TRANSMITTAL No. F-1037

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Page 1 of 1

Identification

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2. Record(s) Description :

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Transmittal

9. Sender Lori Pratt Date: 1/10/00
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1

QA RECORD

AEC letter to PSC dated 7 AUG 72

6907

Microfiche 539 Final
Location F-01603-E08

environmental statement

related to operation of

THE FORT ST. VRAIN NUCLEAR GENERATING STATION

OF

PUBLIC SERVICE COMPANY OF COLORADO

DOCKET NO. 50-267

August 1972

UNITED STATES ATOMIC ENERGY COMMISSION

DIRECTORATE OF LICENSING

2

QA RECORD

SUMMARY AND CONCLUSIONS

This Final Detailed Environmental Statement was prepared by the U.S. Atomic Energy Commission, Directorate of Licensing.

1. This action is administrative.

2. The proposed action is the issuance of an operating license to the Public Service Company of Colorado for the start-up and continuing operation of the Fort St. Vrain Nuclear Generating Station (Docket No. 50-267) located in the State of Colorado, county of Weld, near the city of Greeley.

   The Station will employ a high-temperature gas-cooled reactor to produce 842 megawatts thermal (MWt). A steam turbine-generator will use this heat to provide 330 megawatts electrical (MWe) net of electrical power capacity. The exhaust steam from the turbine will be cooled by water circulated from a mechanical-draft cooling tower. Makeup water for the cooling tower will be taken from St. Vrain Creek and the South Platte River.

3. Summary of environmental impact and adverse effects:

   a. About 80 acres of agricultural land with an earnings potential of $14,000 per year have been converted to industrial use.

   b. Loss of about 3000 acre-ft/year of water by evaporation from the Station's cooling towers might mean that in dry years about 1500 acres of land would be retired from irrigated farming at some place in the irrigation system when the total water available has been allocated.

   c. Drift from the Station's cooling towers will deposit about 1500 tons of salts per year on the Station's property.

   d. Cooling tower blowdown will be released at the rate of 1100 gallons to 2300 gallons per minute to waterways on the Station's property before being discharged to the South Platte River or St. Vrain Creek. At times when the discharge temperature to the stream would be greater than 80°F, the Applicant will take blowdown from the cool side of the cooling tower. At other times, the Applicant will take blowdown from the hot side of the cooling tower.

e. The circulating water of the cooling towers will periodically have free chlorine concentrations (about 1 ppm) toxic to aquatic organisms. Blowdown taken from the circulating water will be released to waterways on the Station's property. The calculated free chlorine concentration under adverse conditions will vary from zero ppm up to 0.01–0.02 ppm after the blowdown water is completely mixed with the receiving water in the South Platte River.

f. Noise from cooling tower operation will be 70 dB at the nearest boundary fence (as loud as a very noisy office).

g. About 1000 curies of radioactivity in gaseous radioactive wastes and about 0.04 curie of radioactivity in liquid radioactive wastes will be released per year to the environment.

h. A very low probability risk of accidental radiation exposure to the population will be created.

i. A visitor's information center on the site has an estimated 25,000 visitor days per year.

j. Operation of the Station will add 2.3×10^6 MWh per year to the electrical power generating capacity needed for the area served by the Applicant's power network.

k. The local economy will be aided through $0.6 million per year taxes, 65 persons directly employed, and goods and services purchased by the Applicant and employees.

4. Principal alternatives considered:

   a. Alternative sites

   b. Other uses of Station's land

   c. Use of fossil fuels as heat source

   d. Use of cooling ponds to dissipate heat

   e. Use of modified radioactive wastes system

   f. Use of alternative transportation procedures

5. Comments on the initial draft detailed statement on environmental considerations dated June 7, 1971, have been received from the following agencies and have been taken into account in this statement:

   Department of Agriculture
   Department of Defense (Army)
   Department of Health, Education, and Welfare
   Department of Housing and Urban Development
   Department of the Interior
   Department of Transportation
   Federal Power Commission
   State of Colorado Department of Health
   State of Colorado Coordinator of Environmental Problems

6. The agencies listed above plus the Environmental Protection Agency and the Board of County Commissioners of Weld County, Colorado were also asked to comment on the draft environmental statement issued in April 1972. Comments have been received from the following agencies and incorporated in this final statement:

   Corps of Engineers
   Department of Agriculture
   Department of Commerce
   Department of Health, Education, and Welfare
   Department of the Interior
   Department of Transportation
   Federal Power Commission
   Environmental Protection Agency
   Advisory Council on Historic Preservation
   State of Colorado Department of Health

7. This final statement was made available to the Council on Environmental Quality, the public, and the previously specified agencies in August 1972.

8. On the basis of the evaluation and analysis set forth in this Statement, and after weighing the environmental, economic, technical and other benefits against environmental costs and considering available alternatives, it is concluded that the action called for is the issuance of an operating license for the Fort St. Vrain Nuclear Generating Station subject to the following conditions for the protection of the environment:

   (1) The Applicant will, under an ongoing program, monitor stream temperatures when the Station's heated effluents

mix with the water in St. Vrain Creek and the South Platte River (p. V-7).

(2) The Applicant is being required, under a revised program, to conduct non-radiological monitoring of intake and discharge water before operation and for at least the first year of operation of the Station to monitor chlorine, salts, compounds (e.g. Nalco 345, Nalco 321, Nalco 71-D5), and trace elements at or below concentrations that may be toxic to aquatic organisms in St. Vrain Creek and the South Platte River (p. V-7).

(3) The Applicant will provide an operational radiological monitoring program at a level considered by the AEC's regulatory staff to be adequate to determine any radiological effects on the environment from operation of the Station (p. V-23).

(4) The Applicant will have additional ecological studies such as ecological inventory and analyses performed to provide a comprehensive ecological baseline to which adverse effects from heat, chemicals, and radioactivity can be correlated together with findings from other monitoring programs through at least the first 5 years of operation of the Station (pp. V-16 and V-17).

(5) The Applicant takes the following actions:

(a) The Applicant will discharge all demineralizer regeneration effluents to two evaporation ponds with a total surface area of about 1.5 acres located northeast of the reactor building, instead of into St. Vrain Creek (pp. III-34 and III-38).

(b) The Applicant will (as a condition for normal operation) discharge no more than 3.75 million gallons of liquid effluents per day, including the period of draining and cleaning of the Station's cooling tower basin (p. III-22).

(c) The Applicant will (as a condition for normal operation) discharge blowdown from the cool side of the Station's cooling towers at times when the discharge temperature to the streams would be greater than 80°F (p. V-3).

(d) The Applicant will discharge blowdown, which may include liquid radioactive wastes, into Goosequill Ditch and thence to the Station's farm pond under normal conditions of operation. Discharge of blowdown will be made through the slough to St. Vrain Creek only because of abnormal circumstances, the definition of which must be approved by the AEC's regulatory staff before any discharge of blowdown to the slough is made (p. III-20).

FOREWORD

In the National Environmental Policy Act of 1969 (NEPA), Section 102(2)(C), Congress authorizes and directs that, to the fullest extent possible, all agencies of the Federal Government shall include, in every recommendation or report on proposals for major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on

(i) the environmental impact of the proposed action,

(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) alternatives to the proposed action,

(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

The U. S. Atomic Energy Commission (AEC) has implemented NEPA in its regulation "Licensing of Production and Utilization Facilities," 10 CFR Part 50, Appendix D, as revised on September 9, 1971 (36 F.R. 18071) and revised further on September 30, 1971 (36 F.R. 19158), November 11, 1971 (36 F.R. 21579), January 20, 1972 (37 F.R. 864), May 13, 1972 (37 F.R. 9619), May 17, 1972 (37 F.R. 9779), and June 15, 1972 (37 F.R. 11871).

The effect of the revised regulations makes the AEC directly responsible for evaluating the total environmental impact, including thermal effects, of nuclear power plants, and for assessing this impact in terms of the available alternatives and the need for electric power.

This final environmental statement related to the proposed issuance of an operating license to the Public Service Company of Colorado (the Applicant), for the Fort St. Vrain Nuclear Generating Station (the Station), has been prepared under the direction of the AEC's Director of Regulation pursuant to

Appendix D of 10 CFR Part 50, following guidelines provided on April 23, 1971 (36 F.R. 7724), by the Council on Environmental Quality which was established by title II of NEPA.

In October 1971, the Applicant submitted a document entitled "Supplement Number 1, Applicant's Environmental Report - Operating License Stage" (the Applicant's Supplemental Report) for the Station in accordance with sections C and D, Appendix D of 10 CFR Part 50. The Applicant's Supplemental Report, other submittals concerning the Applicant's Supplemental Report, the draft environmental statement of April 1972, and this final environmental statement are available for public inspection under Docket No. 50-267* at the AEC's Public Document Room at 1717 H Street, N. W., Washington, D. C.

This final environmental statement takes into account (1) comments previously received from Federal, State, and local agencies concerning the AEC's Draft Detailed Statement on environmental considerations dated June 7, 1971 (prior to revisions of Appendix D) and responses by the Applicant, and (2) comments received from Federal, State, and local agencies concerning the AEC's draft environmental statement issued in April 1972 and responses by the Applicant.

The AEC is transmitting copies of this final environmental statement to appropriate Federal, State, and local agencies. In addition, the AEC is publishing in the Federal Register a summary notice of the availability of the Applicant's Supplemental Report, other submittals concerning the Applicant's Supplemental Report, the draft environmental statement of April 1972, and this final environmental statement.

A Notice of AEC Consideration of Issuance of Facility Operating License for the Station was published in the Federal Register on May 4, 1972 (37 F.R. 9049).

The Applicant is required to comply with section 21(b) of the Federal Water Pollution Control Act, as amended by the Water Quality Improvement Act of 1970.

James J. Henry is the AEC Environmental Project Manager (Telephone 301-973-7597), for this Statement.

* In December 1970, the Applicant submitted a document entitled "Applicant's Environmental Report - Operating License Stage" for the Station. That environmental report and a Draft Detailed Statement on environmental considerations, dated June 7, 1971, are also available for public inspection under Docket No. 50-267.

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I. INTRODUCTION

By application dated October 20, 1966 (Docket No. 50-267), Public Service Company of Colorado (the Applicant) applied for a construction permit for the Fort St. Vrain Nuclear Generating Station (the Station) to be located in Weld County, Colorado. In accordance with §2.101(b) of 10 CFR Part 2, the AEC sent a copy of the application to the Governor and other appropriate officials of Colorado and published in the Federal Register a notice of receipt of the application, stating the purpose of the application and specifying Weld County, Colorado at which the proposed activity would be conducted.

A safety review of the information submitted in the Preliminary Safety Analysis Report in support of that application was performed by the AEC's regulatory staff and by the AEC's independent Advisory Committee on Reactor Safeguards. Each concluded that the Station could be constructed and operated without undue risk to the health and safety of the public. After publication of a 30-day notice in the Federal Register on May 28, 1968, (33 F.R. 8357), a public hearing was held before the Atomic Safety and Licensing Board (ASLB) in Greeley, Colorado, to consider issuance of a provisional construction permit for the Station. In accordance with the ASLB decision, the AEC's Director, Division of Reactor Licensing issued Provisional Construction Permit CPPR-54 on September 17, 1968, authorizing the construction of a high temperature gas cooled reactor at the Station.

By letter dated November 4, 1969, the Applicant applied for an operating license for the Station. The application for an operating license and the information submitted in the Final Safety Analysis Report in support of this application are currently under review by the AEC's regulatory staff.

The Applicant was requested on June 17, 1970, to supply certain information on environmental matters in accordance with requirements of NEPA. By letter dated December 22, 1970, the Applicant submitted a document entitled "Applicant's Environmental Report-Operating License Stage" for the Station. Copies of that environmental report and a draft detailed statement on environmental considerations dated June 7, 1971, were made available for comment by interested persons by a summary notice of availability published in the Federal Register on June 22, 1971 (36 F.R. 11878).

By letter dated October 18, 1971, the Applicant submitted a document entitled "Supplement Number 1, Applicant's Environmental Report-Operating License Stage," by letter dated March 6, 1972, the Applicant submitted "Additional Information with Respect to Applicant's Environmental Report - Operating License Stage" and by letter dated May 11, 1972, the Applicant submitted "Additional Information Regarding Applicant's Ecological Study". Copies of these documents are available for inspection at the Greeley, Colorado Public Library, and the AEC's Public Document Room.**

This final environmental statement includes where appropriate a discussion of problems and objections raised by other Federal, State, and local agencies and by private organizations and individuals in the review process and the disposition of the issues involved.

Copies of the final environmental statement are being transmitted to the following Federal agencies: U.S. Departments of Agriculture, Commerce, Defense, Health, Education and Welfare, Housing and Urban Development, Interior, and Transportation, the Environmental Protection Agency, and the Federal Power Commission. Copies also are being sent to the Governor of the State of Colorado and other State agencies and are being made available to the Greeley, Colorado Public Library, the Council on Environmental Quality, and the AEC's Public Document Room.

Copies of (a) the Applicant's Environmental Report, (b) the Applicant's Supplemental Environmental Report and additional information, (c) the AEC's June 7, 1971, Draft Detailed Statement on environmental considerations, (d) the AEC's draft environmental statement of April 1972, (e) comments thereon received from Federal, State, and local agencies and officials and private organizations and individuals, and (f) this final environmental statement will accompany the application through, and will be considered in, the AEC's review processes for the Station which is scheduled for commercial operation in 1972.

** In addition to these documents, the application for a construction permit and amendments, the application for an operating license and amendments, and other public documents concerned with the Station are available for public inspection under Docket No. 50-267 at the AEC's Public Document Room.

A. SITE SELECTION

The two major considerations that led to selection of the Fort St. Vrain site in 1965 by the Applicant were adequate availability of rights to water of suitable quality and the relative closeness of the site to the Applicant's electrical grid system. About 10 miles of transmission lines was required to tie the Station into the 230-kV loop around Denver and thence to its interconnection to the substation at Fort Lupton. Other advantages of the Fort St. Vrain site were availability of land with topography and transportation facilities suitable for power-plant siting.

The Applicant selected land of little agricultural value on which to build the Station. Of the 2238 acres owned at the site, 80 acres is occupied by the buildings and associated facilities; the remainder is used for irrigated farming, where suitable, or for pasture. The lowland areas along St. Vrain Creek and along the South Platte River are subject to flooding and to standing water and would not appear to be practical for raising crops.

Both rail and highway transportation appear adequate for the needs of the Station. A spur line to the site extends about one mile from a Union Pacific Railroad north-south (N-S) freight line. By paved secondary roads, the site is connected to three nearby (3 to 6 miles) major highways.

To ensure an adequate supply of water at the site under the most adverse conditions, the Applicant has acquired water rights from a variety of sources, which include on-site shallow wells, Colorado-Big Thompson Reclamation Project, Jay Thomas Ditch, Goosequill Ditch, and Beeman Ditch. The total surface water required for Station operation is 6600 acre-ft/year (9.1 cfs), of which 3000 acre-ft/year is lost by evaporation from the Station's cooling towers.

B. APPLICATIONS AND APPROVALS

Table I-1 lists applications filed by the Applicant and various comments and approvals from Federal, State, and local agencies. For those permits and licenses which have been granted, the date of issuance is included.

Table I-1—APPLICATIONS, COMMENTS, AND APPROVALS

Government Agency or Organization	Date of Action	Subject or Agreement
U.S. Atomic Energy Commission	10-66	Preliminary Safety Analysis Report and Application for Construction Permit and Class 104 License submitted to AEC by Applicant
	7-68	Public hearing before Atomic Safety and Licensing Board on construction permit
	9-68	Construction permit issued
	11-69	Application for AEC operating license made to Division of Reactor Licensing (DRL)
	12-70	Applicant's Environmental Report (AER), Operating License Stage, submitted to AEC
	6-7-71	Draft Detailed Environmental Statement (DDES), Operating License Stage, on Fort St. Vrain Nuclear Generating Station issued by AEC
	6-15-71	Copies of AER and DDES sent by AEC to appropriate Federal, State of Colorado, and other departments, commissions, offices, and agencies
	7-30-71	AEC letter to Applicant transmitting copies of letters from HUD, U.S. Dept. of the Army, and the Colorado Coordinator of Environmental Problems (in the Office of the Governor)

Table I-1—APPLICATIONS, COMMENTS, AND APPROVALS - continued

Government Agency or Organization	Date of Action	Subject or Agreement
	9-3-71	Letter from AEC Director of Regulation to Applicant, transmitting revised Appendix D to 10 CFR 50 and document entitled "Scope of Applicants' Environmental Reports with Respect to Transportation, Transmission Lines, and Accidents"
	9-29-71	AEC letter to Applicant transmitting copies of letters from Colorado Dept. of Health, HEW, DOT, FPC, USDA, and DOT
	10-13-71	Statement to show cause that construction permit should not be suspended in whole or in part pending completion of environmental review submitted to AEC by Applicant
	10-71	Supplement Number 1 to Applicant's Environmental Report (AER), Operating License Stage, submitted to AEC
	10-71	Comment from Applicant to AEC regarding DDES
	11-22-71	Determination not to suspend construction activities pending completion of NEPA environmental review issued by AEC
	1-20-72	Safety evaluation of the Fort St. Vrain Nuclear Generating Station issued by DRL

Table I-1–APPLICATIONS, COMMENTS, AND APPROVALS - continued

Government Agency or Organization	Date of Action	Subject or Agreement
	1-72	Letter from Chairman, FPC, to AEC Director of Regulation, transmitting a copy of an FPC bulletin entitled "Adequacy of Electric Generating Capacity in Areas with Pending Nuclear Plant Operating Licenses"
U.S. Dept. of Agriculture (USDA)	9-1-71	Comments to AEC from USDA (Forest Service in particular) on DDES
	9-29-71	USDA comments sent to Applicant by AEC
	10-71	Applicant's response to AEC regarding USDA Forest Service comments
U.S. Dept. of the Army, Corps of Engineers	6-25-71 and 10-1-71	Application for permits to discharge into the St. Vrain Creek and the South Platte River filed with Omaha District, Corps of Engineers, by Applicant
	7-20-71	Comments to AEC from Dept. of Army on AER and DDES
	7-30-71	Dept. of Army comments sent to Applicant by AEC
	10-71	Applicant's response to AEC regarding Dept. of Army comments
	10-22-71	Request to Dept. of Army Corps of Engineers from AEC Division of Radiological and Environmental Protection (REP) for review of Applicant's supplemental environmental report (AER-S)

Table I-1—APPLICATIONS, COMMENTS, AND APPROVALS - continued

Government Agency or Organization	Date of Action	Subject or Agreement
	11-12-71	Public notice of pending permit to discharge cooling water into St. Vrain Creek issued by Omaha District, Corps of Engineers
	11-15-71	Comments from Omaha District, Corps of Engineers to REP on AER-S
U.S. Dept. of Interior (DOI)	9-13-71	Comments to AEC from DOI on DDES
	9-29-71	DOI comments sent to Applicant by AEC
	10-71	Applicant's response to AEC regarding DOI comments
U.S. Dept. of Transportation (DOT)	8-11-71	Comments to AEC from U.S. Coast Guard Office of Marine Environment and Systems (under the DOT) on AER and DDES
	9-29-71	DOT Coast Guard comments sent to Applicant by AEC
	10-71	Applicant's response to AEC regarding DOT Coast Guard comments
U.S. Dept. of Health, Education, and Welfare (HEW)	7-27-71	Comments to AEC from HEW on AER and DDES
	9-29-71	HEW comments sent to Applicant by AEC
	10-71	Applicant's response to AEC regarding HEW comments

Table I-1—APPLICATIONS, COMMENTS, AND APPROVALS - continued

Government Agency or Organization	Date of Action	Subject or Agreement
U.S. Dept. of Housing and Urban Development (HUD)	7-9-71	Comments to AEC from Hud on DDES; no reservations or comments with regard to any adverse impact on urban environment
	7-30-71	HUD comments sent to Applicant by AEC
	10-71	Applicant's response to AEC regarding HUD comments
U.S. Environmental Protection Agency (EPA)	8-71	Informal comments by EPA on the pre-Calvert Cliffs environmental statement (DDES) transmitted to AEC by EPA
Federal Power Commission (FPC)	8-19-71	Comments to AEC from FPC on AER and DDES
	9-29-71	FPC comments sent to Applicant by AEC
	10-71	Applicant's response to AEC regarding FPC comments
	1-72	Letter from Chairman, FPC to AEC Director of Regulation, transmitting a copy of an FPC bulletin entitled, "Adequacy of Electric Generating Capacity in Areas with Pending Nuclear Plant Operating Licenses"
Colorado Dept. of Health	2-70	Building plumbing drawings and specifications reviewed; no deficiencies noted
	5-70	Sewage treatment facility plans and specifications reviewed; no deficiencies noted

Table I-1—APPLICATIONS, COMMENTS, AND APPROVALS—Continued

Government Agency or Organization	Date of Action	Subject or Agreement
	11-10-70	Letter to Applicant stating that (1) there appears to be reasonable assurance that the plant will not violate applicable water quality standards, but that (2) analyses during operation may show improvements or changes to be necessary
	Prior to 1971	Air contaminant emission notices for auxiliary boiler and standby diesel-generators filed
	12-70	Application for radioactive material license filed
	7-6-71	Comments to AEC from Colorado Dept. of Health on DDES
	7-15-71	Comments to Colorado Coordinator on Environmental Problems on AER and DDES from Colorado Dept. of Health
	9-29-71	Colorado Dept. of Health comments sent to Applicant by AEC (in addition to those transmitted through Colorado Coordinator of Environmental Problems, 7-20-71)
	10-71	Applicant's response to AEC regarding Colorado Dept. of Health comments
Colorado Public Utilities Commission	9-67	Application for Certificate of Public Convenience and Necessity for the station and associated transmission lines submitted by Applicant
	4-2-68	Above certificate granted

Table I-1—APPLICATIONS, COMMENTS, AND APPROVALS—Continued

Government Agency or Organization	Date of Action	Subject or Agreement
	1-70	Issuance of above certificate affirmed by Colorado Supreme Court
	10-8-68	Approval of railroad spur obtained by Union Pacific Railroad
State of Colorado, Office of the Governor	7-20-71	Comments to AEC from Colorado Coordinator of Environmental Problems (in the office of the Governor) on AER and DDES; also transmitting comments from Colorado Dept. of Health
	7-30-71	Coordinator's comments sent to Applicant
	10-71	Applicant s response to AEC regarding Coordinator's comments
State of Colorado	Periodic	Industrial Commission: Inspections of construction safety practices State Code Inspector: Pressure vessel inspections State Boiler Inspector: Steam generator and auxiliary boiler inspections State Electrical Board: electrical inspections
Weld County, Colorado	6-15-66	Zoning established by Planning Commission
	4-16-68	Building permit issued by Building Dept.

II. THE SITE

In this section, the site and its environmental features are described and evaluated. Data related to the location of the Station, demography and land use, and the historical and geophysical features within a 50-mile radius of the site are presented. This information will be used in later sections to assess impacts already caused by construction of the Station and to estimate potential changes that may result from operation of the Station.

A proper assessment of a nuclear power station necessitates the acquisition of as much information as directly as possible. To this end, the Fort St. Vrain site was visited December 14-17, 1971, by a regulatory staff group who were representative of numerous technologies - ecology; biology; chemistry; health physics; mechanical, chemical, and reactor-safety engineering; and cost-benefit analysis methodology. The group also included Applicant-independent expertise on reactor fuel development and radioactive emissions from reactors of the HTGR type. The group contacted many county and State representatives knowledgeable about the area. They included: State of Colorado - Coordinator of Environmental Problems, Office of the Governor; Department of Health (Water Pollution Control Commission, Air Pollution Control Commission, Radiological Surveillance, Food and Drug Office, and Occupational Health Office); Department of Natural Resources (Water Conservation Board; Water Resources Board; Game, Fish, and Parks Department; and Cooperative Wildlife Research Unit); State Planning Office. Weld County - Board of County Commissioners, Planning Office, Agricultural Extension Office, Health Department, Sanitarian, Tax Office, and Board of Education. In addition, the group visited the historic Fort Vasquez restoration at Platteville, Colorado, and the visitors' information center of the Station, which includes exhibits on the historic significance of the area surrounding the site. Other information sources have included the Applicant's reports to the AEC on safety and environmental impact, daily issues of the Greeley Daily Tribune (for indications of local conditions and of opinions of the populace on environmental matters), and numerous publications cited in the individual sections of this final environmental statement. Thus, detailed information was gained first-hand about the Station's environment - people, public facilities, industries, natural resources, and life forms - and about the nature and magnitude of the Station's impingements on that environment.

A. LOCATION OF PLANT

The Station has been constructed in the SW corner of Weld County, Colorado, about 2 miles S of the confluence of the South Platte River and St. Vrain Creek and about 35 miles N of Denver (figure II-1). The Station lies at 40 deg 14 min latitude and 104 deg 52 min longitude in a shallow valley formed by the river and the creek and known as "St. Vrain Valley," which is part of the South Platte River Valley. The surface of Weld County in this area is generally level or rolling prairies with low hills beginning to the west; elevations[1] range from 4400 to 5000 ft.

The site is about 3-1/2 miles NW of Platteville (figure II-2). Interstate 25 passes 6 miles W of the reactor site, and U.S. 85 is 3 miles E. Colorado 66, a connecting link between Interstate 25 and U.S. 85, runs 3 miles S of the reactor building. A Union Pacific Railroad secondary freight line runs near the west boundary of the site, and a spur line serves the Station.

The Station is located at an elevation of 4790 ft inside a 2238-acre area owned by the Applicant (figure II-3). The South Platte River and St. Vrain Creek both border the site and join near the northern tip of the Applicant's property. Roosevelt National Forest is 25 miles W of the site in the foothills of the Rocky Mountains. The Rocky Mountain Arsenal is 30 miles S, and the AEC reservation at Rocky Flats is about 35 miles SW.

B. REGIONAL DEMOGRAPHY AND LAND USE

Most of the land within 20 miles of the site is agricultural. Farther to the south is the urban area of Denver. The area immediately surrounding the site consists of irrigated farm land and pasture with low rolling hills (figure II-4). A small privately owned air-port with a single runway is located 7 miles ESE of the Station. The nearest transmission line passes 7000 ft from the end of the runway and is 91 ft below the glide path for the airport.[2]

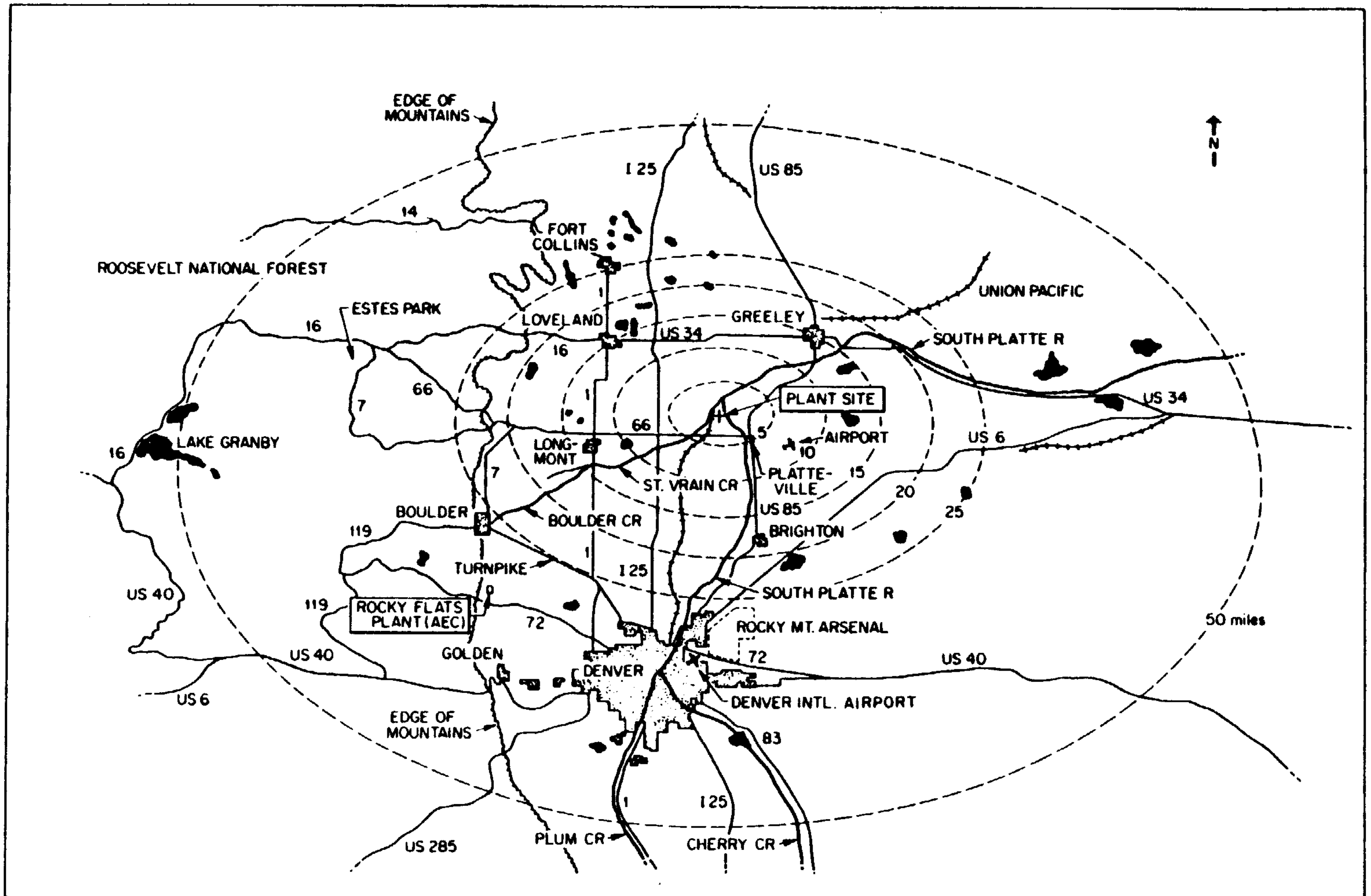

Figure II-1—AREA WITHIN 50-MILE RADIUS OF FORT ST. VRAIN NUCLEAR GENERATING STATION

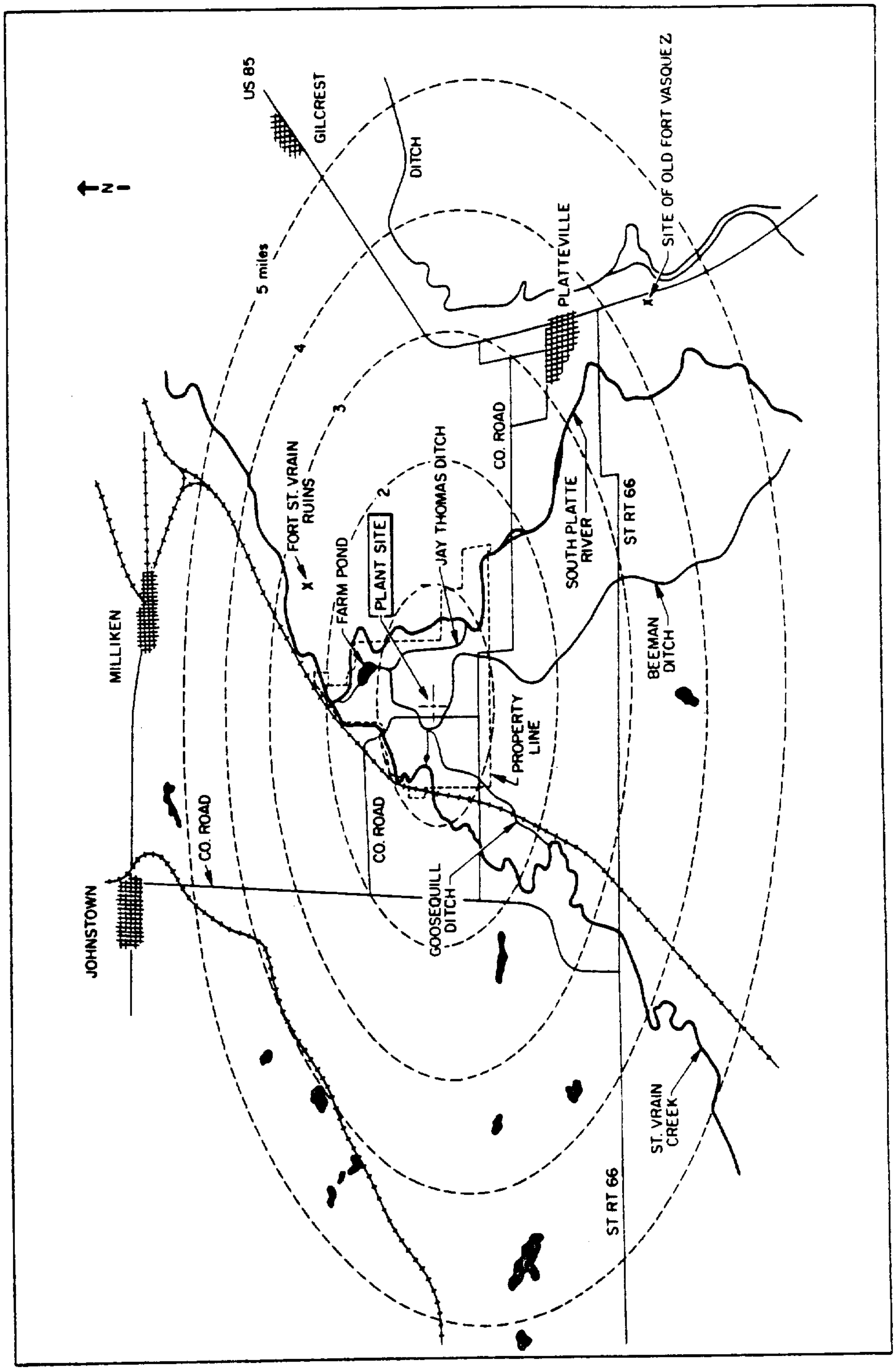

Figure II-2—AREA WITHIN 5-MILE RADIUS OF STATION

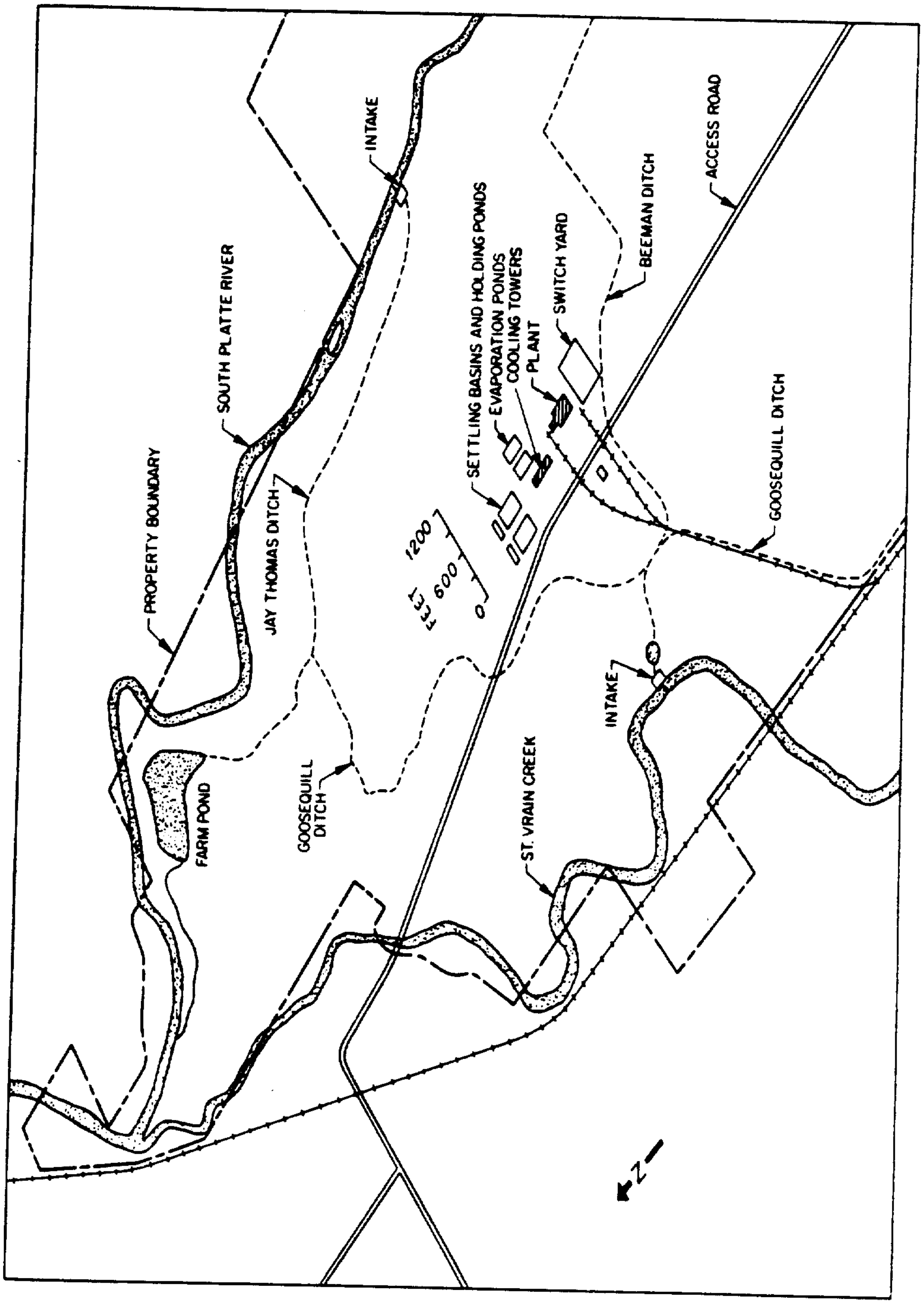

Figure II-3—PROPERTY OWNED BY PUBLIC SERVICE COMPANY OF COLORADO

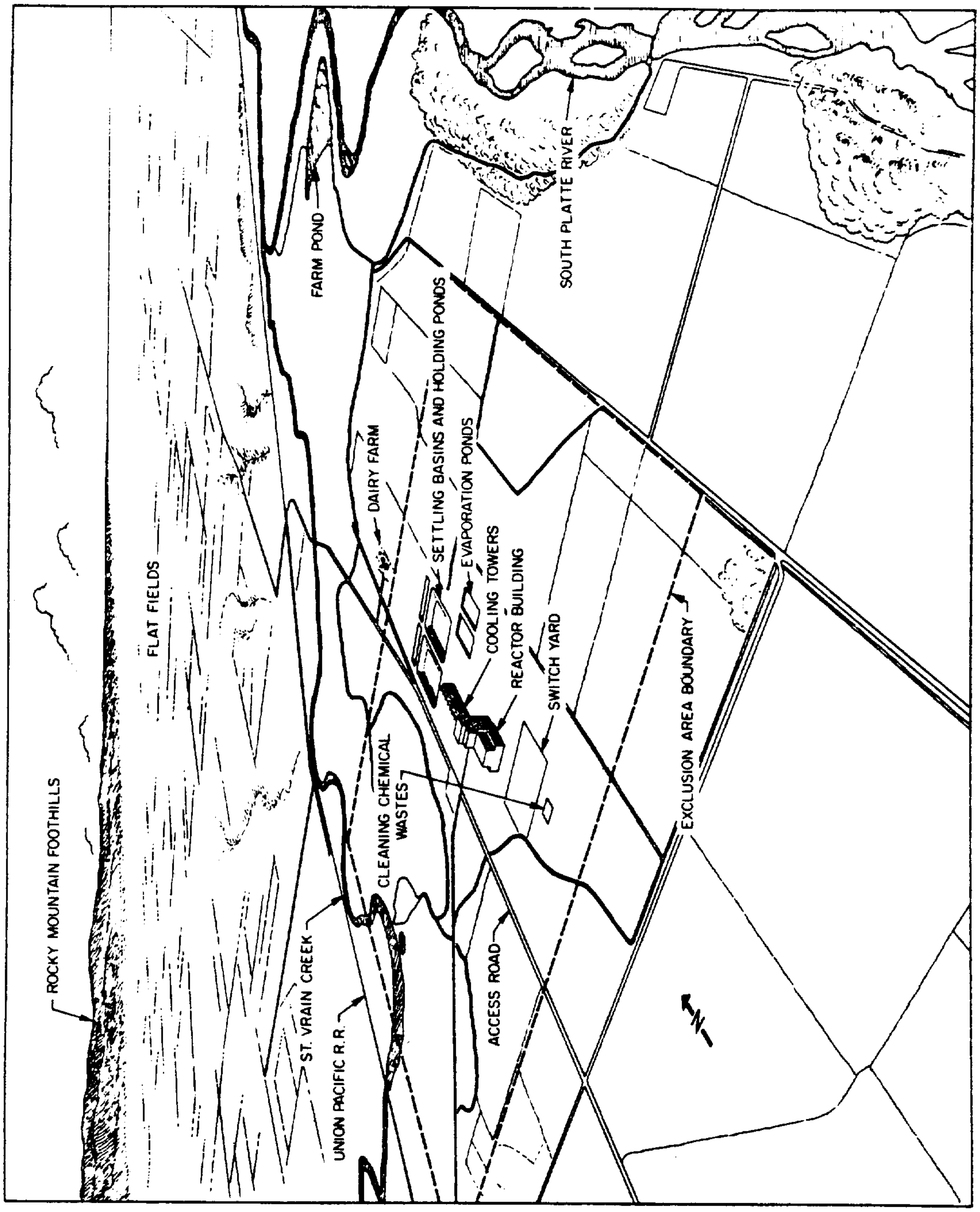

Figure II-4—VIEW FROM SOUTHEAST OF AREA SURROUNDING STATION

The reactor building is located near the center of the exclusion area (figure II-4), whose boundary nearest to the reactor building is about 2000 ft E. However, the Applicant can exercise complete control over the entire property in case of emergency. The point on the Applicant's property line closest to the reactor building is about 4000 ft away.

The exclusion area has been rezoned for industry, although the remainder of the Applicant's property has been left zoned agricultural, as it has been for a number of years. A small portion of the exclusion area will be used for agriculture, as will the remainder of the Applicant's property. A dairy farm with about 40 cows is located on the Applicant's property one-half mile N of the Station.

The predominantly rural nature of this section of Weld County, which can be seen in all directions from the site, is undergoing an important change. The mechanization of agriculture has caused a significant decrease in the number of agricultural workers needed to raise and harvest crops. However, the advent of industrial plants in the region may reverse this trend to a lower population. An IBM plant at Niwot, an Eastman Kodak plant at Windsor, and the Station at Platteville are examples of this new trend.

The nearest schools are in Platteville; their total enrollment is about 510 students.[3] The nearest medical facility is the 490-bed Weld County General Hospital in Greeley. A small nursing home in Platteville accommodates five residents.

The nearest permanent residence is at the dairy farm on the Applicant's property about 2300 ft N of the reactor building. The nearest temporary residence (figure II-5) is about the same distance to the SE. About 420 persons permanently reside within 3 miles of the Station; population density in the area surrounding the Station is approximately 15 persons/sq. mile.[4] The nearest towns are

Town	Distance from the Station (miles)	1970 Population
Platteville	3.5 SE	683
Greeley	14 NE	40,000
Fort Collins	24 NW	43,000
Boulder	25 SW	66,000
Denver City	35 S	514,000

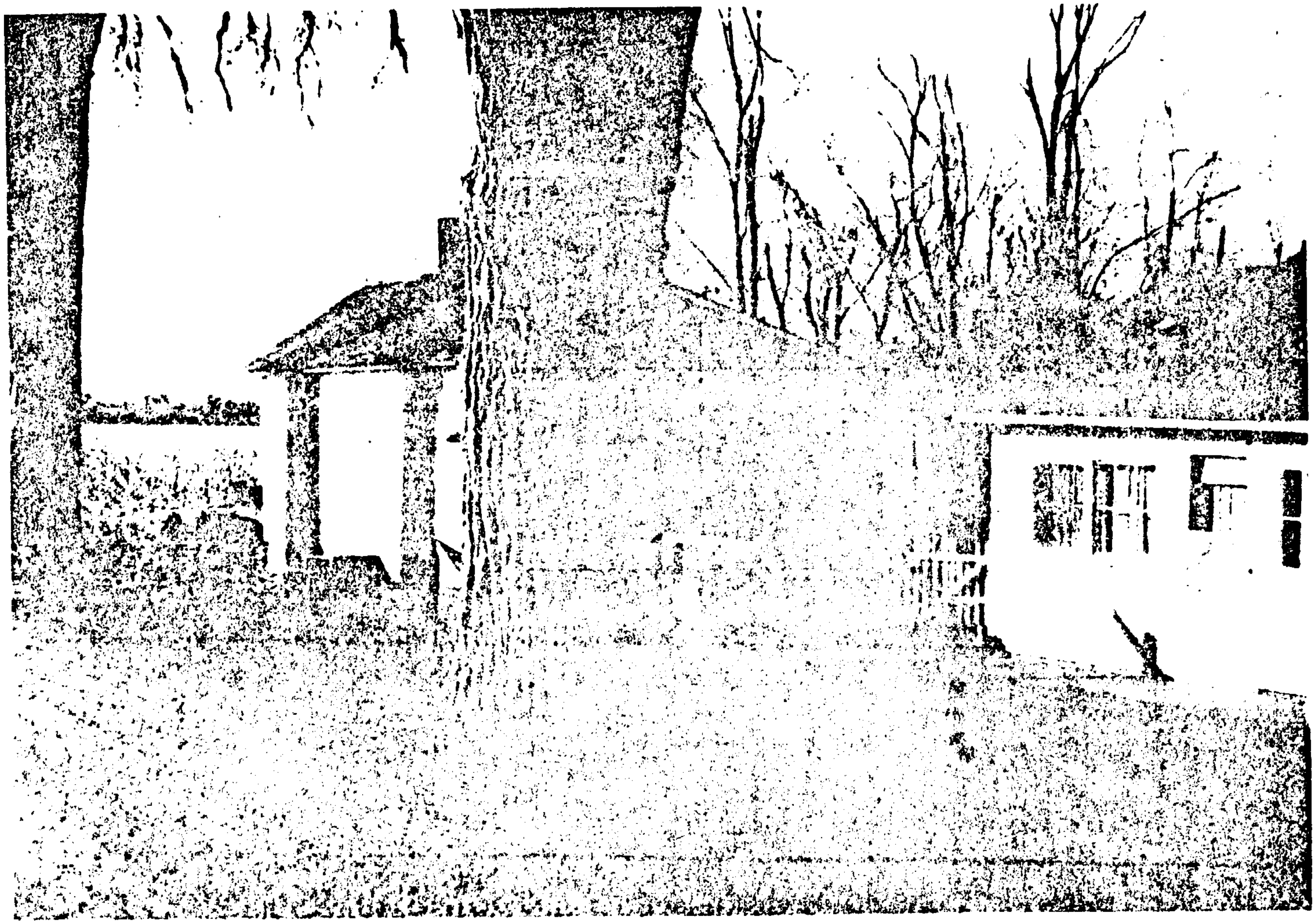

Figure II-5 – NEAREST TEMPORARY RESIDENCE

The five-county Denver area had a 1970 population of 1,200,000.

Table II-1 shows the population distribution within a 50-mile radius of the Station, which is an estimate based on computer output from 1970 Bureau of the Census reports.

Population growth in the area will probably occur by expansion of the larger cities and towns. A major growth rate is expected to the south of the Station as the Denver suburbs expand. The population of the rural areas around the Station is expected to decline, except for some migration of farm workers into the area during the summer. However, growth predictions indicate that this area of Colorado will be one of the future top-ten population centers in the United States.[5] For this reason, the Colorado Environmental Commission (CEC) has proposed that the Colorado General Assembly adopt a Colorado Environmental Policy Act and recommended both stabilization and planned distribution of the population of Colorado, with consideration for the present and future ecological balance. Of special concern is the problem of internal migration to large metropolitan areas, such as Denver,[6] where approximately 1.2 million people are concentrated in a five-county area.

To achieve CEC's aims, the State would need to channel industry and services, such as water and electricity, to low-density populated areas.[7] In another recommendation, CEC urged the Colorado General Assembly to enact a policy of Rural Revitalization without stimulating immigration. Two of the recommended measures would use water policy to direct growth. For example, no further transmountain diversion of water to the Denver area would be permitted and statutory limitations would be placed on the size and growth of Denver.

The land in the vicinity of the Station has been used for agriculture for many years. The major farm products from the area include sugar beets and beef cattle (figure II-6), and many vegetable farms, turkey farms, and feed lots are in the area. In the State, Weld County is a major producer of barley, wheat, corn, beans, oats, and hay. A limited amount of dairy farming is done in the area. In addition to the dairy farm on the Applicant's property, two others are nearby, one 1-1/2 miles NW and the other 2 miles E; each has about 40 cows. About 25 dairies located within a 10-mile radius of the site distribute milk to the Denver area.[8]

The industries in Weld County include coal mining, petroleum and gas production, and sand-and-gravel operations. Sugar refining employs more people than does any other industry. An Eastman Kodak Company plant being built 17 miles N of the site will employ 1000 people in 1972 and may expand to 20,000 employees later.

Table II-1–POPULATION DISTRIBUTION (1970) IN VICINITY OF FORT ST. VRAIN NUCLEAR GENERATING STATION

Sector[a]	Population from preceding to stated distance										
	1 mile	2 miles	3 miles	4 miles	5 miles	10 miles	20 miles	30 miles	40 miles	50 miles	Total
N	2	2	18	33	48	1,670	2,030	1,403	527	175	5,908
NNE	3	2	0	7	19	1,023	16,199	4,829	292	87	22,461
NE	0	0	14	26	11	354	33,824	1,009	54	90	35,382
ENE	0	6	18	44	59	1,123	2,193	1,570	15	646	5,674
E	0	9	30	48	55	253	1,364	652	556	1,778	4,745
ESE	0	16	22	11	11	68	382	1,184	41	51	1,786
SE	0	5	56	627	15	39	1,245	770	668	613	4,038
SSE	14	15	3	15	26	310	4,899	601	193	453	6,529
S	0	4	28	44	52	335	12,355	43,458	410,243	133,143	599,662
SSW	5	8	22	22	22	515	2,531	95,572	334,326	66,354	499,377
SW	4	9	6	15	7	364	5,189	80,099	2,112	4,062	91,867
WSW	6	9	0	33	55	368	27,185	5,041	3,167	128	35,992
W	0	4	20	33	26	587	906	2,225	387	14	4,202
WNW	0	8	15	44	44	310	3,672	546	2,879	206	7,724
NW	6	6	12	19	52	393	20,521	1,260	359	22	22,650
NNW	0	7	9	60	26	576	1,901	55,138	2,759	331	60,807
Total	40	110	273	1,081	528	8,288	136,396	295,357	758,578	208,153	1,408,804
Cumulative Total	40	150	423	1,504	2,032	10,320	146,716	442,073	1,200,651	1,408,804	

[a]Within $22\frac{1}{2}°$ sectors ($11\frac{1}{4}°$ to either side of stated radial direction).

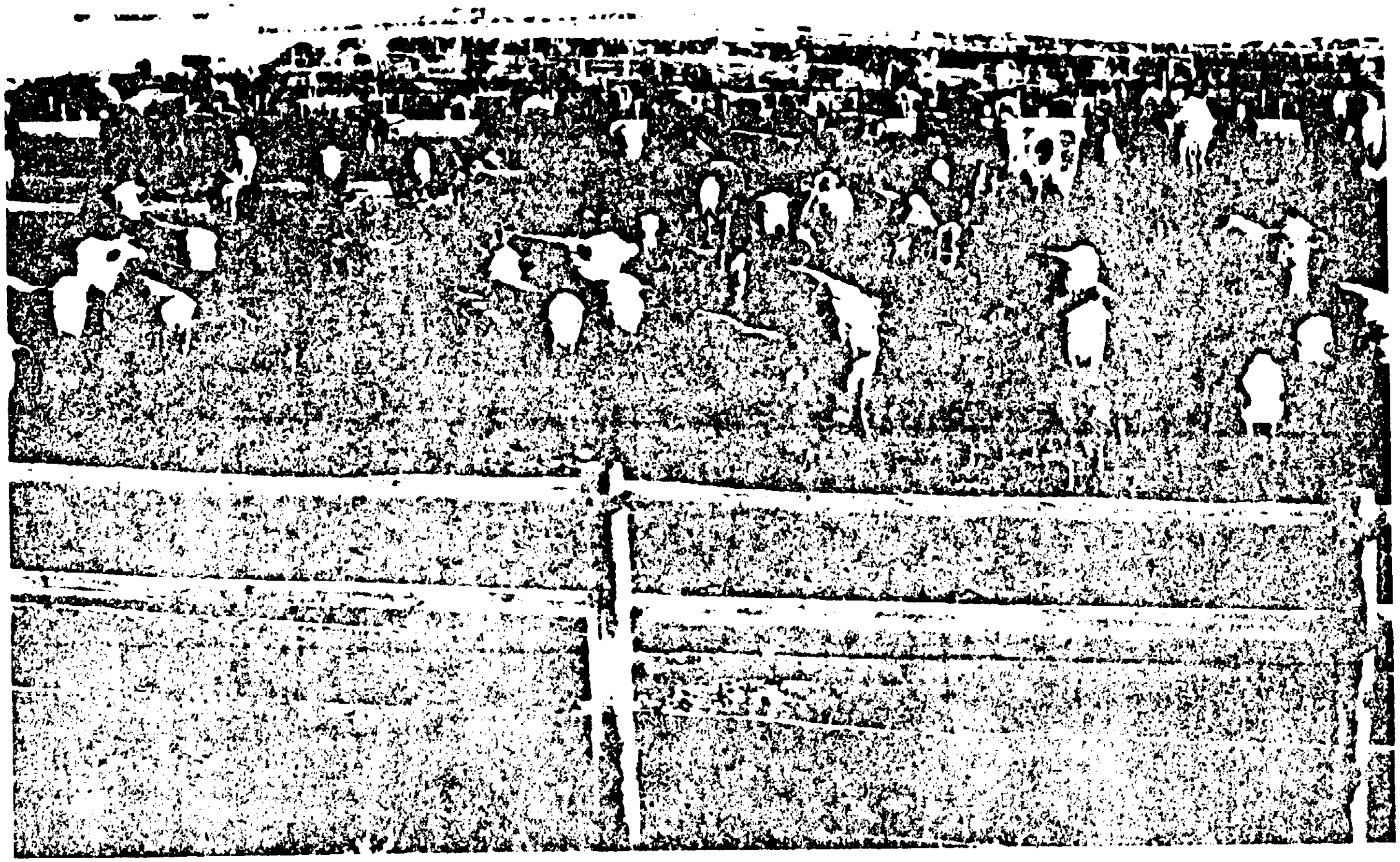

Figure II-6 – TYPICAL FEED LOT NEAR STATION

Because of the rural nature of the surroundings, no recreational facilities exist within 10 miles of the Station. The area surrounding the Applicant's property is used to some extent for hunting waterfowl and small game, but most of the large game has disappeared. Both the South Platte River and St. Vrain Creek are too shallow to be used for boating or water-skiing.

