source of domestic water supply. The nuclear power plant draws circulating water from a deep well and recharges the condenser outlet back underground via a dry well. A small portion of the circulating water is used for power plant make-up water. Additionally, a well at the edge of Jarvis Creek may be used to supply water for diluting the liquid radioactive waste stream before it is discharged into Jarvis Creek. Table I furnishes a list of wells at Fort Greely with their location, depth, use, and maximum pumping capacities.

7. Radioactive Waste Disposal.

The SM-1A discharges low-level liquid and airborne radioactive materials into the environment under controlled conditions such that the effluents at the point of discharge do not exceed the maximum permissible concentrations established by the U. S. Atomic Energy Commission (see Ref 3).

a. Liquid Radioactive Waste Disposal

Liquid radioactive waste from the SM-1A is accumulated in three hot-waste tanks and two laboratory waste tanks.

b. Hot Waste Tanks

The hot waste tanks consist of one 5,200-gallon tank and two 7,500-gallon tanks. Radioactive liquid wastes from the following sources are discharged to the tanks:

Laboratory waste holdup tanks.
Demineralizer room floor drain.
Radioactive sample sink drain.
Diversion of primary blowdown upon high radiation alarm.
Diversion of primary blowdown cooling water upon high radiation alarm.
Secondary blowdown upon high radiation alarm.
Backwash from micrometallic filter in primary blowdown line.
Rod drive sump pump.

Liquid waste from the demineralizer floor drain and the sample sink drain is discharged only to hot waste tank #1. Liquid waste from the other listed sources may be discharged into all three tanks. Liquid waste in any tank can be transferred to either of the other two by selective pump operation and valve manipulation. A pump located at each tank is utilized to discharge liquid waste through

TABLE I

PHYSICAL DATA ON DEEP WELLS AT FORT GREELY, ALASKA

Well No.	Location	Use	Suction Depth (feet)	Daily Output (gallons)
1	Bldg T-131	General domestic	225	16,000
3	Bldg T-105	General domestic	195	2,600
4	Bldg T-117	General domestic	204	22,000
5	Bldg T-329	General domestic	214	2,200
6	Bldg T-300	General domestic	210	6,600
8	Bldg 625	General domestic	350	140,000
9	Bldg 606	General domestic	250	84,000
10	SM-1A	Power plant cooling water	251	1,440,000
11	SM-1A	Power plant cooling water	241	1,440,000
13	Jarvis Creek	SM-1A hot waste dilution	214	1,340,000
14	Bldg T-680	General domestic (when in use)	206-252	288,000
15	Bldg T-1330 (Beales range)	General domestic	155	250
16	Bldg 1910 (Bolio Lake)	General domestic	257	400
No #	Bldg 1605 (Tank range)	General domestic	255	200
SM-1A Dry well	215 Yards No. of SM-1A	Capable of accepting 1500 gpm (approx. 250 ft. deep)		

a valve-control station to either the Jarvis Creek dilution station or the skid-mounted radioactive waste disposal system. A flowmeter, integrator, and totalizer in the disposal line indicates flow rate and total waste pumped into disposal.

c. Laboratory Waste Holdup Tanks

Two 270-gallon tanks are located in the waste tank pit for the containment of small volumes of liquid waste. One tank is used at a time while the other tank is on standby. A pressurized air system is used to transfer the liquid waste to the hot waste tanks. Waste is routed to the laboratory waste holdup tanks from the following points:

Laboratory hot sinks.
Emergency shower.
Contaminated clothes washing machine.
Hot sink at the vapor container entrance.

d. Storage, Monitoring, and Dilution of Liquid Wastes

The radioactive liquid waste generated within the plant is stored in the hot waste tanks until it is further processed by dilution or concentration prior to release. Liquid waste is normally processed through radioactive waste disposal skid. The concentrated activity is collected and disposed of as solid waste. The liquid condensate from evaporation is diluted with condenser cooling water or sewer water, and discharged to the dry well or the sanitary sewer. Release of this condensate is carefully controlled so that the maximum permissible concentration for discharge to the environment is not exceeded.

Liquid waste may also be disposed of by using the Jarvis Creek dilution station. The undiluted waste is pumped from the hot waste tanks through a closed, pressurized pipe to the dilution facility located near the stream bed of Jarvis Creek. The dilution facility includes a well, a dilution pump system, and a means of metering and monitoring the pump discharge. When the waste flow from the SM-1A is at a maximum, a dilution ratio of approximately 1000:1 is possible; reduced flow rates permit correspondingly greater dilution ratios. Pumping and dilution of the radioactive liquid waste is permitted only when the flow of water in Jarvis Creek is continuous, generally May through August of each year.

e. Discharge of Liquid Waste to Jarvis Creek

The shift supervisor must obtain the permission of the officer-in-charge prior to:

Beginning any discharge from the plant.
Any change in pump discharge rate.
Realign the discharge system so as to pump from a different tank.

