ACID WASTE STORAGE TANKS 8D-3 AND 8D-4

SAFETY ANALYSIS

BY

THE DIVISION OF MATERIALS LICENSING

NUCLEAR FUEL SERVICES, INC.

DOCKET NO. 50-201

## AUTHORIZATION REQUESTED

By a letter dated December 20, 1967, and supplemented by a letter dated September 27, 1968, Nuclear Fuel Services, Inc., (NFS) submitted information relevant to the design and construction of stainless steel waste storage tanks (8D-3 and 8D-4) to be used for the storage of acidic, self-heating, high level radioactive waste from the processing of Consolidated Edison Company's Core A fuel. The above letters requested approval of these tanks, and removal of the restriction on processing Category III fuel from Technical Specification 2.2 of Provisional Operating License CSF-1.

## BACKGROUND

Under Technical Specification 2.2 of Provisional Operating License CSF-1, no conversion of fuels of Category III, V, and VII from the form in which they are received may be made in the plant until such time as installation of the tankage which may be necessary for storage of the processing waste from these fuels has been completed and approved by the United States Atomic Energy Commission. Consolidated Edison Company's Core A fuel is Category III fuel, and NFS has installed tankage (8D-3 and 8D-4) for storage of the processing waste from this fuel.

## DESCRIPTION

Waste tanks 8D-3 and 8D-4 are 15,000 gallon stainless steel (304L) tanks supported above an 18" stainless steel pan with sump, in an underground concrete vault. This facility is located in the Waste Tank Farm area adjacent to the underground concrete vaults for waste tanks 8D-1 and 8D-2.

The concentrated, high level, acidic waste from processing the Core A fuel will be transferred from tank 7D-4 via a jacketed stainless steel line to one of the 15,000 gallon stainless steel waste tanks (8D-3 or 8D-4) for long term storage. While one tank will be used for waste storage, the other identical tank will be maintained as an emergency spare.

The vault contains an installed steam ejector for the transfer of tank leakage from the pan to either 8D-3 or 8D-4. The routing to either tank is controlled by a manually operated 3-way selector valve which is located below grade in a shielded pit above the vault.

The fission products contained in the stored waste will have a total decay heat generation rate of about 230,000 Btu/hr. This stored waste, containing the thorium and fission products, will be maintained in a non-boiling condition, at a temperature not exceeding 140°F, with the aid of cooling coils. Each tank has three separate cooling coils, two vertical and one horizontal, which together are designed to remove a total of 1,350,000 Btu/hr.

The quality of materials used for construction of the tanks, cooling coils and piping was evaluated relevant to corrosion resistance and tested for integrity. Both tanks were fabricated by certified welders from one heat of 304L stainless steel on which Huey tests were performed to detect stress corrosion. The root and final weld passes were X-ray and dye penetrant checked, and the vessels were helium leak tested.

Both tanks were filled with water, the instruments were calibrated, and the high alarms were set to sound at the desired levels for alarm. The cooling coils were tested to determine their capability to control the temperature of the waste tank contents. The sump jet was tested to determine that it would function. The waste transfer line from tank 7D-4 to tanks 8D-3 and 8D-4 also was tested and made ready for future waste transfer.

SAFETY CONSIDERATIONS

1. Collection of Waste in the Vault Sump

The vault sump (16" x 16" x 16") contains a level instrument which is set to alarm at 15" (1" from the vault floor) and is tested routinely (Specification 6.3). Any seepage of ground water into the vault, or leakage of cooling water piping in the vault external to the tanks, or leakage of high level waste from the waste storage tank, would be collected in the sump. At a level of 15" in the sump, an alarm would sound in the control room which would be immediately investigated by the operating personnel. The contents of the sump can be sampled to determine whether it contains high level waste, or water, or both.