C. HISTORIC SIGNIFICANCE

The Applicant furnished a grant to archaeologists from Otero Junior College to survey the area before construction began; no valuable finds were unearthed. According to archaeologists from the University of Colorado, the only significant archaeological site in the area is the Dent site about 4-1/2 miles NE of the Station on the South Platte River; it contains mammoth remains left by prehistoric Indians.

The original Fort St. Vrain was 2-1/2 miles NE of the Station and was one of several forts built at different times along the South Platte River near the Applicant's property. Fort Lupton is 10 miles SE of the station; Fort Vasquez (figure II-7), which has been restored, is 4 miles SE; and the remains of Fort Jackson are 8 miles SE. Fort St. Vrain was abandoned in the 1840's, but its location is marked by a monument erected by the Colorado Historical Society. Fort Vasquez is listed in the National Register of Historic Places, and the other forts are under consideration for listing.

In a letter dated June 29, 1972, Mr. Stephen H. Hart wrote as Colorado State Liaison Officer under the National Historic Preservation Act:

> The Colorado State Historical Society, of which I am Chairman of the Board, and which acts as a staff under the National Historic Preservation Act, has made a very thorough study of the historic sites in the area of the proposed generating stations. It is my conclusion, based upon their studies and my own knowledge, that there is no evidence that the generating station in question will have any impact on any historical sites in this region.[8c]

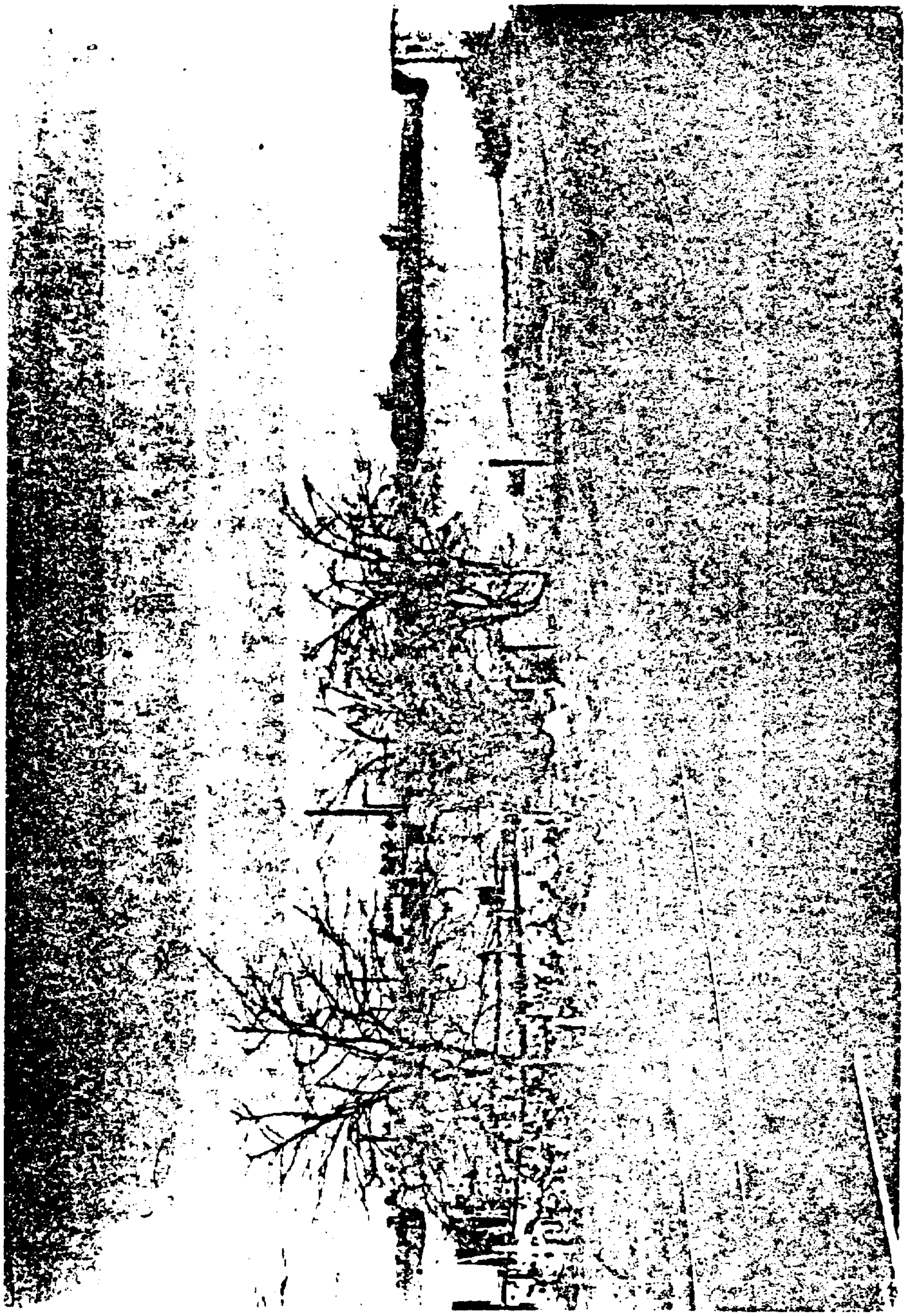

Figure II-7 — FORT VASQUEZ COLORADO

D. ENVIRONMENTAL FEATURES

1. Geology

The site of the Station lies in the central part of the Denver Basin, the Front Range of the Rocky Mountains immediately west. The Denver Basin is a stratigraphic and structural basin some 300 miles long (N-S) and 160 miles wide (E-W). In its deeper parts, the basin contains sediments about 13,000 ft thick which range in age from Cambrian to Recent. The site is on the axis of the basin, which is underlain with essentially horizontal rocks.

Only three geologic formations[9,10] are of prime importance at the site: Pierre Shale, so-called Older Quaternary Alluvium, and Broadway Alluvium. The Pierre Shale, of Cretaceous age, underlies the Station area at depths of 44 to 85 ft; it is a hard-to-very-hard, dark-gray, silty shale that contains a very few thin beds of sandstone. The Pierre Shale does not outcrop in this general area but was encountered by drilling at the site. The Pierre Shale is overlain in the general site area by the Laramie Formation and the Fox Hills Sandstone, also of Cretaceous age. These two sandstones were not found by drilling at the site, although they outcrop in steep bluffs west of St. Vrain Creek.

The Pierre Shale and other Cretaceous rocks were deeply eroded in the Tertiary period after the uplift of the Rocky Mountains. With the advent of the Quaternary period and the onset of the several glacial epochs some 2 million years ago, more rock and sand were formed in the headwaters of the South Platte River and St. Vrain Creek than these streams could transport in their lower reaches. The valleys carved in the Cretaceous rocks in Tertiary time were backfilled with the sand and gravel deposited by these streams. Although the early deposits have locally been separated into formations, at the site they are classed together and are called the Older Quaternary Alluvium. These deposits vary greatly. The valley fill is predominantly a medium-dense sand with a locally persistent bed of gravel in the lower part. The thickness of these deposits ranges from 24 to 50 ft and averages 40 ft; the age ranges from Kansan to early Wisconsin.

These early sands and gravels are overlain by the Broadway Alluvium of late Wisconsin - the most widespread surficial deposit in the area. This alluvium (the fill in the last Wisconsin floodplain of the South Platte River and its tributaries) is composed of a reddish-brown, well-washed, pebbly sand and gravel. These deposits are at least 26 ft thick. The terrace of Broadway Alluvium on which the Station was built lies 17 to 26 ft above stream level; its average height is 20 ft. Throughout most of the area, the edge of the terrace is well delineated topographically.

Locally, a thin but highly variable mantle of windblown and colluvial deposits covers the Broadway Alluvium. Thin but variable deposits of Recent Alluvium occur along the present courses of the South Platte River and St. Vrain Creek. These deposits are of relatively minor importance.

2. Hydrology

The South Platte River rises in the mountains to the far southwest of the site, flows east to a point some 60 miles S of Denver, and then flows north through Denver and on past the site. In its northward flow, it is joined by several large tributaries from the mountains to the west. One is St. Vrain Creek, which rises to the southwest of the site and flows northeast to its junction with the South Platte River. Both streams have much larger flows in late spring and early summer than during winter. In May and June, most of the water in the streams comes from the melting winter snows in the mountains. In the winter, the precipitation in the mountains is in the form of snow, which does not contribute to immediate runoff. On the foothills and the lowlands, the precipitation is rain, which is less taken up by evapotranspiration than is snow, but the total rainfall in the lower areas is small at best and contributes relatively little to the total.

For the South Platte River at Henderson,[11] some 23 miles upstream from the site, the average flow in January has been 105 cubic feet per second (cfs), and in June, 744 cfs. On St. Vrain Creek at the plant site, corresponding flows have been 91 and 553 cfs. These measured figures are valid, but many of the computed values for the June flow at other points must be used with caution because of the way river water is used for irrigation. Many ditches take off from both of the streams; during the growing season, ditches take water out to the lowlands alongside the river where it is spread over the fields. Much of the water seeps down to the underlying sands and gravel, joins the water table, and flows back underground to join the river. In the computation of the flow on the South Platte River at the site, based on the flow measured at Henderson, the flow at Henderson is usually subtracted from the amount of water diverted into the ditches that branch out of this 23-mile stretch. Because much of this water does return to the river, the true net loss in flow will be less than the calculated value. The actual flow, therefore, particularly in summer, at the site is more than the computed flow but less than the flow at Henderson. How much less cannot be determined without actual measurements, which have not been made.

Through intake structures from both streams, the Station draws makeup water (av. 9.1 cfs) for the main cooling tower. During most of the year - even in the winter when the flow is low - the two streams can supply all the water required. However, because of the extensive use of water for irrigation during summer - the season of greater natural flow - the flow of the streams may be inadequate. Consequently, the Station has a battery of wells to supplement the river flow when required.

The monthly figures given above are averages for the period 1951 to 1967. In dry years the flows can be very much less. For example, on August 3, 1961, the river flow at Henderson was only 5 cfs, and on June 15, 1955, the flow in St. Vrain Creek was only 16 cfs. The total annual flow also differs a great deal between wet and dry years; in 1954 the total annual flow of the South Platte at Henderson was 75,460 acre-ft, and in 1957, 444,900 acre-ft.

Floods do not appear to be a problem at the site. The largest flood on record (June 16-17, 1965) was caused by heavy rains in the drainage area of tributary streams upstream from Denver. The maximum discharge at Denver was 40,300 cfs, and the calculated discharge at Henderson was 29,600 cfs. Previous record discharges were 22,000 and 14,800 cfs, respectively. During both floods, the river lost water to the adjacent sand and gravel beds in flowing from Denver to Henderson and must have lost still more water between Henderson and the site. The maximum river stage at the site during the record flood was nearly 13 ft - still 17 ft below the grade at the reactor building. The maximum theoretical flood as reported to the Applicant by the Corps of Engineers is 500,000 cfs, but the crest of such a flood would be 10 to 13 ft below the reactor building grade.

Table II-2 gives information on the quality of water in the shallow wells, the South Platte River, and St. Vrain Creek in the vicinity of the Station.[12] The quality certainly varies greatly during the year, and many analyses would be necessary to determine the trends and the factors responsible. In general, the late spring runoff coming from melting snows on the cystalline rocks in the mountain areas should be of very good quality - much better than the winter flow that is supplied by drainage from the local sands and gravels. However, by the time the streams reach the site, extensive removal of water by irrigation ditches and the return of this water after

Table II-2–CHEMICAL QUALITY OF NATURAL WATER IN STATION AREA

Component	Component concentration (ppm) [a]		
	Shallow wells	St. Vrain Creek	South Platte River
Total hardness	445	631	266
Sulfate	100.0	1340	37.0
Chloride	69	27	85
Chromium	0.020	0.032	0.021
Magnesium	0.031	0.085	0.018
Sodium	82	144	104
Zinc	0.044	0.034	0.045
Acidity (pH)	7.3	7.4–8.6	6.9–8.1

[a] Based on values reported in reference 12

it has seeped through agricultural soils[13] has seriously impaired the quality of the river water in the summer, particularly at times of low flow. Partly for this reason, the larger public water supplies in this general area, including part of the water supply to the Station, are brought in directly from the mountain areas to avoid contamination by salt-loaded irrigation water. However, much local domestic water is supplied from wells. No public water supplies are taken from the South Platte River downstream from Denver.[14] The Narrows Unit Dam and Reservoir Project in Morgan County downstream on the South Platte River from the Station is planned as a reservoir for irrigation water only. This project is expected to be completed in about 10 years. Although no specific provisions are included in the design of the reservoir, conversion to either municipal or industrial water is not precluded should the need arise.[15]

The Pierre Shale contains no groundwater, but the overlying 50 to 80 ft of Older Quaternary and Broadway sands and gravels is largely saturated, and well water is easily available over wide areas. Much of the water in the surficial sands comes from the streams, so that in the long run whether water is taken from one of the streams or from a nearby well makes little difference. In brief periods of low stream flow, the groundwater provides a convenient reservoir from which large supplies can be pumped, the loss to the groundwater being made up at the next period of high flow. Also, virtually all the surface flow has long since been legally appropriated. In 1969 the Colorado General Assembly decreed that groundwater reserves are related to but are junior to surface-water rights. In acknowledgment of this situation, the Applicant has tied groundwater reserves to those surface-water rights already owned.[16]

3. Meteorology

The climate around the site is semiarid; precipitation averages 10 to 15 in./year. Wind direction at the site is usually from the southwest, the same as the direction of flow of the South Platte River, but the north winds quite often override this local effect. Wind speeds average 10 mph, although local winds of 40 to 60 mph have been recorded. The Applicant constructed a meteorological tower at the site in November 1966. Continuous temperature measurements and wind directions and speeds are available[17] for a period of 1.6 years.

Monthly average temperatures recorded at the Station over a 2-year period ranged from 16 to 80°F, and monthly precipitation in the area has varied from 0 to 7 in. over an 8-year period. No precipitation measurements have been made at the Station, but data from the Weather Service Office at Fort Collins show wide year-to-year variation. Over a 7-year period, precipatation varied from 7 to 27 in., most of it falling in late spring and summer. Records of extremes of temperature, rain, snowfall, and wind are available from the Fort Collins Weather Service Office. A report[18] on the meteorological characteristics of the site --tabulated by Dr. Elmar Reiter, Professor of Atmospheric Science, Colorado State University--shows that terrain effects on winds at the site during weak wind conditions disrupt thermal stability and mass exchange near the ground and could cause slow dispersal of gaseous effluents. Data from Stapleton Field, Denver, indicate that 75% of the time inversions will occur in the early morning hours during the winter months. Because of the low humidity at the site,[19] fogging in the vicinity of the cooling towers may occur only three or four times a year.

E. ECOLOGY OF THE SITE AND ENVIRONS

This ecological description of the Fort St. Vrain site is based on general references, on information obtained during the site visit, and on the Applicant's reports.[20,21] Other references on the ecology of the specific area, especially on the aquatic biota, are not available. The Applicant's information on the biota is very meager. The ecological studies were outgrowths of the Environmental Radiation Surveillance Program. Those studies, begun in 1971, are preliminary. Although the information provided by them[20,21] is meager, it is the best available on the aquatic biota.

The site is in the transitional zone between the grasslands of the plains and the foothills of the Rocky Mountains. For many years, the growth of natural vegetation has been interrupted by farming and grazing. That which remains grows on the wetland and bottom land along St. Vrain Creek and the South Platte River, which border the Applicant's property. These areas afford some habitat for wildlife and serve as a resting place for large numbers of migratory waterfowl. The creek and river originate in the mountains but pick up heavy loads of dissolved solids and of industrial and municipal wastes before reaching the site. Their aquatic biota (fish, algae, and benthic organisms) are characteristic of polluted streams.

1. Aquatic

The aquatic environment of the site includes the South Platte River, St. Vrain Creek, the Station's farm pond, and a series of irrigation ditches. Some collections of aquatic biota have been undertaken for the Applicant.[20,21] Figure II-8 shows the locations of the sampling stations, and table II-3 describes them.

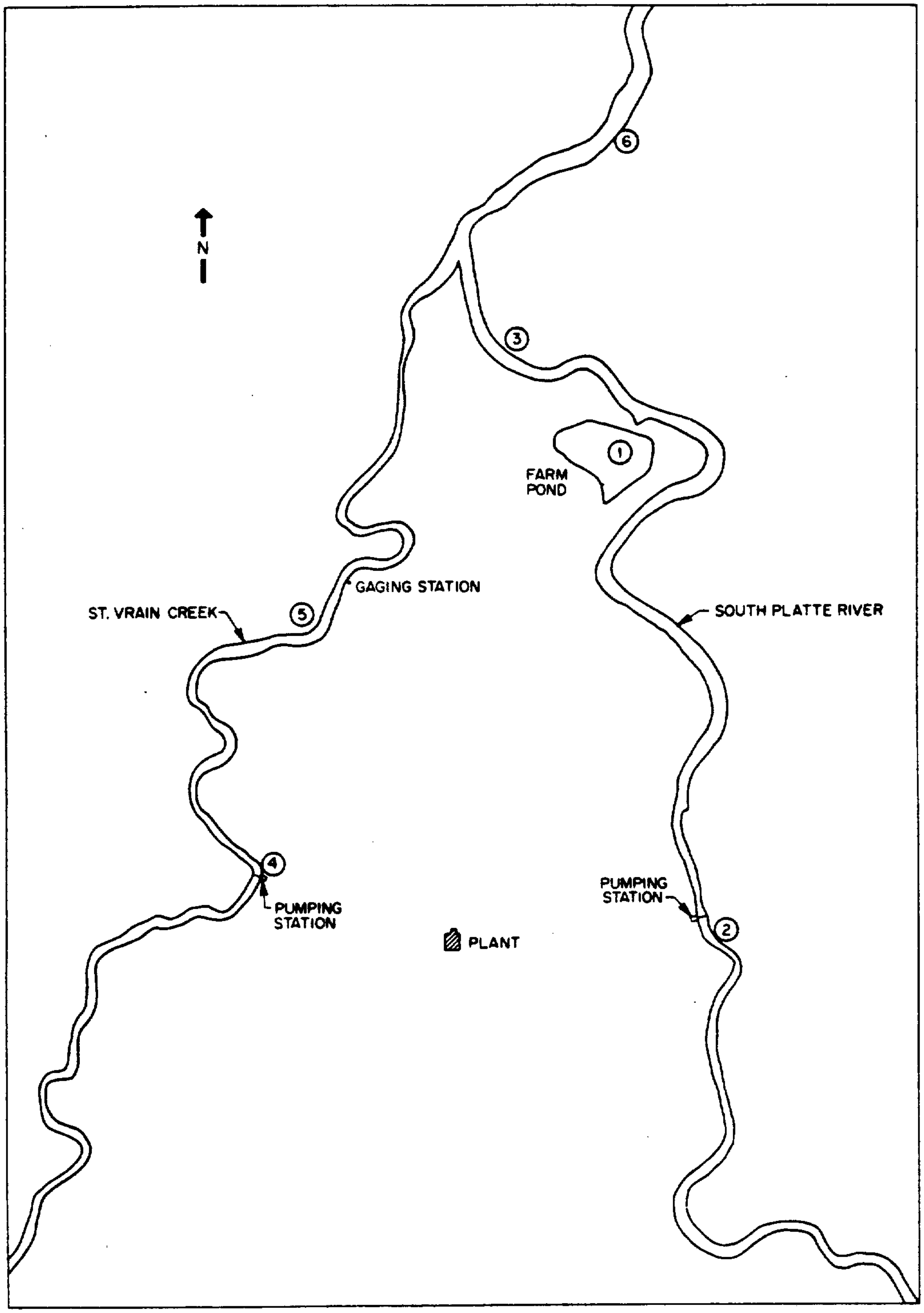

Figure II-8—LOCATION OF BIOLOGICAL SAMPLING STATIONS

Table II-3—DESCRIPTION OF LOCATIONS OF BIOLOGICAL SAMPLING STATIONS

Station No.	Project No.	Location[a]
1	E-38	The farm pond
2	U-43	South Platte River (above plant-effluent entrance)
3	D-43	South Platte River (below plant-effluent entrance)
4	U-42	St. Vrain Creek at pumping station (above effluent entrance)
5	D-45	St. Vrain Creek at gaging station (below effluent entrance)
6	D-40	South Platte River (below confluence with St. Vrain Creek)

[a]See figure II-8

a. South Platte River

The South Platte River is a typical, silted, sandy river of the plains.[22] Above the confluence of St. Vrain Creek and the South Platte River and during times of low water, the river consists of pools, riffles, and shifting sandbars; below the confluence, it has a sand-and-gravel bottom and becomes wider, deeper, and swifter.

(1) Animals

The types of aquatic biota indicate that the South Platte River is polluted. Fish collected represent only a few species.[20,21] The most abundant species are carp, white suckers, and green sunfish (these survive in water that contains a large amount of organic debris). Table II-4 lists the large number of species of fish whose ranges could extend into an unpolluted stream in the area. Only a few species of invertebrates were in the collections. Oligochaete worms and blood worms (Chironomids) are abundant (they tolerate comparatively heavy loads of organic pollutants).[23] Some species of mayflies (Ephemeroptera) and stoneflies (Plecoptera) were collected; they are less tolerant of pollution than are other species, and their presence could indicate a partial recovery of the river from pollution. Table II-5 lists a few of the aquatic bottom fauna collected in the river.

(2) Plants

The most abundant species of algae found in the South Platte River are the attached forms, Cladophora glomerata, which is found during all seasons, and Stigeoclonium flagelliferum, which blooms seasonally when the water is clear. These attached forms, along with Ulothrix tenuissima and Spirogyra sp., clog the riffles of the river when the water level is low. Below the confluence of the South Platte River with St. Vrain Creek, where the water becomes swift, attached algae are not as abundant; there the dominant species is Cladophora glomerata. Table II-6 lists species of algae found in the river. Some diatoms and zooplankton were collected from the river but were not identified.[21]

b. St. Vrain Creek

St. Vrain Creek in the vicinity of the Station is a rapidly flowing stream without riffles or pools except for a sheet-piling dam constructed by the Applicant (figure III-6). The stream bottom is gravel and sand, which affords little protection for most aquatic life.

Table II-4—LIST OF FISH SPECIES WHOSE RANGES COULD EXTEND INTO UNPOLLUTED STREAMS IN AREA AROUND THE STATION [20, 21]

Scientific name	Common name
Campostoma anomalum	Stoneroller
Catostomus commersoni	White sucker
Catostomus catostomus	Longnose sucker
Cyprinus carpio	Carp
Darosoma cepedianum	Gizzard shad
Fundulus kansae	Plains killifish
Fundulus sciadicus	Plains top minnow
Hybognathus hankinsoni	Brassy minnow
Ictalurus melas	Black bullhead
Ictalurus nebulosus	Brown bullhead
Lepomis cyanellus	Green sunfish
Lepomis humilis	Orange spotted sunfish
Micropterus dolomieui	Smallmouth bass
Micropterus salmoides	Largemouth bass
Notropis cornutus	Common shiner
Notropis lutrensis	Red shiner
Notropis stramineus	Sand shiner
Perca flavescens	Yellow perch
Pimephales promelas	Fathead minnow
Pomoxis annularis	White crappie
Pomoxis nigromaculatus	Black crappie
Salmo gairdneri	Rainbow trout
Semotilus atromaculatus	Creek chub

Table II-5–LIST OF SOME BOTTOM ORGANISMS COLLECTED IN SOUTH PLATTE RIVER

Scientific Name	Common Name
Diptera	Chironomid
Annelida	Oligochaete
Gastropoda	Snail
Ephemeroptera	Mayfly
Diptera	Mosquito larva
Coleoptera	Water beetle
Trematoda	Trematode
Odonata – Anisoptera	Dragonfly
Odonata – Zygoptera	Damselfly
Plecoptera	Stonefly
Diptera	Two-winged fly
Hemiptera	Water bug
Eucopepoda	Copepod

Table II-6–SPECIES LIST OF ALGAE FOUND IN SOUTH PLATTE RIVER[20, 21, 24]

Scientific name	Description
Green algae	
Cladophora glomerata	Attached, branched filaments
Enteromorpha intestinalis	Ribbon-like grass
Harmidium klehsii	Unbranched filaments
Hydrodictyon reticulatum	Water net
Microspora sp.	Unattached, unbranched filaments
Oedogonium sp.	Attached, unbranched filaments
Rhizoclonium hieroglyphicum	Long, wiry, unbranched filaments
Spirogyra sp.	Long, unbranched filaments
Stigeoclonium flagelliferum	Branched filaments
Tetraspora gelatinosa	Attached, mucilaginous common tube
Ulothrix tenuissima	Long filaments
Blue-green algae	
Anabaena sp.	Amorphous-mucilage filaments
Oscillatoria sp.	Filamentous elongate without sheath

The aquatic biota of St. Vrain Creek in the vicinity of the site is similar to that of the South Platte River. The greatest obvious difference is the presence in the creek of the alga Enteromorpha intestinalis. This grass-like alga is normally found in saltwater habitats;[24] however, it grows in irrigation ditches and other waterways where there is a heavy influx of dissolved salt. Enteromorpha intestinalis was the algal species dominant[21] in St. Vrain Creek during August 1971.

Fish are not as abundant in St. Vrain Creek as in the South Platte River, and not as many species were collected. The benthic fauna consist primarily of Oligochaete worms and blood worms. Except for Enteromorpha intestinalis, the algae found in the creek are the same as those found in the river. Enteromorpha intestinalis is not observed below the confluence of the two streams, and its presence indicates that St. Vrain Creek is brackish. The dissolved solids content of St. Vrain Creek is about twice that of the South Platte River.[25]

c. The Farm Pond

The farm pond (about 25-acre area and 4-ft maximum depth) — which is man-made — has a sand-and-gravel bottom and an abundance of vegetation along its shore. From the Goosequill and Jay Thomas Ditches, water that contains dissolved solids and suspended matter in high concentrations drains into the pond (figure III-5). The pond was drained in April 1970; the aquatic biota was thereby eliminated. The pond has since refilled. During the 1971 season, a heavy growth of the algae Hydrodictyon reticulatum, Oedogonium sp., and Rhizoclonium hieroglyphicum occurred in the pond. The fish now present are small minnows, mostly carp, which undoubtedly have made their way through the irrigation ditches.[26] The aquatic fauna include a wide variety of insects compared with the fauna of the South Platte River and St. Vrain Creek. The fauna include the waterbug, water strider, and back swimmer (Hemiptera), dragonfly and damselfly (Odonata), stonefly (Plecoptera), mayfly (Ephemoptera), water beetle (Coleoptera), and two-winged fly (Diptera). A large population of crayfish (Cambarua) occurs in the pond as well as at all the other aquatic sites. The pond is used heavily by the wildfowl population in the area.

2. Terrestrial

a. Plants

At the site, the dominant species of the grasslands are blue grama (Bouteloua gracilis) and buffalo grass (Buckloe dactyloides).[27] Plant communities of the foothills are characterized by Ponderosa pine (Pinus ponderosa), which shares its dominance with cottonwood (Populus augustifola) in moist areas and along streams.[28]

For many years, most of the site has been used for farming and grazing, the natural vegetation being controlled by physical or chemical means. Grasses such as fescue, brome, intermediate wheat, and orchard grass have been planted for pasture, and the growth of natural vegetation has been limited to roadsides, hedgerows, and irrigation ditches. Areas along the banks and bottoms of the South Platte River have been less disturbed by agriculture; however, they are exposed to seasonal floods, which can drastically change the vegetation of the area. The vegetation along the river is dominated by cottonwood, willow, cattail, and bullrushes; some native grasses and weeds are also present.[20] Table II-7 is a species list of the most common natural vegetation found at the site. A thesis by Fraley[29] gives a more complete list of the native grasses, sedges, and forbs of the area.

b. Animals

The wildlife that inhabits the terrestrial environment can be divided into animals associated with agricultural and grazing land and those associated with habitats along the streams. The farming and grazing of the land, together with the accompanying fencing, has eliminated most of the large mammals, such as deer and antelope, that were once native to the area. An antelope now in the area would be considered a wanderer; however, both mule deer and whitetail deer are occasionally found in the cover along the river bottoms. The small mammals found on the farm land are skunk, cottontail rabbit, grey fox, opossum, badger, weasel, and coyote. Undoubtedly, these animals take advantage of the natural cover and food supply along the river bottom as well as that in the pasture and farm land. Animals of the river habitat are raccoon, beaver, mink, and muskrat. Mink and raccoon certainly exploit the irrigation ditches in their nightly excursions. Table II-8 lists the mammals of the area.

Birds are abundant on the site. A field list for the Denver area gives 284 species that could range in the vicinity. During 1971, a member of the Denver Ornithological Society observed 86 species of birds on the site.[30] Birds commonly found in the area are robin,

Table II-7–SPECIES LIST OF MOST COMMON NATURAL VEGETATION FOUND AT FORT ST. VRAIN SITE

	Weeds
Milk vetch	*Vicia*
Buttercup	*Ranunculus* sp.
Sunflower	*Helianthus* sp.
Rush	*Juncus* sp.
Wild licorice	*Glycyrrhiza lepidota*
Water pennywort	*Hydrocotyle rannunculoides*
Canadian thistle	*Cirsium arvense*
Bur marigold	*Bidens* sp.
Cocklebur	*Xanthium* sp.
Lesser duckweed	*Lemna minor*
Bindweed	*Convolvulus* sp.
Speedwell	*Veronica connata* var. *glaberrima*
Cattail	*Typha* sp.
Pondweed	*Potamogeton foliosus*
Bulrush	*Scirpus* sp.
Smartweed	*Polygonum* sp.
	Native Grasses
Switch grass	*Panicum* sp.
Indian grass	*Sorghastrum* sp.
Big bluestem	*Andropogon gerardi*
Cordgrass	*Spartina* sp.
Western wheat	*Agropyron* sp.
Salt grass	*Distichlis* sp.
Alkali sacaton	*Sporobolus airoides*
Foxtail grass	*Alopecurus* sp.
Fescue	*Festuca* sp.
Brome	*Bromus* sp.
Orchard grass	*Dactylis glomerata*
	Trees
Alder	*Alnus* sp.
Cottonwood	*Populus* sp.
Willow	*Salix* sp.
Russian olive	*Elaeagnus* sp. (naturalized)

Table II-8—MAMMALS OF AREA AROUND THE STATION

	Common Name
Geomyidae	
Thomomys talpoides	Northern pocket gopher
Heteromyidae	
Perognathus flavus	Silky pocket mouse
Perognathus hispidus	Hispid pocket mouse
Dipodomys ordii	Kangaroo rat
Castoridae	
Castor canadensis	Beaver
Cricetidae	
Reithrodontomys montanus	Plain harvest mouse
Reithrodontomys megalotis	Western harvest mouse
Peromyscus maniculatus	Deer mouse
Onychomys leucogaster	Grasshopper mouse
Neotoma mexicana	Wood rat
Clethrionomys gapperi	Redback vole
Microtus pennsylvanicus	Meadow vole
Microtus montanus	Mountain vole
Ondatva zibethicus	Muskrat
Muridae	
Rattus rattus	Black rat
Rattus norvegicus	Norway rat
Mus musculus	House mouse
Zapodidae	
Zapus princeps	Western jumping mouse
Erethizontidae	
Erethizon dorsatum	Porcupine
Canidae	
Canis latrans	Coyote
Canis lupus	Gray wolf
Urocyon cinereoargenteus	Gray fox
Ursidae	
Ursus americanus	Black bear
Procyonidae	
Procyon lotor	Raccoon
Mustelidae	
Mustela frenata	Long-tailed weasel
Mustela vison	Mink
Taxidea taxus	Badger
Spilogale gracilis	Western spotted skunk
Mephitis mephitis	Striped skunk
Lutra canadensis	River otter
Felidae	
Felis concolor	Mountain lion
Lynx rufus	Bobcat
Cervidae	
Odocoileus hemionus	Mule deer
Odocoileus virginiana	White-tail deer
Antilocapridae	
Antilocapra americana	Pronghorn antelope
Didelphidae	
Didelphis marsupialis	Opossum
Soricidae	
Sorex cinereus	Masked shrew
Sorex vagrans	Vagrant shrew
Vespertilionidae	
Myotis lucifugus	Little brown bat
Myotis evotis	Long-eared bat
Myotis volans	Long-legged bat
Myotis subulatus	Small-footed bat
Lasionycteris noctivagans	Silver-haired bat
Eptesicus fuscus	Big brown bat
Lasiurus cinereus	Hoary bat
Leporidae	
Sylvilagus floridunus	Eastern cottontail
Sylvilagus nuttulli	Nuttall's cottontail
Lepus americanus	Snowshoe rabbit
Lepus californicus	Blacktailed jackrabbit
Sciuridae	
Eutamias minimus	Least chipmunk
Eutamias quadrimaculatus	Long-eared chipmunk
Marmota flaviventris	Yellow-bellied marmot
Spermophilus tridecemlineatus	13-Lined ground squirrel
Spermophilus spilosoma	Spotted ground squirrel
Spermophilus lateralis	Golden-mantled ground squirrel
Cynomys ludovicianus	Black-tailed prairie dog
Tamiasciurus hudsonicus	Red squirrel

magpie, mourning dove, blackbird, heron, and several species of sparrow. Birds that are occasional or rare visitors include the peregrine falcon, bald eagle, whistling swan, snow goose, and white-front goose. Of these, the peregrine falcon and bald eagle are endangered species in the United States.

Colorado is located on the Central Flyway for migratory waterfowl. In addition to the large transient population of waterfowl, many ducks and geese may overwinter in Colorado.[31] The peak of the migration south is late November, when 20,000 to 30,000 waterfowl may be sighted in a day. An inventory for Colorado records 282,340 ducks and 57,395 geese during January 1969.[23] Waterfowl wintering in Colorado feed on waste grain left in the fields and use the wetlands along the rivers for resting areas; they fly to and from the fields each day. Along streams and in ponds near the site property, waterfowl are plentiful. A few ducks are permanent residents, but the majority are transients or winter residents. About 90% of the ducks are mallards; they are both transients and winter residents. Other ducks observed on the site are the gadwall, pintail, golden eye, merganser, and blue- and green-winged teal. Occasionally, adverse weather conditions may force Canadian geese to take shelter along the river bottoms, but usually they remain in the area for only a short time. Table II-9 lists waterfowl common to the area.

Table II-9—WATERFOWL COMMON TO AREA AROUND THE STATION

Mallard	*Anas platyrhynchos*
Pintail	*Anas acuta*
Green-winged teal	*Anas carolinensis*
Blue-winged teal	*Anas discors*
Cinnamon teal	*Anas cyanoptera*
Canvasback	*Aythya valisineria*
Gadwall	*Anas strepera*
Shoveler	*Spatula clypeata*
Wood duck	*Aix sponsa*
Widgeon	*Mareca americana*
Redhead	*Aythya americana*
Lesser scaup	*Aythya affinis*
Bufflehead	*Bucephala albeola*
Common goldeneye	*Bucephala clangula*
American merganser	*Mergus merganser americanus*
Hooded merganser	*Lophodytes cucullatus*
Ruddy	*Oxyura jamaicensis rubida*
Canada goose	*Branta canadensis*

III. THE PLANT

A. EXTERNAL APPEARANCE

The Station is designed from a color and form standpoint to blend as much as possible into the terrain of the surrounding farmlands. The Station is visible from two county roads (figure II-2) - one about 4000 ft S of the reactor building and one (the Station Access road) about 600 ft W of the reactor building. From both U.S. 85 and Interstate 25, the Station's structures can be seen; however, distances are so great that they appear to be small spots on the horizon.

One building - a structural steel frame covered with green and light-brown metal siding - houses both the reactor and the steam-electric system (figure III-1). A large and a small cooling tower are located about 200 ft north of the building; settling basins are north of the cooling towers. Although the larger cooling tower is readily visible from the access county road, it is not visually objectionable. The settling basins and the intake structures for makeup water from the two streams cannot be seen from the roads.

A visitors' information center built to resemble the original adobe Fort St. Vrain (figure III-2) is located about 700 ft west of the reactor building. Entry to the center's parking lot is from the access county road.

The most visible feature of the operating Station will be white plumes that will rise from the cooling towers. However, the plumes will be only small white forms on the horizon when seen from U.S. 85 and Interstate 25.

B. TRANSMISSION LINES AND SWITCHYARD

The Station distributes power to the Applicant's grid through four transmission lines. Two lines, which connect the Station to a coal-fired power station near Boulder and to the U.S. Bureau of Reclamation system north of the Station, were not caused by construction of the Station because the Boulder station would have been connected to the U.S. Bureau of Reclamation system in any case. Routing the connections through the Station's switchyard (figure III-3) did not require extra transmission lines. Two lines between the Station and Fort Lupton 10 miles away tie the new power station into a 230-kV loop around Denver and are a direct result of construction of the Station.

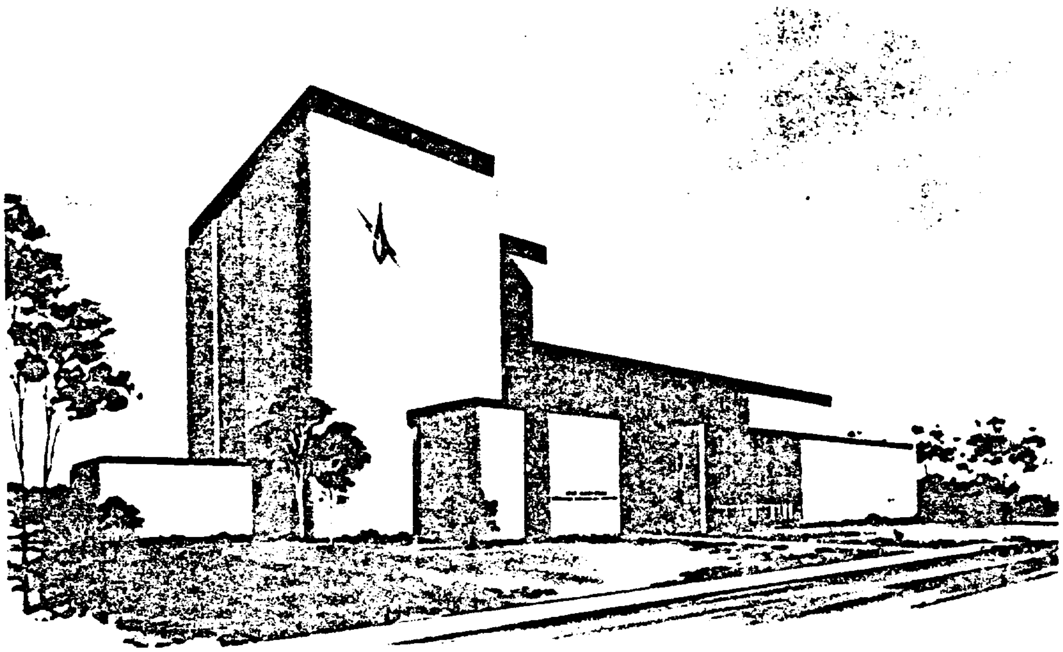

Figure III-1 – ARCHITECTURAL DRAWING OF FORT SR. VRAIN NUCLEAR GENERATING STATION

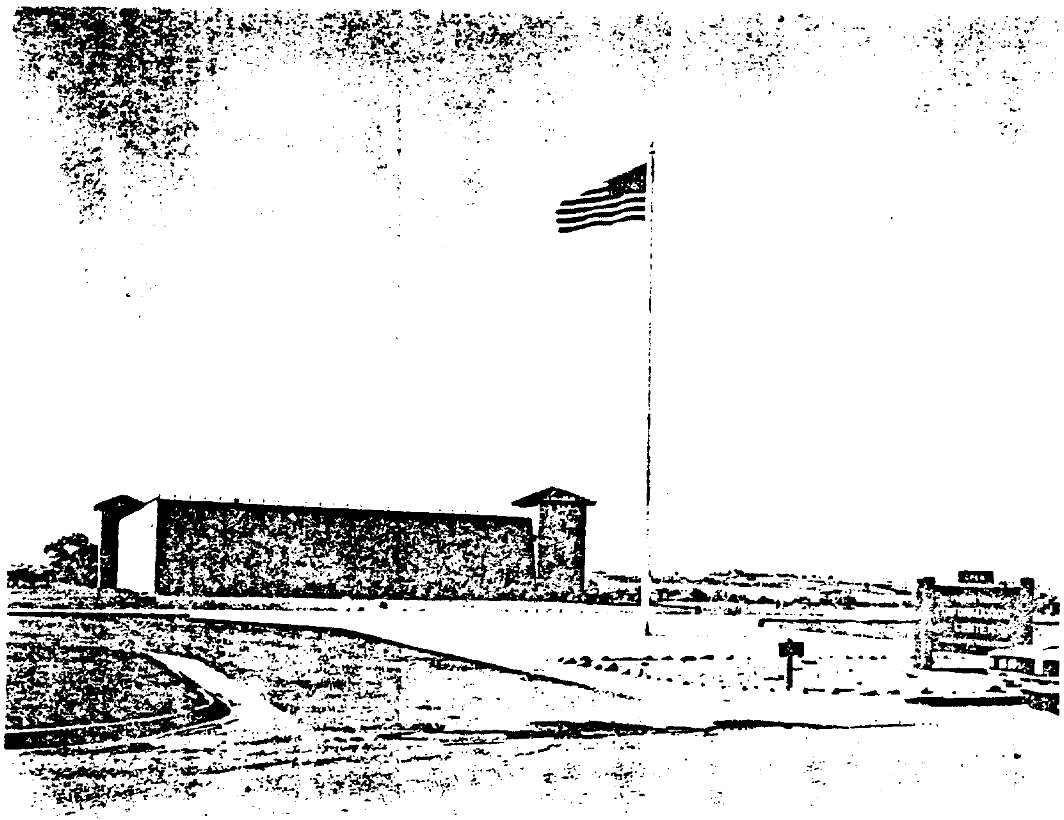

Figure III-2 – FORT ST. VRAIN INFORMATION CENTER

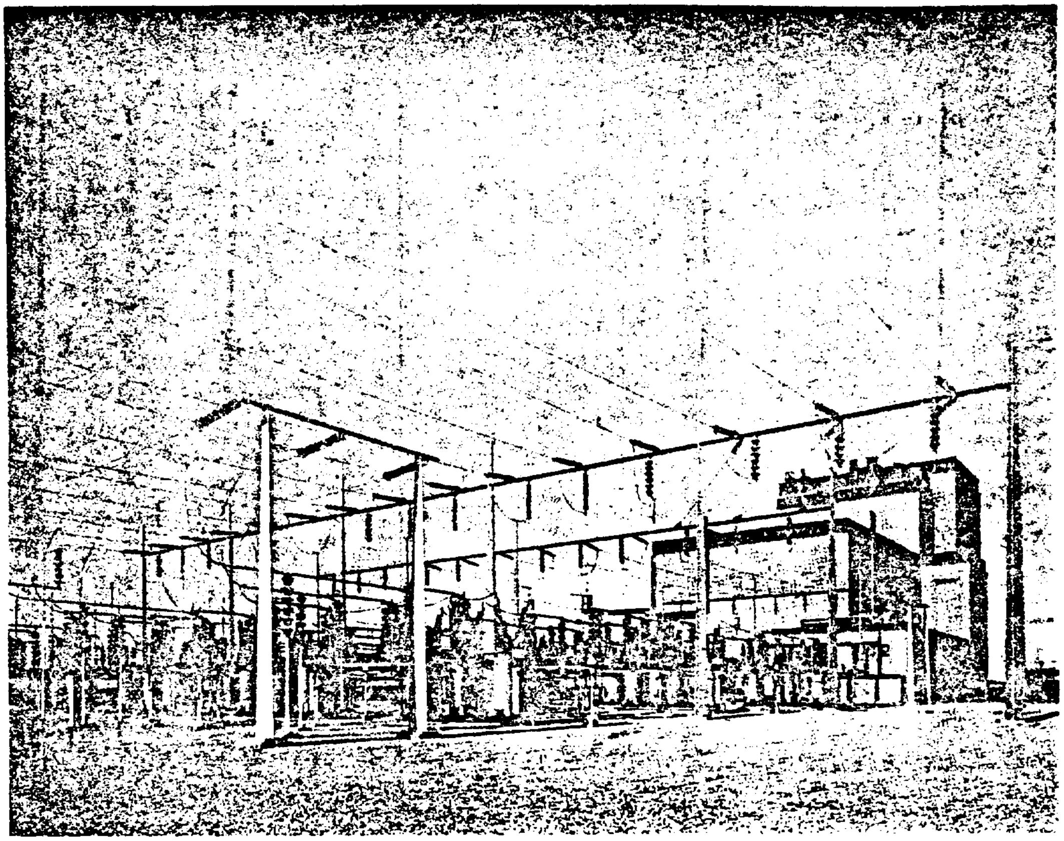

Figure III-3 – SWITCHYARD SOUTH OF REACTOR BUILDING

The 250-ft-wide right-of-way for the lines runs through agricultural and pasture land to a substation at Fort Lupton; the right-of-wav may be expanded if additional lines are required. At Fort Lupton, 10 acres of land has been acquired for a substation site, 3 acres of which will be fenced and covered with gravel.

The transmission poles and towers are estimated to occupy about 0.15 acre per mile of land.[1]

As a general rule, transmission lines detract from the esthetic value of an area. The Applicant attempts to route them in such a way that they interfere as little as possible with the natural background of the area. Ornamental poles are used in residential areas; to reduce the environmental impact, their colors are chosen to blend with the scenic background. After the poles and towers are constructed, the land owners are encouraged to use the affected land as before, except for building purposes. The bases of the towers and poles are sprayed with herbicides; however, the Applicant does not plan to spray the rights-of-way with herbicides.

C. REACTOR AND STEAM-ELECTRIC SYSTEM

The 842 MWt Station will generate 330 MWe by use of a high-temperature gas-cooled reactor (HTGR) and a conventional steam-turbine generator.

The reactor uses ^{235}U as the fissile material, ^{232}Th as the fertile material, graphite as the moderator, cladding structure, and reflector, and helium as the coolant. In operation, ^{232}Th is coverted to ^{233}U, a fissile material.

The helium coolant, at a pressure of almost 700 psia, flows through the reactor core - where it is heated to 1430°F - to the steam generators, where it gives up heat to convert water to steam and is cooled to about 750°F. It is then returned to the reactor by helium circulators. The generated steam flows to the turbine that drives the electrical generator. The steam is expanded as it rotates the turbine; the expanded steam, after passing through the turbine, is condensed and returned as water to the steam generators. A circulating-water system pumps cooling water through the main condenser, which condenses the steam. The main condenser is designed for 80°F inlet temperature of circulating water and for 2.5 in. Hg absolute pressure at rated turbine output. The condenser is a two-pass, divided-water-box type with a design heat rejection capacity of 1670×10^6 Btu/hr. Circulating water is heated 21.5°F (to 101.5°F) in passing through the condenser and on to the main cooling tower which dissipates unrecoverable heat to the atmosphere.

The reactor, with its accessories (helium circulators and steam generators), is contained in a prestressed concrete reactor vessel (PCRV). The PCRV is a vertical hexagonal prism about 61 ft across and 106 ft high; it has 9-ft-thick side walls.

The nuclear steam-supply system was designed and fabricated by Gulf General Atomic Company.

D. HEAT DISSIPATION SYSTEM

1. General Description

Heat from the main condenser is dissipated to the atmosphere by one 400-ft-long 10-cell, induced-draft, cross-flow cooling tower with a heat load capacity of 1670×10^6 Btu/hr (figure III-4). Heat from the service-water system is dissipated to the atmosphere from an 80-ft-long, 2-cell cooling tower. From the South Platte River or St. Vrain Creek, makeup water for the main cooling tower can be taken either directly or by way of irrigation ditches (figure III-5). Water from either source is pumped to one of two settling basins and from there to one of two holding ponds. Makeup water for the main cooling tower is taken from the holding ponds at an average rate of 4100 gpm (9.1 cfs). Blowdown from the cooling tower will be directed through an irrigation ditch to the Station's farm pond, which overflows into a ditch that discharges into the South Platte River. Discharge of the blowdown will be made through a natural drainage slough to St. Vrain Creek only because of abnormal circumstances.

In Colorado, all water taken from rivers, irrigation ditches, or wells is governed by State laws that establish the water rights of the individual. The right to water is governed by the priority which is determined by the date of the individual's rights. In a year of water shortage, rights established at an early date are most valuable. The right to 18 cfs of Jay Thomas Ditch water from the South Platte River as purchased by the Applicant was established in 1865. This early right helps to ensure to the Applicant sufficient water for Station operation.