Samples of Jarvis Creek water are collected by the SM-1A process control section to establish a radiation background reading of the water prior to discharge of liquid radioactive waste. Thereafter, samples are taken to determine the activity of the radioactive waste stream, the dilution water, and Jarvis Creek.

f. Airborne Radioactive Waste Disposal

SM-1A plant effluent air, which may contain radioactivity, is monitored or sampled at the final point of effective control prior to being released to the atmosphere through the vent stack.

The five tanks vented to the stack are:

Laboratory waste holdup tanks #1 and #2.
Hot waste tanks #1, #2, and #3.

The following airstreams are filtered to remove contaminants before discharge into the stack:

Effluent air from the vapor container (when open).
Hot waste tank area.
Demineralizer room.
Spent fuel pit area.
Laboratory fume hoods.

The vapor container entrance is sealed during operation of the reactor. Prior to opening the vapor container following reactor shutdown, the vapor container air is recirculated through a filter until the air activity is within the limits of the prescribed maximum concentration for discharge.

8. Other Sources of Radioactive Contamination.

Other than the SM-1A Nuclear Power Plant, there are no significant sources of man-made radioactivity in the vicinity of Fort Greely.

9. Background Radiation Data.

Attachment A is a background radiation survey conducted prior to construction and operation of the SM-1A Nuclear Power Plant.

10. Radiation Monitoring Within the Restricted Area.

Radiation monitoring systems in continuous use during plant operation consist of an area monitoring system, a process monitoring system, an air particulate monitor, and a gas monitor. During periods of discharge of waste water to Jarvis Creek, a discharge water monitor is in continuous use. These systems are supplemented by the collection of air and water samples which are examined in the laboratory.

a. Area Monitoring System

The area monitors measure the radiation levels in the following plant areas:

Laboratory.
Vapor container (interior).
Vapor container (exterior).
Demineralizer room.
Spent fuel pit.

b. Process Monitoring System

The process monitors measure the system processes. There are six process monitor gamma-sensitive detectors located as follows:

Vapor container cooling water.
Discharge to recharge (dry) well.
Demineralizer effluent.
Primary coolant blowdown.
Steam generator blowdown.
Main steam.

c. Airborne Radioactivity Monitoring

Effluent air which may contain radioactivity is discharged through the vent stack and is monitored at the point of discharge to the atmosphere. An exception is the primary make-up tank relief valve, which vents through a flame arrestor to the atmosphere. The airborne effluent monitoring system detects, indicates, and records the radiation level of airborne material, and activates an alarm when the activity leaving the vent stack approaches permissible limits.

In operation, an air sample from the vent stack is pumped into the stack monitor where it is passed through a series of filters and monitored for particulate, iodine, and gaseous radioactivity. The detector outputs are recorded on a chart, thus providing a continuous indication of airborne discharges.

A mobile air monitor is provided to measure the airborne particulate activity at various locations through selective valving.

Portable air samplers are provided to collect potential radioactive airborne material on filters. The samplers are used for spot sampling during reactor operations and during maintenance work.

Air samples are analyzed for activity by passing a known volume of air through filter paper and counting the deposited particulate material with a scaler and detector unit. In the case of the mobile air monitor, where the monitor has a detector-counting system, a preliminary survey can be made without reference to the laboratory scaler.

d. Liquid Effluent Monitoring

Radioactive liquid effluents from the SM-1A can be discharged from either the hot waste tanks or the radioactive waste disposal system to Jarvis Creek during the summer period. Before this is allowed, samples are taken for analysis of radioactivity, and discharge and dilution rates determined. Thereafter the discharge is monitored continuously by a monitor located within the Jarvis Creek dilution water pump house.

Water samples are analyzed for activity by evaporating to dryness a known volume of water, and counting the resulting residue with a scaler and detector unit. Samples are routinely taken from both primary and secondary systems to check leakage, and a control measure for release of contamination to the environment.

B. ENVIRONMENTAL RADIATION MONITORING IN THE UNRESTRICTED AREA:

The environmental monitoring in the unrestricted area is performed by the Health Physics Section, SM-1A.

The sampling program provides a full range of specimen types to be examined: Fallout material, soil, water, river sediment, and fish. Maximum effort will be expended in the collection and examination of fallout samples, since these samples will yield the most meaningful information in the Fort Greely situation. Of next importance is the monitoring of Jarvis Creek during the periods of waste discharge to the creek. The collection of other samples is restricted, but sufficient examinations will be made to permit valid statistical processing of the data on an annual basis.