Since the vault has been sealed, and because of the nature of the silty till soil, little, if any, seepage of ground water into the vault is expected. On the other hand, if a cooling line should burst, the sump would fill rapidly (40 gpm) and the sump alarm would sound within one minute. It is believed that the source of the cooling water leak could be determined and stopped within one hour; before the depth of water in the vault's stainless steel pan would exceed the 18" height of the pan. Depending upon the activity level of the water, whether intermediate level or low level waste, NFS could install a temporary line above ground from the sump jet discharge line at the 3-way selector valve, to establish a connection to the waste storage tank containing neutralized high level waste, or to the interceptor, and empty the vault by jetting the sump to either appropriate alternative. Such an off-standard transfer would be evaluated by the Safety Review Committee, and would be performed under special work permit conditions supervised by the Assistant Production Manager.

If the vault sump collects high level waste, such as from a minor tank leak, the contents of the sump could be jetted back into the waste storage tank via the sump jet and 3-way selector valve. Such transfers are within the shielded vault, and should present no special problems. However, routine jetting of the sump could eventually fill the waste tank with steam condensate from the jet transfers and thus commit utilization of the spare tank for waste storage. Frequent jetting of high level waste from the sump would indicate tank failure, and similarily commit utilization of the spare tank. A large leak of high level waste from the waste storage tank would require transfer from the sump to the spare waste storage tank. At such a time that the spare waste tank is committed, a new Technical Specification, 5.4, will require NFS to provide a replacement spare tank of sufficient capacity to contain the stored wastes.

Since the vault's stainless steel pan holds only about 1/3 of the contents of one full waste storage tank, and the ejector capability for discharging waste from the sump is limited to about 20 gpm, it is possible that leaking high level, acidic waste could come into contact with the vault's concrete walls above the pan. For a short period this would not seriously affect the integrity of the vault. Furthermore, if any waste did escape from the vault, it would be absorbed and fixed in the silty till adjacent to the vault.

2. Control of the High Level Waste Temperature

The acidic, high level waste from processing Core A fuel will contain the thorium and fission products which would have a total decay heat generation rate of about 230,000 Btu/hr. In order to minimize the corrosion rate of the stainless steel, and thus prolong the life of the storage tank, the temperature of the waste will be controlled at a temperature below 140°F. The waste storage tanks contain two vertical coils, either one having the capability to maintain the temperature of the stored waste below 140°F. In addition, a third, bottom spiral, cooling coil has been provided in case some unforseeable condition should cause a precipitate which might require cooling at the bottom of the tank. Our independent evaluation, and NFS's operability tests of the cooling coils, indicate that the tank coils should be adequate to control the temperature of the stored wastes.

NFS's operability tests determined that with tank solution temperatures between 140°F and 100°F, and cooling water temperature during mid-summer between 65°F to 70°F, one side coil removed 190,000 Btu/hr, two side coils removed 270,000 Btu/hr, and both side plus the bottom coil removed 340,000 Btu/hr. Our calculations indicate that one side coil should be adequate to control the contents of the tank below 140°F. Further, we believe that since the heat transfer test was based upon rate of removal of heat (temperature drop vs time) from the tank's contents rather than based upon the amount of heat input which could be removed by the tank coils while maintaining a temperature below 140°F, the results of NFS's heat transfer test were conservative.

Cooling water is normally supplied from the plant cooling water system. Interconnections also permit use of the plant utility water as coolant with discharge to the storage lagoon. Both cooling water sources are connected to the emergency power system. The cooling coils are always pressurized; by either the cooling water or by utility air. A radiation detector in the cooling water return line and an air flow indicator in the utility air supply line monitor cooling coil integrity. Both instruments are connected to alarms. In addition, each tank has level, pressure and temperature indicators, and the high level and the high temperature alarms are connected to the Waste Tank Farm trouble alarm which annunciates in the Control Room. A new Technical Specification, 6.9, requires routine verification of the operability of the cooling water alarm.

If, for some reason, the cooling system in the tank containing the stored waste should fail completely, the temperature of the waste solution would increase at a rate of about 2°F/hr. If corrective measures taken by NFS to reduce the waste temperature cannot maintain a temperature below 140°F, NFS would transfer the stored waste to the spare tank. NFS believes that such a transfer could be initiated within 16 hours.