2. Water Intakes

The water intake from St. Vrain Creek is about 2700 ft west of the settling basins; figures III-6 and III-7 show the complete system. A sheet-piling dam was built to hold a pool of water about 3 ft deep at the intake opening. A trash rack (or grizzly screen), inclined at about 30 deg from the vertical, covers the intake opening. Water flows

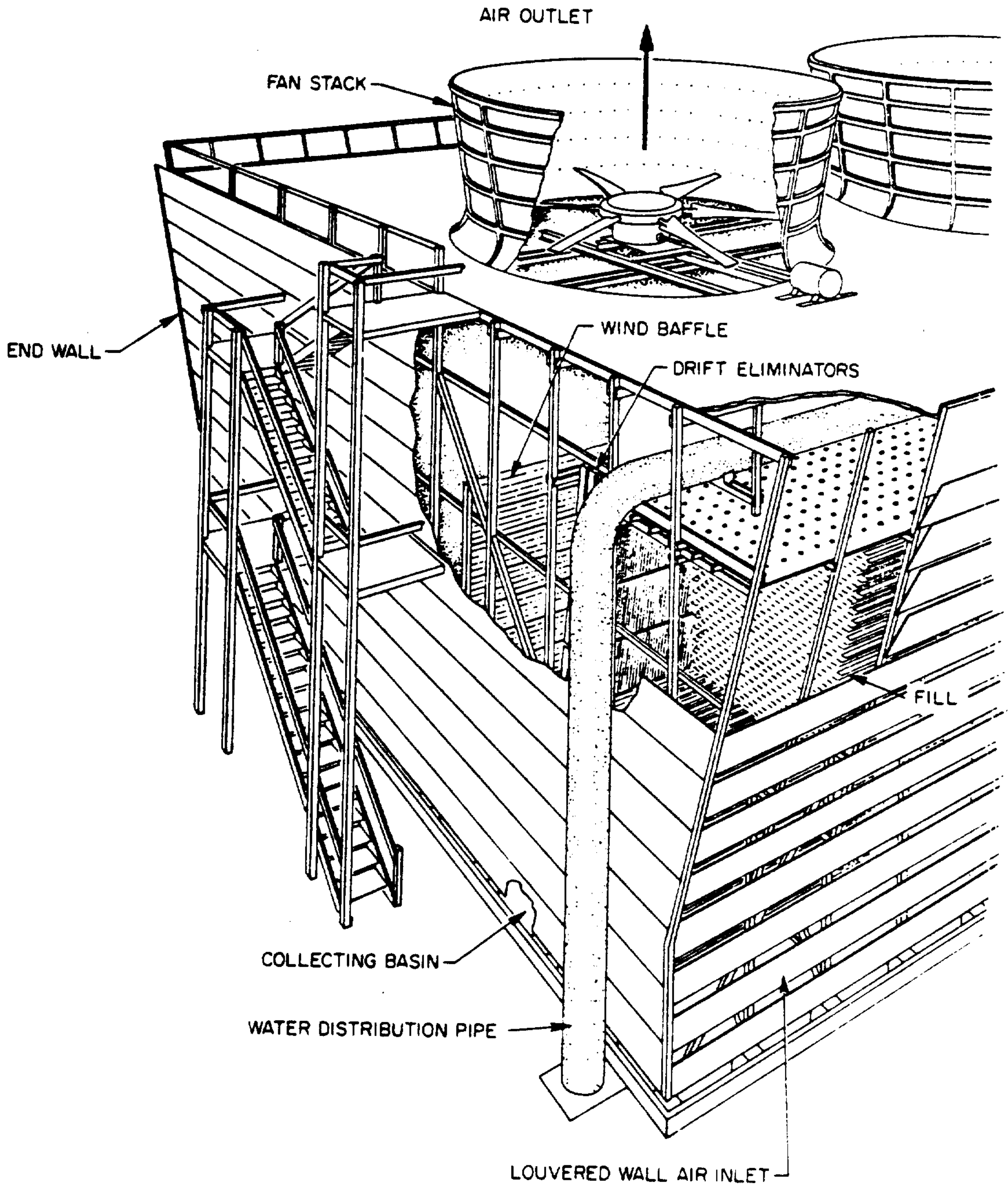

Figure III-4—CUTAWAY DRAWING OF MECHANICAL DRAFT COOLING TOWER

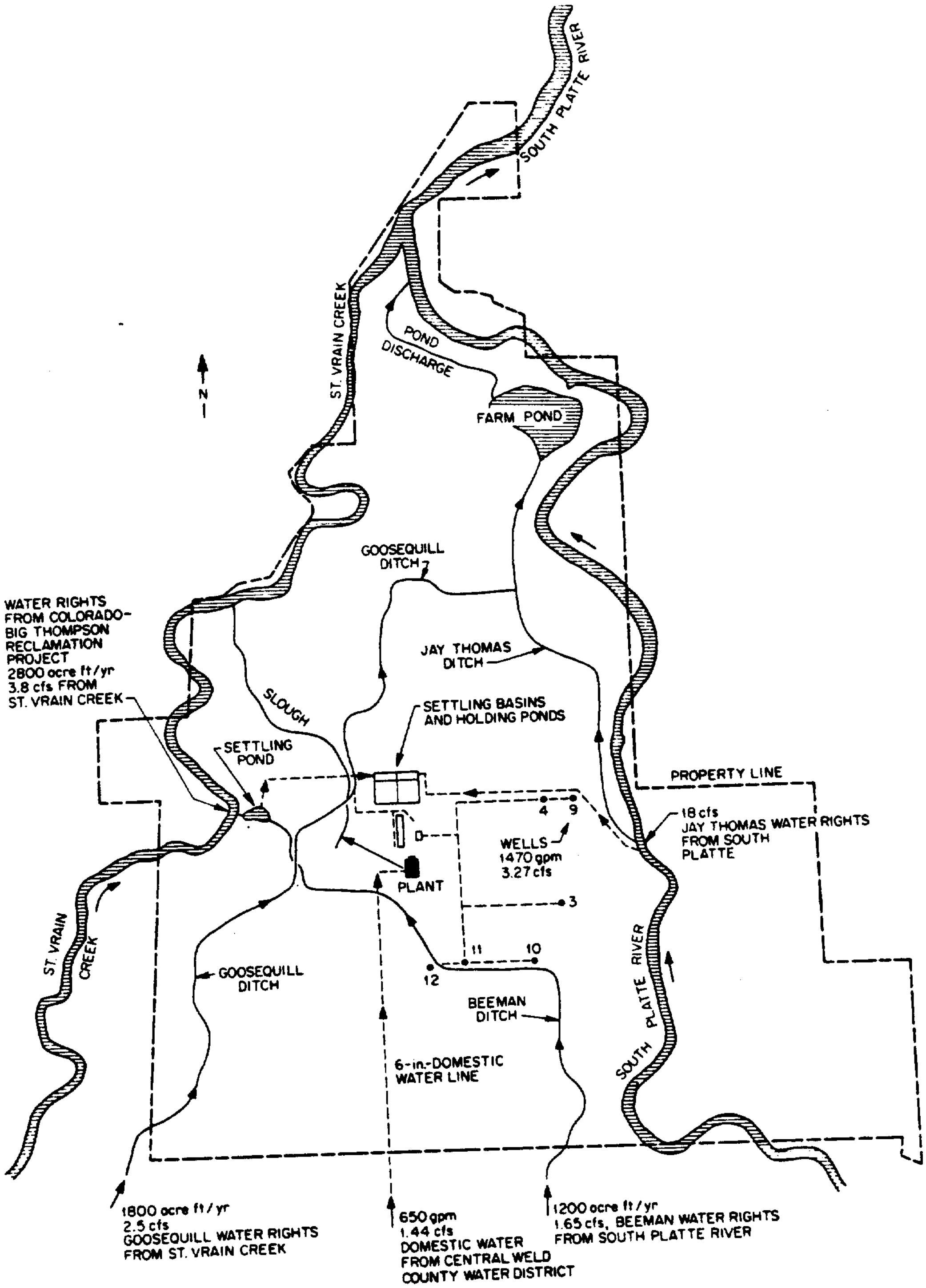

Figure III-5—IRRIGATION DITCHES AROUND FORT ST. VRAIN NUCLEAR GENERATING STATION

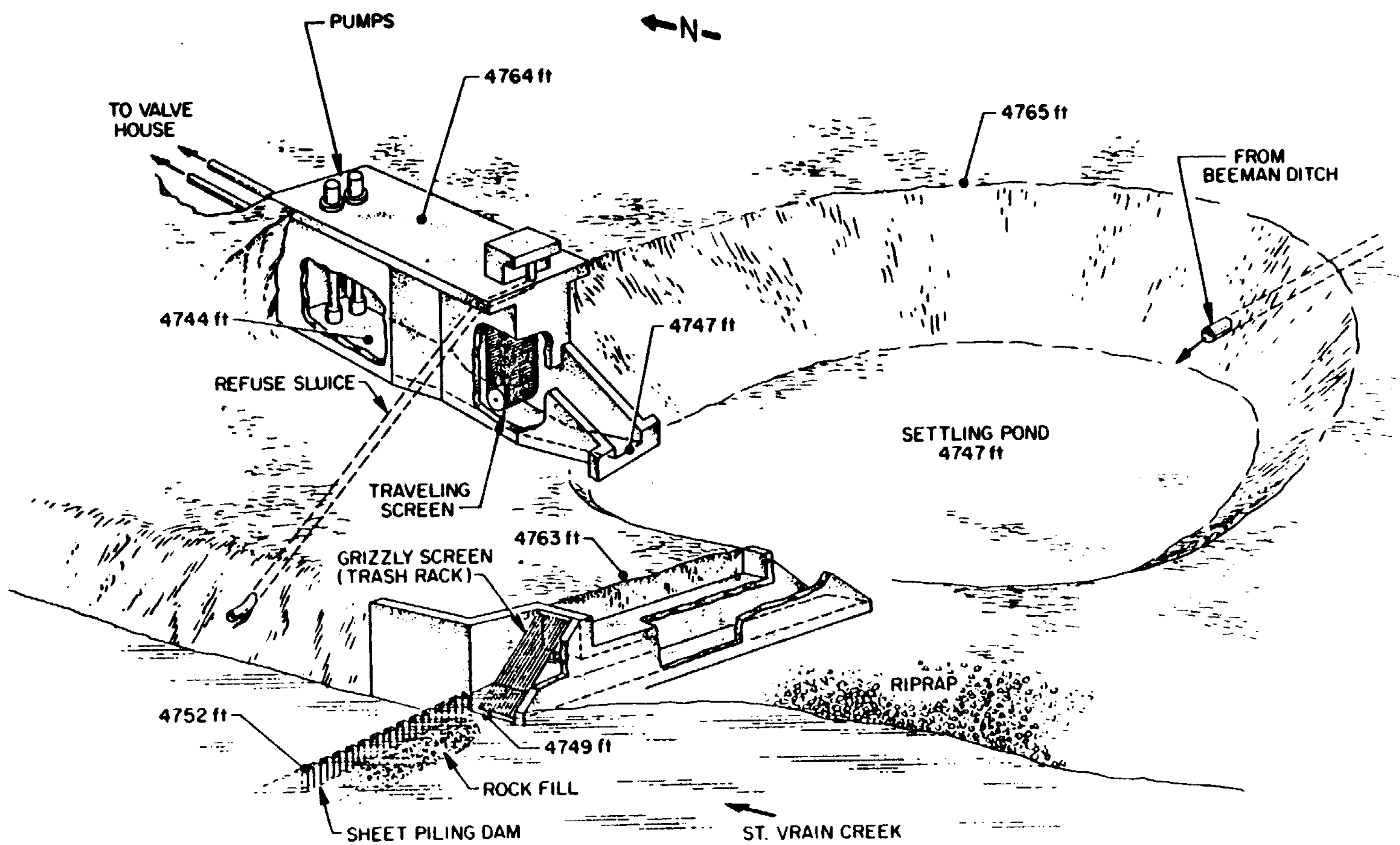

Figure III-6—WATER INTAKE FROM ST. VRAIN CREEK

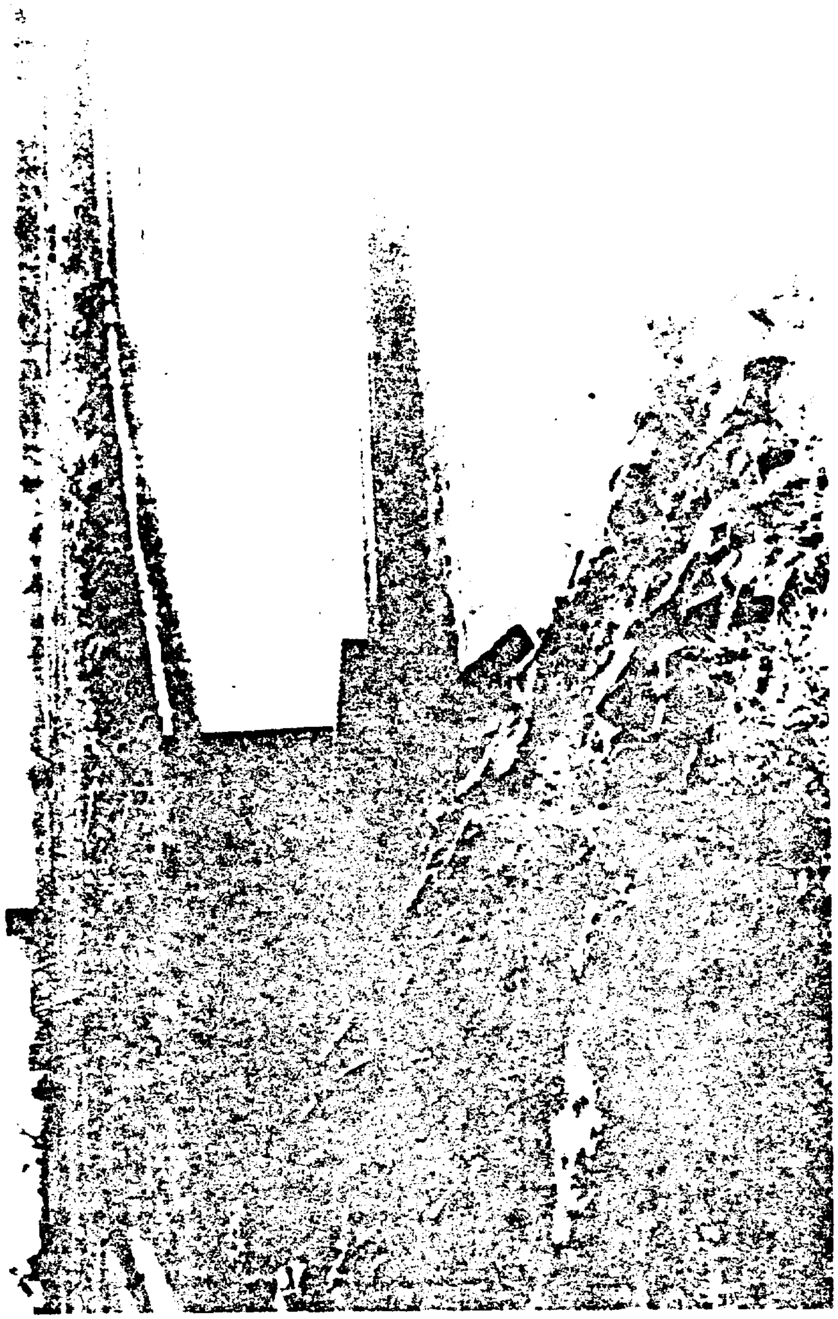

Figure III-7 — PHOTOGRAPH OF INTAKE STRUCTURE OF ST. VRAIN CREEK by gravity from St. Vrain Creek across the trash rack, through a concrete tunnel (about 5 x 8 x 40 ft), and into an earthen settling pond, the bottom of which is 2 ft lower than that of the intake opening. Water flows by gravity from the settling pond into the pump structure, which also houses a traveling screen. Two pumps [4100-gpm (9.1-cfs) combined capacity] are used. Flow velocities at 9.1 cfs are as follows:

Water Level	Flow velocity (ft/sec) Through trash rack	Flow velocity (ft/sec) Through traveling screen
Normal	0.415	0.56
Low	1.24	0.75

The trash racks for intakes at the St. Vrain Creek and the South Platte River use 3/8- by 2-1/2-in. vertical bars spaced on 5-in. centers.

The settling pond is an earthen structure about 175 ft in diameter and 17 ft deep. With normal water level in St. Vrain Creek, water in the pond will be 5 ft deep. This pond also receives tail water from the Beeman and Goosequill Ditches (figure III-5).

The intake at the South Platte River (figures III-8 and III-9) is about 3300 ft east of the settling basins and uses part of the preexisting structure that diverts water into the Jay Thomas Ditch. During normal water conditions, the structure maintains a 3-ft-deep pool at the intake opening and trash rack. This trash rack, like the one for St. Vrain Creek, is inclined about 30 deg from the vertical. Water flows by gravity through the trash rack into a chamber, which is open to the pump structure and to the gate to the Jay Thomas Ditch opening. The bottom of the chamber is 4 ft below the bottom of the intake, thus providing additional depth at the traveling screen in the pump structure. The two pumps are sized to supply at least 9.1 cfs to the main cooling tower for makeup. At this flow rate and at normal water level, velocities through the trash rack and the traveling screen are 0.34 and 0.65 ft/sec, respectively. At low river water level (4759 ft), no flow into the intake structure occurs.

The Jay Thomas Ditch has water rights for 18-cfs flow. Velocity through the trash rack at that flow and at normal water level would be 0.67 ft/sec; however, such flow is not likely to occur, as discussed below.

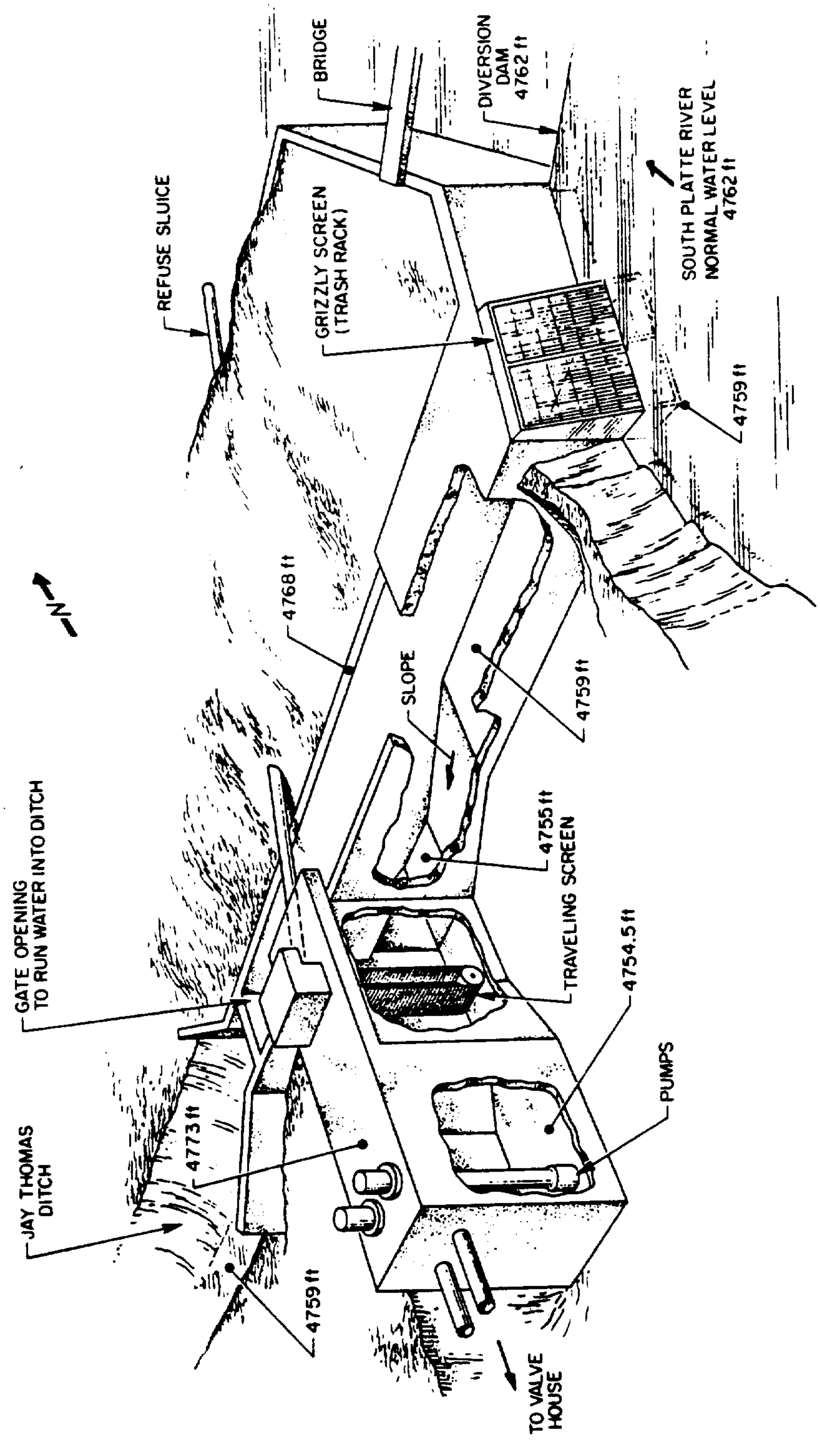

Figure III-8—INTAKE ON THE SOUTH PLATTE RIVER

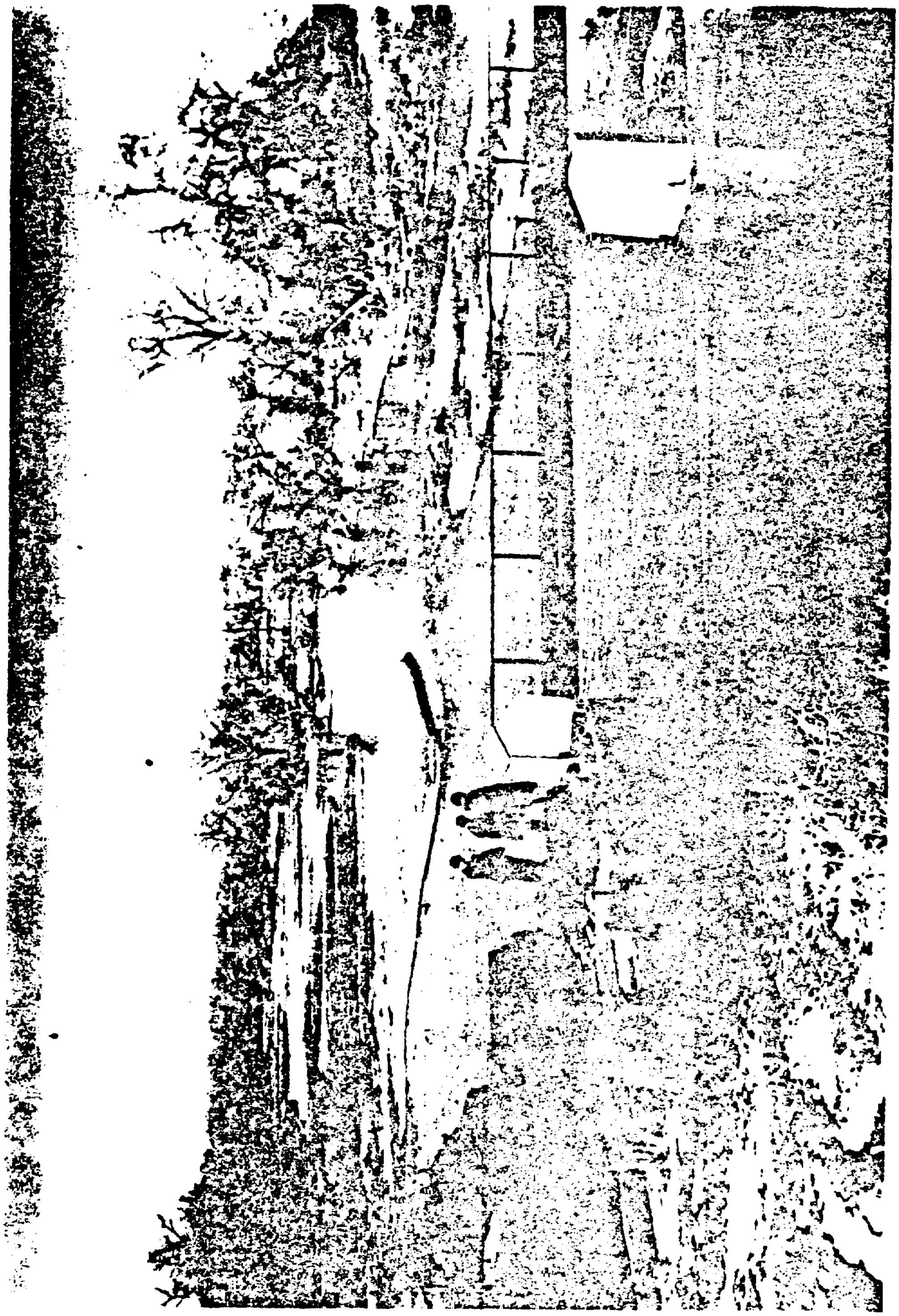

Figure III-9 – PHOTOGRAPH OF SOUTH PLATTE RIVER INTAKE

3. Water Supplies

In the region of the Station, water is a most important resource because of its relative scarcity. The relation between the Station and this resource must be considered very carefully in assessing the environmental impact of the station and in making a cost-benefit analysis. Figure III-5 shows water supplies available for Station operation. St. Vrain Creek and the South Platte River supply all water except that from wells. Goosequill Ditch begins at St. Vrain Creek about 2-1/4 miles SSW of the Station, and Beeman Ditch at the South Platte River about 10 miles SSE. Ultimate availability of water depends on meteorological factors. An extremely dry year can create a desperate shortage of water for crops and industrial uses. The availability of water in past years is evident from the historical review of river and creek flows (Tables III-1 to III-3). The lowest monthly average flows for the South Platte River (25.4 cfs) and St. Vrain Creek (27.9 cfs) occurred in April 1953 and 1954, respectively. Records for the South Platte River were taken at Henderson, 23 miles upstream from the plant. Based on the average flows indicated in Table III-2, the South Platte River flow at its junction with Jay Thomas Ditch would be about half the Henderson flow. At the lowest flow, available water would be 25.4 cfs/2 = 12.7 cfs. Although all that water possibly could not be withdrawn for the Jay Thomas Ditch, perhaps about half the 9.1 cfs required for Station operation might be available. Also, at the lowest period of flow for St. Vrain Creek (27.9 cfs), surely a portion of the Applicant's 3.8-cfs rights could be withdrawn.

In addition to the Jay Thomas Ditch, two other irrigation ditches cross the applicant's property - Goosequill and Beeman (figure III-5). From each, water can be routed to the settling pond at the St. Vrain inlet structure. A diversion box permits the use of Goosequill Ditch to divert blowdown to the farm pond on the north edge of the Applicant's property. Jay Thomas Ditch runs north from the South Platte intake to the farm pond. If agricultural activities continue on the Applicant's property, this ditch will continue to be used as a source of irrigation water.

Table III-1—MONTHLY AND YEARLY MEAN DISCHARGE FOR ST. VRAIN CREEK AT MOUTH, NEAR FORT ST. VRAIN NUCLEAR GENERATING STATION

Water year[a]	Flow (cfs)												
	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Year Av
L-1954	57.3	66.3	66.0	62.0	48.5	48.5	27.9	45.8	56.7	85.1	54.4	44.7	55.4
L-1955	43.9	43.1	46.7	46.3	49.5	59.0	39.8	43.8	94.3	61.3	80.4	67.6	56.3
H-1957	55.1	69.8	61.6	49.5	60.4	59.6	209	2009	1626	802	320	166	460
H-1958	234	228	153	134	152	158	208	1579	651	177	151	110	330
1963	140	109	103	83.5	109	115	49.6	74.5	278	109	155	131	110.9
1964	95.9	107	108	91.9	83.2	78.9	70.0	91.6	147	121	102	89.0	98.8
H-1965	73.8	84.8	80.4	69.2	80.0	84.6	79.9	104	1109	863	653	246	294.0
1966	240	150	149	135	140	132	64.9	60.6	133	127	127	180	136.5
1967	103	84.5	76.6	84.8	74.4	50.8	107	87.1	791	890	245	186	231.7
Av 1951–67	130	120	105	90.5	103	103	126	437	553	292	214	138	199

[a]L, low-flow years; H, high-flow years.

Table III-2–MONTHLY AND YEARLY MEAN DISCHARGE FOR THE SOUTH PLATTE RIVER AT HENDERSON

Water year[a]	Flow (cfs)												
	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Year Av
L-1953	59.8	65.0	63.1	47.6	44.8	47.3	25.4	355.0	783.0	488.0	455.0	87.2	211
L-1954	90.7	56.9	88.9	86.5	49.5	57.1	83.2	213.0	106.0	184.0	131.0	96.1	104
L-1955	37.3	56.7	37.0	41.6	39.7	62.9	114.0	396.0	326.0	146.0	492.0	275.0	169
H-1957	65.9	34.1	56.9	78.2	143.0	142.0	134.0	1978.0	2092.0	1442.0	923.0	243.0	615
H-1962	563.0	632.0	436.0	343.0	468.0	397.0	693.0	632.0	554.0	515.0	165.0	76.1	456
L-1963	43.6	41.3	75.1	72.9	82.1	74.7	71.9	123.0	286.0	116.0	228.0	231.0	120
1964	78.5	50.3	75.0	82.1	195.0	96.2	77.9	434.0	314.0	325.0	276.0	97.8	175
H-1965	79.3	145.0	89.5	119.0	232.0	184.0	255.0	460.0	2102.0	1465.0	1252.0	527.0	576
1966	531.0	241.0	170.0	158.0	171.0	133.0	184.0	244.0	258.0	258.0	280.0	169.0	233
1967	183.0	198.0	187.0	183.0	187.0	183.0	283.0	312.0	451.0	669.0	364.0	246.0	287
Av 1951–67	145	128	107	105	135	149	207	627	744	499	386	185	285

[a]L, low-flow years; H, high-flow years.

Table III-3—AVERAGE ANNUAL FLOW FOR THE SOUTH PLATTE RIVER AND IRRIGATION DITCHES BETWEEN HENDERSON AND MOUTH OF ST. VRAIN CREEK

Based on 32-year records except as noted

Stream	Stream flow (cfs)	Outflow to ditches (cfs)	Calculated flow below junction (cfs)
South Platte River at Henderson (23 miles up stream from plant) (39 year)	326		
Five ditches (Brighton, Lupton Bottom, Platteville, Meadow Island #1, Evans #2)		97	229
Meadow Island ditch #2 and Beeman ditch		12	217
Farmers Independent ditch and Western ditch		55	162
Jay Thomas ditch (5 year)		4	158
St. Vrain Creek (40 year)	194		352

The total available surface water rights owned by the Applicant at the site are:

Source	Water rights (cfs)
Jay Thomas Ditch	18.0
St. Vrain Creek (Big Thompson)[a]	3.8
Goosequill Ditch	2.5
Beeman Ditch	1.6
Total	25.9

[a]These are Colorado-Big Thompson water rights exerted on St. Vrain Creek by an exchange agreement. In a dry year, the Colorado-Big Thompson rights are more firm than other water rights.

The 9.1 cfs required for makeup water is 35% of the allowable 25.9 cfs. The Applicant states that the wells can be used for backup if required. Allowable rights to water from the wells total 2360 acre-ft/year (3.27 cfs). Since 0.82 cfs is required for the service-water cooling tower, backup capacity of 2.45 cfs is available from the wells. Records indicate that the Station might be short of water a few months during a 10-year period.

4. Water-Distribution System

Water from the two intakes is distributed to two settling basins and from there to two holding ponds that supply makeup water to the main cooling tower (figure III-10). Makeup water for the service-water cooling tower is supplied from six shallow wells.

The two concrete-lined settling basins (figure III-10) are each about 90 by 330 ft and 10 ft deep. Each has a capacity of about 2 million gallons (Mgal). In the settling basins, trash, silt, and other solids are removed from the water. Water flows from the settling basins to two bentonite-lined holding ponds, each about 330 by 465 ft and 10 ft deep. Each has about 10-Mgal capacity. The storage capacity of the ponds is sufficient for full-power,

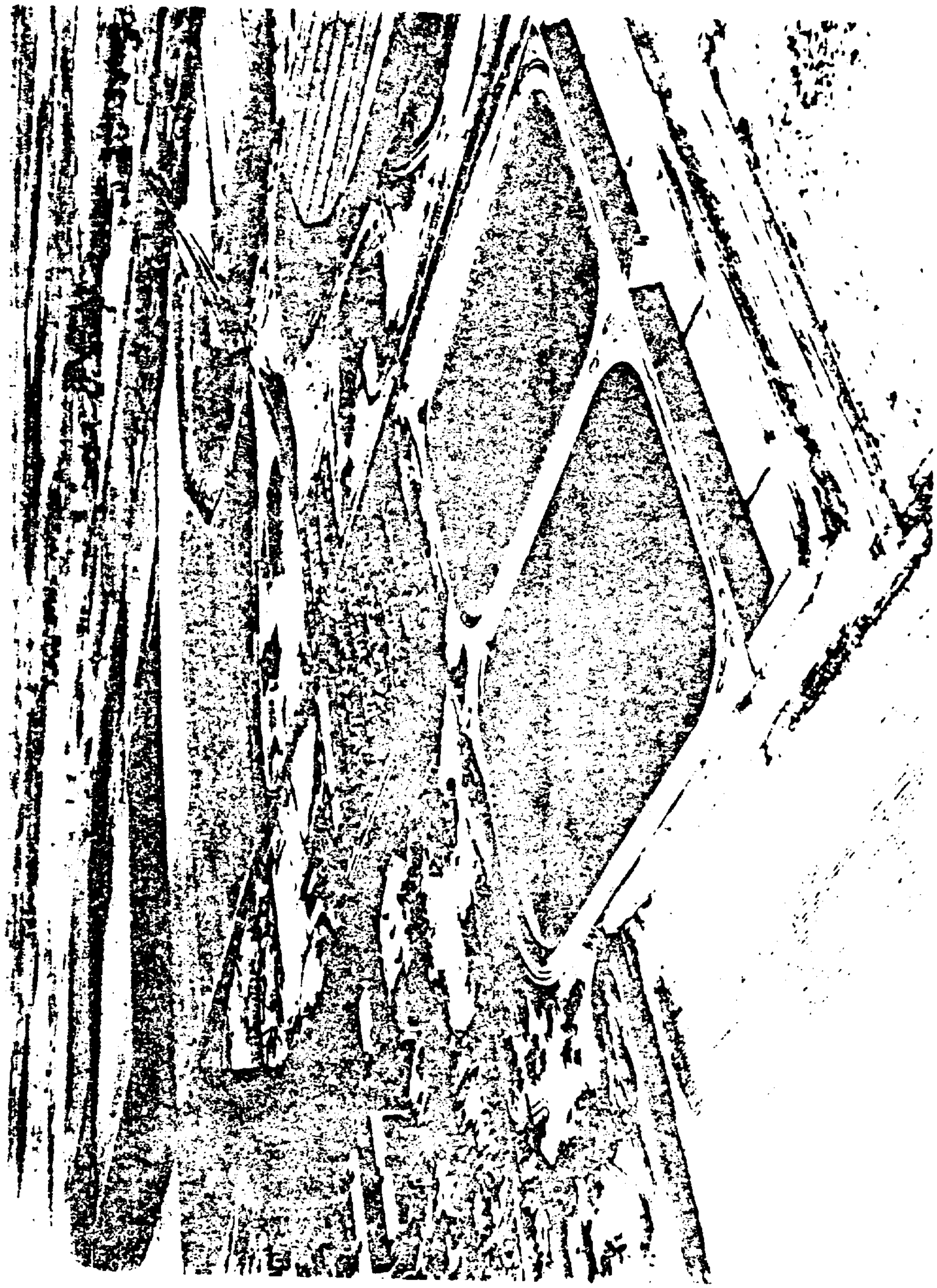

Figure III-10 – SETTLING BASINS AT STATION

5-day-operation, cooling tower water requirements. Water for the main cooling-tower makeup is pumped from the holding ponds to a basin beneath the 10-cell main cooling tower.

5. Circulating-Water System

Cooling water for the main condenser is circulated in a closed loop from the condenser to the cooling tower, where heat is removed, and back again to the condenser. The average system flow is 156,000 gpm; inlet- and outlet-water temperatures are 101.5° and 80°F, respectively. Average main cooling tower blowdown is 1800 gpm (maximum is 2300 gpm) and combined evaporation and drift is 2300 gpm. Therefore, the total average makeup-water requirement is 4100 gpm.

The average total flow in the service-water system is 10,500 gpm. The average rate of makeup for the service water cooling tower is 370 gpm to replace 265-gpm blowdown plus 105-gpm loss by evaporation and drift.

Both cooling towers will be chemically treated to control corrosion, acidity (pH), and biological fouling. A more detailed discussion of this subject appears in a following section.

6. Blowdown and Drainage

Blowdown is the water removed continually from the collection basins of the cooling towers; it will be removed to prevent buildup of dissolved solids in the cooling-tower water. Figure III-11 shows schematically the drainage paths for blowdown from the cooling towers. Blowdown will flow through the 42-in.-diam line to the diversion box where it will be directed to Goosequill Ditch which flows 8700 ft. to reach the 25-acre farm pond (figure III-5). Water will enter at the south end and flow out at the northwest corner. Total pond capacity is about 32 Mgal. Discharge will be made through the slough to St. Vrain Creek only because of abnormal circumstances.

Since average blowdown is about 3 Mgpd, holdup time in the pond will be about 10 days. Overflow from the farm pond travels about 2800 ft before entering the South Platte River. During all seasons, blowdown will mix in the irrigation ditches with irrigation water. Estimated blowdown quantities are:

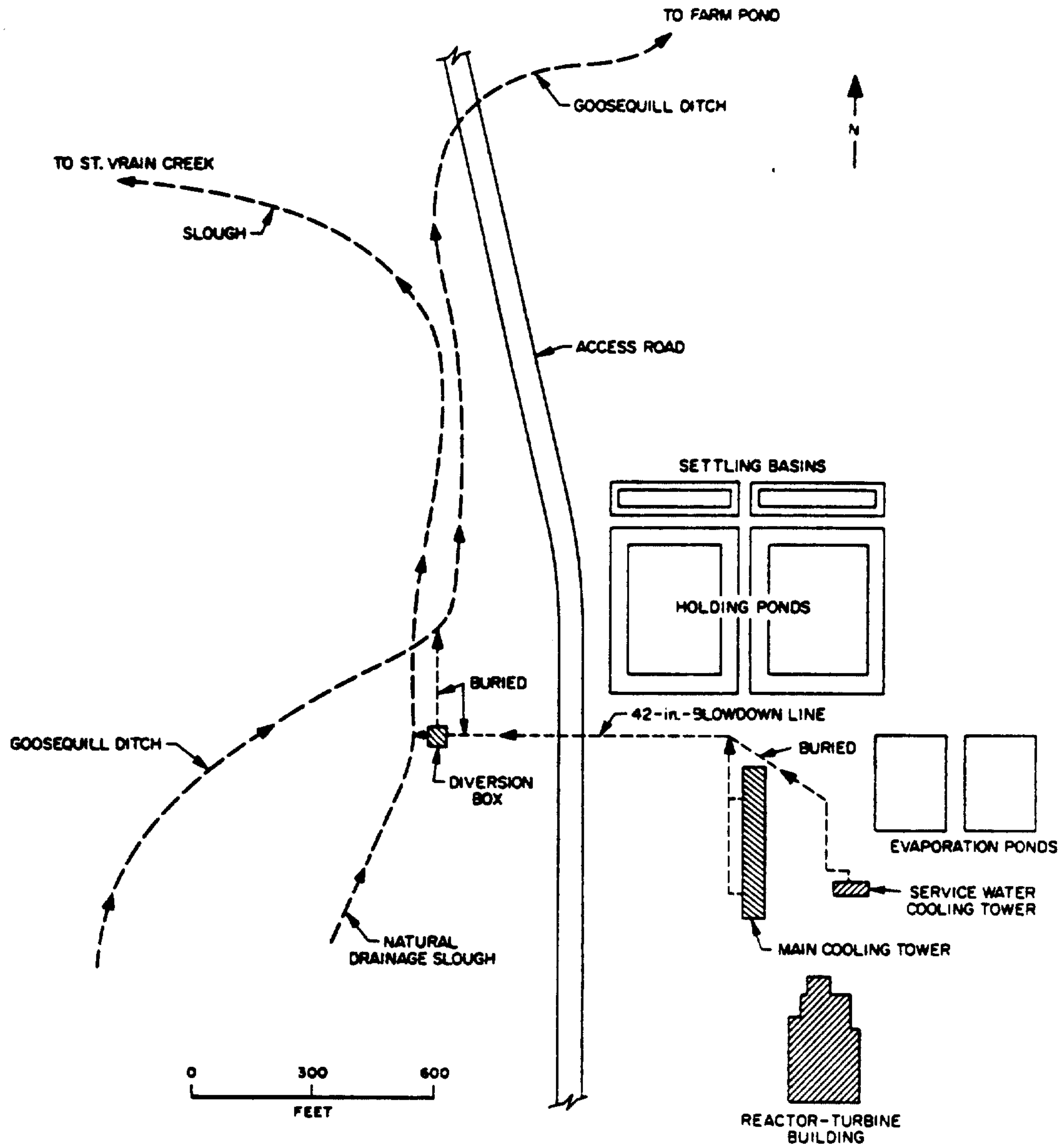

Figure III-11—DRAINAGE PATHS FOR BLOWDOWN FROM COOLING TOWERS

Tower		Blowdown (gpm) Average[a]	Maximum[b]
Service water		265	350
Main cooling		1800	2300
	Total	2065	2650

[a]Based on average annual temperature.

[b]Based on maximum summer temperature.

Maximum blowdown will occur on hot summer days, when temperatures of the streams are also the highest. The maximum temperature of the circulating water in the hot leg of the cooling tower will be 101.5°F. During midsummer, blowdown will be taken from the cold leg of the tower (where the temperature will be 80°F) at times when the discharge temperature to the streams would be greater than 80°F.

The cooling tower basins will be drained for cleaning about once a year during the spring or fall season. One settling basin, one holding pond, and the cooling-tower basin together would contain the largest quantity of liquid (about 12.5 Mgal) to be discharged at one time. This quantity may be pumped out at a rate of no more than 3.75 million gallons per day (about 6 cfs). This quantity is about 6% of the estimated flow for St. Vrain Creek during the spring or fall months.

7. Shutdown and Emergency Heat Dissipation

Although an emergency period resulting from losses of makeup water and the use of the cooling towers and basins may not occur during the lifetime of the Station, the two holding ponds' 20 Mgal of water could be used for once-through cooling of the reactor. This water supply could provide cooling for about 11 days by appropriate regulation of coolant flow.

3.E. RADIOACTIVE WASTES SYSTEMS*

The operation of the Station's gas-cooled nuclear reactor will result in the production of radioactive fission products. Most of these fission products will remain within the coated-fuel particles; however, small amounts may escape through the pyrolytic graphite coatings into the graphite structure of the fuel elements and diffuse into the primary helium coolant. In a gas-cooled reactor, very small amounts of radioactivity will also result from activation of impurities which may be circulating in the primary coolant. Radioactive materials (fission products and activated impurities) may be released under controlled conditions to the environment after appropriate treatment, sampling and analysis, dilution, and radiation-monitoring procedures.

The quantity of radioactivity that may be released to the environment during operation of the Station will be in accordance with the Commission's regulations as set forth in 10 CFR Part 20 and 10 CFR Part 50.

1. Gaseous Wastes

The gaseous waste treatment system is designed to collect, store, treat, and monitor radioactive gases which leave the prestressed concrete reactor vessel (PCRV) and secondary coolant systems.

Figure III-12 indicates the sources of radioactive gas and their processing before being released to the environs.

The principal source of high activity gaseous waste originates from the helium purification system. Small amounts of potentially contaminated gaseous waste also come from the sampling of the primary coolant, purging of fuel storage and handling systems, purging of the helium circulator handling-cask and from the PCRV support floor vent and liquid waste tank vent headers. Additional sources of effluent gases containing lower levels of radioactivity are the secondary system steam-jet air ejectors, the deaerator vent and the reheat steamline relief valves. The total radioactive releases from these additional sources is not expected to be a contributing source of activity.

Gas will enter the system through either of two headers. The low activity header will collect gases of sufficiently low activity

*The radioactive waste treatment systems incorporated in the Fort St. Vrain Nuclear Generating Station are described in detail in the Applicant's Final Safety Analysis Report (FSAR), and the Applicant's Environmental Report and Supplements.

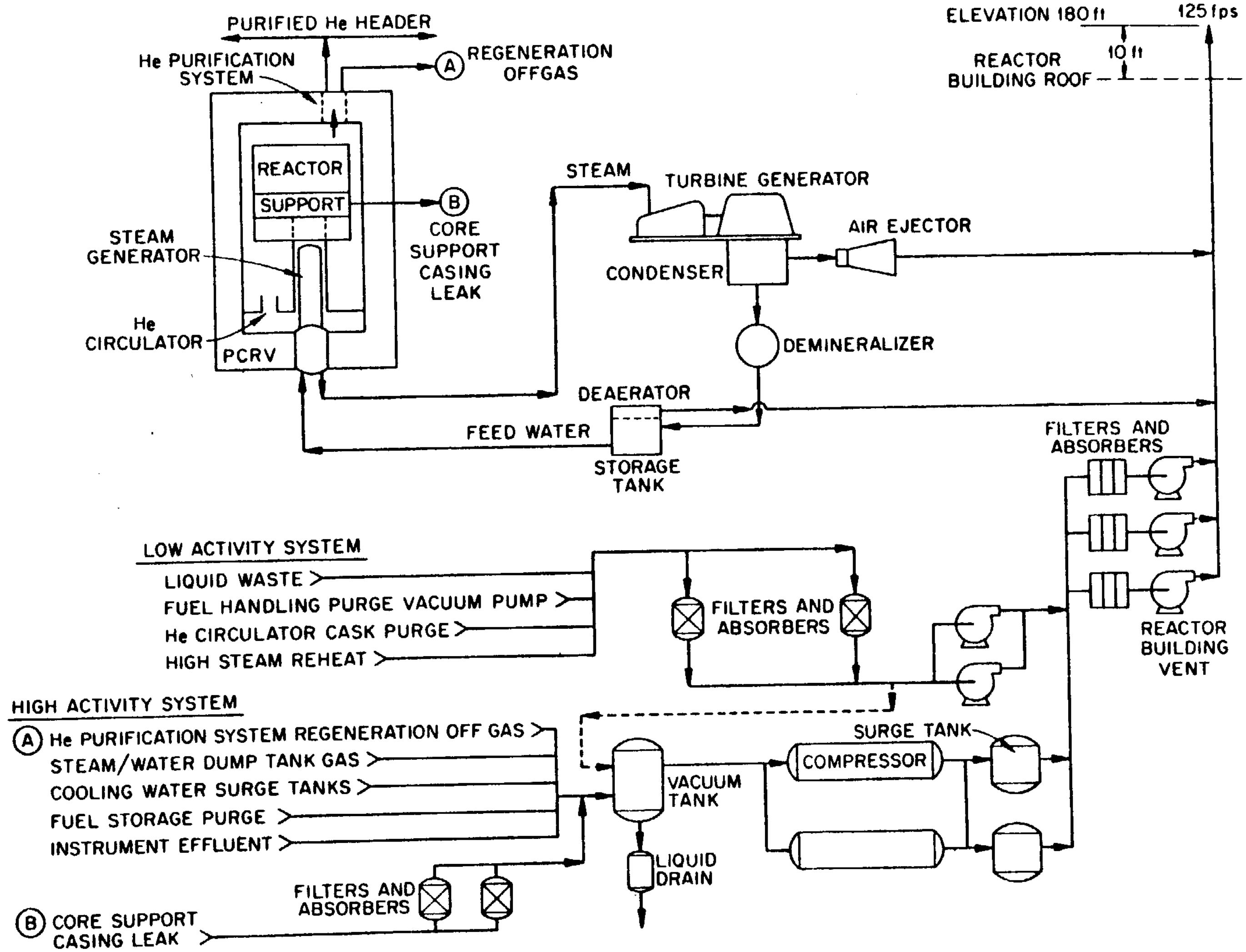

Figure III-12–STATION'S GASEOUS RADIOACTIVE WASTE SYSTEM

and flow rate that they can be discharged through the reactor building vent after passing through a prefilter, a high efficiency particulate filter (HEPA), and a charcoal adsorber. The high activity header will collect gases that are normally too radioactive to be released after treatment by filtration only.

The helium purification system consists of two complete gas processing trains. The purification system is used to remove fission products and chemical impurities from the primary coolant. One train will normally operate for 6 months and then shut down while the second train is put into operation. Each train consists of a high-temperature filter-adsorber to remove particulates and halogens (mostly iodines), a helium cooler, a dryer, a low-temperature adsorber, and a hydrogen getter unit (titanium sponge) which removes gaseous hydrogen and tritium.

The helium dryer and the low-temperature filter-adsorber are regenerated by passing hot helium through the unit, which strips the accumulated gases (including the radioactive ones) from the adsorber. These gases are collected in a 500-ft^3 "vacuum" tank, compressed, and stored in a 700-ft^3 "surge" tank at pressures up to 500 psi. Gases will be held in the surge tank for as long as practical and will be sampled and analyzed prior to controlled venting to the reactor building vent. The anticipated annual releases of radioactive material in the regeneration off-gases shown in table III-4 were based on a minimum holdup time of 60 days.

Before entering the reactor building vent, the effluent of both systems passes through HEPA filters and charcoal adsorbers. Activity monitors on the vent will ensure that the activity released does not exceed the specified limits. In addition, the activity of the low level system is monitored downstream of that system's filters. If the activity is above a predetermined level, the gas stream is diverted to the vacuum tank of the high activity system for further treatment. Certain tanks in the liquid radwaste system are also vented to the gaseous waste treatment system with the expected activity release being negligible.

The steam in the economizer and superheater sections of the steam generator is at a higher pressure (≈2500 psia) than the helium (≈693 psia), so any leakage will be essentially steam into the primary coolant (helium). However, the steam in the reheat section of the steam generator is at a lower pressure (≈649 psia max) so it is possible for radioactive primary coolant to enter the steam through

Table III-4—ANTICIPATED ANNUAL RELEASES OF RADIOACTIVE MATERIAL IN GASEOUS EFFLUENTS FROM STATION

Isotope	Reactor Bldg. Leak (Ci/yr)	Off-gas from Regeneration System (Ci/yr)	Air Ejector (Ci/yr)	Total (Ci/yr)
Kr-85	0.05	947	0.002	947
Kr-87	2.	-	1.2	3.2
Kr-88	11.	-	3.2	14.2
Xe-131m	0.04	4.8	0.002	4.8
Xe-133	12.	9.	0.6	21.6
Xe-135	2.4	-	0.2	2.6
Xe-138	0.01	-	0.03	0.04

leaks in this portion of the steam generator. Activity released from this source is expected to be negligible.

During the annual refueling operation, spent fuel is transported from the reactor to the fuel storage pits in special casks which are vented to the gaseous waste treatment system. The helium blanket maintained in the fuel storage pits is also vented to this system. Spent fuel shipping casks are vented to the treatment system while being loaded. The annual volume of gas involved in these operations is approximately one and a half times that of a normal regeneration of the low-temperature filter adsorbers, but the activity is only about 0.3% of a normal regeneration.

The vents of the surge tanks in the Station cooling water system used for process heat removal from auxiliary equipment are connected to the gaseous waste treatment system. This water might become slightly radioactive if leaks developed in the system (e.g., in the coolers of the helium purification system), but the activity discharge to the gaseous waste system is expected to be negligible.

Whenever it is necessary to remove a helium circulator from the reactor, is is transported in a cask which is purged with helium, the vent going to the low activity section of gaseous radwaste system. The activity released is expected to be negligible. All radioactive waste processing and storage will be performed inside the reactor building together with all irradiated fuel storage and fuel handling operations.

Although design provisions preclude the escape of gases containing radioactivity from any of these facilities, the reactor building exhaust system will collect, filter and monitor all airborne radioactivity originating from small leaks in components inside the reactor building prior to their release through the plant vent. Based on the design of the facility and experience at Philadelphia Electric's Peach Bottom Atomic Power Station (Docket No. 50-171), no airborne halogen or particulate activity is expected.

The Applicant is required by the facility Technical Specifications to manage the releases from the Station so that they occur only during favorable atmospheric dispersion conditions. The Applicant is also committed to operating the gaseous radioactive waste system such that annual releases will be in accordance with the Commission's regulations as set forth in 10 CFR Part 20 and 10 CFR Part 50.

Anticipated annual releases of radioactive material in gaseous waste shown in table III-4 were based on 1% failed fuel during the six year fuel cycle.

2. Liquid Wastes

The Station's gas-cooled reactor will not routinely generate significant quantities of liquid radioactive wastes. The largest volume, estimated by the Applicant at 3000 gal/year, will be produced by decontamination operations. Smaller quantities will accumulate in the regeneration section of the helium purification system. Additional radioactive liquid wastes may result from leaks in the PCRV (prestressed concrete reactor vessel) liner cooling system and from leaks in the steam generator feedwater system. The PCRV liner cooling water may contain neutron activation products from dissolved materials from corrosion. The steam generator feedwater system will contain small quantities of tritium diffused through the walls of the steam generators from the primary coolant; it may also contain small amounts of fission products resulting from leaks of the primary coolant (at 688 psia) into the reheat steam lines (640 psia).

In the event of the rupture of a steam generator tube, the contents of the affected steam generator would be discharged to the steam-water dump tank. The contents of the tank ($\sim$ 2,280 gal of potentially radioactive water) will be transferred to the liquid radioactive waste system for storage and disposal.

During the annual refueling operation, 6 of the 37 control rod drives will be replaced. The surfaces of these control rod drives will contain some adsorbed radionuclides. After removal from the reactor and storage to allow for radioactive decay, these control rod mechanisms will be decontaminated. Normally, the decontamination procedure will involve washing with water (or with water containing a detergent) to remove the loosely adherent material. The resulting waste water expected to total approximately 3000 gallons annually, will be transferred to the liquid radioactive waste treatment system (figure III-13) for processing before it is released to the environment.

In some instances, the use of decontamination solutions containing a chelating agent might be necessary to adequately decontaminate a control rod drive. In that situation, the used decontamination solution will be recycled as long as is practicable and then put in drums and disposed of as solid waste.