1. Basis for Sampling Program

a. Particulate Fallout Samples. Primary reliance for monitoring the environment has been placed on the continuous collection of particulate airborne radioactivity being deposited from the atmosphere. The prevalent wind conditions were the governing factor in choosing the sample station locations. Figure 1 shows the location of sample stations.

b. Water Samples. Jarvis Creek will be sampled during the periods when liquid radioactive waste is being discharged to the creek. Samples will also be taken from the dry well and the discharge of the radioactive waste disposal system when that system is in use.

c. Soil Samples. Soil will be sampled only in the immediate vicinity of the plant directly north of the area used for processing and storing low level solid radioactive waste.

d. Sediment Samples. Sediment samples from the bed of Jarvis Creek will be examined before and after periods of liquid radioactive waste discharge to the creek.

e. Fish Samples. To provide evidence that radioactivity is not being concentrated in aquatic life, fish will be collected from the first productive fishing area below the point of liquid radioactive waste discharges.

2. Sampling Schedule

The following sampling schedule will be observed except when precluded by weather conditons:

a. Water

Station: 101

Location: Approximately 1/2 mile upstream from SM-1A discharge point on Jarvis Creek.

Frequency Code: B during periods of liquid waste discharge to Jarvis Creek; C otherwise (see note).

Station: 102

Location: Jarvis Creek at Richardson Highway Bridge

Frequency Code: B during periods of liquid waste discharge to Jarvis Creek; C otherwise (see note).

Station: 103

Location: Delta River between junction of Jarvis Creek and Tanana River

Frequency Code: A (see note).

Station: 104

Location: Domestic water supply

Frequency Code: B during periods of liquid waste discharge to the sanitary sewer or dry well; D otherwise.

NOTE: *Samples will be taken only during those periods in which the flow in Jarvis Creek is continuous, as radioactive discharges to Jarvis Creek are not permitted.*

b. Particulate Fallout

Station: 201

Location: Point 1, Figure 1.

Frequency Code: A

Station: 202

Location: Point 2, Figure 1.

Frequency Code: A

Station: 203

Location: Point 3, Figure 1.

Frequency Code: A

Station: 204

Location: Point 4, Figure 1.

Frequency Code: A

Station: 205

Location: Point 5, Figure 1.

Frequency Code: A

Station: 206

Location: Point 6, Figure 1.

Frequency Code: A

Station: 207

Location Point 7, Figure 1.

Frequency Code: A

Station: 208

Location: Point 8, Figure 1.

Frequency Code: A

Station: 209

Location: Point 9, Figure 1.

Frequency Code: A

c. Fish

Station: 301

Location: Tanana River, vicinity of Shaw Creek.

Frequency Code: E

d. Sediment

Station: 401

Location: Approximately 1/2 mile upstream from SM-1A discharge point on Jarvis Creek.

Frequency Code: A during periods of waste discharge to Jarvis Creek. If no waste is discharged to the creek, collect one sample in April and one in September.

Station: 402

Location: 100-200 feet downstream from SM-1A discharge point on Jarvis Creek.

Frequency Code: B during periods of waste discharge to the creek.

Station: 403

Location: Jarvis Creek at the Richardson Highway Bridge.

Frequency Code: B during periods of waste discharge to the creek.

e. Soil/Overburden

Station: 501

Location: 100-200 feet north of SM-1A.

Frequency Code: D

TABLE II

SAMPLING FREQUENCY

Frequency Code	Description
A	Objective is one sample per week. A minimum of 40 samples per year will be collected with no more than 14 days having elasped between any two consecutive samples.
B	Objective is three samples per week. A minimum of 140 samples per year will be collected with no more than three working days having elapsed between any two consecutive samples.
C	One sample per month.
D	Objective is one sample every two weeks. A minimum of 20 samples will be collected with no more than 21 days having elapsed between any two consecutive samples.
E	Five samples each month during fishing season.

3. Processing and Counting of Samples

Environmental samples will be counted using equipment capable of maintaining the minimum sensitivities contained in Table III. These sensitivities are based on the processing procedures of Reference 4 which will be used.

TABLE III

SAMPLE TYPE	MINIMUM SENSITIVITY IN COUNTS/MINUTE ABOVE INSTRUMENT BACKGROUND
Water	1.5
Fallout	2.0
Fish	3.0
Sediment	3.0
Soil	3.0
Vegetation	3.0

EXAMPLE:

For the most restrictive limit of 1.5 cpm (water sample) a sample of 1 liter counted for 30 minutes would detect radioactivity in a concentration of 5 x 10^{-9} μCi/ml. If additional sensitivity is desired, a larger sample can be taken or the counting time can be increased.

4. Records

A permanent log will be kept of all sample data.

5. Reports

Results obtained from processing and counting the samples will be sent to Engineers Division, USAERG, at the end of each month. Any unusual results will have a note of explanation if possible.