Acidic vapors from the waste storage tanks are passed through an industrial caustic spray scrubber (8C-1), knock-out drum (8D-6), and high efficiency filter (8T-1 or 8T-1A) prior to discharge from the plant stack. The scrubber has been designed for 20 cfm so that utility air may be introduced into the tank space above the waste solution to preclude the buildup in the tank of radiolytic hydrogen to explsoive concentrations. This system should reduce the acid content of the off-gas below a concentration which might be harmful to the exhaust system. Further, the system would be adequate to exhaust and condense steam if the waste solution should reach boiling conditions. Thus, the control of the waste solution at temperatures below 140°F is primarily an economic consideration relevant to prolonging the useful life of the tank since the corrosion rate increases substantially at higher temperatures.

3. Transfer of Waste to Spare Tank

These stainless steel tanks are designed for a useful life in excess of 50 years. Provisions have not been installed for an inter vault transfer of the waste from one tank to the other because it is believed that after some extended period of immersion in acidic waste, the probability of such a transfer system being operable is very low. However, an assembly drawing, scope of safety considerations, and the flanges, piping and submerged ejector for making such a transfer will be maintained for emergency use on the plant site.

In order to transfer the waste from one tank to the other, it will be necessary to install an ejector assembly, with access port cover flange, directly into the waste through the 18" diameter tank access port at ground level. This ejector assembly would be connected by 37' of 2" stainless steel flexible hose piping above ground to a 2" line in the sample plug which discharges into the spare tank. The waste transfer would be accomplished by remote operation of the ejector. If necessary, the above ground transfer line could be covered with lead or dirt during the waste transfer to reduce radiation levels.

The future transfer of waste to the spare tank would be a one time event due to tank or cooling failure. Since the transfer may involve various weather and tank conditions, the transfer will be supervised by the Production Manager, with guidance from the Safety Committee, under special work procedures.

CONCLUSION

Based on our review of the proposed installation, we conclude that it does not present significant hazard considerations not described or implicit in NFS's "Final Safety Analysis Report" and that there is reasonable assurance that the health and safety of the public will not be endangered by the installation and use of the proposed high level tanks. Approval of waste tanks 8D-3 and 8D-4 for the storage of high level, acidic waste from the processing of Consolidated Edison Company's Core A fuel is recommended.

Signed: T. R. Workinger
T. R. Workinger

Approved:
R. B. Chitwood, Chief
Irradiated Fuels Branch
Division of Materials Licensing

## Chapter 2

# ARMS SURVEYS OF NFS, INC., WEST VALLEY, NEW YORK

### 2.1 DETAILED SURVEYS (PRIMARY BOUNDARIES)

Two detailed aerial radiological surveys of the NFS facilities are reported here. The 1968 survey consisted of 11 parallel flight lines, 5 miles in length and ½ mile apart, over a 25 square mile area centered on the NFS buildings. The 1969 survey consisted of 11 flight lines 5 miles in length and ¼ mile apart and were flown in a criss-cross pattern centered on the NFS buildings. The discussion immediately following is limited to the actual fuel processing and disposal areas within the primary boundaries of the facility, for which isoexposure maps are given in Fig. 2.1 (1968 survey) and Fig. 2.2 (1969 survey).

The exposure rates measured within the primary NFS boundaries are substantially higher than typical background radiation levels observed elsewhere in the vicinity. Exposure rates of up to 100 μR/hr were measured over the fuel processing buildings and waste burial grounds in the 1968 survey, and ≳750 μR/hr were measured during the 1969 survey. This year-to-year difference is discussed below, in terms of plant operations.

The highest ground exposure rates in both surveys were centered around the processing buildings and the waste burial ground, and in each survey the radiation levels fell rapidly towards normal background values near the primary boundaries of the facility, with the one exception discussed below. The ground exposure rates, as measured from the air, appear to exceed normal levels for short distances beyond the primary boundaries owing to the extended field of view of the airborne detectors, rather than to the presence of artificial radioactivity exterior to these boundaries.

Non-background nuclides distinctly identified in the γ spectral data recorded over the primary plant and burial ground were also the same for the two surveys: $^{137}Cs$, $^{134}Cs$, and $^{60}Co$. Both cesium isotopes are common long-lived fission products, whereas cobalt is an activated fuel rod material. As discussed earlier each of these species is expected at a nuclear fuel reprocessing plant. Figure 2.3 shows a typical γ-ray spectrum obtained over the NFS site, with identified nuclides noted.