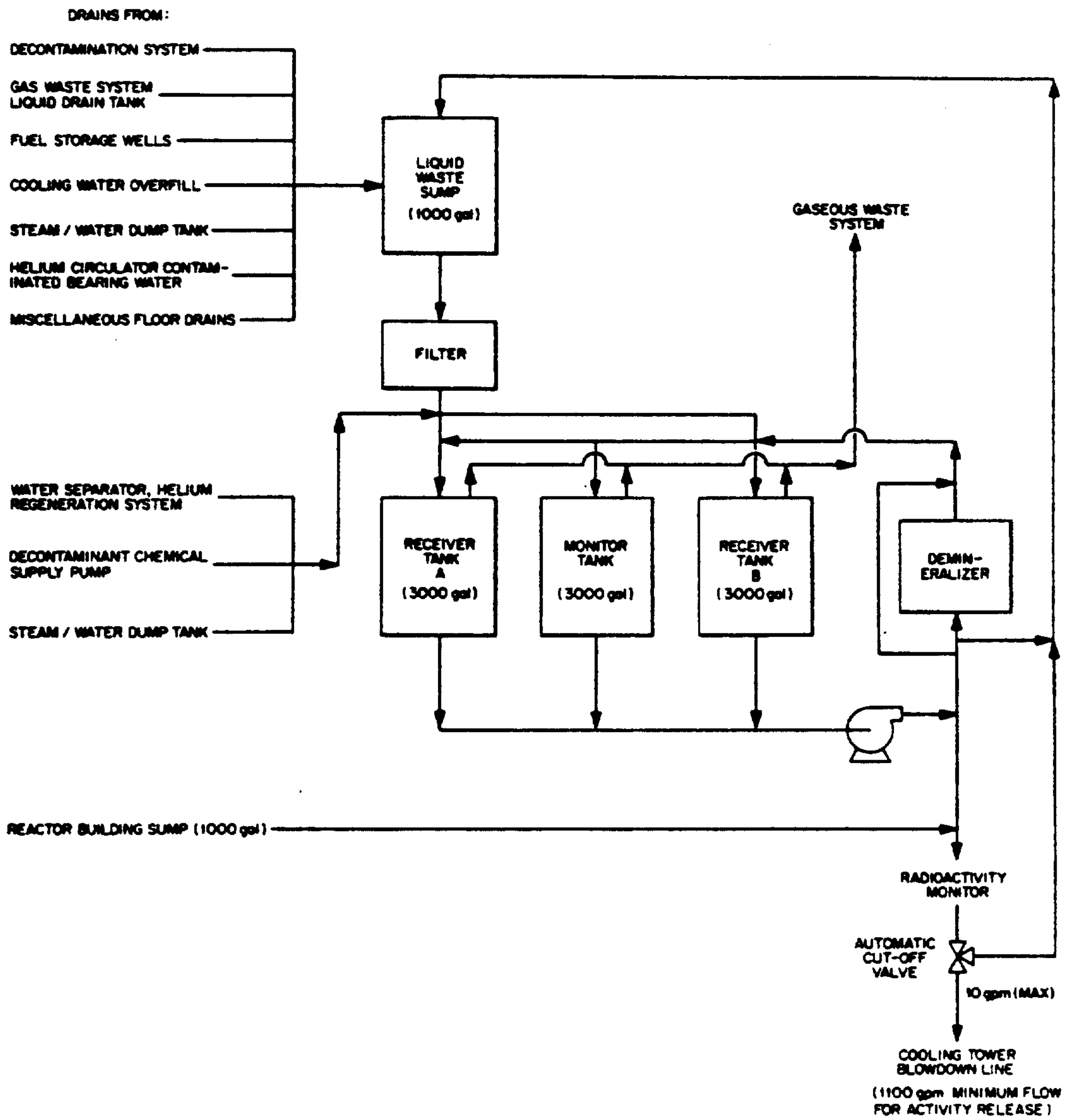

Figure III-13—STATION'S LIQUID RADIOACTIVE WASTE SYSTEM

Although the decontamination system was designed primarily to handle control rod drives, other pieces of equipment may need to be decontaminated in this facility. Additional liquid radioactive waste may also be produced if decontamination of fuel storage wells is necessary. The activity of the waste generated by these operations is expected to be much lower than that arising from control rod drive decontamination.

In attempting to estimate the relative radioactivities of fission products which may plateout on the control rod drives, several assumptions were made. It was assumed that all fission products which could escape from the fuel elements would escape at the same rate. It was further assumed that these fission products in the helium coolant would all plate out on the control rod drive at the same rate. Thus, over the 6-year period that a control rod drive would be in the reactor, the amounts of fission products plated out on the control rod drive would be proportional to the amounts formed within the fuel during its 6-year cycle in the reactor. Since the control rod drives will be stored for 270 days to allow radioactive decay to occur, this decay period will greatly reduce the number of isotopes present in significant amounts on the control rod drives.

The water separator in the helium regeneration system will collect the water from the helium purification train being regenerated. Under normal operations, only small quantities are expected to be collected. The purification train is expected to be regenerated every six months. Very little activity is expected to be associated with this liquid.

Activation of the carbon steel tubes carrying PCRV cooling water may lead to small quantities of ^{14}C, ^{55}Fe, and ^{59}Fe in this water. Activated metallic corrosion products will be removed by a filter-demineralizer combination in a by-pass stream and subsequently disposed of as solid waste. If ^{14}C is present as the carbonate ion, it also may be removed and disposed of by this system.

Fission products may enter the steam in the reheater tubes if leaks develop in the wall separating the primary coolant (at 688 psia) from the reheat steam (at 640 psia). Such leaks are detected by radiation monitors on the hot reheat steam discharge line on each loop; these monitors trip isolation valves that limit the instantaneous release to about 20 Ci as gases and soluble materials or solids. The solids and ionic impurities could subsequently be removed from the steam generator feedwater by the full-flow polishing demineralizers. Thus, any significant radioactivity from this source will be disposed of as solid waste.

Another radionuclide that will enter the steam generator feedwater system is tritium, which is produced in small quantities in the primary coolant by the neutron activation of ^{3}He. Some tritium will diffuse through the steam generator walls into the steam generator feedwater system. Any tritium would ultimately be disposed of as leakage from this steam generator feedwater system. If any leakage contained significant tritium activity, it could be disposed of via the cooling tower blowdown line, averaging 2068 gpm.

The main potential sources of liquid radioactive wastes are shown in figure III-13. Some sources drain directly to one of the two receiver tanks, while others are routed first to the liquid waste sump. Decontamination solutions (the primary source of liquid radwaste) are collected at the bottom of the decontamination pit and then pumped through a filter before entering the liquid waste sump. All liquids transferred from the liquid waste sump to a receiver tank are filtered by one of two filters. When sufficient liquid has been collected in a receiver tank, its contents are recirculated, sampled and analyzed for radioactivity. If the activity of these samples does not exceed 2×10^{-6} µCi/ml, the liquid waste will be pumped to the cooling tower blowdown line for dilution and discharge from the plant site. The maximum pump discharge rate is 10 gpm. An alarm terminates the release if the blowdown line flow drops below 1100 gpm. Redundant radioactivity monitors are also incorporated in the discharge line to automatically terminate a release if a preset activity level is exceeded.

If the activity of the liquid in a receiver tank exceeds 2×10^{-6} µCi/ml, the liquid will be pumped through one of two demineralizers to the monitor tank or to the other receiver tank. The liquid is then mixed thoroughly by recycling, analyzed, and either released or passed through the demineralizer again, or passed through the alternate demineralizer.

Liquid waste which collects in the reactor building sump will also be discharged through the liquid waste discharge system. Although this liquid will not normally contain activity, unexpected leaks may cause it to become radioactive. Samples of this liquid will be analyzed before discharge. Routing this discharge through the radioactivity monitors and the associated automatic cutoff valve also ensures that excessive radioactivity will not inadvertently be released from the Station.

Since the various ions are removed to varying degrees by the demineralizers, the relative amounts of the nuclides present will change during the treatment process. Table III-5 presents the anticipated amount of radioactivity in liquids to be discharged from the Station, assuming one pass through a demineralizer with decontamination factors of 1000 for all elements except cesium and yttrium, for which factors of 10 and 1, respectively, were estimated.

The average flow in the blowdown line is expected to be 2068 gpm. The applicable 10 CFR 20 limit of 1×10^{-7} µCi/ml in liquid discharges to an unrestricted area sets an upper limit of 0.41 Ci/yr that can be released from the Station. However, the Technical Specifications require that the activity of the liquid to be discharged must be less than 2×10^{-6} µCi/ml. Since the maximum discharge rate of radioactive liquid is 10 gpm, this would give an average dilution factor of 200. The discharge of liquid radioactive waste is not expected to be continuous throughout the year. The activity released will be less than 0.041 Ci/yr.

Based on the Applicant's estimate and assuming a total volume of 8000 gallons of decontamination solution per year arising from cleaning the control rod systems and one helium circulator, the expected annual release of radioactivity would be as shown in table III-5.

The Applicant has provided (Amendment 18, FSAR) a change in the design of the waste discharge system so that blowdown flow enters a flow diversion box where it can be directed via a concrete-lined canal to the Station's farm pond and then into the South Platte River or via a slough into St. Vrain Creek. The normal discharge will be through the farm pond. Discharge will be made through the slough to St. Vrain Creek only because of abnormal circumstances.

Table III-5—ANTICIPATED ANNUAL RELEASES OF RADIOACTIVE MATERIAL IN LIQUID EFFLUENTS FROM STATION

Isotope	Ci/yr
Sr-89	0.000021
Sr-90	0.00013
Y-90	0.00013
Y-91	0.032
Zr-95	0.000005
Nb-95	0.000010
Sb-125	0.000002
Te-125m	0.000032
Te-127m	0.000031
Te-129m	0.000031
Te-129	0.000004
Cs-134	0.0028
Cs-137	0.0028
Ba-137m	0.0028
Ce-144	0.000003
Pr-144	0.000003
Eu-154	0.000006
Eu-155	0.000005
Total	~ 0.04

3. Solid Wastes

Solid radioactive waste will normally be spent demineralizer resin cartridges from the liquid waste system; contaminated filter and strainer elements; tritiated titanium sponge; contaminated refuse, such as rags and paper; and contaminated disposable paper clothing. These wastes will be collected, packaged, and temporarily stored in a designated area until there is sufficient quantity to justify a shipment. Because the Station normally produces only small quantities of radioactive solid wastes at relatively low levels of activity, a special solid waste handling system has not been provided. Unexpected radioactive solid wastes at high levels of activity will be handled in the hot cell facility.

The radioactive filter and demineralizer cartridges will be replaced and packaged in suitable shipping containers. All containers used for the transport of solid wastes will meet the specifications of the Department of Transportation and the Atomic Energy Commission. Shipment will be made in accordance with Department of Transportation regulations to an AEC-licensed burial ground. The Applicant has estimated the amount of low-level solid radioactive waste to be 400 ft^3/yr resulting in only one shipment per year from the Station.

F. CHEMICAL AND SANITARY WASTES SYSTEMS

The primary nonradioactive chemical wastes from the Station will be those produced by demineralizer regeneration and by additions to the water circulating from the condensers to the cooling towers. Table III-6 lists the expected chemicals, their use, annual consumption, discharge procedure, concentration in the discharge liquid, and the stream receiving the discharged liquid. Normally, the main cooling-tower blowdown, the service-water cooling-tower blowdown, and the sewage-treatment effluent will be discharged via Goosequill Ditch to the South Platte River. It will be diverted to St. Vrain Creek via the slough only because of abnormal circumstances. Figure III-14 shows schematically the origin and pathways for the various nonradioactive liquid effluents. Figure III-15 presents a schematic representation of the water balance for the Station. This figure also indicates the various interconnections between the systems and the losses from the cooling tower by evaporation and drift.

1. Demineralizer Regeneration Effluents

Two demineralizer resins used at the Station are regenerated. Both demineralizer systems are dual units (one operating, one on standby),

Table III-6–ESTIMATED LIQUID DISCHARGES OF STATION'S NONRADIOACTIVE CHEMICAL WASTES

Chemical	Use	Annual consumption, (lb/year)	Discharge procedure	Concentration in discharge liquid (ppm)	Receiving stream for discharged liquid
H_2SO_4 (93%)	Demineralizer regeneration	20,930	Batch (100 gpm max)	5780 SO_4^{2-} (max)	Evaporation ponds
NaOH	Demineralizer regeneration	12,500	Batch (100 gpm max)	1880 Na^+ (max)	Evaporation ponds
H_2SO_4 (93%)	Cooling tower pH control				
	Main Service	3,358,000 153,300	Continuous	347 SO_4^{2-} 114 SO_4^{2-}	S. Platte River[d]
Nalco 347[a]	Cooling tower corrosion inhibitor				
	Main Service	109,500 5,293	Continuous	12.4 4.3	S. Platte River[d]
Chlorine	Cooling tower biocide	69,400	Several times per day	1 (max)	S. Platte River[d]
Nalco 321[b]	Cooling tower biocide				
	Main Service	5,666 432	Monthly	50 (max)	S. Platte River[d]
Nalco 71-D5[c]	Cooling tower anti-foaming agent used with Nalco 321				
	Main Service	567 43	Monthly	5 (max)	S. Platte River[d]
Ammonia	Condensate feedwater pH control	4,088	Batch (accumulated leakage)	0.8 (max)	Evaporation ponds
Hydrazine	Condensate feedwater hydrogen control	1,300	Chemically used up; not discharged		
NH_4OH	PCRV cooling water pH control	3	Intermittent	100 (max)	S. Platte River[d]
NaOCl	Sewage treatment	80	Continuous	1.5 (max)	S. Platte River[d]
Na_2SO_3	Chlorine removal from domestic water supply	10	Intermittent (as needed)	SO_4^{2-} reaction product, probably removed by demineralizer	St. Vrain Creek and S. Platte River
Detergent	Floor cleaning, etc.	420	Intermittent		St. Vrain Creek and S. Platte River

[a]Nalco Chemical Company, phosphated, ethoxylated glycerine.
[b]20% 1-alkyl (C_6-C_{18}) amino-3-aminopropane monoacetate; 30% isopropanol; 50% inert (water + nonionic detergent).
[c]Fatty acid–polyglycol.
[d]An alternate is St. Vrain Creek.

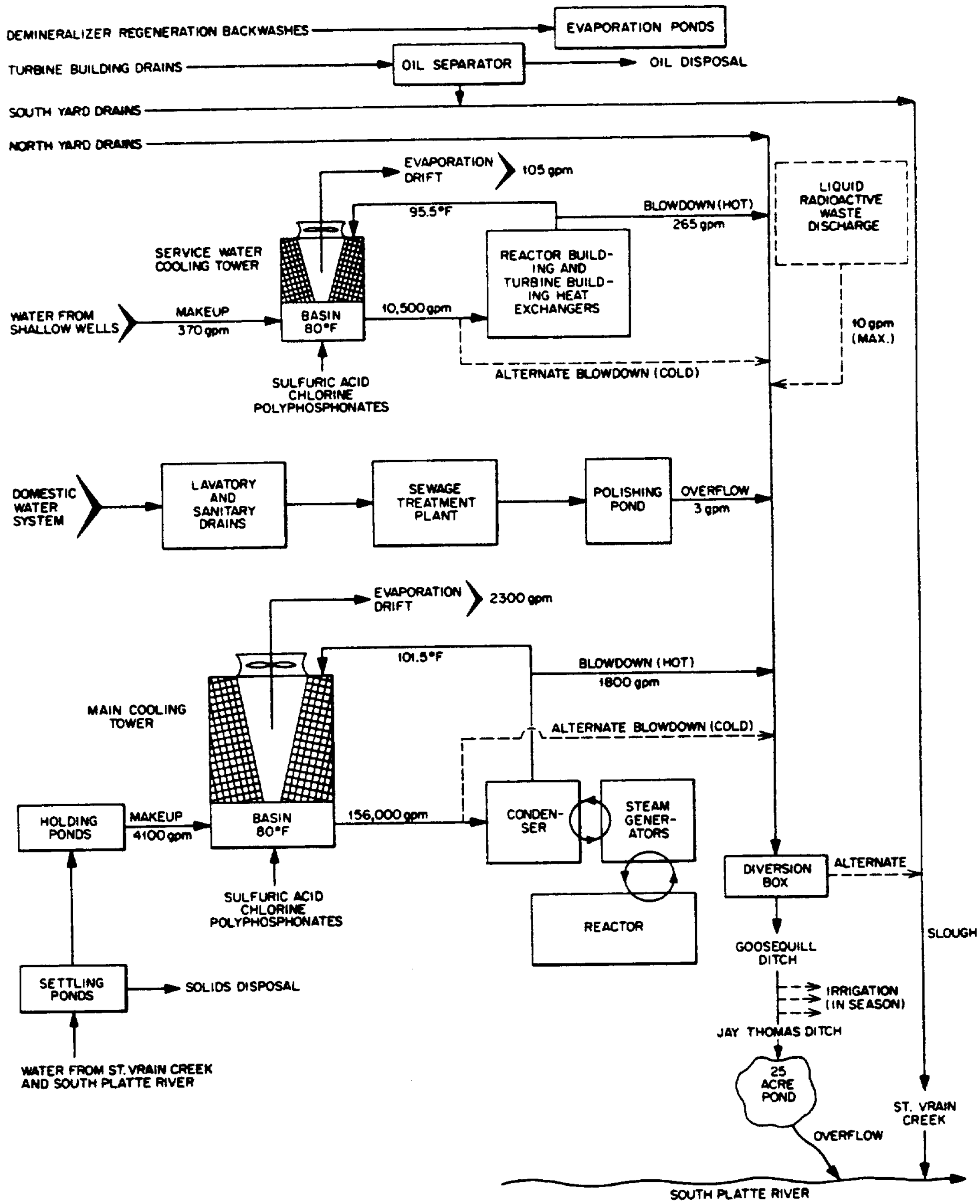

Figure III-14—STATION'S NONRADIOACTIVE LIQUID WASTE SYSTEM

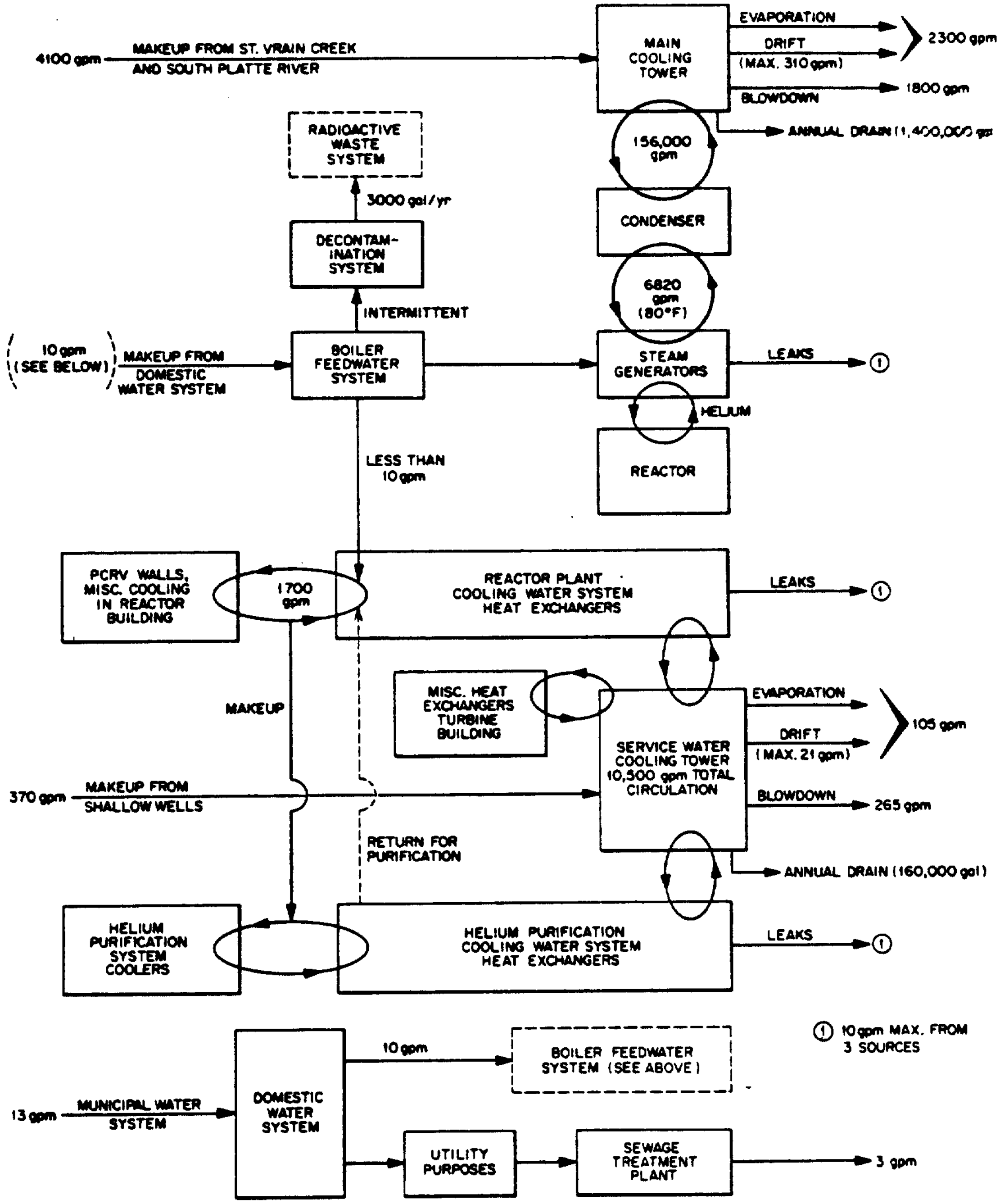

Figure III-15—STATION'S WATER BALANCE (ANNUAL AVERAGE USE)

C-6 C-18

C6-C18

so that one unit can be regenerated while the other remains in service. The steam-generator-condensate demineralizers are regenerated monthly; this operation results in a total backwash of 20,000 gal/month. The demineralizers that treat the makeup to the steam-generator-feedwater system are normally regenerated weekly. The resulting backwash effluent, about 29,600 gal/month, is transferred to a neutralizing tank, where pH is adjusted to 6.5 to 7.5. The effluent is then discharged to two lined evaporation ponds with a total surface area of about 1.5 acres located a few hundred feet northeast of the reactor building. The ponds are large enough so that accumulation of salts is not expected to be a problem, but waste could be disposed of by burial on site if necessary.

2. Cooling-Tower Blowdown

The two cooling towers are similar in design and operation, differing mainly in size and in source of their makeup water. The concentrations of impurities in water from these sources are given in table II-2. Additional values have been estimated based on data for similar wells in the Prospect Valley (table III-7, ref. 2). Each tower requires additives to control the pH (acidity from sulfuric acid), to inhibit corrosion (Nalco 345, a phosphated ethoxylated glycerine), to reduce algae formation [chlorine and Nalco 321, a 20% solution of 1-alkyl (C_6-C_{18}) amino-3-aminopropane monoacetate in an isopropanol-water-detergent solution], and to prevent foaming (Nalco 71-D5, a fatty acid polyglycol). Table III-7 summarizes the concentrations of the important constituents from the cooling-tower blowdown, along with the sewage-treatment-system effluent (which becomes part of the same blowdown stream), and the average combined effluent composition. Discharge concentrations after dilution in the average stream flow of South Platte River are given; the average concentrations of these constituents in the South Platte River are also shown.

Of the chemicals used in the cooling towers, sulfuric acid and Nalco 345 will be added continuously. The Applicant will bring free chlorine in the cooling-tower circulating water up to a 1-ppm concentration periodically to prevent growth of microorganisms.[3] Nalco 321 and 71-D5 will be added about once a month to increase periodically the effectiveness of chlorine as a biocide. The maximum concentrations of Nalco 321 and of Nalco 71-D5 in the cooling-tower

Table III-7—ESTIMATED AVERAGE COMPOSITION (PPM EXCEPT AS NOTED) OF BLOWDOWN WATER FROM COOLING TOWERS

	Main cooling tower		Service water cooling tower		Combined blowdown stream (2065 gpm)	Utility water and sanitary treatment effluent		Average effluent composition (2068 gpm)	After dilution in South Platte River (145,000 gpm[e])	Average South Platte River composition[f] (145,000 gpm[e])
	Makeup[a] (4100 gpm)	Blowdown (1800 gpm)	Makeup[b] (370 gpm)	Blowdown (265 gpm)		Makeup[c] (3 gpm)	Effluent[d] (3 gpm)			
Chemical constituents originally present										
SiO_2	11.6	22.5			20			20	0.28	14.4
Fe	0.10	0.19	0.1[g]	0.13	0.18	8	8	0.18	0.0025	0.17
Ca	95	185	126.5	164	182	16.7	16.7	182	2.56	75
Mg	52	101	31	40	93	8	8	93	1.31	0.018
Na	120	233	82	106	217	6	6	217	3.05	104
K	6.2	12.0	6[g]	7.8	11.4			11	0.15	7.7
Zn			0.044	0.057	0.0073	0.041	0.041	0.0073	0.00010	0.045
SO_4^{2-}	390	1089	100	241	980	1.0	1.0	980	13.78	164
Cl^-	56	109	69	89	106	9	9	106	1.49	85
F^-	1.3	2.5			2.2			2.2	0.031	1.3
NH_3			0.72	0.93	0.12	0.76	0.76	0.12	0.0017	
NO_3^-	8.4	16.3	44	57	22	2.1	2.1	22	0.31	7.4
B	0.30	0.58			0.51			0.51	0.0072	0.32
P			0.20	0.26	0.03	0.13	0.13	0.03	0.00042	
Total alkalinity, bicarbonate	286	556	264	342	530	46	46	530	7.45	257
Dissolved solids	932	2154	810	1164	2030	71	71	2030	28.54	621
Hardness as $CaCO_3$	458	890	445 (total)	576	850	50	50	850	11.95	362
Hardness, noncarbonate	222	431								127
Sodium adsorption ratio	2.5									3.4
pH	7.45	8.0	7.3	8.0	8.0	7.5–8.5		8.0		7.4
Specific conductivity, micromhos	1250									1300
Chemical constituents introduced as additives										
Free Cl		1 (max)		1 (max)	1 (max)		1.5 (max)	1 (max)[h]	0.015 (max)[h]	
Nalco 345		12		4.2	11.0			11.0	0.15	
Nalco 321		50 (max)		50 (max)	50 (max)			50 (max)	0.70 (max)	
Nalco 71-DS		5 (max)		5 (max)	5 (max)			5 (max)	0.07 (max)	

[a]Averaged from Tables 4 and 5, *Applicant's Environmental Report*[6] (50–50 mixture from St. Vrain Creek and South Platte River).
[b]Shallow well water, data from letter of C. K. Millen, Public Service Company of Colorado to L. F. Otto, U.S. Army Corps of Engineers, Omaha District, Sept. 28, 1971.
[c]Domestic water supply data from same source as (*b*).
[d]Effluent composition same as makeup, except for free Cl.
[e]Annual average flow from Table 2, *Applicant's Environmental Report.*[6]
[f]Included for comparison; from Table 4, *Applicant's Environmental Report.*[6]
[g]Ref. 2

[h]Includes chlorine from sanitary waste system (<2 ppb).

water will be 50 and 5 ppm, respectively. The concentrations of these two intermittently added chemicals in the blowdown stream will periodically be a maximum, after which they will gradually be reduced to nearly zero by the continuing blowdown and drift discharge and by the accompanying addition of makeup water.

3. Cooling-Tower Drift

Drift (droplets that escape from cooling towers) is of concern because it can carry dissolved solids to the environment. Drift from the Station's cooling towers is guaranteed by the manufacturer of the tower to be no more than 0.2% of the circulating flow. Therefore, a maximum of 310 gpm may be expected from the main cooling tower, and 21 gpm from the service-water cooling tower. If the composition of the drift is the same as that of the blowdown (table III-7), the maximum quantity of solids that will accumulate on the Applicant's land as a result of drift, will be 1462 and 53 tons/year from the main and service cooling towers, respectively.

4. Sanitary-Waste-System Effluent

Sanitary and sink drains are combined and treated in a package sewage aeration plant. The final stage of treatment involves chlorination by the addition of NaOCl and passage of the effluent through a polishing oxidation pond. The effluent from this pond (3 gpm, average) will be combined with the blowdown from the cooling towers and discharged from the Station (table III-7).

5. Miscellaneous Liquid Effluents

Detergents will be used in normal amounts for the usual floor cleaning and utility purposes. Sodium sulfite may be used in small quantities to remove chlorine (if present) from the domestic water supply that goes to the steam-generator-feedwater system. The amount of sodium sulfite to be used will be small, and the resulting effluent will contain Na_2SO_4 and NaCl from the chlorine-sulfite reaction. Ammonia (for pH control) and hydrazine (for oxygen control) will be added to the steam-generator-feedwater system. Hydrazine will normally be used up chemically (to form N_2 and H_2O), whereas ammonia will be present in very small amounts, in the plant discharges as a result of leaks. Ammonium hydroxide will be used in small quantities to control the pH of the PCRV cooling water. Only as a result of leaks, will it too appear in the discharge.

G. OTHER WASTES SYSTEMS

A 1400-gal oil separator positioned in the drain line from the turbine building (figure III-11) is not expected to accumulate significant quantities of oil; consequently, it should not need to be emptied for several years. When oil disposal is required, pickup service is available for trucking it to a refinery for reclamation.

Nonradioactive solid wastes (e.g., trash, shop debris, garbage) will be disposed of by a local trash-removal company. Although most nearby disposal sites are of the open-dump type, some are sanitary landfills. The State of Colorado is encouraging the development of sanitary landfills in place of open dumps.

Other solid wastes (mostly silt) will accumulate in the bottom of the settling pond. They will be removed by means of a drag line and will be spread over portions of the farmland at the site, presumably thereby improving the soil at the site.

Small debris that collects on the traveling screens of the Station's water intake structures will be flushed off them by hydraulic sprays and discharged back to the South Platte River or St. Vrain Creek. The flow of these two streams and the design of the intake structures prevents large debris from accumulating at the trash racks where the intake structures remove water from these streams.

Nonradioactive air pollution is minimized by use of low-sulphur No. 2 fuel oil (535,000 gal/yr) for the Station's auxiliary boiler which has a capacity of 45,000 pounds of steam per hour. Although four diesel engines are used as emergency power sources, they are started up only once a week to ensure their reliability. In any case, the distance between the diesel engines and the nearest residence is about half a mile, more than sufficient to render their emissions innocuous.

IV. ENVIRONMENTAL IMPACTS OF SITE PREPARATION AND PLANT CONSTRUCTION

A. IMPACTS ON ENVIRONMENT

Both short- and long-term impacts resulted from the site preparation and construction of the Station. Since the construction is about 99% complete (figure IV-1), the short-term impacts have already been spent; thus, the long-term impacts are those that now require greatest consideration.

1. Area Involved

Of the 2238 acres in the Station's site, 640 acres is within the exclusion area. About 80 acres of the exclusion area is devoted to Station structures and grounds and therefore is removed from future agricultural use. Only 10 acres of the site is specifically devoted to buildings. The 80 acres of the immediate plant site is the least suitable land for agriculture; the remaining 2158 acres will become a carefully managed agricultural operation.

2. Manpower Effects

Peak periods of construction-manpower usage are past for the Station. A steadily decreasing construction force will be involved for a few months. The employment of the operating force of about 65 people will be a continuing effect on manpower. These people have, for the most part, already established their residences in the several surrounding communities. This small number of people distributed among several communities will have no noticeable impact.

The manpower already spent (about 20,000 man-years) in the planning, construction, and training for operation of this Station constitutes an investment that can bring reasonable returns only if the Station operates as planned.

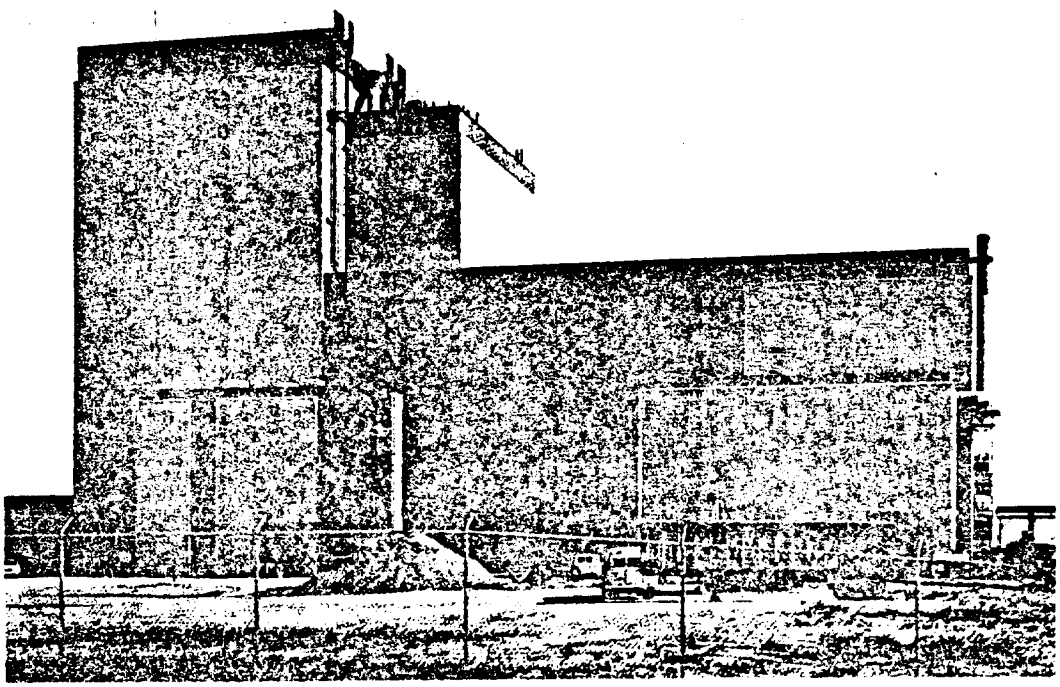

Figure IV-1 – FORT ST. VRAIN NUCLEAR GENERATING STATION IN LATE STAGES OF CONSTRUCTION

3. Land

The construction site originally was cleared farm and pasture land; therefore, little additional clearing of the natural vegetation was necessary. The land along the river which has some natural vegetation and provides habitat for wildlife was not disturbed during construction. The greatest land impact was the diversion of about 30 acres of pasture and agricultural land to construction use.

To reach bedrock during construction, large amounts of sand and gravel were excavated at the building site. The excavated material was used to increase the height of the construction site about 5 ft.

The 10 miles of transmission lines directly associated with the Station will have little adverse effect on the terrestrial environment. An estimated 0.15 acre per mile of transmission line will be occupied by towers. Only a small amount of natural vegetation had to be cleared when the transmission lines were erected. Except for the area occupied by the bases of the poles and towers, the rights-of-way will continue to be used by the lessees or owners.

The site preparation and Station construction had no impact on Fort Vasquez.

4. Water

Construction of the Station had no effect on the potable water in the area since the streams and wells involved are not used for drinking purposes.

A sheet-piling dam was constructed on St. Vrain Creek to divert water into a settling pond (figures III-6 and III-7). Undoubtedly, some disturbance was caused in the stream, but the impact was probably negligible.

The man-made farm pond (about 25 acres) was drained so it could be enlarged during the construction period.

5. Life Systems

The 80-acre Station area and the areas occupied by the bases of transmission-line towers and poles are now lost to animals and birds that might have inhabited these areas. Since a large amount of similar habitat exists on the site, little adverse impact would be anticipated on the local mammal and bird populations. The undisturbed area along the South Platte River, where most of the wildlife is found, will continue to provide good habitat. This land affords good waterfowl hunting; however, the Applicant has no specific plans for opening it to public hunting or setting it aside as a wildlife preserve. Most land along the river in this area is privately owned and is not open to public hunting.

Drainage of the farm pond effectively eliminated all the aquatic biota in the pond. The pond has since refilled and now has a great diversity of bottom organisms.

B. CONTROLS TO REDUCE OR LIMIT CONSTRUCTION EFFECTS

Excavated material taken from the large holding ponds was used to extend the side of a small valley located northwest of the Station (hardly obvious in Fig. III-10; see at the right across the road from the parking lot and above the settling basins); this material is available for other construction purposes. The water quality of the South Platte River and St. Vrain Creek was not affected by these excavated materials, since the construction area is some distance from both the streams. The Applicant has considered the possibility of future erosion of the material after its use for construction has ended. Techniques such as contouring and planting with grass could be used to help stabilize the material if this should become necessary.

Waste solutions from cleaning metal pipes during construction were accumulated in a polyethylene-lined pond (figure IV-2) and allowed to evaporate to avoid chemical contamination of groundwater. If it should become necessary to remove salt from the pond, particular attention would be given to disposal of this waste; it is expected that the waste would be buried.

On completion of construction, the Applicant will landscape the area inside the Station fence.

Figure IV-2 — PREVENTION OF GROUNDWATER CONTAMINATION BY ACID WASTES PRODUCED DURING STATION CONSTRUCTION

V. ENVIRONMENTAL IMPACTS OF PLANT OPERATION

A. LAND USE

Those long-term impacts on the land that resulted from site preparation and Station construction would extend through the period of operation of the Station; the only new impact derived from Station operation would be the accumulation of about 1500 tons of solids per year spread over Applicant's land as a result of drift from the Station's cooling towers. Although this amount may seem large, drift from larger cooling towers such as the one at the Applicant's coal-fired Cherokee Station (figure V-1) has resulted in no observable change in terrestrial ecology at the Cherokee Station site nor have damage or claims for damage ever been made for vehicles parked and operated around the cooling towers. In any case, because of the prevailing northerly winds, nearly all deposits from the drift will occur on the Applicant's land.

B. WATER USE

The hydrosphere in the vicinity of the Station will be subject primarily to thermal, chemical, and quantitative impacts. Such impacts as fog formation (which also involves the atmosphere) and sediment transport will be of no consequence.

1. Thermal impact

A maximum of 2650 gpm of blowdown water at a maximum temperature of 101.5°F could be released to the environment from the Station. The heated water would be released to the South Platte River via Goosequill Ditch and the farm pond (figure III-11). Release will be made through a natural drainage slough to St. Vrain Creek only because of abnormal circumstances.

The Applicant has calculated the increase in the water temperature of St. Vrain Creek that can be expected to result from the discharge of 101.5°F effluents from the Station.[1] For the calculations, adverse circumstances were assumed, i.e., maximum stream temperature (about 80°F) and low stream flow. The calculated increases were 2.05°F (summer) and 4.32°F (winter, low-flow). These calculations, verified by the regulatory staff, are conservative estimates based on the assumption that the effluent is discharged directly into the creek.

Calculations were also made of the estimated temperature decrease of the heated water if it should flow through Goosequill Ditch and the farm pond to the South Platte River and also if it should pass

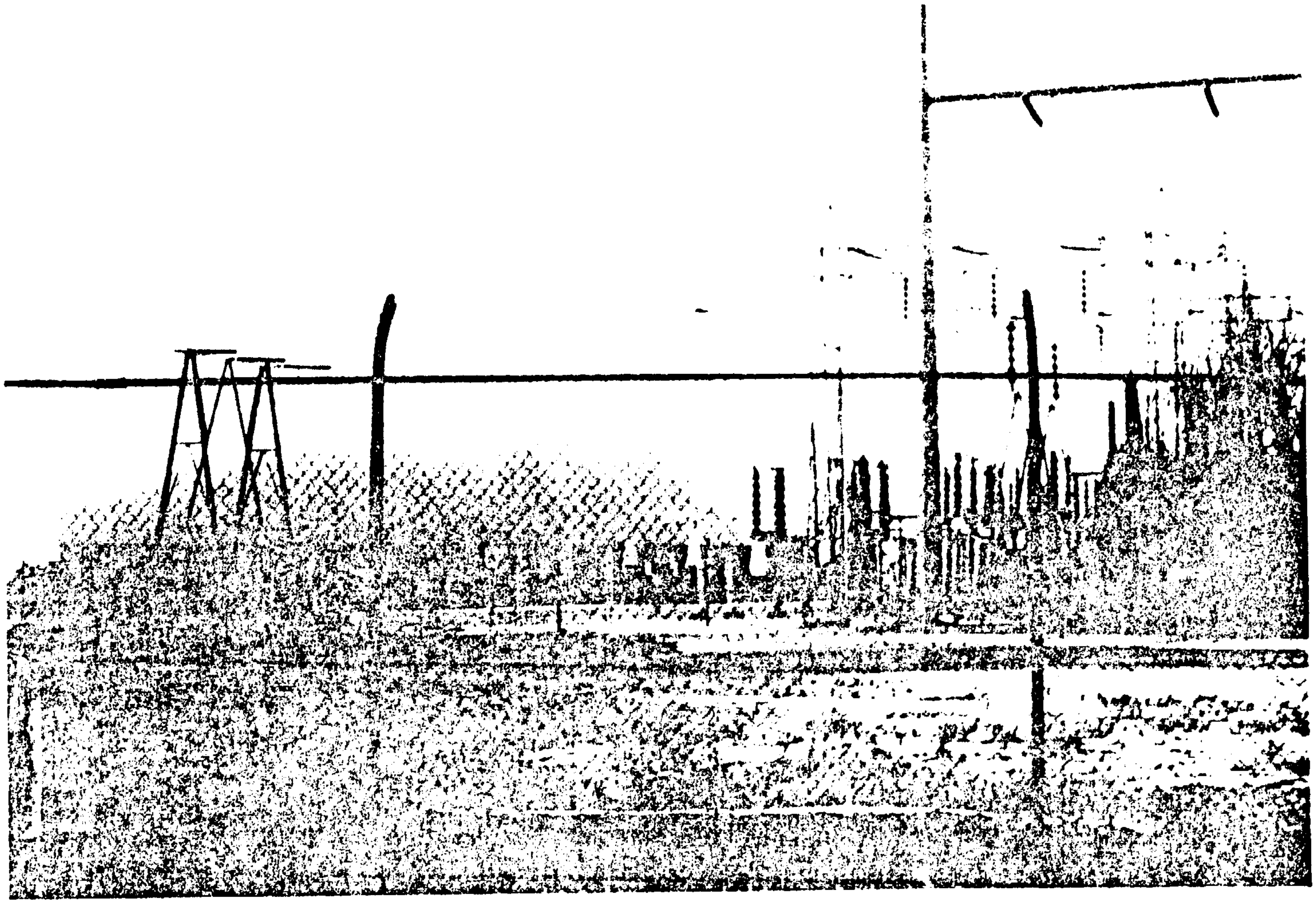

Figure V-1 – A TWELVE-CELL COOLING TOWER IN OPERATION AT A COAL-FIRED GENERATING STATION OWNED BY APPLICANT through the drainage slough to St. Vrain Creek. A decrease of 12.2°F is estimated to occur before it enters the South Platte River. Before it enters St. Vrain Creek, the decrease is estimated to be only 0.7°F. The Applicant assumes that mixing of the heated effluent in the farm pond and in St. Vrain Creek is complete. However, a thermal plume can be anticipated in St. Vrain Creek, especially in the winter months. The sizes of the plume and the mixing zone have not been defined. Heat loss in the farm pond is large and the stream flow in the South Platte River is greater than that in St. Vrain Creek; hence, the heated effluent discharged to the river is estimated to increase the temperature of the river only 0.83°F, even under adverse summer conditions when the blowdown temperature is 100.6°F upon entering Goosequill Ditch.

The Applicant has taken into consideration the extent that the thermal effluents will mix with the water of each stream. After the Station becomes operational, the temperature of each stream will be monitored (see p. V-7).

At times when the discharge temperature to the stream would be greater than 80°F, the Applicant will release effluents at a temperature of about 80°F from the cool side of the cooling tower.

Increasing the temperature of a polluted stream decreases the dissolved oxygen in the water and reduces the waste-assimilative capacity of the stream (self-purification process).[2] Since no increase in temperature over 80°F is predicted, such an effect is not anticipated in the South Platte River or St. Vrain Creek.

Releasing heated water in the winter months to either St. Vrain Creek or the farm pond (figure V-2) will keep them free of ice over some areas. No adverse impact is expected from such conditions.

2. Chemical Impact

The South Platte River and St. Vrain Creek in the vicinity of the Station have been classified by the Colorado Water Pollution Control Commission as both C (water for industrial use) and D (water for irrigation).[3] The streams are used primarily for irrigation. Several chemicals will be used in the Station which will be discharged to either the South Platte River or St. Vrain Creek (table III-6); table III-7 gives their concentrations in the discharge liquid.

Figure V-2 – FARM POND IN WINTER

From the average flow rate and average dissolved-solids content of St. Vrain Creek, the average amount of dissolved solids carried by the creek is estimated to be 230,000 tons/year. The chemicals released by the Station (1900 tons per year, table III-6) should have little effect on the water quality of St. Vrain Creek.

Blowdown water will be released to the South Platte River; on occasion, under abnormal circumstances, it may be released to St. Vrain Creek. Table V-1 gives the concentrations of various chemicals in the blowdown water both before and after dilution in the streams. Columns five and six represent conditions that will be expected to occur each year,[3] whereas column seven represents the minimum monthly stream flow in St. Vrain Creek during the past 17 years (table III-1). Under this adverse condition, the solids dissolved in the effluent would increase the creek salinity about 30% and possibly would eliminate some aquatic species from the creek. If the blowdown water were released to the South Platte River during average stream flow, the increase in salinity would be insignificant. An increase in salinity increases the cost of cleaning up the water for uses other than irrigation.

The annual draining of the cooling tower basins, holding ponds, and settling basins is not expected to have any detectable effect on the environment. The chemicals discharged from a cooling tower basin will be diluted by mixing with water from a holding pond and settling basin before a further dilution of at least 16:1 occurs in the receiving stream.

The free chlorine concentration of the blowdown water will periodically reach about 1 ppm, from the addition of chlorine gas.[6] Chlorine gas dissolves in water and hydrolyzes immediately and completely according to the reaction[7]

$$Cl_2 + H_2O \rightarrow HOCl + H^+ + Cl^- \ .$$

The HOCl is a weak acid strongly affected by acidity; it dissociates thus

$$HOCl \rightarrow OCl^- + H^+ \ .$$

When chlorine is added to water that contains nitrogenous material chloramines are formed. The best estimate of the toxicity of free chlorine and of chloramines is obtained from a measurement

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Table V-1–ESTIMATED AVERAGE COMPOSITION (PPM) OF BLOWDOWN WATER AFTER DILUTION IN ST. VRAIN CREEK AND THE SOUTH PLATTE RIVER

	Average South Platte River composition[b] (145,000 gpm)[c]	Average blowdown effluent composition (2068 gpm)	Composition after dilution in			
			South Platte River[a]		St. Vrain Creek	
			At average annual flow (145,000 gpm)[c]	At lowest average monthly flow (47,127 gpm)[d]	At lowest average monthly flow (40,843 gpm)[e]	At 17-year minimum monthly flow (11,670 gpm)[e]
			Chemical constituents originally present			
SiO_2	14.4	20	0.28	0.88	1.01	3.54
Fe	0.17	0.18	0.0025	0.008	0.009	0.03
Ca	75	182	2.56	7.99	9.22	32.25
Mg	0.018	93	1.31	4.08	4.71	16.48
Na	104	217	3.05	9.52	10.99	38.45
K	7.7	11	0.15	0.48	0.56	1.95
Zn	0.045	0.0073	0.0001	0.00032	0.00037	0.0014
SO_4^{2-}	164	980	13.78	43.003	49.62	173.66
Cl^-	85	106	1.49	4.65	5.37	18.78
F^-	1.3	2.2	0.031	0.097	0.11	0.39
NH_3		0.12	0.0017	0.005	0.006	0.02
NO_3^-	7.4	22	0.31	0.965	1.11	3.90
B	0.32	0.51	0.0072	0.022	0.026	0.09
P		0.03	0.00042	0.0013	0.0015	0.005
Total alkalinity, bicarbonate	257	530	7.45	23.26	26.83	93.92
Dissolved solids	621	2030	28.54	89.08	102.78	359.73
Hardness as $CaCO_3$	362	850	11.95	37.30	43.04	150.63
			Chemical constituents introduced as additives (max)			
Free Cl		1	0.015	0.04	0.05	0.17
Nalco 345		11.0	0.15	0.48	0.56	1.95
Nalco 321		50	0.70	2.19	2.43	8.86
Nalco 71-D5		5	0.07	0.22	0.25	0.87

[a]The 17-year minimum monthly flow of the South Platte River is about the same as that of St. Vrain Creek.
[b]Included for comparison; from Table 4, *Applicant's Environmental Report.*
[c]Average annual flow, from Table 2, *Applicant's Environmental Report.*
[d]From Table III-2 of this Statement.
[e]From Table III-1 of this Statement.

of total residual chlorine.[8] The "Cl" in the South Platte River at its concentration after the blowdown water has been diluted (0.01 - 0.02 ppm) will not likely be toxic to aquatic organisms.

3. Quantitative Impact

Evaporative water loss from the cooling towers is about 5 cfs, and some water is lost by evaporation from the settling basins and holding ponds. This water is lost to the atmosphere from the immediate area. It might be returned to that area as an increase in rainfall or it might be deposited in another area.

The Applicant has supplied limited information on water temperatures collected when biota samples were taken. Also, the Applicant has installed two temperature monitors each on the South Platte River and St. Vrain Creek. The monitors are constant-recording devices with capillary sensors. The sensors are suspended in the streams from Styrofoam floats. On the South Platte River, one monitor is at the pumping structure and the other below the Station and 200 yards above the confluence of the South Platte River and St. Vrain Creek. On St. Vrain Creek, one monitor is at the pumping structure, the other on the county-road bridge just below the Station. The recordings were begun in September 1971, and some preliminary data have been collected. During the first year of operation, stream temperatures will be correlated with the discharge of effluent to determine if any change in stream temperature attributable to the discharge of effluent can be measured. However, the temperature monitoring program will continue beyond this period.

A water chemistry program is being conducted by the Applicant. This program includes water quality studies before operation and for at least the first year of operation of the Station. Intake and discharge water are being analyzed to determine the effect, if any, of the Station on the water quality of St. Vrain Creek and the South Platte River. Such analyses include determination of trace elements at or below concentrations that may be toxic to aquatic organisms in the streams.

C. AIR USE

Fog and noise are anticipated impacts on the atmosphere. The sources of each will be the Station's two mechanical-draft cooling towers.

The Applicant has never had a problem associated with fog originating from cooling towers similar in size and construction during their many years of operation in Colorado.[1]

The dry atmosphere of the area is not conducive to fog formation. Even if fog should occur locally, it would cause little inconvenience in the rural environment of the site.

Noise from tower operation is estimated to be no greater than 70 dB at the perimeter fence on the county road 300 ft from the Station's main cooling tower. This estimate is based on the following measurements of loudness from a 12-cell tower (figure V-1) of the same general design at one of the Applicant's coal-fired plants.

Distance from side of tower (ft)	Loudness (dB)
3	82
60	74
150	72

A loudness of 70 dB is the approximate level of a very noisy office. The cooling tower of the Station will probably be quieter since it is a 10-cell unit and less background noise will be present.

D. BIOLOGICAL IMPACTS

By their interaction with land, water, and air, biota are subjected to the sum of impacts on those environmental realms. The impacts are greater on aquatic than on terrestrial biota.

1. Aquatic Biota

Operation of the Station may impose thermal, radiological, and chemical impacts on aquatic biota. Also, entrainment and impingement of the biota may result from taking water for cooling-tower operation from the streams through the intake structures at a significant velocity.

a. Thermal Impact

About 2300 gpm of heated effluents would be released into the environment. To lessen any biological impact, alternate ways of releasing heated effluents are built into the cooling system. The thermal impact on aquatic biota would be greatest when the stream flow is low and the ambient water temperature is high. The Applicant has calculated what the downstream temperature would be after the heated effluents are completely mixed with the stream.[1] The calculated increase in temperature under adverse conditions is

2.05°F for summer and 4.32°F for winter. The calculations by the regulatory staff were based on the assumption that under adverse winter conditions heated effluents would not be discharged into St. Vrain Creek. If the heated effluents should be released to the South Platte River under adverse conditions, about 11% of the stream would consist of heated effluents. Under normal operation, when the heated effluents would be released via Goosequill Ditch and the farm pond, the temperature of the effluents that would enter the South Platte would be equal to or below an assumed stream temperature of 80°F because the Applicant has accepted as a condition for normal operation that blowdown will be discharged from the cool side of the tower at times when the discharge temperature to the stream would be greater than 80°F. If the heated effluents were released to St. Vrain Creek, the temperatures of the entering effluents would also be equal to or below an assumed stream temperature of 80°F. During August and September when the water temperature is high and the stream flow is low, the effluents would constitute about 13% of the stream flow.

(1) Fish

The fish populations of the South Platte River or St. Vrain Creek would be expected to suffer little adverse thermal effect under average stream conditions when the heated effluents from the power station represent 1 to 3% of the stream flow. Under adverse stream conditions, especially during winter, heated effluents may constitute as much as 13% of the stream flow. Fish are attracted to warm water[9] and will remain in heated areas during the colder months.[10] Fish that live in heated water experience increases in metabolic rates and in consumption of oxygen and food. Premature spawning can also occur in heated effluents.[11] If 13% of the stream was made up of heated effluents, impact on biota in a small area near the immediate discharge could be significant; however, effect on the total aquatic biota should be negligible.

Since the farm pond was drained, and the original fish population thus eliminated, the fish population of the farm pond is not to be considered. Those fish now found in the pond have been randomly introduced and the regulatory staff would not consider the small fish population currently existing in the farm pond significant to the ecology of the area in the vicinity of the Station.

(2) Algae and Benthic Fauna

Algae and benthic fauna are also subject to thermal impact. High temperatures tend to restrict the number of species of periphyton and macroscopic invertebrates such as insect larvae, flatworms, roundworms, mollusks, and crustaceans. The number of species in heated-water zones is reduced during summer, but their standing crops increase during winter.[12] Midges (Tendipedidae) seem to be one of the species most tolerant to high temperatures.

Literature about the effects of thermal discharges on algal communities is limited.[13] Each species has an optimum temperature range.[14] As the temperature increases or decreases, one species replaces another as the dominant organism; figure V-3 indicates the most commonly observed types of population shift. As the water temperature reaches 95°F, a population shift from green to blue-green algae occurs.