Engineering Division, USAERG, will issue a data summary report each year. This report will contain all the information required by Army Materiel guidelines. Statistical tests will be used to compare the activity at each sample point to determine if statistically significant differences exist.

6. Sample Verification

In the event a sample shows abnormal activity for that particular sample point, the following action will be taken:

a. Verify counting equipment reliability.

b. If counting equipment is functioning properly, take additional samples to assure reliable condition representation.

c. If high activity level is verified, notify the OIC, SM-1A, and Engineering Division, USAERG.

REFERENCES

1. Army Regulations 385-80, Nuclear Reactors Systems Health and Safety.

2. Letter, The Adjutant General, 20 October 1965, subject: Guidelines for Environmental Radiological Monitoring at U. S. Army Nuclear Reactor Facilities.

3. Title 10 (Atomic Energy), part 20 (Standards for Protection Against Radiation), Code of Federal Regulations (10 CFR 20).

4. Health Physics-Process Control Reference Manual, Engineering Division, USAERG, 1 July 1966.

ATTACHMENT A.

FORT GREELY BACKGROUND RADIATION SURVEY

1. A background radiation surveillance program for the SM-1A site was accomplished during the period of 1 July 1957 through 30 June 1958. The program was conducted by the Sanitary Sciences Branch, Engineer Research and Development Laboratory, Corps of Engineers, with the Atomic Energy Commission as advisor.

2. The following agencies contributed necessary weather and geological data for the program:

a. Big Delta Civil Aeronautics Administration.

b. Seventh Weather Group, Detachment 6, Big Delta Air Force Base.

c. Water Resources Division, U. S. Geological Survey.

d. Department of Public Health.

3. The purpose of the background radiation surveillance program was to establish baseline data of natural and man-produced radiation prior to the construction of the SM-1A Nuclear Power Plant at the Fort Greely site.

4. The following measurements were considered:

a. Gamma background.

(1) A series of surveys conducted by automobile and jeep in the Fort Greely and Big Delta Area.

(2) The instrument used was a precision radiation scintillator, Model 111B, with a sodium iodine crystal detector, having a range of 0.025 to 5.0 mr/hr.

Beta activity in air: Air activity samples were collected from the SM-1A site area using gummed paper, air particulate filters, and sediment contained in precipitation.

c. Ground water analysis: Ground water samples were collected at the Fort Greely conventional power plant water well on a weekly basis.

d. Surface water analysis

(1) Surface water sampling stations were established on Jarvis Creek, Delta River, and Tanana River.

(2) Only the Tanana River station was operated throughout the year. The other two streams were not sampled from 1 October 1957 to 28 May 1958.

e. River sediments and landforms: Numerous samples of river and soil were secured in the Fort Greely Big Delta areas.

5. Monitoring Schedule.

a. The monitoring progran was initiated 1 July 1957 with the establishment of the collection stations. The environmental radiation sampling encompassed six types of samples on the following schedule:

(1) Gummed paper

Locations: #1 - 2700 ft east of SM-1A site.
#2 - 2800 ft north of SM-1A site.
#3 - 2400 ft northwest of SM-1A site.
#4 - 2600 ft west southwest of SM-1A site.
#5 - 5500 ft north northwest of SM-1A site.
#6 - 2800 ft north northwest of SM-1A site.
#7 - 1300 ft south southwest of SM-1A site.

Frequency: Once each week.

(2) Air filter:

Location: At SM-1A site.
Frequency: Three to five times each week.

(3) Precipitation:

Location: Roof of conventional power plant.
Frequency: As rain or snow occurred.

(4) Surface water:

Location: Jarvis Creek, Tanana, and Delta Rivers.
Frequency: Once each week.

(5) River sediments:

Location: Jarvis Creek, Tanana, and Delta Rivers.
Frequency: Once each week.

[redacted]

(6) Subsurface water

Location: Well at conventional power plant.
Frequency: Once each week.

b. The schedule was modified during the winter. Gummed paper stations were reduced to four. The surface water and river sediments were omitted from the schedule.

6. Summary of results

a. Gamma background showed no significant changes, although a slight variation was noted from season to season. This could not, however, be attributed directly to weather conditions.

b. Beta activity in air activities for the survey period:

(1)	Gummed paper	15 pci/ft^2
(2)	Air filter	0.1 pci/m^3
(3)	Precipitation	20 pci/liter

c. Ground water yielded no significant radioactivity, averaging 1.1 cpm/liter.

d. Surface water indicated a significant increase in periods of high water flow due to the accumulation of radioactive fallout in snow and ice fields during the winter months. Substantiation of this theory was accomplished by comparison of snow samples taken at mile 210 Richardson Highway, which produced a slightly higher background activity than river water samples during the "high water flow season."

e. River sediments and landforms produced no marked increase in radioactivity. Soil samples showed no variation in relation to depth of the sample.