The radiation levels observed during the two surveys are consistent with normal plant operations, and in fact they correlate with concurrent phases of the plant's operations, as follows:

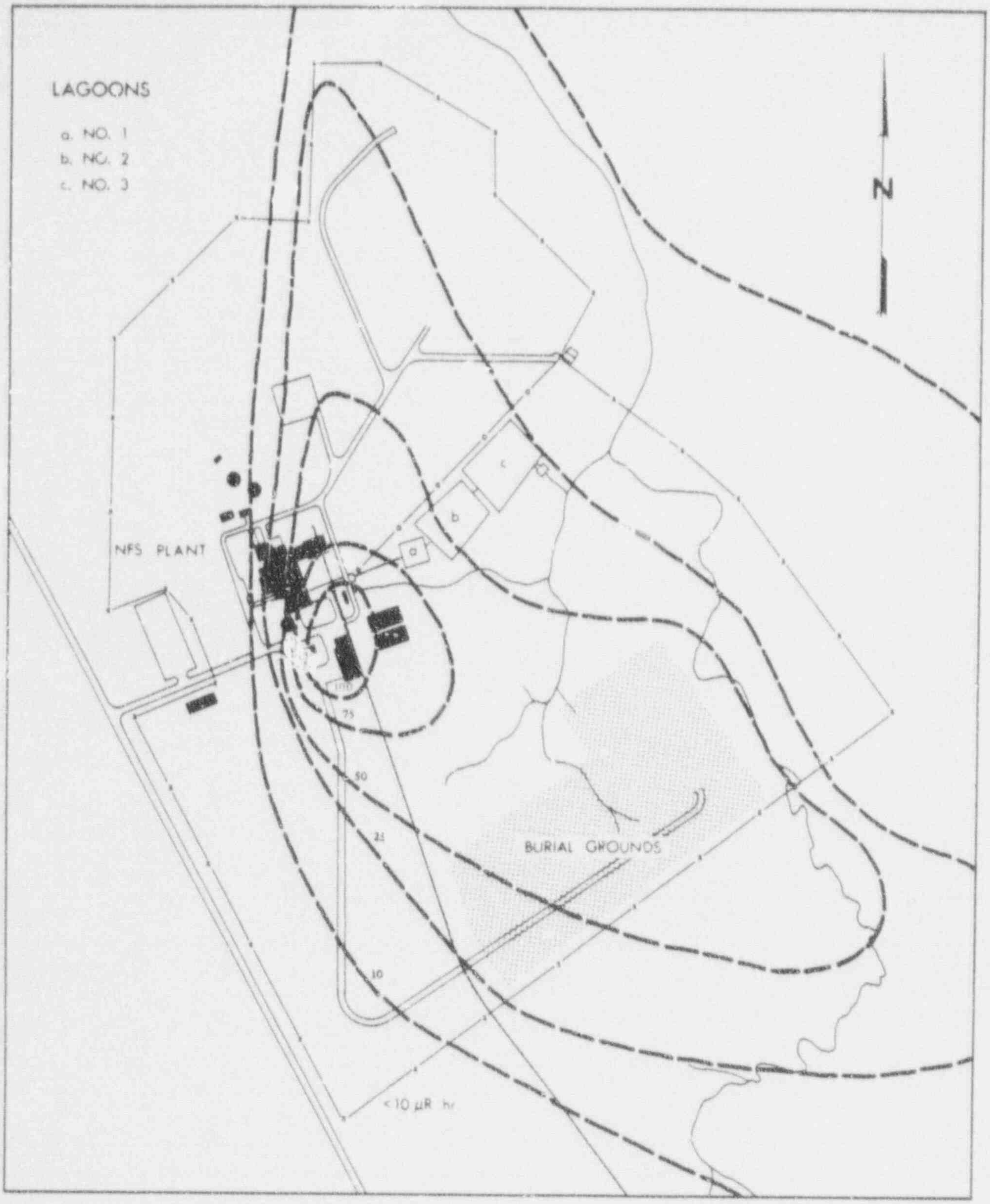


Fig. 2.1. Isoexposure map of NFS, West Valley primary boundaries, 1968. The 50- and 100-μR/hr contours appear to extend beyond the NFS primary boundaries owing to the extended field of view of the aircraft detectors.