Limited information is available on the algal populations in the South Platte River and St. Vrain Creek. Two genera of blue-green algae, Anabaena and Oscillatoria, were found - but not in great abundance. Blue-green algae likely would become the dominant species in the irrigation ditches and discharge areas. Since the heated area would be relatively small, few adverse effects would be expected on the phytoplankton, zooplankton, periphyton, and benthic fauna.

According to the Applicant's calculations, the temperature decrease of 101.5°F blowdown water would be 1.5°F as it flowed down Goosequill Ditch into the farm pond.[1] The blowdown water would enter the pond at a temperature of 99.1°F and leave the pond at 88.4°F. Thus, the temperature of much of the water in the pond would be above 90°F (10°F above the stream-water temperature). However, this circumstance would require the Applicant to discharge blowdown from the cool side of the Station's cooling towers so long as the discharge temperature to the stream is greater than 80°F.

The farm pond has a greater variety of bottom fauna than either the South Platte River or St. Vrain Creek; the fauna are the result of repopulation after the pond was drained. The 10°F increase in temperature postulated above would eliminate most of the bottom fauna, and then blood worms and Oligochaete would become the dominant bottom fauna.

Undoubtedly, the irrigation ditches that would receive heated effluents would support growth of blue-green filamentous algae.

The impact of the heated effluents on the aquatic environment of the South Platte River will be reduced at the expense of changing the biota in the farm pond. Since the size of the farm pond is only 25 acres and the biota was recently eliminated by draining the pond, the heated effluents will not have a major impact on the aquatic ecology.

b. Chemical Impact

The chemical effluents that will be discharged from the Station into the South Platte River and St. Vrain Creek have been discussed

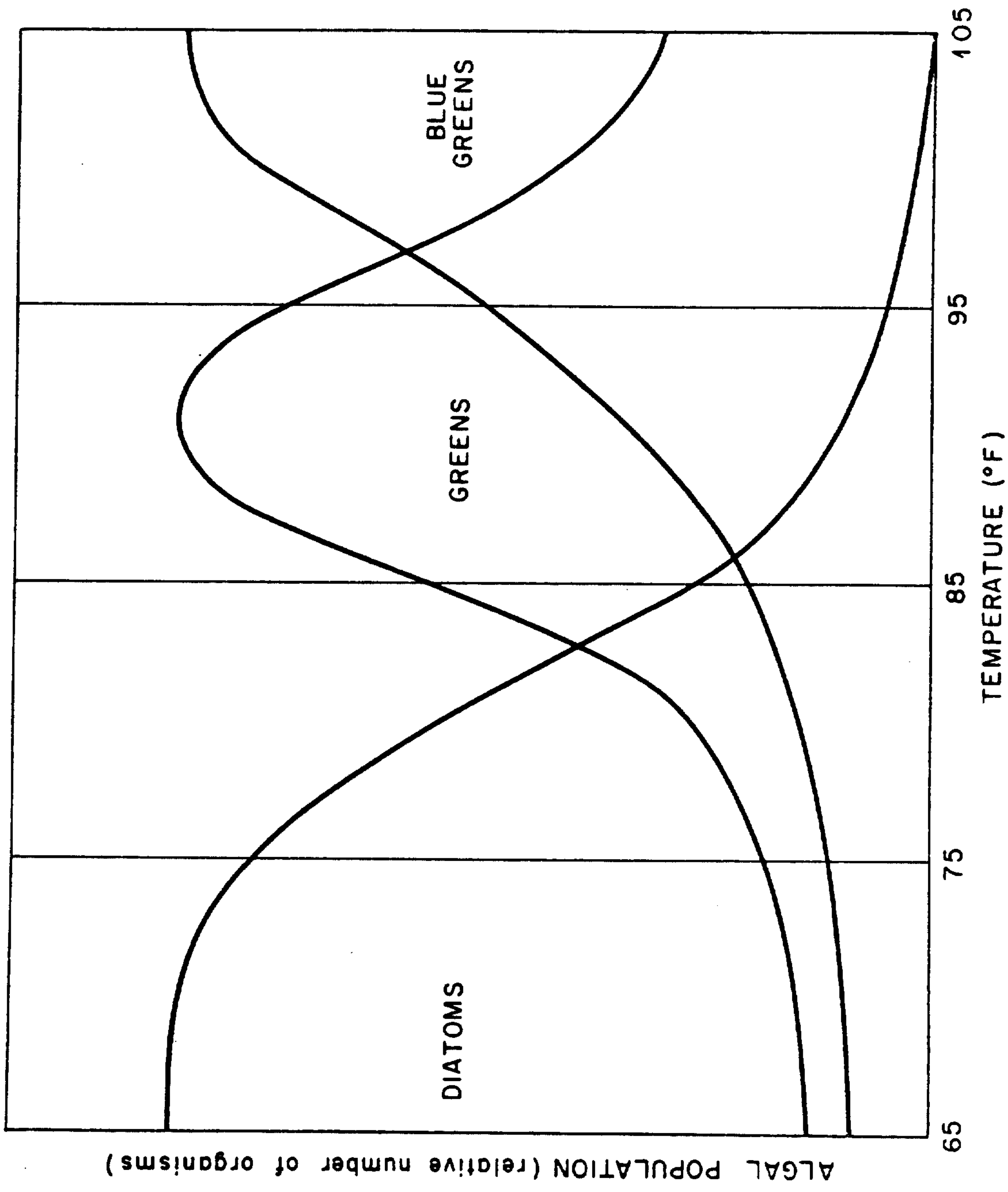

Figure V-3—POPULATION CHANGES AMONG ALGAL GROUPS WITH CHANGE IN TEMPERATURE above; Table V-1 gives their compositions. The greatest effect on aquatic biota would be expected under the adverse condition of low stream flow.

The salinities of the South Platte River and St. Vrain Creek may seem unusually high for freshwater streams but are normal for surface streams in the arid west. Organisms that inhabit these streams have been selected and adapted to those high salt contents. An example is Enteromorpha intestinalis, which was found in St. Vrain Creek; this algae needs large concentrations of dissolved salts to grow in freshwater. The salinity of the streams is already at such a high level for freshwater streams that a large increase would be necessary to produce a significant adverse effect on the biota.[15] If the blowdown water were released to St. Vrain Creek under the most adverse stream conditions, some aquatic species possibly would be eliminated by the increased salinity.

The biocide (Nalco 321 listed in Table V-1) used in the cooling towers is toxic by design. Its toxicity is greatly reduced by dilution in the streams. Although it may have some toxic effects, no major adverse effect on the aquatic biota is expected.

Chlorine in the blowdown water will reach periodically levels toxic to aquatic organisms.[16] But, when blowdown water is discharged to the South Platte River, most of the chloramines and free chlorine may be retained in the biota of Goosequill Ditch and the farm pond. However, field tests have shown that chlorinated sewage effluents have completely eliminated caged fish populations for a distance as far as 4 miles below the point of discharge;[17,18] Merkens[8] observed that residual chlorine in concentration as low as 0.08 ppm killed half the fish in seven days. Chlorinated sewage effluents that had a residual chlorine concentration of 0.04 to 0.05 ppm were toxic to fathead minnows.[19] Basch[20] found that 50% of a population of rainbow trout could tolerate chlorine at 0.23-ppm concentration for only 96 hr. Arthur and Eaton[21] learned that after 96 hr half a population of the invertebrate Gammarus pseudolimnaeus survived at a chlorine concentration of 0.22 ppm and that reproduction was reduced when chronic concentrations (for 15 weeks) were maintained at 0.0034 ppm. The highest concentration that produced no effect on the life-cycle of the fathead minnow was 0.016 ppm. Sprague and Drury[22] showed an avoidance response by rainbow trout to free chlorine at the 0.001-ppm level.

The maximum concentrations of free chlorine will reach 1 ppm periodically in the cooling tower blowdown effluent and are calculated to be only 0.01 - 0.02 ppm maximum in the South Platte River, after dilution at the average annual flow rate. The lowest average monthly flow of 47,217 gpm gives a maximum concentration of 0.04 ppm. The estimation of these concentrations did not consider a number of factors that will effectively decrease them. The chloramines and the free chlorine may be retained in the biota of Goosequill Ditch and the farm pond in transit from the towers to the South Platte River, figure II-3, a distance of approximately 2 miles. Information is not available on the chlorine demand of this pathway. Evaporative chlorine losses were not considered. The concentrations given represent those that could be attained during the chlorine charging periods that occur daily.

The uncertainties in both the expected chlorine concentrations and the application of existing data on the effects of chlorine make an exact determination of impact impossible. However, the chlorine concentrations are high enough to require monitoring of the discharge which monitoring program will be defined in the Technical Specifications for the Station. This information coupled with increased knowledge of the effects of chlorine, will enable the regulatory staff to properly evaluate the tower blowdown effect. Irreversible or irretrievable damage to the environment is not anticipated during the interim period.

c. Impact of Entrainment and Impingement

The makeup water for the cooling towers for the Station will usually be taken from either the South Platte River or St. Vrain Creek. An average of 4100 gpm (9.1 cfs) is required, which is about 3 and 5% of the average flow of the South Platte River and St. Vrain Creek, respectively. However, during low stream flow, which usually occurs in January,[1] these figures would increase to about 8.6 and 10%. If all the makeup water were taken from either of these streams during extremely dry periods, about one-third of the stream flow (26 cfs) would be required.

(1) Fish

The effect on the aquatic biota of taking water from a stream depends on what percent of the stream flow is used[9] and on the velocity of the water through the intake structure.[23] At high water, the velocity through the trash racks is less than 0.5 ft/sec, and fish would not be trapped on the racks. At lower water, the velocity increases to about 1.2 ft/sec, which could cause some large fish to be impinged.[23] Since the bars on the trash racks are about 5 in. apart, most of the fish would pass through the racks into the diversion structures (figures III-6 to III-9); only very large carp and white suckers are apt to be trapped. The fish would then be subjected to the intake velocities of the pumps. The intake velocity at the traveling screen is about 1.6 ft/sec, which is sufficient to trap fish.[23] Only larval fish and small minnows are small enough to pass through the traveling screen. The small fish would be entrained in the pump and pipes that lead to the settling basins. Although very little is known about this type of entrainment, we would assume that the larval fish and minnows would be killed by the action of the pumps before they reached the settling basins.

The impact of taking makeup water from St. Vrain Creek or the South Platte River depends largely on the stream flow. At low water, the probability of diverting fish through the traveling screen would be greatest, although this still involves only a small percentage of the fish living in the streams. Some minnows and larval fish would be killed. The available information[24,4,5] on fish in the South Platte River and St. Vrain Creek is not adequate; it indicates that they consist primarily of trash fish (white suckers and carp). This indication is supported by the poor quality of the stream water (high concentration of dissolved solids) and the lack of sport fishing on the streams. From these considerations, there should be no major impact on the fish populations from entrainment or impingement.

(2) Zooplankton and Benthic Fauna

Zooplankton and benthic fauna that are carried by the streams' currents would be diverted from the streams and pumped to the settling basins. Although the mortality of zooplankton and benthic fauna that pass through is not known exactly, more than half the organisms would be expected to survive. The organisms would be pumped to the settling basins and removed when the basins are cleaned or when they flow with the water into the storage ponds. Little information exists on the zooplankton and benthic fauna of the South Platte River and St. Vrain Creek in the vicinity of the Station. Since the volume of water taken from the two streams usually would be a small percent of the total flow, little adverse impact is expected on their zooplankton and benthic fauna. The greatest impact would occur during extremely low water flow. The organisms usually have short generation times, and the population recovers rapidly under favorable conditions.

d. Radiation Dose to Species Other Than Man

No limits have been established for radiation exposure of species other than man. However, it is generally agreed that the limits established for man are very conservative when applied to plants and lower animals. Aquatic organisms living in water containing released radionuclides will be expected to receive radiation doses. Primarily because of their ability to reconcentrate the isotopes of cesium, the maximum dose in this category will be received by fish and aquatic invertebrates. A fish living in the Station's discharge canal will receive about 0.017 rad/year, while the dose to aquatic invertebrates would be 0.092 rad/year.

2. Terrestrial Biota

On terrestrial biota, the only potential impact of Station operation which requires significant attention is the radiochemical impact. Terrestrial biota in the environs of the Station would receive approximately the same radiation doses as those calculated in a following section for man.

3. Ecological Monitoring

a. On-going Program

A biota-sampling program, begun in January 1971, is being conducted for the Applicant.[24] The program consists of the biweekly to bimonthly sampling of the aquatic biota; it also includes some water-chemistry studies. This program is an outgrowth of the Environmental Radiation Surveillance Program; its purpose is to establish an efficient sampling program and a base for comparing pre- and post-plant-operation ecological conditions.

Particular attention was to be given to fish, microorganisms in and on the bottom, and aquatic plants. The lengths and weights of fish were to be recorded. Fish scales were to be taken for age analysis, and stomach contents were to be analyzed to determine diets. Also, the radionuclide contents off the fish were to be determined. From all aquatic nitches, macroorganisms were to be collected and analyzed for radionuclides. The changes in species, composition, and radionuclide contents of aquatic plants (including algae) were to be measured to determine the thermal and chemical effects of the Station operations. The data obtained were presented in the 10th and 11th quarterly reports of the Environmental Radiation Surveillance Program.[4,5] The information on fish, algae, and aquatic invertebrates was preliminary and incomplete; many of the organisms found were identified only by order. No quantitative data were collected, and studies of zooplankton were lacking.

The program is inadequate in several respects. (See below for Applicant's future program.) Terrestrial organisms have not been investigated during the preoperational studies. Seasonal measurements of radionuclides from gaseous effluents through the food chain should be made, and samples should be taken from different tropic levels at various distances from the plant. General information is lacking on fish populations in the South Platte River and St. Vrain Creek. Sufficient samples should be collected to establish the diversity and abundance of species. Physical examination of these fish should be made, along with sensitive determinations of chemical and radionuclide concentrations. Post-operational studies should include periodic examinations of the traveling screens, and records should be kept of dead fish and other dead organisms, along with other pertinent information. The settling basins should be sampled to determine whether minnow and larval fish are entrained and to what extent. A program should be developed to sample the periphyton, phytoplankton, zooplankton, and benthic fauna. Species diversity should be established and quantitative data collected. Species that are known to concentrate certain chemicals should be analyzed to determine chemical and radionuclide concentrations. Sampling should continue on a seasonal basis after the Station becomes operational.

b. Future Program

The Applicant has contracted to have additional ecological studies performed. The three-phase program is as follows:

Phase I - Study design and ecological reconnaissance; March 1 - May 1, 1972. The primary objective of this phase was to design the specific elements of the program. Data which have been collected to date which are pertinent were utilized. Part of this reconnaissance was a thorough literature search, including unpublished documents available to the public. The geographic area included within the ecological study was the site property, the remaining contiguous river bottom lands and first river terraces, and such other areas as Phase I may demonstrate to be needed for control and comparison purposes. This area is generally within a circle with a radius of approximately three miles from the reactor building. Information developed during Phase I was submitted by letter dated May 11, 1972, as "Additional Information Regarding Applicant's Ecological Study."

Phase II - Ecological inventory and analyses and design of supplementary monitoring system; May 1, 1972 - May, 1973. The primary emphasis of this phase will be to complete an environmental resource inventory for terrestrial and aquatic biota, including an analysis of the food chains and other ecosystem dynamics. Biota will include dominant species of vegetation, such as trees, shrubs, grasses, herbs and crops; mammals, birds, other vertebrates, invertebrates, zooplankton, phytoplankton, and such other species as are determined in Phase I to be necessary for a comprehensive ecological baseline study. During this phase the supplementary monitoring program will be designed.

Phase III - Supplementary monitoring program through first year of operation of the Station and subsequent thereto as indicated. This phase will consist of supplementary monitoring of ecosystem components and processes and will be continued through the first full year of Station operation. At the end of this period, the results will be reviewed to determine the scope of the subsequent ongoing monitoring program for at least the following four years.

E. RADIOLOGICAL IMPACTS OF ROUTINE OPERATION

During routine operation of the Station at full power, small quantities of radioactive materials will be released to the environment. The releases will be conducted in accordance with the limitations set forth in 10 CFR 20 and the guidance of 10 CFR 50 to keep the levels of radioactive material in effluents to unrestricted areas "as low as practicable."

1. Impacts of Liquid Releases

During normal operation the liquid effluents from the Station will be combined with blowdown water from the cooling towers and emptied into a 25 acre farm pond via the discharge canal (Goosequill Ditch). Holdup time in the pond is about 10 days, after which time the effluent enters the South Platte River. Ducks, and possibly fish, caught in the vicinity of the Station may be eaten by man in limited amounts. Bioaccumulation factors for radionuclides in aquatic species are listed in table V-2.[28]

Radiation dose estimates from liquid effluents were calculated on the basis of concentrations which the regulatory staff estimates in Section III will be released from the Station. If an individual were to consume 20 grams of fish per day,* all grown in the discharge canal, his whole body dose would be about 0.5 mrem per year. The same consumption would result in a radiation dose of about 0.4 mrem per year to the individual's gastrointestinal (GI) tract and less than 6×10^{-5} mrem per year to his thyroid. The same fish catch made in the South Platte River would result in an additional dilution factor of about 35 in radionuclide concentration and in dosage. Consumption of fish caught in the South Platte River would result in a whole body dose of 0.014 mrem per year, a GI tract dose of 0.011 mrem per year, and a thyroid dose of 1.5×10^{-6} mrem per year.

*The per capita fish consumption for the U.S. is 17.4 g/day (6.35 kg/yr).[29]

Table V-2—BIOACCUMULATION FACTORS FOR RADIONUCLIDES IN FRESHWATER ORGANISMS

Isotope	Concentration Factor in Fish	Concentration Factor in Invertebrates
Sr-89	40	700
Sr-90	40	700
Y-90	100	1,000
Y-91	100	1,000
Zr-95	100	1,000
Nb-95	30,000	100
Sb-125	40	16,000
Te-125m	400[a]	150[a]
Te-127m	400[a]	150[a]
Te-129m	400[a]	150[a]
Te-129	400[a]	150[a]
Cs-134	1,000	1,000
Cs-137	1,000	1,000
Ba-137m	10	200
Ce-144	100	1,000
Pr-144	100	1,000
Eu-154	100	1,000
Eu-155	100	1,000

[a]ORNL, private communication

Recreational use of either St. Vrain Creek or the South Platte River for swimming or fishing will be limited by the water quality, which has been downgraded by contributions (pollution) of upstream users. However, it is possible to postulate a potential exposure mode, perhaps for unsupervised children and for others after water quality has been improved, and seek an upper-limit estimate. Using the liquid discharge quantities listed in Table III-5 and assuming a 100 hour per year submersion in the untreated blowdown discharge water or in Goosequill Ditch, the resultant dose estimate is 1.06×10^{-3} mrem/year with a corresponding 35 fold decrease by dilution in the waters of the South Platte River. A fisherman standing along side the discharge canal for the same period of time would receive considerably less dose. If the South Platte River was used as the source of drinking water, the doses would be 0.0012 mrem/yr to the whole body, 0.006 mrem/yr to the GI tract, and 0.0048 mrem/yr to the bone.

The significance of game or wildfowl as a potential food-chain-exposure pathway for man is minimal. This conclusion rests on the essential absence of wildgame such as deer, that could by any conceivable circumstance have a diet significantly contaminated by discharges to Goosequill Ditch. For example, the fraction of ducks, from among the wildfowl available during the hunting season--which are transient species feeding on corn grown on farms adjacent to the Station--far surpasses the few that may overwinter or be permanent residents of the area. If overwintering wildfowl are bagged, they will be diluted by others bagged and will, in any case, contribute only a trivial fraction of the annual diet of an average hunter.

The potential pathway to man via the irrigation of crops may be through: (1) beef that are fed by the Applicant's farm manager on crops grown on land irrigated by the blowdown water and (2) use of downstream irrigation water from the South Platte River to grow crops used directly as food for people. Calculations have been made indicating that the annual dose to an individual from both pathways is negligible.

2. Impacts of Gaseous Releases

The most significant radiation dose to the public will result from the radionuclides in the gaseous effluents from the Station. The radioactive materials released to the atmosphere are principally the fission-product noble gases krypton and xenon. Nearly all of the dose received by persons living, working, or using recreational facilities in the vicinity of the plant will result from radioactive krypton and xenon in the air surrounding the individual. The postulated gaseous effluents from the Station are listed in table III-4. We have calculated the potential annual doses using averages for meteorological conditions and assuming releases of the listed isotopes at a constant rate.

During normal operation of the Station at full power, the maximum dose rate due to cloud immersion at the Station's exclusion boundary is calculated [$\frac{X}{Q} = 3 \times 10^{-5}$ sec/m^3] to be 1.8 mrem per year. The individual dose at the nearest permanent residence (2300 ft north) is calculated to be 0.52 mrem per year while the dose at the nearest community (Platteville, 3.5 miles S.E.) is less than 0.009 mrem/year.

3. Population Doses From All Sources

The regulatory staff has made calculations of radiation doses using estimates of release rates relative to dilution, biological reconcentration in food chains, and "use factors" by people. The calculations are meant to apply to the average individual. Radiation doses to specific individuals may be higher or lower, depending on the individual's living habits, food preferences, or recreational activities.

The combined dose to individuals eating fish caught in the South Platte River was calculated assuming that each person within a 50-mile radius of the Station consumes 20 grams of fish per day, but that only 10% of the population gets 10% of its daily intake of fish from the South Platte River. In calculating the dose from drinking water and from swimming, it was assumed that 10% of the population within the 50-mile radius participated in these activities. The combined annual population dose via the fish, swimming, drinking water pathway is calculated to be 0.52 man-rem.

The combined dose to all individuals living within a 50-mile radius of the Station, calculated on the basis of exposure to radioactive gaseous effluents, is estimated to be 6.4 man-rem per year. Values of the man-rem dose for the 1970 population at various distances from the Station are listed in table V-3.

The population dose from all sources including cloud immersion, eating fish, swimming, drinking water, and transportation of nuclear fuel and radioactive wastes is summarized in table V-4.

Table V-3—CUMULATIVE POPULATION, ANNUAL MAN-REM DOSE, AND AVERAGE DOSE FROM GASEOUS EFFLUENTS IN SELECTED CIRCULAR AREAS AROUND THE STATION

Radius (Miles)	Cumulative Population	Annual Cumulative Dose (Man-rem)	Average Annual Dose for Cumulative Population (Millirem)
1	40	0.016	0.39
2	150	0.033	0.22
3	420	0.055	0.13
4	1,500	0.095	0.063
5	2,030	0.11	0.055
10	10,300	0.27	0.026
20	147,000	1.2	0.0081
30	442,000	2.4	0.0055
40	1,200,000	5.5	0.0046
50	1,410,000	6.4	0.0045

Table V-4–ESTIMATED ANNUAL MAN-REM DOSES FROM STATION

	Exposed Population	Man-rem
Cloud (Immersion)	1,410,000	6.4
Fish (South Platte River)	141,000	0.20
Swimming (Goosequill Ditch)	141,000	0.15
Drinking water (South Platte River)	141,000	0.17
Transportation of nuclear fuel and radioactive wastes	160,000	2
	Total	~9

4. Radiological Environmental Monitoring

The Applicant's proposed radiological monitoring program has been planned to serve two objectives: to determine background concentrations of radioactive materials in the Station's environment prior to startup (preoperational studies) and, subsequently, to determine the radiological effects of plant operations on the environment (operational studies). The preoperational phase began in July 1967. The operational phase will essentially be a continuation of the preoperational phase, with appropriate expansions. Only the salient features are presented here.

The sampling locations, types, and frequencies and the analyses were established in consideration of the potential amounts and modes of radionuclide releases, population density and distribution, food and water sources, activities (e.g., agriculture, recreation, industry, etc.) in the region, and natural biological and physical features of the region.

Air monitoring will include sampling particulates, iodine, and precipitation, and measuring external exposure at appropriate on-site and off-site locations. The aquatic monitoring program includes sampling aquatic biota, sediments, and river water, and potable surface and groundwaters. The terrestrial radiological monitoring program will include sampling and analyzing forage vegetation, vegetables, grasses, soils, and significant foodstuffs, including milk and beef.

Table V-5 summarizes the Station's sampling schedule. The sampling program as presented under Action Level 3 in Table V-5 will be carried out for a period of 3 years. More detailed information on the Applicant's radiological monitoring program is presented in the Final Safety Analysis Report, Section 2.7-1, and will be further defined in the Technical Specifications. This program is felt to be adequate to determine any radiological effects on the environment from the operation of the Fort St. Vrain Nuclear Generating Station.

5. Evaluation of Radiological Impacts

Using conservative estimates, the total man-rem dose from all effluent pathways, received by the approximately 1,410,000 people who live within a 50-mile radius of the Station, would be about 9

Table V-5–ENVIRONMENTAL SAMPLING SCHEDULE

Exposure routes or media and sample types (number of locations)	Number and location[a] of samples	Action level 1: less than 3%[b]	Action level 2: 3% to 10%	Action level 3: greater than 10%
		External exposure		
TLD chips (36 locations)	12S, 12A, 12R	Average mR/day determined by QUARTERLY cumulative exposures; collection and analysis in rotation of 1/3 of all TLDs MONTHLY	Same as for level 1	Average mR/day determined by MONTHLY analysis of all TLDs
		Atmosphere		
Membrane filters for particulates; charcoal cartridges for iodine (7 locations)	4S, 3A	Gross beta, every filter, WEEKLY; gamma spectrum of filter and cartridge composites, MONTHLY	Same as for level 1, plus gross alpha on one weekly set of filters, MONTHLY	Gross alpha and beta, every filter; gamma spectrum of filter and cartridge composites, all WEEKLY
Tritium oxide (2 locations: F1, F4)	2S	Specific activity of tritium in atmospheric water vapor by passive absorption and liquid scintillation counting, QUARTERLY	Same as for level 1, but MONTHLY	Same as for level 1, but WEEKLY
		Water		
Potable water (2 locations)	2A	Gross beta, tritium, and gamma spectrum analyses; facility area and nearest offsite supply (shallow wells at town of Gilcrest, 6 miles northeast), QUARTERLY	Same as for level 1, but MONTHLY	Same as for level 1, plus Sr 89 and 90 analyses, MONTHLY
Precipitation (2 locations: F1, F4)	2S	No collection or analyses of precipitation at level 1	Gross beta, MONTHLY	Gross beta, tritium, and Sr 89 and 90, MONTHLY; gamma spectrum of composite, QUARTERLY
Surface water and silt (7 locations)[c]	4S, 1U, 1D, 1A	Gross beta, tritium, and gamma spectrum, QUARTERLY	Same as for level 1, but MONTHLY	Same as for level 2, plus Sr 89 and 90 analyses, MONTHLY
		Food chains		
Soil, forage, and crops (13 locations)	7A, 6R	Tritium and gamma spectrum analyses of forage and crops in the most probable routes to man, QUARTERLY, as available (i.e., spring, summer, and fall)	Same as for level 1, but MONTHLY during growing season (i.e., approx. April to October)	Same as level 2, plus Sr 89 and 90, plus concurrent soil samples analyzed for the same nuclides, MONTHLY during growing season
Beef cattle (1 location: facility area)	1S	No analysis of beef at level 1	Gamma spectrum, tritium, and Sr 89 and 90 analyses on one meat sample from beef raised in facility area, ANNUALLY, at end of grazing season (i.e., late fall)	Same as for level 2, plus total body count of 2 to 4 animals from facility area, QUARTERLY
Milk (13 locations)	7A, 6R	Tritium, gamma spectrum, and Sr 89 and 90 analyses on composite: facility area only, QUARTERLY	Tritium, gamma spectrum, and Sr 89 and 90 analyses on composite: facility, adjacent, and reference areas, MONTHLY during pasture season, otherwise QUARTERLY	Same as for level 2, but WEEKLY during pasture season, otherwise MONTHLY
		Aquatic biota		
Both streams, above and below discharge points (6 locations)	4S, 1U, 1D	Gross beta and gamma spectrum analyses of composites of each of 4 categories: (1) suspended organisms, (2) benthic organisms, (3) vascular plants, and (4) fish, QUARTERLY, as available	Same as for level 1, but MONTHLY during summer; otherwise QUARTERLY, as available	Same as for level 2, plus Sr 89 and 90 analyses

[a]Location is designated as follows: S is the actual site area, within a 1-mile radius of the power plant; A is the adjacent area, within the concentric limits of the 1-mile and 10-mile radii from the power plant; R is the reference area, within the concentric limits of the 10-mile and 20-mile radii from the power plant; E is the point of discharge of effluent from the power plant; D is downstream from the effluent discharge point; and U is upstream from the effluent discharge point.

[b]The release limit of radioactive material calculated for the plant based on 10 CFR 20 exposure limits for individuals in an uncontrolled area.

[c]Temperature measurements will be made at the time and point of collection by direct immersion of a thermometer in the water.

man-rem per year. By comparison, an annual total of about 353,000 man-rem to the same population results from an average natural background dose rate of 0.25 rem per year in the State of Colorado.

Operation of the Station will contribute only an extremely small increment of the radiation dose that persons living in the area normally receive from natural background radiation. Fluctuations of the natural background dose may be expected to exceed the small dose increment contributed by the Station. Thus, the incremental increase will be immeasurable in itself and will constitute no meaningful risk.

F. TRANSPORTATION OF NUCLEAR FUEL AND SOLID RADIOACTIVE WASTE

1. Transportation of New Fuel

The fuel for the Station's reactor consists of fissile particles, $ThUC_2$, in which the uranium is 93% enriched, and fertile particles, ThC_2. The particles are provided with a 3-layer coating. The outer layer is highly impervious, high density isotropic pyrolytic carbon. The particles range in size from 0.008 to 0.020 inches in diameter. The fuel particles are bonded together in a powdered graphite coal tar pitch matrix to form a fuel rod one-half inch in diameter and about two inches long. The rods are assembled into fuel elements. Each fuel element is about 31 inches long and 14 inches across and contains a maximum of 1.4 kg ^{235}U, 0.0975 kg ^{238}U, 11.8 kg ^{232}Th, and weighs about 145 kg.

The Applicant states this fuel can withstand a burnup of 20%, a temperature of 1300°C, and a fluence of 8×10^{21} neutrons per square centimeter with less than 1% coating failure.

The Applicant has indicated that cold fuel will be transported by truck from Gulf General Atomic, San Diego, California, to the plant site, a shipping distance of about 1200 miles. It will be shipped in double-drum type containers with vermiculite packing, approved by AEC and DOT, and will contain one fuel element per drum. The Applicant indicates 80 drums can be carried on a truck-load. The initial loading will require 20 truckloads. About one-sixth of the fuel will be replaced each year which will require 3 or 4 truckloads per year of replacement fuel.

2. Transportation of Irradiated Fuel

The irradiated fuel elements when removed from the reactor will be unchanged in appearance from cold fuel. The irradiation of thorium will result in the formation of ^{233}U. As a result of the fissioning of uranium, the fuel elements will contain large amounts of fission products and small amounts of plutonium. The fuel elements will be stored at the site for at least 100 days cooling prior to transport. The irradiated fuel will be placed in a depleted uranium shielded cask for transport. The container, which weighs 43,000 pounds empty, will hold 6 fuel elements. The 6 elements will be placed in a stainless steel inner container with a gasketed and bolted lid which fits snugly into the cask which also has a gasketed and bolted lid. The fuel elements will be kept dry at all times during shipment. A thick uranium shield will reduce the radiation levels at 6 feet from the cask to about 7 mr/hr. The radiation level at the rear of the cab of the truck on which the cask is shipped will be less than 2 mr/hr.

The Applicant estimates the heat generated by each fuel element will be about 2300 Btu per hour. For 6 fuel elements, that would be about 14,000 Btu per hour being released from the cask. For comparison, 35,000 Btu per hour is about equal to the heat released from an air-conditioner in an average size home. Because the amount of heat is small and is being released over the entire transportation route, no appreciable thermal effects on the environment will result.

For the first 8 years the irradiated fuel will be shipped by truck to Idaho Nuclear Corporation at Idaho Falls, Idaho, for storage. It will travel the 673 miles by the following routes: Interstate 25, Interstate 80, U. S. 89, and Interstate 15.

The fuel will be shipped by truck one cask per truck and the Applicant estimates 40 shipments per year. The Applicant indicates the single cask on the truck will meet the State limits for weight of the truck.

3. Transportation of Solid Radioactive Waste

The Applicant estimates that there will be about 50 drums of miscellaneous solid radioactive wastes and an occasional shielded flask with filters shipped to waste disposal sites for disposal each year. The disposal site will probably be Nevada. The shipping distance is approximately 900 miles. The Applicant estimates one shipment per year.

4. Principles of Safety in Transport

Protection of the public and transport workers from radiation during the shipment of nuclear fuel and waste is achieved by a combination of limitations on the contents (according to the quantities and types of radioactivity), the package design, and the external radiation levels. Shipments move in routine commerce and on conventional transportation equipment. Shipments are therefore subject to normal accident environments, just like other nonradioactive cargo. The shipper has essentially no control over the likelihood of an accident involving his shipment. Safety in transportation does not depend on special routing.

Packaging and transport of radioactive materials are regulated at the Federal level by both the Atomic Energy Commission (AEC) and the Department of Transportation (DOT). In addition, certain aspects, such as limitations on gross weight of trucks, are regulated by the States.

The probability of accidental releases of low level contaminated material is sufficiently small that, considering the form of the waste, the likelihood of significant exposure is extremely small. Packaging for these materials is designed to remain leakproof under normal transport conditions of temperature, pressure, vibration, rough handling, exposure to rain, etc. The packaging may release its contents in an accident.

For larger quantities of radioactive materials, the packaging design (Type B packaging) must be capable of withstanding, without loss of contents or shielding, the damage which might result from a severe accident. Test conditions for packaging are specified in the regulations and include tests for high-speed impact, puncture, fire, and immersion in water.[25]

In addition, the packaging must provide adequate radiation shielding to limit the exposure of transport workers and the general public. For irradiated fuel, the package must have heat-dissipation characteristics to protect against overheating from radioactive decay heat. For fresh and irradiated fuel, the design must also provide nuclear criticality safety under both normal and accident damage conditions.

Each package in transport is identified with a distinctive radiation label on two sides, and by warning signs on the transport vehicle.

Based on the truck accident statistics for 1969,[26] a shipment of fuel or waste from a reactor may be expected to be involved in an accident about once every six years. In case of an accident, procedures which carriers are required[27] to follow will reduce the consequences of an accident in many cases. The procedures include segregation of damaged and leaking packages from people, and notification of the shipper and the Department of Transportation. Radiological assistance teams are available through an inter-Governmental program to provide equipped and trained personnel. These teams, dispatched in response to calls for emergency assistance, can mitigate the consequences of an accident.

5. Exposure During Normal (No Accident) Conditions

a. New Fuel

Since the nuclear radiations and heat emitted by cold fuel are small, there will be essentially no effect on the environment during transport under normal conditions. Exposure of individual transport workers is estimated to be less than 1 millirem (mrem) per shipment. For 3 or 4 shipments, with two drivers for each vehicle, the total dose would be about 0.01 man-rem* per year. The radiation level associated with each truckload of cold fuel will be less than 0.1 mrem/hr at 6 feet from the truck. A member of the general public who spends 3 minutes at an average distance of 3 feet from the truck might receive a dose of about 0.005 mrem per shipment. The dose to other persons along the shipping route would be extremely small.

b. Irradiated Fuel

The radiation level at 3 feet from the truck is estimated to be about 14 mrem/hr. This was based on a conservative extrapolation of the Applicant's estimate of the dose rate of 7 mr/hr at 6 feet from the barrier. A more rigorous calculation indicates the ratio would be more nearly 1.5 for the closer-in radiation dose level. The difference between the assumed ratio of 2 and the more exact value is not significant in relation to the other factors involved in the dosage estimates.

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* Man-rem is an expression for the summation of whole body doses to individuals in a group. In some cases, the dose may be fairly uniform and received by only a few persons (e.g., drivers and brakemen) or, in other cases, the dose may vary and be received by a large number of people (e.g., 10^5 persons along the shipping route).

A member of the general public who spends 3 minutes at an average distance of 3 feet from the truck, might receive a dose of as much as 0.7 mrem. If 10 persons were so exposed per shipment, the total annual dose for the 40 shipments by truck would be about 0.3 man-rem. Approximately 70,000 persons who reside along the 700-mile route over which the irradiated fuel is transported would receive a cumulative annual dose of about 0.3 man-rem. The radiation level of 7 mrem/hr at a distance of 6 feet from the vehicle was used to calculate the integrated dose to persons in an area between 100 feet and 1/2 mile on both sides of the shipping route. It was assumed that the shipment would travel 200 miles per day and the population density would average 110 persons per square mile along the route.

c. Solid Radioactive Waste

Under normal conditions, the individual truck driver might receive as much as 15 mrem per shipment. The cumulative dose for the year, assuming 2 drivers per vehicle, would be about 0.03 man-rem.

A member of the general public who spends 3 minutes at an average distance of 3 feet from the truck might receive a dose of as much as 1.3 mrem. If 10 persons were so exposed per shipment, the cumulative annual dose for the 1 shipment would be about 0.01 man-rem. Approximately 90,000 persons who reside along the 900-mile route over which the solid radioactive waste is transported might receive an annual dose of about 0.02 man-rem. These doses were calculated for persons in an area between 100 feet and 1/2 mile on either side of the shipping route, assuming 110 persons per square mile, 10 mrem/hr at 6 feet from the vehicle, and the shipment traveling 200 miles per day.

G. PLANT DISMANTLING

Information contained in the application for the Station's operating license demonstrates that the Applicant has reasonable assurance of obtaining the funds necessary to cover the estimated $5.6 million cost of permanently shutting the Station down and the estimated $40,000 per year cost of maintaining it in a safe condition.

1. Impacts on the Environment

Dismantling the Station will have many of the same impacts on the environment as the original site preparation and Station construction. There will be temporary disturbances due to the dismantling activities and the permanent restoration of most of the site to ecological productivity.

The turbine building and equipment are expected to be disassembled and salvaged according to the Applicant's usual practice for retiring a station. The exterior walls of the reactor building will be left intact up to the operating floor level. That portion of the reactor building above the operating floor will be removed and the standard non-radioactive auxiliary equipment in the reactor building will be salvaged.

Retirement of the reactor and auxiliaries will consist of removal of reflector, removal of reactor auxiliary equipment such as helium purification system components, removal of gases and liquids, shipment of the above items offsite, and disposal of other components, decontamination of remaining plant components, isolation of the prestressed concrete reactor vessel and auxiliary storage well area, and securing of the reactor plant building. Special attention will be given to protection against in-leakage of ground water into the reactor building, and to security of the building to prevent access by the public.

During the time of dismantling, workmen will be on the site, and quantities of debris, the above mentioned salvageable materials, and radioactive material will be transported from the site by truck or rail. Construction materials will be used to entomb the reactor and associated highly radioactive components. A considerable amount of earth-moving will be required to restore the parking lot and turbine building areas to usable grade levels. Finally, a security fence will be erected on the ground above the entombed reactor site.

To the extent that the mechanical-draft cooling towers are not completely demolished and their foundations removed, those small amounts of land will be committed to non-productive use. If the soil under the settling ponds is not replaced or cleared of bentonite, that small amount of land will be non-productive. If the soil under the farm pond is not cleared of contamination, that 25 acres of land will be non-productive until natural processes leach the contamination away.

After completion of the dismantling and securing of the Station, the following procedures will be followed to ensure the integrity of the retired facility for as long as deemed necessary.

- Inspection of the property at least once each week to ensure that the portion of the reactor building remaining after the dismantling remains sealed, that deterioration of the external walls of the building has not occurred and that no settling of the ground around the building has occurred.

- Routine maintenance of property including removal of weeds and trash, fence repair, and other general housekeeping items.

- Special maintenance such as correction of ground settling around facility, repair of any sealed closures in building, and repair of any deterioration of reactor building walls.

The overall impact of dismantling the Station will be beneficial to the environment since the objective of that proposed action is to restore most of the Station's affected acreage to ecological productivity.

2. Radiological Impacts on the Environment

The dismantling of the Station will have radiological impacts characteristic of transporting from the site irradiated fuel and radioactive wastes.

The radioactive materials not transported offsite will be entombed with the reactor and associated components. The entombment will be designed to maintain its integrity for more than 100 years to provide time for radioactive decay of activated and fission products.

Under the terms of a dismantling license that may be issued by the Commission (with the Applicant obtaining 50% of the necessary funds from retained earnings and the balance from the sale of securities) for permanently shutting the Station down and maintaining it in a safe condition, it is expected that the proposed action will have no significant radiological impact on the environment.

VI. ENVIRONMENTAL IMPACT OF POSTULATED ACCIDENTS

A. PLANT OPERATION ACCIDENTS

Protection against the occurrence of postulated design basis accidents in the Station is provided through the defense-in-depth concept of design, manufacture, operation and testing, and the continued quality assurance program used to establish the necessary high degree of assurance for the integrity of the reactor primary system. These aspects were considered in the Commission's Safety Evaluation for the Station, dated January 20, 1972. Off-design conditions that may occur are limited by protection systems which place and hold the power plant in a safe condition. Notwithstanding this, the conservative postulate is made that serious accidents might occur, even though unlikely, and engineered safety features are installed to mitigate the consequences of these postulated events. The probability of occurrence of accidents and the spectrum of their consequences to be considered from an environmental effects standpoint have been analyzed using estimates of probabilities and realistic fission product release and transport assumptions. For site evaluation in the regulatory staff's safety review, extremely conservative assumptions were used for the purpose of evaluating the adequacy of engineered safety features and for comparing calculated doses resulting from a hypothetical release of fission products from the fuel against the 10 CFR Part 100 siting guidelines. The computed doses that would be received by the population and environment from actual accidents would be significantly less than those presented in the regulatory staff's Safety Evaluation. The Commission issued guidance to applicants on September 1, 1971, requiring the consideration of a spectrum of accidents with assumptions as realistic as the state-of-knowledge permits. The Applicant's response was contained in the Applicant's Supplemental Environmental Report dated October 18, 1971.

The Applicant's Supplemental Report has been evaluated, using accident assumptions and guidance similar to that for light-water reactors that were issued by the Commission as a proposed amendment to Appendix D of 10 CFR Part 50 on December 1, 1971 (36 FR 22851). Nine classes of postulated accidents and occurrences ranging in severity from trivial to very serious have therein been identified by the Commission. In general, accidents in the high potential consequence end of the spectrum have a very low occurrence rate, and those on the low potential consequence end are characterized by a higher occurrence rate.

Although the philosophy of the aforementioned proposed amendment to Appendix D applies to this high-temperature gas-cooled reactor (HTGR), the accident class breakdowns, values of radioactive material releases, and analytical assumptions are not directly applicable. We therefore have determined more appropriate accident class breakdowns for this HTGR. A comparison of appropriate accident class breakdowns for this HTGR with the accident class breakdown published in the proposed amendment to Appendix D of 10 CFR Part 50 is given in table VI-1.

Estimates of the dose which might be received by an assumed individual standing at the site boundary in the downwind direction, using assumptions similar to those contained in the proposed amendment to Appendix D, are presented in table VI-2. Estimates of the integrated exposure in man-rem that might be delivered to the population within 50 miles of the site are also presented in table VI-2. These man-rem estimates were based on the projected population around the site for the year 2000.

To rigorously establish a realistic annual risk, the calculated doses in table VI-2 would have to be multiplied by estimated probabilities of their occurrences. The events in Classes 1 and 2 represent occurrences which are anticipated during Station operation and the consequences, which are very small, are considered within the framework of routine effluents from the Station. The events in Classes 3 and 5 are not anticipated during Station operation but events of this type could occur sometime during the 40-year Station lifetime. The accident in Class 7 is of similar or lower probability than accidents in Classes 3 and 5 but is still possible. The probability of occurrence of Class 8 accidents is very small. The postulated occurrences in Class 9 involve sequences of successive failures more severe than those normally required to be considered for the design basis of protection systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is so small that their environmental risk is extremely low. Defense-in-depth (multiple physical barriers), quality assurance for design, manufacture, and operation, continued surveillance and testing, and conservative design are all applied to provide and maintain the required high degree of assurance that potential accidents in this class are, and will remain, sufficiently remote in probability that the environmental risk is extremely low.

The information given in table VI-2 indicates that the realistically estimated radiological consequences of the postulated accidents would result in exposures of an assumed individual at the site boundary to concentrations of radioactive materials within the Maximum Permissible

Table VI-1—COMPARISON OF CLASSIFICATION OF POSTULATED ACCIDENTS AND OCCURRENCES

Classification as in the Annex to Appendix D of 10 CFR Part 50		Modification for Fort St. Vrain Nuclear Generating Station	
Class	**Description**	**Class**	**Description**
1.	Trival incidents	1.	Trival incidents (small spills)
2.	Miscellaneous small releases outside containment	2.	Miscellaneous small releases outside containment (spills or leaks)
3.	Radwaste system failure	3.	Radwaste system failures (leakage and gas or liquid storage tank failure)
4.	Fission products to primary system (BWR)	4.	Not applicable
5.	Fission products to primary and secondary systems (PWR)	5.	Fission products to secondary systems (reheater tube break)
6.	Refueling accidents	6.	Not applicable
7.	Spent fuel handling accidents	7.	Spent fuel handling accident (fuel cask drop)
8.	Accident initiation events considered in design basis evaluation in the safety analysis report	8.	Accident initiation events considered in design basis evaluation in the safety analysis report (instrumentation line break and helium purification system regeneration line accident, rapid depressurization accident and permanent loss-of-forced circulation)
9.	Hypothetical sequences of failures more severe than Class 8	9.	None

Table VI-2—SUMMARY OF RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS FOR FORT ST. VRAIN NUCLEAR GENERATING STATION

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[a]	Estimated Dose to Population in 50 mile Radius, man-rem
1.0	Trivial incidents	*b*	*b*
2.0	Small releases outside containment	*b*	*b*
3.0	Radwaste system failures		
3.1	Equipment leakage or malfunction	<< 0.001	< 0.001
3.2	Release of waste gas storage tank contents	<< 0.001	0.001
3.3	Release of liquid waste storage tank contents	<< 0.001	< 0.001
4.0	NOT APPLICABLE	N.A.	N.A.
5.0	Fission products to secondary system		
5.1	Reheater tube break	<< 0.001	< 0.001
6.0	NOT APPLICABLE	N.A	N.A.
7.0	Spent fuel handling accident		
7.1	Fuel cask drop	<< 0.001	< 0.001
8.0	Accident initiation events considered in design basis evaluation in the safety analysis report		
8.1	Instrumentation line break	0.001	0.01

Table VI-2–SUMMARY OF RADIOLOGICAL CONSEQUENCES OF POSTULATED ACCIDENTS FOR FORT ST. VRAIN NUCLEAR GENERATING STATION–Continued

Class	Event	Estimated Fraction of 10 CFR Part 20 Limit at Site Boundary[a]	Estimated Dose to Population in 50 Mile Radius, man-rem
8.2	Helium purification system regeneration line accident	0.041	5.1
8.3	Rapid depressurization accident	0.24	30
8.4	Permanent loss-of-forced circulation accident	< 0.001	< 0.001

[a]Represents the calculated fraction of a whole body dose of 500 millirem, or the equivalent dose to an organ.

[b]These releases are expected to be a small fraction of 10 CFR Part 20 limits.

Concentrations (MPC) of 10 CFR Part 20, Appendix B, Table II. The tabulated information also shows that the estimated integrated exposure of the population within 50 miles of the Station from each postulated accident would be orders of magnitude smaller than that from the naturally occurring radioactivity, which for the projected population (year 2000) corresponds to approximately 600,000 man-rem/yr based on a natural background level of 0.25 rem/yr. When considered with the probability of occurrence, the annual potential radiation exposure of the population from all the postulated accidents is an even smaller fraction of the exposure from natural background radiation and, in fact, is well within naturally occurring variations in the natural background. It is concluded from the results of the "realistic" analysis that the environmental risks due to postulated radiological accidents at the Station are exceedingly small and need not be considered further.

B. TRANSPORTATION ACCIDENTS

1. New Fuel

Under accident conditions other than accidental criticality, the form of the nuclear fuel, its three coatings, and the low specific activity of the fuel, limit the radiological impact on the environment to negligible levels.

The packaging is designed to prevent criticality under normal and severe accident conditions. To release a number of fuel assemblies under conditions that could lead to accidental criticality would require severe damage or destruction of more than one package, which is unlikely to happen in other than an extremely severe accident.

The probability that an accident could occur under conditions that could result in accidental criticality is extremely remote. If criticality were to occur in transport, persons within a radius of about 100 feet from the accident might receive a serious exposure but beyond that distance, no detectable radiation effects would be likely. Persons within a few feet of the accident could receive fatal or near-fatal exposures unless shielded by intervening material. Although there would be no nuclear explosion, heat generated in the criticality reaction would probably separate the fuel elements so that the reaction would stop. The reaction would not be expected to continue for more than a few seconds and normally would not recur. Residual radiation levels due to induced radioactivity in the fuel elements might reach a few roentgens per hour at 3 feet. There would be very little dispersion of radioactive material.

2. Irradiated Fuel

In the improbable event that a loaded cask is involved in an accident, it is highly unlikely that the three layers of containment, i.e., the cask outer container, the cask inner container, and the coatings on the fuel, will be breached. If in an extremely severe accident the cask containment is breached, some radioactive gas might be released from the cask. The amount of radioactivity released would be limited to the fraction of the gases which penetrated the coating on the particles. It is highly unlikely that any plutonium would be released. The radiation exposures would be limited to persons in the immediate area and would be small.

3. Solid Radioactive Wastes

It is highly unlikely that a shipment of solid radioactive waste will be involved in a severe accident during the 30-year life of the plant. If a shipment of low-level waste (in drums) becomes involved in a severe accident, some release of waste might occur, but the specific activity of the waste will be so low that the exposure of personnel would not be expected to be significant. Other solid radioactive wastes will be shipped in Type B packages. The probability of release from a Type B package, in even a very severe accident, is sufficiently small that, considering the solid form of the waste and the very remote probability that a shipment of such waste would be involved in a very severe accident, the likelihood of significant exposure would be extremely small.

In either case, spread of the contamination beyond the immediate area is unlikely and, although local clean-up might be required, no significant exposure to the general public would be expected to result.

4. Severity of Postulated Transportation Accidents

The events postulated in this analysis are unlikely but possible. More severe accidents than those analyzed can be postulated and their consequences could be severe. Quality assurance for design, manufacture, and use of the packages, continued surveillance and testing of packages and transport conditions, and conservative design of packages ensure that the probability of accidents of this latter potential is sufficiently small that the environmental risk is extremely low. For those reasons, more severe accidents have not been included in the analysis.

VII. ADVERSE EFFECTS WHICH CANNOT BE AVOIDED

The construction and operation of a large facility such as the Fort St. Vrain Nuclear Generating Station will produce some unavoidable adverse effects. Land for the site is committed to long-term use - the estimated life of the Station is 30 years. At the end of its life, the Station might be dismantled and the land returned to other uses; however, some portion of the land will probably be committed indefinitely. The exclusion zone (1 sq. mile) has restricted use. The excluded land other than that occupied by the construction site can be used for agriculture but is effectively removed as home and building sites.

The reactor building is a large modern structure in agricultural surroundings. The building is relatively attractive; however, its presence may detract from the aesthetic value of the area.

The Station will emit small amounts of radioactivity in its gaseous and liquid discharges. The radioactive effluents discharged to the environment during the life of the Station and under normal operating conditions will not be enough to be detrimental to humans or to terrestrial and aquatic life. The Station will release radioactivity at concentrations below required maximum permissible concentrations (MPC).

From the Station, chemicals - primarily as inorganic salts - will be discharged into either the South Platte River or St. Vrain Creek. The streams are classified for industrial and irrigation purposes. Their salinities may seem unusually high for freshwater streams but are normal for surface streams in the arid west. During average stream flow, the chemical discharges from the Station will not greatly influence the salinity. Under abnormal conditions with minimum stream flow, the salinity of St. Vrain Creek could be increased as much as 30% by the Station's blowdown water. If the water quality classifications of the streams were upgraded, chemical discharges from the Station would increase the salinities of the streams in the vicinity of the Station. Chemicals that deposit in the bottom sediments of the streams during low-water conditions would flush down the streams during high-water conditions, and would mix into the solids already present in the streams.

Operation of the cooling towers will produce some adverse effects. The mechanical-draft cooling towers will be noisy (about 80 dB near their bases) and heard at the county road that runs through the site. Also, water is lost to the atmosphere at the rate of about 5 cfs by evaporation from the cooling towers. During a drought, this water loss could be significant to those farmers with low-priority water rights downstream of the Station.

VIII. SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

A. SHORT-TERM EFFECTS

During construction of the Station, somewhat more land than the 10 acres immediately involved with structures was disturbed by grading and heavy-equipment traffic. Erosion from freshly graded ground increased the suspended solids in the already heavily silted South Platte River and St. Vrain Creek. This impact and the unavoidable heavy traffic, noise, and unsightly appearance of a construction site were the principal short-term effects.

B. LONG-TERM EFFECTS

The major long-term effect is the conversion of land and water from agricultural to industrial use. An 80-acre area will be used exclusively for power production and associated activities and therefore lost from agricultural production.