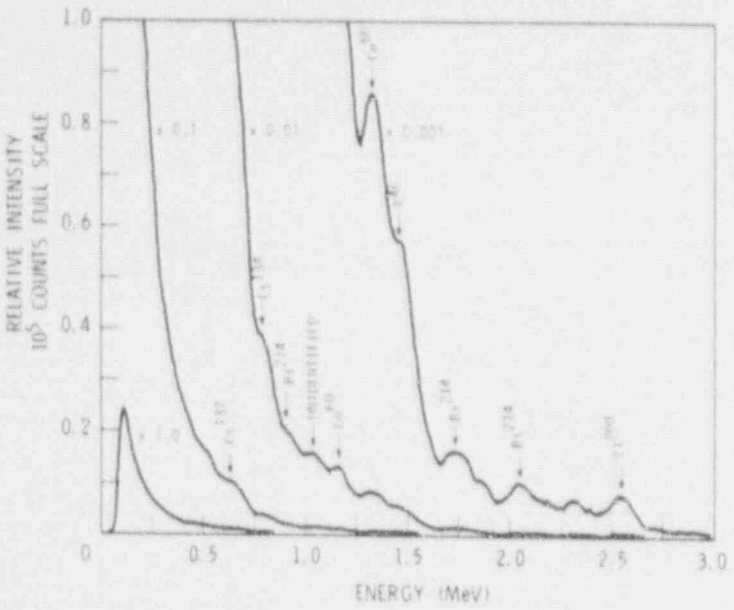


Fig. 2.3. ARMS γ-ray spectrum showing artificial radionuclides within primary NFS boundaries.

2951-A

### 2.1.1 Burial Grounds

Average ground exposure rates were ~60 μR/hr in 1968 (Fig. 2.1) and ≥750 μR/hr in 1969 (Fig. 2.2). If no concentrations of radioactive materials are uncovered while awaiting interment, the burial grounds approximate a large-area source, for which uncorrected ground exposure rates are valid. The radiation levels so inferred from the 1968 and 1969 measurements are typical of waste burial operations.

The difference in the inferred 1968-1969 burial ground radiation levels has several possible contributing causes.

1. It represents in part a genuine increase of the radiation-source concentration in the burial grounds. There is, of course, an increase with time of the total radioactive material buried at the site; however, this increase is by itself not large enough to produce the observed count rate differences. The total material buried during all plant operations previous to the 1968 survey was ~23,000 Ci;[1] between the surveys ~18,000 Ci were added.[2] Even neglecting decay of the waste material activity, the increase in waste inventory between the surveys can account only for a factor of ~1.8 increase in the observed radiation level.

2. A difference of up to a factor of two can be produced by differing amounts of surface water deposited by rainfall. As discussed earlier the ground water would shield some of the ground sources from detection by the aircraft. The actual rainfall histories pertinent to the two surveys are not known.

3. Count rate excursions of a factor of 10 can easily be produced during normal waste burial operations, when radioactive material is present on the burial ground site but has not yet been covered with earth. As shown in Fig. 1.2 the exposure rate near such a limited-size source can exceed the average exposure rate inferred from the ARMS measurement by more than a factor of 100.

The difference of the burial ground radiation levels of 1968 and 1969 indicate that a waste burial operation was probably underway during the 1969 flights but not during those in 1968. In support of this hypothesis we have investigated the operating status during the surveys. During the 1968 flights no fuel reprocessing operation was underway.[3] During the 1969 survey, however, a reprocessing operation was nearing completion and was at a phase in which wastes would be available for burial.[4] Unfortunately, no concurrent records or photographs of the site are readily available to evaluate whether burial operations were actually in progress.

### 2.1.2 Processing Plant

The radiation levels observed from the ARMS aircraft, expressed as <u>average</u> ground exposure rates over the processing plant buildings, were 70 to 100 μR/hr during the 1968 survey (Fig. 2.1), and $\gtrsim$750 μR/hr during the 1969 survey (Fig. 2.2). Nothing in the processing plant is large enough to classify as a "large area" source, and, consequently, local exposure rates would have exceeded the above values. Based on the correction factors given in Fig. 1.2 the average exposure rates listed in Table 2.1 would be measured over limited-area features of the processing plant, if each were the source of the observed radiation. These data are not corrected for attenuation by any shielding that may be present.

TABLE 2.1 -- RADIATION LEVELS OBSERVED OVER PROCESSING PLANT BUILDINGS, EXPRESSED AS AVERAGE EXPOSURE RATES OVER THE ENTIRE FIELD OF VIEW AND ALSO OVER CERTAIN LIMITED-AREA FEATURES.*

| Feature | Area, square feet | Correction Factor | MR/hr (average) | |
|---|---|---|---|---|
| | | | 1968 | 1969 |
| Aircraft field of view | ~1,000,000 | 1 | ~0.1 | ~0.8 |
| Whole processing area | ~80,000 | 7 | ~0.6 | ~5.0 |
| Fuel-element storage pool | ~4,500 | 26 | ~2.2 | ~20.0 |

*Data are not corrected for any shielding that may be present.

As was the case with the burial ground radiation the higher exposure levels observed in the 1969 flights over the processing buildings also appear to correlate with the different fuel reprocessing phases underway at NFS during the two surveys, (see 2.1.1).

One contributing factor has been isolated that produces at least part of the enhanced radiation levels observed in 1969.* A batch of spent fuel was received by NFS during 1969 that contained substantially more radioactive impurities than usual. During mechanical processing of this fuel these impurities were released into the fuel storage pool, bringing its radioactivity concentration from $\sim 10^{-4}$ μCi/ml typical of 1968 operations up to $\sim 10^{-2}$ μCi/ml at the time of the 1969 survey. This concentration would enhance the 1968 γ-ray count rate by at least a factor of three and so must have significantly contributed to the higher levels in 1969.

## 2.2 DETAILED SURVEYS (SECONDARY BOUNDARIES)

The ground exposure rates were observed to fall rapidly to normal background levels near the primary boundaries of the NFS site, except for two regions of terrain in which the rates were 2 to 3 times higher than average:

1. A ribbon that extends north from the processing plant, then veers to the northwest, with a local maximum about 2 miles NNW of the plant buildings, as shown in Figs. 2.4 and 2.5. This ribbon coincides with the paths of the waterways into which low-level liquid wastes from the fuel reprocessing operation are dispersed. Analysis of the observed radiation is the primary subject of this section.
2. Above-background radiation contours to the west of the processing plant, in the vicinity of a waterway called Quarry Creek, into which no radiohydrological paths are known to exist (see Fig. 2.5). This "Quarry Creek Anomaly" is discussed at the end of this section.

### 2.2.1 Liquid-Waste-Dispersal Waterways

Figures 2.4 and 2.5 show isoexposure contours within the secondary boundaries of the NFS facility as derived from the 1968 and 1969 data, respectively. Both figures demonstrate above-background radiation levels that correlate with the paths of Frank's Creek and Buttermilk Creek, with local maxima at confluences between Frank's and Buttermilk and between Buttermilk and Cattaraugas Creeks. This complex of waterways is the system into which low-level liquid wastes are dispersed.

Above-background radiation levels were also inferred for Cattaraugas Creek, downstream from NFS. Since this waterway lies outside the NFS boundaries, the presentation of the Cattaraugas Creek data and their analysis are reserved for our discussion of the wide-area surveys, in the next section.

A detailed analysis of the gross γ count rate data unequivocally demonstrates that the enhanced exposure rates were caused by radioactivity in or around Frank's Creek and Buttermilk Creek downstream from NFS. Plots of simultaneous

---

*We gratefully acknowledge the contribution made by the AEC Compliance staff in calling this factor to our attention.