C. EXTENT TO WHICH ACTION CURTAILS RANGE OF BENEFICIAL USES OF THE ENVIRONMENT

The loss of 3000 acre-ft/year of water by evaporation from the cooling towers might mean that in dry years about 1500 acres of land would be retired from irrigated farming at some place in the irrigation system when the total water available has been fully allocated. The exact location of the retired 1500 acres will be indeterminate and will be decided by many interrelated factors, the strongest of which would be the source of water rights purchased by the Applicant. Obviously, the water that evaporates from the towers will return to earth somewhere but possibly not within the geographical boundaries of the affected irrigation system. Hence, the assumption must be made that some 1500 acres will be retired from irrigated farming and either not be used productively or converted to dry farming. If the latter is done, only crops such as wheat could be grown. When operation of the Station should cease at any future time, the water diverted for power production could be returned to agricultural use.

IX. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Three significant commitments of resources are irreversible and irretrievable - manpower, material, and ^{235}U. The manpower and material committed to the design and construction of the Station and its associated equipment have already been expended and can never be retrieved directly. Successful operation of the Station would provide electrical energy as a return for this investment, but if for any reason the Station should fail to go into operation, the manpower resource and much of the material resource would be irretrievably lost. The ^{235}U will be consumed in the generation of energy. Again, energy would be the return for the irretrievably committed resource.

X. THE NEED FOR POWER

For the Western National Power Survey Region, which includes the westernmost third of the country, the Federal Power Commission (FPC) in 1970 predicted a growth[1] in electrical-energy consumption from 2.13×10^8 megawatt hours per year (MWh/year) in 1965 to 12.33×10^8 MWh/year in 1990. The FPC further predicted an increase in peak demand from 37,500 MW in 1965 to 216,400 MW in 1990. The predicted load factor is relatively constant. Thus, the predicted growth rate, for both energy used and peak demand, is about 7.3% per year.

For Public Service Areas (PSA's) 31 and 32 (which include Colorado and Wyoming), the Power Survey[1] predicted an electrical-energy-consumption growth from 1.06×10^7 MWh/year in 1965 to 6.41×10^7 MWh/year in 1990 and a peak-demand growth from 1971 MW in 1965 to 11,180 MW in 1990. The predicted load factor for these two areas improves from 63.3% in 1965 to 65.6% in 1990. These figures mean an annual growth in energy consumption of 7.5% and an annual growth in demand of 7.2%. The predictions for growth rates in the immediate vicinity of the Station are almost identical with those for the Western Region.

In October 1971, the FPC predicted[2] a peak demand of 2934 MW during the winter of 1971-72 for PSA's 31 and 32. A comparison of this peak demand with that of 1965 (1971 MW) shows a growth rate for this 6-year period of 6.8%, a rate not too different from the predicted 7.2% for these areas. Peak demand[3] for the Applicant was 1426 MW in the winter of 1970-71, whereas predicted demand[2] for the winter of 1971-72 was 1587 MW. This prediction indicates a growth rate of 12% per year, which value seems to verify the Applicant's claim that, because of normal growth and large new customers, the demand growth rate for the Applicant's system will exceed the predicted growth for the area during the period 1970 to 1975.

Table X-1 summarizes information from three sources about the estimated peak demand for the Applicant. The sources differ in the periods for which predictions are made and in what is included in the generating capacity, but even the largest reserve-margin percentage without the Station (17.1%) is still less than is advisable. As of October 1971, the reserve capacity[2] predicted for the winter of 1971-72 for PSA's 31 and 32 was 23.8%; for the whole Western Region, it was 19.2%. Thus, the Applicant's system appears to be somewhat lacking in reserve capacity as compared with both the local and the general regions.

Table X-1—COMPARISON OF PREDICTED POWER AVAILABILITY AND DEMAND (MW)

Power parameter	Winter 1971–72 without Fort St. Vrain (from Ref. 2)	1972 without Fort St. Vrain (from Ref. 3)	Summer 1972 without Fort St. Vrain (from Ref. 4)	Winter 1972–73 with Fort St. Vrain (from Ref. 4)
Generating capacity	1778	1778[a]	1778	2108
Maximum generating capacity		1834[b]		
Commitments with other systems				
Firm sales	−144			
Firm purchases	224			
Total available capacity	1858			
Peak demand	1587	1725[c]	1586	1725
Reserve margin (MW)	191 (gener.) 271 (avail.)	53 (av) 109 (max)	192	383
Reserve margin (%)	12.1 (gener.) 17.1 (avail.)	3.1 (av) 6.3 (max)	12.1	22.2

[a]Includes average pumped storage generating capacity of 268 MW.
[b]Includes peak pumped storage generating capacity of 324 MW.
[c]Includes 93 MW committed to other utilities.

For a utility to provide for maintenance and to meet unpredicted outages and peak loads on its systems, a reserve of 20% of peak load is generally accepted as necessary. Because of unscheduled outages in the long transmission lines in the area served by the Applicant and the trend toward larger single generating units, a 20% reserve is a minimum.

If the Station comes on line in 1972, it will bring the Applicant's generating capacity up to about 2108 MW, which will give a 22.2% reserve over the 1725 MW estimated by the Applicant[3] to be the total peak demand for 1972. In 1973 the reserve would amount to 13.2%, and in 1974 it would be only 5% if the Station or other capacity were not added. These figures include the 93 MW committed to other utilities as a part of the total peak demand but not the purchased power or the peak pumped storage capacity as a part of the Applicant's capacity. From these considerations, the capacity of the Station is definitely needed if the Applicant is to meet its commitments within the area it serves.

XI. ALTERNATIVES TO THE PROPOSED ACTION AND COST-BENEFIT ANALYSIS OF THEIR ENVIRONMENTAL EFFECTS

A discussion of alternatives and the regulatory staff's independent cost-benefit analysis are set out in this section. In many cases, the regulatory staff found the Applicant's estimates of environmental costs and benefits adequate and these were used in the analysis. In other cases, estimates were made independently.

A. SUMMARY OF ALTERNATIVES

Without the Station, the reserve margin of the Applicant's system would be below standard in 1972. Therefore, the alternatives considered were those with respect to avoiding some or all of the probable adverse environmental effects which might occur during operation of the Station.

1. Alternative Sites

The question of site selection is first discussed in Section I.A. The Applicant considered several alternative sites in 1965 prior to selecting the present one. All the other alternatives were within a 100-mile radius of the present Station location, but for reasons of marginal availability of acceptable water and the need for longer transmission lines, the other sites were rejected in favor of the Fort St. Vrain site. Construction at the site is essentially complete and this, in addition to the fact that construction effects are largely a matter of the past, merits consideration. However, in order to analyze costs and benefits, the alternative uses of the site are examined below.

2. Alternative Land Uses

The only reasonable alternative use in the near future for the 80 acres diverted for Station usage would have been for farming. In addition, the loss of 3000 acre-ft/year of water by evaporation from the cooling tower means that about 1500 acres of land must be retired from irrigated farming at some place in the irrigation system whenever all the water available has been allocated. The water evaporated from the towers will obviously return to earth at some point, but it may not be within the geographical boundaries of the affected irrigation system. However, two offsetting possibilities must be considered. First, the lowland areas along the St. Vrain Creek and South Platte River are subject to flooding and standing water and would not appear to be particularly suitable for raising crops. Secondly, some of the acreage retired from potential irrigation farming because of the evaporated water lost could be converted to dry farming. In that case, only crops such as wheat could be grown, with an anticipated yield of 20 bushels/acre.

Expressing the value of agricultural production in terms of annual rental rates, the value of the 80 acres actually occupied by the plant is $1,600 per year at the rate of $20 per acre. Over the 30-year life of the Station, the total estimate is $48,000. This amount does not seem significant. Also, Weld County and the State of Colorado have been experiencing a long-term reduction in the amount of agricultural land in production. Apparently this trend is expected to continue.

Other uses of the land such as residential or industrial do not appear to be particularly appropriate for this site. The availability of hundreds of square miles of similar land nearby does not place the present site in a position such that it would command a higher price because of unique characteristics. This is evidenced by a purchase value of about $400 per acre. If the present site were put to other uses, either residential or industrial, there would not be a similar economic benefit without larger environmental losses. The Station, with an investment of about $71 million, has created directly about 65 additional jobs and annual tax revenues of some $0.6 million. In order to obtain the same increase in valuation by building residences, for example, about 2,000 residences and a population increase of some 6,000 would be required, at least. Their resulting environmental impact would be quite significant. Similarly, the environmental impact created by the installation of some other industrial plant and associated residences to provide an increase in valuation of $71 million would also be quite large.

3. Alternative Fuels and Sources

The main sources of additional electricity for the Applicant are from coal-fired plants or from other nuclear power plants. Evidence from the Western Systems Coordinating Council's Summary of Estimated Loads and Resources[1] shows that no block of base-load power is available from neighboring systems or pools which could replace the Station in the 1972-75 period. Hydroelectric plants, so-called base-load "hydro," are not practical in this region. Their requirements for large amounts of water exceed supplies available in this area to produce power of the magnitude of 330 MWe capacity of the Station.

Pumped-storage hydroelectric units are in use now on the Applicant's system and additional units are being planned, but these require a generating source such as the Station for their primary power supply.

Oil-fired plants were ruled out because they are much more costly to operate than coal-fired plants on account of higher fuel prices. Reliable, low-cost natural gas is not available.

During determination of the best power plant to build and operate, the Applicant's analysis showed that the cost of producing electricity from the nuclear high-temperature gas-cooled reactor was lower than that from a coal-fired plant. (See attached table XI-2 for comparison of capital and operating costs.) Additional considerations, such as the capital-intensive characteristics of the Station and environmental effects of fossil versus nuclear plants, were considered advantageous by the Applicant to the high-temperature gas-cooled reactor.

The more capital-intensive (and less fuel-dependent) nuclear power station has a more stable power cost because it is less affected by fuel price increases resulting from inflation. When coal plants were compared to nuclear power stations in 1965, fuel costs were estimated to be between 2 and 2-1/2 mills/kwh for coal and 1.8 mills/kwh for nuclear. Since that time, development of the nuclear industry has helped reduce nuclear fuel cost to an estimated 1.6 mills/kwh. Recent escalation of coal costs plus emphasis on reducing the sulfur content of coal has almost doubled the fuel cost for coal-fired plants in the Fort St. Vrain vicinity. These fuel cost changes illustrate the long-term effects of inflation on power costs and the advantages of a less fuel-dependent plant.

In comparing the environmental effects of nuclear versus coal-fired plants, it appeared that a coal-type plant would have the disadvantages of the use of more land, large particulate and chemical releases to the air, and a noisy operation.

The Station, on the other hand, has the advantages of less land utilization, no chemical or particulate air pollution from products of combustion, less noise, and a more pleasant visual design.

4. Alternative Heat Dissipation Systems

There are two general methods available for dissipating the waste heat from the Station: 1) adding heat to the South Platte River and St. Vrain Creek, or 2) adding heat directly to the air. The Station's two existing cooling towers were installed to achieve cooling by the evaporation of water and the addition of heat to the atmosphere.

Original plans for the Station provided for discharge of cooling tower blowdown only to St. Vrain Creek via a slough. As an alternate (which will be the normal mode), Goosequill Ditch was extended to provide for discharge via this extension into Jay Thomas Ditch, and subsequently through the Station's farm pond into the South Platte River. The cost of the ditch extension was $29,000. The environmental benefit will be to reduce the estimated stream temperature rise on a hot summer day from 1.95°F in St. Vrain Creek to 0.83°F in the South Platte River.

The normal means of withdrawing blowdown water from the Station's main cooling tower is to drain 101.5°F water from the tower's inlet line. As an alternative, an additional blowdown connection has been installed on the tower's outlet line to permit discharge of 80°F water even on a hot summer day. The cold-side blowdown connection cost about $35,000 to install and will incur annual costs of about $6,500 from additional operating costs and penalties during operation of the connection. The environmental benefit will be the effective elimination of thermal effects from the main cooling tower's blowdown under summer conditions.

Present plans for the Station provide for treatment of cooling-tower water several times per day with chlorine gas to about 1 ppm residual chlorine. As an alternative, plans would provide for treatment of cooling-tower water every 4 days with chlorine gas to about 6 ppm residual chlorine, which would fall off to essentially zero ppm towards the end of the 4-day cycle. The differential economic cost of the cyclic treatment is negligible. The environmental benefit is less total effect downstream after effluent discharge,[7] but the uncertainties of environmental cost (from cyclically higher free chlorine residuals) caused the Applicant to reject this alternative.[8]

a. Dry Cooling Towers

Dry cooling towers are, like their wet counterparts, basically heat exchangers designed to remove process heat from water. Heat is transferred by convection to the air as it passes over the coils or heat transfer surfaces in the tower, raising the temperature of the inlet air. Since no water is lost by evaporation, no heat is transferred to the air by mass transfer as is done in wet towers. This characteristic makes heat transfer less efficient in the dry tower, but affords the advantage that consumptive use of water is kept to a minimum. In addition, the Station would experience a loss of generating capability during hot weather whenever a dry-type cooling system inherently could not meet the back pressure requirements (5 in. Hg or less) of the Station's conventional turbine.[9] In consideration of these factors, this alternative was not elected by the Applicant.

b. Cooling Pond

Another alternative cooling method is the cooling pond where water is recirculated between it and the plant in a closed cycle. Generally, about 1 to 2 acres of cooling surface are required per MWe plant capacity. Therefore, to meet the cooling requirements of the Station, some 350 to 700 acres of flat ground would be needed for a pond. Spraying the water would reduce the pond area required. However, because of shallow water depth near the shore, use of spraying devices would probably require large pump systems to prevent recycling of the heated water. Furthermore, for a pond to show an appreciable advantage over wet cooling towers, it would have to cause fewer acres to be removed from irrigation than is the case because of evaporation from such towers.

The Station's cooling towers cause an average evaporation of some 5 cfs, which deprives up to 1500 acres of land of irrigation water (table XI-1). The water loss from a cooling pond used as an alternative to the cooling towers is estimated to be also around 5 cfs. However, an additional area of some 400 acres would be removed from agricultural use by the creation of the pond. Furthermore, the cost of creating the pond is in excess of $0.2 million.

c. Once-through Cooling

Once-through cooling by use of the required flow from available waterways is also a suggested alternative method. Comparison of the combined flows of St. Vrain Creek and the South Platte River at low-flow conditions (21 cfs) with the flow required for the circulating-water system of the Station (350 cfs) shows that this alternative is not feasible even if much larger sources of water are developed.

5. Alternative Radioactive Wastes Systems

The Applicant discussed at some length two methods of decreasing the radioactivity of the gaseous effluent from the Station. One involved adding equipment to remove ^{3}H; the other, to remove ^{85}Kr. The implementation of these methods would reduce the cumulative exposure to the population within a 50-mile radius by 6.4 man-rem/year. Comparison of this exposure with a total exposure from natural background and medical x-rays of 116,275 man-rem/year shows that the use of these alternatives would produce a completely insignificant improvement. Furthermore, this insignificant reduction would cost well over $500,000 to implement, primarily for the equipment to remove ^{85}Kr. It was therefore decided not to add the equipment to remove ^{85}Kr. The equipment to remove ^{3}H has been installed and will be used on a regular basis.

6. Alternatives to Normal Transportation Procedures

Alternative transportation procedures, such as special routing of shipments, providing escorts in separate vehicles, adding shielding to the containers, and constructing a fuel recovery and fabrication plant on the site rather than shipping fuel to and from the Station, have been examined by the regulatory staff for the general case in an analysis in preparation. The impact on the environment of transportation under normal or postulated accident conditions is not considered to be sufficient to justify the additional effort required to implement any of the alternatives.

B. SUMMARY OF COST-BENEFIT ANALYSIS

Previous sections described characteristics of the Station and various alternatives of siting, power sources, heat dissipation systems and radwaste systems. This section reviews beneficial and detrimental effects of the Station and of the alternatives as a basis for a cost-benefit comparison.

1. Economic and Environmental Benefits

a. Power Generation

The Station is designed to operate at a generation rate of approximately 330 MWe. At a plant factor of 80%, annual generation will be about 2.3 billion kWh.

b. Employment

The permanent work force for the Station is about 65 persons. On the basis of one service or support job created for each industrial position, this results in a total increase of about 130 jobs.

Construction of the Station eliminated about 100 acres of farmland or about two agricultural and service jobs. Consequently, the net effect of Station construction was an increase of about 128 jobs.

c. Tax Generation

Construction of the Station added to the tax bases an estimated $71 million plus the potential for more than 125 residential units worth over $3.5 million in surrounding communities. This assumes that the new jobs were additive and resulted in one new residence for each new job. The resulting increase in tax payments would be $0.6 million per year, based on the local tax rate.

d. Educational Benefits

The Applicant has devoted significant efforts to educate the public about nuclear power plants and their environmental effects. An important part of these efforts has been construction of a visitor information center explaining atomic energy, nuclear power plants, and the beneficial uses of the atom. So far about 30,000 visitors have been through the center. The visitors have originated from all 50 States and 42 foreign countries.

e. Cultural and Social Factors

A review of the historical significance of four old forts, which were the centers of a thriving fur trade in the 1836-1844 era, and the resulting modeling of the exterior of the visitors' information center after the original Fort St. Vrain constitute a small cultural benefit to the area.

2. Economic and Environmental Costs

a. Capital Costs and Related Resource Commitments

Construction of the Station is estimated to cost about $71 million. This does not include development and research costs of about $142 million for the high-temperature gas-cooled reactor concept. Assuming the normal distribution between labor and materials for nuclear plants results in expenditures of about $15 million for labor, $35 million for site materials, and $21 million for Station equipment.

Permanent resource commitments include the construction materials used, especially materials in the reactor, plus adjacent shields and equipment. These probably will be committed for decades because of activation of long-half-life materials by the reactor neutrons.

Land occupied by the reactor and turbine buildings also is probably irretrievably committed to industrial use. Dismantling the Station and isolating the Station's reactor vessel would cost about $5.6 million, probably more costly than the value of the land. Obsolescence of the existing Station, however, does not preclude modification of the buildings and contents to accommodate future industrial activities.

b. Agricultural Costs

Less than 100 acres of Weld County's 914,000 acres of crop land (excluding 1,100,000 acres of pasture land) have been taken out of actual production by the Station. Annual revenue from agricultural production in this country averaged $113 per acre according to the 1964 U.S. Census of Agriculture. Allowing for a 20% inflation factor since that census yields some $14,000 annual drop in agricultural income.

c. Aesthetics

The Station's transmission lines travel across the Colorado farmlands with minor effect on the terrain. There was a minimum of tree removal along the right-of-way.

The transmission lines have the normal aesthetic impact of such lines across agricultural land. They clutter up the local view in the same manner as fences, telephone lines, farm buildings, etc. There are no unique scenic views along the transmission line routes.

d. Water Pollution

Radionuclides released to the water bodies from the present radioactive wastes facilities are estimated to create a radiation dose of less than 1 man-rem per year.

Reduction in thermal releases through use of the cooling towers provides an environmental benefit accompanied, however, by an environmental cost from blowdown and drift.

The potential hazard of chlorine releases is attenuated by dilution of the cooling tower blowdown streams.

e. Air Pollution

There is no significant release of particulates or noxious chemical compounds to the atmosphere. The primary exception is the release of small amounts of diesel engine exhaust fumes during periodic testing of the emergency electrical equipment.

Radionuclides released to the air from the present radioactive wastes facilities would lead to a radiation dose of 6.4 man-rem per year distributed among the approximately 1.4 million persons expected to be living within 50 miles of the Station in 1972. Thus the average increased annual dose received by that same population (4.5×10^{-6} rem per person per year) would be negligible in comparison to the normal background dose rate of 0.25 rem per person per year.

3. Summarized Comparison of Station and Alternatives

Table XI-1 summarizes those features that enter into an evaluation of costs and benefits in order to achieve a balance between economic considerations and environmental quality (tables XI-2 and XI-3 list costs and assumptions used). Factors receiving consideration are listed in the first column. The second column identifies the cost of impact on those factors for the Station as presently constructed, and the remaining columns provide the same information for several alternatives.

The first four lines in the table list values in millions of dollars for those items that are quantifiable in monetary terms. The remaining lines provide comparison through numerical descriptions of other terms.

To provide a common basis for comparison of alternative actions, only incremental costs and benefits were considered. The approximately $71 million already invested in the Station represents a problem which would offer considerable difficulty if an alternative such as a coal-fired plant or another type of nuclear plant were chosen.

Viable alternatives and their significant differential costs and benefits compared to the existing Station are summarized in the table. Because the various capital and operating costs for the several alternatives listed occur at different times, a present worth calculation has been used to reduce these factors to an equivalent present capital expenditure. Each of the costs shown in the table represents the amount of money that must be invested in 1971 at 8.75% interest to provide the funds necessary to cover the related expenditures during the assumed 30-year life of the applicable option. Alternative actions are compared in terms of the differential in costs and benefits relative to the existing design (reference case).

The second column of the table lists the remaining costs for the reference case and the environmental impacts of the present design. Over the lifetime of the Station, the annual fuel and operating expenses are equivalent to a present worth of $76 million. The remainder of the column shows that the existing design has a minor impact on the environment in a detrimental sense.

Table XI-1–DIFFERENTIAL COST SUMMARY FOR THE STATION–ALTERNATE ACTIONS

Type of cost or impact	Fort St. Vrain reactor	Cost or impact of alternate above cost or impact of Fort St. Vrain reactor: Light-water reactor	Coal-fired plant	Cooling pond[a]
		Monetary costs (millions of dollars)		
Capital	4[1,3b]	95[2,3]	69[3,5]	1.2[1a]
Present worth of				
Replacement power at 10 mills/kWhr		104 (6 year)[4]	75 (4 year)[4]	
Fuel and operating expense	34 (first 8 years)[3,6] 42 (last 22 years)[3,6]	−17 (24 year)[3,6]	41 (26 year)[3,6]	
Total present-worth costs	80	182	185	1.2
		Environmental impact		
Land use				
Land required				
Plant	2238 acres; 80 acres removed from agriculture[1]		Additional land – about 10 acres for coal storage and handling[4]	Additional land – about 400 acres for cooling pond[1a]
Transmission lines	About 10 miles of 230-kV line at 0.15 acre/mile equals 1.5 acres removed from agriculture[1]			
Total agriculture	About 81 acres taken out of agriculture		About 10 acres for storage and handling	About 400 acres in pond
Historic and scientific	No impact			
Water use				
Commercial				
Industrial	No change			
Irrigation	About 1500 acres might be denied irrigation[1]	About 700 more acres might be denied irrigation	About the same as for the Fort St. Vrain reactor	~200 acres less (unsprayed); 150 acres more (sprayed)
Recreation	No appreciable effect			
Marine life	No effect			
Air emissions	1000 Ci/year noble-gas emissions[1]		SO_2 = 10,000 tons/year; NO_x = 5000 tons/year; particulate = 600 tons/year[4]	Fewer vapors and solids put into air
Radiological	Whole-body dose of about 7 man-rem/year to people in 50-mile radius[1]		Radioactivity in fly ash[4a,4b]	
Fuel transport	Total shipped, 950 tons/year [this includes new and spent fuel elements and casks – 72 tons/year is fuel elements (36 tons in, 36 tons out)]	About 60 tons/year, less in actual fuel shipped[4]	523,000 tons/year[4]	
Waste products	About 20 tons/year of solid wastes[1]		50,000 tons/year, ash and combustion products[4]	
Aesthetic	Relatively low profile plant; architectural treatment blends to surrounding		Tall stacks, visible emissions, vapor and particulates, 5 to 10 acres of coal	400-acre pond

[a]Alternate to cooling towers.
[b]Cost of completing reactor.

Table XI-2–BASES OF COSTS SHOWN IN TABLE XI-1

	From PSC[a]	Estimate from literature	Used
Capital costs ($/kW)			
HTGR[b] (1972 operation)	71		71
LWR[c] (1978 operation)	436	390[d]	400
Coal (1976 operation)	254	280[e]	270
Replacement power (mills/kWhr)	9.87	10[f]	10
Operation, maintenance, insurance, and fuel costs (mills/kWhr)			
HTGR	2.58 (1st 8 years)	3.5[g]	2.58 for 8 years 3.5 for 22 years
LWR	3.4	2.6[h]	2.6
Coal	4.17	5.4[h]	5.0

[a]Public Service Company of Colorado.
[b]High-temperature gas-cooled reactor.
[c]Light-water reactor.
[d]From ref. 2.
[e]From ref. 5.
[f]From ref. 4.
[g]ORNL estimate.
[h]From ref. 6.

Table XI-3—ECONOMIC ASSUMPTIONS USED IN COST EVALUATION OF ALTERNATIVE ACTIONS

Useful life of plant	30 years
Average load factor	80%
After tax cost of capital	8.75%
Incremental cost of replacement power	10 mills/kWhr

The next columns identify differential costs associated with building a nuclear light-water reactor or a coal-fired plant as an alternative to provide the needed power. The capital costs are given as the present values over a 6-year or 4-year construction period as the case might be. During these construction periods, replacement power would have to be supplied in place of the present Station at present values which are listed. Fuel and operating expenses for the balance of the lives of the alternative plants are also present-worthed. The remainders of the columns show the incremental impacts on the environment produced by the alternatives to the reference case.

Based on these comparative evaluations, it is evident that none of the alternatives considered produces a significant environmental benefit or a reduction in environmental costs with respect to the reference case. Furthermore, all of the alternatives result in economic costs that cannot be balanced by economic or environmental benefits.

It is concluded that the existing Station will provide the needed increased generation of electric power with a minor environmental impact. Significant expenditures have been and are being made by the Applicant to protect environmental quality by monitoring and maintaining the environmental impact at a practicable minimum.

XII. DISCUSSION OF COMMENTS RECEIVED ON THE DRAFT ENVIRONMENTAL STATEMENT

Pursuant to paragraph A.6 of Appendix D to 10 CFR Part 50, the draft environmental statement of April 1972 was transmitted, with a request for comment, to:

- Corps of Engineers
- Department of Agriculture
- Department of Commerce
- Department of Health, Education, and Welfare
- Department of Housing and Urban Development
- Department of the Interior
- Department of Transportation
- Federal Power Commission
- Environmental Protection Agency
- State of Colorado Department of Health
- State of Colorado Coordinator of Environmental Problems
- Board of County Commissioners of Weld County, Colorado

In addition, the AEC requested comments on the draft environmental statement from interested persons by a notice published in the Federal Register on April 19, 1972 (37 F.R. 7727).

Comments in response to the requests referred to above were received from:

- Corps of Engineers
- Department of Agriculture
- Department of Commerce
- Department of Health, Education, and Welfare
- Department of the Interior
- Department of Transportation
- Federal Power Commission
- Environmental Protection Agency
- Advisory Council on Historic Preservation
- State of Colorado Department of Health

Our consideration of comments received and the disposition of the issues involved are reflected in part by revised text in other sections of this final environmental statement and in part by the following discussion.

A. WATER RIGHTS

A question was raised about acquiring emergency water for the Station by court condemnation of the water rights of other users. Such an act is most unlikely and would never be attempted unless the overall impact of not condemning other rights would have detrimental effects on the welfare of the State and the people. Obtaining water rights by condemnation would be difficult and time-consuming, and the procedure would probably be too slow to meet emergency water needs. The Applicant has stated an intention to purchase more water rights, which are available in the area.

B. WATER AVAILABILITY

The regulatory staff conducted a careful review of water availability before reaching the conclusion in the environmental statement that the Station might be short of water a few months during a 10-year period.

The regulatory staff made the analysis on the basis of 30-day low-flow averages covering 20 years. Analysis on a 7- to 14-day, once-in-10-years low-flow basis was suggested. Such selection for the basis of analysis is a matter of practical choice. For the Station, the settling basins could provide emergency water for a 7-day low-flow period. Undoubtedly, during a succeeding 7-day period, the flow would be sufficiently better to provide minimum water quantities. After these critical two weeks, water flows would have to increase to raise the monthly averages to the values the regulatory staff used for analysis. Because of these factors, the monthly low-flow averages were chosen for analysis.

Three ditches with decrees for 117.7 cfs of water have prior claims upstream of the Jay Thomas Ditch. About half the water removed from the river for irrigation finds its way back into the river as runoff and seepage. Consequently, in a dry season, if these three ditches were allowed only about one-third of their water rights (40 cfs), probably 20 cfs would return to the river to supply needs down-stream, thus giving the Jay Thomas Ditch about 6 cfs if the same one-third allocation restriction were applied. If as little as half of the 6 cfs could be pumped, then water from Colorado-Big Thompson rights, which are more firm than other rights, might be combined with this water and added to a small amount from wells and other rights to obtain sufficient water for the Station. However, if 9.1 cfs could not be obtained, then generation of power could be reduced for a short time until sufficient water flow was available.

Table III-3 answers the comments on study of the flow relationship between Henderson, Colorado, and the Station. The figures in this table are based on about 30 years of river and irrigation history.

Availability of water will be one of the operational problems at the Station, but with astute water management techniques, power reductions can probably be held to a minimum or eliminated.

C. COLORADO STATE WATER QUALITY STANDARDS

St. Vrain Creek and the South Platte River are designated as Class C - Industrial and Class D1 - Irrigational in the area of the site. Requirements for such streams follow:

Class C. The following standards shall apply to waters classified for industrial uses:

a. Dissolved Oxygen: Dissolved oxygen content shall not go below 3 milligrams per liter.

b. pH: pH shall be maintained between 5.0 and 9.0.

c. Turbidity: No turbidity shall exist in concentrations that will interfere with established levels of treatment.

d. Temperature: The temperature shall not exceed 90°F.

Class D1. The following standards shall apply to waters classified for irrigation:

a. Total Dissolved Solids (Salt) Concentration: A time-weighted monthly mean at a monitoring station which exceeds the time-weighted monthly mean for a base period established by the Water Pollution Control

Commission (WPCC) by more than two standard deviations shall be subject to review by WPCC.

b. Sodium Adsorption Ratio: A time-weighted monthly mean at a monitoring station which exceeds the time-weighted monthly mean for a base period established by WPCC by more than two standard deviations shall be subject to review by WPCC.

c. Toxic Material: Free from biocides, toxic, or other deleterious substances attributable to municipal, domestic, industrial wastes, or other controllable sources in concentrations or combinations which are harmful to crop life.

D. EFFECT OF EFFLUENTS ON WATERFOWL

Questions were received on the effects on migrating waterfowl of chemical and thermal releases to the farm pond. Migrating waterfowl are discussed in Sect. II.E.2.b. Since the pond is relatively small, only a small percentage of migrating waterfowl could use the pond. However, thermal effluents will undoubtedly change the freezing pattern of the pond and could cause an abnormal concentration of waterfowl in the area. The chemicals released to the pond at the higher concentrations are not highly toxic to most organisms.[1] This does not discount the fact that a combination of chemical and thermal releases from the Station could produce conditions toxic to waterfowl. The Applicant's biological monitoring program should determine such conditions.

E. EFFECT OF EFFLUENTS ON ST. VRAIN CREEK

Concern was expressed about the effect of heated effluents on St. Vrain Creek and the South Platte River during adverse stream conditions. When heated effluents are released to the South Platte River during average stream flow conditions, no significant adverse effect is expected on the biota of the stream. The thermal impact would be greatest when the stream flow is lowest. The calculations of the increase in temperature in the streams assumed that under adverse winter conditions heated effluents would not be discharged into St. Vrain Creek (Sect. V.D.1.a.). The Applicant has considered the extent of mixing between the thermal effluents and the water of each stream. After the Station becomes operational, the boundaries of the mixing zones will be determined for each stream under adverse conditions (Sect. V.B.1). Blow-down from the cooling towers can be released from the cold leg of the towers at a temperature of 80°F (Sect. III.D.6); this mode allows the Station to operate under adverse stream conditions without producing a significant effect on the biota of either stream. The biota of the South Platte River and St. Vrain Creek were not adequately described (Sects. V.D.3.a and b); i.e., population data on important species were not available. However, the possible effects that heated effluents would have on the streams are described in Sects. V.D.1.a(1) and (2) and V.B.1.

F. COST-BENEFIT COMPARISON OF ALTERNATIVE COOLING SYSTEMS

1. Cooling Towers

A request was made for a comparison of the costs and benefits of all cooling system alternatives. Specifically, natural-draft wet cooling towers and dry cooling towers were suggested for reduction of the consumptive use of water.

The regulatory staff believes that the difference between the consumptive use of water in a natural-draft wet cooling tower and the use in a mechanical-draft wet cooling tower is probably so small as to be insignificant. Furthermore, the natural-draft towers operate to greater advantage under conditions of high humidity rather than under the low humidity conditions usually prevailing at the Fort St. Vrain site.

The knowledge of how to build dry cooling towers is increasing rapidly. However, the present state of knowledge about design of such towers for generating stations of 330 MWe size leaves much to be desired.

For these reasons, consideration of systems other than the mechanical-draft cooling tower is thought to be unnecessary.

2. Cooling Ponds

A comment asked for consideration of the cooling pond alternative both with and without spraying devices.

Evaporation of 5 cfs dissipates 81.5% of the heat load. The regulatory staff has estimated that a cooling pond [2,3] would dissipate approximately 70% of the heat put into it by evaporation, and a spraying device might increase this figure to 80 to 90%. Thus, if the 81.5%

heat loss by evaporation causes a loss of irrigating water for 1500 acres, use of an unsprayed cooling pond would cause (.70/.815) x 1500 = 1288 acres to be without irrigation water and use of the pond with a spraying device would cause from 1470 to 1656 acres to lose irrigation water.

If pond area is included as land lost to agriculture, then there seems to be no way in which the acreage lost to agriculture can be significantly reduced.

3. Assumed 30-Year Life of Options

A 30-year economic life is used to provide a reasonable and consistent analytical basis for evaluating all steam-electric power plant alternatives. In selecting a 30-year life for economic evaluation, it is recognized that the technical operating life of specific units may be substantially longer. Although a facility might be used for more than 30 years—especially for spinning reserves or peaking purposes, such added generation makes an insignificant contribution to the total on a present worth basis. Furthermore, great uncertainties exist as to the long-term use of any facility in a world of rapidly changing technologies and energy supply conditions. As a result, 30 years is used for evaluating the economic life of facilities while a 40-year licensing permit is issued to encompass the anticipated technical life of nuclear units.

G. TOXICITY OF ALGAE

A comment pointed out that the blue-green algae *Anabaena* is known to be toxic to livestock. According to Gorham,[4] six species of blue green algae are know to be toxic to livestock, e.g., *Anabaena fos-aquae*. There are several species of *Anabaena* that are not toxic. The Applicant identified the algae as *Anabaena* sp.; therefore, whether the species of algae at the Fort St. Vrain site is toxic or not is not known. In the biological monitoring program, the regulatory staff has recommended that the Applicant have the algae species identified.

The Applicant has initiated a more intensive biological study. In any case, the livestock that use the water in question are owned by the Applicant.

H. YTTRIUM-91 VALUE IN SOURCE TERM

One comment noted that the yttrium-91 value appears to be high in relation to the other isotopes in the source term for the Station.

Yttrium-91 is a decay product of strontium-91 which has a half-life of 9.7 hours. In the decontamination solution which is the principal source of liquid radioactive waste, there is sufficient holdup time to permit most of the strontium-91 to decay yttrium-91 prior to processing. In the evaluation in Section III.E.2., the regulatory staff assumed one pass through a demineralizer with decontamination factors of 1000 for all elements except cesium and yttrium, for which factors of 10 and 1, respectively, were estimated. Based on this analysis, the regulatory staff calculated 0.032 Ci/yr of yttrium-91 and a total of about 0.008 Ci/yr of other isotopes in the anticipated annual releases of radioactive material in liquid effluents from the Station.

I. RADIOACTIVITY IN REGENERATION EFFLUENTS

A comment was made that in the event the regeneration effluents are radioactive, capability must be provided to treat these effluents as liquid radioactive waste. The final safety analysis report for the Station states that the isotopic concentrations of radionuclides with half-lives greater than or equal to one day in the condensate demineralizer regeneration solutions are expected to be zero. The only radionuclide normally present in the secondary coolant system is a small amount of nitrogen-16 (half-life - 7.4 sec).

J. VAPORIZATION OF IRRADIATED FUEL

A request was made that a statement assuring that there would be a minimal chance of spent fuel elements becoming vaporized in part, as a result of hot spots developing during transport, should be presented. The transportation of irradiated fuel requires approval of both the Department of Transportation and the Atomic Energy Commission. The design of HTGR fuel for the Station and the design of the spent fuel cask are such as to preclude the possibility of fuel elements becoming vaporized during transportation.

K. AMOUNT OF EXPECTED FAILED FUEL

A comment noted that the failed fuel value (1%) does not appear to be conservative, if the meaning is cracks in the graphite coating. Based on research and development testing of the HTGR fuel for the Fort St. Vrain Nuclear Generating Station, the regulatory staff expects that this Station's reactor will experience less than 1% failed fuel. In the sense used here, failed fuel includes cracks in the graphite coatings that could permit release of fission products.

L. REALISTIC ASSESSMENT OF ACCIDENTS

Comments questioned the validity of applying the bases used for evaluating the consequences of LWR accidents to the HTGR accidents for this Station.

As set forth in section VI, the regulatory staff determined a more appropriate accident class breakdown for the Station than those set forth in the Annex to Appendix D. In addition, since the assumptions set forth in the Annex to Appendix D are not directly applicable for the Station, the regulatory staff used a similar set of more realistic assumptions in the analysis. The assumptions relating to the percentage of inventory released from various holdup tanks for various accidents, the use of atmospheric diffusion conditions that are expected to occur 50% of the time, the weighting of effects in different directions by the frequency the wind blows in each direction, and the averaging of a dose over a 22-1/2 degree sector are identical to those set forth in the Annex to Appendix D.

Some of the assumptions used in evaluating certain accidents are quite different from those set forth in the Annex to Appendix D. Included among these differences are (1) the determination that Class 4 accidents (fission products to the primary coolant) are not applicable because fission products cannot escape into the primary coolant by the one step process of fuel failure identified in the Annex, and (2) Class 6 accidents (refueling accidents) are not applicable for the same reason and with the additional factor that the breaking the fuel particle coatings and the breaking of the graphite-fuel block does not constitute a significant occurrence by itself because during all refueling operations the fuel is contained in a closed system. Other unique assumptions include:

(1) For the fuel cask drop accident, the regulatory staff assumed that the shipping cask contained the maximum number of fuel blocks (6) after end-of-life operation, that the 1% failed fuel (i.e., particle coatings failed) in the 6 blocks was hypothetically submersed in water (if not, there would not be a significant fission product release), and the fuel kernels (UC-ThC) of the entire 1% failed fuel were completely converted to the oxide form by hydrolysis.

(2) For the instrument line break, it was assumed that 45% of the primary coolant inventory was released over a 4 hr period and that the primary coolant noble gas inventory was at its "expected" limit as set forth in the final safety analysis for the Station.

The analysis included two accidents, namely the rapid depressurization accident and the permanent loss-of-forced circulation accident, in Class 8 although they could only occur following a specific sequence of several postulated successive failures and, as such, could be considered Class 9 accidents. These two accidents have been included in Class 8 to maintain consistency with the philosophy of including design basis accidents in this classification. It was considered appropriate to include these very low probability accidents in the evaluation of the station's safety features since it is a first-of-a-kind facility.

The doses calculated as consequences of the postulated accidents are based on airborne transport of radioactive materials resulting in both a direct and an inhalation dose. The evaluation of the accident doses assumes that the Applicant's radiological monitoring program and appropriate additional monitoring (which could be initiated subsequent to an incident detected by in-plant monitoring) would detect the presence of radioactivity in the environment in a timely manner such that remedial action could be taken if necessary to limit exposure from other potential pathways to man. The small quantities of dispersed radioactive material which might enter the food chain would not be significant in terms of endangering aquatic life.

M. NATURAL BACKGROUND RADIATION LEVELS NEAR SITE

One comment suggested that anomalies in the natural background levels in the environment adjacent to the site should be discussed. Natural gamma aeroradioactivity of the Fort St. Vrain site area has been reported.[5] The aeroradioactivity of the site was measured as 1000 counts per second which is in the higher range of readings for the entire Denver area -- from 300 to 1550 counts per second. Debris, consisting of Precambrian metamorphic and igneous rocks and Tertiary intrusive rocks, from the Front Range (see page II-14) is the chief cause of the high radioactivity areas. The radioactivity of many of these rocks is due to accessory minerals monazite, zircon, and apatite. These are particularly stable numerals that persist in the sediments derived from crystalline rocks for long distances from their source areas. St. Vrain Creek, among other creeks in the area, drains portions of the Front Range. Along the South Platte River and tributaries that originate in the Front Range, the younger alluvium derived from crystalline rocks has a high radioactivity which contrasts with the surrounding sedimentary rocks.

N. LOCATION OF PRINCIPAL REVISIONS OF TEXT IN RESPONSE TO COMMENTS

Topics Commented Upon	Section Where Topics are Addressed
Source of Information on Site Ecology	II.E
Alternate Effluent Path Deleted	II.E, Fig. II-8
Transmission Lines	III.C

Shutdown and Emergency Heat Dissipation	III.D.7
Schedule for Operation Deleted	IV.
Stream Monitoring for Thermal Mixing Zone	V.B.1
Effect of Annual Draining of Cooling Towers and Ponds	V.B.2
Identification of Bottom Fauna Corrected	V.D.1.a.(2)
Salinities of Streams in Arid West	V.D.1.b
Identification of Biocide Corrected	V.D.1.b
Objectives of Radiological Monitoring Program	V.E.4
Plutonium in Spent Fuel	V.F.2
Tax Generated by Station	XI.B.1.c
Cost of Station Construction	XI.B.2.a

O. COMMITMENTS BY APPLICANT

The Applicant has made commitments to Federal and State agencies that necessitated a number of text revisions in this statement. The commitments and the resulting text revisions are identified below.

PCRV Cooling Water pH Control

By letter dated May 15, 1972, the Applicant submitted the volume of Attachments to Amendment No. 25 to the Application dated October 19, 1966, for a construction permit and operating license for the Station. In section 9.7.2 Design Criteria the Applicant states "Aqua ammonia is supplied by a chemical injection system, as required, to control pH" of the PCRV liner cooling water. The resulting text revisions are located on pages III-30, III-35, and III-40.

Disposal of Tritium as Solid Waste

By letter dated May 15, 1972, the Applicant submitted the volume of Technical Specifications for the Station. In Specification LCO 4.8.1j), the Applicant specifies "Under normal operating conditions, tritium from the H_2 Getters shall be disposed of as a solid waste on an absorbent material." The resulting text revision is located on page XI-5.

Environmental Sampling Schedule

By letter dated May 15, 1972, the Applicant submitted the volume of Technical Specifications for the Station. In Specification SR 5.9.1, the Applicant specifies that sampling shall be conducted in accordance with Table 5.9-1 and Table 5.9-2. The resulting text revision is located in Table V-5 on page V-24.

Annual Volume of Liquid Radioactive Wastes

By letter dated June 30, 1972, the Applicant transmitted a document titled, "Applicant's Comments Regarding Draft Environmental Statement Issued April, 1972, by the United States Atomic Energy Commission for the Fort St. Vrain Nuclear Generating Station." On page 8 of that document, with respect to the volume of liquid radioactive wastes the Applicant stated "... Applicant has revised the estimated quantity to 8000 gallons per year." The resulting text change is located on page III-32.

Discharge of Demineralizer Regeneration Effluents

On page 8 of the Applicant's comments regarding the draft environmental statement issued April 1972, the Applicant states

> "Applicant's plans for discharge of demineralizer regeneration effluents have been revised in cooperation with the Environmental Protection Agency. These effluents will be ponded in two evaporation ponds with a total surface area of about 1.5 acres located a few hundred feet northeast of the plant building instead of being discharged into St. Vrain Creek."

The resulting text revisions are located on pages III-36, III-38, V-5.

Discharge of Cooling Tower Blowdown

By letter dated June 30, 1972, the Applicant transmitted a document titled, "Applicant's Comments Regarding Agency Comments Relative to the Draft Environmental Statement for the Fort St. Vrain Nuclear Generating Station." On page 10 of that document, the Applicant states

> "The normal path of discharge of cooling tower blowdown, which would include liquid radwaste, will be through the farm pond. Applicant has also agreed with EPA Region VIII to accept this mode of discharge as a condition for normal operation. Discharge would be made through the slough only because of abnormal circumstances...."

The resulting text revisions are located on pages III-6, III-20, V-1.

Blowdown from Cool Side of Cooling Tower

On page 12 of the Applicant's comments regarding agency comments, the Applicant states

> "As a result of discussions with EPA Region VIII, Applicant will accept as a condition for normal operation that blowdown will be discharged from the cool side of the tower at times when discharge temperature to the stream would be greater than 80°F."

The resulting text revisions are located on pages i, III-22, V-3, V-9.

Blowdown and Drainage

On page 19 of the Applicant's comments regarding agency comments, the Applicant states

> "Applicant has been engaged in discussions with the Region VIII Office of EPA for some period of time regarding the Agency's review of Applicant's request for a permit to discharge. One of the effluent limits that has been established for normal operation is a maximum discharge of 3.75 million gallons per day. During the draining and cleaning of the cooling tower basin, the 3.75 MGD discharge rate would not be exceeded, which would be equivalent to about 6 CFS."

The resulting text revisions are located on pages III-22, V-5.

REFERENCES

References for Section II

1. Geologic Map of Colorado, U.S. Geological Survey, 1967.

2. Public Service Company of Colorado, Applicant's Response to Letter from Department of Transportation, Aug. 11, 1971, p. 10-30 in Applicant's Environmental Report, Operating License Stage, Fort St. Vrain Nuclear Generating Station, Supplement 1, October 1971.

3. Town of Platteville, Colorado, Comprehensive Plan and Zoning Ordinance, 1969, p. 20.

4. U.S. Department of Commerce, Number of Inhabitants, Colorado, Bureau of the Census, Population of Places, 1970.

5. Private communication, U.S Department of Interior to USAEC Regulatory Staff, p. 10-38 in Applicant's Environmental Report, Operating License Stage, Fort St. Vrain Nuclear Generating Station, Supplement 1, October 1971.

6. Colorado Environmental Commission, Second Interim Report, December 1971, p. 13.

7. Ibid., p. 16.

8. Personal communication, S. Boyes, Weld County Agent, to W. E. Browning, Oak Ridge National Laboratory, Dec. 15, 1971.

8a. Letter from Stephan H. Hart, Colorado State Liaison Officer, The State Historical Society of Colorado, to D. R. Muller, AEC, June 29, 1972.

9. C. B. Hung, Pleistocene and Recent Deposits in the Denver Area, Colorado, U.S. Geological Survey Bulletin 996-C, 1954.

10. G. R. Scott, Geology of the Littleton Quadrangle, Jefferson, Douglas, and Arapahoe Counties, Colorado, U.S. Geological Survey Bulletin 1121-L, 1962.

11. R. O. Smith, P. H. Schneider, and L. R. Petri, Groundwater Resources of the South Platte River Basin in Western Adams and Southwestern Weld Counties, Colorado, U.S. Geological Survey Water Supply Paper 1658, 1964.

12. Letter from C. K. Millen, Vice President, Electric Operations Division, Public Service Company of Colorado, Denver, to U.S. Corps of Engineers, Sept. 28, 1971.

13. G. S. Garbarini and H. K. Veal, "Potential of Denver Basin for Disposal of Liquid Waste," in Subsurface Disposal in Geologic Basins--A Study of Reservoir Strata, ed. by J. Galley, American Association of Petroleum Geologists, Tulsa, Okla.

14. Personal communication, F. Rozich, Director, Water Pollution Control, Colorado Department of Health, to W. E. Browning, Oak Ridge National Laboratory, Dec. 15, 1971.

15. U.S. Department of Interior, Report on the Narrows Unit, Colorado - South Platte Division, Bureau of Reclamation, Denver, Colorado, August 1966, p. 6.

16. Personal communication, S. Kuiper, Director of Water Resources Board, Department of Colorado Natural Resources, to W. E. Browning, Oak Ridge National Laboratory, Dec. 15, 1971.

17. Public Service Company of Colorado, Applicant's Environmental Report, Operating License Stage, Fort St. Vrain Nuclear Generating Station, December 1970, p. 4-22.

18. E. Reiter, "Meteorological Condition at the Fort St. Vrain Nuclear Generating Station," Section 2.8 in Final Safety Analysis Report for Fort St. Vrain Nuclear Station, June 1967.

19. Personal communication, W. May, Colorado State Meteorologist Colorado Department of Health, to W. E. Browning, Oak Ridge National Laboratory, Dec. 15, 1971.

Other References Used

20. K. J. Schiager and S. T. Bard, Environmental Radiation Surveillance Program for the Public Service Company of Colorado, Tenth Quarterly Progress Report for the Period April-June 1971, Aug. 26, 1971; also in Amendment 24 of the FSAR.

21. W. H. Everhart and M. Johnson, "Aquatic Biota Sampling Program," pp. 8-24 in Environmental Radiation Surveillance Program for the Public Service Company of Colorado, Eleventh Quarterly Progress Report for the Period July-September 1971, ed. by K. S. Schiager and S. T. Bard, Nov. 13, 1971; also in Amendment 24 of FSAR.

22. R. W. Pennak, "Rocky Mountain States," pp. 349-369 in Limnology in North America, ed. by D. G. Frey, The University of Wisconsin Press, Madison, 1963.

23. L. E. Keup, W. M. Ingram, and K. M. Mackenthun, The Role of Bottom-Dwelling Macrofauna in Water Pollution Investigation, U.S. Department of Health, Education, and Welfare, Public Health Service, Division of Water Supply and Pollution Control, Cincinnati, Ohio, 1966.

24. C. M. Palmer, Algae in Water Supplies, Public Health Service Publication 657, Washington, D. C., 1962.

25. Public Service Company of Colorado, Applicant's Environmental Report, Operating License Stage, Fort St. Vrain Nuclear Generating Station, December 1970.

26. K. F. Lager, Freshwater Fishery Biology, Wm. C. Brown Company, 2d ed., Dubuque, Iowa, 1956.

27. A. W. Kuchler, Potential Natural Vegetation of the Conterminous United States, American Geographic Society, New York, 1964.

28. H. J. Oosting, The Study of Plant Communities, W. H. Freeman and Company, San Francisco, Calif., 2d ed., 1956.

29. L. Fraley, Jr., Response of Shortgrass Plains Vegetation to Chronic and Seasonally Administered Gamma Radiation, Ph.D. thesis submitted to the Department of Radiology and Radiation Biology, Colorado State University, Fort Collins, August 1971, Appendix 1.

30. Personal communication, R. Sargent, Vice President, Public Service Company of Colorado, to G. Blaylock, Oak Ridge National Laboratory, Dec. 17, 1971.

31. F. A. Glover, Waterfowl of Colorado, Colorado Division of Game, Fish, and Parks, Department of Natural Resources, Code: GFP-G-1-27-70.

References for Section III

1. Public Service Company of Colorado, Applicant's Environmental Report, Operating License Stage, Fort St. Vrain Nuclear Generating Station, Supplement 1, October 1971.

2. Estimated from Chemical Quality of Ground Water in the Prospect Valley Area, Colorado, Colorado State University Experiment Station, Fort Collins, General Series 870, July 1963.

3. Public Service Company of Colorado, Applicant's Environmental Report, Operating License Stage, Fort St. Vrain Nuclear Generating Station, December 1970.

References for Section V

1. Public Service Company of Colorado, Applicant's Environmental Report, Operating License Stage, Fort St. Vrain Nuclear Generating Station, Supplement Number 1, October 1971.

2. P. A. Krenkel and F. L. Parker, "Engineering Aspects, Sources, and Magnitude of Thermal Pollution," pp. 10-61 in Biological Aspects of Thermal Pollution, vol. 1, ed. by P. A. Krenkel and F. L. Parker, Vanderbilt University Press, Nashville, Tenn., 1969.

3. Public Service Company of Colorado, Applicant's Environmental Report, Operating License Stage, Fort St. Vrain Nuclear Generating Station, December 1970.

4. K. J. Schiager and S. T. Bard, Environmental Radiation Surveillance Program for the Public Service Company of Colorado, Tenth Quarterly Progress Report for the Period April-June 1971, Aug. 26, 1971; also in Amendment 24 of the FSAR.

5. W. H. Everhart and M. Johnson, "Aquatic Biota Sampling Program," pp. 8-24 in Environmental Radiation Surveillance Program for the Public Service Company of Colorado, Eleventh Quarterly Progress Report for the Period July-September 1971, ed. by K. J. Schiager and S. T. Bard, Nov. 13, 1971; also in Amendment 24 of FSAR.

6. Ibid., p. 5-17.

7. The Resources Agency of California, Water Quality Criteria, ed. by J. E. McKee and H. W. Wolf, Publication 3-A, 1963.

8. J. C. Merkens, "Studies on the Toxicity of Chlorine and Chloramines to the Rainbow Trout," Water Waste Treat. J. 7, 150-51 (1958).

9. C. C. Coutant, "Biological Aspects of Thermal Pollution. I. Entrainment and Discharge Canal Effects," Environ. Cont. 1, 341 (1970).

10. D. E. Merriman et al., The Connecticut River Investigations, 1965-72, Semiannual Progress Reports to Connecticut Yankee Atomic Power Co., Haddam, Conn., 1965.

11. P. C. Marcy, The Connecticut River Investigation, ed. by D. E. Merriman, 9th Semiannual Progress Report to Conn. Water Res. Comm., Oct. 13, 1969.

12. F. J. Trembley, "Effects of Cooling Water from Steam-Electric Power Plants on Stream Biota," pp. 334-37 in Biological Problems in Water Pollution, U.S. Department of Health, Education, and Welfare, Public Health Service, Division of Water Supply and Pollution Control, Cincinnati, Ohio, 1965.

13. R. M. Patrick, "Some Effects of Temperature on Freshwater Algae," pp. 161-70 in Biological Aspects of Thermal Pollution, vol. 1, ed. by P. A. Krenkel and F. L. Parker, Vanderbilt University Press, Nashville, Tenn., 1969.

14. J. Cairns, Jr., Ind. Wastes 1, 150 (1956).

15. R. W. Pennak, Fresh-Water Invertebrates of the United States, The Ronald Press Company, New York.

16. Battelle Memorial Institute, Columbus Laboratories, Water Quality Criteria Data Book, vol. 3, Effects of Chemicals on Aquatic Life, prepared for the EPA, May 1971.

17. M. R. Wuerthele, 1970a, The Toxic Effects of the Lansing Waste Water Treatment Plant Effluent to the Fathead Minnow. Pimephales promelas., Michigan Water Res. Comm. Rept. unpublished.

18. M. R. Wuerthele, 1970b, Fish Toxicity Studies at the Lansing Waste-Water Treatment Plant on the Grand River, Michigan Water Res. Comm. Rept., unpublished.

19. J. A. Zillich, A Discussion of the Toxicity of Combined Chlorine to Lotic Fish Populations, Michigan Water Res. Comm. Rept., unpublished.

20. R. E. Basch, In-Situ Investigations of Toxicity of Chlorinated Municipal Waste Water Treatment Plant Effluents to Rainbow Trout (Salmo gairdneri) and Fathead Minnows (Pimephales promelas), Complet. Rept. Grant 38050G22, EPA Water Quality Office, 1971.

21. J. W. Arthur and J. G. Eaton, Chloramine Toxicity to the Amphipod, Gammarus pseudolimnaeus, and the Fathead Minnow, Pimephales promelas, Environmental Protection Agency, National Water Quality Lab., Duluth, Minn., 1971.

22. J. B. Sprague and D. E. Drury, "Avoidance Reactions of Salmonid Fish to Representative Pollutants," pp. 169-79 in Advances in Water Pollution Research, Proc. 4th Int. Conf., Prague, 1969, Pergamon Press, New York, 1969.

23. Consolidated Edison Electric Company, Fish Protection at Indian Point No. 1, Environmental Report, Indian Point Nuclear Station No. 3.

24. W. H. Everhart and L. Woods, "Biota Sampling Program," pp. 13-33 in Environmental Radiation Surveillance Program for the Public Service Company of Colorado, Ninth Quarterly Progress Report for the Period January-March 1971, ed. by K. J. Schiager and S. T. Bard, May 20, 1971.

25. 49 CFR § 173.398; 10 CFR § 71.36.

26. Federal Highway Administration, "1969 Accidents of Large Motor Carriers of Property," December 1970.

27. 49 CFR §§ 171.15, 174.566, 177.861.

28. W. H. Chapman, H. L. Fisher, and M. W. Pratt, Concentration Factors of Chemical Elements in Edible Aquatic Organisms, Univ. of California, Livermore, Lawrence Radiation Laboratory Report UCRL-50564, Dec. 30, 1968.

29. U.S. Department of Agriculture, "Agricultural Statistics 1969," U.S. Government Printing Office, Washington, D.C., 1969.

References for Section X

1. Federal Power Commission, The 1970 National Power Survey, Part III, 1970.

2. Federal Power Commission, San Francisco Regional Office, Memorandum to All Utilities in the West Region Submitting Reports on the FPC Monthly Form 12-E, October 1971.

3. Public Service Company of Colorado, Applicant's Environmental Report, Operating License Stage, Fort St. Vrain Nuclear Generating Station, Supplement 1, Paragraph 7-2, October 1971.

4. Federal Power Commission, Bureau of Power, Adequacy of Electric Generating Capacity in Areas with Pending Nuclear Plant Operating Licenses, January 1972 (letter, Chairman, Federal Power Commission to AEC Director of Regulation).

References for Section XI

1. Public Service Company of Colorado, Applicant's Environmental Report. Operating License Stage, Fort St. Vrain Nuclear Generating Station, December 1970.

1a. Public Service Company of Colorado, Applicant's Environmental Report, Operating License Stage, Fort St. Vrain Nuclear Generating Station, Supplement 1, October 1971.

2. H. E. Vann, M. J. Whitman, and H. I. Bowers, "Factors Affecting Historical and Projected Capital Costs of Nuclear Power Plants in the United States," presented at the Fourth United Nations Conference on the Peaceful Uses of Atomic Energy, Geneva, Switzerland, Sept. 6-16, 1971.

3. Personal communication, R. F. Walker, Public Service Company of Colorado, to C. E. Bettis, Oak Ridge National Laboratory, Feb. 18, 1972.

4. U.S. Atomic Energy Commission, Division of Radiological and Environmental Protection, Draft Detailed Statement on the Environmental Considerations Related to the Proposed Issuance of an Operating License to the Baltimore Gas and Electric Company for the Calvert Cliffs Nuclear Power Power Plant, Units 1 and 2, Docket Nos. 50-317 and 50-318, Jan. 20, 1972.

4a. M. E. Eisenbud and H. G. Petros, "Radioactivity in the Atmospheric Effluents of Power Plants That Use Fossil Fuel," Science 144, 288-89 (1964).

4b. P. H. Bedrosian, D. G. Easterly, and S. L. Cummings, Radiological Survey Around Power Plants Using Fossil Fuels, EERL 71-3, Eastern Environmental Radiation Laboratory, Montgomery, Ala. (July 1970).

5. L. L. Bennett, H. I. Bowers, and M. L. Myers, "Estimated Future Costs of Central Station Steam-Electric Power Plants," presented at the Winter Meeting of the American Nuclear Society, Miami Beach, Florida, Oct. 17-21, 1971.

6. M. Benedict, "Electric Power from Nuclear Fission," Technology Review. 32-41, October/November (1971).

7. Personal communication, O. R. Lee, Public Service Company of Colorado, to W. E. Browning, Jr., Oak Ridge National Laboratory, March 3, 1972.

8. Personal communication, R. F. Walker, Public Service Company of Colorado, to AEC regulatory staff, March 27, 1972.

9. J. P. Rossie, "Dry-type Cooling Systems," Chemical Engineering Progress, 67, No. 7, 58-63 (July 1971).

References for Section XII

1. The Merck Index, Eighth Ed., P. G. Stecher (ed.). Merck and Co., Inc., Rahway, N. J., 1968.

2. F. L. Parker and P. A. Krenkel (eds.), Engineering Aspects of Thermal Pollution. Vanderbilt University Press, Nashville, Tenn., 1969.

3. D. R. F. Harleman et al., Engineering Aspects of Heat Disposal from Power Generation, Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics, MIT, Cambridge, Massachusetts, 1971.

4. P. R. Gorham, Toxic Algae, pp. 307-336, in Algae and Man, F. Jackson (ed.). Plenum Press, New York, 1964.

5. Popenoe, P., "Natural Gamma Aeroradioactivity Map of the Denver Area, Colorado," U.S.G.S. Geophysical Investigations Map GP-505 (1965).

APPENDIX A

COMMENTS

ON

DRAFT ENVIRONMENTAL STATEMENT

FOR

THE FORT ST. VRAIN NUCLEAR GENERATING STATION

DOCKET NO. 50-267

184

DEPARTMENT OF THE ARMY
OMAHA DISTRICT, CORPS OF ENGINEERS
7410 U.S. POST OFFICE AND COURT HOUSE
OMAHA, NEBRASKA 68102

MROED-PE

30 May 1972

Mr. Lester Rogers, Director
Division of Radiological and Environmental Protection
U. S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Rogers:

Reference is made to the Draft Environmental Statement for the Fort St. Vrain Nuclear Generating Station, transmitted for review and comment on 19 April 1972.

You are to be complimented for the excellent job of preparing this environmental documentation. The following general suggestions are offered for your consideration:

1. Water quality studies should be continued for the life of the project. This would provide useful data for planning of future generating facilities of this type.

2. Consideration should be given to preserving the project lands as a wildlife preserve. With the increased industrialization occurring in the area these lands would provide a natural green belt around the facility.

3. If it does not prove feasible to have the project lands set aside as a wildlife preserve, then only nonlivestock uses should be allowed for the following reasons. A blue-green alga, *Anabaena*, is present in the ditches crossing project lands. The area climate, agricultural runoff and station discharges will encourage accelerated algae growth and *Anabaena* has been known to be toxic to livestock under accelerated growing conditions.

MROED-PE
Mr. Lester Rogers

30 May 1972

We appreciate the opportunity to comment on the subject draft statement.

Sincerely yours,

for M. G. Ellis
R. G. BURNETT, P.E.
Chief, Engineering Division

DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D. C. 20250

50-267

June 2, 1972

Mr. Lester Rogers, Director
Division of Radiological and
Environmental Protection
Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

We have had the draft environmental impact statement for the Fort St. Vrain Nuclear Generating Station, Public Service Company of Colorado, reviewed in the relevant agencies of the Department of Agriculture. Comments from the Soil Conservation Service, the Economic Research Service, and the Agricultural Research Service, all agencies of the Department, are enclosed.

Forest Service, of the Department, has sent its comments to you directly.

Sincerely,

Fred H. Tschirley, for

T. C. BYERLY
Coordinator, Environmental
Quality Activities

Enclosures

Economic Research Service Comments on the Draft Environmental Statement for the Fort St. Vrain Nuclear Generating Station, Colorado

The statement is generally complete with regard to NEP Act and CEQ Guideline requirements. However, the statement would be strengthened by expanding Table XI-1 - Differential Cost & Summary - to consider the cooling pond alternative both with and without spraying devices. In addition, the table is not clear with respect to differences in blowdown water effluent between the cooling tower and cooling pond alternatives.

Soil Conservation Service
United States Department of Agriculture
Comments on Draft Environmental Statement
Prepared by U.S. Atomic Energy Commission
for
Public Service Company of Colorado
Issuance of an Operating License
for
Fort St. Vrain Nuclear Generating Station
Docket No. 50-267

1. The environmental statement is complete and well written. It appears to meet all of the requirements of NEPA 102(c).

2. Plans for ecological monitoring and future ecological study (pp. 101-102) are particularly commendable.

3. Section IV, pg. 82, states, "the remaining 2,158 acres will become a carefully managed agricultural operation." We suggest a complete conservation plan be developed with technical assistance from the Soil Conservation Service through the Platte Valley Soil Conservation District.

UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
SOIL AND WATER CONSERVATION RESEARCH DIVISION
Plant Science Building
Colorado State University
Fort Collins, Colorado 80521

The April 1972 Draft Environmental Statement and Environmental Report for the St. Vrain Nuclear Generating Station has been reviewed by this agency.

There does not appear to be any undue impact on agricultural operations from operation of this facility. The main effect on agriculture is the annual withdrawal of 3,000 acre feet of irrigation water from a combined total of 146,000 acre feet in the irrigation system involved. The loss of water for irrigation of approximately 1,500 acres must be balanced against the benefit from increase of nearly 430,000 horsepower available to farms, homes and industry in northeastern Colorado.

Specified operating procedures require that the quality of irrigation water not be significantly lowered by plant operations. Adequate safeguards including a water chemistry sampling program are provided to ensure that limits are not exceeded.

The possible deposition of approximately 1500 tons of salt annually by cloud drift from the cooling towers presents a potential hazard which should be more carefully evaluated. A large but undetermined proportion of this salt will, under the generally prevailing dry atmospheric conditions, be dispersed in the form of fine aerosol over a very wide area with no adverse effects. Salt levels on the applicant's property should be established at selected sampling sites prior to beginning operations and annually thereafter. In addition, salt levels should be established at both dryland and irrigated sites at one mile or two mile radius from the plant and sampled annually.

The applicant will be managing a sizeable agricultural operation on the 2158 acres surrounding the power plant. It is recommended that a Memorandum of Agreement as to recommended land use and conservation practices be established with the Brighton, Colorado Soil Conservation District. It is also recommended that the Soil Conservation Service be consulted for recommendations on sampling sites and procedures to evaluate the salt accumulation hazard.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

W O

REPLY TO: 1940 Environmental Statements

May 23, 1972

SUBJECT: AEC Draft Environmental Statement - Ft. St. Vrain Nuclear Generating Station - Public Service Co. of Colorado Your Ref: Docket No. 50-267

TO: Mr. Roger S. Boyd, Assistant Director
for Boiling Water Reactors
Division of Reactor Licensing
United States Atomic Energy Commission
Washington, D.C. 20545

We have reviewed the Draft Environmental Impact Statement for the Fort St. Vrain Nuclear Generating Station. Our only comment is with regard to Figure II-1, page 12. In the upper left hand corner of the figure, "Roosevelt National Park" should be changed to "Roosevelt National Forest."

Adrian M. Gilbert

ADRIAN M. GILBERT
Acting Deputy Chief

MAY 25 1972

A-9

THE ASSISTANT SECRETARY OF COMMERCE
Washington, D.C. 20230

May 31, 1972

50-267

Mr. Lester Rogers, Director
Division of Radiological and
Environmental Protection
U.S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

The draft detailed statement on the environmental considerations by the U.S. Atomic Energy Commission related to the Proposed Issuance of an Operating License to the Public Service Company of Colorado for the Fort St. Vrain Nuclear Generating Station, Docket Number 50-267, which accompanied your letter of April 19, 1972, has been received by the Department of Commerce for review and comment.

In order to give you the benefit of the Department's analysis, the following comments are offered for your consideration.

As expressed in our comments to the AEC Division of Reactor Licensing on March 13, 1971, we have calculated a maximum annual average dilution rate $4x10^{-5}$ sec m^{-3} at the site boundary. This is in close agreement with the AEC's value of $3x10^{-5}$ sec m^{-3} as stated on page 106 of the draft environmental statement. However, both values are applicable only if the release is routine throughout the entire year and not biased towards any particular time of day or period.

With regard to the environmental impact of postulated accidents, we would suggest that the actual meteorological assumptions used to compute the radiological consequences be specified rather than referring to the proposed amendment to Appendix D of 10 CFR 50. It is our understanding from this proposed amendment that the relative atmospheric concentration values used in the accident evaluation are 1/10 of the values given in the AEC Safety Guides 3 and 4. We interpret this to mean a value that is 10 times less conservative than those in the Safety Guides.

We hope these comments will be of assistance to you in the preparation of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

50-267

JUN 1 9 1972

Dear Mr. Muntzing:

This is in response to Mr. Rogers' letter of April 19, 1972, requesting our comments on the Atomic Energy Commission's draft environmental statement, dated April 1972, on environmental considerations for Fort St. Vrain Nuclear Generating Station, Weld County, Colorado.

Summary and Conclusions

According to page i the applicant is requesting a 40-year operating license. Table XI-3 of page 143 shows that the cost evaluation of alternative actions is based on 30 years. If there is a reason for the difference, it should be given in the statement.

Historical Significance

The statement indicates that a pre-construction survey revealed no evidence of archeological resources within the station site. It also indicates that no historical values would be affected; however, this should be substantiated by showing evidence of consultation with the Colorado State Historical Preservation Officer, State Historical Society, Colorado State Museum, 200 14th Avenue, Denver, Colorado 80203.

Blowdown and Drainage

The chemical and biological contents of the cooling tower basins and holding ponds should be described on page 61. The statement shows that the draining and cleaning of these facilities would take place about once a year and that the discharge would be equivalent to about 40 cfs. over a 24-hour period. It appears that this discharge could have a significant adverse impact on the aquatic life; consequently, we think an evaluation should be made and the results included in the final statement.

Cooling Tower Drift

According to page 79, about 1,500 tons per year of solids will be carried in the drift from the cooling towers and deposited on the applicant's land. Since these solids are rich in sodium salts and therefore potentially corrosive to common ferrous and nonferrous metals on which they are deposited, we suggest that the possibilities of damage to offsite structures and vehicles be assessed. If such damage is significant, it should be considered in the approximate sections of the final environmental statement.

Recreational Development

Little mention is made of recreation values of project lands. Land areas in the vicinity of the South Platti and St. Vrain Rivers have considerable recreation potential and esthetic values. The environmental statement should reflect this value for current and future recreation use. Also, it should include an assessment of the impact of the project on the recreation values of the surrounding lands.

Ecological Monitoring

The Phase III monitoring program, as explained on page 103, will continue as planned through the first year of operation. At the end of this period, the results will be reviewed to determine the scope of the subsequent monitoring program. Conceivably, the full extent of accumulation as a result of continuous or intermittent exposures could require more than one or two years of monitoring for some species. Therefore, the statement should show that postoperational radiological and environmental surveys will be continued, even though less frequent intervals may be adequate, until it has been demonstrated conclusively that no significant adverse environmental impacts are resulting from station operations.

Environmental Impact of Postulated Accidents

The radiological effects of accidents are given in terms of estimated doses to the population from airborne emissions. However, the environmental effects of releases to water is lacking. We think that the final environmental statement should include estimates of the pathways of the escaping radionuclides and quantities involved.

We also think that Class 9 accidents resulting in radioactive releases to both air and water should be described and the impact on human life and the remaining environment discussed as long as there is any possibility of occurrence. The consequences of an accident of this severity could have far-reaching effects which last for centuries.

Irreversible and Irretrievable Commitments of Resources

We think that this section should describe the annual loss of fish and wildlife resources due to the construction and operation of the project. Annual Resources foregone are irretrievable for all practical purposes.

We hope these comments will be helpful to you in the preparation of the final environmental statement.

Sincerely yours,

Deputy Assistant Secretary of the Interior

Mr. L. Manning Muntzing
Director of Regulation
Atomic Energy Commission
Washington, D. C. 20545

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (WS/82)
400 SEVENTH STREET SW
WASHINGTON, D.C. 20590
PHONE: (202) 426-2262

SA 1019

24 MAY 1972

Mr. Lester Rogers, Director
Division of Radiological and
Environmental Protection
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

This is in response to your letter of 19 April 1972 addressed to Mr. Herbert F. DeSimone, Assistant Secretary for Environment and Urban Systems, concerning the revised environmental impact statement, environmental report and other pertinent papers on the Fort St. Vrain Nuclear Generating Station located near the city of Greeley in Weld County, Colorado.

The concerned operating administrations and staff of the Department of Transportation have reviewed the material submitted. Reference is made to this Department's comments as submitted in our letter of 11 August 1971. It appears that the problems raised at that time have been adequately addressed.

It is the determination of this Department that the impact of this project upon transportation is minimal and we have no further comments to offer.

The opportunity to review and comment on the Fort St. Vrain Nuclear Generating Station is appreciated.

Sincerely,

W. M. Benkert

W. M. BENKERT
Rear Admiral, U. S. Coast Guard
Chief, Office of Marine Environment
and Systems

FEDERAL POWER COMMISSION
WASHINGTON, D.C. 20426

May 24, 1972

IN REPLY REFER TO:
PWR-ER

Mr. Lester Rogers
Director, Division of Radiological
and Environmental Protection
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

This is in response to your letter dated April 19, 1972, requesting comments on the Draft Environmental Statement Related to the Proposed Issuance of an Operating License to the Public Service Company of Colorado for the Fort St. Vrain Nuclear Generating Station.

The Federal Power Commission's Bureau of Power staff has commented previously on the need for the Fort St. Vrain unit in a letter dated August 19, 1971. These comments were based on the then scheduled commercial service date of March 1972. In addition, the Bureau of Power staff has commented on the need for this and other nuclear generating units in letters to the AEC dated January 18, 1972, (Draft Environmental Statement Reference X-4) and February 7, 1972. The Federal Power Commission published the 1972 Summer Electric Load Supply Outlook on April 21, 1972, (FPC News Release No. 18209) which comments on the Applicant's system reserves. A copy of this report is enclosed.

The commercial service date for this unit is now not expected until January 1973, according to latest information available from AEC. The following comments will update the previous comments, and are based on the latest available estimates of electric resources, load and reserve margins relating to the Applicant's system. These comments are in accordance with the National Environmental Policy Act of 1969 and the Guidelines for the President's Council on Environmental Quality dated April 23, 1971.

The Need for the Facilities

The estimated reserve margin on the Applicant's system forecast from the recent analysis by the staff of the Bureau of Power totals 343 megawatts or 21.3 percent of the 1972 summer peak load and 461 megawatts or 26.8 percent of the 1972-73 winter peak load. These reserves for the 1972-73 winter peak were calculated from available capacity resources which include the capacity of the Fort St. Vrain unit. The calculations for these peak periods are contained in the tabulation below.

Mr. Lester Rogers

Public Service Company of Colorado
Capacity-Load Analysis

	1972 Summer	1972-73 Winter
Installed Generating Capacity	1,778	2,108 1/
Leased G/T Capacity Available 4/72 to 10/72	100 2/	-
Firm Purchases	208 2/	208 2/
Firm Obligations	-134 2/	-134 2/
Net Dependable Capacity	1,952	2,182
Peak Load	1,609 2/	1,721 2/
Reserve Margin	343	461 3/
Percent of Peak Load	21.3	26.8 3/

1/ Includes Fort St. Vrain unit (330 MW).
2/ Source - Applicant's Monthly FPC Form 12-E for February 1972.
3/ Without St. Vrain unit, margin is reduced to 131 megawatts, or 7.6 percent.

The Applicant uses a reserve criteria for system reliability of 20 percent of the estimated annual peak load. The Applicant is a member of the WSCC, as well as the Rocky Mountain Power Area (RMPA), a subregional data collecting organization. For the 1972 summer peak load forecast, the 343 megawatts reserve margin is vested in the largest unit in the subregion, the Applicant's 350-megawatt Cherokee Unit No. 4. As shown, should the Fort St. Vrain unit not be available in the peak load period of the winter of 1972-73, the Applicant's reserve margin would be reduced to 7.6 percent, a potentially more hazardous situation from the standpoint of the Applicant's ability to withstand forced outages without incurring operating emergencies.

The staff of the Bureau of Power notes that until 1968 with the installation of the Cherokee No. 4 unit, the largest unit in operation on the Applicant's system was approximately half that size. This is to say that until that time a reserve margin of 20 percent permitted the forced outage of approximately two large units, whereas in the present planning cycle the same 20 percent reserve margin is vested in one large unit.

Transmission Facilities

The output of the plant is integrated into the existing bulk power system by four 230-kilovolt lines. Two of these will result from

Mr. Lester Rogers

looping into the plant existing USBR lines; and two new lines, approximately 10 miles in length each, will tie into the Applicant's transmission line loop around Denver. The results of engineering studies upon which this configuration was based, as related to adequacy and reliability of service, were not discussed. In the absence of more specific information, the staff of the Bureau of Power can only comment that the ability of four 230-kilovolt lines to provide adequate and reliable capacity for the plant output under normal and reasonable contingency conditions would be expected.

Alternates to the Proposed Facilities and Costs

The Fort St. Vrain nuclear unit is the first commercial-size high temperature gas-cooled reactor (HTGR) to be constructed in this country, and construction is essentially complete. Capital costs of $210,000,000 are estimated by the Applicant, resulting in a plant cost of $636 per kilowatt of capacity. The staff of the Bureau of Power, in the absence of cost data for comparable units, can make no comment related to this costs except to say that costs of prototype units are generally higher than succeeding units, and with an increase in size of this type of unit, economies of scale may be realized. The immediate need for this unit has been shown with reference to the 1972 summer load period, which it will not be able to meet, and for the 1972-73 winter load period for which it may be available in part. However, this unit is expected to serve the growing base-load requirements of the Applicant for approximately 30 years, and the denial of this resource would require substitute measures on the part of the Applicant. In the absence of long term firm power contracts which are not indicated to exist, the Applicant would, in order to maintain a reasonable level of adequacy and reliability of power supply, have to install such capacity as might be obtained on a relatively short notice, such as gas turbines, until such times as other less costly to operate facilities could be constructed. For base-load, fossil-fired units, this time period might vary between three to seven or eight years, depending upon the variables involved in such changes of plans.

Mr. Lester Rogers

Conclusions

In the light of the foregoing, the staff of the Bureau of Power concludes that the economic and service interests of the ultimate customers on the Applicant's system will be best served by an early resolution of the matters now contributing toward the delay in the commercial operation of this unit.

Very truly yours,

T. A. Phillips
Chief, Bureau of Power

Enclosure No. 57659

FEDERAL POWER COMMISSION

NEWS RELEASE WASHINGTON, D.C. 20426

IMMEDIATE RELEASE
APRIL 21, 1972 No. 18209
Electric Load Supply Situation

FPC RELEASES REPORT ON 1972 SUMMER ELECTRIC LOAD SUPPLY OUTLOOK

Some sections of the United States may again experience electric power supply shortages this summer, according to reports filed with the Federal Power Commission by the Nation's electric utilities.

Delays in availability of planned new facilities will lessen the amounts of installed generating capacity planned earlier to provide adequate and reliable service. Much of the Nation, particularly east of the Mississippi River, is affected by the delays.

Analysis by the FPC staff of the utilities' reports indicates that for three of the six National Power Survey Regions the generating capacity reserve margins are somewhat better than for the corresponding period of 1971. For the remaining three they are lower.

While reserve margin alone cannot be considered to be a complete indicator of a system's adequacy and reliability, it can, in conjunction with a comprehensive knowledge and understanding of other related system characteristics, represent a helpful measurement if used with discretion in analyzing system capability to meet demands.

From reports filed with FPC by the electric utilities, it appears that detailed system studies usually indicate needs for reserve margins within a range of about 15 to 25 percent.

Current indications are that 60 of 157 systems or utility groups covered by the staff analyses may have reserves of less than 15 percent. Twenty-seven of the 60 may have reserves of less than 10 percent.

(over)

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The FPC staff analysis compares estimated 1972 summer peak loads with generating capacity scheduled to be in service at the end of May, increased or decreased by firm power purchases or obligations expected to be in effect at the time of summer peak load.

The staff analysis considers only those intersystem power transfers that are reported to be under firm contract and no attempt has been made to account for emergency measures that might be used to improve low reserve situations. Any capacity that becomes available after May 31 would increase the indicated reserves. Additional capacity scheduled for service across the Nation during June, July, and August amounts to 8,696 megawatts, or 2.7 percent of the sum of the estimated peaks.

On a nationwide basis, electric utilities expect peak loads totaling 316,960 megawatts for the summer of 1972. This compares with 296,791 megawatts in 1971, an increase of 6.8 percent. The percent capacity for reserves as indicated for the summer of 1972 is 17.2 percent, compared with 15.3 percent in 1971. The Nationwide picture is summarized in the attached table.

In the Northeast Region as a whole, reserves are estimated at 17.9 percent of the expected peak, compared with 18.3 percent last summer. The New England Power Exchange is expected to have 17.5 percent reserves, the New York Power Pool 15.2 percent, and the Pennsylvania-New Jersey-Maryland Interconnection, 19.8 percent.

In the New York City area, there may again be problems in meeting peak demands. The Consolidated Edison Company now expects that the Indian Point No. 2 nuclear unit will not be available at least until late summer. The company has acted to expedite the availability of additional barge-mounted gas turbine units in an effort to improve the reserve situation.

The East Central Region has estimated reserves of about 18.9 percent, up significantly from last summer's 12.6 percent. Included in this, however, is the American Electric Power System's new Amos No. 2 800-megawatt unit at Scary, W. Va., expected to be in service by June 1,

(continued)

No. 18209

and its Mitchell No. 1 800-megawatt unit, at Captina, Ohio, which is out of service at this time because of generator problems.

The Southeast Region has an indicated reserve margin of 11.1 percent, the lowest of any of the six regions. This compares with 12.4 percent in 1971. Within the Region, the southern Florida and the Virginia-Carolinas areas may have severe problems if significant outages of major generating units are experienced at times of peak load periods.

The West Central region as a whole has an indicated reserve margin of 11.6 percent, compared to 14 percent in 1971. Promise of some generation at the Cordova, Ill., Quad Cities nuclear plant, owned by Commonwealth Edison Company and Iowa Illinois Gas and Electric Company, brightens the outlook for the Iowa Power Pool and the Commonwealth Edison Company, of Chicago. Commonwealth also has recently negotiated for some additional supplemental power which brings its estimated reserve margin up to about 10.9 percent.

The South Central Region in total has an indicated reserve margin of 20.1 percent, up from 15.1 percent in 1971. No particular problems in meeting summer loads were indicated, provided a number of relatively new steam-electric units perform dependably during the summer season.

The West Region as a whole has an indicated reserve margin of 23.8 percent, up from 18.8 percent last summer. Although specific reserve margins for some of the individual utilities are considerably lower, the overall situation appears to be sufficient to meet summer demands.

Summaries of the information filed by the utilities are contained in a Bureau of Power staff memorandum. More detailed reports by regions appear in summaries being distributed by the Commission's five regional offices to all affected utilities and state regulatory commissions. Copies of these materials are available upon request from the Office of Public Information, Federal Power Commission, Washington, D. C. 20426.

-FPC-

For further information call 386-6102 (Area Code 202) DC-114

LOAD-SUPPLY SITUATION FOR SUMMER 1972

Region	Installed Capacity 1/31/72	Firm Power Purchases	Firm Power Sales	Net Dependable Resources	New Capacity Additions by 5/31/72	Net Dependable Resources 5/31/72	Estimated Peak Load	Capacity Available for Reserves		Additional Capacity Scheduled for Service During June, July and August	
	MW	MW	MW	MW	MW	MW	MW	MW	Percent of Peak	MW	Percent of Peak
Northeast	67,409	561	150	67,820	3,332	71,152	60,364	10,788	17.9	1,778	2.9
East Central	57,140	4,327	5,070	56,397	3,778	60,175	50,704	9,471	18.7	570	0.1
Southeast	67,631	5,297	4,996	67,932	3,078	71,010	63,939	7,071	11.1	4,188	6.5
West Central	39,371	7,208	5,796	40,783	3,614	44,397	39,766	4,631	11.6	580	0.1
South Central	51,104	6,970	5,834	52,240	3,708	55,948	46,577	9,371	20.1	368	0.1
West	65,986	19,621	17,233	68,374	459	68,833	55,610	13,223	23.8	1,212	2.2
Contiguous U.S.	348,641	43,984 1/	39,079 1/	353,546	17,969 2/	371,515	316,960	54,555	17.2	8,696 3/	2.7

1/ It is reasonable to expect some imbalance between purchases and sales because of purchases from Canadian sources, relatively minor purchases from small non-included sources, and because the non-simultaneous nature of some of these events do not lend themselves to arithmetical summation. The staff of the Bureau of Power was unable to rationalize the magnitude of the indicated difference since the respondents' reporting was not in this detail.

2/ See Table 2 for major units contained in New Capacity Additions.

3/ See Table 3 for major units contained in Additional Capacity Scheduled for Service during June, July and August.

ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

50-267

OFFICE OF THE ADMINISTRATOR

8 JUN 1972

JUN 5 1972

Mr. L. Manning Muntzing
Director of Regulation
U.S. Atomic Energy Commission
Washington, D.C. 20545

Dear Mr. Muntzing:

The Environmental Protection Agency has reviewed the draft environmental statement for the Fort St. Vrain Nuclear Generating Station and we are pleased to provide our comments to you.

Because the Fort St. Vrain facility is the first commercial-size High Temperature Gas-Cooled Reactor (HTGR) to be constructed, a base of operating information for this reactor type does not exist. Careful observation and recording of conditions during start up and operation will be valuable for the evaluation of this and subsequent HTGR plants. We would be pleased to cooperate with you in identifying and, perhaps obtaining the information needed.

We seriously question the validity of applying the bases used for evaluating the consequences of light water reactor accidents to this HTGR plant for reasons described in the attached comments. Presumably, this is a matter that should be discussed on a general rather than a plant-by-plant basis. If you agree, we would be pleased to discuss this matter with members of your staff at their convenience.

Our comments indicate concern over the availability of adequate supplies of water to operate the Fort St. Vrain Station. Uncertainty concerning the restrictions imposed by the applicant's water rights and the fact that 7-14 day, 10-year low flows are much lower than the design-basis monthly low flow assumed in the draft statement raises a question about the availability of an adequate water supply during critical low flow periods. Also, it is not certain whether the discharge of cooling tower blowdown water will meet Colorado State water quality standards, particularly during low flow periods.

We will be pleased to discuss our comments with you or members of your staff.

Sincerely,

Sheldon Meyers
Director
Office of Federal Activities

Enclosure

EPA#D-AEC-00049-45

ENVIRONMENTAL PROTECTION AGENCY

Washington, D.C. 20460

June 1972

ENVIRONMENTAL IMPACT STATEMENT COMMENTS

Fort St. Vrain Nuclear Generating Station

TABLE OF CONTENTS

INTRODUCTION AND CONCLUSIONS

The Environmental Protection Agency has reviewed the draft environmental impact statement for the Fort St. Vrain Nuclear Generating Station prepared by the U.S. Atomic Energy Commission and issued on April 19, 1972. Following are our major conclusions:

1. We believe the water supply problem is significantly more serious than indicated in the draft statement. Thus, in our opinion, acute seasonal water shortages may have serious consequences for plant operation.

2. The discharge of cooling tower blowdown water may degrade water quality in the South Platte River or the St. Vrain Creek. Also, it is not certain whether such discharges will meet Colorado State Water Quality Standards, particularly during low flow periods.

3. Since there are few data available on the sources of radioactive wastes from an operating HTGR, it will be necessary to obtain operational data from Fort St. Vrain to confirm the anticipated radioactive effluents postulated in the draft statement and to provide accurate source term models for the large HTGR's being planned for construction in the future.

4. In order to achieve lowest practicable radwaste discharge levels, the liquid radwaste treatment system should be utilized to its full capability by processing all liquid waste through the demineralizer before discharge to the environment.

5. No commercial facility is now available for the reprocessing of spent HTGR fuel. The final disposition of this fuel, either by reprocessing or very long-term storage, should be discussed.

6. The expected discharges of iodine and strontium and resulting population doses through the milk pathway should be evaluated.

7. The relationship between the HTGR accidents to analogs in the LWR which were used in the draft statement is not clear. Therefore, the potential consequences of reactor accidents should be discussed in greater detail with presentation of all the assumptions and their bases pertinent to the calculated doses.

RADIOLOGICAL ASPECTS

Radioactive Waste Management and Discharges

The evaluation of the radiological impact of the Fort St. Vrain Nuclear Generating Station depends on the source terms for the gaseous and liquid radwaste. There are few data available on the sources of radioactive wastes from an operating HTGR, since this is the first commercial scale plant of this type to be built. It will therefore be necessary to obtain operational data from Fort St. Vrain to confirm the anticipated radioactive effluents postulated in the draft statement and to provide accurate source term models for the large HTGR's being planned for construction in the future.

The radioactive waste treatment systems for the Fort St. Vrain Station have been designed so that discharges from the station can be reduced to the lowest practicable levels. The extent to which the design capability will be realized will be determined by administrative controls placed on the radioactive waste treatment systems.

The anticipated annual releases of radioactive material in liquid effluents, shown in Table II-3 of the draft statements, appear to be based primarily on the dilution capacity available in the cooling water blowdown line and the intent to hold effluent concentrations below 10% of the 10 CFR 20 limits. It is also stated, on pg. 70, that liquid wastes will be discharged directly to the environment without additional treatment whenever the in-plant concentration is below $2 \times 10^{-6} \mu Ci/ml$. This concentration corresponds to an environmental concentration of 1 x 10^{-8} μCi/ml when a dilution factor of 200 in the cooling tower blowdown line is applied. We believe that, considering the small volume of liquid waste expected from the station, consideration should be given to processing all liquid waste through the demineralizer before discharge to provide for the lowest practicable environmental radioactivity concentrations.

It is our understanding, based on discussions between EPA and the applicant regarding Permit Applications, that the liquid radioactive effluents from Fort St. Vrain will be stored in a suitably lined evaporation pond effective July 1, 1973. The final statement should reflect the considerations which led to this decision, including the alternatives considered and their advantages and disadvantages. In addition, the applicant should assess the various alternative approaches to the final disposal of the waste accumulated in the pond, including burial on-site and disposal at an authorized disposal site. These disposal alternatives should be discussed in the final statement.

Prior to July 1, 1973, liquid radwaste will be discharged as discussed in the draft statement. Liquid effluents from the Station will be routed either through a slough to St. Vrain Creek or through a farm pond to the South Platte River. Analyses reported indicate that the latter pathway is to be greatly preferred, and is stated to be the normal pathway since it allows a much greater time for decay of radionuclides and for reducing the impact of heat in the effluent. The final statement should discuss criteria for use, if ever, of the less desirable pathway to St. Vrain Creek.

The draft statement postulates a mechanism for leakage of fission products from the primary coolant into the secondary coolant through leaks in the steam generator reheater tubes. In the event that such a leak should occur, but is small enough that the isolation valves activated by radiation monitors on the reheat steam discharge lines are not tripped, there will be a continuous source of fission products to the secondary coolant. This source of liquid radwaste could be a significant portion of the total station liquid radwaste discharge. A portion of these fission products would be retained by the full-flow condensate demineralizers. The applicant states that the demineralizer regeneration effluents will be discharged into the cooling tower blowdown line and to St. Vrain Creek via the slough. In the event that the regeneration effluents are radioactive, capability must be provided to treat these effluents as liquid radwaste. The fission products not retained by the full flow condensate demineralizers will be available as a source term for secondary system leakage. Since significant leakage can be expected from the secondary system (based on operational data from PWR's) some fission products would leak from the secondary system. The final statement should discuss the significance of this liquid radwaste source term and the necessity for treatment.

Fuel Management

A significant potential impact of the Fort St. Vrain Nuclear Generating Station may be the reprocessing and/or long-term storage of the irradiated fuel. It is stated on pg. 112 of the draft statement that irradiated fuel will be stored at Idaho Falls, Idaho, for the first eight years. There is now no commercial facility available to reprocess the spent fuel from an HTGR. Since the HTGR will operate as a high-gain converter, we would assume that eventual reprocessing is contemplated. If not, very long-term storage of the spent fuel must be arranged. Discussion of this aspect of HTGR operation is desirable and should be provided in the final statement.

Population Dose Assessment

Population doses resulting through the milk pathway were not presented in the draft statement.. There are dairy operations on site and there is a possibility of both iodine and strontium radionuclides being released in the gaseous effluents, especially in the event of a Class 3 accident. The magnitude of potential iodine and strontium radionuclides should be addressed and the population dose through the milk pathway should be discussed where appropriate.

Transportation and Reactor Accidents

In evaluating potential consequences of reactor facility accidents, the environmental statement followed the general guidance for dose estimates and philosophy of the proposed annex to Appendix D to 10 CFR part 50. EPA commented to the AEC on the proposed annex on January 13, 1972. Although "...assumptions similar to those contained in the proposed amendment to Appendix D..." were used in the assessment of accident consequences, the statement does not indicate any assumptions used in the evaluations. Since the accident mechanisms and fission product transport phenomena are significantly different between light-water-reactor (LWR) and high-temperature-gas-cooled reactors (HTGR), it is not apparent how the assumptions indicated as appropriate for LWR's can be applied to HTGR accidents, particularly in the so-called Class 8 accidents, which are the ones of greatest concern. While the consequences of a loss-of-coolant accident in the HTGR are not expected to be as serious as for the LWR and the emergency core cooling controversy does not apply to the HTGR, there are serious potential consequences of fission product release from plateout material in the coolant system following a penetration blowout accident. Thus, the relationship between the HTGR accidents to analogs in the LWR cannot be justified without much greater details of assumptions (and their bases) and accident mechanisms. The final statement should address these assumptions and their bases pertinent to the doses presented.

NON-RADIOLOGICAL ASPECTS

Water Quality Effects

The draft statement notes that, at a maximum blowdown of 2,650 gallons per minute, a cooling water temperature of 101.5°F is reached. Routinely, blowdown will be routed through the Goosequill Ditch and into the farm pond for a ten-day retention period prior to release to the South Platte River. According to calculations made by the applicant, the pond water, when discharged, will cause an increase of approximately 2°F in the summer and 4.2°F in the winter at low flow. Although it is noted in the statement that all discharges will be 80°F or lower and that a thermal plume will be established in the South Platte River or the St. Vrain Creek, the effects of this plume were not estimated.

No comment was made in the statement to indicate whether or not the resulting discharge of heated blowdown, containing dissolved solids and other material, will or will not violate Colorado State Water Quality Standards. In addition, no reference is made to the applicability of the non-degradation clause. The final statement should indicate the ability of the Fort St. Vrain plant to meet applicable standards under all conditions of operation and stream flows.

An alternate, but less desirable, mode of discharge would be to route blowdown directly to St. Vrain Creek. If this mode were employed, the most unfavorable period for discharge would be in July or August of the year. This is based on an assumption that the lowest flow in St. Vrain Creek during July and August is 54.4 cfs. The 7-day, once-in-ten years low flow is, however, approximately 30 cfs (April 1963). Assuming a stream temperature of 40°F the result of a calculation similar to that described in the applicant's environmental report shows that after complete mixing, a temperature of 50°F will result. Obviously, the creek will not mix completely for some distance; therefore, in local areas near the discharge, temperatures as much as 15-30°F above ambient temperature could be observed. We believe, therefore, that the use of this alternate discharge mode would have a significant effect on the ecology of the stream. The possibility and extent of such effects should be discussed in the final statement.

The demineralizer regeneration system was designed to be discharged into St. Vrain Creek, however, the applicant has agreed to direct the demineralizer regeneration effluents to a lined evaporation pond. This alternative method of disposal was instituted because the effects of a discharge to St. Vrain Creek could be significant. The direct discharge would contain dissolved solids collected over a long period of time and they would be discharged to St. Vrain Creek in "slug" form. Although the use of the lined evaporation pond will represent some additional consumptive use of water (80,000 gallons/month), the amount is insignificant when compared to the 5 cfs evaporated in the cooling tower.

Since discharges to St. Vrain Creek may occur prior to operation of the lined evaporation pond, the effect of the discharge should be presented other than as shown in Table III-7. The calculations in the draft statement were done using average low flows which in our opinion tends to distort the results for extreme conditions. For example, the 7-day, once-in-ten-year low flow is only about 1/3 of the flow rate employed in the statement (30 cfs as compared to 90.5 cfs). The statement indicates that "...after dilution with the average minimum monthly flow of St. Vrain Creek, most of the chemicals added by the station will be present in concentrations much lower than their present concentrations in the stream." Ammonia concentration, however, is the parameter of greatest concern and during low flow could reach a maximum of 11 mg/l in the St. Vrain Creek. In addition, the sulfate concentration could go from 617 mg/l to 659 mg/l. The concentrations given in the table, since they were computed on the basis of average low flows, are actually one third of the values that should be considered.

The impact upon the South Platte River, due to various chemicals contained in the cooling tower blowdown that will be discharged, is unclear. The calculations in the environmental report are based on monthly average low flows and, thus, do not reflect the situation under extreme conditions. The most severe impact will occur at 7-day, once-in-ten-year low flow, which is about 31,500 gpm if the water in St. Vrain Creek is also included (i.e. 7-day, once-in-ten-year low flow below the confluence). Comparing this to the 145,000 gpm used in Table III-8, demonstrates that all rises in concentration given in column 9 should be multiplied by 4.4. Using the data in the table and true low flows, we see that an increase in TDS of 130 mg/l, or 20%, is possible.

Water Requirements and Availability

We believe that the water supply problem mentioned in the draft statement will prove to be significantly more serious than has been anticipated by either the applicant or the AEC. Uncertainty concerning the restrictions imposed by the applicant's water rights, and the fact that 7-14 day, once-in-ten-year low flows are much lower than the design-basis monthly average low flow assumed in the draft statement, caused concern as to the availability of adequate water supplies during critical low flow periods. Thus, in our opinion, it is likely that for several months during the station's life-time, it will require all of the available stream and well water and part of the domestic water supply for cooling water makeup. In addition, there are likely to be a number of one or two week periods in which "all available water" will prove inadequate for station operation, necessitating a cut-back in power production or a shutdown.

The Fort St. Vrain facility is located in a semi-arid plains region. The typical annual distribution of stream flows in this area tends to follow the pattern of two or more months of intense snowmelt runoff and generally diminished flows during the rest of the year, with irrigation utilizing much of the stream flow during the growing seasons. In our opinion, the use of average stream flows is inappropriate for calculations, since the median daily flow would fall considerably below the arithmetic average on a yearly basis. Low flows are the norm, as is great variability in total runoff from one year to the next. It would be more meaningful to base an analysis on a 7-day, once-in-ten-years low flow, than on a monthly or seasonal average.

With the general scarcity of water in this region, a situation developed over the years where water rights were filed on a claim basis for certain beneficial uses, and these rights were organized on a seniority system (western water law appropriation doctrine). Under this system the earliest filed claims have the legal rights to first use of the available water in a given stream, in specified amounts, based on the original claim. The environmental statement, however, does not indicate the seniority of the water rights purchased by the applicant. The statement indicated, however, that the applicant has purchased 18 cfs of Jay Thomas Ditch water but does not specify the water right senority of water, stating only, "This early right helps to insure to the applicant sufficient water for station operation." The Jay Thomas Ditch itself has two decreed water rights: one for 104.35 cfs and one for 86.35 cfs The water to satisfy these decreed water rights is to be withdrawn only from the South Platte River. The original decreed right was for the purpose of irrigation. Although this issue was not discussed in the environmental statement, presumably this water right has now been converted to industrial or commercial use. In order to clarify this point the final statement should indicate the status of any such water use rights.

Three diversions of higher priority than the Jay Thomas Ditch diversion are situated between U.S.G.S. gauge established at Henderson, Colorado, and the Jay Thomas Ditch diversion at the vicinity of the applicant's site. These diversions are:

Diversion	CFS	Appro. Date	Priority Number
Platteville Ditch	47.8	1862	77
Lupton Bottom Ditch	47.7	1863	96
Brighton Ditch	22.2	1863	110
Total	117.7 CFS		

In assuming that the early date of appropriation of the applicant helps assure a sufficient supply of water, the environmental impact does not appear to take into account the total of 117.7 cfs of water of higher water-right seniority which has priority over the water allotted to the applicant. In a time of water shortage, any or all of these diversions would have the right to a full quota of water before any water could be diverted to the Jay Thomas Ditch.

However, considering that the applicant is a public utility and could obtain power of condemnation, it is possible that more senior users of water, both upstream and downstream, might have their water rights condemned on the basis that the use of the water by the Fort St. Vrain plant is more beneficial to a larger segment of the public than if it is used for irrigation. The final statement should indicate under what circumstances such action might be possible and describe the environmental effects that would result. In our opinion, this approach to solving the plant's water supply problems should be avoided if possible.

The statement attempts to show the amount of water that would be available to the applicant in times of water shortage in the area. It assumes that, based on monthly average flows, the flow at the applicant's point of diversion would be about half of the flow measured at the nearest U.S.G.S. Gauging Station - Henderson, Colorado, twenty-three river miles upstream. The three senior water rights previously mentioned, however, tend to invalidate this assumption. This occurs because, in a time of intense shortage, at least 235.4 cfs of water would have to pass the Henderson gauge to make it possible for 117.7 cfs to be supplied to these senior water rights and have sufficient water remaining for diversion to the plant.

Therefore, in order to determine the actual amount of water available for plant use during critical low flow periods, a detailed study should be undertaken by the applicant or the AEC to establish a flow relationship between the gauge at Henderson, Colorado, and the amount of water passing the point of diversion of the applicant. These data could be correlated with existing U.S.G.S. Water Supply Data on the established gauge at Henderson.

The draft statement indicates that wells can be used for backup, if required in a time of water shortage, but fails to discuss the possibility that the Colorado Water Law might not entitle the applicant to use wells in a time of intense water shortage. The final statement should address this possibility.

If, during extreme conditions, the wells or other emergency water sources cannot supply needed water or are not available for use, it will be possible to use water from the settling basin and cooling tower pond. It is postulated, however, that these sources will only provide a 4 1/2 to 7 day supply. An assessment of the available water from all sources under extreme situations, therefore, is essential in order to calculate the degree of risk involved with respect to exceeding the emergency water supplies (in terms of a 30, 50, or 100 year low flow for a 7 or 14 day period).

Biological Effects

The draft statement provides only descriptive information on aquatic and terrestrial biota. In order to determine the effects of the operation of the Fort St. Vrain plant, there should be a quantitative baseline evaluation of the important species in the area. This should include a discussion of population sizes, species interactions, and specie susceptibility to environmental changes induced by the plant.

If the plant's thermal and chemical effluent discharges were made directly into St. Vrain Creek under low flow conditions, they could have a significant impact on the aquatic biota and would definitely hamper any efforts to reintroduce a desirable species mix and to upgrade the stream's water quality. This problem can be minimized, however, if all blowdown discharge is sent to the farm pond and demineralizer effluent routed to an evaporator pond. Also, chlorine is not likely to be a problem if blowdown is routed through the Goosequill Ditch and stored in the farm pond for an average ten days. The effects of other salts will similarly be mitigated by dilution and chemical reactions occurring during retention in the farm pond.

There is one area of concern in terms of the use of the farm pond for discharges. The pond is frequented by several species of migrating waterfowl and may well be the only area stopover on their flyway. There is some question as to the effects of the thermal and chemical discharges on foodstuffs in the pond and on the birds themselves. Wildfowl use of the farm pond may necessitate a further modification of the stated thermal and chemical discharge levels. If biological monitoring of the farm pond determines that thermal and chemical discharges are having a deleterious effect on the bird populations and/or their food supply, and if it is determined that the Fort St. Vrain farm pond is a major stopover on the flyway, then controls on thermal and chemical discharges into the pond may be required. Specifically, it might prove desirable to remove dissolved solids from the blowdown prior to release to the pond and to discharge blowdown from the "cool" (80°F) side of the cooling tower at all times.

COST-BENEFIT

Although Fort St. Vrain is, in some respects, a novel plant for U.S. technology, it is similar to the existing Peach Bottom demonstration plant constructed and operated as part of the AEC Power Demonstration Program. This similarity, as well as extensive experience with graphite moderated nuclear reactors in France and Great Britain, means that Fort St. Vrain can be judged as a commercial reactor plant and not merely as a prototype. In our opinion, the environmental impact should be an important factor considered in this judgment.

In general, the environmental effects of this facility will be less than that of a light-water plant of comparable size. The high thermal efficiency as compared with light-water reactors promises a relatively low heat discharge; the breeding ratio of the uranium-thorium fuel promises low fuel costs; and the use of cooling towers permits operation with a lesser amount of the scarce water of this region than once-through cooling would require. Thus, in our opinion, the adverse environmental impact of the Fort St. Vrain plant probably does not outweigh the benefits to be derived from the production of electrical power.

Although the need for electricity is adequately demonstrated and a satisfactory comparison of the economics of alternative power plants is presented, the draft statement does not address all the important relevant issues in the brief cost-benefit section. For example, it appears that a major environmental cost of the plant may be water consumption in a region where supplies are limited.

The evaporation of 5 cfs of water by the mechanical draft towers denies irrigation water to up to 1,500 acres. In view of this, the selection of mechanical draft towers over natural draft towers, with less evaporative loss, is questionable. The statement indicates that this selection was made because natural draft towers tend to have reduced efficiency in summer. The significance of this factor in relation to other costs and benefits should be discussed. Inasmuch as the demands of the applicant's system peak in winter rather than summer, slight losses in efficiency during summer do not appear critical.

Another alternative cooling system available to the applicant, considering the power plant type and thermal capacity, would be dry cooling towers. The draft statement, however, presents only a brief discussion of this alternative and concludes that they are not practical. Where water availability and water quality are as critical as in the South Platte River Basin, it would seem appropriate that dry cooling towers be given more consideration. Our opinion, based in part on our Federal Water Quality Administration study published in August 1970, is that dry towers, if properly designed, would result in a maximum of 10% increase in power generation cost. This would mean approximately 3% difference in the fixed charge rate (when compared with that for once-through cooling). Comparisons of the costs and benefits of all cooling system alternatives, including environmental costs and benefits, should be presented in the final statement.

MONITORING

We agree with the environmental statement that the applicant's baseline studies are inadequate. With respect to the future program, we do not feel that a commitment through CY 1973 is adequate or that an evaluation of the program after one year of operation will yield enough data to enable an accurate determination of future monitoring needs. We recommend, therefore, a minimum five year commitment for the establishment of the permanent program. EPA will be pleased to work with the applicant and the AEC in this effort. The final impact statement should include a detailed description of the proposed non-rad environmental sampling and monitoring program.

GENERAL DEVELOPMENT

Recognizing the limited water supply in the area served by the Fort St. Vrain plant, it is not unreasonable to assume that surplus electrical power could lead to development that may exceed the carrying capacity of the region. This is particularly true in terms of water quality and supply. We therefore suggest that the Public Service Company of Colorado work closely with other regionally orientated organizations to use the additional electrical energy supplied by this plant as a means to encourage development that would cause minimum degradation to the environment.

ADDITIONAL COMMENTS

During our review we noted that in certain instances the statement does not present sufficient information to substantiate the conclusions presented. We recognize that much of this information is not of major importance in evaluating the environmental impact of the Fort St. Vrain Nuclear Generating Station. The cumulative effect, however, could be significant. It would, therefore, be helpful in determining the impact of the plant if the following information were included in the final statement.

1. Table II-5 should include the expected concentration of tritium in liquid effluents.

2. The statement should include the assumptions and bases for the source terms for radioactive liquid effluents (Table III-5 of the statement) and radioactive gaseous effluents (Table III-4 of the statement). These estimates should be based, whenever possible, on the experience at the Peach Bottom HTGR, modified by the differences in design between the two stations.

3. The final statement should present more details regarding assumed fish reconcentration factors, and dilution factors used for the fish consumption man-rem calculations, and the basis for the assumed 20 grams/day intake of fish (usually 50 grams/day is assumed.

4. Due to the low concentrations of radionuclides anticipated in the effluents from the station, environmental monitoring would be expected to detect only abnormal releases or the long-term buildup of activity in specific environmental media. Thus effluent monitoring at the point of discharge must be relied upon as the major source of information regarding potential environmental effects of radionuclides discharged from the station. Discharges should be analyzed and reported in accordance with the AEC Safety Guide 21.

5. Figure II-8 (pg. 29) incorrectly represents the drainage path of the liquid radwaste that under normal operation will go through Goosequill Ditch to the farm pond. This should be corrected in the final statement. Mention should also be made of the concrete trough that runs from the Goosequill Ditch to the St. Vrain Creek and the potential for liquid radwaste to flow through this pathway.

6. The draft statement indicates that the maximum quantity of solids that will accumulate on the applicant's land, as a result of drift will be 1462 and 53 tons/year from the main and service cooling towers, respectively. The final statement should indicate how this solid waste will be handled and disposed.

7. The draft statement also indicates that nonradioactive solid wastes will be disposed of by a local trash-removal company. The applicant should indicate that this solid waste will be disposed of in such a manner as to conform to all applicable local, state, and Federal regulations. The applicant could contract the services of a removal company that would utilize a sanitary land fill and in so doing would assure that waste would not be open burned.

8. The use of one auxiliary boiler and two diesel engines, for use as emergency power sources are mentioned on pg. 81 of the draft statement. Although low sulphur fuel oil is to be used in the station's auxiliary boiler, additional information on the sizes of the units and quantity of fuel oil that will be burned should be included in the final statement.

9. On pg. 115 of the draft statement the radiation level at 3 feet from the truck is stated to be about 14 mrem/hr. Based on an extrapolation from the stated dose rate of 7 mr/hr at 6 feet without credit for shielding the 3 foot dose rate appears low. The assumptions for the 14 mrem/hr dose rate should be presented in the final statement.

10. On page 67, the statement is made that, "Anticipated annual releases of radioactive material in gaseous waste ... were based on 1% failed fuel during the six year fuel cycle." The failed fuel value (1%) dose not appear to be conservative, if the meaning is cracks in the graphite coating. The percentage of

failed fuel used here is the value used by some light-water reactors to evaluate anticipated release rates from metal clad fuels. The final statement should clarify this issue.

11. On page 77, beginning with line 2, the draft statement indicates that approximately [illegible],000 gallons of water per month will be used to backwash demineralizer beds (D.I.). The steam-generator-condensate D.I. will be in a system potentially containing radioactive materials; therefore, the backwash water should be monitored for radioactive materials. Plans to accomplish this monitoring should be presented in the final statement. This would facilitate determinations of the effects these substances would have on wildlife.

12. The final statement should provide more toxicity data on NALCO-345, NALCO-321, and NALCO 71-D5.

13. The final statement should indicate steps be taken to stabilize or remove the large excavation mound to the west of the station, as well as to stabilize the discharge ditches, primarily the Goosequill. These ditches and the excavation mound may be susceptible to erosion which would degrade water quality in local streams.

14. The applicant should ensure that the contractor responsible for salt removal from the evaporation ponds (pre-operation scrubbing solutions and demineralizer residues) disposes of these salts in a manner consistent with sound solid waste

management policies and applicable local ordinances. The final statement should indicate the methods and controls for this disposal.

A-52

ADVISORY COUNCIL
ON
HISTORIC PRESERVATION

WASHINGTON, D.C. 20240

MAY 10 1972

RECEIVED MAY 16 1972 U.S. ATOMIC ENERGY COMMISSION Regulatory Mail Section

50-267

RE: Fort St. Vrain Nuclear Generating Station, Colorado

Dear Mr. Rogers:

This is in response to your request for comments on the environmental impact statement identified by a copy of your cover letter attached to this document. The staff of the Advisory Council has reviewed the submitted impact statement and suggests the following, identified by checkmark on this form:

_____ The final statement should contain (1) a sentence indicating that the National Register of Historic Places has been consulted and that no National Register properties will be affected by the project, or (2) a listing of the properties to be affected, an analysis of the nature of the effects, a discussion of the ways in which the effects were taken into account, and an account of steps taken to assure compliance with Section 106 of the National Historic Preservation Act of 1966 (80 Stat. 915) in accordance with procedures of the Advisory Council on Historic Preservation as they appear in the Federal Register, March 15, 1972.

_____ In the case of properties under the control or jurisdiction of the United States Government, the statement should show evidence of contact with the official appointed by your agency to act as liaison for purposes of Executive Order 11593 of May 13, 1971, and include a discussion of steps taken to comply with Section 2(b) of the Executive Order.

✓ The final statement should contain evidence of contact with the Historic Preservation Officer for the State involved and a copy of his comments concerning the effect of the undertaking upon historical and archeological resources.

_____ Specific comments attached.

Comments on environmental impact statements are not to be considered as comments of the Advisory Council in Section 106 matters.

Sincerely yours,

Robert R. Garvey, Jr.
Executive Secretary

cc: Mr. Stephen H. Hart, State Historical Society, 200 14th Avenue Denver, Colorado 80203 w/inc.

A-53

50-267

STATE OF COLORADO DEPARTMENT OF HEALTH

4210 EAST 11TH AVENUE • DENVER, COLORADO 80220 • PHONE 388-6111

R. L. CLEERE, *M.D., M.P.H., DIRECTOR*

June 28, 1972

Mr. Lester Rogers, Director
Division of Radiological and
Environmental Protection
U. S. Atomic Energy Commission
Washington, D.C. - 20545

Dear Mr. Rogers:

Enclosed is a summary of comments from key technical personnel of the Colorado Department of Health relative to the draft environmental statement of PSC's Fort St. Vrain Nuclear Generating Station, which you transmitted to this Department on April 19, 1972.

If you wish additional information, please let me know.

Sincerely,

Roy L. Cleere

Roy L. Cleere, M.D.,M.P.H.
Executive Director

cc: Governor John A. Love
Mr. Sam Ross, Public Service Co.

COLORADO DEPARTMENT OF HEALTH
STAFF COMMENTS
ON THE
US AEC ENVIRONMENTAL STATEMENT
FOR THE
PSC's FORT ST. VRAIN NUCLEAR GENERATING STATION

Page 25 - No mention is made of "natural background" levels from pre-operational data. The Department of Health and Colorado State University have identified anomalies in the adjacent environment that should be discussed.

Page 27 - Regarding water rights in Colorado, the term "appropriated" is a better legal term than "preempted."

The high frequency of thermal inversions in the winter months will necessitate extra precautions prior to deliberate release of radioactive gases to the environment.

Page 53 - The statement - "Also, at the lowest period of flow of St. Vrain Creek (27.9 cfs), surely a portion of the Applicant's 3.8 cfs rights could be withdrawn." - is not necessarily accurate. It depends on the water rights of senior appropriators. Under Colorado law, there is no sharing of rights or proportional use. The senior right can take all of his, even if more junior right holders have none. Thus, if rights senior to this 3.8 cfs right equaled or exceeded the total flow of the river, this right would have none. The water rights must be appropriate for such a facility under any eventuality.

Pages 25 and 59 - Regarding cooling tower and service water blowdowns, these items have already been taken into account in previous comments by the Department. (See Colorado Department of Health letter of November 10, 1970 referred to on page 9 of the statement).

Page 61 - If blowdown water is reused over a protracted period (i.e. 5.5 days), the build up of condensed salts will necessitate the use of stronger solutions for their removal.

Pages 67 - 72 - This section on liquid wastes states that the Applicant plans to discharge approximately 3,000 gallons of decontamination solutions per year to either the South Platte River or St. Vrain Creek. Although the amount of possible radioactivity in this wastewater may be small, it is recommended that this water not be discharged into either river but be retained in a small pond and evaporated.

Page 72 - The ^{91}Y value appears to be high in relation to the other nuclides. The statement on page 71 qualifies the figure, but does not completely explain the apparent anomaly.

Page 77 - The statement says that demineralizer regeneration effluents will be discharged into the St. Vrain Creek. A change in design has been made and this liquid will be evaporated in a pond.

Page 79, 89, and 135 - The application of 1500+ tons of dissolved solid deposited on agricultural land per year must have some deleterious effect on the productivity of such land.

Page 87 and 91 - The Applicant has agreed to route all blowdown water through the Farm Pond to utilize all available natural cooling ditches and areas before final discharge of this water. Further, the Applicant has agreed that when the temperature of the discharge from the Farm Pond reaches 80°F., all discharge from the cooling towers will promptly be made from the cold side of the towers, and not from the hot side.

Page 98 - The statement is made, "The salinities of the South Platte River and St. Vrain Creek are unusually high for fresh water streams..." This depends on the comparison streams and would not be true for streams in the arid west.

Page 111 - There is no provision for noble gases and tritium analyses in the Environmental Sampling Schedule and are of major concentrations in the planned effluent releases.

Page 112 - A statement assuring that there would be minimal chance of spent fuel elements becoming vaporized in part, as a result of hot spots developing during transport, should be presented.

Page 124 - It is irrelevant to calculate potential radiation exposure to a total population within 50 miles of the reactor, without placing this exposure into perspective by indicating the effect on the more immediate poprulation, specifically that population immediately downwind from the station. No mention is made of the existing radiation emergency plan for the facility, which also details some of the hazards to the environment and population near the facility.

It would be a general recommendation that all silt or sludge deposits in holding, evaporative or retention ponds be monitored and prior to application to agricultural land, a complete chemical and radiological analyses be done for impact assessment.

ljw
6/28/72

PUBLIC SERVICE COMPANY OF COLORADO
P. O. BOX 840 DENVER, COLORADO 80201

R. F. WALKER
VICE PRESIDENT

June 30, 1972

RECEIVED
JUL 5 1972

Mr. Daniel R. Muller, Assistant Director
For Environmental Projects
Directorate of Licensing
U. S. Atomic Energy Commission
Washington, D. C. 20545

Re: Docket No. 50-267

Dear Mr. Muller:

Transmitted with this letter are three signed originals and twenty-five additional copies of each of the two following documents:

1. A document titled "Applicant's Comments Regarding Draft Environmental Statement Issued April, 1972, by the United States Atomic Energy Commission for the Fort St. Vrain Nuclear Generating Station." The Draft Environmental Statement was transmitted to us by a letter from Mr. Roger S. Boyd dated April 17, 1972.

2. A document titled "Applicant's Comments Regarding Agency Comments Relative to the Draft Environmental Statement for the Fort St. Vrain Nuclear Generating Station." The subject comments from several Federal agencies were transmitted to us by your letters of June 8, 1972, and June 26, 1972.

Very truly yours,

R. F. Walker, Vice President
Engineering and Planning
Electric Department

RFW/jk

BEFORE THE

UNITED STATES ATOMIC ENERGY COMMISSION

In the Matter of the Application of PUBLIC SERVICE COMPANY OF COLORADO	)))))	DOCKET NO. 50-267

APPLICANT'S COMMENTS

REGARDING AGENCY COMMENTS

RELATIVE TO THE DRAFT ENVIRONMENTAL

STATEMENT FOR THE

FORT ST. VRAIN NUCLEAR GENERATING STATION

- -

It is the purpose of this document to transmit Applicant's comments regarding comments from other agencies relative to the Draft Environmental Statement for the Fort St. Vrain Nuclear Generating Station which were forwarded to Applicant by letters from the Directorate of Licensing dated June 8, 1972, and June 26, 1972.

Respectfully submitted,

PUBLIC SERVICE COMPANY OF COLORADO

By R. F. Walker
R. F. Walker, Vice President

Dated: June 30, 1972

LEE, BRYANS, KELLY & STANSFIELD
Bryant O'Donnell
Robert F. Thompson
Public Service Company Building
Denver, Colorado 80202

Attorneys for Applicant

APPLICANT'S COMMENTS
REGARDING AGENCY COMMENTS
RELATIVE TO THE DRAFT ENVIRONMENTAL
STATEMENT FOR THE
FORT ST. VRAIN NUCLEAR GENERATING STATION

DOCKET NO. 50-267

The following comments are submitted in response to comments from several Federal agencies which were transmitted to Applicant with a letter from the Directorate of Licensing dated June 8, 1972.

APPLICANT'S COMMENTS REGARDING LETTER DATED MAY 30, 1972 FROM CORPS OF ENGINEERS

The suggestion regarding continuation of water quality studies is noted. Water quality analyses will be continued as required by the discharge permit for the station. Additional water quality studies will be conducted during performance of the ecological study.

Since most of the site will continue to be used for agricultural purposes, it is not considered practical to designate the project lands as a wildlife preserve. A one-mile square "exclusion area" in which the plant is located is zoned industrial, but this land is under control of the Applicant, and most of this area will continue to be used for agriculture. The remainder of the site is zoned agricultural; thus, further industrialization of the project lands will not occur.

Since raising of livestock is one of the major agricultural uses of project lands, it would be a severe restriction to categorically restrict this activity as suggested. The ecological study being conducted at the site includes detailed investigations of algae. A major objective of the study is to determine whether plant effluents have any effect on the environs surrounding the plant. The program will include a study of potential adverse effects of liquid effluent on biota; algae will be one of the primary indicators. Thus, growth of algae which might be toxic to livestock will be identified by the ecological program.

APPLICANT'S COMMENTS REGARDING LETTER DATED JUNE 2, 1972, FROM DEPARTMENT OF AGRICULTURE

Economic Research Service Comments

A spray pond is an alternate cooling method which could be included in the analyses, but it is doubtful that identifiable effects on the environment from a spray pond would be substantially different than those from a cooling pond.

The effect on effluent from a cooling pond attributable to power plant operation would be expected to be comparable to the effect on cooling tower effluent because the forced evaporation would be comparable. If a cooling pond is created specifically for a power plant, the additional loss of water due to natural evaporation should possibly be considered as a consequence of selection of this alternative.

Soil Conservation Service Comments

It is suggested that a conservation plan be developed with technical assistance from the Soil Conservation Service.

Agricultural use of Applicant's property is much the same as it has been for several years. It is certainly Applicant's intention, under the direction of Applicant's Farm Manager, to adhere to the highest standards of good practice regarding farm operations and conservation practices. Applicant wishes to assure the Soil Conservation Service that recognized soil conservation practices are being observed on Applicant's property, and is agreeable to cooperate by discussing conservation practices with Soil Conservation Service representatives if the Service should like to do so.

<u>Agricultural Research Service Comments</u>

The comment regarding conservation practices is similar to that of the Soil Conservation Service, and the comment made above would apply.

Concern is expressed about the possible deposition of approximately 1500 tons of salt annually by drift from the cooling towers. As noted in Applicant's Environmental Report, Section 5-17, Public Service Company has operated cooling towers since 1948, accumulating 162 tower years of total operating experience. During that period of time agricultural activities have been maintained on and around our facilities, and no deleterious effects from deposition of solids by virtue of cooling tower drift have been observed.

Since the water quality characteristics of drift from the cooling towers will be similar to those of irrigation water, it would not be expected that the effects of drift would be deleterious in comparison to irrigation water which is taken from the same sources as makeup water for the towers. Nevertheless, a study of the effect of cooling tower plumes on the environment will be a specific element of the ecological study. Representatives of the Agricultural Research Service at Colorado State University are welcome to discuss this aspect of the ecological program with Applicant's investigators at Colorado State University.

APPLICANT'S COMMENTS REGARDING LETTER DATED MAY 23, 1972, FROM DEPARTMENT OF AGRICULTURE FOREST SERVICE

Applicant has noted the letter and has no comments to offer.

APPLICANT'S COMMENTS REGARDING LETTER DATED MAY 31, 1972 FROM DEPARTMENT OF COMMERCE

Applicant has noted the letter, and has no comments to offer.

APPLICANT'S COMMENTS REGARDING LETTER DATED MAY 24, 1972, FROM DEPARTMENT OF TRANSPORTATION

Applicant has noted the letter, and has no comments to offer.

APPLICANT'S COMMENTS REGARDING LETTER DATED MAY 24, 1972, FROM FEDERAL COMMISSION

The Federal Power Commission has properly emphasized the importance of placing the Fort St. Vrain STation in commercial operation as soon as possible in order to maintain an adequate reserve margin on Applicant's system.

Leased gas turbine capacity has been noted as being available from 4/72 to 10/72 in the table on Page 2. This capacity has properly not been included in the second column for 1972-73 Winter, since Fort St. Vrain capacity is included. However, the letter correctly comments that the unit may not be in commercial operation until January, 1973. It should be noted that 100 Mw of leased gas turbine capacity would continue to be available until the unit is placed in commercial operation.

It is stated on Page 3 that "capital costs of $210 million are estimated by the Applicant." As noted in Applicant's comments on the draft Environmental Statement, the basis for this number is not clear. Applicant's budgeted costs are $71.0 million.

APPLICANT'S COMMENTS REGARDING LETTER DATED MAY 10, 1972 FROM ADVISORY COUNCIL ON HISTORIC PRESERVATION

Applicant has worked in cooperation with the State Historical Society regarding historical and archeological resources in the site vicinity for some time. Applicant has been in contact with the State Historical Society and has established that the Society concurs with the Applicant that there will be no adverse effect upon historical and archeological resources because of the plant. It is the understanding of the Applicant that a letter consistent with the above comments is being written to the AEC by the State Historical Society.

APPLICANT'S COMMENTS REGARDING LETTER DATED JUNE 3, 1972 FROM ENVIRONMENTAL PROTECTION AGENCY

Comments by the Environmental Protection Agency are contained in a 27 page enclosure to the above referenced letter identified as EPA No. D-AEC-00049-45. The following comments are applicable to the comments in this enclosure.

The following comments are offered in response to the major conclusions presented on Page 1:

1. It is recognized that determination of the adequacy of water resources to provide a dependable water supply to the station during adverse water years is a matter of judgement. Because of the importance of this subject, Applicant retained the services of a water engineer consultant shortly after the project was started in 1965 to evaluate water resources available to the station and to assist in the development of a reliable water supply. Applicant's continued water development program has resulted

in a water supply scheme with considerable flexibility and redundancy. In addition to direct stream flow rights, Applicant has additional water resources in the form of shares of Colorado-Big Thompson project water, three small reservoirs, and has additional backup from shallow wells and other storage water rights on tributary streams. In the judgement of the Applicant, these water resources will be more than adequate to provide a dependable water supply for the plant.

Water rights are considered property rights in Colorado and as such may be purchased and utilized in the same manner as any other properties. As a consequence, in the event that additional water is necessary, it may be purchased just as other supplies for the plant may be purchased.

2. It is stated that discharge of cooling tower blowdown water may degrade water quality in the streams, and that it is not certain whether the discharges will meet State Quality standards. In what specific respect it is felt that the discharges, if any, will not meet standards was not stated.

Applicant has been engaged in dialogue with the Region VIII office of the Environmental Protection Agency for some period of time regarding the Agency's review of Applicant's request for a permit to discharge. It is Applicant's understanding that a general level of agreement has been reached regarding conditions which would be imposed on discharges to adequately protect quality of the streams. Applicant has obtained a letter of certification dated November 10, 1970, from the Colorado Department of Health which states that "there appears to be reasonable assurance that the plant will not violate applicable water quality standards."

Applicant has satisfied itself through conservative calculations that the discharges from the plant will not violate State water quality standards.

As a result of the above actions, it is concluded that the effect of plant effluent on the South Platte River or St. Vrain Creek will not cause applicable water quality standards to be violated.

3. Operational data of all types, including radioactive effluents, which will be obtained from Fort St. Vrain certainly will be an important addition to the records of operating experience for the HTGR. This data will be very useful as confirmation of operating limits and in the design of future HTGR's, just as the data from the Peach Bottom Station has been an important input into the design of Fort St. Vrain. Operational data will be collected and reported in accordance with the Technical Specifications and other applicable regulations.

4. There are several drains which are routed to the liquid radioactive waste system as precautionary measures. The likelihood of radioactivity being present in some of these potential sources is quite small. Therefore, a requirement to process all liquid which might be routed to this system through the demineralizer would serve no useful purpose. This would be considered a wasteful practice from the standpoint that the demineralizer cartridge would be depleted by removal of the normal small concentrations of impurities in the water being processed. It is our opinion that any benefit derived from processing all liquid waste, regardless of activity level, through the demineralizer prior to discharge, is outweighed by the additional solid waste burden generated in the form of spent demineralizer cartridges having very low activity levels.

Applicant's estimate of liquid radioactive effluent is only 60 µCi/year. This is a factor of nearly 1/700 of the calculated limit of 41,000 µCi/year quoted on Page 71 of the Draft Environmental Statement, or less than 0.02% of this limit. In comparison with the natural background activity of the surrounding environment, it is the opinion of the Applicant that further expenditure of resources to reduce this minimal release to a still lower value is not warranted. A limit must be specified at some point. In view of the available dilution and the regulations applicable to activity release it is concluded that 2×10^{-6} µCi/ml is a reasonable limit, wholly consistent with the low as practieable concept.

5. It is correct that there is no commercial facility presently available to reprocess HTGR spent fuel, since there is presently not a sufficient requirement to justify this type of facility. A base program for development of HTGR reprocessing technology has been underway for some time by the AEC in cooperation with industry. Under the terms of the contract between the AEC, PSC, and GGA, the AEC has agreed to receive the spent fuel from Fort St. Vrain for the first eight years of operation. As part of the base program, AEC is considering construction of a pilot plant at Idaho Falls. Until such time as a plant has been constructed, however, irradiated fuel will be stored at Idaho Falls, Idaho, or at another acceptable storage site in a manner which complies with all applicable regulations. The exact manner in which very long term storage will be effected, if necessary, will depend upon Federal policy which remains to be defined. In the meantime, no special problems are foreseen in the interim storage of the solid spent HTGR fuel using proven methods for storing similar solid high level radioactive wastes. The discussion on Page 112 of the

Draft Environmental Statement is quite specific in terms of removal of spent fuel from the station to the interim storage site.

6. The fuel design and helium purification system provide assurance that iodine or strontium will not be released from the reactor vessel into the reactor building; in addition, the exhaust air from the reactor building is continuously discharged through high efficiency filters.

Because of the relatively short half-life of ^{131}I and its precursors, and because of the normal holdup of gaseous and liquid radioactive wastes prior to discharge, the quantity of iodine routinely released to the environment is expected to be negligible. Some small amounts of ^{89}Sr and ^{90}Sr, however, will be released in aqueous effluents from the station as shown in Table III-5. The effect of biological reconcentration in food chains has been considered by the AEC Staff and the results are presented in Table V-3.

In addition, the plant Technical Specifications, in developing limits on gaseous radioactive release specify that "...MPC for halogens and particulates with half lives longer than 8 days will be reduced by a factor of 700 from their listed value in Column 1, Table II of 10 CFR 20, Appendix B." This reduction is made to reflect possible reconcentration in the food chain, and to assure that even under adverse meteorological conditions, dose rates in unrestricted areas will not exceed the limits set forth in 10 CFR 20. As shown in the draft detailed statement, actual releases will be several orders of magnitude below the limiting values.

The potential for release of iodine and strontium during accident conditions was considered extensively during the safety analysis review. The probability of occurrence of an accident in which iodine or strontium could be released to the environment is extremely small.

7. The bases for potential accidents were analyzed at length during the safety analysis review. The environmental consequences of accidents were analyzed for the most part on the basis of the same types of accidents using somewhat less conservative assumptions. It is the opinion of the Applicant that the bases for the analyses of accidents presented in the Draft Statement are sound. It appears that the values are similar to those the Applicant would obtain if realistic, rather than highly conservative assumptions were employed in the assessment of accident consequences.

The following additional comments are submitted with regard to several particular items in the remainder of the EPA document:

Page 4, Paragraph 1

As stated above, anticipated releases from the radioactive liquid waste system are minimal, and it is the Applicant's opinion that further steps to reduce this discharge are not warranted. Nevertheless, Applicant has agreed as a result of discussions with EPA Region VIII to accept the following condition regarding future discharge of effluent from the liquid radioactive waste system:

Applicant will observe the actual requirements for operation of the liquid radioactive waste system during the first full year of commercial operation; during this period Applicant will also investigate alternate forms of disposal which could be employed, such as evaporation ponds or evaporators. Applicant will then submit its conclusions to the EPA for evaluation and subsequent action.

Page 4, Paragraph 2.

The normal path of discharge of cooling tower blowdown, which would include liquid radwaste, will be through the farm pond. Applicant has also agreed with EPA Region VIII to accept this mode of discharge as a condition for normal operation. Discharge would be made through the slough only because of abnormal circumstances, and EPA and the State Department of Health would be notified.

Page 5, Paragraph 1.

In the event of leakage of a reheater tube at a rate below that necessary for automatic trip of the reheat loop isolation valves, several other instrument systems would detect the increased release of radioactivity, and alarm or otherwise alert the operating staff to the need for reheat loop isolation. These instrument systems include the Loop Header Condensate Monitors and the Air Ejector Monitor, both of which have lower limit sensitivities of about 5×10^{-6} μCi/cc. The Technical Specifications also include a requirement for routine sampling for secondary coolant activity. In addition, there are the building ventilation monitors which would detect increases in radioactivity release, and the area radiation monitors--particularly RT-92350-13, which is intentionally located near the condensate demineralizers--which would detect and alarm increases in ambient radiation levels. With these several lines of defense and a high sensitivity for detection (e.g., accumulation of activity in the condensate demineralizers), any significant leakage of a reheater tube would be detected so that loop isolation could be achieved.

Under normal conditions, the demineralizer regeneration effluents are transferred to a neutralizing tank, where they are adjusted to a pH of 6.5 to 7.5. From this tank they are subsequently disposed of in lined evaporation ponds. In the event of reheat tube leakage, as postulated above, the accumulation of any significant quantity of activity in the demineralizer resins would be indicated and/or alarmed by the local area

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radiation monitor (alarm level is set at 2.5 mrem/hr). Accordingly, instead of being disposed of in the routine manner, the liquid waste arising from regeneration of this bed would be transferred to temporary storage and disposed of in accordance with the applicable radwaste disposal regulations and operating rules in effect at that time.

In the event of reheat tube leakage, a small quantity of activity may remain in the secondary coolant following coolant cleanup by the demineralizer. This level would be extremely low, however, because of the full-flow design of the demineralizers. Such leakage as did occur, would therefore be cleaned up as ordinary radioactive contamination and disposed of as low level radioactive waste. Should significant volumes of leakage occur, the liquid could be collected and transferred to the liquid radwaste system.

<u>Page 8, Paragraph 1</u>

The quoted increase in stream temperatures of 2° F in summer and 4.2°F in winter were calculated on the conservative basis of direct discharge of blowdown into the stream and do not correspond to the actual case in which interim cooling will occur. In the usual case in which blowdown is discharged via Goosequill Ditch and the farm pond, a stream temperature increase of only 0.83°F was calculated for adverse summer conditions, when blowdown temperature from the tower is 100.6°F.

As a result of discussions with EPA Region VIII, Applicant will accept as a condition for normal operation that blowdown will be discharged from the cool side of the tower at times when discharge temperature to the stream would be greater than 80°F. This should effectively eliminate concern about thermal effects in the streams.

Because of the small size of the streams, mixing is expected to occur within a short distance. Temperature probes are installed in both the South Platte River and St. Vrain Creek upstream and downstream of potential points of discharge to record any measurable changes in stream temperature.

Page 9, Paragraph 1

To our knowledge, there is no standardized criteria of stream flow for evaluating water quality effects. Hence, the lowest seasonal monthly mean discharge for seventeen years of record was felt to be reasonably conservative. It is correct that lower seven-day, once-in-ten-year flows have been observed. Since the usual path of discharge will be through the farm pond, and from the cool side of the tower during hot weather, temperature effects on the South Platte River should be minim al, even during periods of low flow.

Page 10, Paragraph 1

The two evaporation ponds are already in operation; hence, discharge of demineralizer effluent into St. Vrain Creek will not occur.

Page 10, Paragraph 2.

Impact of effluent on stream quality during low flow conditions would be greater than on an annual average basis. Applicant's calculations indicate that the two standard deviation criteria in the State water quality standards for total dissolved solids would not be exceeded during periods of low stream flow.

We believe that the annual average river flow, as used in calculating the values presented in Table III-8, provides a reasonable basis for assessing the long-term environmental impact of cooling tower blowdown. 253

This is because it provides a measure of the long-term changes that could affect the ultimate ecological balance. The use of rare conditions, such as seven-day, once-in-ten-year low flow, for assessing environmental impact seems generally unwarranted, since such conditions, by definition, affect the local environment only a small fraction of the time and, hence, cannot produce profound, long-term changes.

Pages 11-15

Applicant is well aware of the importance of an adequate water supply to plant operation. However, we fail to see any particular environmental implications involved in the question regarding an adequate water supply. Applicant has investigated this question quite thoroughly, and, as stated previously, feels confident that the several alternate water sources provide reasonable assurance that the water supply for the station will be adequate. Applicant has retained a qualified water engineer consultant since the early stages of the project to evaluate the water supply situation and to advise the Applicant regarding steps to be taken to assure a reliable water supply for the station. Applicant is continuing its review of this vital topic, and will monitor this situation very closely following plant startup.

Pages 15-17

A comprehensive baseline evaluation of important species in the area will be made as a part of the ecological inventory and monitoring program being conducted for Applicant by Thorne Ecological Institute. The program was outlined on Pages 102-103 of the Draft Statement. Investigation of the effects of effluent on biota will be a prime consideration of the program.

Page 19

Applicant has successfully operated mechanical draft cooling for 24 years; therefore, mechanical draft towers were a natural choice for Fort St. Vrain. Natural draft towers have not generally been considered as a desirable alternative in this location because of atmospheric conditions and altitude which affect performance and economics. We are aware that there is some indication in the literature that water consumption for a natural draft tower is slightly less than for a mechanical draft tower, but we question whether there is conclusive operational evidence which confirms this hypothesis.

Installation of a dry cooling tower at Fort St. Vrain would require extensive modifications of turbine plant equipment as well as the cooling circuit. Dry cooling towers may find favor in this semi-arid region in the future, but to date dry towers are not being installed for units the size of Fort St. Vrain. Costs for dry cooling towers are largely conjectural.

Consideration of either natural draft towers or dry cooling towers are not considered to be practical alternatives at this stage because the cooling tower at Fort St. Vrain is complete. It would clearly be a waste of resources to replace the existing tower which will cause a minimal effect on the environment with another type.

<u>Page 21.</u>

The ecological monitoring program is not restricted to calendar year 1973, but will be continued as long as required. Since monitoring requirements cannot be intelligently defined until an ecological inventory has first been completed, it seems reasonable to establish goals for development of the program. One full year of operating data would seem to be a logical base on which to develop the continuation of the monitoring program beyond that point. It is visualized that periodic review of monitoring data and adaptation of the monitoring program as indicated by this data will be a continuing process.

A detailed description of the ecological inventory and monitoring program was contained in a document titled "Additional Information Regarding Applicant's Ecological Study," May 1972, which was submitted to the Division of Reactor Licensing on May 11, 1972.

Page 23, Comment 1.

A small amount of tritium diffusion has been observed at the Peach Bottom reactor. Because of the many fundamental differences between the two plants, extrapolation of the Peach Bottom data to Fort St. Vrain is difficult and is characterized by large uncertainties. Nevertheless, conservative estimates of possible tritium release from the Fort St. Vrain reactor indicate that its concentration in water at the point of release will be well below the limits specified in 10 CFR 20 for unrestricted areas.

Page 24, Comment 5.

It is correct that Figure II.8 does not show the normal drainage path. This figure was apparently based on an outdated background map; the primary purpose was to indicate locations of the biological sampling stations.

Cooling tower blowdown can be intentionally diverted into the slough which drains into the St. Vrain Creek, but the normal path of discharge will be into the South Platte River via Goosequill Ditch and the farm pond.

Page 24, Comment 6.

There has not been a perceptible deposit of solids on the land surrounding Applicant's existing cooling towers at other plants. It is concluded that these solids will be widely dispersed and will not fall in the category of solid waste.

Page 25, Comment 7.

Normal trash from the station will be hauled away by a commercial service which performs this type of service in the area. The trash will be hauled to an approved trash disposal site.

Page 25, Comment 8.

The capacity of the auxiliary boiler is 45,000 pounds per hour. Estimated fuel consumption is 535 thousand gallons per year.

Page 25, Comment 10

The assumption of 1% failed coatings for Fort St. Vrain fuel at the end of 6 years has been shown to be conservative by a number of in-pile irradiation experiments. The following summary of results of the HRB-2 irradiation experiment of fuel particles was contained in the Quarterly Progress Report (Gulf-GA-A10980) for the Fort St. Vrain Research and Development program for the period ending December 31, 1971:

> "In summary, the HRB-2 capsule has demonstrated excellent performance of FSV preproduction fuel to the most severe combined conditions of fast-neutron fluence and temperature. Because of higher than expected thermal neutron flux, the burnups, particularly in the fertile particles, were well in excess of the FSV maxima. This confirms the conservative nature of the FSV coated particle design. Particle failure fractions, both in fuel rods and loose particle samples, were well below the design criterion of 1%. Only three fissile particles of the greater than 2000 examined were observed to have failed during irradiation."

Page 26, Comment 11.

Radioactivity is not expected in the condensate system. Monitors in the condensate system would indicate the presence of radioacivity if leakage into the system should occur. The Technical Specifications also require routine sampling for secondary coolant system activity.

Page 26, Comment 12.

Specific studies of the effect of the NALCO water treatment chemicals will be included in the ecological program.

Page 26, Comment 13.

Applicant is not aware that there have been any particular erosion problems with the construction mound. Consideration has been given to the possibility of future erosion of the mound after its use for construction has ended. Techniques such as contouring and planting with grass could be used to help stabilize the mound if this should be necessary.

No erosion problems would be expected in the Goosequill Ditch since it is concrete lined, but there have been some minor erosion problems in other ditches. As it is important to have the ditches in good repair for their continued use, erosion will be corrected as it occurs by techniques such as lining or reinforcement.

Page 26, Item 14.

The evaporation ponds are designed with sufficient capacity so that it should not be necessary to remove salt during their life. If this should become necessary, particular attention would be given to proper disposal of this waste; it is expected that the waste would be disposed of by burial.

The following comments are submitted in response to comments transmitted to Applicant with a letter from the Directorate of Licensing dated June 26, 1972:

APPLICANT'S COMMENTS REGARDING LETTER DATED JUNE 19, 1972 FROM THE U. S. DEPARTMENT OF THE INTERIOR

Historical Significance

Applicant has worked in cooperation with the State Historical Society regarding historical and archeological resources in the site vicinity for some time. Applicant has been in contact with the State Historical Society and has established that the Society concurs with the Applicant that there will be no adverse effect upon historical and archeological resources because of the plant.

Blowdown and Drainage

Applicant has been engaged in discussions with the Region VIII Office of EPA for some period of time regarding the Agency's review of Applicant's request for a permit to discharge. One of the effluent limits that has been established for normal operation is a maximum discharge of 3.75 million gallons per day. During the draining and cleaning of the cooling tower basin, the 3.75 MGD discharge rate would not be exceeded, which would be equivalent to about 6 CFS. The chemical and biological contents of the cooling tower basin water would be the same as the normal cooling tower blowdown water. Cleaning of the facilities connotates flushing with the normal source of make-up water to the towers and will not result in any additional impact over that associated with normal blowdown from the cooling tower. The holding ponds will contain water that has the same composite quality as that of the streams and will constitute make-up water to plant.

Cooling Tower Drift

As commented on previously, the Applicant has operated cooling towers since 1948, accumulating 162 tower years of total operating experience at a number of locations. During this time Company vehicles have been parked and operated around the cooling towers as well as the personal vehicles of employees on a continuous basis. No damage or claims have ever been made for vehicles due to cooling tower drift during this period of operation.

Recreational Development

The primary use of the land in the vicinity of the plant has been for agricultural purposes. In addition, all the land in the vicinity of the plant is privately owned. Since most of the site will continue to be used for agricultural purposes, it would not be consistent to develop recreational uses of the site as opposed to the established pattern of agricultural use of private land in that particular area.

Ecological Monitoring

As stated elsewhere, the ecological monitoring program is not restricted to calendar year 1973, but will be continued as long as required. Since monitoring requirements cannot be intelligently defined until an ecological inventory has first been completed, it seems reasonable to establish goals for development of the program. One full year of operating data would seem to be a logical base on which to develop the continuation of the monitoring program beyond that point. It is visualized that periodic review of monitoring data and adaptation of the monitoring program as indicated by this data will be a continuing process.

A detailed description of the ecological inventory and monitoring program was contained in a document titled "Additional Information Regarding Applicant's Ecological Study," May 1972, which was submitted to the Division of Reactor Licensing on May 11, 1972.

Irreversible and Irretrievable Commitments of Resources

The operation of the Applicant's facility should not result in any additional loss of fish and wildlife resources over that usually associated with agricultural activities. There may be less of an impact due to one owner as opposed to the five or six previous owners each managing his land.

BEFORE THE

UNITED STATES ATOMIC ENERGY COMMISSION

In the Matter of the Application)
)
of) Docket No. 50-267
)
PUBLIC SERVICE COMPANY OF COLORADO)

APPLICANT'S COMMENTS

REGARDING DRAFT ENVIRONMENTAL STATEMENT

ISSUED APRIL, 1972

by

THE UNITED STATES ATOMIC ENERGY COMMISSION

for the

FORT ST. VRAIN NUCLEAR GENERATING STATION

This document is being submitted to transmit Applicant's comments regarding the Draft Environmental Statement issued April, 1972, for the Fort St. Vrain Nuclear Generating Station which was forwarded to Applicant by a letter from the Division of Reactor Licensing dated April 17, 1972.

Respectfully submitted,

PUBLIC SERVICE COMPANY OF COLORADO

By R. F. Walker
R. F. Walker, Vice President

Dated: June 30, 1972

LEE, BRYANS, KELLY & STANSFIELD
Bryant O'Donnell
Robert F. Thompson
Public Service Company Building
Denver, Colorado 80202

Attorneys for Applicant

APPLICANT'S COMMENTS REGARDING DRAFT ENVIRONMENTAL STATEMENT ISSUED APRIL, 1972 by THE U.S. ATOMIC ENERGY COMMISSION for THE FORT ST. VRAIN NUCLEAR GENERATING STATION

DOCKET NO. 50-267

The following comments are submitted by the Applicant to the Directorate of Licensing of the U. S. Atomic Energy Commission for consideration regarding the Draft Environmental Statement which was issued in April, 1972, relative to the proposed issuance of an operating license to Applicant for the Fort St. Vrain Nuclear Generating Station:

Stream Flow

The subject of stream flow and its relation to quality and availability of water in the streams at the site is touched on in several places in the Draft Environmental Statement.

In assessing the flow in a stream at any particular point, there are several factors which must be considered. One of these factors is gaging station records. For Fort St. Vrain, historical records are available from established gaging stations on St. Vrain Creek and the South Platte River. The gaging station on St. Vrain Creek is on Applicant's site, but the nearest gaging station on the South Platte River is at Henderson, some 23 miles upstream. Therefore, flow in the South Platte River at the site must be estimated.

There are several points of diversion into ditches between Henderson and the plant. The amount of water which may be diverted into each of these ditches during adverse water years is subject to allocation on the basis of the priority system of water rights. It may appear that the sum of these rights which are senior to Applicant's rights would deplete the stream completely in adverse years. It is important to consider that in the actual case, there is a return flow to the stream of typically 40-50 percent of water diverted for irrigation. Therefore, this return flow must be recognized in assessing whether water will be in the stream at a point of diversion downstream. In the case of Fort St. Vrain, return flow to the stream from more senior rights between Henderson and the site should, of itself, be more than sufficient to maintain a flow in the stream at the site during adverse water years in excess of diversions into the Jay Thomas Ditch. Historic records of ditch diversions, which are the best indication of reliability of water rights, would tend to substantiate this conclusion. From a practical standpoint, it is also important to note that the point of discharge for effluent that might overflow from the farm pond into the South Platte River is located only a few hundred feet upstream of the confluence with St. Vrain Creek. Therefore, the combined flow of the two streams should effectively be the basis for considerations of stream quality.

An important point which is applicable to both the South Platte River and St. Vrain Creek is the increasing importation of water from the western slope of the Rocky Mountains to the eastern slope. This trans-mountain diversion has had a continually increasing effect of producing an increasing stream as compared to historical records. Also, 264 as dams and reservoirs have been constructed on the streams, a tendency toward more regulated stream flow has resulted, and it is expected that the tendency toward regulated streams will become more evident as additional dams and reservoirs are constructed.

Page i, Item 2.b.

The 3000 acre-feet of water evaporated annually by the operation of the station will come from the multiple water supply sources available to the Applicant. These water sources include direct flow water rights and wells acquired with the land, Colorado-Big Thompson (CBT) transmountain diversion water acquired by purchase, and off-site reservoir and direct flow rights acquired by Applicant.

The direct flow water rights and wells acquired with the land were previously used for agricultural purposes on this land. This land is managed by the Applicant, and use of water for agricultural purposes on the land is under direct control of the Applicant. In a dry year or year of reduced water availability, the Applicant would restrict agricultural water use on its land if necessary rather than restrict plant use. If the plant were not located at this site, water would all be used for agricultural purposes with no restrictions. Therefore, any affect on irrigated land from use of direct flow rights would be on Applicant's land rather than land belonging to others. CBT water is available every year, and its use is not subject to the water priority system on the South Platte River or is its use affected by low flow conditions on the river. This CBT water is stored in western slope and eastern slope reservoirs subject to call by the owners of shares in the CBT. The

Applicant's shares in CBT water as well as many other shares owned by industrial and municipal users represent water which was voluntarily withdrawn from a predominantly agricultural use by its former owners. This water is particularly valuable for use as supplemental water when normal river flow is low. Off site reservoir storage can be used in a similar manner to supplement direct flow rights during periods of low river flow.

The conversion of agricultural land to residential and commercial use has made available water formerly used to raise crops for use by domestic and industrial users. This conversion of land use is expected to continue for some time. Therefore, it is only hypothetically possible that 1500 acres of land would be deprived of water in dry years, and if any land is deprived of water, it would be the Applicant's land.

Page i, Item 2.c.

It was stated in the enviromental draft statement that the maximum quantity of solids that will accumulate on the Applicant's land in any given year will be 1462 and 53 tons per year from the main and service cooling towers respectively. As indicated in Applicant's environmental report, Section 5-17, Public Service Company has operated cooling towers since 1948, accumulating 162 tower years of total operating experience. During that period of time agricultural activities have been maintained on and around our facilities and no deleterious effects from deposition of solids by virtue of cooling tower drift have been noted.

Page i, Item 2.e.

It is stated that the circulating water of the cooling towers will have free chlorine concentrations of about 1 ppm, and that the free chlorine concentration in the South Platte River may vary up to 0.01-0.02 ppm after effluent is mixed with the stream.

As further clarification, the towers will be treated intermittently, as is stated elsewhere in the Draft Statement, to a maximum residual of 1 ppm, and the residual in the tower will decay to a lower concentration between treatments.

It is our understanding that the calculated value of 0.01-0.02 ppm in the stream is based on the very conservative assumption that the effluent discharging to the stream contains a concentration of free chlorine of 1 ppm, and that the lower calculated stream concentration results solely from dilution.

In actuality, there are several factors which will effectively decrease the chlorine residual in the cooling tower blowdown in transit through Goosequill Ditch and the farm pond; these factors are summarized on Page 99 of the Draft Statement.

Tests were recently conducted at Applicant's Cherokee Station to provide preliminary confirmation that chlorine concentration will decrease to a minimal level before discharge to the stream. The plant effluent was tested for residual chlorine following the chlorination cycle on each of the four cooling towers at the station. In only one of the four cases, in which the blowdown was being routed directly to the discharge ditch from the tower, was a detectable level measured at the sampling point in the ditch a few hundred yards downstream of the tower. The detected level was less than the minimum scale level of 0.1 ppm; the residual measured in the blowdown at the tower during chlorination was 1.3 ppm. No residual was detected in the effluent following chlorination of the other three towers at concentrations up to 0.8 ppm. In these three cases the blowdown was being routed through the ash water tanks to the drainage ditch. These tests are felt to be indicative of the decrease in concentrations which will occur in the ditch and pond at Fort St. Vrain.

The discharge path will be monitored for chlorine concentrations following chlorination, in accordance with the Technical Specifications for the plant, as mentioned on Page 99 of the Draft Statement. The effect of chemical effluent, including chlorine, on biota will also be studied as part of the ecological program. It is concluded by the Applicant that adequate precautions are being taken to ensure that chlorination will not result in adverse environmental effects at Fort St. Vrain.

Page i, Item 2.g.

Release of about 1000 Curies of gaseous radioactive effluent per year appears to be a reasonable realistic estimate based on "expected" values of primary coolant activity, and is considerably less than the conservative "design" levels estimated by Applicant.

Even though quite small, the stated value of 0.04 Curies per year of radioactivity in liquid effluent is a factor of about 650 higher than that which would be calculated on the basis of Applicant's estimated release. This apparent discrepancy is discussed in more detail under the comments regarding page 71, paragraph 3.

Page ii, Item 2.K.

At the time of the Fort St. Vrain environmental assessment site visit of December 16-19, 1971, the estimate of property taxes to be paid on the Fort St. Vrain Plant in 1972 was discussed. The basis for the property tax other than the various mill levies as required by the various districts and apprcpriate funds was the investment in the plant of some $54 million as of December 31, 1970, resulting in an estimated property tax for 1972 of $452,350. Applicant's present budget estimate for investment in the Fort St. Vrain Plant is $71.0 million. Based on the Applicant's total investment, which is the taxable basis, we would estimate that the annual tax revenues might be of the order of $600,000.

Page 65, Table III-4

As noted above, the values in Table III-4 differ significantly from those in Table 19, P. 5-29, of Applicant's Environmental Report, Operating License Stage, December, 1970. A portion of the difference is believed to be due to the use of different assumptions concerning the fraction of failed fuel. Because of the very conservative assumptions employed in the Applicant's Environmental Report, it is our opinion that the AEC figures represent a more realistic, but still conservative, estimate of the annual gaseous release that will actually occur.

Page 69, Paragraph 4

It is no longer planned to use lithium hydroxide for pH control of the PCRV cooling water. Instead, aqua ammonia will be employed for this purpose. Accordingly, there will be no tritium production from neutron reactions with lithium, and references thereto, as on Page 67, should be deleted.

Page 71, Paragraph 3

The stated estimate for release of liquid radioactive effluent of 0.041 Curies per year is a factor of about 650 higher than Applicant's estimate.

It is stated on Page 71 that a volume of 6000 gallons was assumed, although on Page 67 Applicant's estimate of 3000 gallons per year was quoted. In any event, Applicant has revised the estimated quantity to 8000 gallons per year.

If 8000 gallons of liquid were discharged at the Technical Specification limit of 2×10^{-6} μ Ci/ml, the total release would be only 0.0000605 Curies per year, considerably less than the 0.041 Curies stated.

The basis for the distribution of isotopic activity in Table III-5 is not clear. The predominance of activity attributed to Y-91 in particular seems questionable in comparison to the values for Y-90 and the other isotopes on the list.

<u>Page 73, Paragraph 4</u>

Applicant's plans for discharge of demineralizer regeneration effluents have been revised in cooperation with the Environmental Protection Agency. These effluents will be ponded in two evaporation ponds with a total surface area of about 1.5 acres located a few hundred feet northeast of the plant building instead of being discharged into St. Vrain Creek. The data in Table III-7 regarding concentrations in St. Vrain Creek is no longer applicable.

<u>Page 74, Table III-6</u>

References to discharge of regeneration effluent to St. Vrain Creek should be revised to "evaporation pond."

Aqua ammonia will be used instead of lithium hydroxide for PCRV cooling water pH control. On the line presently corresponding to LiOH, change "LiOH' to "Ammonia," "6.2" to "3.0," and "0.7 ppm (max)" to 100 (max)."

Page 77, Paragraph 2

As commented previously, chlorine residual will reach a maximum of 1 ppm during intermittent chlorination, but it will decay between treatment periods rather than being maintained at 1 ppm.

Page 79, Paragraph 1

The subject of cooling tower drift was commented on above.

Page 79, Paragraph 3

As mentioned previously, aqua ammonia will be used to control pH of the PCRV cooling water instead of lithium hydroxide.

Page 89, Paragraph 5

As stated above, demineralizer-backwash effluents will be ponded in evaporation ponds and will not be discharged from the facility.

Page 103, Section V.E.1.

It was mentioned above that the activity in the liquid radioactive effluent may be overestimated. Radiation dose estimates from liquid effluents based on these concentrations may likewise be overestimated in the values quoted in Sections V.E.1, V.E.3, and V.E.4.

Page 111, Table V.5.

The sampling schedule for the environmental radiation surveillance program has been revised. The table contained in the Technical Specifications which were recently filed with the AEC should be used for Table V-5, and as the basis for the description in Section V.E.5.

Page 112, Paragraph 2

It is stated that spent fuel will contain considerable amounts of plutonium. Since Fort St. Vrain will operate on the uranium-thorium cycle, only a minor amount of plutonium will be produced; the bred material will consist primarily of U-233.

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Page 121, Table VI-1.

While the assignment of the permanent loss-of-forced circulation accident to accident Class 8 is appropriate for the Fort St. Vrain Plant, such assignment should not be interpreted as a precedent applicable to subsequent generations of HTGR's. The designs for subsequent HTGR's include provisions (i.e., core auxiliary cooling loops) such that probability of occurence of a permanent loss-of-forced circulation accident is sufficiently low that it need not be considered. Accordingly, for such plants this type of accident is more appropriately assigned to Class 9.

Page 126, Paragraph 5

It is stated that water loss from the cooling towers during a drought might be significant to farmers downstream with low-priority water rights. As discussed above, downstream water users should not be affected differently than they otherwise would be, since Applicant must adhere to the same priority system of water rights.

Page 127, Paragraph 3

Again, the comments made previously about loss of water by evaporation would apply. Although it is correct that 3000 acre feet per year of water would theoretically support 1500 acres of farming, loss of this amount would not necessarily mean that it would be necessary to retire this amount of land from farming.

Page 129, Paragraph 3

A growth rate of 17 percent per year is quoted. The peak demand of 1348 MW for the winter of 1970-71 is Applicant's system net maximum hour, whereas the predicted demand of 1587 MW for the winter of 1971-72 includes 79 MW of load for other utilities served from Applicant's system.

To be stated on comparable terms, the demand for Applicant's system for 1970-71 should be increased by 78 MW from 1348 MW to 1426 MW. The resulting growth rate from 1426 MW to 1587 MW would be 12 percent.

Page 133, Paragraph 2

The basis for investment in the Station of $210 million is not stated. As commented previously, Applicant's budgeted investment is $71 million. Tax revenues are estimated to be of the order of $600,000 per year.

Page 136, Paragraph 2

The estimated cost of a cooling pond is in excess of $1.2 million, or about $0.2 million more than the cost of the cooling tower.

Page 136, Paragraph 4

Applicant plans to dispose of tritium in a solid form by disposal of the titanium sponge getter material in the hydrogen removal section of the helium purification system, rather than releasing this tritium to the gas waste system by regeneration. This operation will be performed on a regular basis, even though the amount of radioactivity involved is quite small.

Page 137, Paragraph 6

Estimated plant construction cost and tax revenues have been discussed in previous comments.

Page 138, Paragraph 3

Again, the basis for the estimated construction cost of $210 million is not stated.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20201

JUL 18 1972

50-267

Mr. Lester Rogers
Director
Division of Radiological and
Environmental Protection
U. S. Atomic Energy Commission
Washington, D. C. 20545

Dear Mr. Rogers:

This is in response to your letter dated April 19, 1972, wherein you requested comments on the draft environmental impact statement for the Fort St. Vrain Nuclear Generating Station, Public Service Company of Colorado.

This Department has reviewed the health aspects of the above project as presented in the documents submitted. We offer no comments.

The opportunity to review the draft environmental impact statement is appreciated.

Sincerely yours,

Merlin K. DuVal, M.D.

Merlin K. DuVal, M.D.
Assistant Secretary for
Health and Scientific Affairs